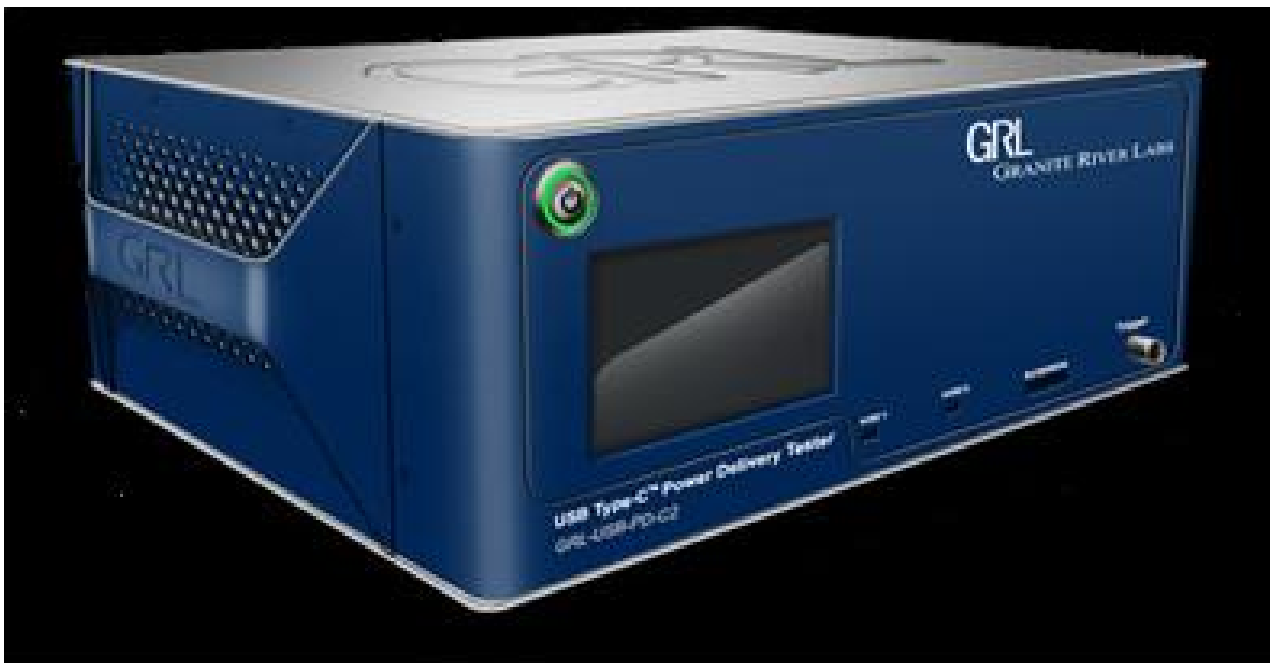


**Granite River Labs**  
**USB Type-C™ Power Delivery and Alt Mode Test Method of  
Implementation (MOI) and User Guide**  
**for GRL USB Type-C Power Delivery Tester and Analyzer**  
**(GRL-USB-PD-C2)**



This material is provided as a reference to install Rev 1.3.5.0 of Granite River Labs (GRL) USB-PD Power Delivery Compliance Test Software.

For software support, contact [support@graniteriverlabs.com](mailto: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 1.172*

*USB Power Delivery Specification Rev2 Version 1.3*

*Power Delivery 3.0 Tests V0P96 (December 22, 2017)*

*USB-C\_Source\_Power\_Test\_Specification\_2018\_01\_03, version 0.74*

*PD Communications Engine USB PD Compliance MOI June10 2017, Version 1.06*

*Deterministic PD Compliance MOI Version Oct. 11<sup>th</sup>, 2017, Version 1.11*

## 1.2 VESA - Display Port

Download the Display Port document from the VESA web site:

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

*Display Port Alt Mode on USB Type-C Standard, Ver.1.0a, August 5<sup>th</sup>, 2016*

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

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

## 1.3 QC4 Testing

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

*Quick Charge 4 Test Specification Version 0.9.4 Oct. 5<sup>th</sup> 2017*

# 2 Scope of this MOI and Quick Start Guide

This MOI (Method of Implementation) and Quick Start Guide serves as the primary user documentation for GRL-USB-PD Compliance Test Software and GRL-USB-C2 USB Type-C Test Controller Hardware. It also provides the technical implementation detail for testing to the various specifications. The subsequent sections provide step-by-step test procedures for specific tests in Test Plans and Compliance Test Specifications for USB Type-C technologies.

The Appendices provide additional technical information and user guidance that falls outside the general flow of testing to the test specifications.

### 3 Getting Started with GRL-USB-PD-C2 Test Solution

This section describes in detail how to get started with the GRL-USB-PD-C2 test solution for USB-PD compliance testing. Whether you are installing for the first time or doing an upgrade, please make sure to follow all the steps in this section to verify your setup prior to testing a UUT. The procedure is as follows:

1. Install the latest version of GRL-USB-PD-C2 SW on the computer (laptop or desktop) connected to the C2.
2. Update the GRL-USB-PD-C2 Controller Firmware. Refer to section 3.3
3. Perform a test on eMark Cable. Refer to section 4.5. If this procedure is followed and any issues arise, please contact [support@graniteriverlabs.com](mailto:support@graniteriverlabs.com).

#### 3.1 Install GRL-USB-PD-C2 Software

Download the GRL-USB-PD-C2 Software from: <http://graniteriverlabs.com/download-center/>. For general information about the C2 go to: <http://graniteriverlabs.com/usb-pd-c2/>.

Download GRL software, user manuals and other detailed product information		
<b>PD 3.0 &amp; QC4+ Solution – USB Power Delivery and Type-C™ Tester and Analyzer (GRL-USB-PD-C2)</b>		
Software/Firmware	1.3.4.5/1.3.4.0.7	<a href="#">Download</a>
User Guide & MOI	1.3.3	<a href="#">Download</a>
<b>GRL USB Type-C™ Power Delivery Performance Analyzer (GRL-USB-PD-A1)</b>		
Software	1.07.8	<a href="#">Download</a>
<b>PD 2.0 Solution – GRL USB Power Delivery Solution: Compliance Test Software (GRL-USB-PD) &amp; USB Type-C™ Test Controller Hardware (GRL-USB-PD-C1)</b>		
Software	1.2.9.6	<a href="#">Download</a>
User Guide & MOI	1.2.6.0	<a href="#">Download</a>
<b>GRL HDMI EDID/DDC/SCDCS Controller (GRL-HDMI-CONT)</b>		
Software/Firmware	1.0.6.5	<a href="#">Download</a>
<b>GRL DisplayPort AUX Protocol Decode Software (GRL-DPAUX-DEC)</b>		
Software/Firmware	1.1.0	<a href="#">Download</a>

FIGURE 3.1: GRL SUPPORT DOWNLOAD PAGE

On the Win7 (or above) computer to be used for testing, create a folder and download the software installer compressed archive (zip file). On the Download Center page, click the “Download” button associated with the latest C2 software. Fill in the required information and click the “Download” button:

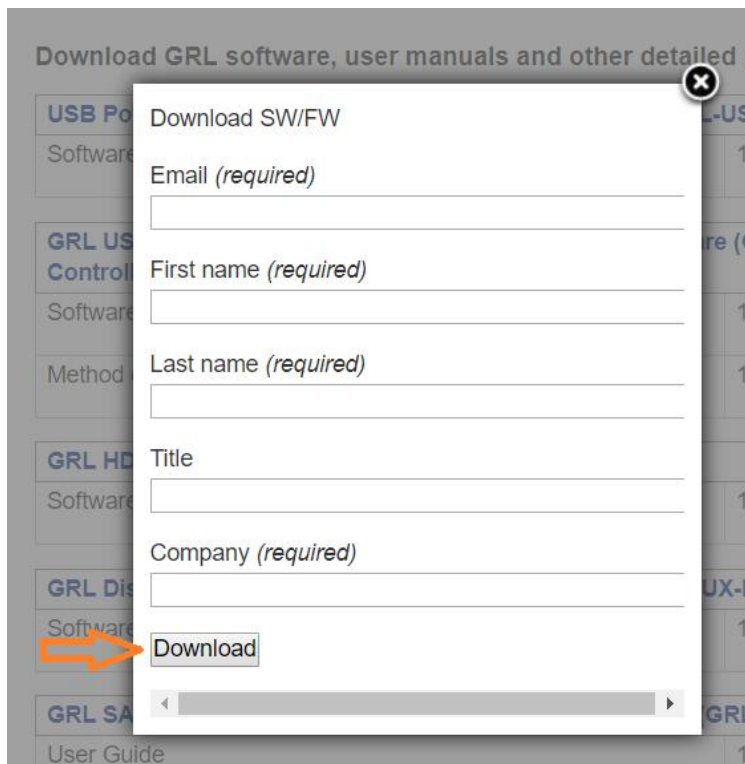


FIGURE 3.2: SOFTWARE DOWNLOAD INFORMATION

Save the zip archive in a convenient folder and extract the GRL Software installer by right clicking the downloaded archive and selecting “Extract All”:

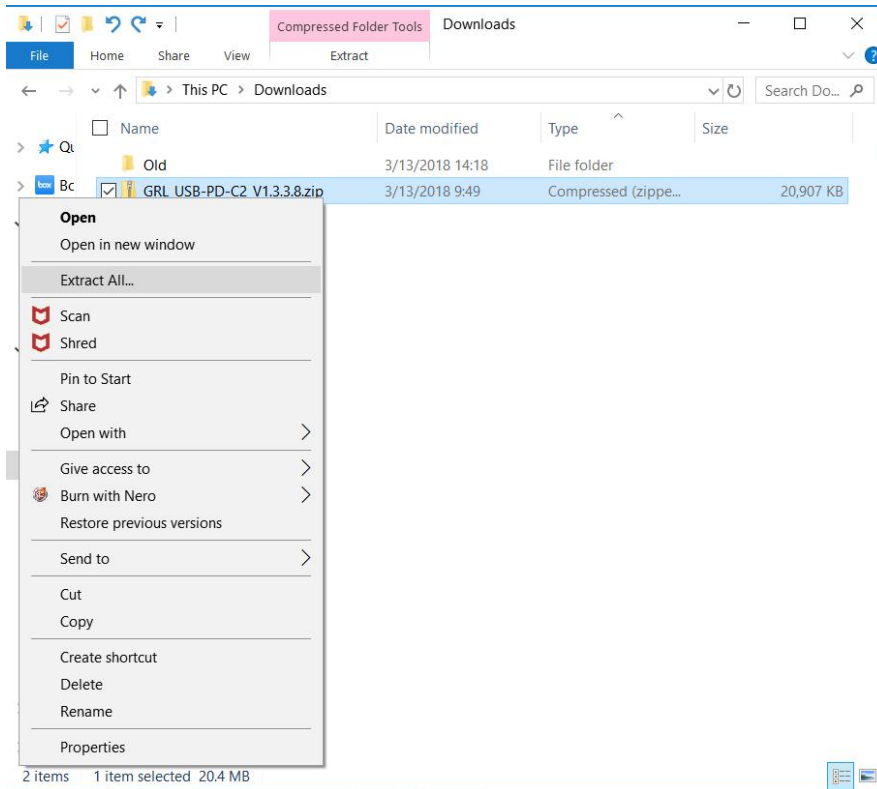


FIGURE 3.3: EXTRACT INSTALLER FROM ZIP ARCHIVE

Run the installer by double clicking the extracted executable:

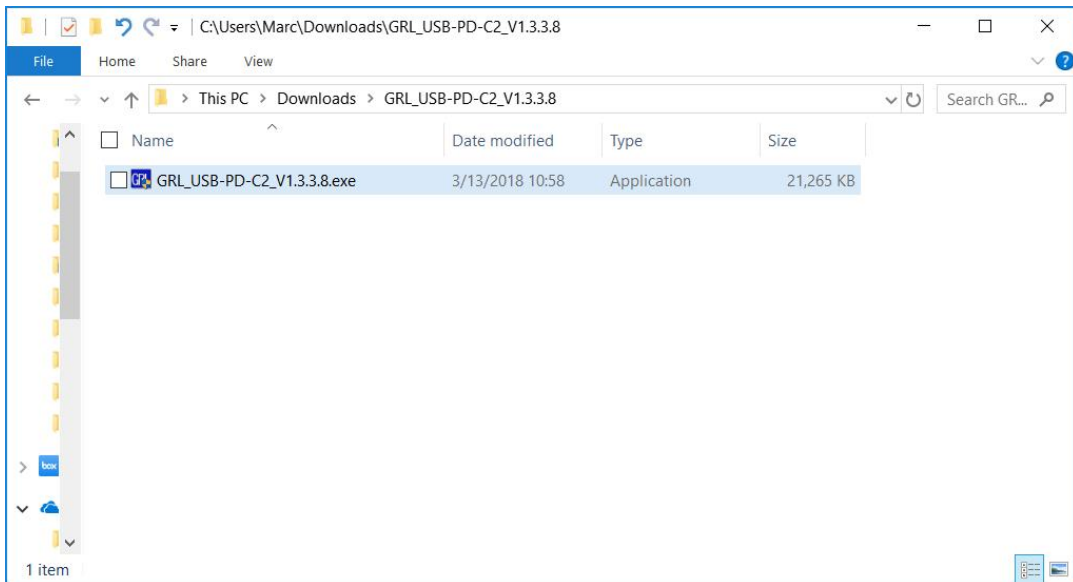
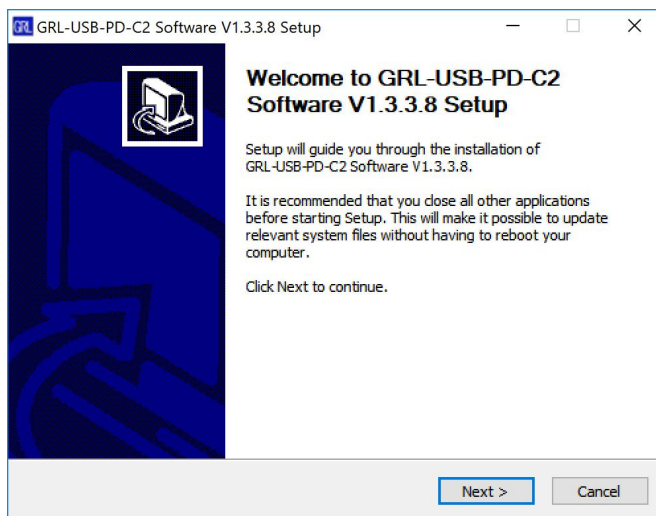


FIGURE 3.4: DOUBLE CLICK EXECUTABLE TO START SOFTWARE INSTALLATION

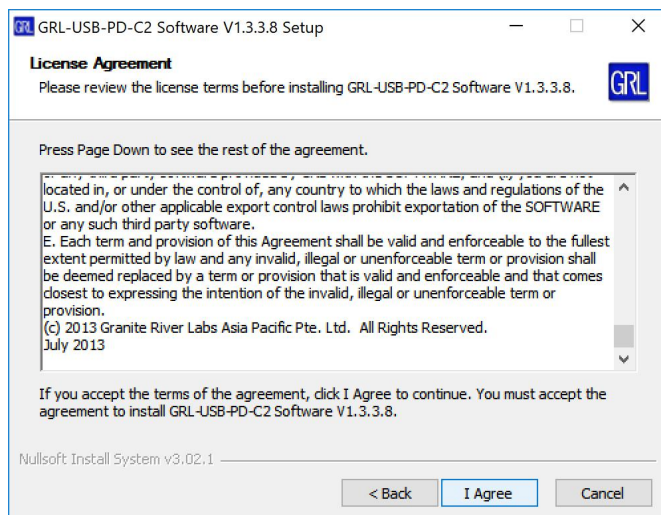
Be sure to click “Yes” when the system prompt asks if you want to allow the installer to make changes to your system.

You will see the following screens during installation:

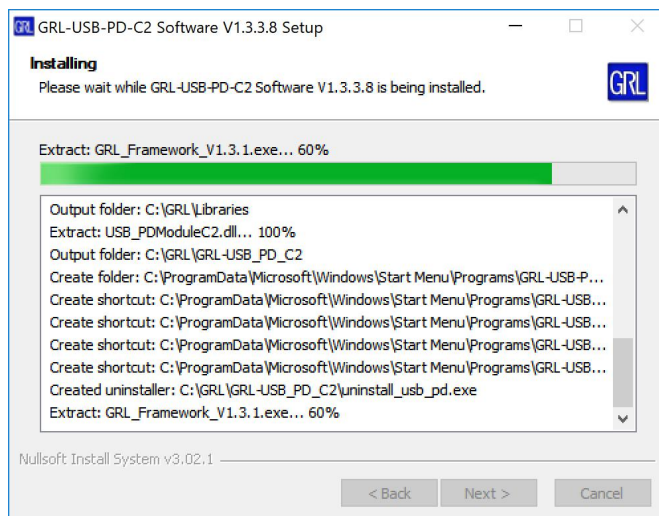
1. Welcome to GRL Automated Test Solutions Software:



2. License Agreement:

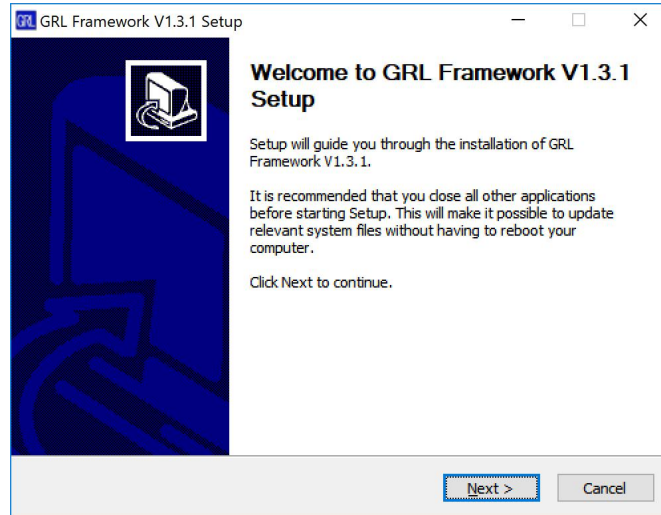


3. Installing:

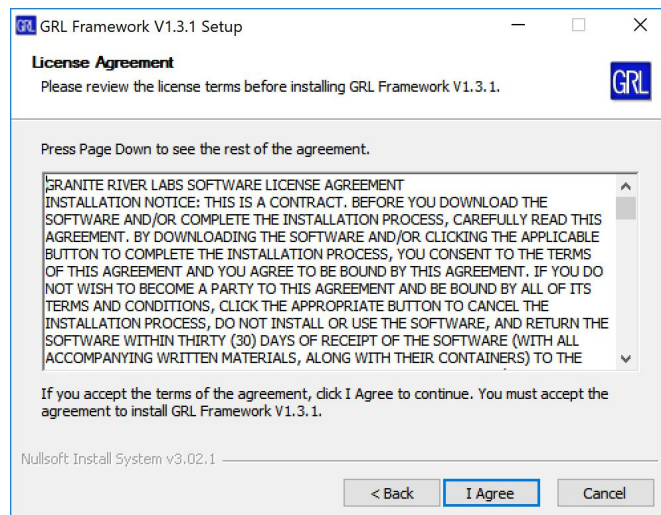


#### 4. Framework Installation:

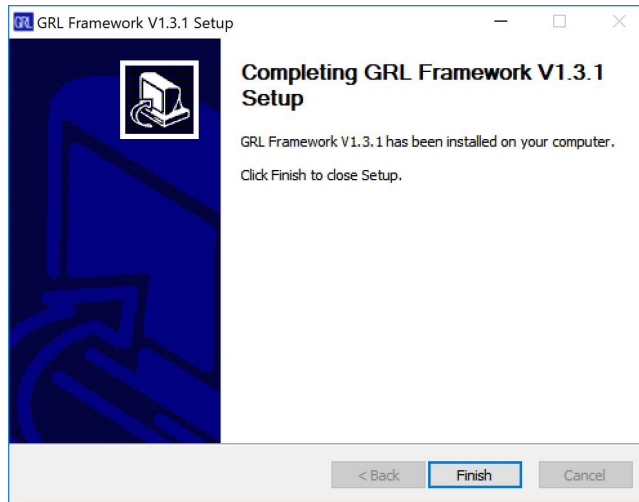
The framework installation starts before the GRL-USB-PD-C2 software installation completes. Completely install the framework before returning to the GRL-USB-PD-C2 installation.



#### 4. Framework License Agreement

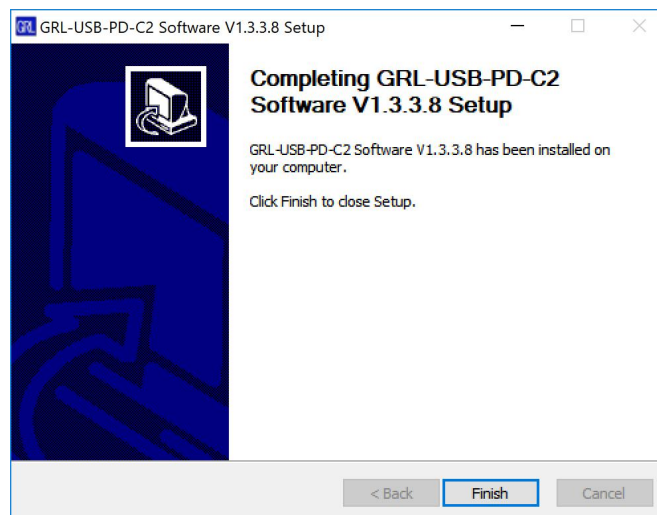


#### 5. Finish Framework Setup



#### 6. Finish GRL-USB-PD-C2 Installation

Once the Framework installation is complete control should return to the GRL-USB-PD-C2 software installation. If the following dialog box does not appear automatically, check your task bar for and installation icon and select this icon to finish the GRL-USB-PD-C2 software installation.



In Windows, pin the GRL Software shortcut to the Task Bar for easy access.

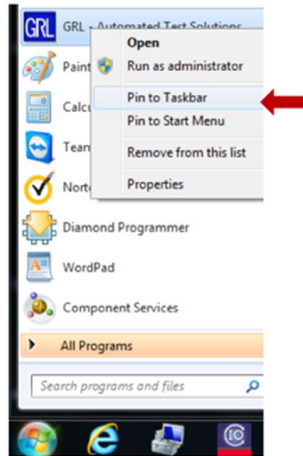


FIGURE 3.5: PIN GRL APPLICATION TO TOOLBAR

### 3.1.1 GRL-USB-PD-C2 Software Navigation

1. Launch the SW by choosing the GRL Icon on the Windows Task Bar.



FIGURE 3.6: USING TASKBAR TO LAUNCH GRL SOFTWARE

Once SW launches, the **Test Steps** menu will appear.

**Quick Start Steps** - This screen gives a tutorial on the test steps navigation buttons that appear across the top of the application.

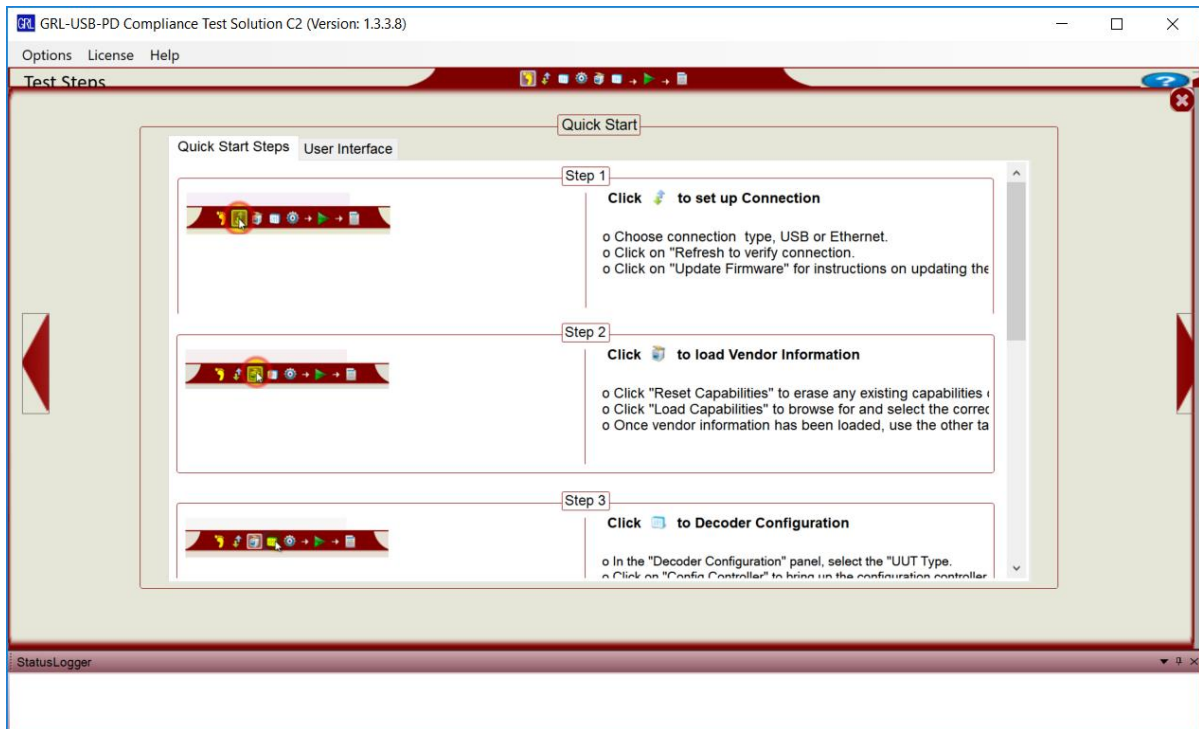


FIGURE 3.7: QUICK START STEPS SCREEN



**User Interface** - This screen shows how to navigate the GRL-USB-PD-C2 SW. You can navigate left to right on the top menu or use the Previous and Next buttons on each side of the application to navigate to the left and right.

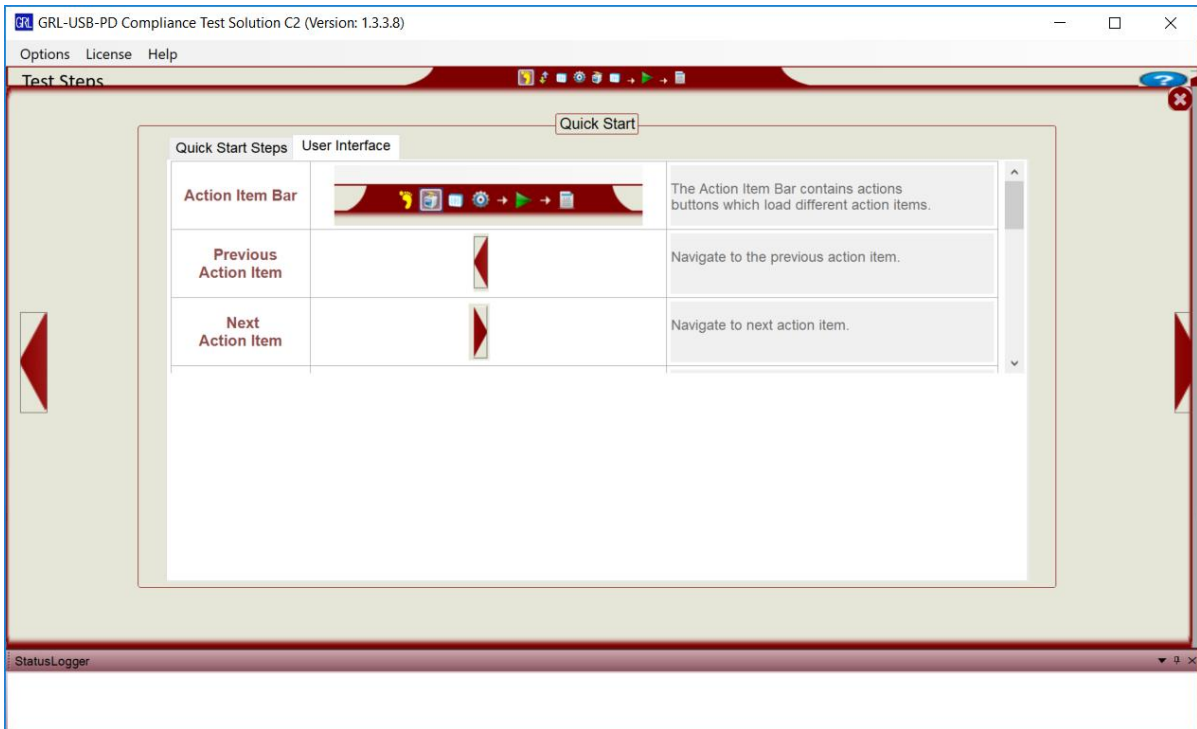


FIGURE 3.8: QUICK START USER INTERFACE SCREEN

### 3.2 GRL-USB-PD-C2 Software License Activation

The licensing for the GRL-USB-PD-C2 test controller is built into the tester hardware so no additional license activation is needed. Check the “Connection Configuration” screen (Figure 3.9) to see which licenses are active on the controller. Contact Granite River Labs support ([support@graniteriverlabs.com](mailto:support@graniteriverlabs.com)) if you have licensing questions or concerns.

### 3.3 Update GRL-USB-PD-C2 Firmware and FPGA

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

- Install the latest USB-PD-C2 Compliance Test Solution software on the control computer attached to the C2.

Power on the C2, connect via Ethernet cable and launch the application. Click the "Connect / Refresh" button and make sure the computer is subsequently connected to the C2 (see section 4.3).

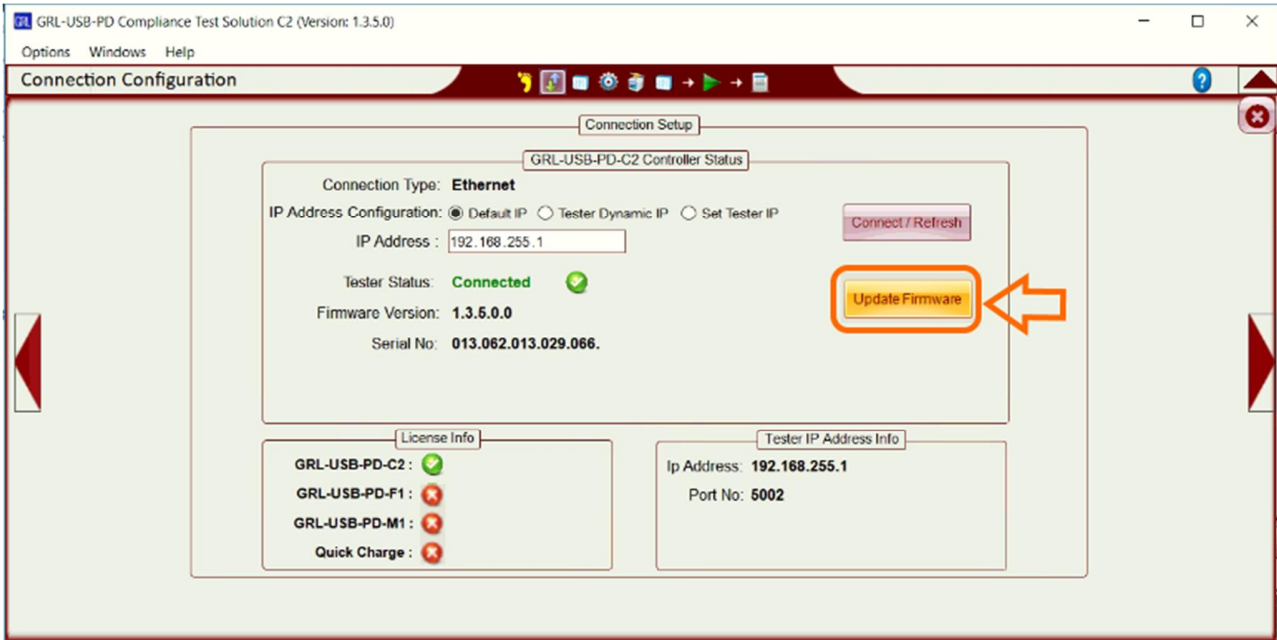
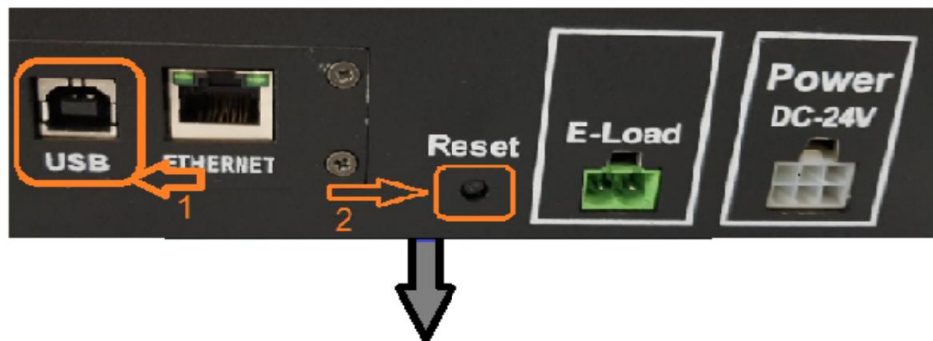


FIGURE 3.9: CONNECTION CONFIGURATION UPDATE FIRMWARE

Clicking the "Update Firmware" causes the following set of instructions to appear:



1. Connect a USB cable between the Type B connector on the rear of the C2 to any convenient USB port on the computer.
2. Press the reset button on the rear of the C2.
3. A new USB drive should appear on the computer.
4. Copy all the files from folder "C:\GRL\GRL-USB\_PD\_C2\Firmware\_Files" to the new USB drive.
5. Once the files have been successfully copied, power cycle the C2.

Connect the C2 USB Type B port (on the rear of the instrument) to any USB port on the computer. Press and release the reset button on the rear of the C2. A new USB disk drive should appear in the “This PC” root folder.

