



Granite River Labs

Tester Card Port Verification Guide for GRL USB Power Delivery & Data Loopback Volume Tester (GRL-V-UP) Using GRL-V-UP API Test Software



This material is provided as a reference to perform port verification of the tester card for the Granite River Labs (GRL) USB Power Delivery & Data Loopback Volume Tester (GRL-V-UP).

For customer support, contact support@graniteriverlabs.com.

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1 Scope of this Verification Guide

This Verification Guide provides the step-by-step procedure to perform port verification of the tester card for the GRL USB Power Delivery & Data Loopback Volume Tester (GRL-V-UP) using the GRL-V-UP API Test software.

For more information on GRL-V-UP, please refer to <https://graniteriverlabs.com/grl-v-up/>.

For more information on the GRL-V-UP API Test software, please refer to the user documentation in <http://graniteriverlabs.com/download-center/>.

For purchase orders, licensing questions and concerns, please contact Granite River Labs support at support@graniteriverlabs.com.

2 Test/Equipment Requirements

GRL-V-UP Hardware Tester



For Automated Port Verification:

- **Digital Multimeter** [Note: GRL recommends using the Scientific SMM5000 Series or Keithley DMM6500 Series Digital Multimeter]

For Manual Port Verification:

- **Digital multimeter** [Note: GRL recommends using a digital multimeter with high accuracy and resolution of 5 ½ digits or above that has been calibrated.]



For Automated Port Verification:

- **DC Power Supply** [Note: GRL recommends using the Keysight E3000 Series or B&K Precision 9130 Series Power Supply]

For Manual Port Verification:

- **DC Power Supply** [Note: GRL recommends using the Keysight E3000 Series power supply]

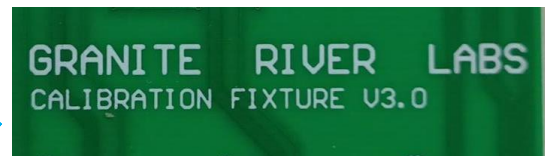
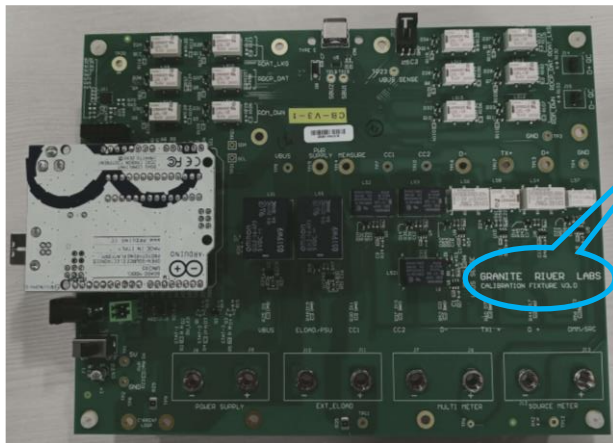
**GRL Calibration Kit** *[See (a) Note: below]***GRL Special EPR (GRL-SPL-EPR) Cable****GRL Special (GRL-SPL) Type-C VCONN passthrough test cable (GRL-USB-PD-STC)****VBUS Sense Cable****Banana Connectors****USB Type-A to Type-B Cables**



Control Computer (laptop or desktop) with the GRL-V-UP API Test software installed [Note: For more information on the GRL-V-UP API Test software, refer to the user documentation in <http://graniteriverlabs.com/download-center/>]

(a) Note:

Make sure Version 3.0 (V3.0) or above of the GRL calibration kit (fixture) is used for port verification (see image below):



3 Start Up GRL-V-UP API Test Software

On the control computer, launch the GRL-V-UP API Test software. There are four main tabs on the left side of the software screen as follows:

- API
- Graph
- Loopback
- Help

Each of these tabs will display its respective functional screen when selected.

For more information on the GRL-V-UP API Test software, refer to the user documentation in <http://graniteriverlabs.com/download-center/>.

3.1 Connect to the GRL-V-UP Tester

Once the GRL-V-UP tester hardware is connected to the control computer, select the **API** tab to establish connection with the tester:

1. In the “V-UP Connection” pane, select the connected GRL-V-UP tester from the **Devices List** drop-down menu. See Figure 3.1 below.
2. Click on the **Select** button to establish connection with the selected tester. When connected successfully, the selected tester model will be displayed in the **Selected Device** field. See Figure 3.1 below.

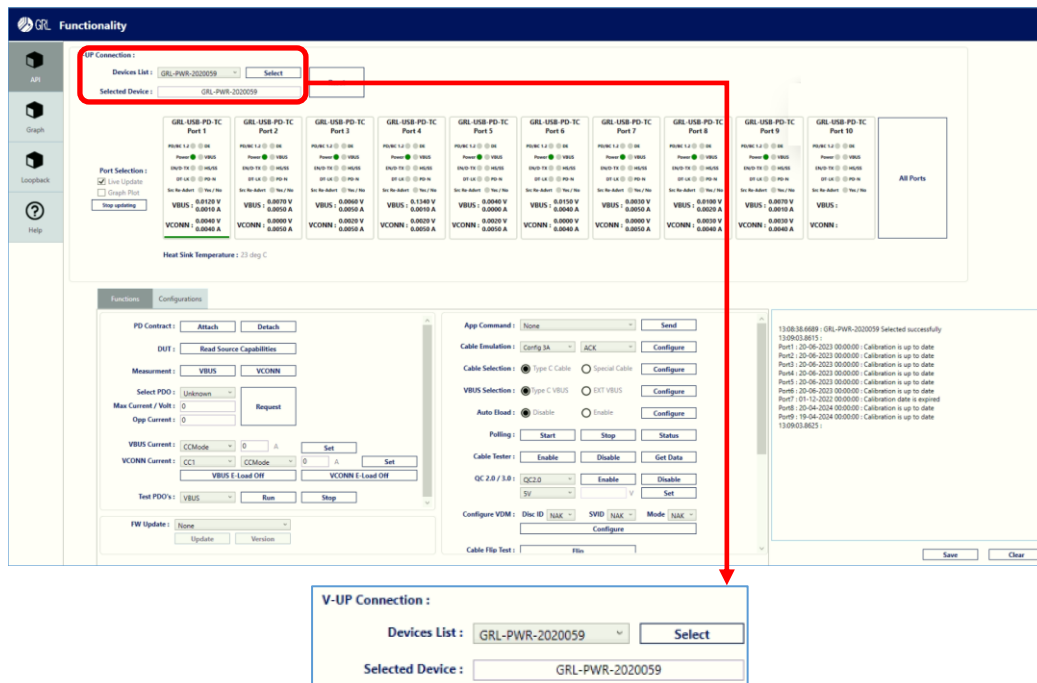


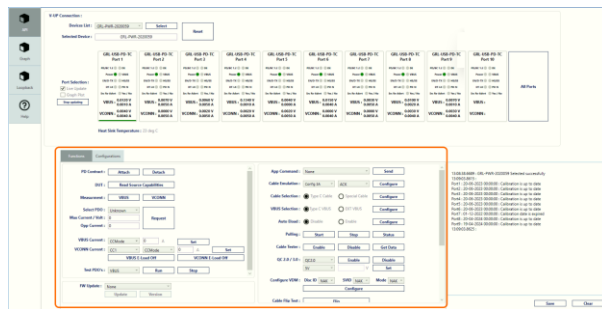
FIGURE 3.1: CONNECT GRL-V-UP API TEST SOFTWARE AND TESTER

Connection with the GRL calibration kit will be established automatically once the tester card port verification process starts. The GRL calibration kit will perform switching of the VBUS voltage, VBUS current and VBUS Sense voltage automatically or the CC1 voltage, CC2 voltage, VCONN current, VBUS voltage, VBUS current and VBUS Sense measurement channels manually.

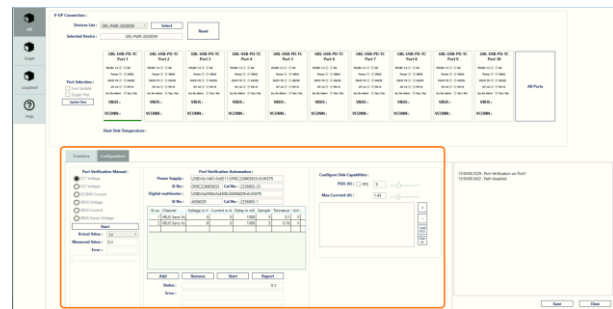
3.2 Access the API Configuration Pane for Port Verification

The API configuration pane contains two tabs: “Functions” allows configuration for USB Power Delivery related API’s, firmware update and other functions. “Configurations” allows configuration for additional features such as port verification. See Figure 3.2.

Select the **Configurations** tab to configure and perform automated or manual port verification of the tester card.



Functions Tab



Configurations Tab

FIGURE 3.2: API CONFIGURATION PANE FOR PORT VERIFICATION

There are six measurement channels for the tester port and their voltage/current ranges are as follows:

- VBUS Voltage : 0 V to 20 V
- VBUS Current : 0 A to 5 A
- VBUS Sense Voltage : 0 V to 20 V
- CC1 Voltage : 0 V to 5 V
- CC2 Voltage : 0 V to 5 V
- VCONN Current : 0 A to 1 A

The “Error” field computes and displays the error percentage with Pass/Fail status using the following formula:

$$\text{Error \%} = \frac{\text{Actual Value} - \text{Measured Value}}{\text{Actual Value}} * 100$$

4 GRL-V-UP Tester Card Port Verification Procedure

This section describes how to verify the GRL-V-UP tester card port manually or using automation mode.

4.1 Manual Port Verification

This section describes how to verify the GRL-V-UP tester card port on the following measurement channels– CC1 voltage, CC2 voltage, VCONN current, VBUS voltage, VBUS current and VBUS Sense.

4.1.1 Equipment Requirements

Equipment	Qty.
GRL-V-UP tester hardware	1
DC power supply	1
Digital multimeter	1
GRL calibration kit	1
GRL Special EPR (GRL-SPL-EPR) Cable / GRL Special (GRL-SPL) Type-C VCONN passthrough test cable (GRL-USB-PD-STC)	1
VBUS Sense cable <i>[See (a) Note: below]</i>	1
Banana connectors	4
USB Type-A to Type-B cable	2
Control computer (laptop or desktop) with the GRL-V-UP API Test software installed	1

(a) Note:

The VBUS Sense cable is required if using the GRL Special (GRL-SPL) Type-C VCONN passthrough test cable (GRL-USB-PD-STC).

4.1.2 Measurement Configuration

1. Open the GRL-V-UP API Test software and select the **Configurations** tab in the API configuration pane. See Figure 4.1.

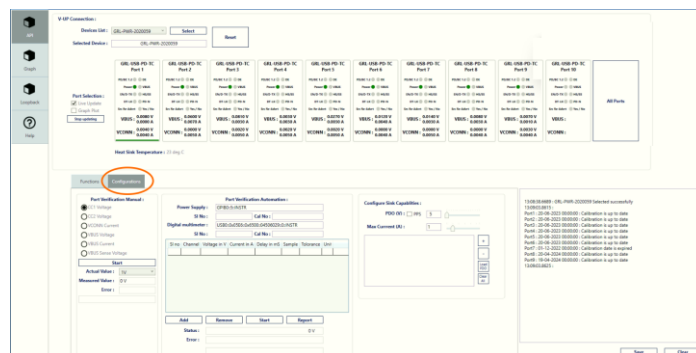


FIGURE 4.1: SELECT CONFIGURATIONS TAB FOR PORT VERIFICATION

2. Select the tester card port(s) that needs to be verified. See example in Figure 4.2 below.

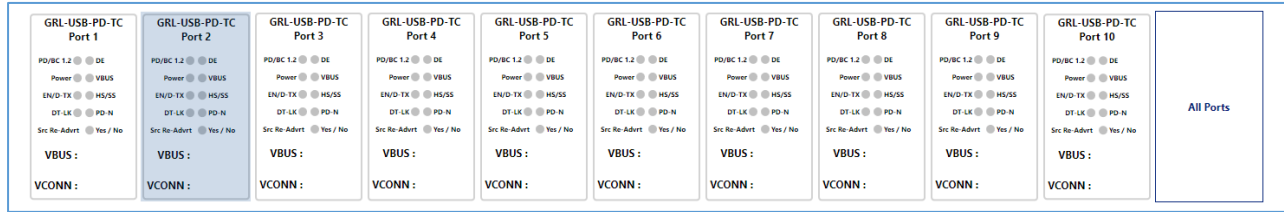


FIGURE 4.2: SELECT TESTER CARD PORT FOR VERIFICATION

3. There are six measurement channels per port (see Figure 4.3) and their voltage/current ranges are as specified in Section 3.2.