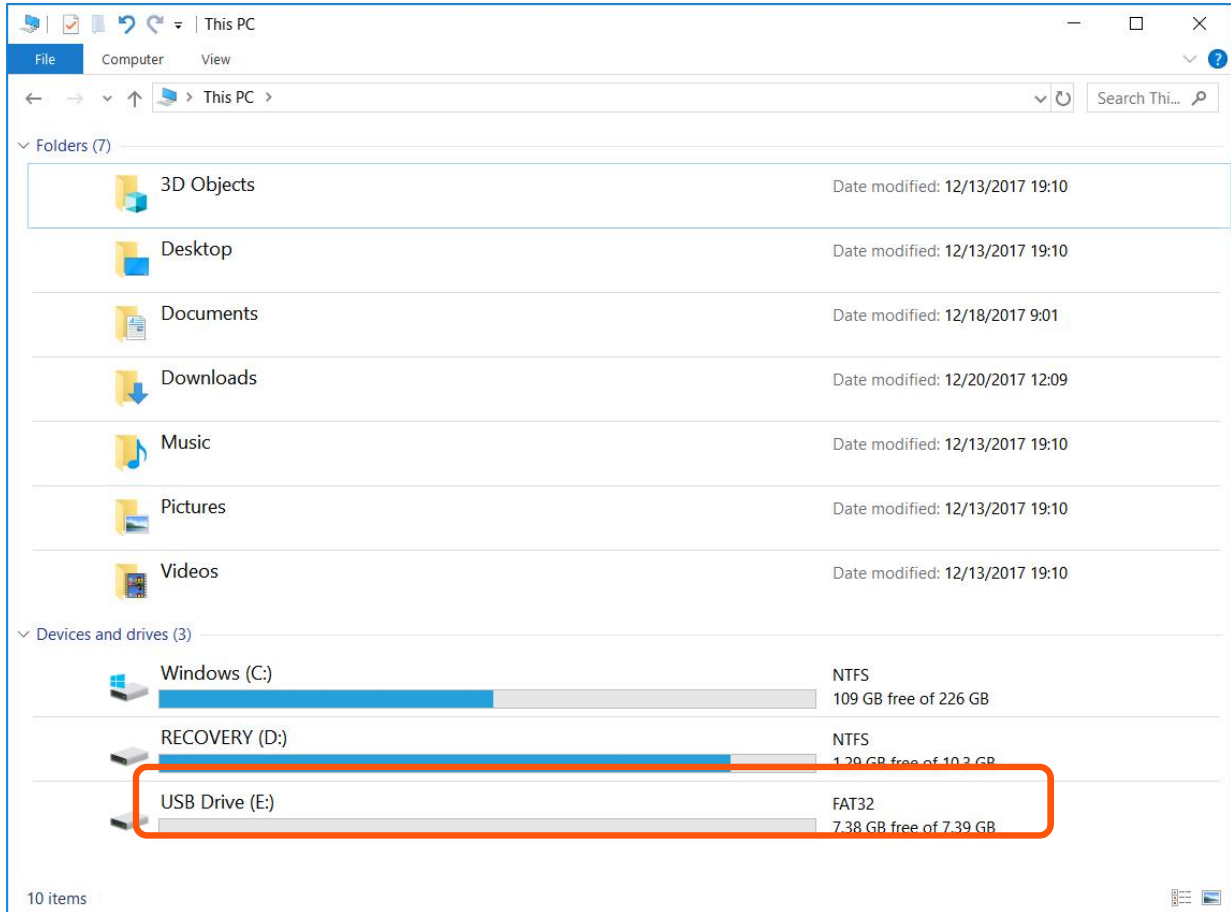


FIGURE 3.10: USB DRIVE DUE TO PRESSING RESET ON THE GRL-USB-PD-C2 REAR PANEL

Copy all files from the “C:\GRL\GRL-USB\_PD\_C2\Firmware\_Files\” to the USB drive.

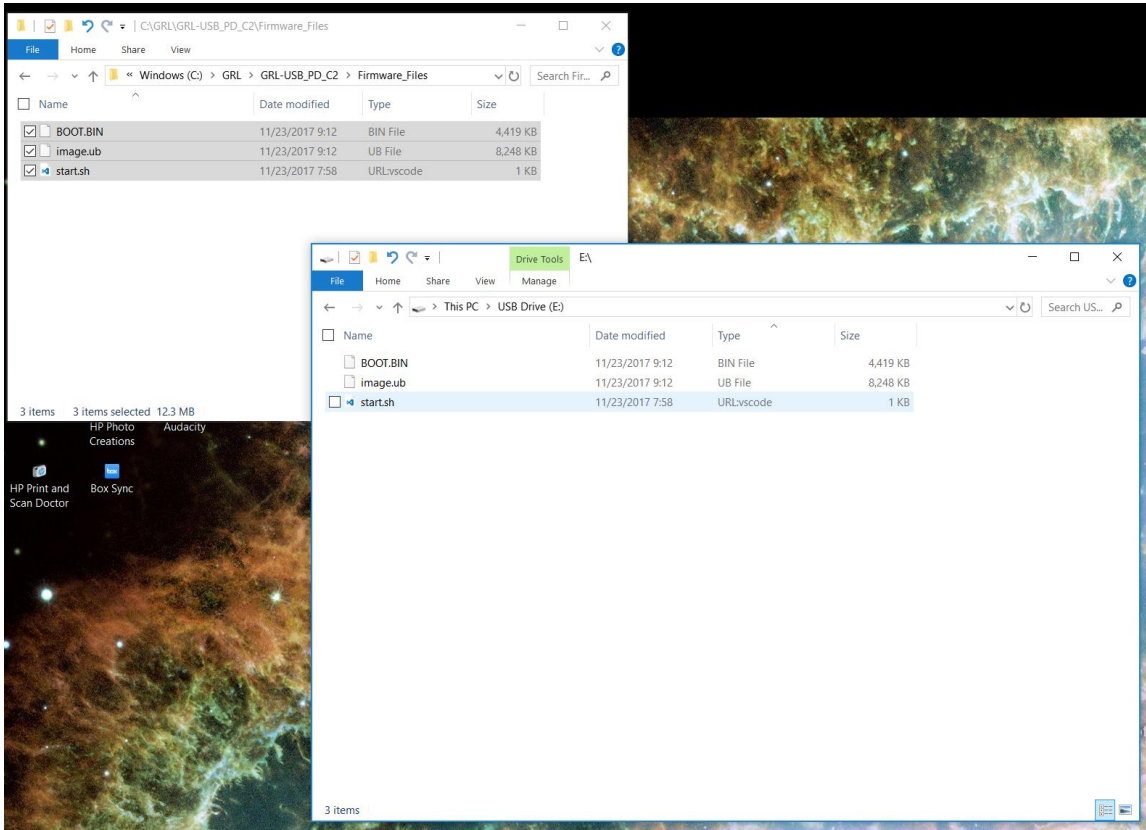


FIGURE 3.11: COPY FILES TO NEW USB DRIVE

Power cycle the C2 then reconnect to the GRL application once the test controller has fully booted (the display shows GRL logo and controller status).



FIGURE 3.12: POWER BUTTON ON TEST CONTROLLER FRONT PANEL

## 4 Connection and Setup of Hardware

Figure 4.1 shows an example setup for testing a USB-PD Provider, Consumer or Dual Role Device.

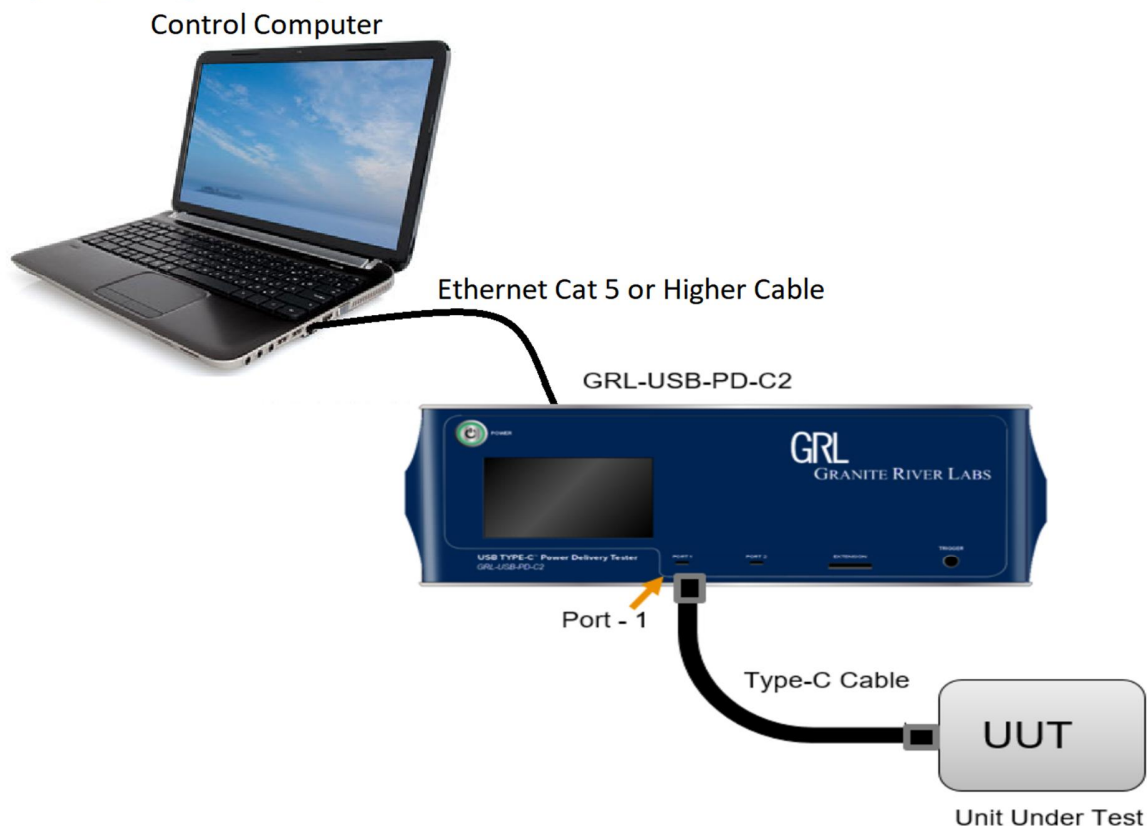


FIGURE 4.1: HARDWARE SETUP FOR PROVIDER, CONSUMER OR DUAL ROLE DEVICE

The GRL-USB-PD-C2 Software loaded on a Win7 (or higher) computer automates the testing process. Below is a procedure for connecting HW and verifying proper HW connections.

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

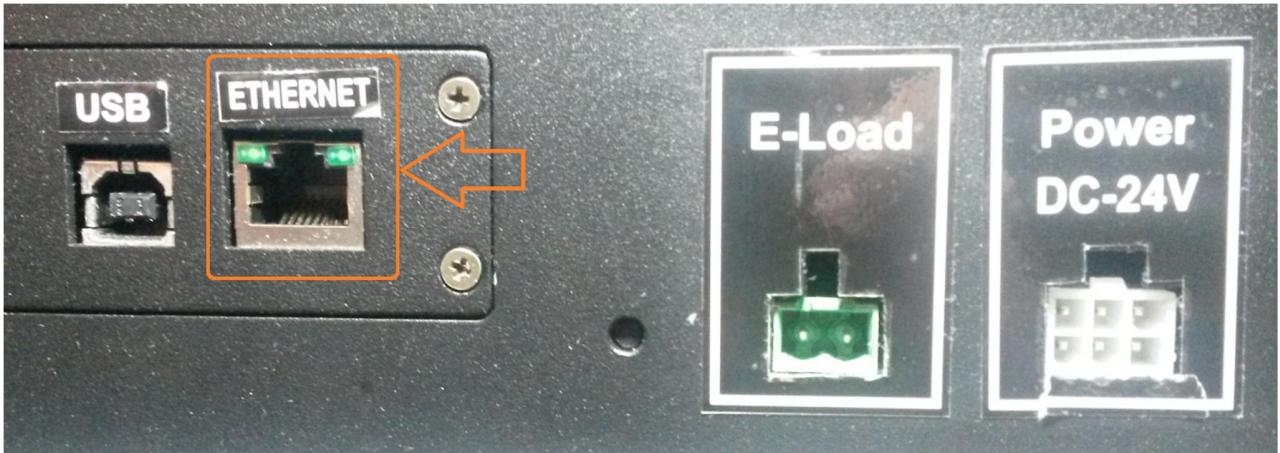
### 4.1 Connect Power Supply to Controller

To setup the GRL-USB-PD-C2 Test Controller, do the following:

1. 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 the 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 Connection Configuration

To set up the control computer, do the following:

Select the **Connection Configuration** menu (second icon from the left).



FIGURE 4.2: INITIAL CONNECTION CONFIGURATION SCREEN

Press the **Refresh Button** next to the **Tester Status** to refresh the connection to the instrument.

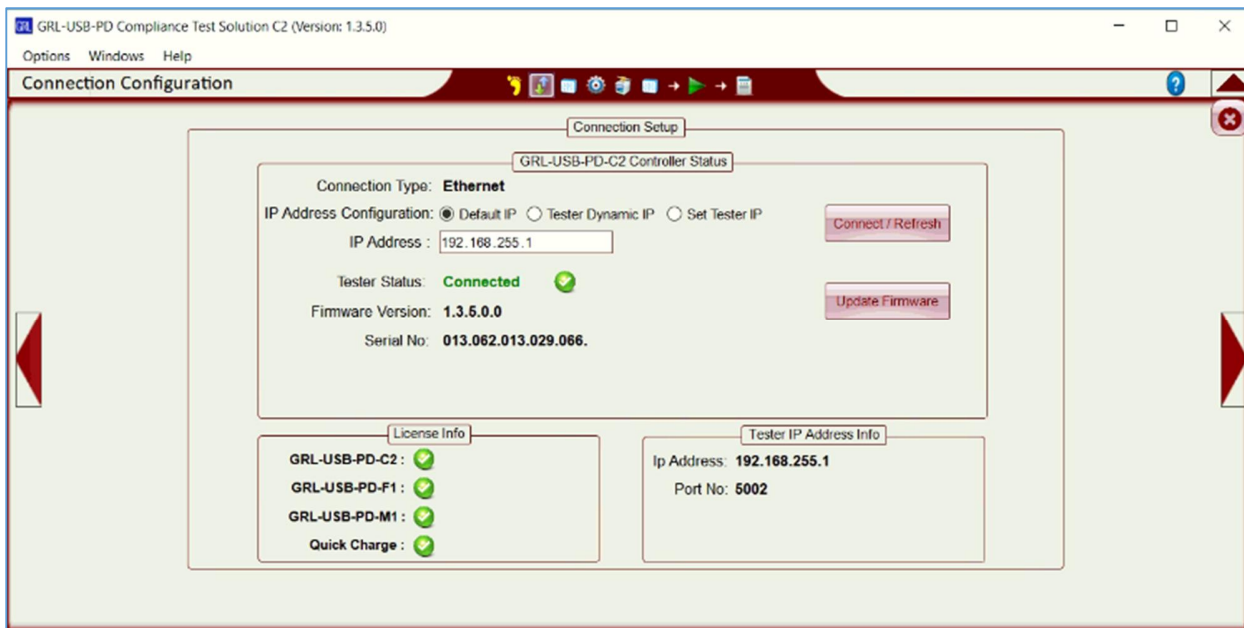


FIGURE 4.3: CONNECTION CONFIGURATION SCREEN AFTER REFRESH

The C2 and control computer are now set up and connected as indicated by the “Tester Status”.

## 4.4 Verifying the GRL-USB-PD-C2 Ethernet Installation

The Ethernet port on the control computer needs to be configured correctly for the C2 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.

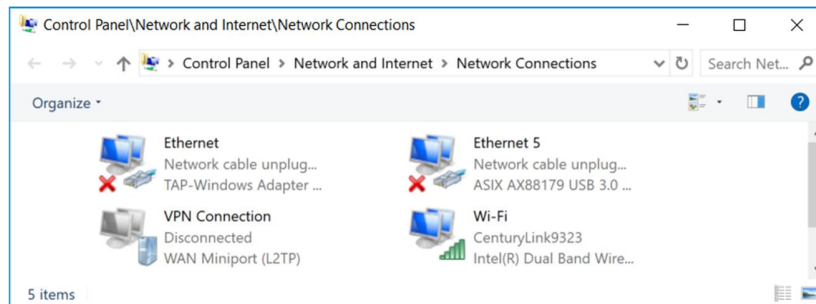


FIGURE 4.4: NETWORK CONNECTIONS BEFORE CONNECTING C2

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

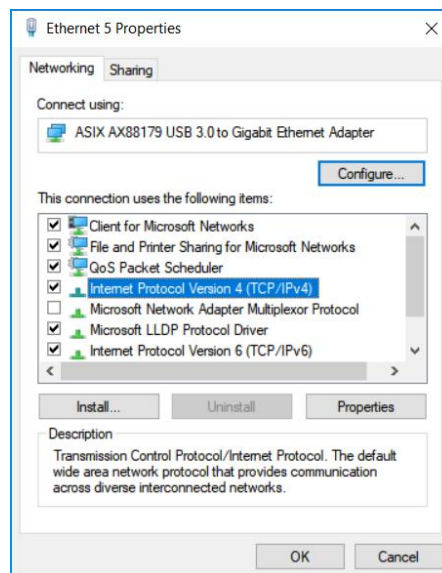


FIGURE 4.5: ETHERNET PROPERTIES

Set up the TCP/IPv4 properties as shown in Figure 4.6.



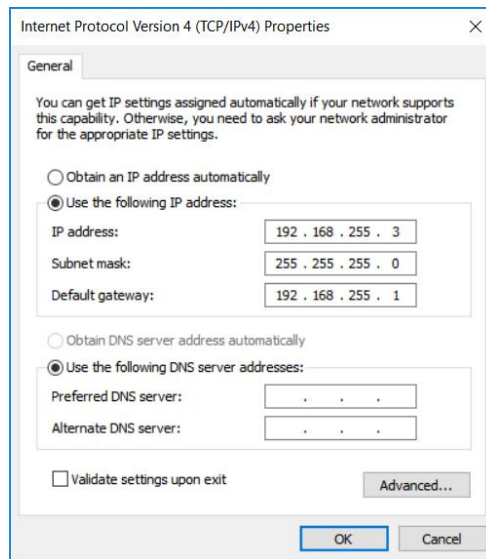


FIGURE 4.6: ETHERNET PROPERTIES WITH TCP/IPV4 SELECTED

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 C2 is powered on and completely booted up (front panel display shows firmware version number) then connect the Ethernet cable from the C2 to the computer’s Ethernet port that was just set up. The network connections panel should now look as pictured in Figure 4.7 below:

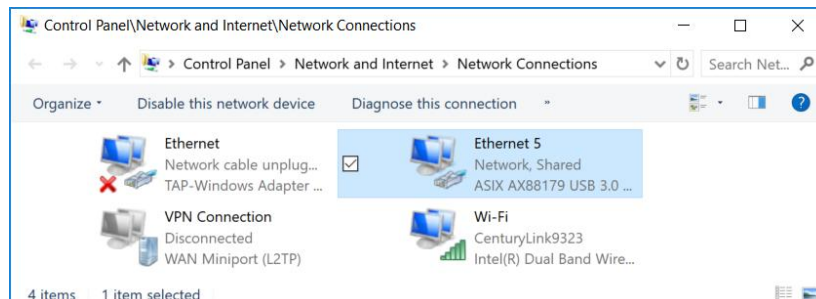


FIGURE 4.7: NETWORK CONNECTIONS AFTER SETUP AND CONNECTION OF C2

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

Before running any tests, it is recommended that you verify that the control computer and the C2 are communicating by going to the Configuration Setup screen and clicking on the “Refresh” button. The tester status should say “Connected” and the indicator should be green.

If a connection is lost and cannot be restored to its ‘green state’, close the GRL-USB-PD-C2 SW application and re-start it. No work will be lost if the application is closed and re-started.

## 4.5 Run Test on eMarker Cable to Verify Update

To verify the update, it is recommended that you run a test on a ‘eMarker’ cable. Follow the procedure in Section 5 selecting “Cable” as the UUT type and “PD Communication Engine Tests” as

the test to be run. Make sure **Offline Analysis** is not selected and be sure to click the **Reset Results** button. Once completed the eMark cable test should display the results of the test run.

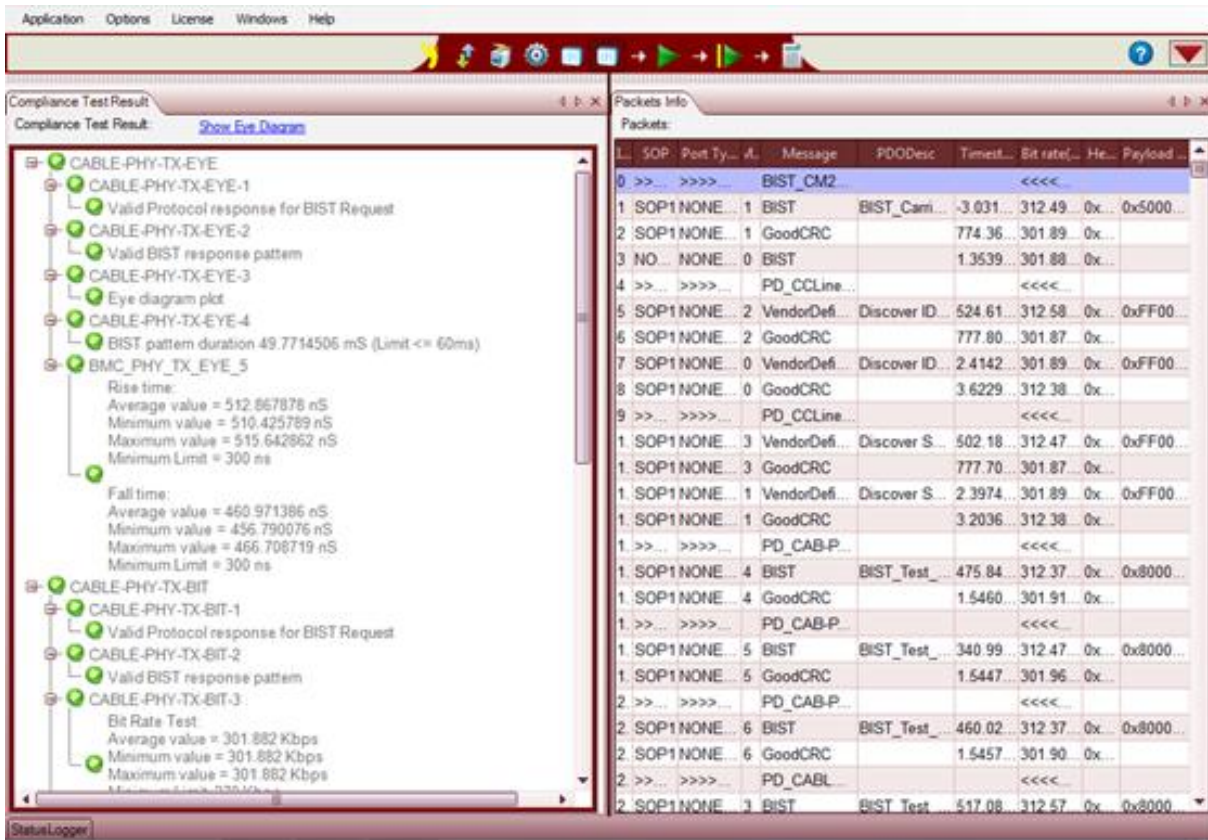


FIGURE 4.8: eMARK CABLE TEST RESULT EXAMPLE

## 5 Compliance Testing with GRL-USB-PD-C2

The GRL-USB-PD-C2 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 software allow the user to select, configure, run and generate reports from these tests for a variety of devices (Units Under Test or UUTs). 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** and querying the Capabilities of the UUT or by **Using a VIF File**.

The “Product Capability” screen allows the user to specify the method to determine the UUT type and display the capabilities of the UUT.

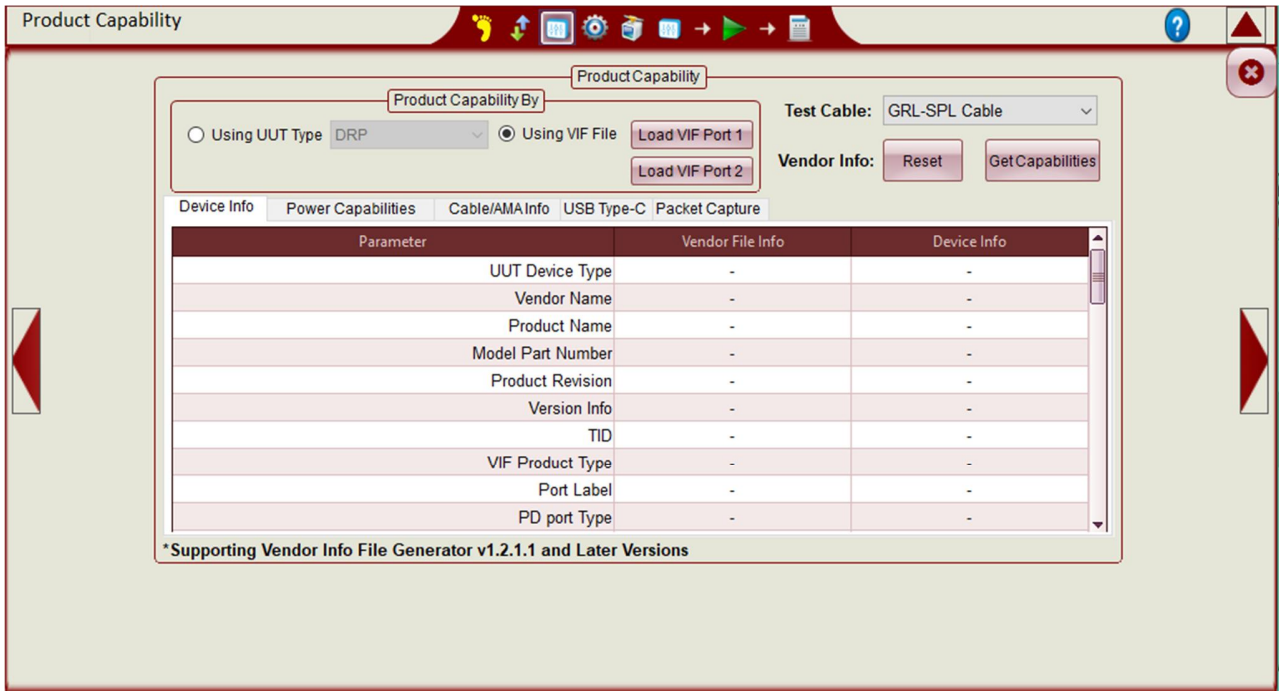


FIGURE 5.1: PRODUCT CAPABILITY SCREEN

**If a VIF File is not provided or available:**

When testing a new UUT, press Reset under Vendor Info. (see Figure 5.6) will clear all product configuration information including what has been read from a VIF and what was read directly from the device.

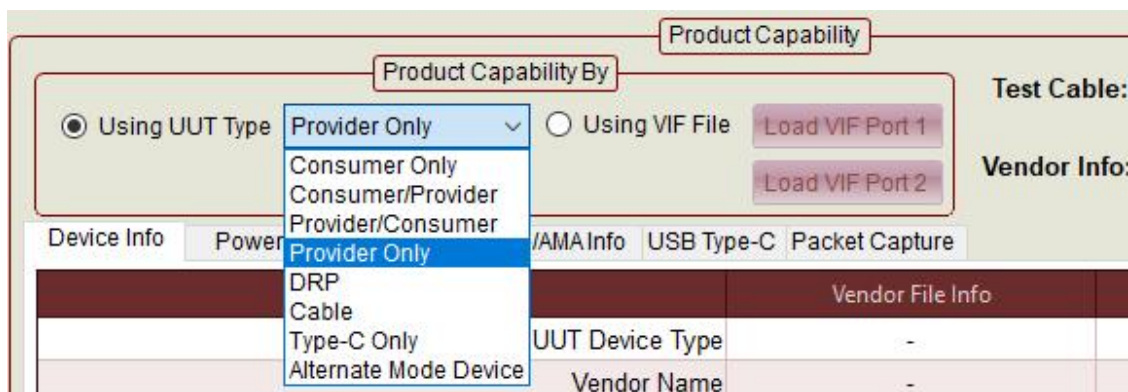


FIGURE 5.2: SELECTING UUT TYPE USING DROP-DOWN MENU

- **Consumer Only** – A device with a PD 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).

- **DRP (Dual Role Port)** - 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. When “Cable” is selected as the UUT type both PD 3.0 and Communication Engine tests (see section 5.2) will include the ability to select between  $V_{CONN}$  of 2.75V, 4.25V, 4.75V, and 5.75V.
- **Type-C Only** - A port that only supports USB Type-C capability
- **Alternate Mode Device** – A device supporting an alternate mode such as Displayport Alt Mode.
- **One Port Power Test** – A port that uses a single port for power testing.
- **Two Port Power Test** – A pair of ports that are used for power testing.

This method of defining the device type is most useful when a Vendor Information File (VIF) is not available. Once the device type has been defined,

Click the “Get Capabilities” button will read the device capabilities from the connected device. If no device is connected, the user will be notified. If the device type read using “Get Capabilities” doesn’t match the type selected from the “Using UUT Type” drop-down menu, the user is notified.

The Device Info from the UUT appears in the Device Info file and the Vendor Info File column remains blank.

#### 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 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:

1. When testing a new UUT, press Reset under Vendor Info. (see Figure 5.6) will clear all product configuration information including what has been read from a VIF and what was read directly from the device.
2. Click the “Using VIF-File” button to enable the adjacent “Load VIF...” buttons:

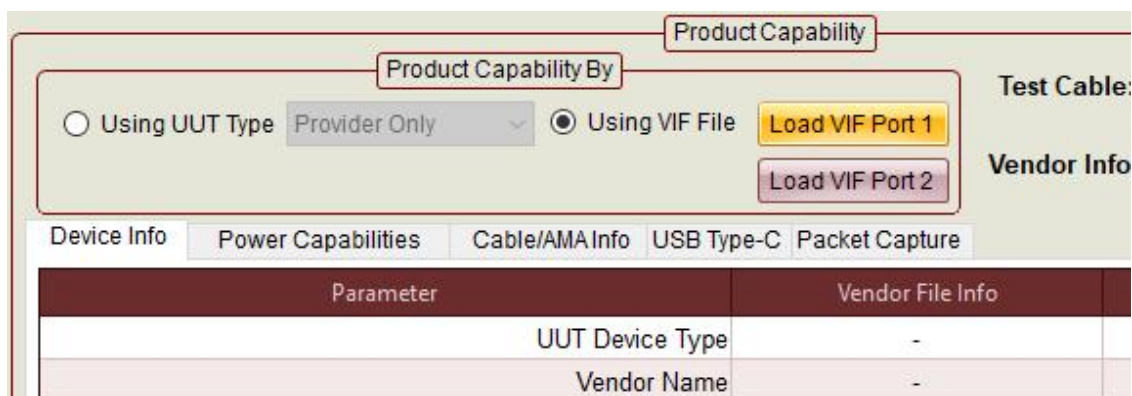


FIGURE 5.3: SELECTING UUT TYPE USING VIF FILE

Clicking on the “Load VIF Port 1” button will read information for the device connected to port 1 while clicking on the “Load VIF Port 2” button reads information for the device connected to port 2. In either case, a file selection dialog box to appear:

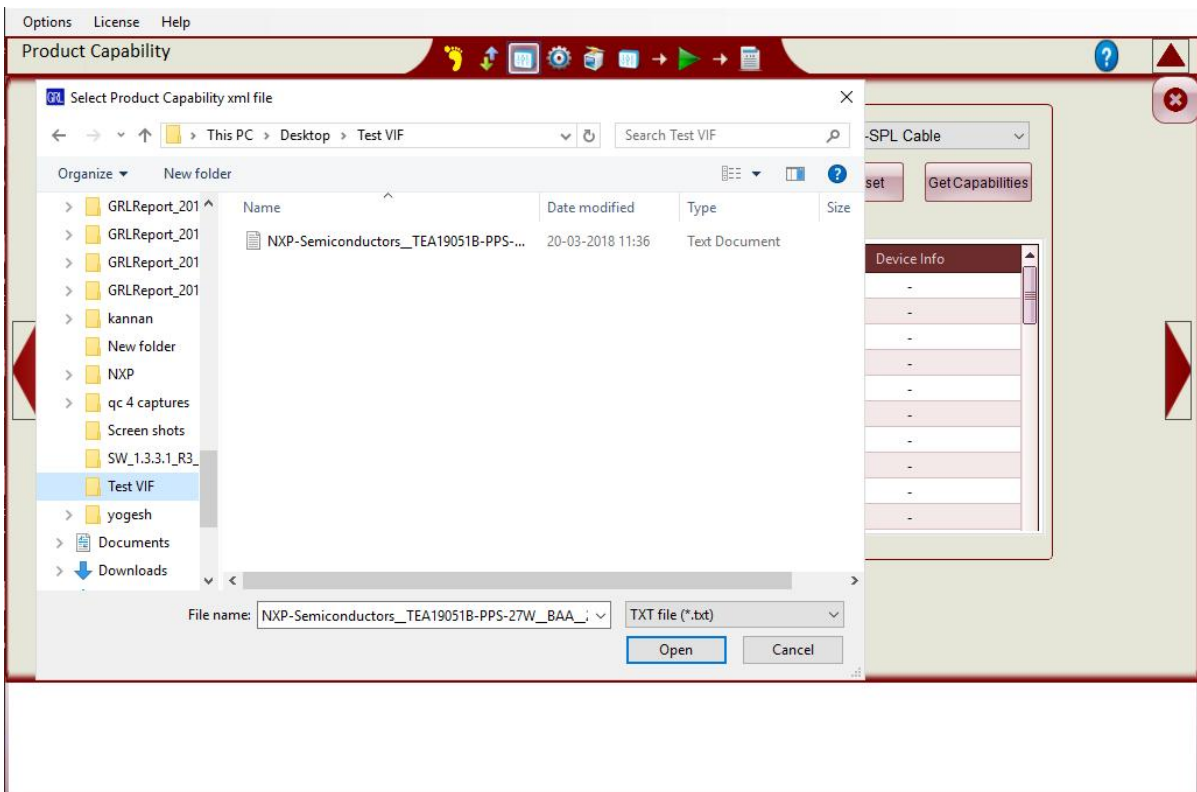


FIGURE 5.4: SELECTING PRODUCT CAPABILITY VIF FILE

This allows the user 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 are displayed in the Vendor Info Column of the Device Capabilities screen.

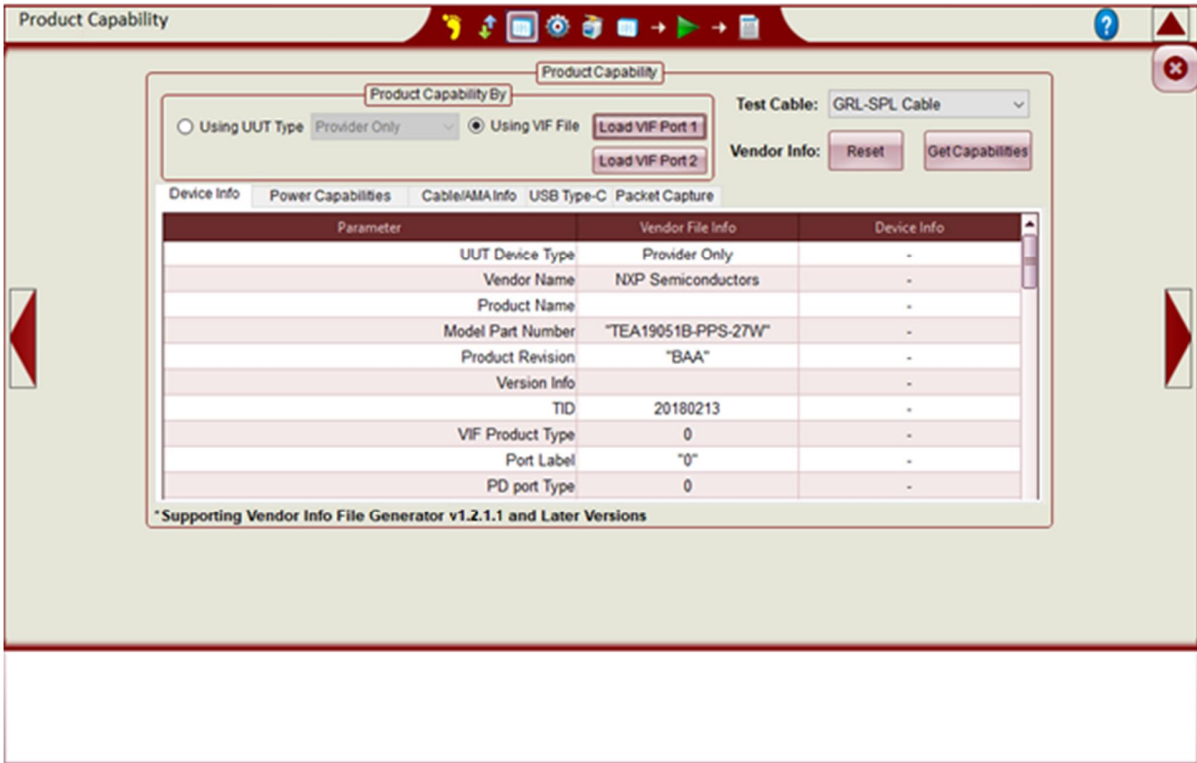


FIGURE 5.5: VENDOR INFORMATION DISPLAYED AFTER READING THE VIF

There are several tabs across the top of the information display area that let the user display different sections of the VIF Information: Device Info, Power Capabilities, Cable/AMA Info and USB Type-C. The final tab, Packet Capture, displays the protocol packets that pass between the tester and the UUT while gathering the UUT's capabilities.



FIGURE 5.6: PRODUCT CAPABILITY VIF "RESET" AND "GET CAPABILITIES"

Clicking the "Reset" button clears all the vendor information in both the "Vendor File Info" and "Device Info" sections of the information display area. This includes all the tabs associated with the information display area as well.

Clicking the "Get Capabilities" button reads the configuration information from the connected device and displays it. The "Vendor File Info" area is not modified by this operation.

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 Get Capabilities information do not match, the device can fail compliance.

Clicking the "Reset" button will clear all VIF information from both the file loaded and the results of getting capabilities from the device.

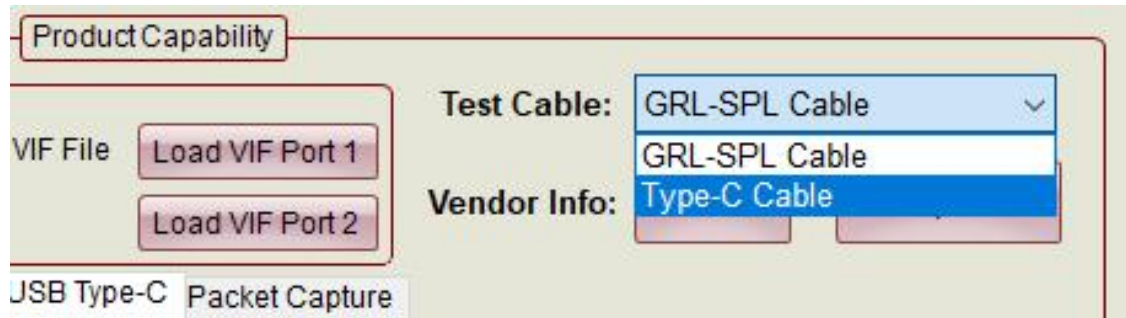


FIGURE 5.7: PRODUCT CAPABILITY TEST CABLE SELECTION

The “Test Cable” selection allows the user to specify what cable connects the unit under test to the C2 test controller. The “Type-C Cable” indicates the Type-C eMarker cable, while the “GRL-SPL Cable” indicates the special cable provided with the C2 test controller which has been characterized specifically for compliance testing. The 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.

## 5.2 Test Configuration

The “Test Configuration” screen allows the user to select which set of tests is run on the UUT.

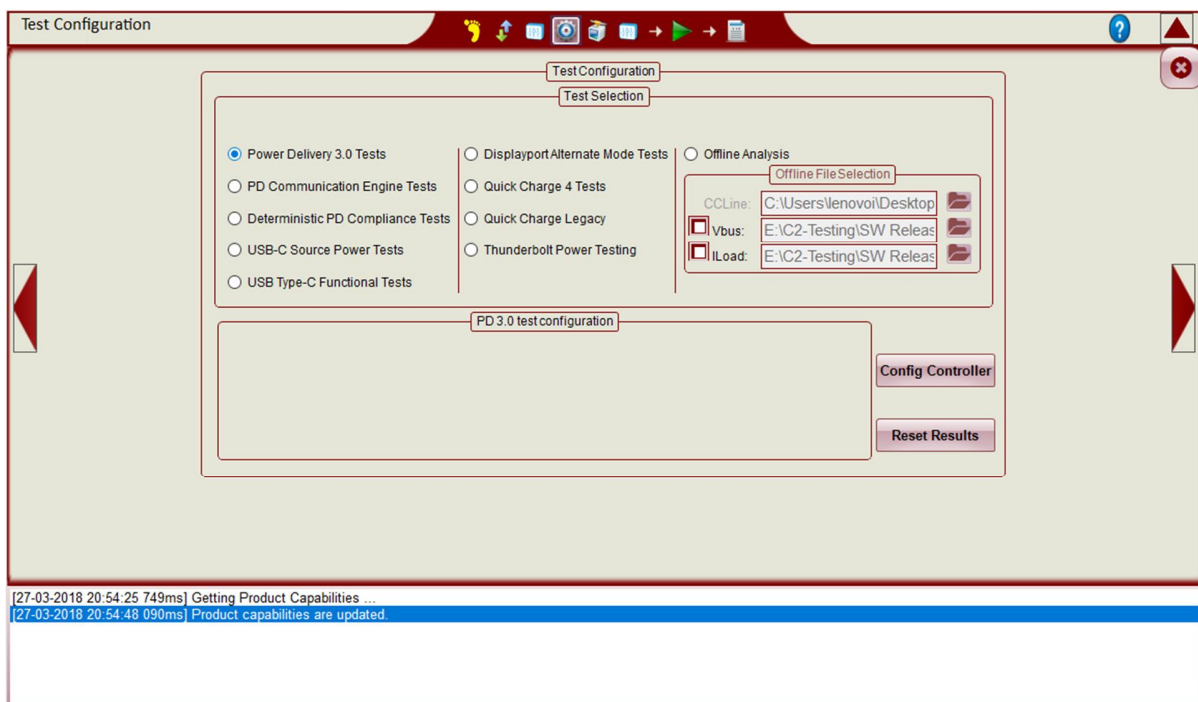


FIGURE 5.8: TEST CONFIGURATION SCREEN

Based on various specifications, the available tests are:

- **Power Delivery 3.0 Tests** – Run the power delivery tests based on the USB Power Delivery 3.0 specification. When “Cable” is selected as the UUT type (see Section 5.1), an input is available to select between 2.75V, 4.25V, 4.75V, and 5.75V for  $V_{CONN}$ .

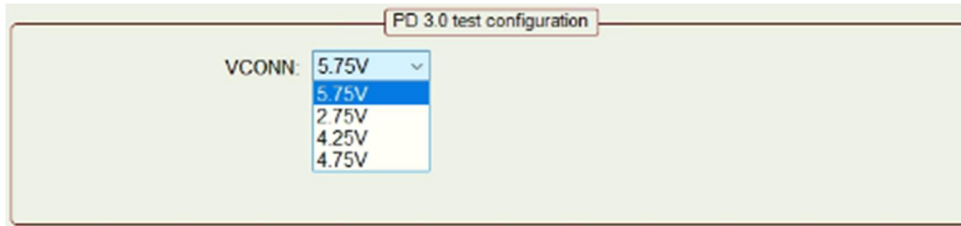


FIGURE 5.9: PD 3.0 VCONN VOLTAGE SELECTION FOR CABLES

- **PD Communications Engine Tests** – Runs the power delivery communications engine compliance tests. These tests have additional inputs to indicate that a cable is connected directly to the device (tethered) and to allow selection between Square-Wave Noise (Gen 1) and Two-Tone Noise (Gen 2) as the Rx noise source definition. See Section 6.2.7 for more details.

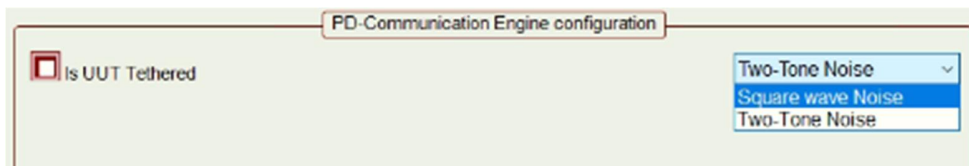


FIGURE 5.10: NOISE SELECTION FOR PD COMM ENGINE TESTS

When the UUT type is set to “Cable”, the  $V_{CONN}$  voltage selection menu allows selecting between 2.75V, 4.25V, 4.75V, and 5.75V.

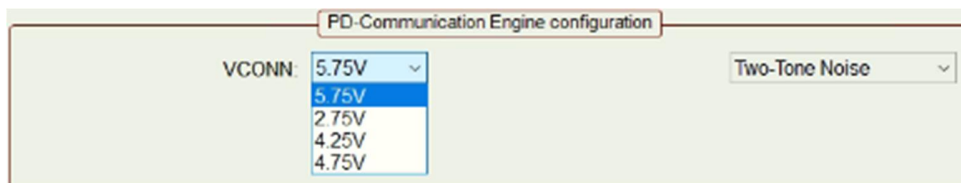


FIGURE 5.11: COMM ENGINE VCONN VOLTAGE SELECTION FOR CABLES

- **Deterministic PD Compliance Tests** – Runs the deterministic power delivery compliance tests.
- **USB-C Source Power Tests** – Runs the Source Power Tests or “QuadraMax” tests for power providers. These tests have an additional input that allows for the selection of how many ports participate in the testing, one or two.

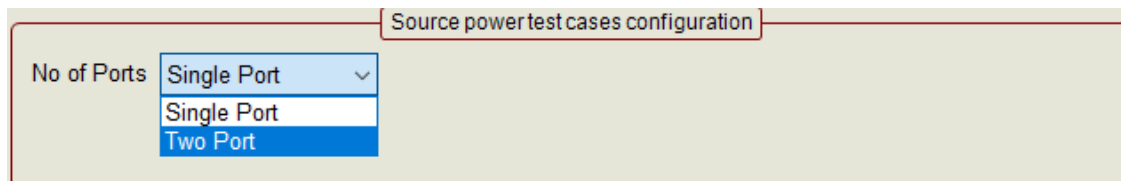


FIGURE 5.12: SELECTING THE NUMBER OF PORTS FOR USB-C SOURCE POWER TESTS

- **USB Type-C Functional Tests** – Runs the functional compliance tests for USB-C chargers.
- **Displayport Alternate Mode Tests** – Runs the Displayport Alternate mode compliance tests.
- **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 have additional inputs to indicate that a cable is connected directly to the device (tethered) and to allow selection of the specific Quick Charge 4/4+ specification to test against.



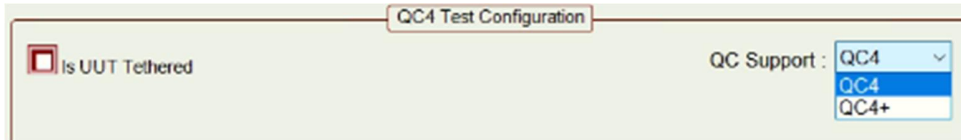


FIGURE 5.13: CABLE TETHERING AND SPECIFICATION SELECTION FOR QUICK CHARGE 4 TESTS

- Quick Charge Legacy Tests** – Runs the Quick Charge Legacy tests. These tests are proprietary to Qualcomm and are only available with arrangement through Qualcomm. These tests have additional inputs to indicate what type of cable is connected to the UUT, to allow the user to indicate the specific current rating (in amps) and power rating (in watts) of the connected device and to allow selection of the specific Quick Charge specification to test against.

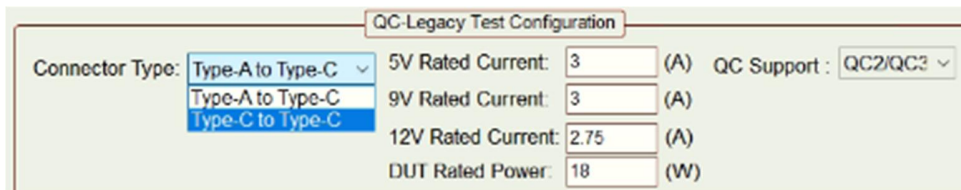


FIGURE 5.14: CABLE TYPE, CURRENT & POWER RATING OF UUT FOR LEGACY QC

Note that if Legacy QC4+ spec is selected, the current and power rating entry will be unavailable.

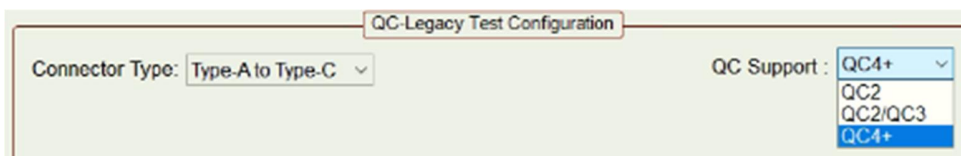


FIGURE 5.15: TEST SPECIFICATION SELECTION FOR LEGACY QC4+

- Thunderbolt Power Testing** – Runs the Thunderbolt power 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. Clicking on the “Read PDO” button will read back from the UUT the PDOs available at both Port A and Port B.

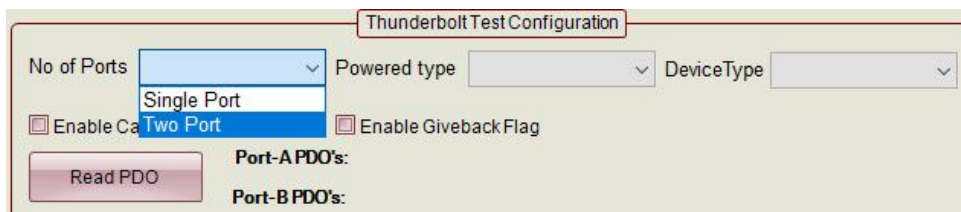


FIGURE 5.16: SELECT NUMBER OF PORTS FOR THUNDERBOLT POWER TESTS

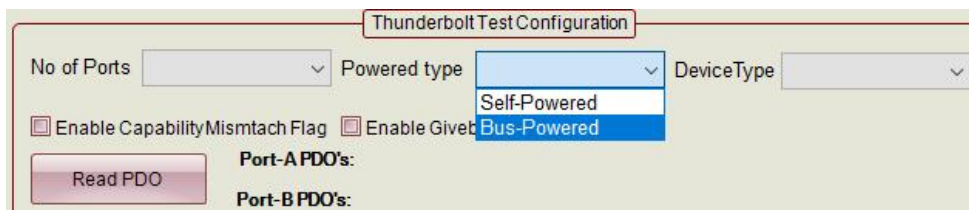


FIGURE 5.17: SELECT POWER TYPE FOR THUNDERBOLT POWER TESTS

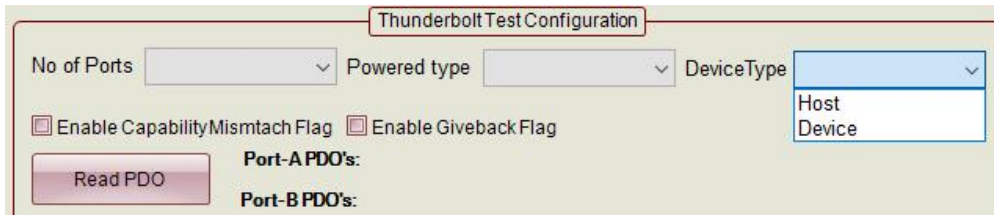


FIGURE 5.18: SELECT DEVICE TYPE FOR THUNDERBOLT POWER TESTS

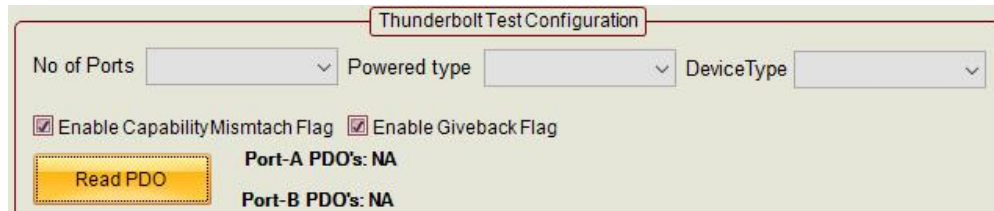


FIGURE 5.19: FLAG ENABLE AND PDO READ CAPABILITIES FOR THUNDERBOLT POWER TESTS

- **Offline Analysis** – When selected, test results are generated based on analysis of waveforms already collected from a UUT. The file folder icons can be selected to allow the user to specify the path to the CC Line waveform and, optionally, to the Vbus and eLoad waveforms.

No UUT is connected to the test controller when offline analysis is being done but a VIF (Vendor Information File) must still be loaded to allow the software to correctly interpret the information contained in the various waveform files.

The “Config Controller” button on the “Test Configuration” screen (see Figure 5.8) displays a configuration utility which allows access to direct control and debugging of the connected device. See Section 8, Appendix B: Using the Configuration Controller for complete information on the configuration utility.

The “Reset Results” button clears all stored results. This should be selected whenever a new device is tested or when all stored results should be cleared (as when restarting all testing of the current device).

### 5.3 Connecting to the UUT

Once the C2 test controller has been successfully connected to the test control computer and the UUT type and test selections have been made the UUT needs to be connected to the test controller.

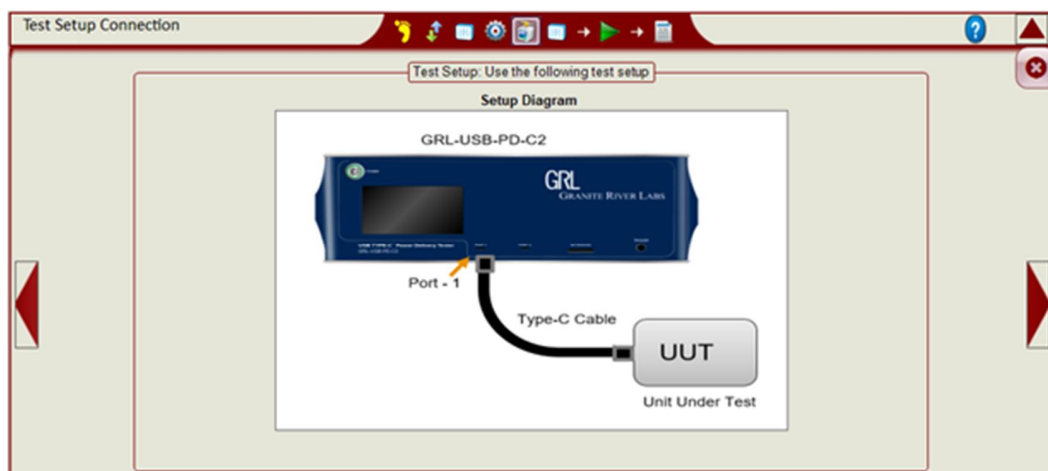


FIGURE 5.20: TEST SETUP CONNECTION SCREEN

Connect the UUT to Port 1 of the C2 test controller using the USB Type-C cable provided by Granite River Labs or a compliant Type-C cable.

### 5.4 Test Selection

Based on the type of UUT selected in Section 5.1 and the test selected in Section 5.2, the specific tests available to be run are shown on the “Test Selection” screen:

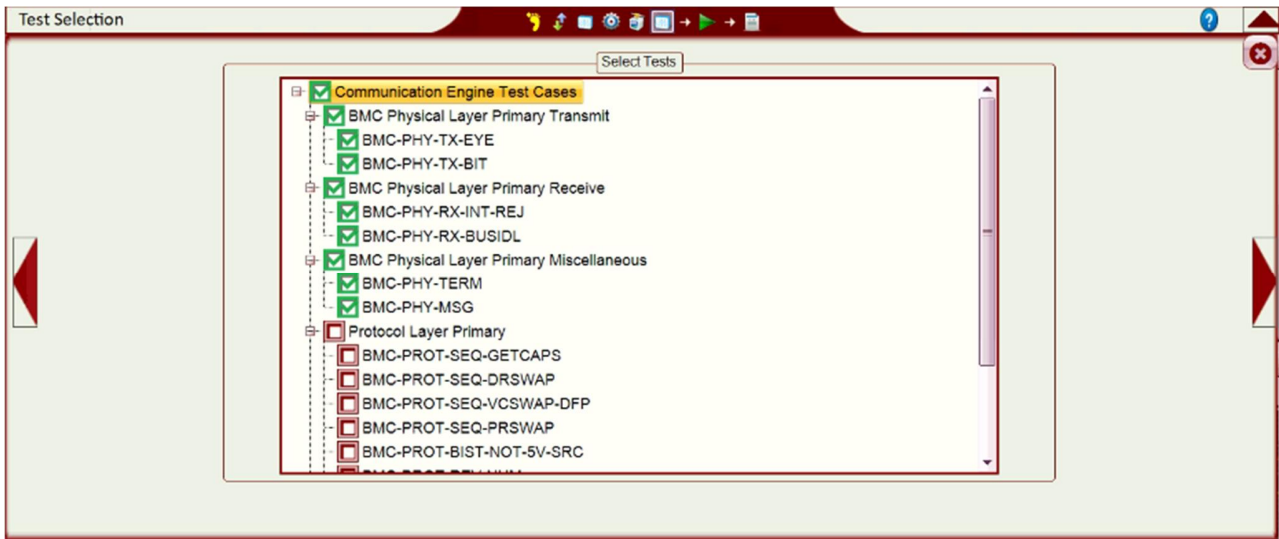


FIGURE 5.21: TEST SELECTIONS FOR COMMUNICATIONS ENGINE TESTS

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.

It is better to run a few tests (six to twelve) at a time rather than selecting all tests to be run at once. Some tests take considerable time to run to completion and it can appear that the test controller has become unstable or frozen. Running a smaller number of tests at once reduces the overall run time for each run and, should the data be lost for some reason, only the limited number of tests selected will need to be re-run. Since results are maintained between test runs (until the “Reset Results” button is clicked, see Section 5.2) with any duplicate tests overwriting previous results, results data is not lost if a set of tests fail to complete.

### 5.5 Running Tests

Once the desired tests have been selected, these tests can be run by pressing the green right-arrow icon at the top of the currently displayed screen:

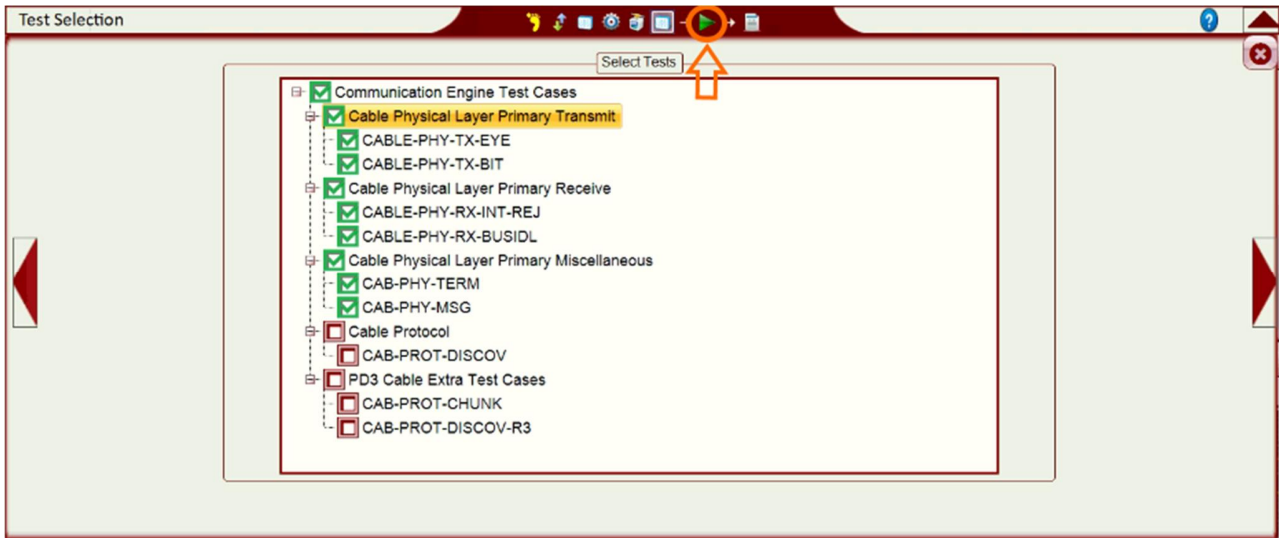


FIGURE 5.22: RUN TEST

Once testing has started a status display will pop-up to show what test is currently running, what tests have passed, what tests have failed, what tests are not applicable, what tests are incomplete and what tests remain to be run:

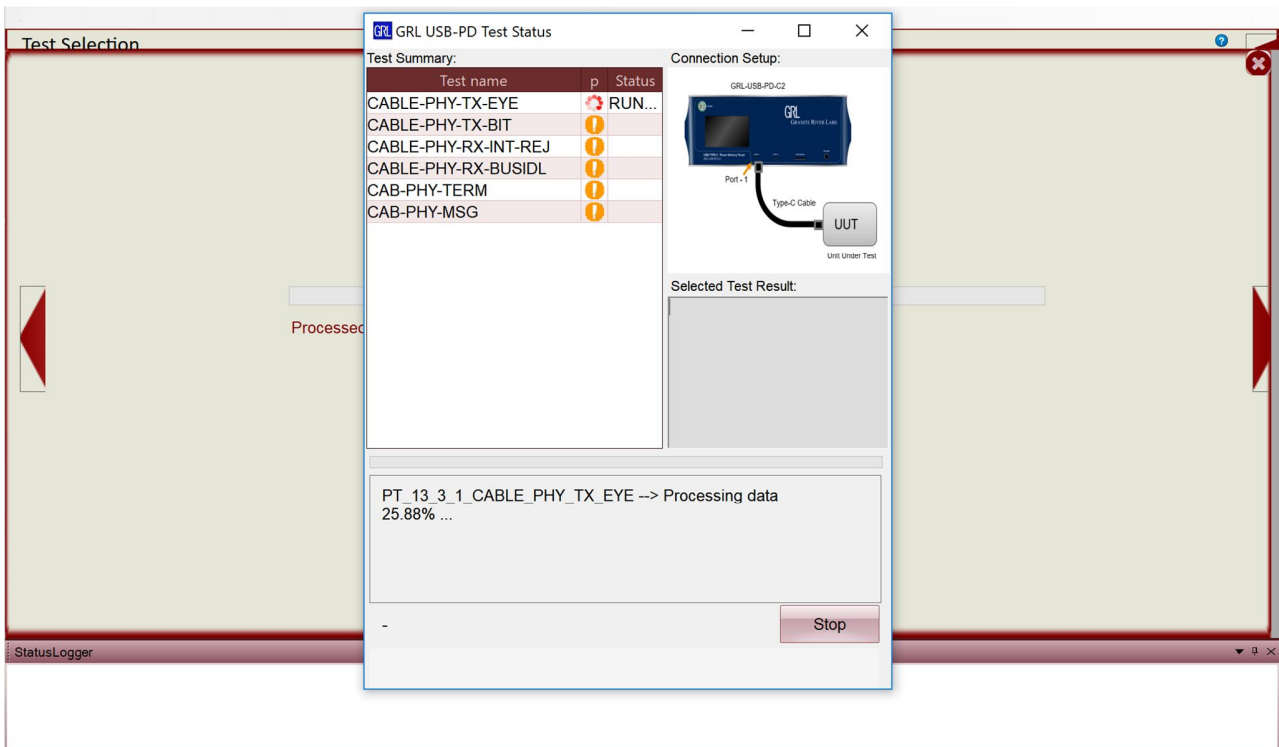


FIGURE 5.23: TESTING STATUS DISPLAY

When the testing is complete, the screen displays all the data gathered during the testing process.

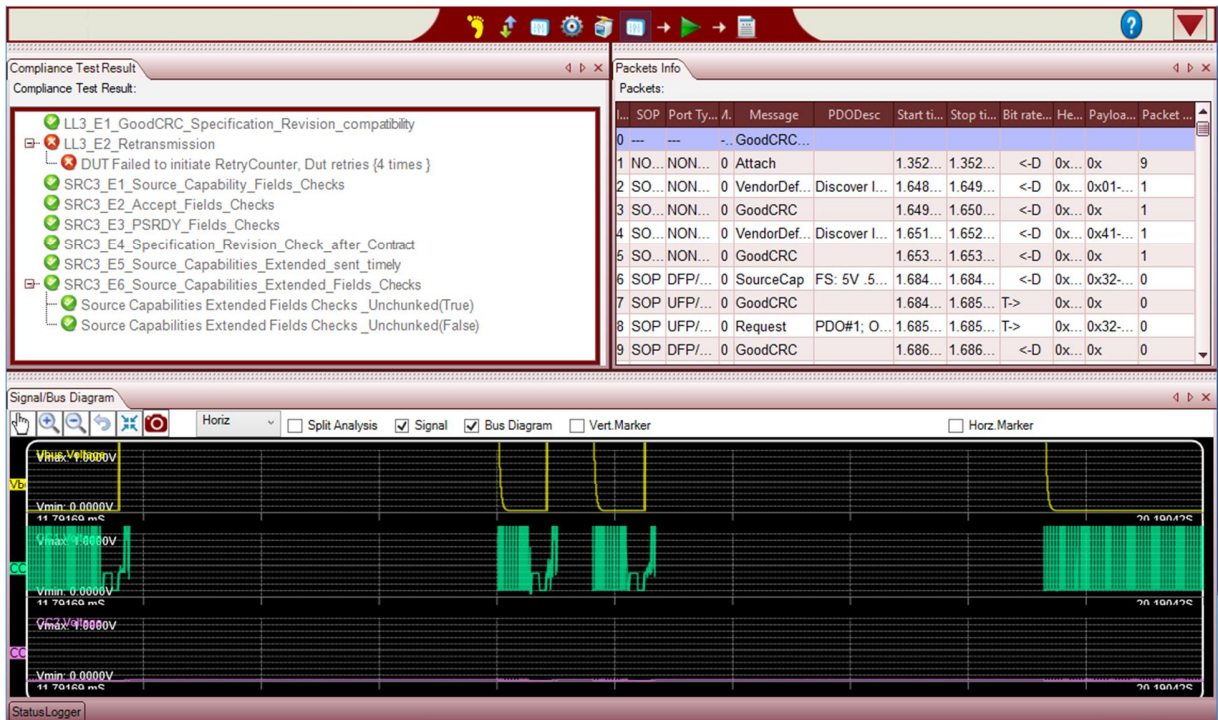


FIGURE 5.24: TEST STATUS, PROTOCOL AND WAVEFORM CAPTURES AT TEST COMPLETION

The user can click on a test in the Compliance Test Result pane and the protocol and waveform displays will automatically scroll to the section representing the start of the selected test: This allows the user to trace failing test to determine the cause of the test failure.

If transmitter electrical tests are included the eye diagrams are available and can be displayed by clicking on the “Eye Diagram” button.