Warning: The range for each channel should not be exceeded at any time. Doing so may cause permanent damage to both the GRL calibration kit and tester card.

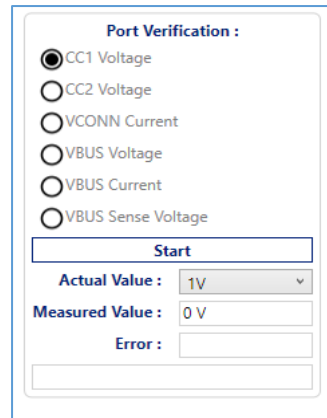


FIGURE 4.3: MEASUREMENT CHANNELS FOR MANUAL PORT VERIFICATION

Actual Value: This drop-down menu allows the voltage/current level that needs to be verified to be selected based on the selected measurement channel. The selected voltage/current level needs to be set on the power supply as well.

Measured Value: This field displays the measured values of the tester port.

Error: This field computes and displays the error percentage with Pass/Fail status as follows:

$$Error \% = \frac{Actual\ Value - Measured\ Value}{Actual\ Value} * 100$$

The acceptance limits for voltage/current are as follows:

For Voltage: @No Load

$$Error = \begin{cases} 5\%, 0V \leq V \leq 5V \\ 2\%, 5V < V \leq 20V \end{cases}$$

For Current:

$$Error = 2\%, 0A \leq A \leq 5A$$

Note: User-defined acceptance limits are also allowed, which the user will need to determine the Pass/Fail status based on the digital multimeter measured values and the GRL-V-UP measured values.

4. Set up the equipment connection and select the measurement channel to perform verification as described in the following sections.

4.1.3 Connection Setup for Voltage Measurements

This section describes the connection diagram to set up the equipment and fixture for manual port verification for voltage measurements. Set up the hardware connection as shown in Figure 4.4 below.

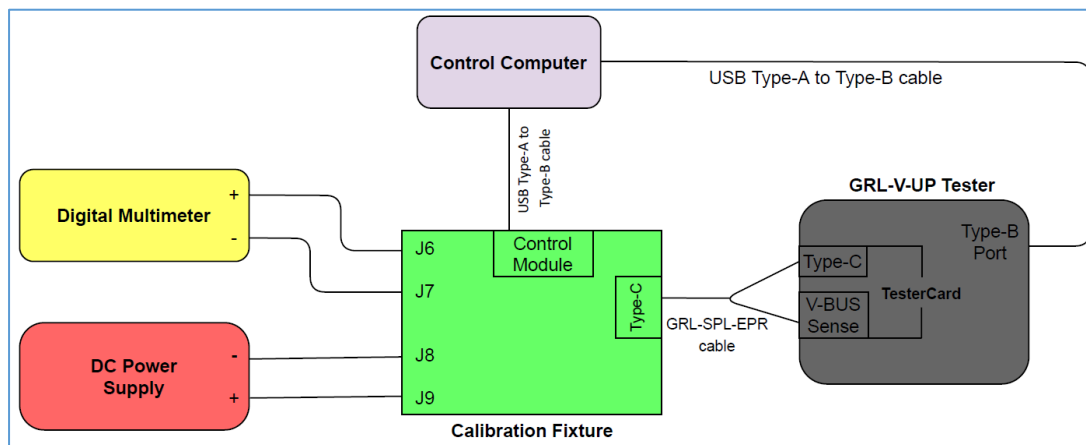


FIGURE 4.4: CONNECTION SETUP FOR GRL-V-UP MANUAL PORT VERIFICATION FOR VOLTAGE MEASUREMENTS

Note: The connection setup may change according to the measurement channel selected.

1. Connect the DC power supply to the J8 and J9 terminals of the GRL calibration fixture.
2. Connect the digital multimeter (DMM) to the J6 and J7 terminals of the GRL calibration fixture.
3. Connect the Control Module of the GRL calibration fixture to the control computer using a USB Type-A to Type-B cable.
4. If using the **GRL-SPL-EPR cable**, connect the USB Type-C receptacle of the GRL calibration fixture to both the USB Type-C Port and VBUS Sense connector of the GRL-V-UP tester hardware.
 - Connect the GRL-SPL-EPR cable end with the GRL logo to the calibration fixture. *Note: Make sure to place the GRL logo in the upward position to maintain the same cable orientation between the calibration fixture and tester.*
 - Connect the GRL-SPL-EPR cable thumb screw end to the GRL-V-UP tester card port.
 - Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-UP tester.

5. If using the **GRL-SPL Type-C cable**, connect the USB Type-C receptacle of the GRL calibration fixture to the USB Type-C receptacle of the GRL-V-UP tester. *Note: Make sure to place the GRL logo on the GRL-SPL Type-C cable in the upward position to maintain the same cable orientation between the calibration fixture and tester.*
 - Connect the VBUS Sense connector of the GRL calibration fixture to the VBUS Sense connector of the GRL-V-UP tester using a VBUS Sense cable.
6. Connect the GRL-V-UP tester hardware to the control computer using a USB Type-A to Type-B cable.

4.1.4 Procedure for CC1 Voltage Measurement

1. Set up the hardware connection as shown in Figure 4.4.
2. See Figure 4.5 for the following procedure:

- i. Select the **CC1 Voltage** channel.

Caution: Make sure that the voltage on the power supply is less than 5 V before proceeding to the next step.

- ii. Click on the **Start** button to start the verification process. A pop-up message will appear to prompt the user to set the voltage on the power supply to ≤ 5 V in order to avoid any permanent damage to the GRL calibration fixture and tester card.
- iii. Set the voltage on the power supply to 0 V and click **OK**.
- iv. Select the voltage level to be verified from the **Actual Value** drop-down menu. Set the same voltage value on the power supply as well.
- v. The **Measured Value** field will display the GRL-V-UP measurement value. The **Error** field will display the error percentage with Pass/Fail status (refer to the acceptance limits as specified above).
- vi. Repeat the above steps for the rest of the voltage levels (1V, 2V, 3V, 4V, 5V) and ensure that all values are within the acceptance limits. When completed, click on the **Stop** button.

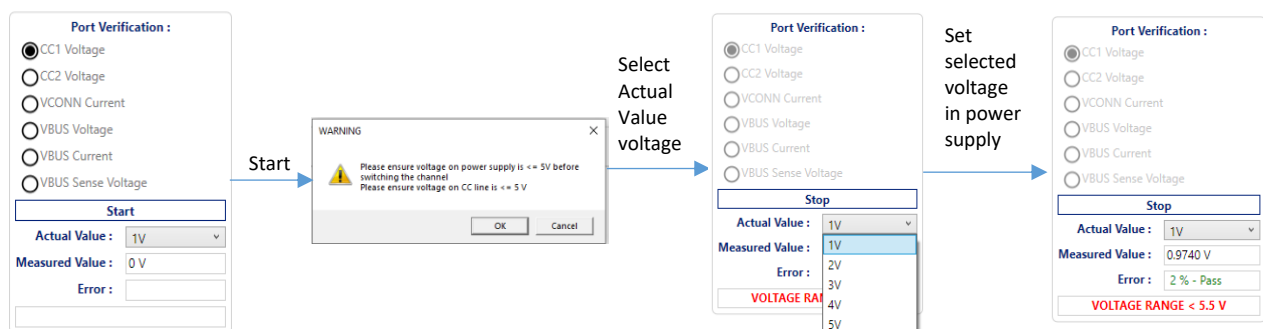
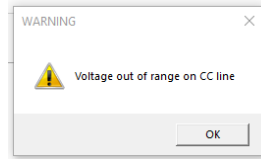


FIGURE 4.5: CC1 VOLTAGE CHANNEL VERIFICATION

Note: If the voltage on this measurement channel exceeds 5.5 V, the GRL calibration fixture will terminate the connection between the power supply terminals and the USB Type-C receptacle. The D3 LED (red color) will start blinking on the GRL calibration fixture to indicate over voltage. This will also trigger the following warning message to appear:



4.1.5 Procedure for CC2 Voltage Measurement

1. Set up the hardware connection as shown in Figure 4.4.
2. See Figure 4.6 for the following procedure:
 - i. Select the **CC2 Voltage** channel.

Caution: Make sure that the voltage on the power supply is less than 5 V before proceeding to the next step.

- ii. Click on the **Start** button to start the verification process. A pop-up message will appear to prompt the user to set the voltage on the power supply to ≤ 5 V in order to avoid any permanent damage to the GRL calibration fixture and tester card.
- iii. Set the voltage on the power supply to 0 V and click **OK**.
- iv. Select the voltage level to be verified from the **Actual Value** drop-down menu. Set the same voltage value on the power supply as well.
- v. The **Measured Value** field will display the GRL-V-UP measurement value. The **Error** field will display the error percentage with Pass/Fail status (refer to the acceptance limits as specified above).
- vi. Repeat the above steps for the rest of the voltage levels (1V, 2V, 3V, 4V, 5V) and ensure that all values are within the acceptance limits. When completed, click on the **Stop** button.

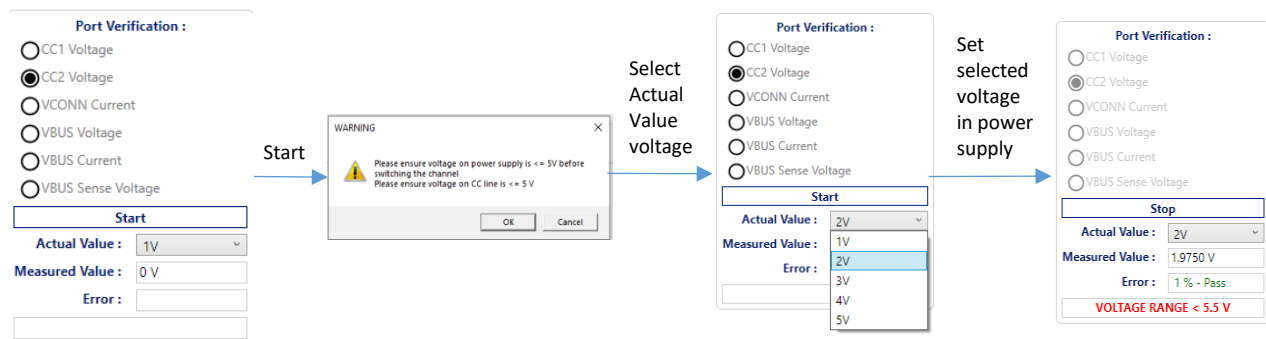
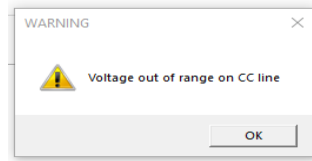


FIGURE 4.6: CC2 VOLTAGE CHANNEL VERIFICATION

Note: If the voltage on this measurement channel exceeds 5.5 V, the GRL calibration fixture will terminate the connection between the power supply terminals and the USB Type-C receptacle. The D3 LED (red color) will start blinking on the GRL calibration fixture to indicate over voltage. This will also trigger the following warning message to appear:



4.1.6 Procedure for VBUS Voltage Measurement

1. Set up the hardware connection as shown in Figure 4.4.
2. See Figure 4.7 for the following procedure:

- i. Select the **VBUS Voltage** channel.