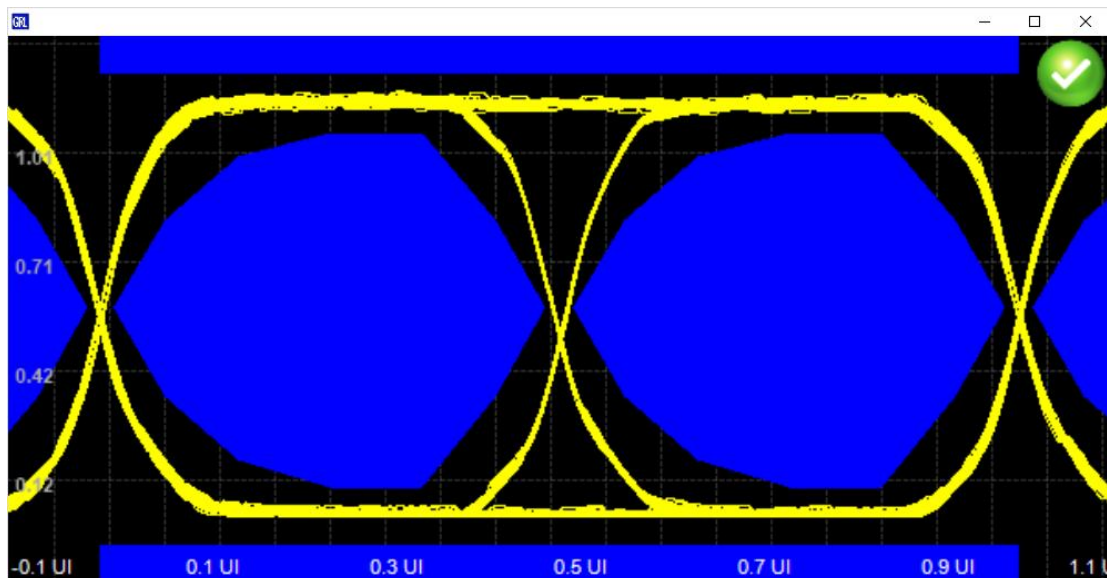


FIGURE 5.25: TRANSMITTER EYE DIAGRAM CAPTURED DURING TESTING

## 5.6 Report Generation

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

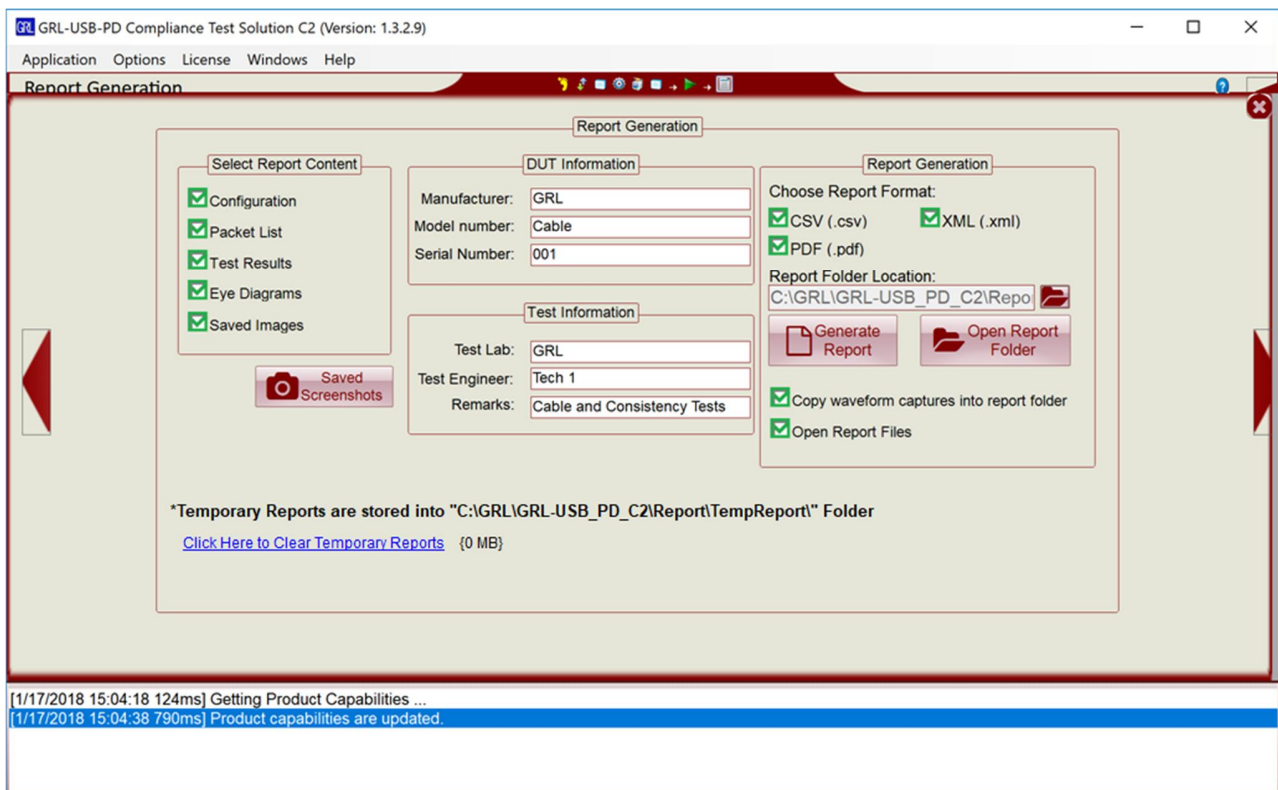


FIGURE 5.26: REPORT GENERATION SCREEN

The content of the generated reports can be set as 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 “DUT Information” and “Test Information” sections are text entry fields in which the user can enter information germane to the specific Device Under Test (DUT, another name for the UUT) and the specific set of tests just run.

Reports can be created in one or more of the following formats:

- **CSV** – Comma Separated Values, most useful for listing the protocol traffic captured during the test.
- **PDF** – Portable Document Format, contains the full test results including product configuration, pass / fail results, etc. as selected.
- **XML** – eXtensible Markup Language, useful for keeping track of what tests were run and the results of those tests in an easily machine-readable format.

The “Report Folder Location” provides a method of specifying or creating a folder to contain all the result information. It is important to note that a new folder is created each time reports are generated and thus the folder specified here will contain a collection of folders, one for each report generated.

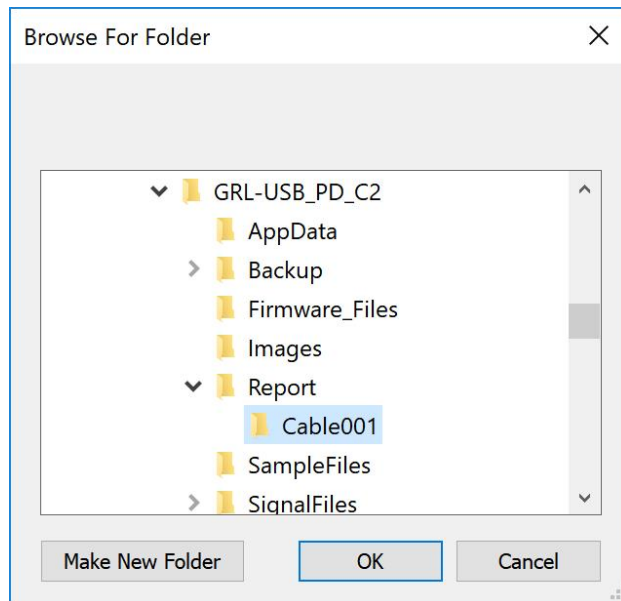


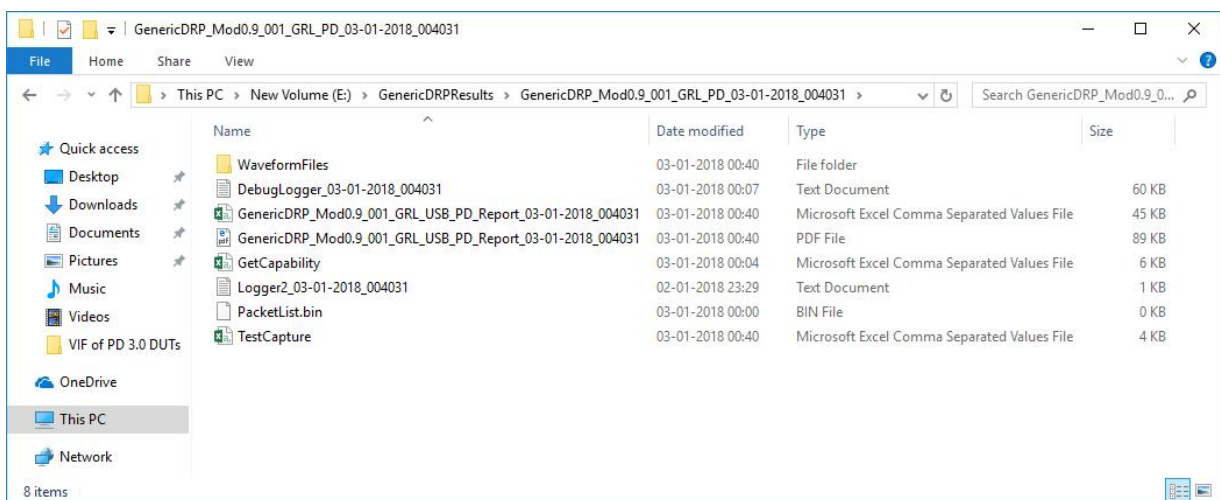
FIGURE 5.27: RESULTS FOLDER SELECTION OR CREATION

Selecting the “Copy waveform captures into report folder” button will keep all the captured waveforms with the generated reports. This is necessary if the user wants to recreate one or more reports (see Section 5.2). On the other hand, waveform files tend to be very large and will consume considerable disk space if all waveforms from a full set of tests are kept with the created reports.

Selecting the “Open Report Files” button will cause all selected report file formats to be displayed when the report generation is complete.

Clicking the “Generate Report” button causes all selected reports to be generated in the selected formats. If “Open Report Files” is selected, all selected file formats will be displayed immediately upon completion of generating the reports.

Clicking on the “Open Report Folder” will open a browser to the report folder just generated allowing the user to see the files generated and select any should they wish to.



Results are cumulative in that the user can select a number of tests and run them, then select the same or different tests and run these. The most recent set of results for all tests run (regardless of when they were run) will be captured in the generated reports. Clicking on the “Click Here to Clear Temporary Reports” link or going to the “Test Configuration” screen (see Section 5.2) and clicking on the “Reset Results” button will clear all saved result information and allow the user to start over collecting results.

## 6 Compliance Tests Supported by GRL-USB-PD-C2

GRL-USB-PD-C2 Supports several Compliance Test Specifications (CTS’s) from different technologies using the USB Type-C Connector. This section provides a detailed listing of all the tests in the latest version of the specification. For detailed test steps, refer to the specification documents referenced in Section 1.

### USB-IF Specifications:

1. PD 3.0 Test Plan
2. PD 2.0 Test Plan – Communications Engine MOI
3. PD 2.0 Test Plan – Deterministic MOI
4. USB Type-C Functional Specification
5. USB PD Source Power Test (SPT) Specification

### VESA Specifications:

6. DisplayPort over Type-C Compliance Test Specification (CTS) and pin assignment ECR

### QC4 Specifications:

7. Quick Charge 4 Test Specification
8. Quick Charge Legacy Test Specification

Refer to Section 1 for the links to the Test Specifications and their latest versions.

The *USB-IF USB Power Delivery Test Plans* are developed by the USB-IF’s Power Delivery Working Group. The *VESA Display Port Alternate Mode Test Plan* is developed by VESA’s DisplayPort work group and so on.

The following table shows the mapping of required tests supported by GRL-USB-PD-C2 tester for various USB Type-C Devices:

Test Items	PD Source (Provider)	PD Sink (Consumer)	PD DRP C/P or P/C	Non-PD Charger	Cable w/ Emarker	Cable w/o Emarker
PD 3.0 CTS Tests	Yes	Yes	Yes	No	Yes	No
PD 2.0 Comm Engine	Yes	Yes	Yes	No	Yes	No
PD 2.0 Deterministic	Yes	Yes	Yes	No	Yes	No
USB Type-C Functional	Yes	No	No	No	No	No
Source Power Tests (SPT)	Yes	No	Yes	No	No	No
DiaplayPort Alt Mode*	Yes	Yes	Yes	No	No	No
Quick Charge 4*	Yes	No	No	No	No	No
Quick Charge Legacy*	Yes	No	No	No	No	No

\* If Alt Mode is supported



## 6.1 PD3.0 Compliance Tests

There are six types of devices defined in the USB Power Delivery 3.0 test specification. These are:

- Cables – Type C cables with eMarker capability (Section 6.1.1).
- Dual Role Ports (DRP) – Devices capable of providing power and accepting power, such as a laptop or smart phone (Section 6.1.2).
- Provider Only – A power supply or charger that only provides power (Section 6.1.3).
- Consumer Only – A device that only consumes power such as a mouse or an audio player (Section 6.1.4).
- Consumer / Provider – A device that generally consumes power but can provide limited power when required (Section 6.1.5).
- Provider / Consumer – A device that generally provides power but can consume limited power when required (Section 6.1.6).

There are six categories of compliance tests defined in the specification. These are:

- Cable Tests – A set of six tests specifically designed to test eMark enabled cables.
- Link Layer Tests – A pair of tests that test the link layer of devices.
- Source Tests – A set of 36 tests that test devices power source capability.
- Sink Tests – A set of 20 tests that test devices power sink characteristics.
- VDM Tests – A pair of tests that check for valid handling of Vendor Defined Messages.
- Consistency Tests – A set of nine tests that check the consistency of information returned from devices.

Not all tests are applicable to all types of devices. Cable tests are applicable to cables only while link layer tests are applicable to all devices but cables. Source tests are applicable only to devices that source power: DRP, Provider Only and Provider / Consumer. A list of which tests are applicable to each device type is shown in Sections 6.1.1 through 6.1.6 below.

### 6.1.1 PD3.0 Compliance Tests for Emarker Cables

Test Ref #	Test Description
	<b>Cable Tests</b>
TD.PD.CBL3.E1	Receiving Chunked Extended Message
TD.PD.CBL3.E2	ChunkSenderResponseTimer Timeout
TD.PD.CBL3.E3	Manufacturer_Info Fields Checks
TD.PD.CBL3.E4	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Target
TD.PD.CBL3.E5	Unrecognized Message Received
TD.PD.CBL3.E6	Not Saving Specification Revision
	<b>VDM Tests</b>
TD.PD.VDM3.E1	Fields Checks - Discover Identity
	<b>Consistency Tests</b>
TD.PD.VNDI3.E3	VDM Identity
TD.PD.VNDI3.E4	Manufacturer Info
TD.PD.VNDI3.E5	Chunking Implemented

Test Ref #	Test Description
	<b>Cable Tests</b>
TD.PD.VNDI3.E7	Security_Msgs_Supported

### 6.1.2 PD3.0 Compliance Tests for Dual Role Ports (DRP)

Test Ref #	Test Description
	<b>Link Layer Tests</b>
TD.PD.LL3.E1	GoodCRC Specification Revision compatibility
TD.PD.LL3.E2	Retransmission
	<b>Source Tests</b>
TD.PD.SRC3.E1	Source Capabilities Fields Checks
TD.PD.SRC3.E2	Accept Fields Checks
TD.PD.SRC3.E3	PS_RDY Fields Checks
TD.PD.SRC3.E4	Specification Revision Check after Contract
TD.PD.SRC3.E5	Source_Capabilities_Extended sent timely
TD.PD.SRC3.E6	Source_Capabilities_Extended Fields Checks
TD.PD.SRC3.E7	Battery Status sent timely
TD.PD.SRC3.E8	Battery Status Fields Checks
TD.PD.SRC3.E9	Battery Status Fields Checks - Invalid Battery reference
TD.PD.SRC3.E10	Unrecognized Message Received in Ready State
TD.PD.SRC3.E11	Get_Status Fields Checks
TD.PD.SRC3.E12	Get_Battery_Status Fields Checks
TD.PD.SRC3.E13	Status sent timely
TD.PD.SRC3.E14	Status Fields Checks
TD.PD.SRC3.E15	Battery_Capabilities sent timely
TD.PD.SRC3.E16	Battery_Capabilities Fields Checks
TD.PD.SRC3.E17	Battery_Capabilities Fields Checks - Invalid Battery Reference
TD.PD.SRC3.E18	Manufacturer_Info Sent Timely
TD.PD.SRC3.E19	Manufacturer_Info Fields Checks
TD.PD.SRC3.E20	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Target
TD.PD.SRC3.E21	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Ref
TD.PD.SRC3.E22	Cable Type Detection
TD.PD.SRC3.E23	Vconn Swap
TD.PD.SRC3.E24	Unexpected Message Received in Ready State
TD.PD.SRC3.E25	Receiving chunked extended message
TD.PD.SRC3.E26	Soft_Reset sent regardless of Rp value
TD.PD.SRC3.E27	PPS_Status Sent Timely
TD.PD.SRC3.E28	PPS_Status Fields Check
TD.PD.SRC3.E29	SourcePPSCmmTimer Deadline
TD.PD.SRC3.E30	SourcePPSCmmTimer Timeout
TD.PD.SRC3.E31	SourcePPSCmmTimer Stopped
TD.PD.SRC3.E32	ChunkSenderResponseTimer Timeout
TD.PD.SRC3.E33	Country_Codes Sent Timely
TD.PD.SRC3.E34	Country_Codes Fields Checks
TD.PD.SRC3.E35	Country_Info Sent Timely
TD.PD.SRC3.E36	Country_Info Fields Checks
	<b>Sink Tests</b>

TD.PD.SNK3.E1	Request Fields Checks
TD.PD.SNK3.E2	Unrecognized Message Received in Ready State
TD.PD.SNK3.E3	Get_Source_Cap_Extended Fields Checks
TD.PD.SNK3.E4	SenderResponseTimer Deadline - Source_Capabilities_Extended
TD.PD.SNK3.E5	SenderResponseTimer Timeout - Source_Capabilities_Extended
TD.PD.SNK3.E6	Get_Status Fields Checks
TD.PD.SNK3.E7	Get_Battery_Status Fields Checks
TD.PD.SNK3.E8	Status sent timely
TD.PD.SNK3.E9	Manufacturer_Info Sent Timely
TD.PD.SNK3.E10	Source_Capabilities_Extended sent timely
TD.PD.SNK3.E11	Receiving chunked extended message
TD.PD.SNK3.E12	Soft_Reset sent regardless of Rp value
TD.PD.SNK3.E13	SinkPPSPeriodicTimer Timeout
TD.PD.SNK3.E14	Request Fields Checks - PPS
TD.PD.SNK3.E15	Status Fields Checks
TD.PD.SNK3.E16	Manufacturer_Info Fields Checks
TD.PD.SNK3.E17	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Target
TD.PD.SNK3.E18	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Ref
TD.PD.SNK3.E19	ChunkSenderResponseTimer Timeout
TD.PD.SNK3.E20	Collision Avoidance after PR_Swap
	<b>VDM Tests</b>
TD.PD.VDM3.E1	Fields Checks - Discover Identity
TD.PD.VDM3.E2	Unrecognized VID in Unstructured VDM
	<b>Consistency Tests</b>
TD.PD.VNDI3.E1	Source Capabilities
TD.PD.VNDI3.E2	Request
TD.PD.VNDI3.E3	VDM Identity
TD.PD.VNDI3.E4	Manufacturer Info
TD.PD.VNDI3.E5	Chunking Implemented
TD.PD.VNDI3.E6	Unchunked_Extended_Messages_Supported
TD.PD.VNDI3.E7	Security_Msgs_Supported
TD.PD.VNDI3.E8	Sink Capabilities
TD.PD.VNDI3.E9	Source_Capabilities_Extended

### 6.1.3 PD3.0 Compliance Tests for Provider Only

Test Ref #	Test Description
	<b>Link Layer Tests</b>
TD.PD.LL3.E1	GoodCRC Specification Revision compatibility
TD.PD.LL3.E2	Retransmission
	<b>Source Tests</b>
TD.PD.SRC3.E1	Source Capabilities Fields Checks
TD.PD.SRC3.E2	Accept Fields Checks
TD.PD.SRC3.E3	PS_RDY Fields Checks
TD.PD.SRC3.E4	Specification Revision Check after Contract
TD.PD.SRC3.E5	Source_Capabilities_Extended sent timely
TD.PD.SRC3.E6	Source_Capabilities_Extended Fields Checks
TD.PD.SRC3.E7	Battery Status sent timely

TD.PD.SRC3.E8	Battery Status Fields Checks
TD.PD.SRC3.E9	Battery Status Fields Checks - Invalid Battery reference
TD.PD.SRC3.E10	Unrecognized Message Received in Ready State
TD.PD.SRC3.E11	Get_Status Fields Checks
TD.PD.SRC3.E12	Get_Battery_Status Fields Checks
TD.PD.SRC3.E13	Status sent timely
TD.PD.SRC3.E14	Status Fields Checks
TD.PD.SRC3.E15	Battery_Capabilities sent timely
TD.PD.SRC3.E16	Battery_Capabilities Fields Checks
TD.PD.SRC3.E17	Battery_Capabilities Fields Checks - Invalid Battery Reference
TD.PD.SRC3.E18	Manufacturer_Info Sent Timely
TD.PD.SRC3.E19	Manufacturer_Info Fields Checks
TD.PD.SRC3.E20	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Target
TD.PD.SRC3.E21	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Ref
TD.PD.SRC3.E22	Cable Type Detection
TD.PD.SRC3.E23	Vconn Swap
TD.PD.SRC3.E24	Unexpected Message Received in Ready State
TD.PD.SRC3.E25	Receiving chunked extended message
TD.PD.SRC3.E26	Soft_Reset sent regardless of Rp value
TD.PD.SRC3.E27	PPS_Status Sent Timely
TD.PD.SRC3.E28	PPS_Status Fields Check
TD.PD.SRC3.E29	SourcePPSCCommTimer Deadline
TD.PD.SRC3.E30	SourcePPSCCommTimer Timeout
TD.PD.SRC3.E31	SourcePPSCCommTimer Stopped
TD.PD.SRC3.E32	ChunkSenderResponseTimer Timeout
TD.PD.SRC3.E33	Country_Codes Sent Timely
TD.PD.SRC3.E34	Country_Codes Fields Checks
TD.PD.SRC3.E35	Country_Info Sent Timely
TD.PD.SRC3.E36	Country_Info Fields Checks
	<b>Sink Tests</b>
	<i>There are no sink tests for a provider only device.</i>
	<b>VDM Tests</b>
TD.PD.VDM3.E1	Fields Checks - Discover Identity
	<b>Consistency Tests</b>
TD.PD.VNDI3.E1	Source Capabilities
TD.PD.VNDI3.E3	VDM Identity
TD.PD.VNDI3.E4	Manufacturer Info
TD.PD.VNDI3.E5	Chunking Implemented
TD.PD.VNDI3.E6	Unchunked_Extended_Messages_Supported
TD.PD.VNDI3.E7	Security_Msgs_Supported
TD.PD.VNDI3.E9	Source_Capabilities_Extended

#### 6.1.4 PD3.0 Compliance Tests for Consumer Only

Test Ref #	Test Description
	<b>Link Layer Tests</b>
TD.PD.LL3.E1	GoodCRC Specification Revision compatibility
TD.PD.LL3.E2	Retransmission

	<b>Source Tests</b>
	<i>There are no source tests for a consumer only device.</i>
	<b>Sink Tests</b>
TD.PD.SNK3.E1	Request Fields Checks
TD.PD.SNK3.E2	Unrecognized Message Received in Ready State
TD.PD.SNK3.E3	Get_Source_Cap_Extended Fields Checks
TD.PD.SNK3.E4	SenderResponseTimer Deadline - Source_Capabilities_Extended
TD.PD.SNK3.E5	SenderResponseTimer Timeout - Source_Capabilities_Extended
TD.PD.SNK3.E6	Get_Status Fields Checks
TD.PD.SNK3.E7	Get_Battery_Status Fields Checks
TD.PD.SNK3.E8	Status sent timely
TD.PD.SNK3.E9	Manufacturer_Info Sent Timely
TD.PD.SNK3.E10	Source_Capabilities_Extended sent timely
TD.PD.SNK3.E11	Receiving chunked extended message
TD.PD.SNK3.E12	Soft_Reset sent regardless of Rp value
TD.PD.SNK3.E13	SinkPPSPeriodicTimer Timeout
TD.PD.SNK3.E14	Request Fields Checks - PPS
TD.PD.SNK3.E15	Status Fields Checks
TD.PD.SNK3.E16	Manufacturer_Info Fields Checks
TD.PD.SNK3.E17	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Target
TD.PD.SNK3.E18	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Ref
TD.PD.SNK3.E19	ChunkSenderResponseTimer Timeout
TD.PD.SNK3.E20	Collision Avoidance after PR_Swap
	<b>VDM Tests</b>
TD.PD.VDM3.E1	Fields Checks - Discover Identity
TD.PD.VDM3.E2	Unrecognized VID in Unstructured VDM
	<b>Consistency Tests</b>
TD.PD.VNDI3.E2	Request
TD.PD.VNDI3.E3	VDM Identity
TD.PD.VNDI3.E4	Manufacturer Info
TD.PD.VNDI3.E5	Chunking Implemented
TD.PD.VNDI3.E6	Unchunked_Extended_Messages_Supported
TD.PD.VNDI3.E7	Security_Msgs_Supported
TD.PD.VNDI3.E8	Sink Capabilities

### 6.1.5 PD3.0 Compliance Tests for Consumer/Provider

Test Ref #	Test Description
	<b>Link Layer Tests</b>
TD.PD.LL3.E1	GoodCRC Specification Revision compatibility
TD.PD.LL3.E2	Retransmission
	<b>Source Tests</b>
	<i>There are no source tests for a consumer/provider device.</i>
	<b>Sink Tests</b>
TD.PD.SNK3.E1	Request Fields Checks
TD.PD.SNK3.E2	Unrecognized Message Received in Ready State
TD.PD.SNK3.E3	Get_Source_Cap_Extended Fields Checks
TD.PD.SNK3.E4	SenderResponseTimer Deadline - Source_Capabilities_Extended

TD.PD.SNK3.E5	SenderResponseTimer Timeout - Source_Capabilities_Extended
TD.PD.SNK3.E6	Get_Status Fields Checks
TD.PD.SNK3.E7	Get_Battery_Status Fields Checks
TD.PD.SNK3.E8	Status sent timely
TD.PD.SNK3.E9	Manufacturer_Info Sent Timely
TD.PD.SNK3.E10	Source_Capabilities_Extended sent timely
TD.PD.SNK3.E11	Receiving chunked extended message
TD.PD.SNK3.E12	Soft_Reset sent regardless of Rp value
TD.PD.SNK3.E13	SinkPPSPeriodicTimer Timeout
TD.PD.SNK3.E14	Request Fields Checks - PPS
TD.PD.SNK3.E15	Status Fields Checks
TD.PD.SNK3.E16	Manufacturer_Info Fields Checks
TD.PD.SNK3.E17	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Target
TD.PD.SNK3.E18	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Ref
TD.PD.SNK3.E19	ChunkSenderResponseTimer Timeout
TD.PD.SNK3.E20	Collision Avoidance after PR_Swap
	<b>VDM Tests</b>
TD.PD.VDM3.E1	Fields Checks - Discover Identity
TD.PD.VDM3.E2	Unrecognized VID in Unstructured VDM
	<b>Consistency Tests</b>
TD.PD.VNDI3.E2	Request
TD.PD.VNDI3.E3	VDM Identity
TD.PD.VNDI3.E4	Manufacturer Info
TD.PD.VNDI3.E5	Chunking Implemented
TD.PD.VNDI3.E6	Unchunked_Extended_Messages_Supported
TD.PD.VNDI3.E7	Security_Msgs_Supported
TD.PD.VNDI3.E8	Sink Capabilities

### 6.1.6 PD3.0 Compliance Tests for Provider/Consumer

Test Ref #	Test Description
	<b>Link Layer Tests</b>
TD.PD.LL3.E1	GoodCRC Specification Revision compatibility
TD.PD.LL3.E2	Retransmission
	<b>Source Tests</b>
TD.PD.SRC3.E1	Source Capabilities Fields Checks
TD.PD.SRC3.E2	Accept Fields Checks
TD.PD.SRC3.E3	PS_RDY Fields Checks
TD.PD.SRC3.E4	Specification Revision Check after Contract
TD.PD.SRC3.E5	Source_Capabilities_Extended sent timely
TD.PD.SRC3.E6	Source_Capabilities_Extended Fields Checks
TD.PD.SRC3.E7	Battery Status sent timely
TD.PD.SRC3.E8	Battery Status Fields Checks
TD.PD.SRC3.E9	Battery Status Fields Checks - Invalid Battery reference
TD.PD.SRC3.E10	Unrecognized Message Received in Ready State
TD.PD.SRC3.E11	Get_Status Fields Checks
TD.PD.SRC3.E12	Get_Battery_Status Fields Checks
TD.PD.SRC3.E13	Status sent timely

TD.PD.SRC3.E14	Status Fields Checks
TD.PD.SRC3.E15	Battery_Capabilities sent timely
TD.PD.SRC3.E16	Battery_Capabilities Fields Checks
TD.PD.SRC3.E17	Battery_Capabilities Fields Checks - Invalid Battery Reference
TD.PD.SRC3.E18	Manufacturer_Info Sent Timely
TD.PD.SRC3.E19	Manufacturer_Info Fields Checks
TD.PD.SRC3.E20	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Target
TD.PD.SRC3.E21	Manufacturer_Info Fields Checks - Invalid Manufacturer Info Ref
TD.PD.SRC3.E22	Cable Type Detection
TD.PD.SRC3.E23	Vconn Swap
TD.PD.SRC3.E24	Unexpected Message Received in Ready State
TD.PD.SRC3.E25	Receiving chunked extended message
TD.PD.SRC3.E26	Soft_Reset sent regardless of Rp value
TD.PD.SRC3.E27	PPS_Status Sent Timely
TD.PD.SRC3.E28	PPS_Status Fields Check
TD.PD.SRC3.E29	SourcePPSCommTimer Deadline
TD.PD.SRC3.E30	SourcePPSCommTimer Timeout
TD.PD.SRC3.E31	SourcePPSCommTimer Stopped
TD.PD.SRC3.E32	ChunkSenderResponseTimer Timeout
TD.PD.SRC3.E33	Country_Codes Sent Timely
TD.PD.SRC3.E34	Country_Codes Fields Checks
TD.PD.SRC3.E35	Country_Info Sent Timely
TD.PD.SRC3.E36	Country_Info Fields Checks
	<b>Sink Tests</b>
	<i>There are no sink tests for a provide/consumer device.</i>
	<b>VDM Tests</b>
TD.PD.VDM3.E1	Fields Checks - Discover Identity
	<b>Consistency Tests</b>
TD.PD.VNDI3.E1	Source Capabilities
TD.PD.VDM3.E3	VDM Identity
TD.PD.VDM3.E4	Manufacturer Info
TD.PD.VDM3.E5	Chunking Implemented
TD.PD.VDM3.E6	Unchunked_Extended_Messages_Supported
TD.PD.VDM3.E7	Security_Msgs_Supported
TD.PD.VDM3.E8	Sink Capabilities
TD.PD.VDM3.E9	Source_Capabilities_Extended

## 6.2 PD2.0 Communications Engine Compliance Tests

The USB Power Delivery **Communications Engine Method of Implementation (MOI)** covers BMC-PHY (BMC Physical Layer), BMC-PROT (Comm Engine Protocol), and BMC-POW (Power). Refer to Section 1 for the link to the Comm Engine MOI and reference to latest version.

The following sections include summaries of Primary and Secondary tests that must be run on each USB-PD Device type. Primary tests are required tests. Secondary tests are tests that must be run on specific PD messages when they occur.

The ‘Test Name’ in the following tables can be cross-referenced with the table in Chapter 12 of the test plan, to identify the test assertions covered by each test. The ‘Test Ref #’ is used to

organize the tests between the Primary and Secondary test suites, and to provide logical grouping for the test report.

## 6.2.1 PD2.0 Communications Engine MOI Tests for eMarker Cables

### Primary Tests

Test Ref #	Test Name	Test Description
<b>Cable Physical Layer Tests - Transmit</b>		
TDA.1.1.1.1.1	CAB-PHY-TX-EYE	Cable Transmitter Eye Diagram (SOP Prime)
TDA.1.1.1.1.2	CAB-DP-PHY-TX-EYE	Cable Transmitter Eye Diagram (SOP Double Prime)
TDA.1.1.1.2.1	CAB-PHY-TX-BIT	Cable Transmit Bit Rate and Bit Rate Drift (SOP Prime)
TDA.1.1.1.2.2	CAB-DP-PHY-TX-BIT	Cable Transmit Bit Rate & Bit Rate Drift (SOP Double Prime)
<b>Cable Physical Layer Tests - Receive</b>		
TDA.1.1.2.1.1	CAB-PHY-RX-BUSIDL	Cable Bus Idle Detection (SOP Prime)
TDA.1.1.2.1.2	CAB-DP-PHY-RX-BUSIDL	Cable Bus Idle Detection (SOP Double Prime)
TDA.1.1.2.2.1	CAB-PHY-RX-INT-REJ	Cable Receive Interference Rejection (SOP Prime)
TDA.1.1.2.2.2	CAB-DP-PHY-RX-INT-REJ	Cable Receive Interference Rejection (SOP Double Prime)
<b>Cable Physical Layer Tests - Miscellaneous</b>		
TDA.1.1.3.1.1	CAB-PHY-TERM	Cable Termination Impedance (SOP Prime)
TDA.1.1.3.1.2	CAB-DP-PHY-TERM	Cable Termination Impedance (SOP Double Prime)
TDA.1.1.3.2.1	CAB-PHY-MSG	Cable PHY Level Message Test (SOP Prime)
TDA.1.1.3.2.2	CAB-DP-PHY-MSG	Cable PHY Level Message Test (SOP Double Prime)
<b>Cable Protocol-Specific Tests</b>		
TDA.1.2.1	CAB-PROT-DISCOV	Cable ID Checks

### Secondary Message Tests

These tests are performed on messages whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.1.1.1	PHY-MSG-GEN	PHY Level General Message Test (SOP*)
TDB.2.1.2.1	PROT-MSG-HDR	Message Header Checks – except GoodCRC
TDB.2.1.2.2	PROT-MSG-HDR-GCRC	Message Header Checks – GoodCRC
TDB.2.1.3	PROT-MSG-CTRL	Control Message Checks
TDB.2.1.4.3	PROT-MSG-DATA-VEND	Vendor Defined Message Checks
TDB.2.1.4.4.1.2	PROT-MSG-DATA-VDM-ID-ACK	Discover ID ACK Message Checks
TDB.2.1.4.4.2.2	PROT-MSG-DATA-VDM-SVID-ACK	Discover SVIDs ACK Message Checks
TDB.2.1.4.4.3.2	PROT-MSG-DATA-VDM-MODE-ACK	Discover Modes ACK Message Check
TDB.2.1.4.4.4	PROT-MSG-DATA-VDM-ENTER-MODE	Enter Mode Message Checks
TDB.2.1.4.4.5	PROT-MSG-DATA-VDM-EXIT-MODE	Exit Mode Message Checks



## Secondary Procedure Tests

These tests are performed on procedures whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.2.2.1.1	PROT-PROC-AMS_1	Procedure and Checks for any Atomic Message Sequence
TDB.2.2.2.1	PROT-PROC-GOONCRC-TSTR	Procedure and Checks for GoodCRC sent by Tester
TDB.2.2.2.2	PROT-PROC-GOONCRC-UUT	Procedure and Checks for GoodCRC sent by UUT (Unit Under Test)
TDB.2.2.12.1	PROT-PROC-SR-TSTR	Procedure and Checks for Tester Originated Soft Reset
TDB.2.2.12.2	PROT-PROC-SR-UUT	Procedure and Checks for UUT Originated Soft Reset
TDB.2.2.13.1	PROT-PROC-HR-TSTR	Procedure and Checks for Tester Originated Hard Reset
TDB.2.2.13.2	PROT-PROC-HR-UUT	Procedure and Checks for UUT Originated Hard Reset
TDB.2.2.14	PROT-PROC-BIST-TSTR	Procedure and Checks for Tester Originated BIST

## 6.2.2 PD2.0 Communications Engine MOI Dual Role Port (DRP) Tests

### Primary Tests

Note that test TDA.2.2.6 BMC-PROT-SEQ-SWAP-REJ is optional and that test TDA.2.2.7 BMC-PROT-BIST-NOT-5V-SRC is required only for devices which support greater than 5 volts.

Test Ref #	Test Name	Test Description
	<b>BMC Physical Layer Tests - Transmit</b>	
TDA.2.1.1.1	BMC-PHY-TX-EYE	BMC Transmitter Eye Diagram
TDA.2.1.1.2	BMC-PHY-TX-BIT	BMC Transmit Bit Rate and Bit Rate Drift
	<b>BMC Physical Layer Tests - Receive</b>	
TDA.2.1.2.1	BMC-PHY-RX-BUSIDL	BMC Bus Idle Detections test
TDA.2.1.2.2	BMC-PHY-RX-INT-REJ	BMC Receive Interference Rejection Test
	<b>BMC Physical Layer Tests - Miscellaneous</b>	
TDA.2.1.3.1	BMC-PHY-TERM	BMC Termination Impedance Test
TDA.2.1.3.2	BMC-PHY-MSG	BMC PHY Level Message Test
	<b>Protocol-Specific</b>	
TDA.2.2.1	BMC-PROT-SEQ-GETCAPS	Get_Source_Cap and Get_Sink_Cap Test
TDA.2.2.2.1	BMC-PROT-SEQ-CHKCAP-P-PC	Check Cable Capabilities (3A Marked) Test
TDA.2.2.2.2	BMC-PROT-SEQ-NOMRK-P-PC	Check Cable Capabilities (Unmarked) Test
TDA.2.2.2.3	BMC-PROT-SEQ-CHKCAB-CP-ACC	Check Cable Capabilities (3A Marked) Test – After PR_Swap
TDA.2.2.2.4	BMC-PROT-SEQ-CHKCAP-NOMRK-CP-ACC	Check Capabilities (Unmarked) – After PR Swap
TDA.2.2.3	BMC-PROT-SEQ-DRSWAP	Dual Role Swap Test
TDA.2.2.4	BMC-PROT-SEQ-VCSWAP	VCONN_Swap Test
TDA.2.2.5	BMC-PROT-DISCOV	ID Checks
TDA.2.2.6	BMC-PROT-SEQ-SWAP-REJ	Optional: Reject Swap Test – Provider / Consumer
TDA.2.2.7	BMC-PROT-BIST-NOT-5V-SRC	BIST Functionality at Above 5V Test
TDA.2.2.8	BMC-PROT-REV-NUM	Revision Number Test
	<b>Power Source/Sink Tests</b>	
TDA.2.3.1.1	BMC-POW-SRC-LOAD-P-PC	Source Dynamic Load Test – Provider or Provider/Consumer
TDA.2.3.1.2	BMC-POW-SRC-LOAD-CP-ACC	Source Dynamic Load Test – Consumer/Provider Accepting Swap
TDA.2.3.2.1	BMC-POW-SRC-TRANS-P-PC	PDO Transition Test – Source, Provider or Provider/Consumer
TDA.2.3.2.2	BMC-POW-SRC-TRANS-CP-ACC	PDO Transition Test – Source, Consumer/Provider Accepting Swap
TDA.2.3.3.1	BMC-POW-SNK-TRANS-C-CP	PDO Transition, Current Draw, and Suspend Test - Sink, Consumer or Consumer/ProviderConsumer
TDA.2.3.3.2	BMC-POW-SNK-TRANS-PC	PDO Transition, Current Draw and Suspend Test – Sink, Provider/Consumer

### Secondary Message Tests

These tests are performed on messages whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.1.1.1	PHY-MSG-GEN	PHY Level General Message (SOP*)
TDB.2.1.2.1	PROT-MSG-HDR	Message Header Checks – except GoodCRC
TDB.2.1.2.2	PROT-MSG-HDR-GCRC	Message Header Checks – GoodCRC

Test Ref #	Test Name	Test Description
TDB.2.1.3	PROT-MSG-CTRL	Control Message Checks
TDB.2.1.3.1	PROT-MSG-CTRL-PING	Ping Checks
TDB.2.1.4.1.1	PROT-MSG-DATA-SRC-CAP	Source Capability Message Checks
TDB.2.1.4.1.2	PROT-MSG-DATA-SNK-CAP	Sink Capability Message Checks
TDB.2.1.4.2	PROT-MSG-DATA-REQ	Request Message Checks
TDB.2.1.4.3	PROT-MSG-DATA-VEND	Vendor Defined Message Checks
TDB.2.1.4.4.1.1	PROT-MSG-DATA-VDM-ID-INIT	Discover ID Initiator Message Checks
TDB.2.1.4.4.1.2	PROT-MSG-DATA-VDM-ID-ACK	Discover ID ACK Message Checks
TDB.2.1.4.4.2.1	PROT-MSG-DATA-VDM-SVID-INIT	Discover SVIDs Initiator Message Checks
TDB.2.1.4.4.2.2	PROT-MSG-DATA-VDM-SVID-ACK	Discover SVIDs ACK Message Checks
TDB.2.1.4.4.3.1	PROT-MSG-DATA-VDM-MODE-INIT	Discover Modes Initiator Message Checks
TDB.2.1.4.4.3.2	PROT-MSG-DATA-VDM-MODE-ACK	Discover Modes ACK Message Checks
TDB.2.1.4.4.4	PROT-MSG-DATA-VDM-ENTER-MODE	Enter Mode Message Checks
TDB.2.1.4.4.5	PROT-MSG-DATA-VDM-EXIT-MODE	Exit Mode Message Checks
TDB.2.1.4.4.6	PROT-MSG-DATA-VDM-ATT	Attention Message Checks

### Secondary Procedure Tests

These tests are performed on procedures whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.2.2.1.1	PROT-PROC-AMS_1	Atomic Message Sequence
TDB.2.2.2.1	PROT-PROC-GOODOCRC-TSTR	GoodCRC sent by Tester
TDB.2.2.2.2	PROT-PROC-GOODOCRC-UUT	GoodCRC sent by Unit Under Test (UUT)
TDB.2.2.3.1.1	PROT-PROC-SWAP-TSTR-SNK	Tester (Sink) Originated Swap
TDB.2.2.3.1.2	PROT-PROC-SWAP-TSTR-SRC	Tester (Source) Originated Swap
TDB.2.2.3.2.1	PROT-PROC-SWAP-UUT-SNK	UUT (Sink) Originated Swap
TDB.2.2.3.2.2	PROT-PROC-SWAP-UUT-SRC	UUT (Source) Originated Swap
TDB.2.2.4	PROT-PROC-PSSOURCEOFFTIMER	Test PSSourceOffTimer when not Swapped
TDB.2.2.5	PROT-PROC-PSSOURCEONTIMER	Test PSSourceOnTimer when not Swapped
TDB.2.2.6	PROT-PROC-PING	Send Ping from Tester
TDB.2.2.7.1	PROT-PROC-REQ-TSTR	Tester Originated Request
TDB.2.2.7.2	PROT-PROC-REQ-UUR	UUT Originated Request
TDB.2.2.8.1	PROT-PROC-SRCCAPS-TSTR	Tester Originated Source Capabilities
TDB.2.2.8.2	PROT-PROC-SRCCAPS-UUT	UUT Originated Source Capabilities
TDB.2.2.9.1	PROT-PROC-GETSRCCAPS-TSTR	Tester Originated Get_Source_Cap
TDB.2.2.9.2	PROT-PROC-GETSRCCAPS-UUT	UUT Originated Get_Source_Cap
TDB.2.2.10.1	PROT-PROC-GETSNKCAPS-TSTR	Tester Originated Get_Sink_Cap
TDB.2.2.10.2	PROT-PROC-GETSNKCAPS-UUT	UUT Originated Get_Sink_Cap
TDB.2.2.11.1	PROT-PROC-GOTOMIN-TSTR	Tester Originated GoToMin
TDB.2.2.11.2	PROT-PROC-GOTOMIN-UUT	UUT Originated GoToMin
TDB.2.2.12.1	PROT-PROC-SR-TSTR	Tester Originated Soft Reset
TDB.2.2.12.2	PROT-PROC-SR-UUT	UUT Originated Soft Reset
TDB.2.2.13.1	PROT-PROC-HR-TSTR	Tester Originated Hard Reset
TDB.2.2.13.2	PROT-PROC-HR-UUT	UUT Originated Hard Reset
TDB.2.2.14	PROT-PROC-BIST-TSTR	Tester Originated BIST

### 6.2.3 PD2.0 Communications Engine MOI Provider-Only Tests

#### Primary Tests

Note that test TDA.2.2.7 BMC-PROT-BIST-NOT-5V-SRC is required only for devices which support greater than 5 volts.

Test Ref #	Test Name	Test Description
	<b>BMC Physical Layer Tests - Transmit</b>	
TDA.2.1.1.1	BMC-PHY-TX-EYE	BMC Transmitter Eye Diagram Test
TDA.2.1.1.2	BMC-PHY-TX-BIT	BMC Transmit Bit Rate and Bit Rate Drift Test
	<b>BMC Physical Layer Tests - Receive</b>	
TDA.2.1.2.1	BMC-PHY-RX-BUSIDL	BMC Bus Idle Detection Test
TDA.2.1.2.2	BMC-PHY-RX-INT-REG	BMC Receive Interference Rejection Test
	<b>BMC Physical Layer Tests - Miscellaneous</b>	
TDA.2.1.3.1	BMC-PHY-TERM	BMC Termination Impedance Test
TDA.2.1.3.2	BMC-PHY-MSG	BMC PHY Level Message Test
	<b>Protocol-Specific</b>	
TDA.2.2.1	BMC-PROT-SEQ-GETCAPS	Get_Source_Cap and Get_Sink_Cap Test
TDA.2.2.2.1	BMC-PROT-SEQ-CHKCAB-P-PC	Check Cable Capabilities (3A Marked) Test
TDA.2.2.2.2	BMC-PROT-SEQ-NOMRK-P-PC	Check Cable Capabilities (Unmarked) Test
TDA.2.2.3	BMC-PROT-SEQ-DRSWAP	DR_Swap Test
TDA.2.2.4	BMC-PROT-SEQ-VCSWAP	VCONN_Swap Test
TDA.2.2.7	BMC-PROT-BIST-NOT-5V-SRC	BIST Functionality at Above 5V Test
TDA.2.2.8	BMC-PROT-REV-NUM	Revision Number Test
	<b>Power Source/Sink Tests</b>	
TDA.2.3.1.1	BMC-POW-SRC-LOAD-P-PC	Source Dynamic Load Test - Provider or Provider/Consumer
TDA.2.3.2.1	BMC-POW-SRC-TRANS-P-PC	PDO Transition Test – Source, Provider or Provider/Consumer

#### Secondary Message Tests

These tests are performed on messages whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.1.1.1	PHY-MSG-GEN	PHY Level General Message (SOP*)
TDB.2.1.2.1	PROT-MSG-HDR	Message Header Checks – except GoodCRC
TDB.2.1.2.2	PROT-MSG-HDR-GCRC	Message Header Checks – GoodCRC
TDB.2.1.3	PROT-MSG-CTRL	Control Message Checks
TDB.2.1.3.1	PROT-MSG-CTRL-PING	Ping Checks
TDB.2.1.4.1.1	PROT-MSG-DATA-SRC-CAP	Source Capability Message Checks
TDB.2.1.4.3	PROT-MSG-DATA-VEND	Vendor Defined Message Checks
TDB.2.1.4.4.1.1	PROT-MSG-DATA-VDM-ID-INIT	Discover ID Initiator Message Checks
TDB.2.1.4.4.1.2	PROT-MSG-DATA-VDM-ID-ACK	Discover ID ACK Message Checks
TDB.2.1.4.4.2.1	PROT-MSG-DATA-VDM-SVID-INIT	Discover SVIDs Initiator Message Checks
TDB.2.1.4.4.2.2	PROT-MSG-DATA-VDM-SVID-ACK	Discover SVIDs ACK Message Checks
TDB.2.1.4.4.3.1	PROT-MSG-DATA-VDM-MODE-INIT	Discover Modes Initiator Message Checks
TDB.2.1.4.4.3.2	PROT-MSG-DATA-VDM-MODE-ACK	Discover Modes ACK Message Checks
TDB.2.1.4.4.4	PROT-MSG-DATA-VDM-ENTER-MODE	Enter Mode Message Checks
TDB.2.1.4.4.5	PROT-MSG-DATA-VDM-EXIT-MODE	Exit Mode Message Checks
TDB.2.1.4.4.6	PROT-MSG-DATA-VDM-ATT	Attention Message Check

## Secondary Procedure Tests

These tests are performed on procedures whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.2.2.1.1	PROT-PROC-AMS	Procedure and Checks for any Atomic Message Sequence
TDB.2.2.2.1	PROT-PROC-GOODECRC-TSTR	Procedure and Checks for GoodCRC sent by Tester
TDB.2.2.2.2	PROT-PROC-GOODECRC-UUT	Procedure and Checks for GoodCRC sent by UUT (Unit Under Test)
TDB.2.2.6	PROT-PROC-PING	Procedures to send Ping from Tester
TDB.2.2.7.1	PROT-PROC-REQ-TSTR	Procedure and Checks for Tester Originated Request
TDB.2.2.8.2	PROT-PROC-SRCCAPS-UUT	Procedure and Checks for UUT Originated Source Capabilities
TDB.2.2.9.1	PROT-PROC-GETSRCCAPS-TSTR	Procedure and Checks for Tester Originated Get_Source_Cap
TDB.2.2.9.2	PROT-PROC-GETSRCCAPS-UUT	Procedure and Checks for UUT Originated Get_Source_Cap
TDB.2.2.10.1	PROT-PROC-GETSNKCAPS-TSTR	Procedure and Checks for Tester Originated Get_Sink_Cap
TDB.2.2.10.2	PROT-PROC-GETSNKCAPS-UUT	Procedure and Checks for UUT Originated Get_Sink_Cap
TDB.2.2.11.2	PROT-PROC-GOTOMIN-UUT	Procedure and Checks for UUT Originated GotoMin
TDB.2.2.12.1	PROT-PROC-SR-TSTR	Procedure and Checks for Tester Originated Soft Reset
TDB.2.2.12.2	PROT-PROC-SR-UUT	Procedure and Checks for UUT Originated Soft Reset
TDB.2.2.13.1	PROT-PROC-HR-TSTR	Procedure and Checks for Tester Originated Hard Reset
TDB.2.2.13.2	PROT-PROC-HR-UUT	Procedure and Checks for UUT Originated Hard Reset
TDB.2.2.14	PROT-PROC-BIST-TSTR	Procedure and Checks for Tester Originated BIST

## 6.2.4 PD2.0 Communications Engine MOI Consumer-Only Tests

### Primary Tests

Test Ref #	Test Name	Test Description
	<b>BMC Physical Layer Tests - Transmit</b>	
TDA.2.1.1.1	BMC-PHY-TX-EYE	BMC Transmitter Eye Diagram
TDA.2.1.1.2	BMC-PHY-TX-BIT	BMC Transmit Bit Rate and Bit Rate Drift
	<b>BMC Physical Layer Tests - Receive</b>	
TDA.2.1.2.1	BMC-PHY-RX-BUSIDL	BMC Bus Idle Detections test
TDA.2.1.2.2	BMC-PHY-RX-INT-REJ	BMC Receive Interference Rejection Test
	<b>BMC Physical Layer Tests - Miscellaneous</b>	
TDA.2.1.3.1	BMC-PHY-TERM	BMC Termination Impedance Test
TDA.2.1.3.2	BMC-PHY-MSG	BMC PHY Level Message Test
	<b>Protocol-Specific</b>	
TDA.2.2.1	BMC-PROT-SEQ-GETCAPS	Get_Source_Cap and Get_Sink_Cap Test
TDA.2.2.3	BMC-PROT-SEQ-DRSWAP	DR_Swap Test
TDA.2.2.4	BMC-PROT-SEQ-VCSWAP	VCONN_Swap Test
TDA.2.2.5	BMC-PROT-DISCOV	ID Check
TDA.2.2.8	BMC-PROT-REV-NUM	Revision Number
	<b>Power Source/Sink Tests</b>	

TDA.2.3.3.1	BMC-POW-SNK-TRANS-C-CP	PDO Transition, Current Draw and Suspend Test – Sink, Consumer or Consumer/Provider
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### Secondary Message Tests

These tests are performed on messages whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.1.1.1	PHY-MSG-GEN	PHY Level General Message (SOP*)
TDB.2.1.2.1	PROT-MSG-HDR	Message Header Checks – except GoodCRC
TDB.2.1.2.2	PROT-MSG-HDR-GCRC	Message Header Checks – GoodCRC
TDB.2.1.3	PROT-MSG-CTRL	Control Message Checks
TDB.2.1.4.1.2	PROT-MSG-DATA-SNK-CAP	Sink Capability Message Checks
TDB.2.1.4.2	PROT-MSG-DATA-REQ	Request Message Checks
TDB.2.1.4.3	PROT-MSG-DATA-VEND	Vendor Defined Message Checks
TDB.2.1.4.4.1.1	PROT-MSG-DATA-VDM-ID-INIT	Discover ID Initiator Message Checks
TDB.2.1.4.4.1.2	PROT-MSG-DATA-VDM-ID-ACK	Discover ID ACK Message Checks
TDB.2.1.4.4.2.1	PROT-MSG-DATA-VDM-SVID-INIT	Discover SVIDs Initiator Message Checks
TDB.2.1.4.4.2.2	PROT-MSG-DATA-VDM-SVID-ACK	Discover SVIDs ACK Message Checks
TDB.2.1.4.4.3.1	PROT-MSG-DATA-VDM-MODE-INIT	Discover Modes Initiator Message Checks
TDB.2.1.4.4.3.2	PROT-MSG-DATA-VDM-MODE-ACK	Discover Modes ACK Message Checks
TDB.2.1.4.4.4	PROT-MSG-DATA-VDM-ENTER-MODE	Enter Mode Message Checks
TDB.2.1.4.4.5	PROT-MSG-DATA-VDM-EXIT-MODE	Exit Mode Message Checks
TDB.2.1.4.4.6	PROT-MSG-DATA-VDM-ATT	Attention Message Checks

### Secondary Procedure Tests

These tests are performed on procedures whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.2.2.1.1	PROT-PROC-AMS	Procedure and Checks for anyAtomic Message Sequence
TDB.2.2.2.1	PROT-PROC-GOODECRC-TSTR	Procedure and Checks for GoodCRC sent by Tester
TDB.2.2.2.2	PROT-PROC-GOODECRC-UUT	Procedure and Checks for GoodCRC sent by UUT
TDB.2.2.6	PROT-PROC-PING	Procedure and Checks to send Ping from Tester
TDB.2.2.7.2	PROT-PROC-REQ-UUT	Procedure and Checks for UUT Originated Request
TDB.2.2.8.1	PROT-PROC-SRCCAPS-TSTR	Procedure and Checks for Tester Originated Source Capabilities
TDB.2.2.9.1	PROT-PROC-GETSRCCAPS-TSTR	Procedure and Checks for Tester Originated Get_Source_Cap
TDB.2.2.9.2	PROT-PROC-GETSRCCAPS-UUT	Procedure and Checks for UUT Originated Get_Source_Cap
TDB.2.2.10.1	PROT-PROC-GETSNKCAPS-TSTR	Procedure and Checks for Tester Originated Get_Sink_Cap
TDB.2.2.10.2	PROT-PROC-GETSNKCAPS-UUT	Procedure and Checks for UUT Originated Get_Sink_Cap
TDB.2.2.11.1	PROT-PROC-GOTOMIN-TSTR	Procedure and Checks for Tester Originated GotoMin
TDB.2.2.12.1	PROT-PROC-SR-TSTR	Procedure and Checks for Tester Originated Soft Reset
TDB.2.2.12.2	PROT-PROC-SR-UUT	Procedure and Checks for UUT Originated Soft Reset
TDB.2.2.13.1	PROT-PROC-HR-TSTR	Procedure and Checks for Tester Originated Hard Reset
TDB.2.2.13.2	PROT-PROC-HR-UUT	Procedure and Checks for UUT Originated Hard Reset
TDB.2.2.14	PROT-PROC-BIST-TSTR	Procedure and Checks for Tester Originated BIST

## 6.2.5 PD2.0 Communications Engine MOI Consumer/Provider Tests

### Primary Tests

Test Ref #	Test Name	Test Description
	<b>BMC Physical Layer Tests - Transmit</b>	
TDA.2.1.1.1	BMC-PHY-TX-EYE	BMC Transmitter Eye Diagram Test
TDA.2.1.1.2	BMC-PHY-TX-BIT	BMC Transmit Bit Rate and Bit Rate Drift
	<b>BMC Physical Layer Tests - Receive</b>	
TDA.2.1.2.1	BMC-PHY-RX-BUSIDL	BMC Bus Idle Detection Test
TDA.2.1.2.2	BMC-PHY-RX-INT-REJ	BMC Receive Interference Rejection Test
	<b>BMC Physical Layer Tests - Miscellaneous</b>	
TDA.2.1.3.1	BMC-PHY-TERM	BMC Termination Impedance Test
TDA.2.1.3.2	BMC-PHY-MSG	BMC PHY Level Message Test
	<b>Protocol-Specific Tests</b>	
TDA.2.2.1	BMC-PROT-SEQ-GETCAPS	Get_Source_Cap and Get_Sink_Cap Test
TDA.2.2.2.3	BMC-PROT-SEQ-CHKCAB-CP-ACC	Check Cable Capabilities (3A Marked) Test – After PR_Swap
TDA.2.2.2.4	BMC-PROT-SEQ-CHKCAB-NOMRK-CP-ACC	Check Cable Capabilities (Unmarked) Test – After PR_Swap
TDA.2.2.3	BMC-PROT-SEQ-DRSWAP	DR_Swap Test
TDA.2.2.4	BMC-PROT-SEQ-VCSWAP	VCONN_Swap Test
TDA.2.2.5	BMC-PROT-DISCOV	ID Checks
TDA.2.2.8	BMC-PROT-REV-NUM	Revision Number Test
	<b>Power Source/Sink Tests</b>	
TDA.2.3.1.2	BMC-POW-SRC-LOAD-CP-ACC	Source Dynamic Load Test – Consumer/Provider Accepting Swap
TDA.2.3.2.2	BMC-POW-SRC-TRANS-CP-ACC	PDO Transition Test – Source, Consumer/Provider Accepting Swap
TDA.2.3.3.1	BMC-POW-SNK-TRANS-C-CP	PDO Transition, Current Draw and Suspend Test – Sink, Consumer or Consumer/Provider

### Secondary Message Tests

These tests are performed on messages whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.1.1.1	PHY-MSG-GEN	PHY Level General Message Test (SOP*)
TDB.2.1.2.1	PROT-MSG-HDR	Message Header Checks – except GoodCRC
TDB.2.1.2.2	PROT-MSG-HDR-GCRC	Message Header Checks – GoodCRC
TDB.2.1.3	PROT-MSG-CTRL	Control Message Checks
TDB.2.1.3.1	PROT-MSG-CTRL-PING	Ping Checks
TDB.2.1.4.1.1	PROT-MSG-DATA-SRC-CAP	Source Capability Message Checks
TDB.2.1.4.1.2	PROT-MSG-DATA-SNK-CAP	Sink Capability Message Checks
TDB.2.1.4.2	PROT-MSG-DATA-REQ	Request Message Checks
TDB.2.1.4.3	PROT-MSG-DATA-VEND	Vendor Defined Message Checks
TDB.2.1.4.4.1.1	PROT-MSG-DATA-VDM-ID-INIT	Discover ID Initiator Message Checks
TDB.2.1.4.4.1.2	PROT-MSG-DATA-VDM-ID-ACK	Discover ID ACK Message Checks
TDB.2.1.4.4.2.1	PROT-MSG-DATA-VDM-SVID-INIT	Discover SVIDs Initiator Message Checks
TDB.2.1.4.4.2.2	PROT-MSG-DATA-VDM-SVID-ACK	Discover SVIDs ACK Message Checks
TDB.2.1.4.4.3.1	PROT-MSG-DATA-VDM-MODE-INIT	Discover Modes Initiator Message Checks
TDB.2.1.4.4.3.2	PROT-MSG-DATA-VDM-MODE-ACK	Discover Modes ACK Message Checks

TDB.2.1.4.4.4	PROT-MSG-DATA-VDM-ENTER-MODE	Enter Mode Message Checks
TDB.2.1.4.4.5	PROT-MSG-DATA-VDM-EXIT-MODE	Exit Mode Message Checks
TDB.2.1.4.4.6	PROT-MSG-DATA-VDM-ATT	Attention Message Checks

### Secondary Procedure Tests

These tests are performed on procedures whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.2.2.1.1	PROT-PROC-AMS	Procedure and Checks for any Atomic Message Sequence
TDB.2.2.2.1	PROT-PROC-GOODCRC-TSTR	Procedure and Checks for GoodCRC sent by Tester
TDB.2.2.2.2	PROT-PROC-GOODCRC-UUT	Procedure and Checks for GoodCRC sent by UUT (Unit Under Test)
TDB.2.2.3.1.1	PROT-PROC-SWAP-TSTR-SNK	Procedure and Checks for Tester (Sink) Originated Swap
TDB.2.2.3.1.2	PROT-PROC-SWAP-TSTR-SRC	Procedure and Checks for Tester (Source) Originated Swap
TDB.2.2.3.2.1	PROT-PROC-SWAP-UUT-SNK	Procedure and Checks for UUT (Sink) Originated Swap
TDB.2.2.3.2.2	PROT-PROC-SWAP-UUT-SRC	Procedure and Checks for UUT (Source) Originated Swap
TDB.2.2.4	PROT-PROC-PSSOURCEOFFTIMER	Procedure to test PSSourceOffTimer
TDB.2.2.5	PROT-PROC-PSSOURCEONTIMER	Procedure to test PSSourceOnTimer
TDB.2.2.6	PROT-PROC-PING	Procedure to send Ping from Tester
TDB.2.2.7.1	PROT-PROC-REQ-TSTR	Procedure and Checks for Tester Originated Request
TDB.2.2.7.2	PROT-PROC-REQ-UUT	Procedure and Checks for UUT Originated Request
TDB.2.2.8.1	PROT-PROC-SRCCAPS-TSTR	Procedure and Checks for Tester Originated Source Capabilities
TDB.2.2.8.2	PROT-PROC-SRCCAPS-UUT	Procedure and Checks for UUT Originated Source Capabilities
TDB.2.2.9.1	PROT-PROC-GETSRCCAPS-TSTR	Procedure and Checks for Tester Originated Get_Source_Cap
TDB.2.2.9.2	PROT-PROC-GETSRCCAPS-UUT	Procedure and Checks for UUT Originated Get_Source_Cap
TDB.2.2.10.1	PROT-PROC-GETSNKCAPS-TSTR	Procedure and Checks for Tester Originated Get_Sink_Cap
TDB.2.2.10.2	PROT-PROC-GETSNKCAPS-UUT	Procedure and Checks for UUT Originated Get_Sink_Cap
TDB.2.2.11.1	PROT-PROC-GOTOMIN-TSTR	Procedure and Checks for Tester Originated GotoMin
TDB.2.2.11.2	PROT-PROC-GOTOMIN-UUT	Procedure and Checks for UUT Originated GotoMin
TDB.2.2.12.1	PROT-PROC-SR-TSTR	Procedure and Checks for Tester Originated Soft Reset
TDB.2.2.12.2	PROT-PROC-SR-UUT	Procedure and Checks for UUT Originated Soft Reset
TDB.2.2.13.1	PROT-PROC-HR-TSTR	Procedure and Checks for Tester Originated Hard Reset



TDB.2.2.13.2	PROT-PROC-HR-UUT	Procedure and Checks for UUT Originated Hard Reset
TDB.2.2.14	PROT-PROC-BIST-TSTR	Procedure and Checks for Tester Originated BIST

## 6.2.6 PD2.0 Communications Engine MOI Provider/Consumer Tests

### Primary Tests

Note that test TDA.2.2.6 BMC-PROT-SEQ-SWAP-REJ is optional and that test TDA.2.2.7 BMC-PROT-BIST-NOT-5V-SRC is required only for devices which support greater than 5 volts.

Test Ref #	Test Name	Test Description
<b>BMC Physical Layer Tests - Transmit</b>		
TDA.2.1.1.1	BMC-PHY-TX-EYE	BMC Transmitter Eye Diagram Test
TDA.2.1.1.2	BMC-PHY-TX-BIT	BMC Transmit Bit Rate and Bit Rate Drift Test
<b>BMC Physical Layer Tests - Receive</b>		
TDA.2.1.2.1	BMC-PHY-RX-BUSIDL	BMC Bus Idle Detection Test
TDA.2.1.2.2	BMC-PHY-RX-INT-REJ	BMC Receive Interference Rejection Test
<b>BMC Physical Layer Tests - Miscellaneous</b>		
TDA.2.1.3.1	BMC-PHY-TERM	BMC Termination Impedance Test
TDA.2.1.3.2	BMC-PHY-MSG	BMC PHY Level Message Test
<b>Protocol-Specific Tests</b>		
TDA.2.2.1	BMC-PROT-SEQ-GETCAPS	Get_Source_Cap and Get_Sink_Cap Test
TDA.2.2.2.1	BMC-PROT-SEQ-CHKCAB-P-PC	Check Cable Capabilities (3A Marked) Test
TDA.2.2.2.2	BMC-PROT-SEQ-NOMRK-P-PC	Check Cable Capabilities (Unmarked) Test
TDA.2.2.3	BMC-PROT-SEQ-DRSWAP	DR_Swap Test
TDA.2.2.4	BMC-PROT-SEQ-VCSWAP	VCONN_Swap Test
TDA.2.2.6	BMC-PROT-SEQ-SWAP-REJ	Optional: Reject Swap Test – Provider/Consumer
TDA.2.2.7	BMC-PROT-BIST-NOT-5V-SRC	BIST Functionality at Above 5V Test
TDA.2.2.8	BMC-PROT-REV-NUM	Revision Number Test
<b>Power Source/Sink Tests</b>		
TDA.2.3.1.1	BMC-POW-SRC-LOAD-P-PC	Source Dynamic Load Test – Provider or Provider/Consumer
TDA.2.3.2.1	BMC-POW-SRC-TRANS-P-PC	PDO Transition Test – Source, Provider or Provider/Consumer
TDA.2.3.3.2	BMC-POW-SNK-TRANS-PC	PDO Transition, Current Draw and Suspend Test – Sink, Provider/Consumer

### Secondary Message Tests

These tests are performed on messages whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.1.1.1	PHY-MSG-GEN	PHY Level General Message Test (SOP*)
TDB.2.1.2.1	PROT-MSG-HDR	Message Header Checks – except GoodCRC

TDB.2.1.2.2	PROT-MSG-HDR-GCRC	Message Header Checks – GoodCRC
TDB.2.1.3	PROT-MSG-CTRL	Control Message Checks
TDB.2.1.3.1	PROT-MSG-CTRL-PING	Ping Checks
TDB.2.1.4.1.1	PROT-MSG-DATA-SRC-CAP	Source Capability Message Checks
TDB.2.1.4.1.2	PROT-MSG-DATA-SNK-CAP	Sink Capability Message Checks
TDB.2.1.4.2	PROT-MSG-DATA-REQ	Request Message Checks
TDB.2.1.4.3	PROT-MSG-DATA-VEND	Vendor Defined Message Checks
TDB.2.1.4.4.1.1	PROT-MSG-DATA-VDM-ID-INIT	Discover ID Initiator Message Checks
TDB.2.1.4.4.1.2	PROT-MSG-DATA-VDM-ID-ACK	Discover ID ACK Message Checks
TDB.2.1.4.4.2.1	PROT-MSG-DATA-VDM-SVID-INIT	Discover SVIDs Initiator Message Checks
TDB.2.1.4.4.2.2	PROT-MSG-DATA-VDM-SVID-ACK	Discover SVIDs ACK Message Checks
TDB.2.1.4.4.3.1	PROT-MSG-DATA-VDM-MODE-INIT	Discover Modes Initiator Message Checks
TDB.2.1.4.4.3.2	PROT-MSG-DATA-VDM-MODE-ACK	Discover Modes ACK Message Checks
TDB.2.1.4.4.4	PROT-MSG-DATA-VDM-ENTER-MODE	Enter Mode Message Checks
TDB.2.1.4.4.5	PROT-MSG-DATA-VDM-EXIT-MODE	Exit Mode Message Checks
TDB.2.1.4.4.6	PROT-MSG-DATA-VDM-ATT	Attention Message Checks

### Secondary Procedure Test`s

These tests are performed on procedures whenever they are encountered during a Primary Test.