Caution: Make sure that the voltage on the power supply is less than 5 V before proceeding to the next step.

- ii. Click on the **Start** button to start the verification process. A pop-up message will appear to prompt the user to set the voltage on the power supply to ≤ 5 V in order to avoid any permanent damage to the GRL calibration fixture and tester card.
- iii. Set the voltage on the power supply to 0 V and click **OK**.
- iv. Select the voltage level to be verified from the **Actual Value** drop-down menu. Set the same voltage value on the power supply as well.
- v. The **Measured Value** field will display the GRL-V-UP measurement value. The **Error** field will display the error percentage with Pass/Fail status (refer to the acceptance limits as specified above).
- vi. Repeat the above steps for the rest of the voltage levels (5V, 9V, 12V, 15V, 20V) and ensure that all values are within the acceptance limits. When completed, set the power supply voltage to ≤ 5 V and click on the **Stop** button.

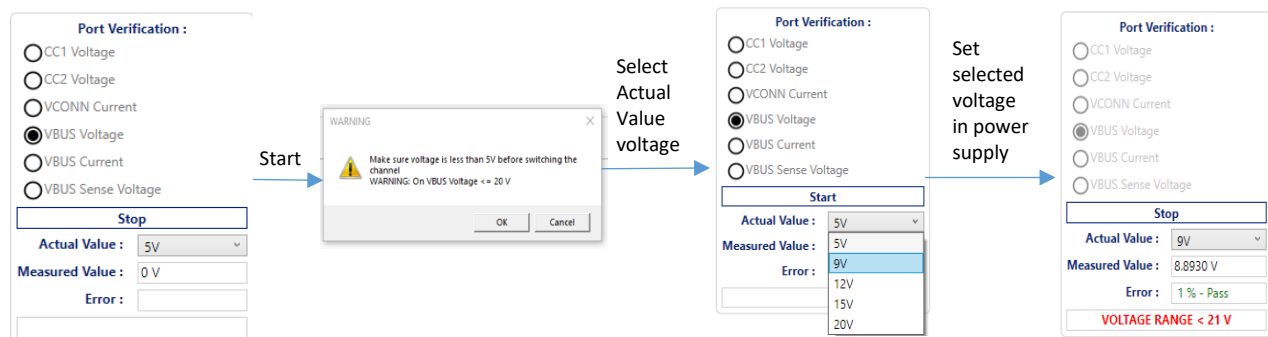
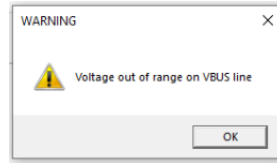


FIGURE 4.7: VBUS VOLTAGE CHANNEL VERIFICATION

Note: If the voltage on this measurement channel exceeds 21 V, the GRL calibration fixture will terminate the connection between the power supply terminals and the USB Type-C receptacle. The D3 LED (red color) will start blinking on the GRL calibration fixture to indicate over voltage. This will also trigger the following warning message to appear:



4.1.7 Procedure for VBUS Sense Voltage Measurement

1. Set up the hardware connection as shown in Figure 4.4.
2. See Figure 4.8 for the following procedure:

- i. Select the **VBUS Sense Voltage** channel.

Caution: Make sure that the voltage on the power supply is less than 5 V before proceeding to the next step.

- ii. Click on the **Start** button to start the verification process. A pop-up message will appear to prompt the user to set the voltage on the power supply to ≤ 5 V in order to avoid any permanent damage to the GRL calibration fixture and tester card.
- iii. Set the voltage on the power supply to 0 V and click **OK**.
- iv. Select the voltage level to be verified from the **Actual Value** drop-down menu. Set the same voltage value on the power supply as well.
- v. The **Measured Value** field will display the GRL-V-UP measurement value. The **Error** field will display the error percentage with Pass/Fail status (refer to the acceptance limits as specified above).
- vi. Repeat the above steps for the rest of the voltage levels (5V, 9V, 12V, 15V, 20V) and ensure that all values are within the acceptance limits. When completed, set the power supply voltage to ≤ 5 V and click on the **Stop** button.

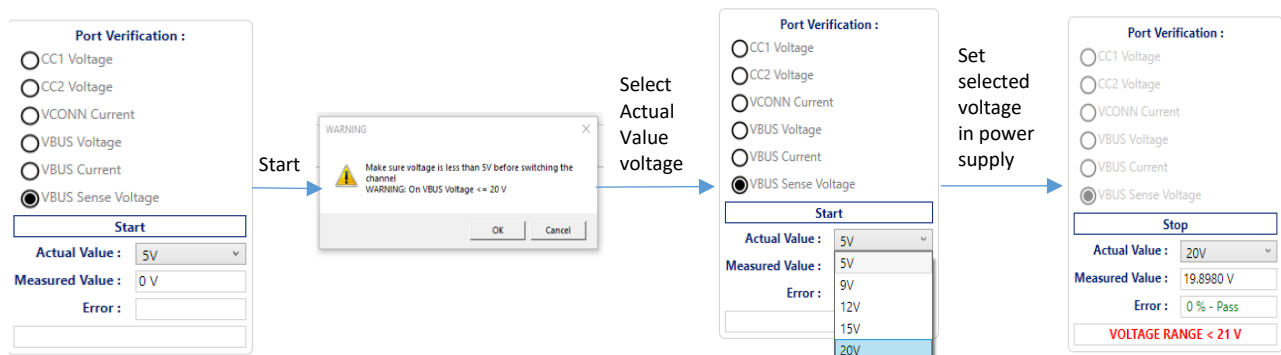
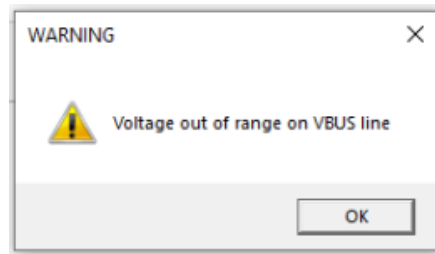


FIGURE 4.8: VBUS SENSE VOLTAGE CHANNEL VERIFICATION

Note: If the voltage on this measurement channel exceeds 21 V, the GRL calibration fixture will terminate the connection between the power supply terminals and the USB Type-C receptacle. The D3 LED (red color) will start blinking on the GRL calibration fixture to indicate over voltage. This will also trigger the following warning message to appear:



4.1.8 Connection Setup for Current Measurements

This section describes the connection diagram to set up the equipment and fixture for manual port verification for current measurements. Set up the hardware connection as shown in Figure 4.9 below.

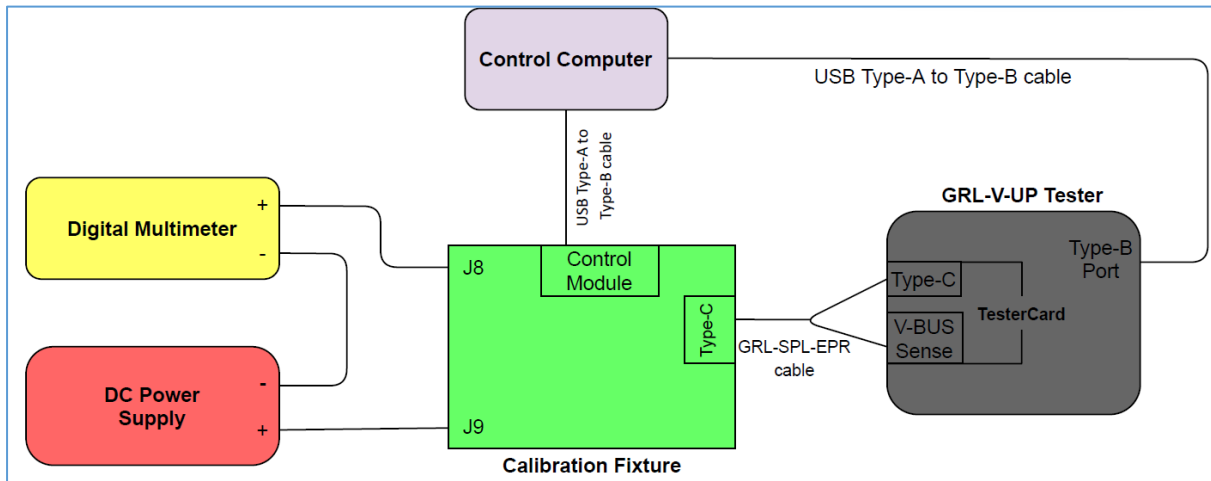


FIGURE 4.9: CONNECTION SETUP FOR GRL-V-UP MANUAL PORT VERIFICATION FOR CURRENT MEASUREMENTS

Note: The connection setup may change according to the measurement channel selected.

1. Connect the DC power supply (- terminal) to the digital multimeter (DMM) (- terminal) and power supply (+ terminal) to the J9 terminal of the GRL calibration fixture.
2. Connect the DMM (+ terminal) to the J8 terminal of the GRL calibration fixture.
3. Connect the Control Module of the GRL calibration fixture to the control computer using a USB Type-A to Type-B cable.
4. If using the **GRL-SPL-EPR cable**, connect the USB Type-C receptacle of the GRL calibration fixture to both the USB Type-C Port and VBUS Sense connector of the GRL-V-UP tester hardware.
 - Connect the GRL-SPL-EPR cable end with the GRL logo to the calibration fixture. *Note: Make sure to place the GRL logo in the upward position to maintain the same cable orientation between the calibration fixture and tester.*
 - Connect the GRL-SPL-EPR cable thumb screw end to the GRL-V-UP tester card port.
 - Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-UP tester.
5. If using the **GRL-SPL Type-C cable**, connect the USB Type-C receptacle of the GRL calibration fixture to the USB Type-C receptacle of the GRL-V-UP tester. *Note: Make sure to place the GRL logo on the GRL-SPL Type-C cable in the upward position to maintain the same cable orientation between the calibration fixture and tester.*

- Connect the VBUS Sense connector of the GRL calibration fixture to the VBUS Sense connector of the GRL-V-UP tester using a VBUS Sense cable.
6. Connect the GRL-V-UP tester hardware to the control computer using a USB Type-A to Type-B cable.

4.1.9 Procedure for VBUS Current Measurement

1. Set up the hardware connection as shown in Figure 4.9.
2. See Figure 4.10 for the following procedure:

- i. Select the **VBUS Current** channel.

Caution: Make sure that the voltage on the power supply is less than 5 V before proceeding to the next step.

- ii. Click on the **Start** button to start the verification process. A pop-up message will appear to prompt the user to set the voltage on the power supply to ≤ 5 V in order to avoid any permanent damage to the GRL calibration fixture and tester card.
- iii. Set the voltage on the power supply to 5 V and click **OK**.
- iv. Select the current level to be verified from the **Actual Value** drop-down menu. The GRL-V-UP tester will draw the requested current automatically from the power supply.
- v. The **Measured Value** field will display the GRL-V-UP measurement value. The **Error** field will display the error percentage with Pass/Fail status (refer to the acceptance limits as specified above).
- vi. Repeat the above steps for the rest of the current levels (1A, 2A, 3A, 4A, 5A) and ensure that all values are within the acceptance limits. When completed, click on the **Stop** button.