Test Ref #	Test Name	Test Description
TDB.2.2.1.1	PROT-PROC-AMS	Procedure and Checks for any Atomic Message Sequence
TDB.2.2.2.1	PROT-PROC-GOODCRC-TSTR	Procedure and Checks for GoodCRC sent by Tester
TDB.2.2.2.2	PROT-PROC-GOODCRC-UUT	Procedure and Checks for GoodCRC sent by UUT (Unit Under Test)
TDB.2.2.3.1.1	PROT-PROC-SWAP-TSTR-SNK	Procedure and Checks for Tester (Sink) Originated Swap
TDB.2.2.3.1.2	PROT-PROC-SWAP-TSTR-SRC	Procedure and Checks for Tester (Source) Originated Swap
TDB.2.2.3.2.1	PROT-PROC-SWAP-UUT-SNK	Procedure and Checks for UUT (Sink) Originated Swap
TDB.2.2.3.2.2	PROT-PROC-SWAP-UUT-SRC	Procedure and Checks for UUT (Source) Originated Swap
TDB.2.2.4	PROT-PROC-PSSOURCEOFFTIMER	Procedures to test PSSourceOffTimer
TDB.2.2.5	PROT-PROC-PSSOURCEONTIMER	Procedures to test PSSourceOnTimer
TDB.2.2.6	PROT-PROC-PING	Procedures to send Ping from Tester
TDB.2.2.7.1	PROT-PROC-REQ-TSTR	Procedure and Checks for Tester Originated Request
TDB.2.2.7.2	PROT-PROC-REQ-UUT	Procedure and Checks for UUT Originated Request
TDB.2.2.8.1	PROT-PROC-SRCCAPS-TSTR	Procedure and Checks for Tester Originated Source Capabilities
TDB.2.2.8.2	PROT-PROC-SRCCAPS-UUT	Procedure and Checks for <u>UUT</u> Originated Source Capabilities
TDB.2.2.9.1	PROT-PROC-GETSRCCAPS-TSTR	Procedure and Checks for Tester Originated Get_Source_Cap
TDB.2.2.9.2	PROT-PROC-GETSRCCAPS-UUT	Procedure and Checks for UUT Originated Get_Source_Cap
TDB.2.2.10.1	PROT-PROC-GETSNKCAPS-TSTR	Procedure and Checks for Tester Originated Get_Sink_Cap
TDB.2.2.10.2	PROT-PROC-GETSNKCAPS-UUT	Procedure and Checks for UUT Originated Get_Sink_Cap

TDB.2.2.11.1	PROT-PROC-GOTOMIN-TSTR	Procedure and Checks for Tester Originated GotoMin
TDB.2.2.11.2	PROT-PROC-GOTOMIN-UUT	Procedure and Checks for UUT Originated GotoMin
TDB.2.2.12.1	PROT-PROC-SR-TSTR	Procedure and Checks for Tester Originated Soft Reset
TDB.2.2.12.2	PROT-PROC-SR-UUT	Procedure and Checks for UUT Originated Soft Reset
TDB.2.2.13.1	PROT-PROC-HR-TSTR	Procedure and Checks for Tester Originated Hard Reset
TDB.2.2.13.2	PROT-PROC-HR-UUT	Procedure and Checks for UUT Originated Hard Reset
TDB.2.2.14	PROT-PROC-BIST-TSTR	Procedure and Checks for Tester Originated BIST

### 6.2.7 Gen1 and Gen2 BMC-RX-INT Noise Source Selection

BMC-RX Noise Source is used for BMC-PHY-RX-INT tests as part of the Communications Engine MOI. There are two definitions of BMC-RX Noise used for receiver interference testing. Gen1 was used for early market device testing and Gen2 is what is defined in the final PD Compliance Plan. Both are provided in GRL-USB-PD-C2. The USB-IF is in the process of migrating from Gen1 to Gen2 noise for official certification.

When **PD Communication Engine Tests** are selected on the **Test Configuration** screen, two buttons are displayed as part of the **Test Configuration** section of the screen for selecting the **Noise Source**: one for selecting Gen 1 (labeled as Square-Wave Noise) and one for selecting Gen 2 (labeled as Two-Tone Noise).

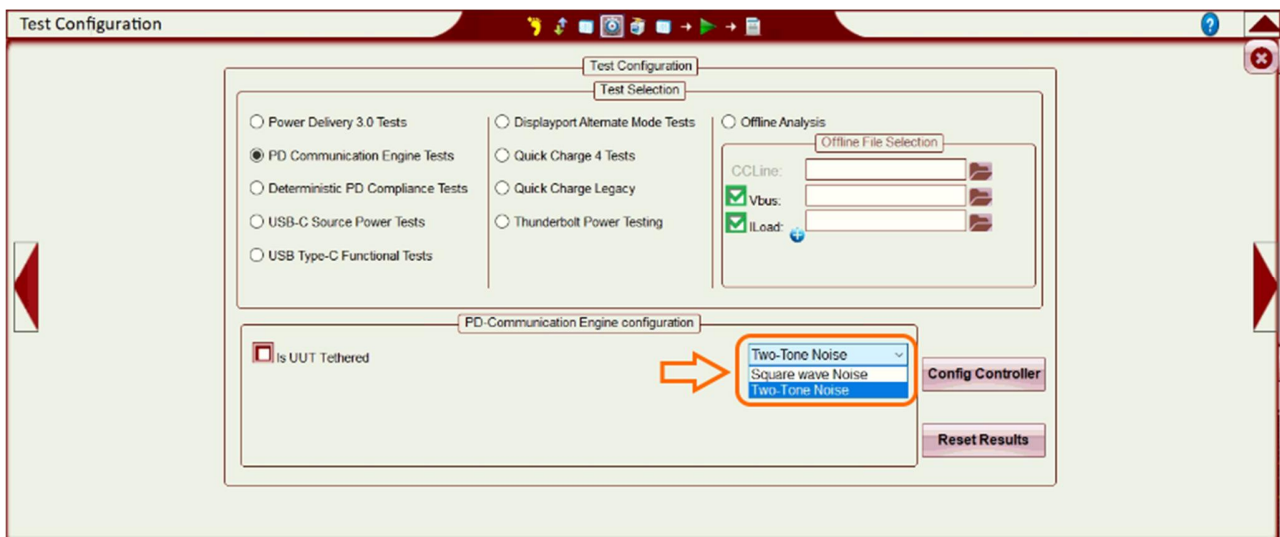


FIGURE 6.1: RX NOISE SOURCE SELECTION IN TEST CONFIGURATION SCREEN

Be sure to select the desired **Noise Source** before continuing.

#### 6.2.7.1 Gen1 BMC-RX Noise Source (Square-Wave Noise)

Gen1 Noise definition (used for early market Compliance testing) is defined in Section 3.4.2 of the Communications Engine MOI. A 100mV, 1.64MHZ square wave is modulated with the 300kb/s BMC signal.

#### 6.2.7.2 Gen2 BMC-RX Noise Source (Two-Tone Noise)

Gen2 Noise definition is defined in Section 5.9.1 of the PD 2.0 Compliance Plan. The Gen2 Noise Source in GRL-USB-PD-C2 uses Noise definition (3) from the test plan, which is a 2-tone sinusoidal waveform modulated with the 300kb/s BMC Signal. The two tones are a 90mV at 750 +/- 50kHz,

combined with 75mV at 5 +/- 0.5MHz. Gen2 noise was defined to emulate the worst case xTalk that the CC line on the USB Type-C connector will see, which is from the Full Speed USB2 SE0 signal.

Note: The convention of using “Square-Wave Noise” (for Gen1) and “Two-Tone Noise” (for Gen2) is a GRL convention to differentiate between the two noise sources that have been historically used for testing.

### 6.3 PD2.0 Deterministic Compliance Tests

The USB Power Delivery **Deterministic Method of Implementation (MOI)** covers additional protocol tests required for compliance testing of PD2.0 devices. Refer to the PD2.0 Deterministic MOI for detailed test definitions.

#### 6.3.1 PD2.0 Deterministic MOI – Type-C Tests

Test Ref #	Test Description
TD.PD.C.E1	DFP Attach / Detach Detection
TD.PD.C.E2	UFP Rp
TD.PD.C.E3	Cable Ra
TD.PD.C.E4	Cable Receiver Impedance
TD.PD.C.E5	DRP

#### 6.3.2 PD2.0 Deterministic MOI - Physical Layer Tests

Test Ref #	Test Description
TD.PD.PHY.E1	BIST Test Data
TD.PD.PHY.E2	BIST Receiver Mode
TD.PD.PHY.E3	BIST Transmitter Mode
TD.PD.PHY.E4	Transmitter Bit Rate and Bit Rate Drift
TD.PD.PHY.E5	Transmitter Collision Avoidance
TD.PD.PHY.E6	Receiver Swing Tolerance
TD.PD.PHY.E7	Receiver Bit Rate Tolerance
TD.PD.PHY.E8	Receiver Bit Rate Deviation Tolerance
TD.PD.PHY.E9	Valid SOP Framing
TD.PD.PHY.E10	Invalid SOP Framing
TD.PD.PHY.E11	Valid SOP' Framing
TD.PD.PHY.E12	Invalid SOP' Framing
TD.PD.PHY.E13	Valid SOP'' Framing
TD.PD.PHY.E14	Invalid SOP'' Framing
TD.PD.PHY.E15	SOP' _Debug / SOP'' _Debug Framing
TD.PD.PHY.E16	Valid Hard Reset Framing
TD.PD.PHY.E17	Invalid Hard Reset Framing
TD.PD.PHY.E18	Valid Cable Reset Framing
TD.PD.PHY.E19	Invalid Cable Reset Framing
TD.PD.PHY.E20	EOP Framing
TD.PD.PHY.E21	Preamble
TD.PD.PHY.E22	CC Transmitter Eye Diagram
TD.PD.PHY.E23	CC Receiver Interference Tolerance

### 6.3.3 PD2.0 Deterministic MOI - Link Layer Tests

Test Ref #	Test Description
TD.PD.LL.E1	GoodCrc Timing
TD.PD.LL.E2	Retransmission
TD.PD.LL.E3	Soft Reset Usage
TD.PD.LL.E4	Hard Reset Usage
TD.PD.LL.E5	Soft Reset
TD.PD.LL.E6	Ping

### 6.3.4 PD2.0 Deterministic MOI - Source Tests

Test Ref #	Test Description
TD.PD.SRC.E1	Source Capabilities sent timely
TD.PD.SRC.E2	Source Capabilities Fields Checks
TD.PD.SRC.E3	SourceCapabilityTimer Timeout
TD.PD.SRC.E4	SenderResponseTimer Deadline - Request
TD.PD.SRC.E5	SenderResponseTimer Timeout - Request
TD.PD.SRC.E6	PSHardResetTimer Timeout
TD.PD.SRC.E7	Accept sent timely
TD.PD.SRC.E8	Accept Fields Checks
TD.PD.SRC.E9	PS_RDY sent timely
TD.PD.SRC.E10	PS_RDY Fields Checks
TD.PD.SRC.E11	Accept Requests can be met
TD.PD.SRC.E12	Reject Requests can't be met
TD.PD.SRC.E13	Reject Request - Invalid Object Position
TD.PD.SRC.E14	Atomic Message Sequence
TD.PD.SRC.E15	Give_Source_Cap
TD.PD.SRC.E16	PDO Transition

### 6.3.5 PD2.0 Deterministic MOI - Sink Tests

Test Ref #	Test Description
TD.PD.SNK.E1	SinkWaitCapTimer Deadline
TD.PD.SNK.E2	SinkWaitCapTimer Timeout
TD.PD.SNK.E3	Request Sent Timely
TD.PD.SNK.E4	Request Fields Checks
TD.PD.SNK.E5	SenderResponseTimer Deadline - Accept
TD.PD.SNK.E6	SenderResponseTimer Timeout - Accept
TD.PD.SNK.E7	PSTransitionTimer Deadline
TD.PD.SNK.E8	PSTransitionTimer Timeout
TD.PD.SNK.E9	GetSinkCap in Place of Accept
TD.PD.SNK.E10	GetSinkCap in Place of PS_RDY
TD.PD.SNK.E11	PDO Transition

### 6.3.6 PD2.0 Deterministic MOI – Provider/Consumer Tests

Test Ref #	Test Description
TD.PD.PC.E1	tSrcTransition Check
TD.PD.PC.E2	PS_RDY Sent Timely

TD.PD.PC.E3	PSSourceOnTimer Deadline
TD.PD.PC.E4	PSSourceOnTimer Timeout
TD.PD.PC.E5	tSwapSinkReady Check
TD.PD.PC.E6	Externally Powered Bit Usage
TD.PD.PC.E7	PDO Transition After PR_Swap

### 6.3.7 PD2.0 Deterministic MOI – Consumer/Provider Tests

Test Ref #	Test Description
TD.PD.CP.E1	PSSourceOffTimer Deadline
TD.PD.CP.E2	PSSourceOffTimer Timeout
TD.PD.CP.E3	PS_RDY Sent Timely
TD.PD.CP.E4	SwapSourceStartTimer Timeout
TD.PD.CP.E5	PDO Transition After PR_Swap

### 6.3.8 PD2.0 Deterministic MOI – VDM Tests for UFPs and Cables

Test Ref #	Test Description
TD.PD.VDMU.E1	Fields Checks - Discover Identity
TD.PD.VDMU.E2	Fields Checks - Discover SVIDs
TD.PD.VDMU.E3	Fields Checks - Discover Modes
TD.PD.VDMU.E4	Fields Checks - Enter Mode
TD.PD.VDMU.E5	Fields Checks - Exit Mode
TD.PD.VDMU.E6	tVDMReceiverResponse - Discover Identity
TD.PD.VDMU.E7	tVDMReceiverResponse - Discover SVIDs
TD.PD.VDMU.E8	tVDMReceiverResponse - Discover Modes
TD.PD.VDMU.E9	tVDMReceiverResponse - Enter and Exit Mode
TD.PD.VDMU.E10	Incorrect SVID - Discover Identity
TD.PD.VDMU.E11	Incorrect SVID - Discover SVIDs
TD.PD.VDMU.E12	Incorrect SVID - Discover Modes
TD.PD.VDMU.E13	Incorrect SVID - Enter Mode
TD.PD.VDMU.E14	Incorrect SVID - Exit Mode
TD.PD.VDMU.E15	Applicability
TD.PD.VDMU.E16	Interruption by PD Command
TD.PD.VDMU.E17	Interruption by VDM Command
TD.PD.VDMU.E18	tDRSwapHardReset
TD.PD.VDMU.E19	Version

### 6.3.9 PD2.0 Deterministic MOI – VDM Tests for DFPs

Test Ref #	Test Description
TD.PD.VDMD.E1	tVDMSenderResponse Deadline - Discover Identity
TD.PD.VDMD.E2	tVDMSenderResponse Timeout - Discover Identity
TD.PD.VDMD.E3	Incorrect Fields - Discover Identity
TD.PD.VDMD.E4	Applicability

### 6.3.10 PD2.0 Deterministic MOI – DisplayPort Alt-Mode Tests for USB UFPs

Test Ref #	Test Description
TD.PD.DPU.E1	Enter Mode ACK Response

TD.PD.DPU.E2	Status Update Command
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### 6.3.11 PD2.0 Deterministic MOI – DisplayPort Alt Mode Tests for USB DFPs

Test Ref #	Test Description
TD.PD.DPD.E1	Cable Determination
TD.PD.DPD.E2	Discover SVIDs ACK with DP SID in Arbitrary Locations
TD.PD.DPD.E3	Status Update Presence
TD.PD.DPD.E4	Enter Mode Sequence Fails, Enter Mode NAK Response
TD.PD.DPD.E5	Enter Mode Sequence Fails, Enter Mode ACK Response Not Sent
TD.PD.DPD.E6	DisplayPort Not Connected then Connected
TD.PD.DPD.E7	Status Update Port Resolution
TD.PD.DPD.E8	Not Compatible Connection

### 6.3.12 PD2.0 Deterministic MOI – Consistency Tests

Test Ref #	Test Description
TD.PD.VNDI.E1	VDM Identity
TD.PD.VNDI.E2	VDM SVIDs
TD.PD.VNDI.E3	VDM Modes
TD.PD.VNDI.E4	SOP* Handling
TD.PD.VNDI.E5	Source Capabilities
TD.PD.VNDI.E6	Sink Capabilities
TD.PD.VNDI.E7	Dual Role Devices - Accepts PR_Swap as Source
TD.PD.VNDI.E8	Dual Role Devices - Accepts PR_Swap as Sink
TD.PD.VNDI.E9	Dual Role Devices - Requests PR_Swap as Source
TD.PD.VNDI.E10	Dual Role Devices - Requests PR_Swap as Sink
TD.PD.VNDI.E11	DisplayPort Alt-Mode - Modes

## 6.4 USB Type-C Functional Compliance Tests (Chargers Only)

The USB Type-C Functional Test Specification covers required functional tests. GRL-USB-PD-C2 supports these tests for chargers (Providers).

### 6.4.1 Connection Tests

Test Ref #	Test Description
TD 4.1.1	Initial Voltage Test

### 6.4.2 Source Tests

Test Ref #	Test Description
TD 4.2.1	Source Connect Sink Test
TD 4.2.2	Source Connect SNKAS Test
TD 4.2.3	Source Connect DRP
TD 4.2.4	Source Connect Try.SRC DRP
TD 4.2.5	Source Connect Try.SNK DRP
TD 4.2.6	Source Connect Audio Accessory
TD 4.2.7	Source Connect Debug Accessory

TD 4.2.8	Source Connect VCONN Accessory
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## 6.5 USB PD Source Power Compliance Tests

The Source Power Test Specification covers required USB Type-C source power tests.

### 6.5.1 PD2.0 Source Power Tests

Test Ref #	Test Description
SPT.1	Load Test
SPT.2	Capabilities Test
SPT.3	Hard Reset Test
SPT.4	GiveBack Test

### 6.5.2 PD3.0 Source Power Tests

Test Ref #	Test Description
SPT.1	Load Test
SPT.2	Capabilities Test
SPT.3	Hard Reset Test
SPT.4	GiveBack Test
SPT.5	Over Current Test
SPT.6	PPS Voltage Step Test
SPT.7	PPS Current Limit Test

## 6.6 DisplayPort Over USB Type-C Compliance Tests

The following are required Power Delivery Tests in the DisplayPort Over Type-C CTS and pin assignment SCR. Refer to the CTS for details on the documents listed in Section 1.

### 6.6.1 Chapter 10 – Discovery and USB-PD

#### 6.6.1.1 DisplayPort Alt Mode on Type-C Tests for UFPs

Test Ref #	Test Description
10.2.1	Enter Modes ACK Response
10.2.2	Status Update Command

#### 6.6.1.2 DisplayPort Pin Assignment Tests

Test Ref #	Test Description
10.2.3	Time from VBUS/VCONN on to UFP Ready (Informative)
10.2.4	Time from HPD Event to PD Message (Informative)
10.2.5	Proper Pin Assignment Support for Receptacle-based Video Sinks (Normative)
10.2.6	Proper Pin Assignment Support for C to DP adaptor cables (Normative)



10.2.7	Proper Pin Assignment Support for adaptor cables with protocol converters (Normative)
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### 6.6.1.3 DisplayPort Alt Mode on Type-C Tests for DFPs

Test Ref #	Test Description
10.3.1	Discover SVIDs ACK with DP SID in Arbitrary Locations
10.3.2	Cable Determination
10.3.3	Enter Mode Sequence Fails, Enter Mode ACK Response Not Sent
10.3.4	Enter Mode Sequence Fails, Enter Mode NAK Response
10.3.5	DisplayPort Not Connected at UFP_U, and then Connected
10.3.6	Status Update
10.3.7	Status Update Port Resolution
10.3.8	DP Mode Device Not Compatible
10.3.9	Field Checks – DisplayPort Configure
10.3.10	No Test Defined (numbering issue introduced with SCR)
10.3.11	Proper pin assignment selection for DFP_U / DFP_D connected to receptacle (Normative)
10.3.12	Proper pin assignment selection for DFP_U/DFP_D connected to plug (Normative)
10.3.13	Proper pin assignment selection for DFP_U/UFP_D connected to receptacle (Normative)
10.3.14	Proper pin assignment selection for DFP_U / UFP_D connected to plug (Normative)
10.3.15	tFirstSourceCap and tTypeCSendSourceCap Measurements (Informative)

## 6.6.2 Chapter 11 – Vbus & Vconn Verification

### 6.6.2.1 Vbus & Vconn

Test Ref #	Test Description
11.2.1	VBUS/VCONN before Attach Detection
11.2.2	DFP VBUS/VCONN after Attach Detection

### 6.6.2.2 Adaptor VBUS and VCONN Tests

Test Ref #	Test Description
11.3.1	VBUS/VCONN for Adapters

## 6.7 Quick Charge 4 Compliance Tests

The Quick Charge 4 CTS covers required tests for QC4 Testing. Summarized in the following table. Refer to CTS for the details. This test group will appear in the GRL-USB-PD-C2 Test Specification Selection page if the unit is Configured with GRL-USB-PD-C2-QC upgrade license.

### 6.7.1 QC4 Tests

Test Ref #	Test Description
QC4.TID-1	Class A Adapter Test

QC4.TID-2	Class B Adapter Test
QC4.TID-3	Current Fold Back Test
QC4.TID-4	Quick Charge Starting Procedure Test
QC4.TID-5	Quick Charge Fault Condition Test
QC4.TID-6	Inquire Charger Case Temperature VDM Test
QC4.TID-7	Inquire Charger Connector Temperature VDM Test
QC4.TID-8	Inquire Voltage at Connector VDM Test
QC4.TID-9	Inquire Charger Type VDM Test
QC4.TID-10	Inquire Charger Protocol Version Test
QC4.TID-11	Supported Message Type Test
QC4.TID-12	Adapter Collapse behavior test
QC4.TID-13	Device removal Test
QC4.TID-14	Slew Rate Test
QC4.TID-15	Voltage and Current Test
QC4.TID-16	Hard Reset Test
QC4.TID-17	Consistency Test
QC4.TID-18	PPS Timeout Test
QC4.TID-19	Mode Transition Validation
QC4.TID-20	D+ and D- Transitions check

## 6.8 Quick Charge Legacy Tests

Quick Charge Legacy tests support Qualcomm's original proprietary Quick Charge capability. These tests are only available to users who are approved Qualcomm QC4 adopters with a signed NDA with Qualcomm indicating this.

### 6.8.1 Quick Charge Legacy Tests

Test Ref #	Test Description
SPT.1	Load Test
SPT.2	Capabilities Test
SPT.3	Hard Reset Test
SPT.4	GiveBack Test

## 7 Appendix A: USB Type-C Controller (GRL-USB-PD-C2)

### 7.1 GRL-USB-PD-C2 Shipping Box Contents



**GRL-USB-PD-C2 - USB Type-C Power Delivery Tester and Analyzer**



**Power Supply & Power Cord.**



**USB Cable** – Standard Type A to Type B Programming cable used to update GRL-USB-PD-C2 firmware. Connects to GRL-USB-PD-C2 upgrade USB port.



**Ethernet Cable** – 3m Cat 5 cable to connect GRL-USB-PD-C2 test controller to control computer.



**GRL-USB-PD-C2-CAB1** – Type-C VCONN Passthrough cable, used for connecting UUT to GRL-USB-PD-C2 test controller.



**External E-Load Connector** – Needed to connect external E-Load to GRL-USB-PD-C2 test controller.



**GRL-USB-PD-C2 CAL Fixture** – Calibration fixture for GRL-USB-PD-C2 test controller, used for USB 3.1 Gen 2 noise calibration.



**Accessory pouch.**

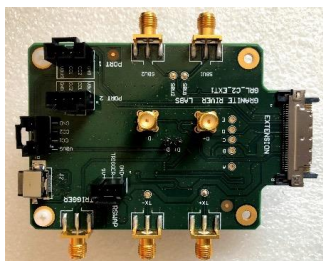
## 7.2 GRL-USB-PD-C2 Orderable Accessories

**GRL-USB-PD-FRS** – GRL Fast Role Swap (FRSWAP) Board (*Coming Soon*), which comprises the following:



- **GRL-C2-FRSWAP AUTO Box Board** – Fixture for GRL-USB-PD-C2 test controller, used to automate Fast Role Swap based testing. Connects to DUT to remove External AC power from DUT.

*Note: The fixture will be shipped inside an enclosure.*



- **GRL-C2-EXT1 DisplayPort Fixture, LFPS & FRSWAP Control Board** – EXT1 extension fixture for GRL-USB-PD-C2 test controller, used for the following functions:
  - Control signals for GRL-C2-FRSWAP AUTO Box Board.
  - Test DisplayPort Alt Mode over Type-C.
  - Control Low Frequency Periodic Signaling (LFPS) sequences in USB 3.0 system.

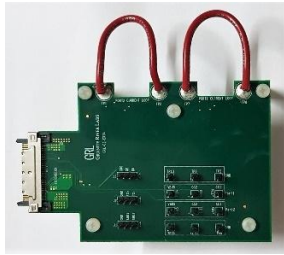


**GRL-USB-PD-PSB** – GRL Protocol Sniffer Board (*Coming Soon*). EXT2 extension fixture for GRL-USB-PD-C2 test controller, used for sniffing USB data packets between two connected DUT's.

**GRL-USB-PD-PTK** – GRL Scope Probing and Triggering Kit, which comprises the following:



- **BNC to BNC Cable** – 1M BNC cable to connect GRL-USB-PD-C2 test controller to external instruments. Can be used as trigger for communication between C2 to C2 or C2 to Oscilloscope.



- **GRL-C2-EXT4 Probing Board** – EXT4 extension fixture for GRL-USB-PD-C2 test controller, used for:
  - Probing the VBUS, CC lines of Port 1, Port 2 and D+/-, SBU1,2, and TX+/- of Port 1.
  - VBUS current measurement of Port 1 and Port 2 using current loop.

*Note: These functions are used with the Oscilloscope for debugging purposes.*



**GRL-USB-PD-C2-CAB1** – Type-C VCONN Passthrough cable, used for connecting UUT to GRL-USB-PD-C2 test controller.



**GRL-USB-PD-G2NCB** – Gen 2 Noise Calibration Board for GRL-USB-PD-C2 test controller, used for USB 3.1 Gen 2 noise calibration.



**GRL-USB-PD-SAB** – SI Automation Board for GRL-USB-PD-C2 test controller, used for automation control of USB Serial Interface communication protocol testing.



**GRL-USB-PD-ELDC** – External E-Load Connector, used to connect external E-Load to GRL-USB-PD-C2 test controller.

*Note: It is recommended by Granite River Labs to connect the extension fixture/board only during power-off on the GRL-USB-PD-C2 test controller.*

## 8 Appendix B: Using the Configuration Controller

This section describes how to use the **Config Controller** utility, which allows the user to manually send USB-PD Commands from the GRL-USB-PD-C2 controller to the UUT. To access the **Config Controller** utility, go to the **Test Configuration** screen and click the **Config Controller** button.

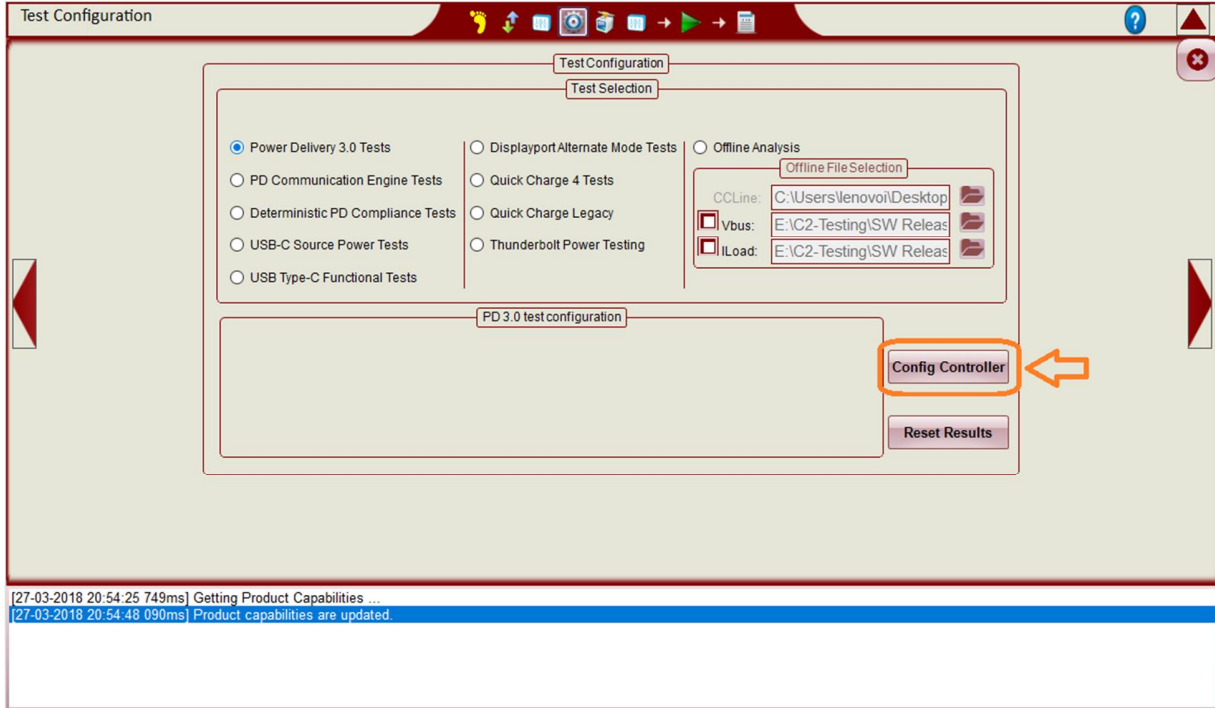


FIGURE 8.1: CONFIGURATION CONTROLLER

Testing the UUT for a particular scenario can be performed using the **Configuration Controller** utility. Across the top of the screen are a number of tabs that can be selected to focus on specific capabilities and requirements.

### 8.1 Configure Tab

The configure tab allows the user to set the configuration of the controller.

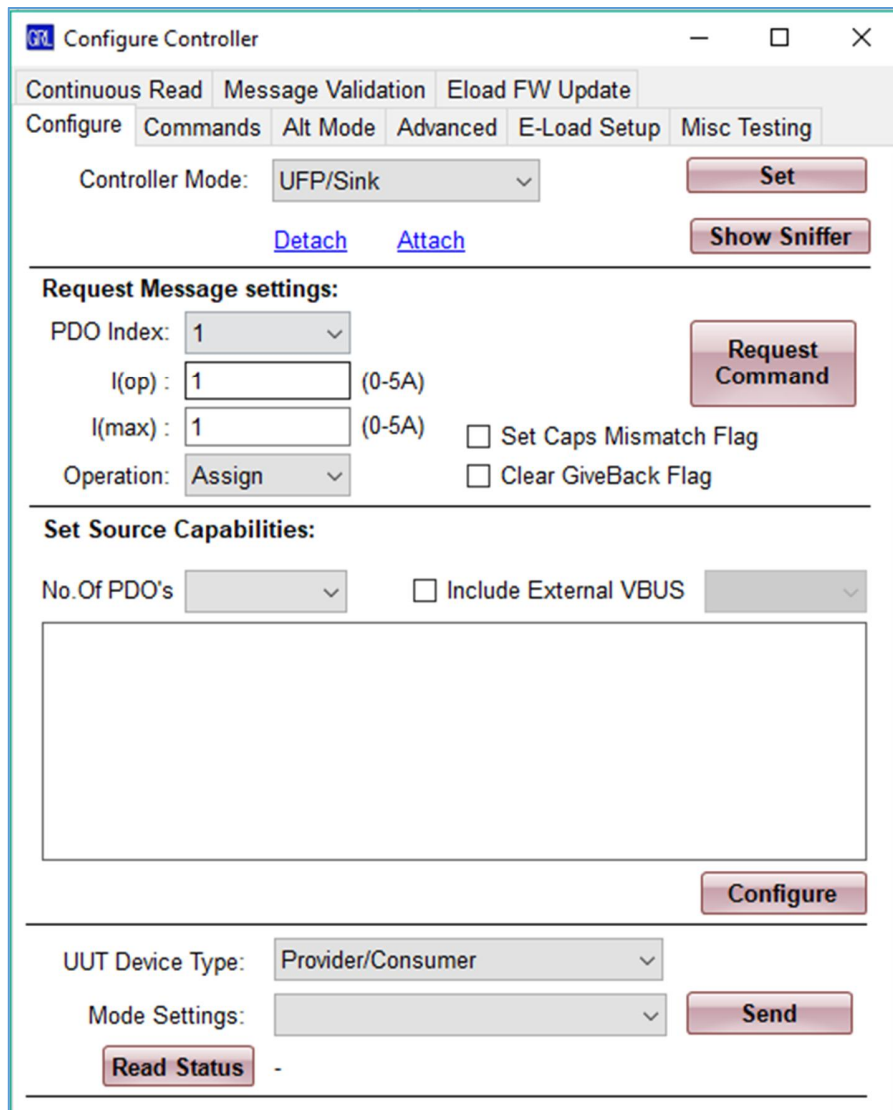


FIGURE 8.2: CONFIGURATION CONTROLLER – CONFIGURE TAB

**Controller Mode** - The Controller Mode drop down sets the controller's mode of operation.

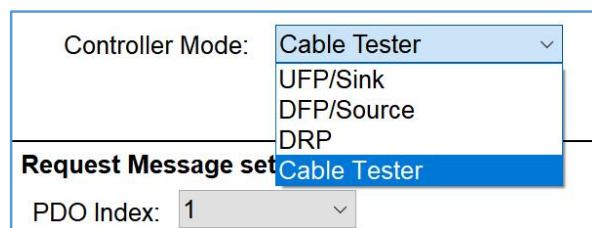


FIGURE 8.3: CONFIGURATION CONTROLLER MODE SELECTION

1. **UFP/Sink** – Upward Facing Port, sink power
2. **DFP/Source** – Downward Facing Port, source power
3. **DRP** – Dual Roll Port
4. **Cable Tester** – Cable only

Clicking on [Detach](#) or [Attach](#) will negotiate a Detach or Attach respectively between the Config Controller and the UUT. Clicking the **Set** button causes the mode to be set.

Clicking the **Show Sniffer** button allows the user to validate USB-PD communications between the Config Controller and the UUT. Select the VBUS and CC1/CC2 line voltage and current connections and D+/D- voltage to view the PDO negotiations. Enter the number of intervals required to run sub sampling of USB-PD data packets and click the **Start** button to generate the PDO communications exchange protocol. When the protocol is running, click the **Stop** button at any time to end the process.

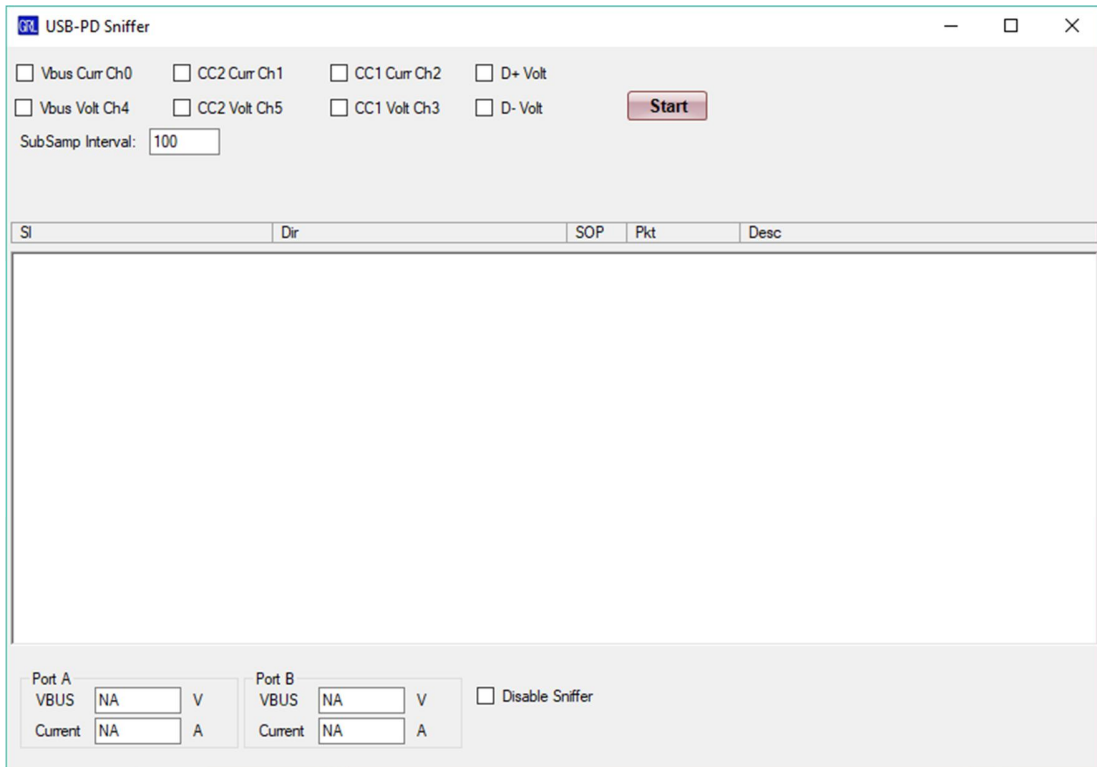


FIGURE 8.4: CONFIGURATION CONTROLLER MODE SNIFFER FUNCTION

For a 2-port UUT, enter the VBUS and current values available at both Port A and Port B. To turn off the sniffer function, select the “Disable Sniffer” check box.

- **Request Message Settings** - This section allows the user to select the Request message settings which are sent from the Controller during PD Contract negotiation phase. These settings are also sent when the **Request Command** button is clicked.

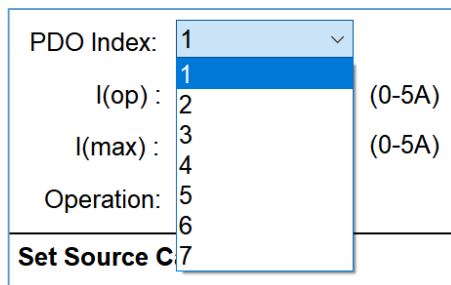


FIGURE 8.5: REQUEST MESSAGE PDO INDEX SELECT



The **PDO Index** dropdown allows the user to select the index of the PDO being accessed. The **I(op)** (operating current level) input is used to specify the operating current value between 0A and 5A. The **I(max)** (maximum current level) input is used to specify the maximum allowable current value between I(op) and 5A. These values are assigned to the current parameter in the Source and Sink Capability message sent from the Controller.

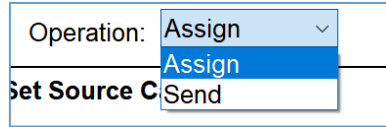


FIGURE 8.6: REQUEST MESSAGE OPERATION SELECTION

The user should choose **Assign** in the **Operation** drop down to assign the **Request Message** settings or select **Send** to send the message.

The “**Set Caps Mismatch Flag**” is set if there is a check mark in the box next to the flag title. Clicking on the check box will toggle the value between set and cleared.

Similarly, the “**Clear GiveBack Flag**” can be set (check mark in box) or cleared (no check mark) by clicking on the “**Clear GiveBack Flag**” check box.

- **Set Source Capabilities** – The source capabilities are set in this section including the number of PDOs, the specific capabilities of each PDO and which, if any, PDO has an external Vbus capability.

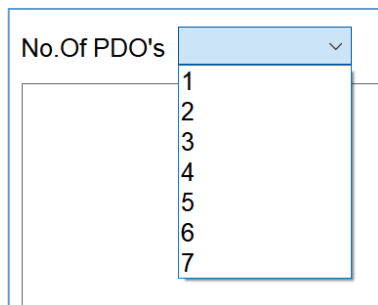


FIGURE 8.7: SET SOURCE CAPABILITIES SET NUMBER OF PDOs

The number of PDOs supported is selected using the **No. Of PDOs** drop down. From one to seven PDOs can be selected.

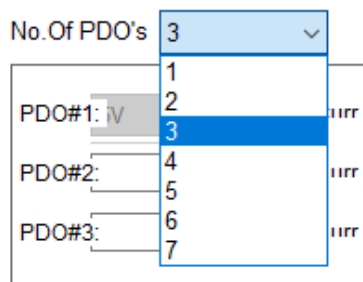


FIGURE 8.8: SET SOURCE CAPABILITIES FOUR PDOs SELECTED

In the case shown with three PDOs defined, the first three PDOs, with indices 1, 2, and 3, have internally controlled voltage and current limits that are set by the first three sets of voltage and current boxes. An external power supply is selected by clicking on the **Include External VBUS** check box.

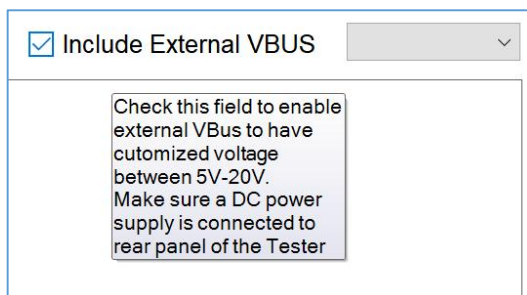


FIGURE 8.9: SET SOURCE CAPABILITIES EXTERNAL VBUS

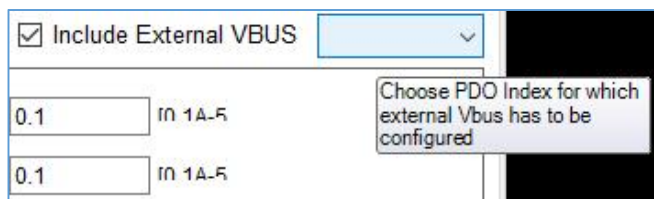


FIGURE 8.10: SET SOURCE CAPABILITIES EXTERNAL VBUS REQUIREMENTS

Only one PDO with index greater than one can be specified as an external VBUS PDO. The user needs to connect their external power supply to the rear of the GRL-USB-PD-C2 Controller to provide the external Vbus power capability.

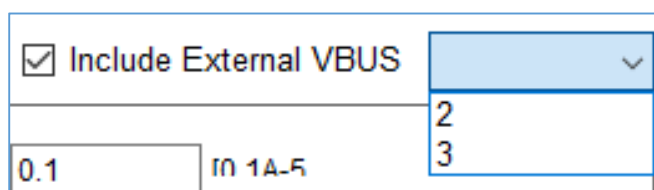


FIGURE 8.11: SET SOURCE CAPABILITIES EXTERNAL VBUS SELECTION

Clicking the **Configure** button will cause the specified configuration parameters to be communicated to the attached UUT.

The **UUT Device Type** drop down allows the user to select the type of UUT connected to the Controller.

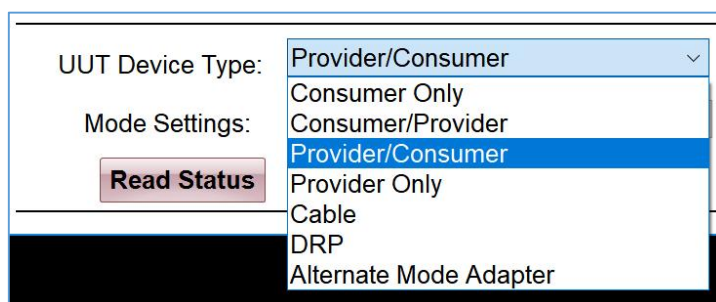


FIGURE 8.12: SELECT UUT TYPE

The available UUT types are Consumer Only, Consumer/Provider, Provider/Consumer, Provider Only, Cable, DRP and Alternate Mode Adapter.

The **Mode Settings** dropdown allows the user to select the Controller configuration to match the behavior of the attached UUT. For example, if the Controller should accept the PR\_SWAP command

received from the UUT, it can be configured by selecting “Accept PR\_SWAP” from drop down list, and can then be applied to the Controller by pressing the Send button.

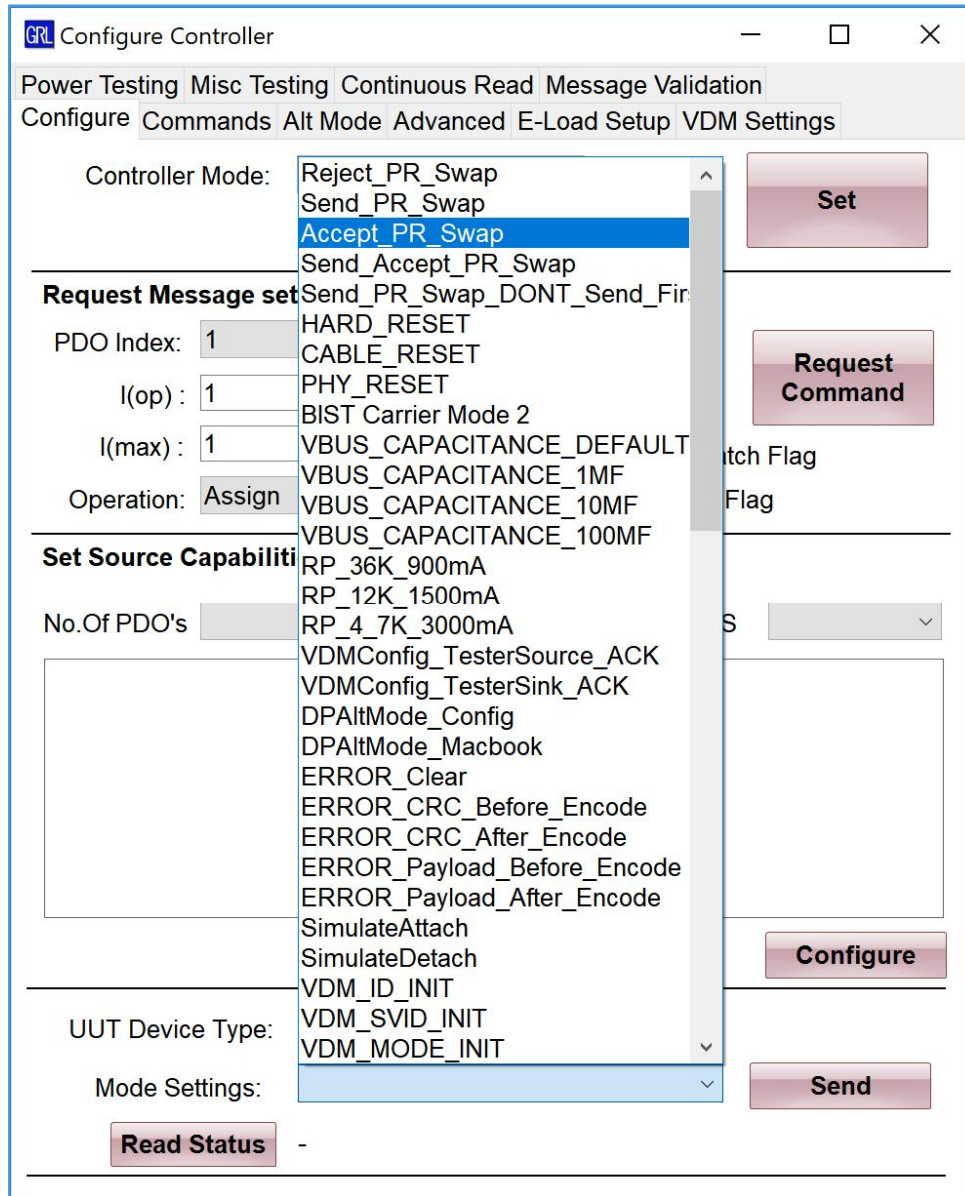


FIGURE 8.13: CONFIG CONTROLLER CONFIGURE TAB

The table below shows the available commands and provides details for each command.

Mode Setting	Command Description
Reject_PR_SWAP	If PR_SWAP command to be rejected
Send_PR_SWAP	To initiate PR_SWAP command
Accept_PR_SWAP	Accept PR_SWAP
Send_Accept_PR_SWAP	Initiate PR_SWAP & Accept if PR_SWAP received
Send_PR_Swap_DONT_Send_First_PS_RDY	Initiate PR_SWAP & Don't Send PS_RDY
HARD_RESET	Send Hard Reset to UUT
CABLE_RESET	Send Cable Reset command to UUT
PHY_RESET	Reset PHY layer of the Controller

Mode Setting	Command Description
BIST Carrier Mode2	Send BIST Carrier Mode 2 command to UUT
VBUS_CAPACITANCE_DEFAULT	All capacitance is m
Vbus_CAPACITANCE_1MF	1uF Capacitance is applied on Vbus pin
Vbus_CAPACITANCE_10MF	10uF Capacitance is applied on Vbus pin
Vbus_CAPACITANCE_100MF	100uF Capacitance is applied on Vbus pin
RP_36K_900mA	Assert 36K Rp resistance
RP_12K_1500mA	Assert 12K Rp resistance
RP_4_7K_3000mA	Assert 4.7K Rp resistance
VDMConfig_TesterSource_ACK	Update Controller with the VDM Source Data
VDMConfig_TesterSink_ACK	Update Controller with the VDM Sink ACK Data
DPAItMode_Config	Configure controller with VDM message to respond to any UUT
DPAItMode_Macbook	Configure controller with VDM message to respond to Macbook
ERROR_Clear	Clear all the error inserted
ERROR_CRC_Before_Encode	Insert Corrupt CRC data before 4B/5B encoding while transmitting packet from Controller
ERROR_CRC_After_Encode	Insert Corrupt CRC data after 4B/5B encoding while transmitting packet from Controller
ERROR_Payload_Before_Encode	Insert Corrupt payload data before 4B/5B encoding while transmitting packet from Controller
ERROR_Payload_After_Encode	Insert Corrupt payload data after 4B/5B encoding while transmitting packet from Controller
Simulate Attach	Simulate Attaching Type-C connector without manual intervention
Simulate Detach	Simulate Detach of Type-C connector without manual intervention
VDM_ID_INIT	Configure the Controller with the VDM Discover ID initialize data
VDM_SVID_INIT	Configure the Controller with the VDM Discover SVID data
VDM_MODE_INIT	Configure the Controller with the VDM Discover Mode data
Enable VCONN	
Select Cable	
SOFT_RESET	Send Soft Reset to UUT
INIT_Src_Cap	Configure Controller with the Source Capability PDO
VBUS_OFF	Disconnect Vbus from the Type-C connector on the controller
VBUS_5V	Connect 5V Vbus supply to Type-C Connection on the controller
VBUS_12V	Connect 12V Vbus supply to Type-C Connection on the controller
VBUS_20V	Connect 20V Vbus supply to Type-C Connection on the controller
Set_Src_Cap1	Configure controller with the 5V, 900ma PDO
Set_Src_Cap2	Configure controller with the 12V, 1.5A PDO
Set_Src_Cap3	Configure controller with the 20V, 3.0A PDO
Enable eLoad Mod	Enable E-Load Connected to the Controller
Disable eLoad Mod	Disable E-Load Connected to the Controller
Enable VDM	Enable VDM, So controller will respond to VDM messages
Disable VDM	Disable VDM, So controller will respond with NAK for VDM messages
Reject_DR_SWAP	Configure controller to reject DR swap if received from UUT
Send_DR_SWAP	
Accept_DR_SWAP	Configure controller to Accept DR swap if received from UUT
Send_Accept_DR_SWAP	Send DR_SWAP or Accept DR_SWAP
Tester_Reset	Reset the Controller
Tester_Reconnect	

Mode Setting	Command Description
ERROR_CRC_ReservedSymbol	
AutoRetry_Enable	
AutoRetry_Disable	
PHY_MSG_1_BistSOPs	
PHY_MSG_2_PhyEncErr	
PHY_MSG_3_MsgIDCabRst	
PHY_MSG_4_MsgIDRpt	
SoftReset_With_PDC	
SoftReset_Without_PDC	
DiscovIDResp_All_SOPs	
DiscovIDResp_SOP_Only	
SetExtTrigger_RuntimeCmd	
SetExtTrigger_AllPackets	
MsgID_Inc_Enable	
MsgID_Inc_Disable	
BusIdle3_Noise_Enable	
BusIdle3_Noise_Disable	
Disable_GoodCRC_CfgSRAccept	
Enable_GoodCRC_CfgSRAccept	
Disable_PPS_AutoReq	
Enable_PPS_AutoReq	
FE_FPGA_FR	
Reset_Board	

Clicking the **Read Status** button gets status from the UUT and displays it.



FIGURE 8.14: CONFIGURE CONTROLLER READ STATUS BUTTON

## 8.2 Commands Tab

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

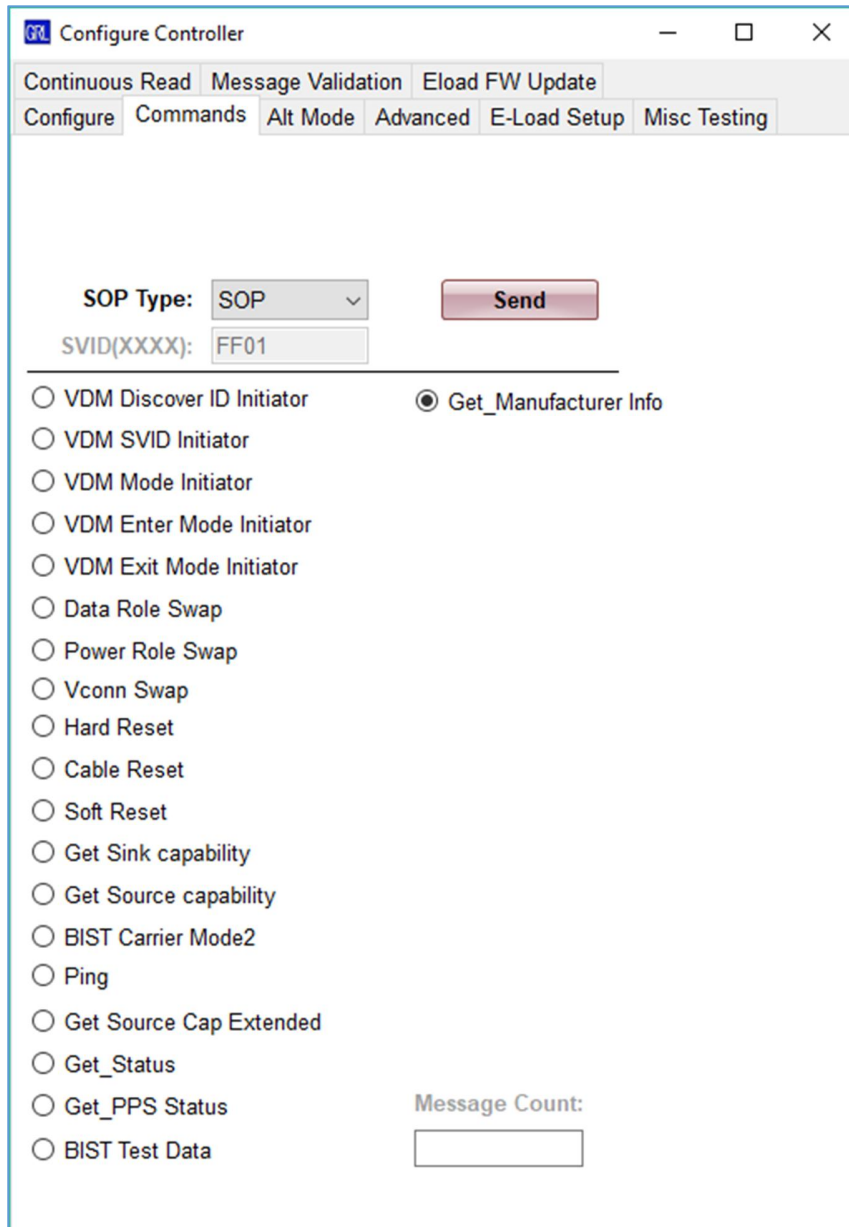


FIGURE 8.15: CONFIG CONTROLLER COMMANDS TAB

The **SOP Type** drop down allows the user to select the SOP type in the message sent from Controller. It includes SOP, SOP' and SOP".

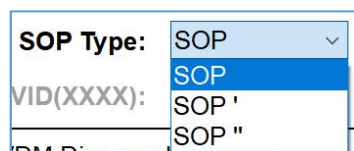
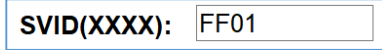


FIGURE 8.16: CONFIG CONTROLLER SET SOP TYPE DROPDOWN MENU

The **SVID** field allows user 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.



SVID(XXXX):

FIGURE 8.17: CONFIG CONTROLLER COMMAND SVID F0E;D

Power, Data and Vconn swap can be initiated by selecting the appropriate radio button in the command tab.

Resets such as **Hard Reset**, **Cable Reset** and **Soft Reset** can be sent from the controller by selecting the appropriate radio button in the command tab.

Capability commands such as **Get Sink Capability** and **Get Source Capability** can be sent from this tab.

Ping command can also be sent to UUT by selecting the **Ping** radio button.



Get\_PPS Status Message Count:  
 BIST Test Data

FIGURE 8.18: CONFIG CONTROLLER BIST TEST DATA MESSAGE COUNT INPUT

When the **BIST Test Data** is selected the **Message Count** input field is used to specify the number of **BIST Test Data** messages to be sent.

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

### 8.3 Alt Mode Tab

This tab is used for testing the attached UUT in the Alternate Mode. Refer to Section 5.2 for more detailed description of what configurations the GRL-USB-PD-C2 can support and test.

The Alt Mode Tab allows the user to send configuration data to and receive status information from a UUT operating in DisplayPort Alt Mode.

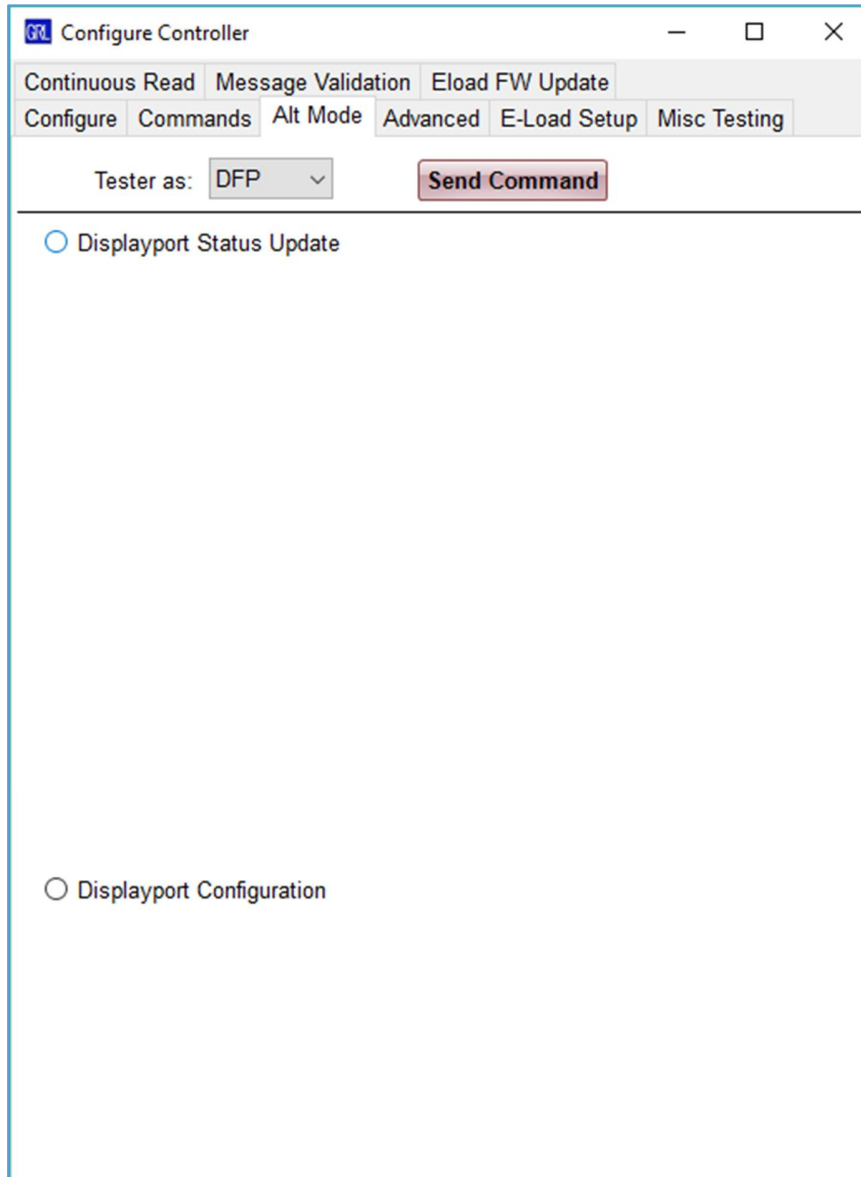


FIGURE 8.19: CONFIG CONTROLLER DISPLAYPORT ALT MODE TAB

The **Tester type** dropdown is used to select the type of device connected to the controller, DFP or UFP.



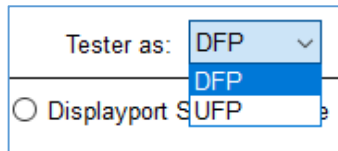


FIGURE 8.20: CONFIG CONTROLLER ALT MODE TYPE SELECTION

Selecting the **DisplayPort Status Update** radio button then clicking the **Send Command** button causes the controller to get and display the status of the attached UUT. Selecting the **DisplayPort Configuration** radio button then clicking the **Send Command** button sends the command to the UUT.

### 8.4 Advanced Tab

The Advanced Tab in the Configure Controller supports advanced features such as managing delay, Swap and Trigger as shown below.

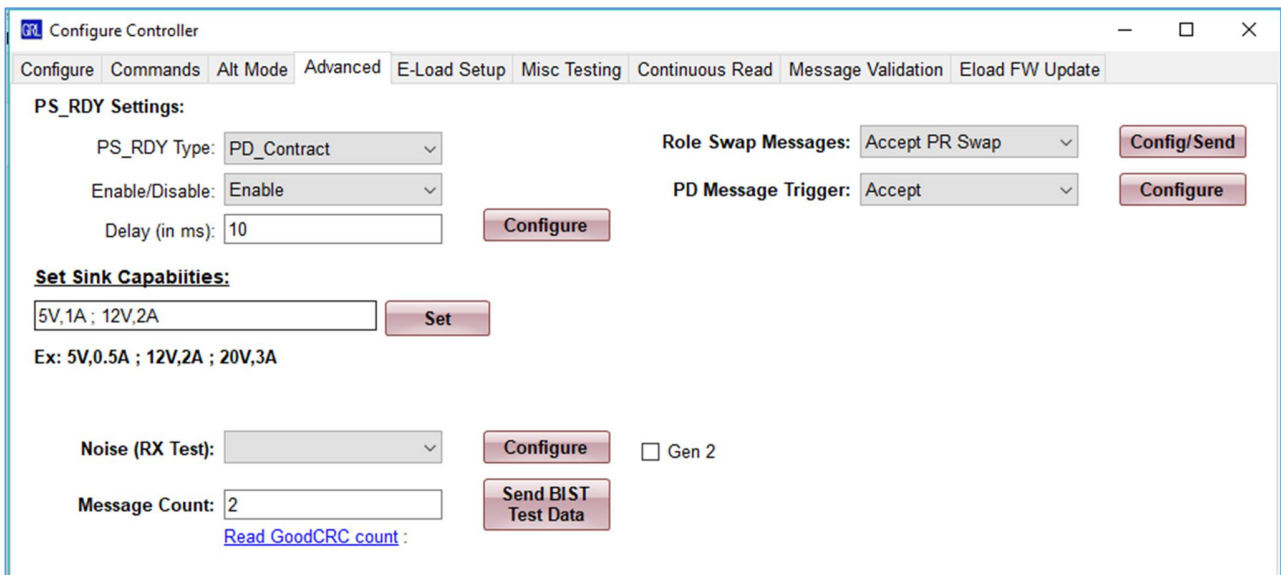


FIGURE 8.21: CONFIG CONTROLLER ADVANCED TAB

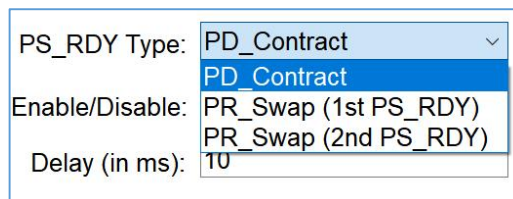


FIGURE 8.22: CONFIG CONTROLLER ADVANCED PS\_RDY TYPE SELECTION

- **PS\_RDY Settings** – The **PS\_RDY\_Type** dropdown allows the user to select when a PS\_RDY message is sent: during PD\_contract or during varying PR\_Swap operations.

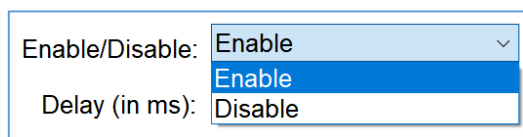


FIGURE 8.23: CONFIG CONTROLLER ADVANCED PS\_RDY ENABLE/DISABLE

The Enable/Disable dropdown allows the user to select whether or not to enable sending PS\_RDY.

Delay (in ms):

FIGURE 8.24: CONFIG CONTROLLER ADVANCED PS\_READY DELAY SET AND CONFIGURE

When sending the PS\_RDY message is enabled, the **Delay** input field allows the user to specify the number of milliseconds the Controller will wait before sending the PS\_RDY message.

Clicking on the **Configure** button adjacent to the **Delay** input field causes all the **PS\_RDY Settings** to be sent to the UUT by the Controller.

**Role Swap Messages:** Accept PR Swap ▾  
**PD Message Trigger:** Accept PR Swap  
Reject PR Swap  
Send PR Swap  
Accept DR Swap  
Reject DR Swap  
Send DR Swap  
Accept Vconn Swap  
Reject Vconn Swap  
Send Vconn Swap

FIGURE 8.25: CONFIG CONTROLLER ADVANCED ROLE SWAP MESSAGES

- **Role Swap Messages** - This field is used to test the Role Swap handling behavior such as Accept PR swap, Reject PR Swap, Send PR Swap and other swap messages. This allows the user to see how the UUT responds based on the configuration.

The following table contains a full list of all the Role Swap Messages:

PD Message	Description
Accept PR Swap	
Reject PR Swap	
Send PR Swap	
Accept DR Swap	
Reject DR Swap	
Send DR Swap	
Accept Vconn Swap	
Reject Vconn Swap	
Send Vconn Swap	

Clicking on the **Config/Send** button adjacent to the **Role Swap Messages** dropdown causes all the **Role Swap Messages** to be sent to the UUT by the Controller.

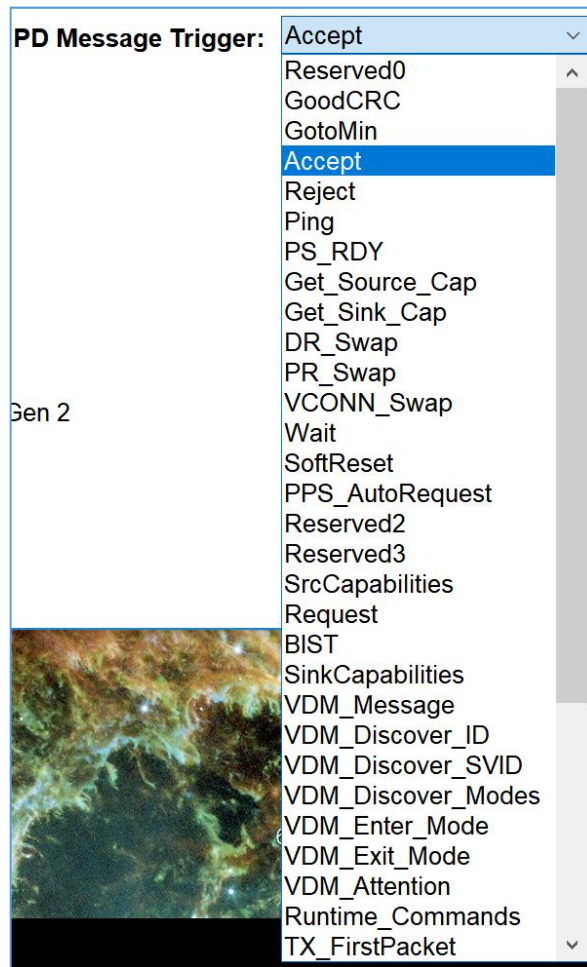


FIGURE 8.26: CONFIG CONTROLLER PD MESSAGE TRIGGER

- **PD Message Trigger** - This dropdown allows the user to select the message that will cause a pulse on the front panel Trigger BNC connector before the selected message is sent from the Controller.