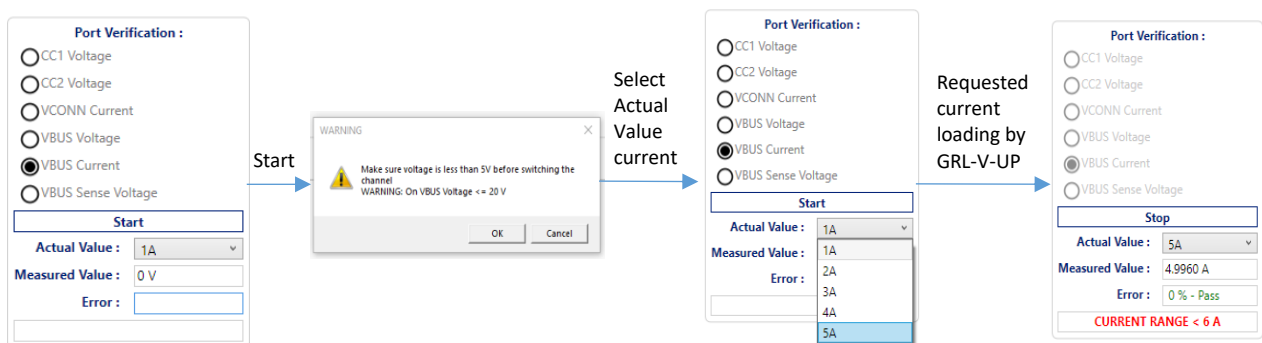


FIGURE 4.10: VBUS CURRENT CHANNEL VERIFICATION

4.1.10 Procedure for VCONN Current Measurement

1. Set up the hardware connection as shown in Figure 4.9.

2. See Figure 4.11 for the following procedure:

- i. Select the **VCONN Current** channel.

Caution: Make sure that the voltage on the power supply is less than 5 V before proceeding to the next step.

- ii. Click on the **Start** button to start the verification process. A pop-up message will appear to prompt the user to set the voltage on the power supply to ≤ 5 V in order to avoid any permanent damage to the GRL calibration fixture and tester card.
- iii. Set the voltage on the power supply to 5 V and click **OK**.
- iv. Select the current level to be verified from the **Actual Value** drop-down menu. The GRL-V-UP tester will draw the requested current automatically from the power supply.
- v. The **Measured Value** field will display the GRL-V-UP measurement value. The **Error** field will display the error percentage with Pass/Fail status (refer to the acceptance limits as specified above).
- vi. Repeat the above steps for the rest of the current levels (0A, 250mA, 500mA, 750mA, 1A) and ensure that all values are within the acceptance limits. When completed, click on the **Stop** button.

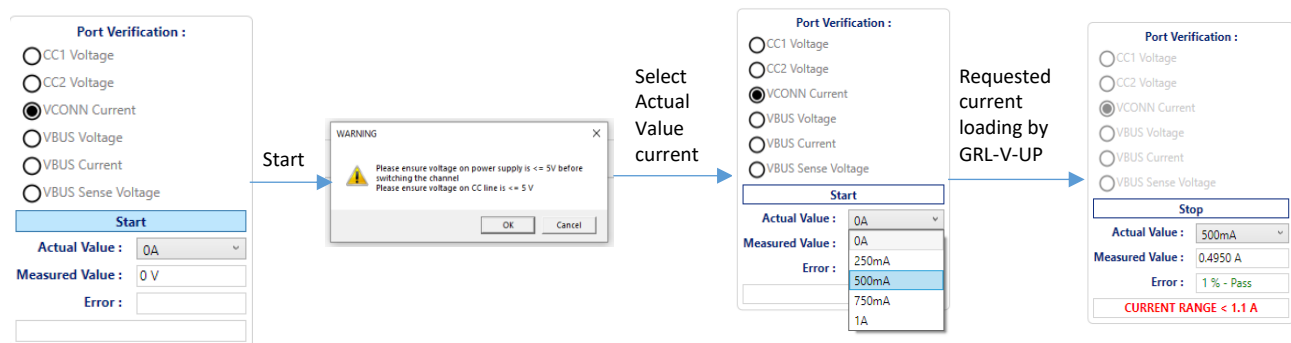


FIGURE 4.11: VCONN CURRENT CHANNEL VERIFICATION

4.2 Automated Port Verification

4.2.1 Equipment Requirements

Equipment	Qty.
GRL-V-UP tester hardware	1
DC power supply	1
Digital multimeter	1
GRL calibration kit	1
GRL Special EPR (GRL-SPL-EPR) Cable / GRL Special (GRL-SPL) Type-C VCONN passthrough test cable (GRL-USB-PD-STC)	1
VBUS Sense cable <small>[See (a) Note: below]</small>	1
Banana connectors	4
USB Type-A to Type-B cable	4
Control computer (laptop or desktop) with the GRL-V-UP API Test software installed	1

(a) Note:

The VBUS Sense cable is required if using the GRL Special (GRL-SPL) Type-C VCONN passthrough test cable (GRL-USB-PD-STC).

(b) Note:

As the DMM, power supply and calibration fixture are connected to the GRL-V-UP tester hardware over USB, the user needs to note the VISA addresses and identification (ID) of the DMM and power supply via their respective I/O software, e.g., the Keysight IO Libraries Suite software.

4.2.2 Connection Setup

This section describes the connection diagram to set up the equipment and fixture for automated port verification. Set up the hardware connection as shown in Figure 4.12 below.

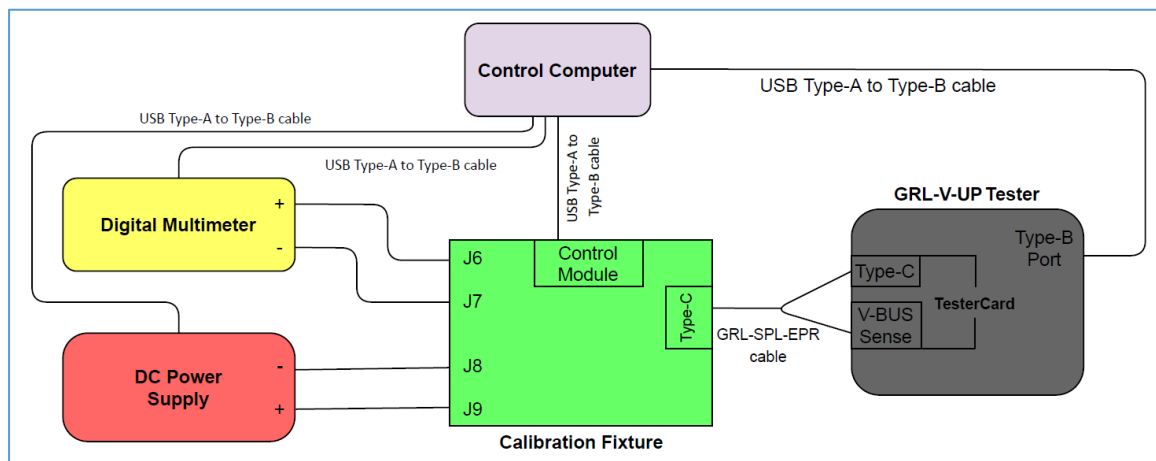
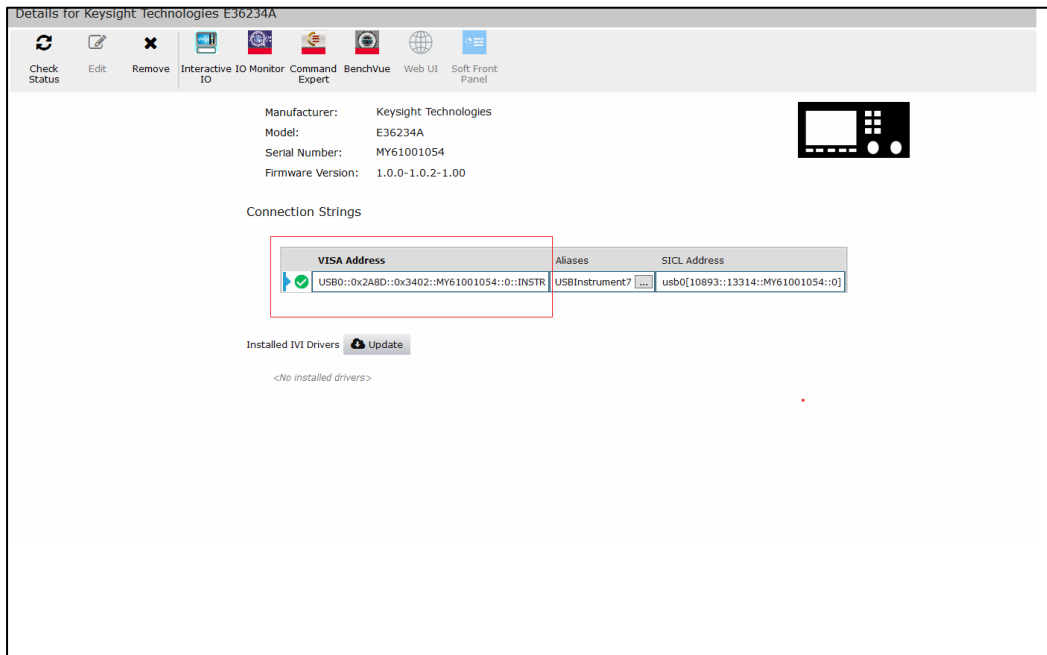


FIGURE 4.12: CONNECTION SETUP FOR GRL-V-UP AUTOMATED PORT VERIFICATION

Note: The connection setup may change according to the measurement channel selected.

1. Connect the DC power supply to the J8 and J9 terminals of the GRL calibration fixture.
2. Connect the digital multimeter (DMM) to the J6 and J7 terminals of the GRL calibration fixture.
3. Connect the Control Module of the GRL calibration fixture to the control computer using a USB Type-A to Type-B cable.
4. If using the **GRL-SPL-EPR cable**, connect the USB Type-C receptacle of the GRL calibration fixture to both the USB Type-C Port and VBUS Sense connector of the GRL-V-UP tester hardware.
 - Connect the GRL-SPL-EPR cable end with the GRL logo to the calibration fixture. *Note: Make sure to place the GRL logo in the upward position to maintain the same cable orientation between the calibration fixture and tester.*
 - Connect the GRL-SPL-EPR cable thumb screw end to the GRL-V-UP tester card port.
 - Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-UP tester.
5. If using the **GRL-SPL Type-C cable**, connect the USB Type-C receptacle of the GRL calibration fixture to the USB Type-C receptacle of the GRL-V-UP tester. *Note: Make sure to place the GRL logo on the GRL-SPL Type-C cable in the upward position to maintain the same cable orientation between the calibration fixture and tester.*
 - Connect the VBUS Sense connector of the GRL calibration fixture to the VBUS Sense connector of the GRL-V-UP tester using a VBUS Sense cable.
6. Connect the GRL-V-UP tester hardware to the control computer using a USB Type-A to Type-B cable.
7. Connect the DMM and power supply to the control computer using USB Type-A to Type-B cables.
8. If using the Keysight IO Libraries Suite software as the I/O software for the connected equipment (DMM and power supply), download the latest version of the Keysight IO Libraries Suite software from the Keysight website and install on the control PC.
9. Open the Keysight IO Libraries Suite application and check for the detected DMM and power supply units as shown in the following example:



- Copy the VISA addresses for the DMM and power supply to be pasted in the Port Verification pane of the GRL-V-UP API Test software.