The following table contains a full list of all the PD Message Triggers:

TABLE 8-1: PD MESSAGE TRIGGER SELECTIONS

PD Message	Description
Reserved0	
GoodCRC	
GotoMin	
Accept	
Reject	
Ping	
PS_RDY	
Get_Source_Cap	
Get_Sink_Cap	

PD Message	Description
DR_Swap	
PR_Swap	
VCONN_Swap	
Wait	
SoftReset	
PPS_AutoRequest	
Reserved2	
Reserved3	
SrcCapabilities	
Request	
BIST	
SinkCapabilities	
VDM_Message	
VDM_Discover_ID	
VDM_Discover_SVID	
VDM_Discover_Modes	
VDM_Enter_Mode	
VDM_Exit_Mode	
VDM_Attention	
Runtime_Commands	
TX_FirstPacket	
30	
31	
RX_FirstPacket	
All_Packets	
34	
35	
36	
37	
38	
39	
Voltage_Current	

Clicking on the **Configure** button adjacent to the **PD Message Trigger** dropdown causes the **PD Trigger** value to be sent to the UUT by the Controller.

**Set Sink Capabilities:**

5V,1A ; 12V,2A

Ex: 5V,0.5A ; 12V,2A ; 20V,3A

FIGURE 8.27: CONFIG CONTROLLER SINK CAPABILITIES SETTING

- **Set Sink Capabilities** – If the UUT supports USB-C power Sink capabilities, enter the sink power profiles that are supported by the UUT and click on the **Set** button.

Noise (RX Test):    Gen 2

Message Count:

Idle Noise 600KHz  
Group Noise 1  
Group Noise 2  
Group Noise 3  
Idle Noise 600KHz  
Disable Noise

FIGURE 8.28: CONFIG CONTROLLER NOISE SOURCE SELECTION

- **Noise (RX Test)** – The **Noise** drop down allows the user to either disable noise generation or enable any one of 4 different noise features supported by the Controller. The following table contains a full list of all the Noise selections:

Noise Selection	Description
Group Noise 1	Group noise defined as
Group Noise 2	Group noise defined as
Group Noise 3	Group noise defined as
Idle Noise 600KHz	Idle noise at 600KHz is defined as
Disable Noise	Disable all noise sources

Clicking on the **Configure** button adjacent to the **Noise** dropdown causes the **Noise** selection to be sent to the UUT by the Controller.

When checked, the **Gen 2** checkbox adjacent to the **Configure** button causes the Gen 2 noise definition to be used. If the checkbox is not checked, the Gen 1 definition is used. See Section 6.2.7 for more information.

Message Count:

[Read GoodCRC count](#) :

FIGURE 8.29: CONFIG CONTROLLER MESSAGE COUNT, READ GOODCRC AND SEND BIST

- **Message Count** – The Message Count input field allows the user to set the number of BIST Test data messages that need to be sent from the Controller when **Send BIST Test Data** is clicked. Clicking on the **Send BIST Test Data** button adjacent to the **Message Count** input field causes the specified number of **BIST Test Data** messages to be sent to the UUT by the Controller.
- **Read GoodCRC Count** - Clicking the [Read GoodCRC](#) link reads the total number of GoodCRC messages received from the UUT after sending the specified number of **BIST Test Data** messages.

## 8.5 eLoad Setup Tab

This tab is used for setting the eLoad current parameters, turning the eLoad ON or Off and reading voltage and current values from the eLoad.

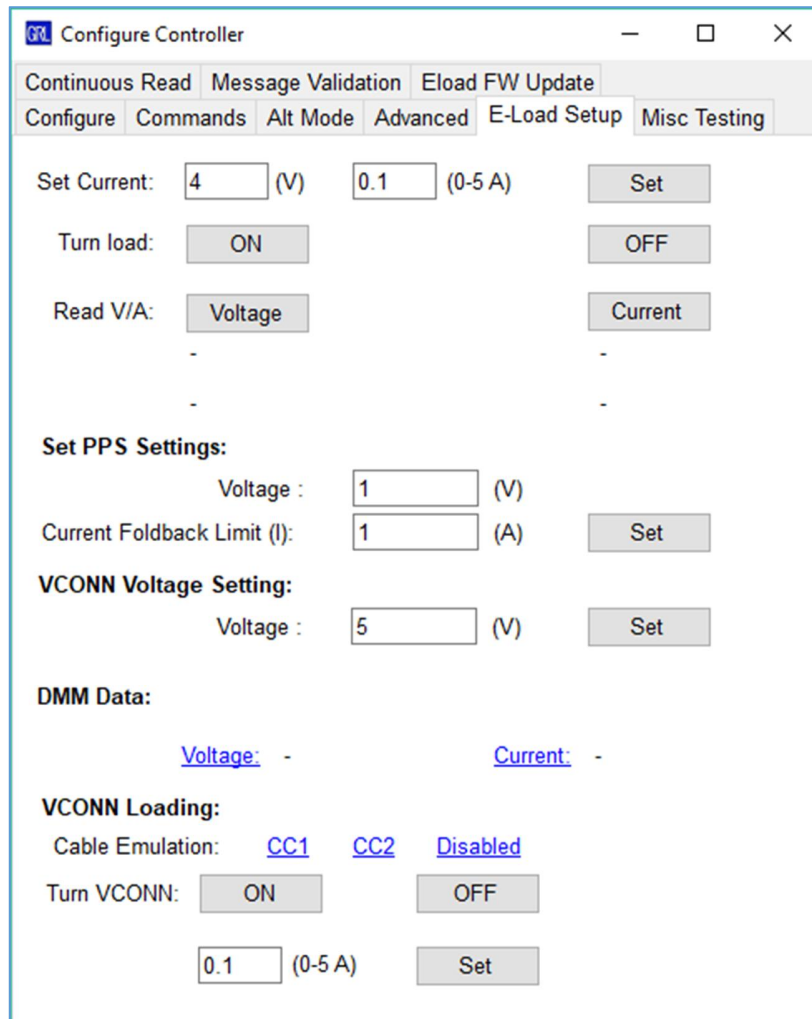


FIGURE 8.30: CONFIG CONTROLLER ELOAD TAB

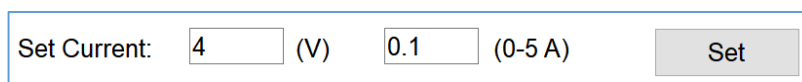


FIGURE 8.31: CONFIG CONTROLLER ELOAD SET CURRENT

- **eLoad Settings** – The **Set Current** input fields allow the user to specify the maximum allowable eLoad values. The first input field (**V**) specifies the maximum allowable voltage across the eLoad. The second input field (**0-5 A**) specifies the maximum allowable current through the eLoad. Clicking on the **Set** button causes the specified parameters to be set within the eLoad.



FIGURE 8.32: CONFIG CONTROLLER ELOAD ON / OFF CONTROLS

Clicking on the **Turn Load: On** button turns on the eLoad. Clicking on the **Turn Load: Off** button turns the eLoad off.

Read V/A:	<input type="button" value="Voltage"/>	<input type="button" value="Current"/>
	0.0	0.0
	0.0(0x000(0))	0.0(0x000(0))

FIGURE 8.33: CONFIG CONTROLLER ELOAD READ VALUES CONTROLS

Clicking either the **Voltage** or **Current** buttons will read the eLoad voltage and current and display both values.

Voltage :  (V)

FIGURE 8.34: CONFIG CONTROLLER SET PPS SETTINGS VOLTAGE INPUT

- **Set PPS Settings** – The **Voltage** input field allows the user to specify the voltage for the programmable power supply.

Current Foldback Limit (I):  (A)

FIGURE 8.35: CONFIG CONTROLLER SET PPS CURRENT FOLDBACK

The **Current Foldback Limit** input field allows the user to specify the current at which the programmable power supply should reduce the power supply voltage to avoid sourcing a current higher than the specified limit.

Clicking the **Set** button adjacent to the input field causes the Controller to set the foldback limit of the programmable power supply.

Voltage :  (V)

FIGURE 8.36: CONFIG CONTROLLER VCONN VOLTAGE SETTING

- **VCONN Voltage Setting** – The **Voltage** input field allows the user to specify the maximum allowable voltage on the  $V_{CONN}$  lines. Clicking the **Set** button adjacent to the input field will cause the Controller to set the indicated voltage limit for  $V_{CONN}$ .

[Voltage:](#) - [Current:](#) -

FIGURE 8.37: CONFIG CONTROLLER DMM DATA VOLTAGE AND CURRENT INPUTS

- **DMM Data** – Clicking on the [Voltage](#) input link causes the Controller to read and display the voltage value from the DMM (Digital Multi-Meter). Clicking on the [Current](#) input link causes the Controller to read and display the current value from the DMM.

Cable Emulation: [CC1](#) [CC2](#) [Disabled](#)

FIGURE 8.38: CONFIG CONTROLLER VCONN LOADING

- **VCONN Loading** – Clicking on the **Cable Emulation** [CC1](#) input link causes the Controller to read and display the CC1 emulation value. Clicking on the [CC2](#) input link causes the Controller to read and display the CC2 emulation value. Clicking on the [Disabled](#) input link causes the Controller to read and display information about disabled cable emulation.

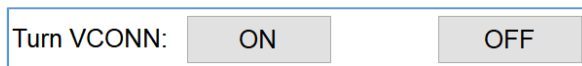


FIGURE 8.39: CONFIG CONTROLLER VCONN ON AND OFF

Clicking the **ON** button will turn  $V_{CONN}$  loading on while clicking the **OFF** button will turn  $V_{CONN}$  loading off.

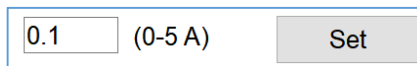


FIGURE 8.40: CONFIG CONTROLLER VCONN LOADING CURRENT LIMIT INPUT

The user can use the **VCONN Loading** input field to specify the maximum allowable current on the  $V_{CONN}$  lines. Clicking the **Set** button adjacent to the **VCONN Loading** input field will cause the Controller to set the indicated current limit for  $V_{CONN}$  loading.

## 8.6 Misc Testing Tab

This tab gives the user access to miscellaneous commands and tests.

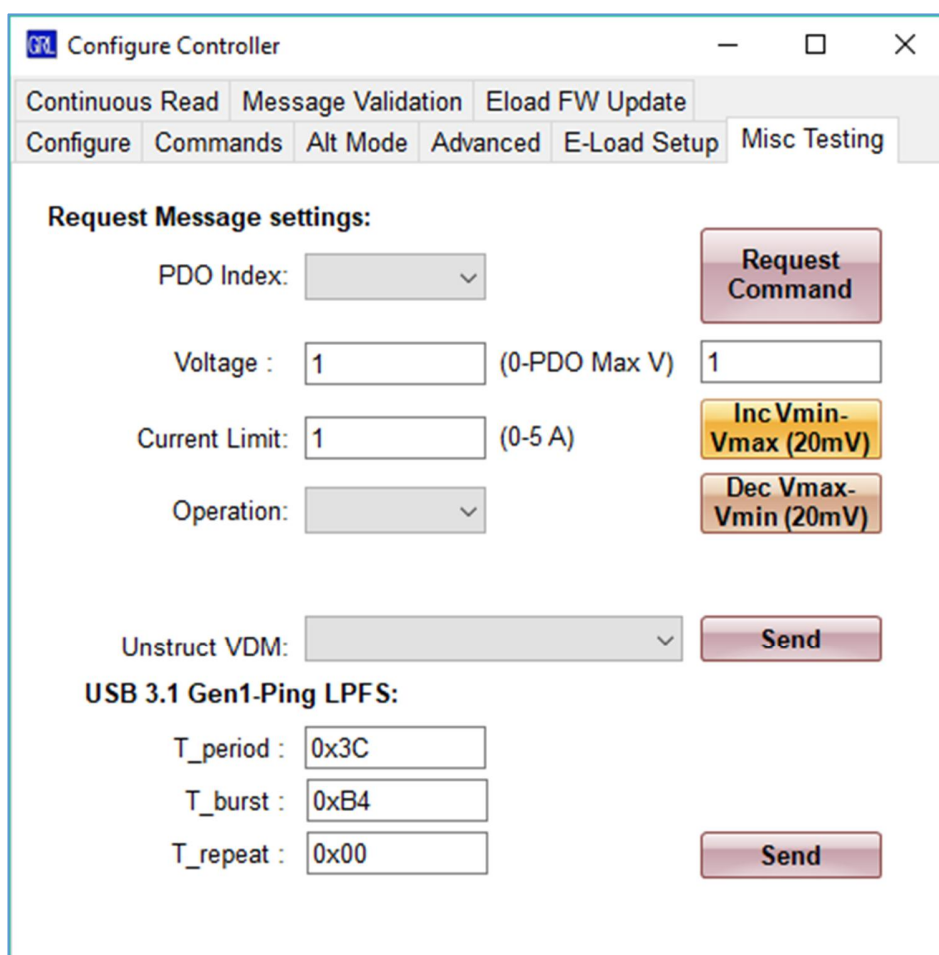


FIGURE 8.41: CONFIG CONTROLLER MISCELLANEOUS TESTING TAB



**Request Message settings:**

PDO Index:

Voltage :  (0-PDO Max V)

Current Limit:  (0-5 A)

Operation:

FIGURE 8.42: MISC TESTING REQUEST MESSAGE SETTINGS

- **Request Message Settings** – The **PDO Index** dropdown allows the user to select the index of the PDO to which the message is to be sent. The required voltage is set using the **Voltage:** input field and the maximum current is set using the **Current Limit:** input field. The **Operation:** dropdown allows the user to select the required operation for the request message.

Operation:

FIGURE 8.43: CONFIG CONTROLLER REQUEST MESSAGE OPERATION SELECTIONS

The available operations are **Assign** and **Send**. **Assign** will save the specified values for the next time the **Request Message** is sent. **Send** will cause the specified values to be sent to the UUT the next time the **Request Message** is sent.

**Request Command**

**Inc Vmin-Vmax (20mV)**

**Dec Vmax-Vmin (20mV)**

FIGURE 8.44: CONFIG CONTROLLER REQUEST MESSAGE REQUEST COMMAND

Clicking on the **Request Command** button causes the accumulated request message data to be assigned or sent to the UUT based on the **Operation** selected. The input field allows the user to input a value. Clicking the **Inc Vmin-Vmax** and **Dec Vmax-Vmin** causes a 20 mV increment or decrement respectively in the range of Vmin and Vmax.

Unstruct VDM:

FIGURE 8.45: CONFIG CONTROLLER REQUEST MESSAGE UNSTRUCTURED VDM AND SEND

The **Unstruct VDM** dropdown allows the user to select what kind of unstructured vendor defined message to send.

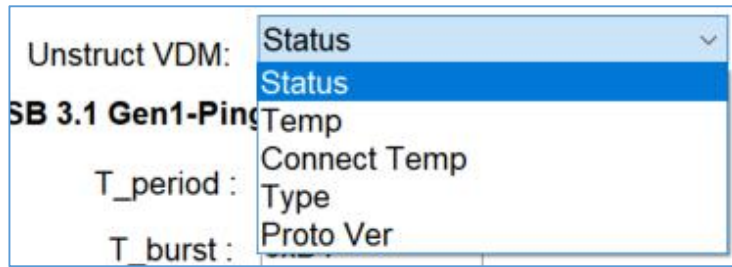


FIGURE 8.46: CONFIG CONTROLLER REQUEST MESSAGE UNSTRUCTURED VDM TYPE SELSCTION

The available unstructured VDM message types include:

Unstructured VDM Type	Description
Status	Get status
Temp	Get temperature
Connect Temp	Get connector temperature
Type	Get type
Proto Ver	Get version

Clicking on the **Send** button will cause the request message described by the previous parameters to be sent to the UUT.

- **USB 3.1 Gen1-Ping LFPS** – The **USB 3.1 Gen1-Ping LFPS** section allows the user to configure the output to provide a USB Gen1 Ping.LFPS signal on the C2 expansion port using the GRL-C2-EXT4 extension board.

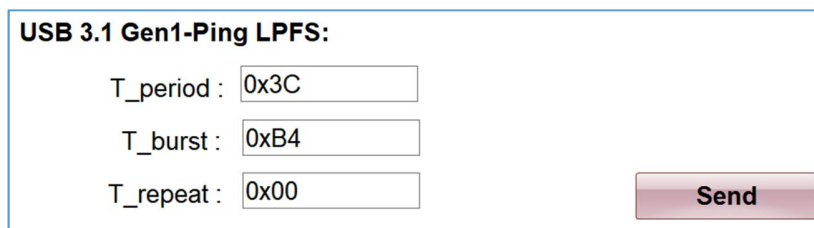


FIGURE 8.47: CONFIG CONTROLLER USB 3.1 GEN1-PING LFPS SETTINGS AND SEND

The **T<sub>period</sub>** input field allows the user to specify the tPeriod parameter of the Ping.LFPS signaling. This specifies the period of the output signal in units of 10nS. The **T<sub>burst</sub>** input field allows the user to specify the tBurst parameter of the Ping.LFPS signaling. This specifies the period between bursts of tPeriod outputs. This specifies the burst period in units of 10ns. The **T<sub>repeat</sub>** input field allows the user to specify the number of times to repeat the tBurst output of the Ping.LFPS signaling. The minimum and maximum number of repeats is specified by the USB specification.

Clicking the **Send** button causes the Controller to output the specified Ping.LFPS signal on the appropriate pin of the connected GRL-C2-EXT4 extension board.

## 8.7 Continuous Read Tab

This tab allows the user to continuously monitor several parameters of the connected UUT.

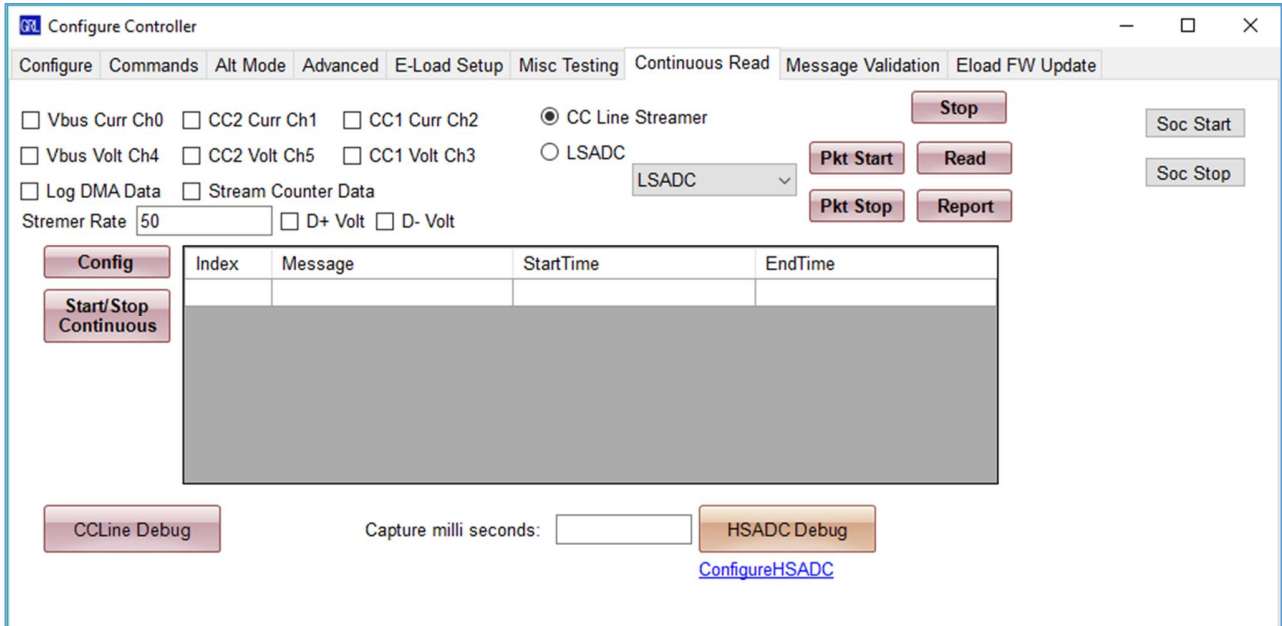


FIGURE 8.48: CONFIG CONTROLLER CONTINUOUS READ TAB

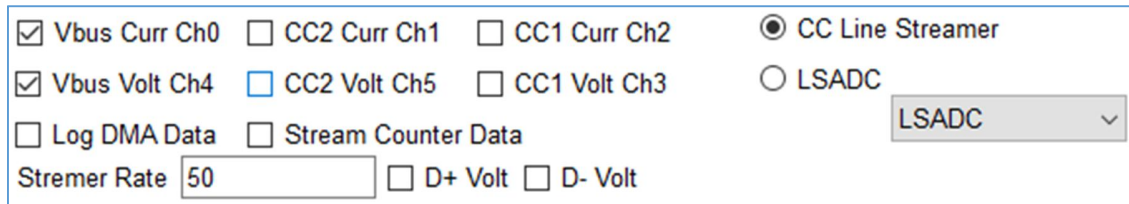


FIGURE 8.49: CONFIG CONTROLLER CONTINUOUS READ SELECTION

The display selection check boxes allow the user to select which parameters are streamed from the UUT to the display on this tab. When a checkbox is checked, the associated parameter is displayed. When not checked, the parameter is not displayed. The available parameters are listed below:

Parameter	Description
Vbus Curr Ch0	Vbus current in mA
Vbus Volt CH4	Vbus voltage in V
CC2 Curr Ch1	CC2 current in mA
CC2 Volt Ch5	CC2 voltage in V
CC1 Curr Ch2	CC1 current in mA
CC1 Volt Ch3	CC1 voltage in V
Log DMA Data	Captures and displays DMA transactions
Stream Counter Data	Captures and display stream counter values
D+ Volt & D- Volt	D+ and D- voltages in V

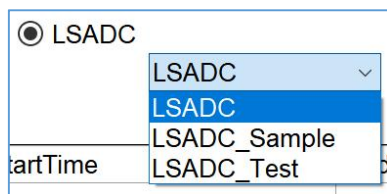


FIGURE 8.50: CONFIG CONTROLLER CONTINUOUS READ LSADC SELECTION

The user can further select either the CC Line Streamer to display transaction data on the CC line or LSADC (Low Speed Analog Digital Converter) to monitor the output of the LSADC. When this option is selected, the user can select to monitor either the LSADC output or a test pattern. The latter option lets the user check for missing codes.

The user can also set the streamer rate using the **Streamer Rate** input field.

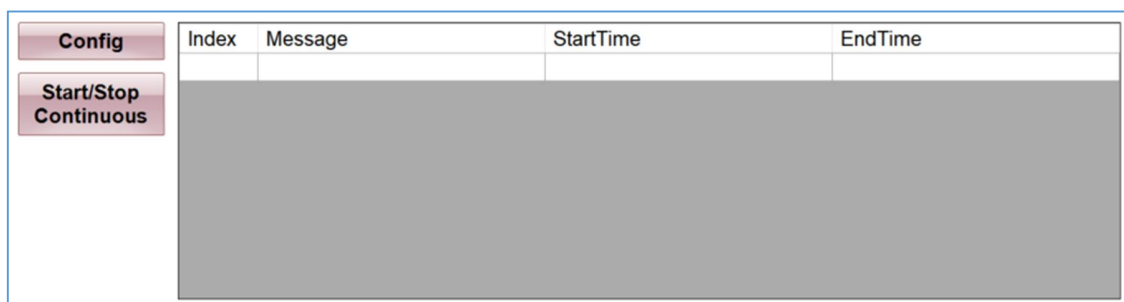


FIGURE 8.51: CONFIG CONTROLLER CONTINUOUS READ CONTROL AND DISPLAY

Clicking the **Config** button captures and saves the parameters specified for the display. These are the parameters that are displayed whenever the **Continuous Read** facility is active. Clicking on the **Start/Stop Continuous** button toggles between start/stop display and continuous display of the selected parameters.

Adjacent to these two buttons is the display area that shows the index, message, start and stop times of each message being read.

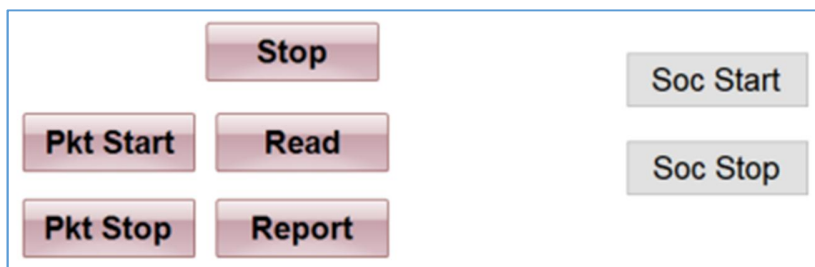


FIGURE 8.52: CONFIG CONTROLLER CONTINUOUS READ CONTROLS

Clicking on the **Stop** button stops reading and displaying messages. Clicking the **Pkt Start** and **Pkt Stop** buttons start and stop the reading and displaying of packet data respectively. Clicking the **Read** button reads and displays a single message. Clicking the **Report** button saves the accumulated data to a file for later analysis. The **Soc Start** and **Soc Stop** buttons appear to do nothing at all, respectively.

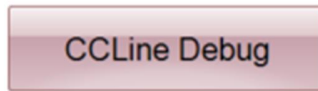


FIGURE 8.53: CONFIG CONTROLLER CONTINUOUS READ CCLINE DEBUG

Clicking on the **CCLine Debug** button invokes the CC line debugger. Although at the moment all it does is hang the application forcing the user to close and re-start it.



FIGURE 8.54: CONFIG CONTROLLER DATA ACQUISITION AND HSADC DEBUG

Set the duration in milliseconds in the **Capture milli seconds** input field for data acquisition. Clicking on the **HSADC Debug** button invokes the high-speed A/D converter debugger while clicking on the [ConfigureHSADC](#) link allows the user to configure the high-speed A/D converter settings. Although at the moment these button and link appear to do nothing at all, respectively.

## 8.8 Message Validation Tab

This tab allows the user to validate saved message files.

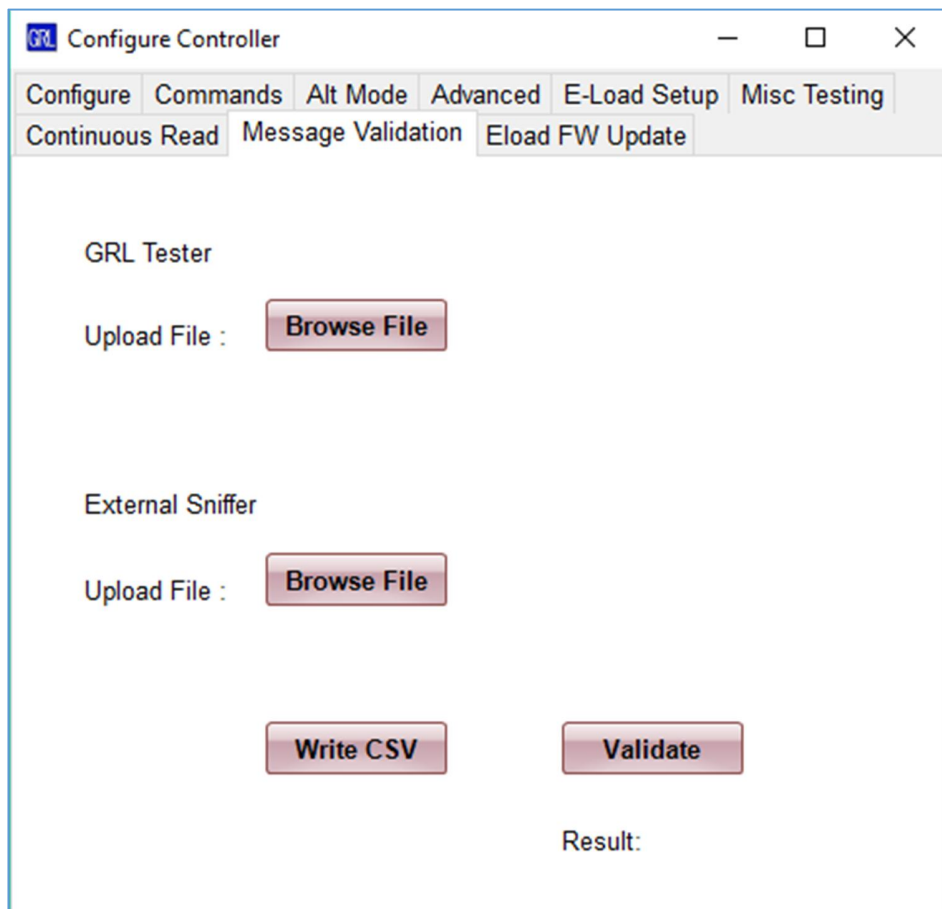


FIGURE 8.55: CONFIG CONTROLLER MESSAGE VALIDATION TAB

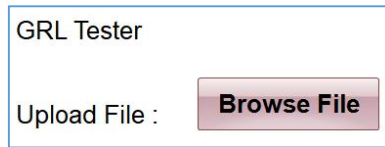


FIGURE 8.56: CONFIG CONTROLLER VERIFICATION OF TESTER MESSAGE FILE UPLOAD

- **GRL Tester** – Clicking on the **Browse File** button brings up a file selection dialog box allowing the user to navigate to and select the GRL tester file to upload for validation.
- **External Sniffer** – Click on the **Browse File** button brings up a file selection dialog box allowing the user to navigate to and select the external sniffer file to upload for validation.

Clicking the **Write CSV** button writes the current file in .csv (comma separated values) file. Clicking the **Validate** button validates the currently loaded file. The results of the validation are displayed to the right of the **Result:** label.

### 8.9 eLoad Firmware Update Tab

This tab is used for updating the eLoad firmware for both USB Port 1 and Port 2 of the C2 test controller. Connect the C2 USB Type B port (on the rear of the instrument) to any USB port on an external laptop PC (that contains the firmware update files) using the USB Type A to Type B programming cable provided by Granite River Labs.

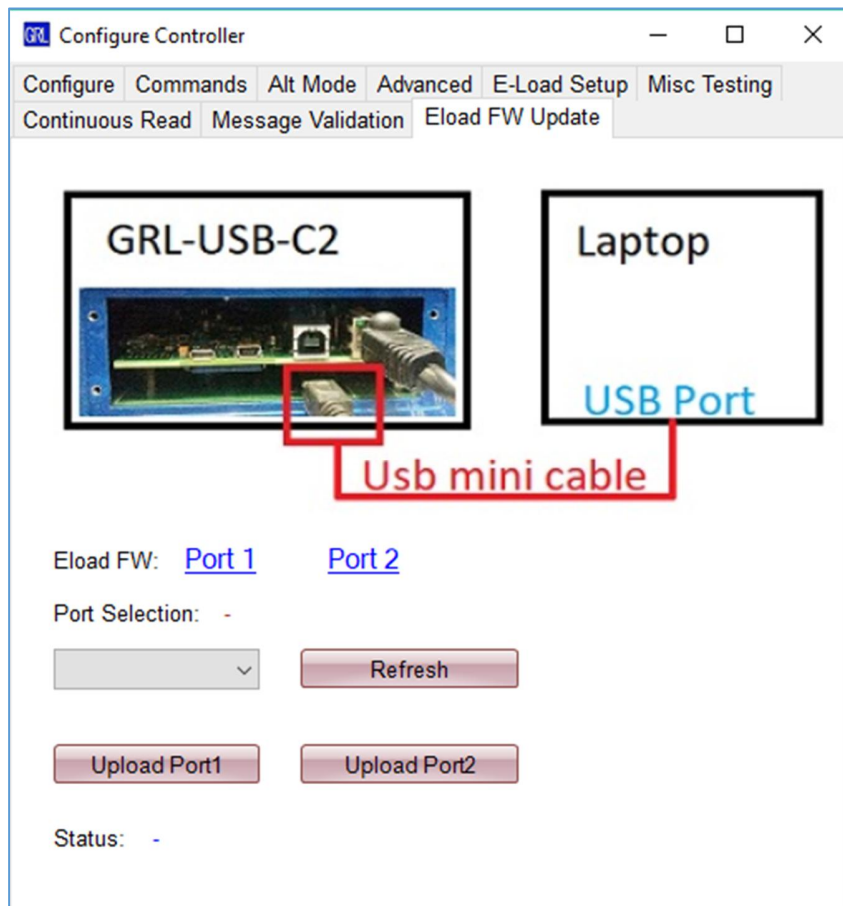


FIGURE 8.57: CONFIG CONTROLLER ELOAD FW UPDATE TAB

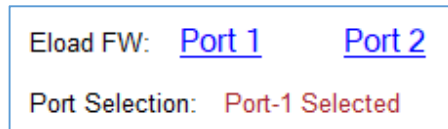


FIGURE 8.58: CONFIG CONTROLLER ELOAD FW UPDATE PORT SELECTION

- **eLoad FW & Port Selection** – The **Eload FW** field allows the user to select a USB Port of the C2 test controller to be updated with the eLoad firmware. Clicking on the [Port 1](#) or [Port 2](#) link displays the selected port at the **Port Selection** field. *Note: The eLoad firmware needs to be updated for both Port 1 and Port 2.*

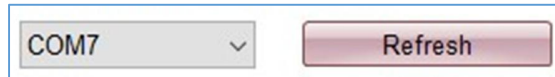


FIGURE 8.59: CONFIG CONTROLLER ELOAD FW UPDATE PC COM PORT

Clicking on the **Refresh** button causes the COM port connection on the PC to be automatically updated and appear in the adjacent drop-down list.



FIGURE 8.60: CONFIG CONTROLLER ELOAD FW UPDATE FILE UPLOAD

Finally, clicking on the **Upload Port 1** or **Upload Port 2** button (depending on the Port selected) allows the firmware update file to be uploaded to perform firmware update for the specific Port. Upon successful file upload, the Status bar will display a message to inform the user.

**END\_OF\_DOCUMENT**