4.2.3 Procedure for VBUS Voltage Measurement

- In the Automation panel, enter the VISA addresses along with SI and calibration numbers for the power supply and DMM units connected to the GRL-V-UP tester hardware. *Note: The VISA address can be found in the respective I/O software of each equipment as shown in the Keysight IO Libraries Suite example in 4.2.2, Connection Setup.*

Port Verification Automation :

Power Supply :

SI No : **Cal No :**

Digital multimeter :

SI No : **Cal No :**

SI no	Channel	Voltage in V	Current in A	Delay in mS	Sample	Tolerance	Unit

Status :

Error :

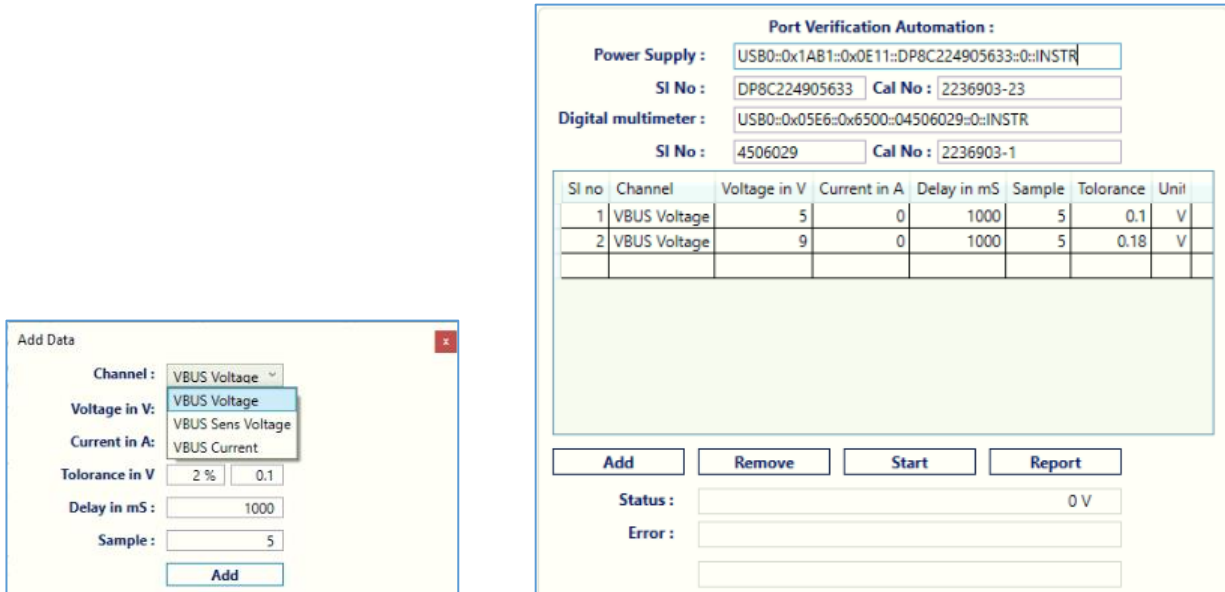
FIGURE 4.13: SET EQUIPMENT VISA ADDRESS AND ID FOR GRL-V-UP AUTOMATED PORT VERIFICATION

2. Click on the **Add** button and configure the following parameters:

- **Channel** — This field allows the user to select the test case/measurement to be tested.
- **Voltage in V** — When testing VBUS voltage or VBUS sense voltage, this field allows the user to add the voltage levels for the respective test.
- **Current in A** — When testing VBUS current, this field allows the user to configure the required current value.
- **Tolerance in V** — The configuration in this field will change according to the measurement type (VBUS voltage, VBUS sense voltage or VBUS current) selected in the 'Channel' field. This field allows the user to set the tolerance level for the pass/fail criteria. The user can increase or decrease the tolerance level as required and the output in percentage will be set in tandem.
- **Delay in mS** — This field allows the user to set the delay value between two samples.
- **Sample** — This field allows the user to set the number of samples to be run in each test step.

Once configured, click on the **Add** button to add the configuration to the list.

Note: The user can add a single or multiple measurement channels to be run simultaneously during testing.

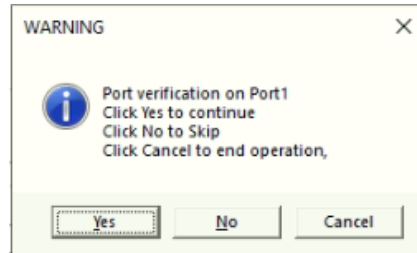


The image shows two screenshots of the 'Port Verification Automation' software. The left screenshot is a 'Add Data' dialog box with the following fields: Channel (dropdown menu showing 'VBUS Voltage'), Voltage in V (dropdown menu showing 'VBUS Voltage'), Current in A (dropdown menu showing 'VBUS Current'), Tolerance in V (input field with '2 %' and '0.1'), Delay in mS (input field with '1000'), and Sample (input field with '5'). There is an 'Add' button at the bottom. The right screenshot is the main configuration window. It has sections for 'Power Supply' (USB0::0x1AB1::0x0E11::DP8C224905633::0::INSTR, SI No: DP8C224905633, Cal No: 2236903-23) and 'Digital multimeter' (USB0::0x05E6::0x6500::04506029::0::INSTR, SI No: 4506029, Cal No: 2236903-1). Below these is a table with columns: SI no, Channel, Voltage in V, Current in A, Delay in mS, Sample, Tolerance, and Unit. The table contains two rows: Row 1: 1, VBUS Voltage, 5, 0, 1000, 5, 0.1, V; Row 2: 2, VBUS Voltage, 9, 0, 1000, 5, 0.18, V. At the bottom of the table are buttons for 'Add', 'Remove', 'Start', and 'Report'. Below the buttons are fields for 'Status' (showing '0 V') and 'Error'.

FIGURE 4.14: ADD MEASUREMENT CONFIGURATION

3. The user can delete an unwanted measurement configuration by selecting its respective row and click on the **Remove** button.
4. Click on the **Start** button to execute the automated port verification test.

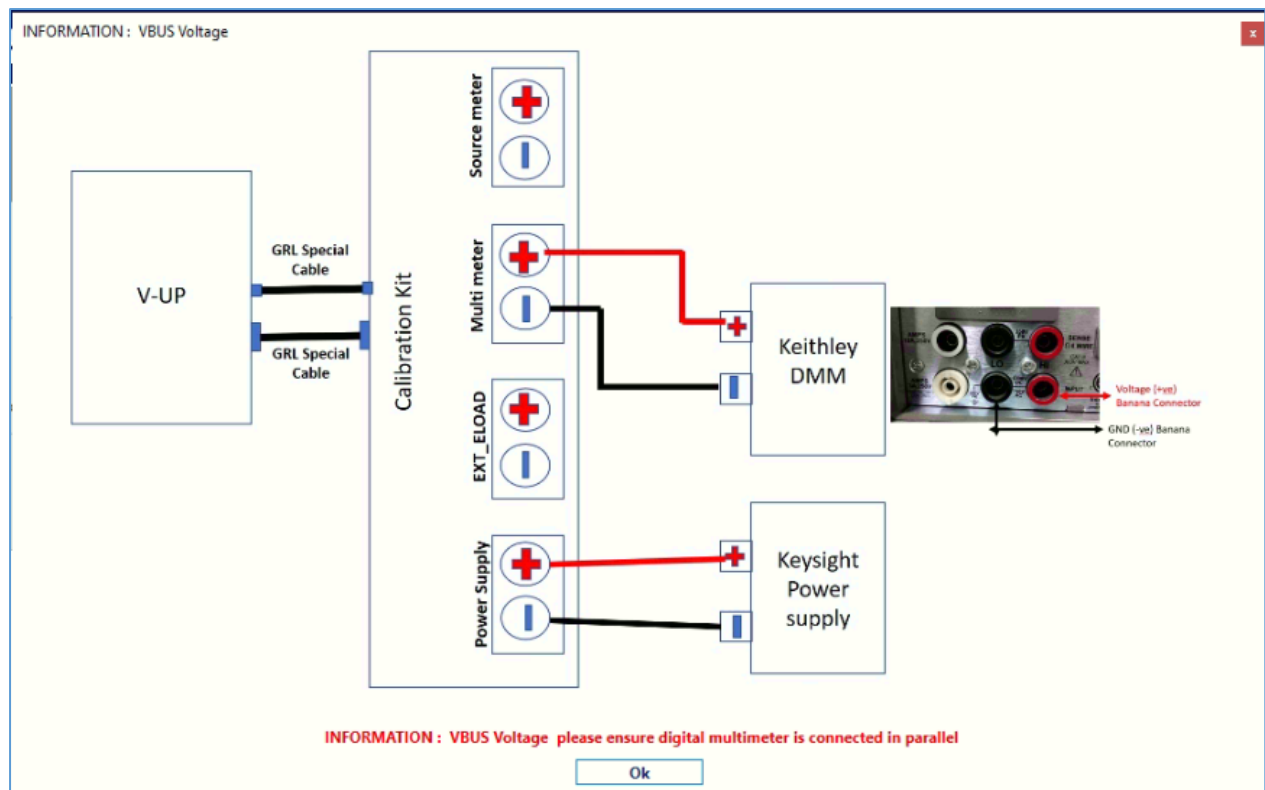
5. When the following screen appears, click **Yes** to proceed with the verification test for the selected tester port.



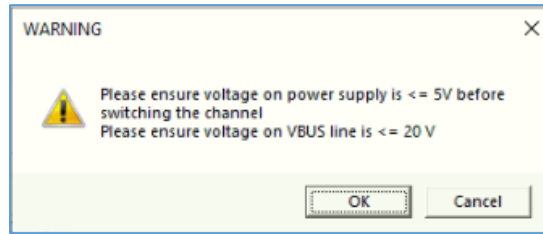
6. The activity log pane will also display the detected power supply and DMM log.



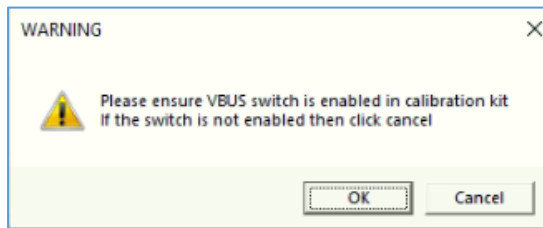
7. The connection diagram for the selected measurement channel will then appear as shown in the example below. Confirm that all devices are properly connected following the diagram and click **Ok** to proceed.



8. The following screen will appear as shown in the example below which requires the user to check the power supply voltage and VBUS line settings. Click **OK** to proceed.



9. Next, the user will need to check that the calibration kit's VBUS switch is turned ON as shown in the example screen below. Click **OK** to proceed.



10. While the port verification test is running, the GRL-V-UP measurement will be indicated in the 'Status' field. In case an error occurs during the test run, it will be indicated in the 'Error' field.

Port Verification Automation :

Power Supply : USB0:0x1A81:0x0E11:DP8C224905633:0:INSTR

SI No : DP8C224905633 Cal No : 2236903-23

Digital multimeter : USB0:0x05E6:0x6500:04506029:0:INSTR

SI No : 4506029 Cal No : 2236903-1

SI no	Channel	Voltage in V	Current in A	Delay in ms	Sample	Tolerance	Unit
1	VBUS Voltage	5	0	1000	5	0.1	V
2	VBUS Voltage	9	0	1000	5	0.18	V

Add Remove Stop Report

Status : 4.9990 V

Error : 0.1 % - Pass

VOLTAGE RANGE < 6 V

Configure Sink Capabilities :

PDO (V) : ☐ PPS 9

Max Current (A) : 1.43

Load POO

Clear All

13:40:33.6401 : Power supply connected

13:40:34.2316 : Keysight Technologies,E36234A,MY61001054,1.0.0-1.0.2-1.00

13:40:34.4500 : Digital multimeter connected

13:40:34.6256 : KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b

13:41:11.1898 : Revision :3.0

13:41:11.1918 : Verification on VBUS_Voltage

13:41:13.2070 : All path disabled

13:42:09.6579 : Path enabled

13:42:10.2581 : Verifying voltage : 5 V

13:42:12.2838 : Reading...

13:42:15.2869 : Reading...

13:42:18.3075 : Reading...

13:42:21.2847 : Reading...

13:42:24.2652 : Reading...

13:42:27.8975 : Sequence execution done


13:42:27.9284 : Path enabled

13:42:28.5328 : Verifying voltage : 9 V

13:42:30.5607 : Reading...

Save Clear

11. The test report will be automatically generated and displayed once the test is completed, as shown in the example below.



Equipment details

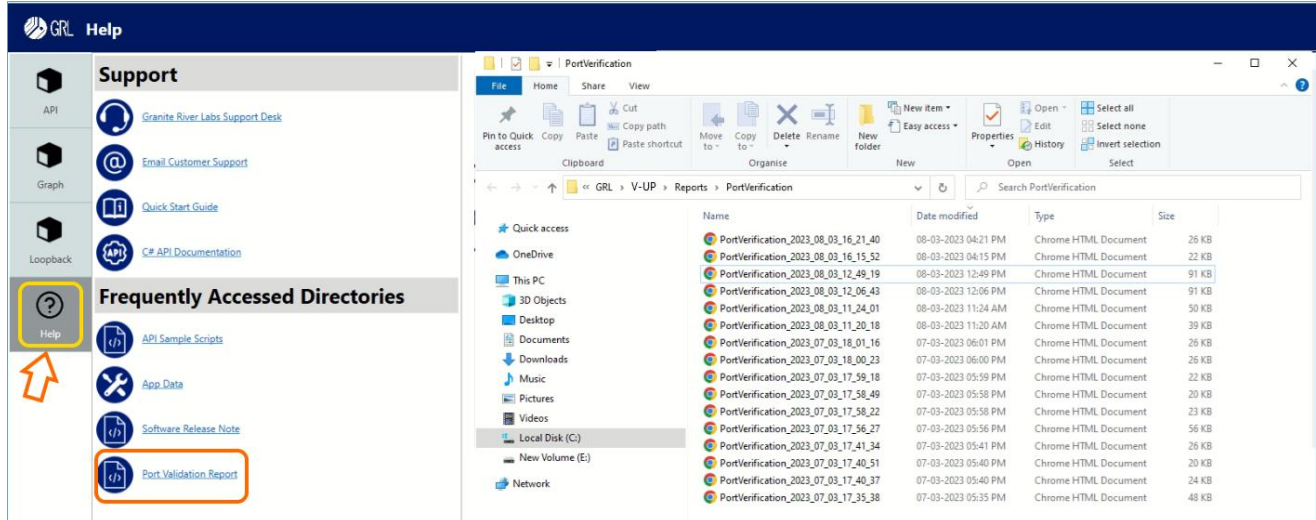
GRL-PWR-2020059 - Validation Report - 26-05-2023 13:42:48

Sl.No	Equipment	ID	Serial number	CERT NO
1	Power supply	Keysight Technologies,E36234A,MY61001054,1.0.0-1.0.2-1.00	MY59001458	2236903-5
2	Digital multimeter	KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b	4506029	2236903-1

VBUS Voltage Verification for Port1

Sl.No	Set VBUS Voltage in V	V-UP Voltage Measurement in V	V-UP Current Measurement in A	Power supply Voltage in V	Power supply Current in A	DMM Measurement in V	Deviation percentage / Result
1	5	4.999	0.005	5.01	0.001	5.004	0.1 % - Pass
2	5	4.998	0.005	5.01	0.001	5.004	0.12 % - Pass
3	5	4.998	0.004	5.01	0.001	5.004	0.12 % - Pass
4	5	4.996	0.004	5.01	0.001	5.004	0.16 % - Pass
5	5	4.999	0.004	5.01	0.001	5.004	0.1 % - Pass
6	9	8.975	0.005	9	0.117	8.997	0.24 % - Pass
7	9	8.979	0.006	9	0.114	8.997	0.2 % - Pass
8	9	8.969	0.003	9	0.113	8.997	0.31 % - Pass
9	9	8.976	0.004	9	0.113	8.997	0.23 % - Pass
10	9	8.975	0.005	9	0.113	8.997	0.24 % - Pass

12. The user can locate test reports from all port verification test runs by selecting the **Help** tab followed by **Port Validation Report** under 'Frequently Accessed Directories'. This will display the directory of all saved reports.



13. To perform verification for other GRL-V-UP tester card ports, select the required ports and repeat the above procedure.

4.2.4 Procedure for VBUS Sense Voltage Measurement

1. In the Automation panel, enter the VISA addresses along with SI and calibration numbers for the power supply and DMM units connected to the GRL-V-UP tester hardware. *Note: The VISA address can be found in the respective I/O software of each equipment as shown in the Keysight IO Libraries Suite example in 4.2.2, Connection Setup.*

Port Verification Automation :

Power Supply :

SI No : **Cal No :**

Digital multimeter :

SI No : **Cal No :**

Sl no	Channel	Voltage in V	Current in A	Delay in mS	Sample	Tolerance	Unit

Status :

Error :

FIGURE 4.15: SET EQUIPMENT VISA ADDRESS AND ID FOR GRL-V-UP AUTOMATED PORT VERIFICATION

- Click on the **Add** button and configure the following parameters:
 - Channel** — This field allows the user to select the test case/measurement to be tested.
 - Voltage in V** — When testing VBUS voltage or VBUS sense voltage, this field allows the user to add the voltage levels for the respective test.
 - Current in A** — When testing VBUS current, this field allows the user to configure the required current value.
 - Tolerance in V** — The configuration in this field will change according to the measurement type (VBUS voltage, VBUS sense voltage or VBUS current) selected in the 'Channel' field. This field allows the user to set the tolerance level for the pass/fail criteria. The user can increase or decrease the tolerance level as required and the output in percentage will be set in tandem.
 - Delay in ms** — This field allows the user to set the delay value between two samples.
 - Sample** — This field allows the user to set the number of samples to be run in each test step.

Once configured, click on the **Add** button to add the configuration to the list.

Note: The user can add a single or multiple measurement channels to be run simultaneously during testing.

Add Data

Channel : VBUS Sens Vc

Voltage in V: VBUS Voltage

Current in A: VBUS Sens Voltage

Tolerance in V 2 % 0.1

Delay in mS: 1000

Sample: 5

Add

Port Verification Automation :

Power Supply : USB0::0x1AB1::0x0E11::DP8C224905633::0::INSTR

SI No : DP8C224905633 Cal No : 2236903-23

Digital multimeter : USB0::0x05E6::0x6500::04506029::0::INSTR

SI No : 4506029 Cal No : 2236903-1

SI no	Channel	Voltage in V	Current in A	Delay in mS	Sample	Tolerance	Unit
1	VBUS Sens Vo	5	0	1000	5	0.1	V
2	VBUS Sens Vo	9	0	1000	5	0.18	V

Add **Remove** **Start** **Report**

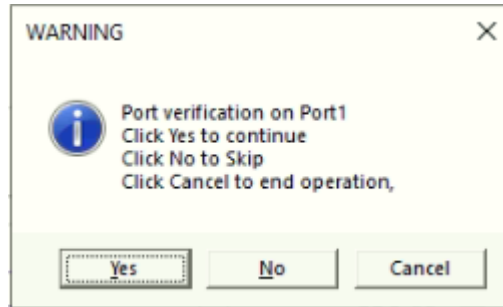
Status : 0 V

Error :

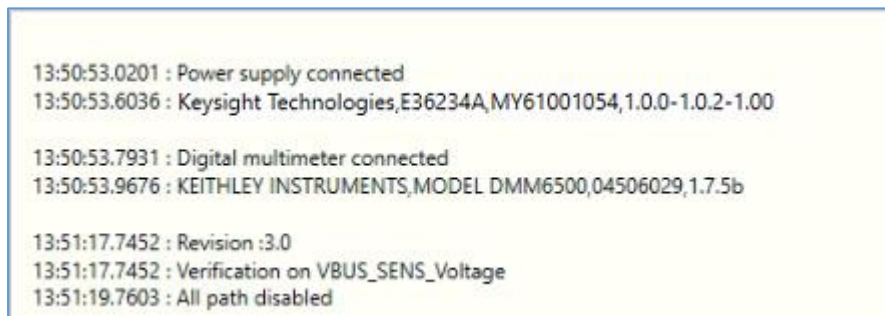
FIGURE 4.16: ADD MEASUREMENT CONFIGURATION

3. The user can delete an unwanted measurement configuration by selecting its respective row and click on the **Remove** button.
4. Click on the **Start** button to execute the automated port verification test.

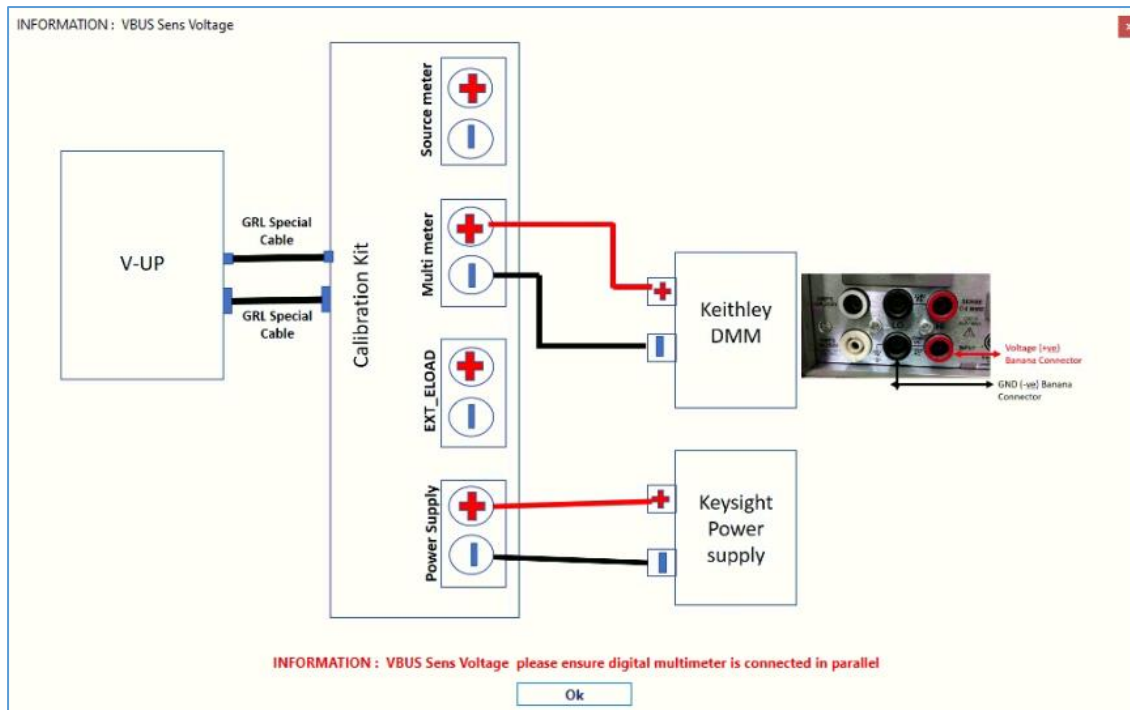
- When the following screen appears, click **Yes** to proceed with the verification test for the selected tester port.



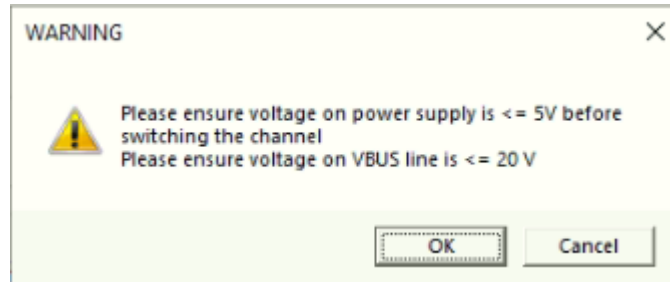
- The activity log pane will also display the detected power supply and DMM log.



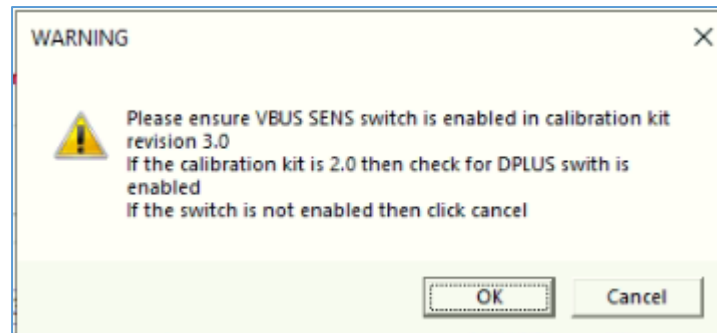
- The connection diagram for the VBUS sense voltage measurement will then appear as shown in the example below. Confirm that all devices are properly connected following the diagram and click **Ok** to proceed.



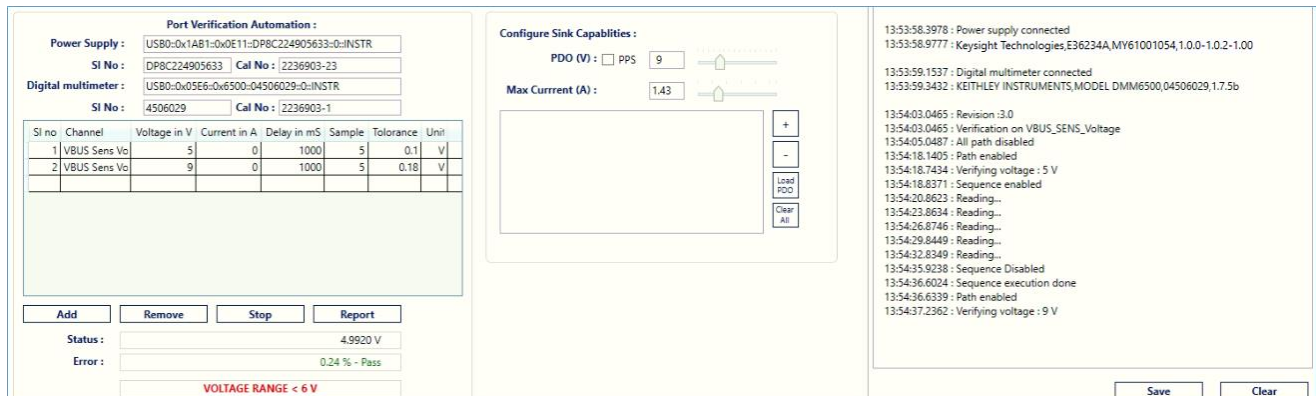
8. The following screen will appear as shown in the example below which requires the user to check the power supply voltage and VBUS line settings. Click **OK** to proceed.




9. Next, the user will need to check that the VBUS SENSE switch of calibration kit revision 3.0 is turned ON as shown in the example screen below. If revision 2.0 of the calibration kit is being used, then check that the DPLUS switch on the kit is turned ON. Once done, click **OK** to proceed.



10. While the port verification test is running, the GRL-V-UP measurement will be indicated in the 'Status' field. In case an error occurs during the test run, it will be indicated in the 'Error' field.



11. The test report will be automatically generated and displayed once the test is completed, as shown in the example below.



Equipment details

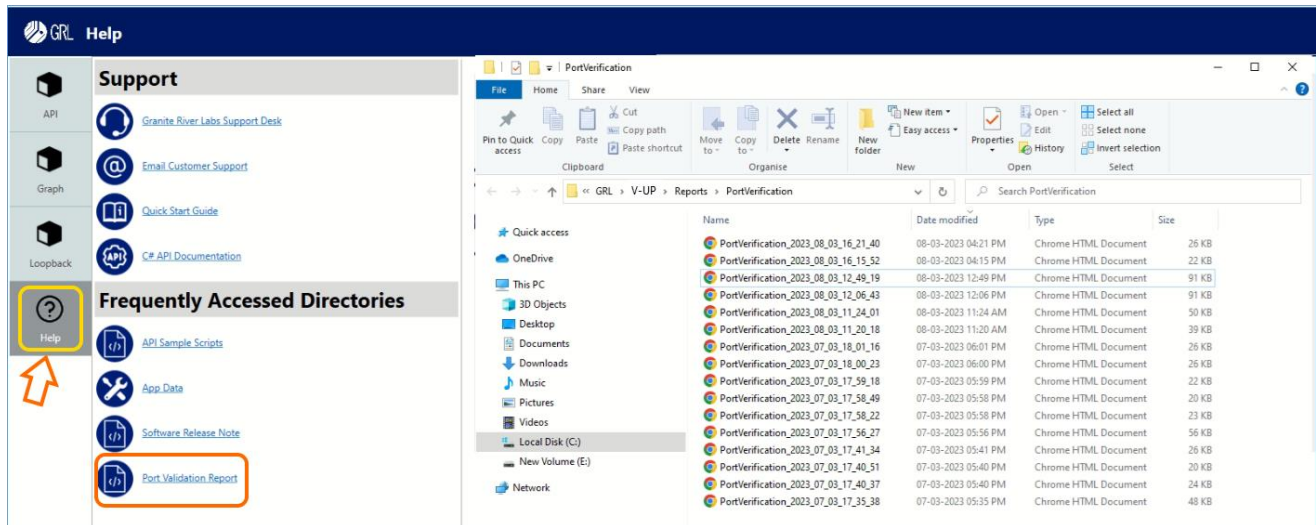
GRL-PWR-2020059 - Validation Report - 26-05-2023 13:54:57

Sl.No	Equipment	ID	Serial number	CERT NO
1	Power supply	Keysight Technologies,E36234A,MY61001054,1.0.0-1.0.2-1.00	MY59001458	2236903-5
2	Digital multimeter	KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b	4506029	2236903-1

VBUS Sens Verification for Port1

Sl.No	Set VBUS Sens Voltage in V	V-UP Voltage Measurement in V	V-UP Current Measurement in A	Power supply Voltage in V	Power supply Current in A	DMM Measurement in V	Deviation percentage / Result
1	5	4.989	0.004	5.01	0.001	5.004	0.3 % - Pass
2	5	4.987	0.004	5.01	0.001	5.004	0.34 % - Pass
3	5	4.986	0.005	5.01	0.001	5.004	0.36 % - Pass
4	5	4.991	0.006	5.01	0.001	5.004	0.26 % - Pass
5	5	4.992	0.006	5.01	0.001	5.004	0.24 % - Pass
6	9	8.973	0.006	9	0.113	8.997	0.27 % - Pass
7	9	8.981	0.006	9	0.113	8.997	0.18 % - Pass
8	9	8.974	0.005	9	0.113	8.997	0.26 % - Pass
9	9	8.975	0.006	9	0.112	8.997	0.24 % - Pass
10	9	8.979	0.005	9	0.112	8.997	0.2 % - Pass

12. The user can locate test reports from all port verification test runs by selecting the **Help** tab followed by **Port Validation Report** under 'Frequently Accessed Directories'. This will display the directory of all saved reports.



13. To perform verification for other GRL-V-UP tester card ports, select the required ports and repeat the above procedure.

4.2.5 Procedure for VBUS Current Measurement

1. In the Automation panel, enter the VISA addresses along with SI and calibration numbers for the power supply and DMM units connected to the GRL-V-UP tester hardware. *Note: The VISA address can be found in the respective I/O software of each equipment as shown in the Keysight IO Libraries Suite example in 4.2.2, Connection Setup.*

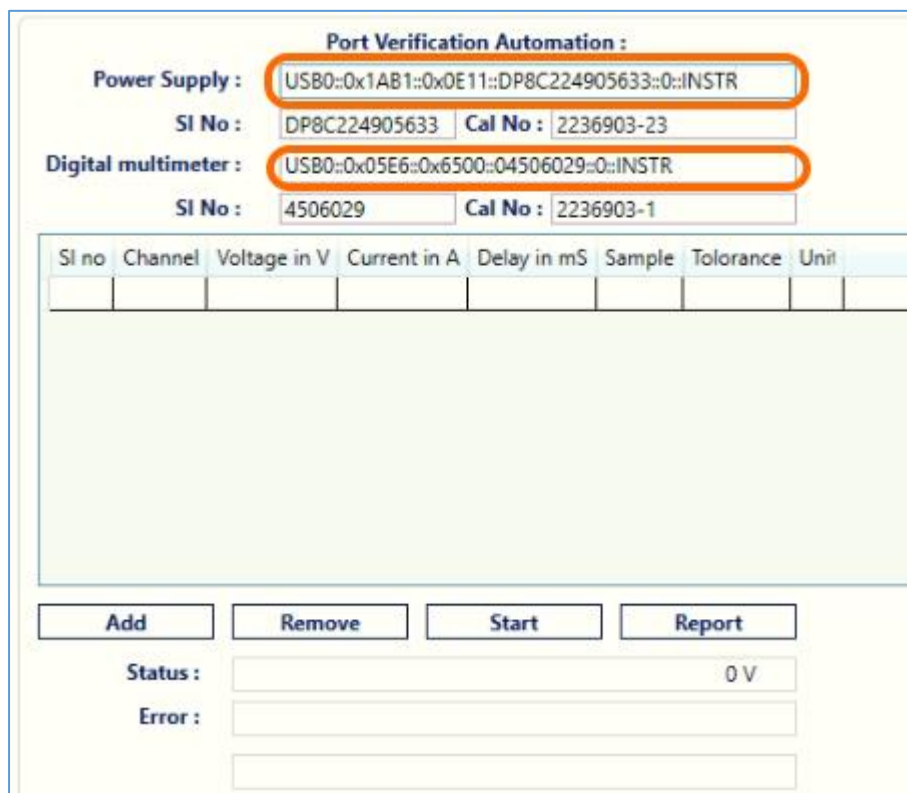


FIGURE 4.17: SET EQUIPMENT VISA ADDRESS AND ID FOR GRL-V-UP AUTOMATED PORT VERIFICATION

2. Click on the **Add** button and configure the following parameters:
 - **Channel** — This field allows the user to select the test case/measurement to be tested.
 - **Voltage in V** — When testing VBUS current, this field allows the user to add the voltage levels for the respective test.
 - **Current in A** — When testing VBUS current, this field allows the user to configure the required current value.
 - **Tolerance in A** — The configuration in this field will change according to the measurement type (VBUS voltage, VBUS sense voltage or VBUS current) selected in the 'Channel' field. This field allows the user to set the tolerance level for the pass/fail criteria. The user can increase or decrease the tolerance level as required and the output in percentage will be set in tandem.
 - **Delay in mS** — This field allows the user to set the delay value between two samples.

- **Sample** — This field allows the user to set the number of samples to be run in each test step.

Once configured, click on the **Add** button to add the configuration to the list.

Note: The user can add a single or multiple measurement channels to be run simultaneously during testing.

Add Data
✖

Channel :

VBUS Current ▾

Voltage in V:

VBUS Voltage

VBUS Sens Voltage

Current in A:

VBUS Current

Tolerance in A

2 %

0.02

Delay in mS :

1000

Sample :

5

Add

Port Verification Automation :

Power Supply :

USB0::0x1AB1::0x0E11::DP8C224905633::0::INSTR

SI No :

DP8C224905633

Cal No :

2236903-23

Digital multimeter :

USB0::0x05E6::0x6500::04506029::0::INSTR

SI No :

4506029

Cal No :

2236903-1

SI no	Channel	Voltage in V	Current in A	Delay in mS	Sample	Tolerance	Unit
1	VBUS Current	5	1	1000	5	0.02	A
2	VBUS Current	9	1	1000	5	0.02	A

Add

Remove

Start

Report

Status :

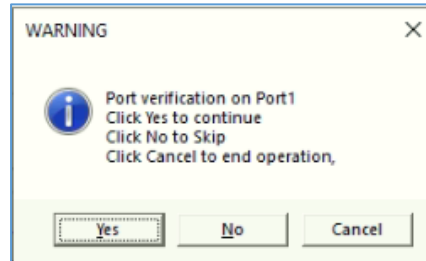
0 V

Error :

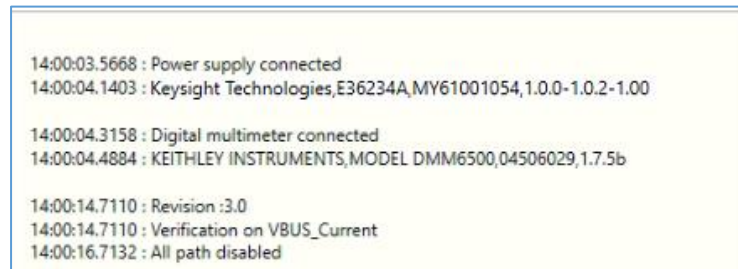
FIGURE 4.18: ADD MEASUREMENT CONFIGURATION

- The user can delete an unwanted measurement configuration by selecting its respective row and click on the **Remove** button.

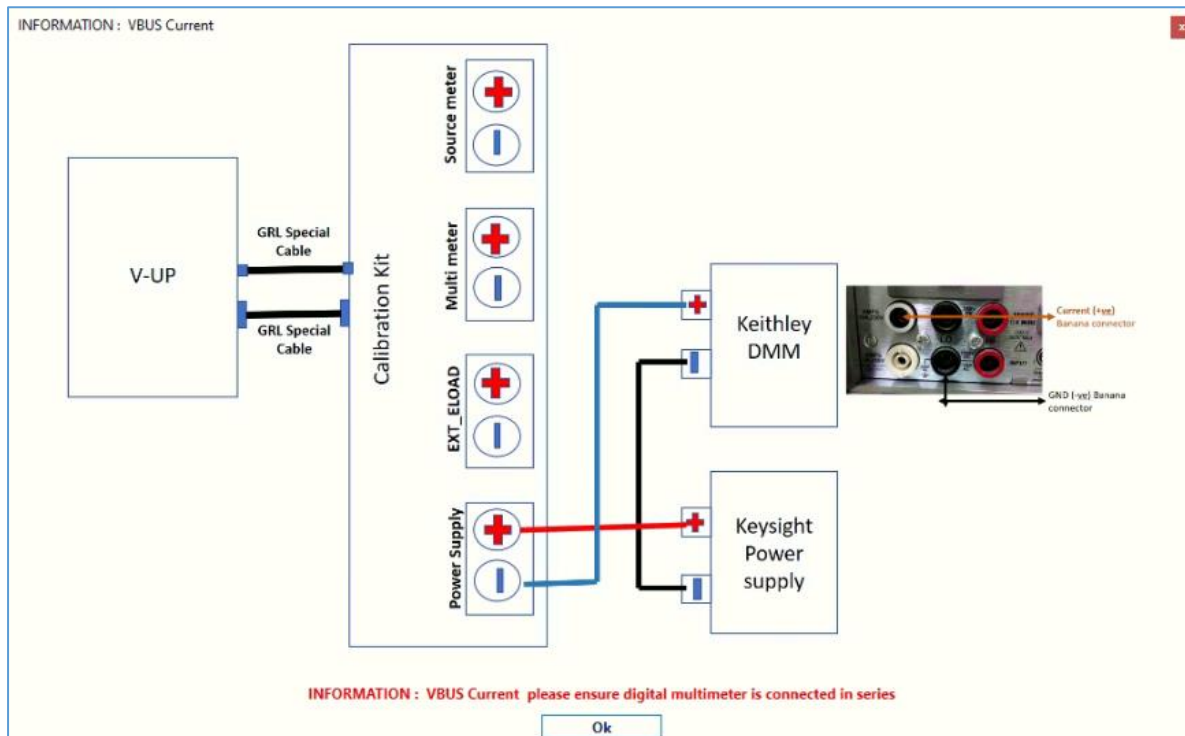
- Click on the **Start** button to execute the automated port verification test.
- When the following screen appears, click **Yes** to proceed with the verification test for the selected tester port.



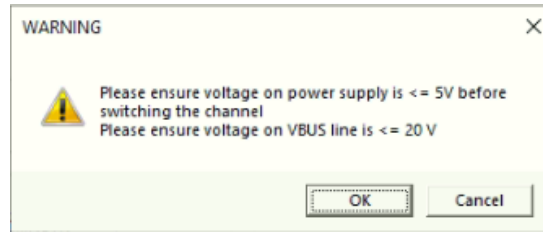
- The activity log pane will also display the detected power supply and DMM log.



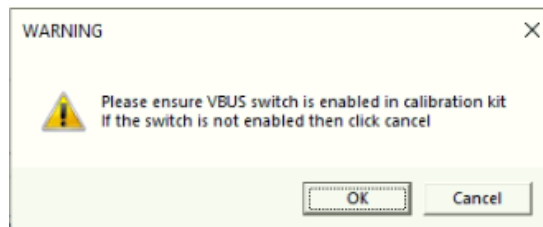
- The connection diagram for the VBUS current measurement will then appear as shown in the example below. Confirm that all devices are properly connected following the diagram and click **Ok** to proceed.



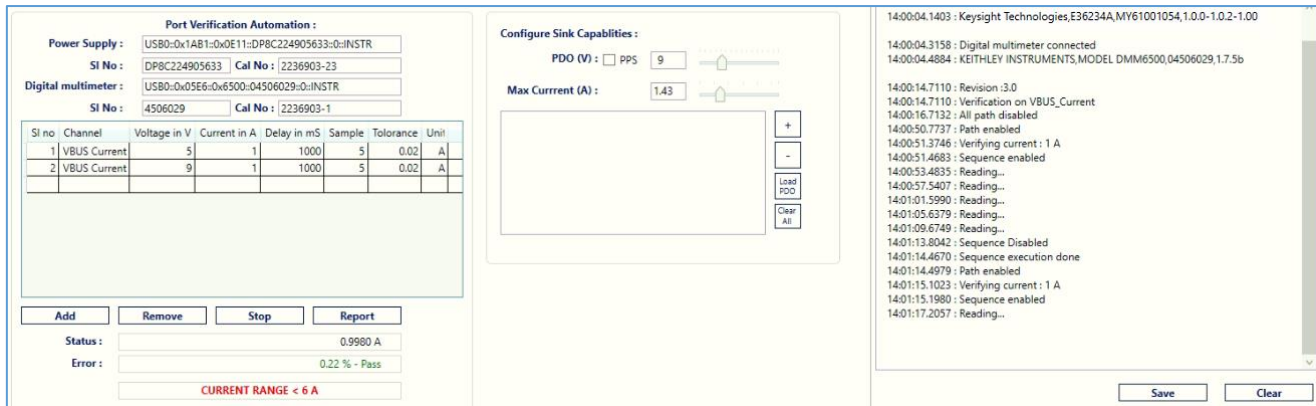
8. The following screen will appear as shown in the example below which requires the user to check the power supply voltage and VBUS line settings. Click **OK** to proceed.




9. Next, the user will need to check that the calibration kit's VBUS switch is turned ON as shown in the example screen below. Click **OK** to proceed.



10. While the port verification test is running, the GRL-V-UP measurement will be indicated in the 'Status' field. In case an error occurs during the test run, it will be indicated in the 'Error' field.



11. The test report will be automatically generated and displayed once the test is completed, as shown in the example below.



Equipment details

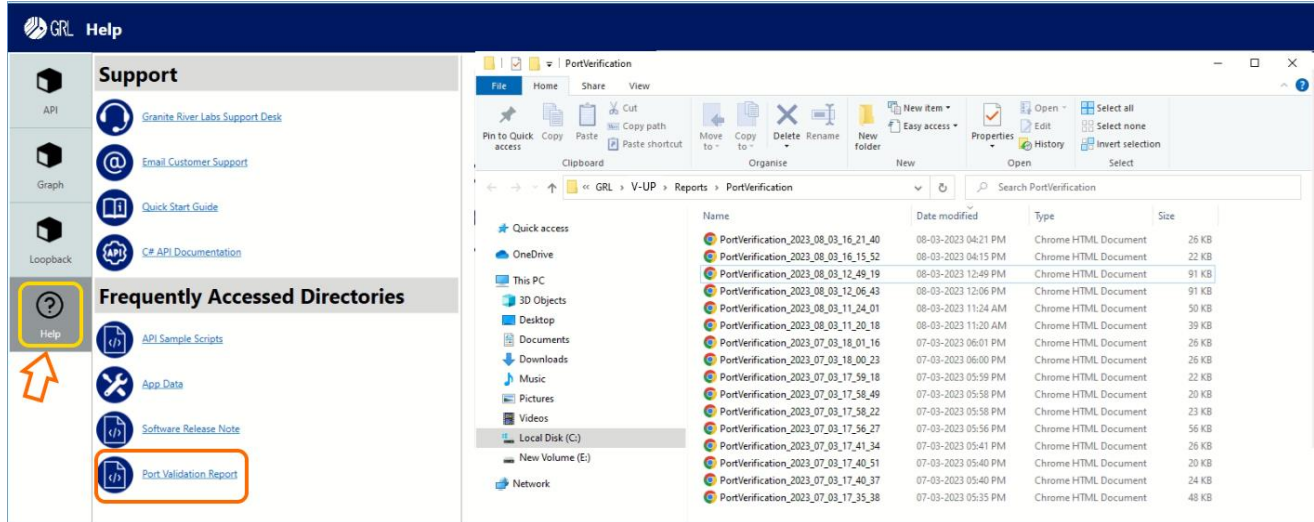
GRL-PWR-2020059 - Validation Report - 26-05-2023 14:01:40

Sl.No	Equipment	ID	Serial number	CERT NO
1	Power supply	Keysight Technologies,E36234A,MY61001054,1.0.0-1.0.2-1.00	MY59001458	2236903-5
2	Digital multimeter	KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b	4506029	2236903-1

VBUS Current Verification for Port1

Sl.No	Set VBUS Current in A	V-UP Voltage Measurement in V	V-UP Current Measurement in A	Power supply Voltage in V	Power supply Current in A	DMM Measurement in A	Deviation percentage / Result
1	1	4.791	0.996	5.01	0.994	0.9956	0.04 % - Pass
2	1	4.791	0.996	5.01	0.994	0.9957	0.03 % - Pass
3	1	4.791	0.998	5.01	0.994	0.9957	0.23 % - Pass
4	1	4.79	0.998	5.01	0.995	0.9958	0.22 % - Pass
5	1	4.79	0.998	5.01	0.994	0.9958	0.22 % - Pass
6	1	8.772	0.998	9	0.996	0.9972	0.08 % - Pass
7	1	8.781	0.999	9	0.996	0.9972	0.18 % - Pass
8	1	8.774	0.998	9	0.996	0.9972	0.08 % - Pass
9	1	8.776	0.997	9	0.996	0.9973	0.03 % - Pass
10	1	8.776	0.997	9	0.996	0.9973	0.03 % - Pass

12. The user can locate test reports from all port verification test runs by selecting the **Help** tab followed by **Port Validation Report** under 'Frequently Accessed Directories'. This will display the directory of all saved reports.



END_OF_DOCUMENT