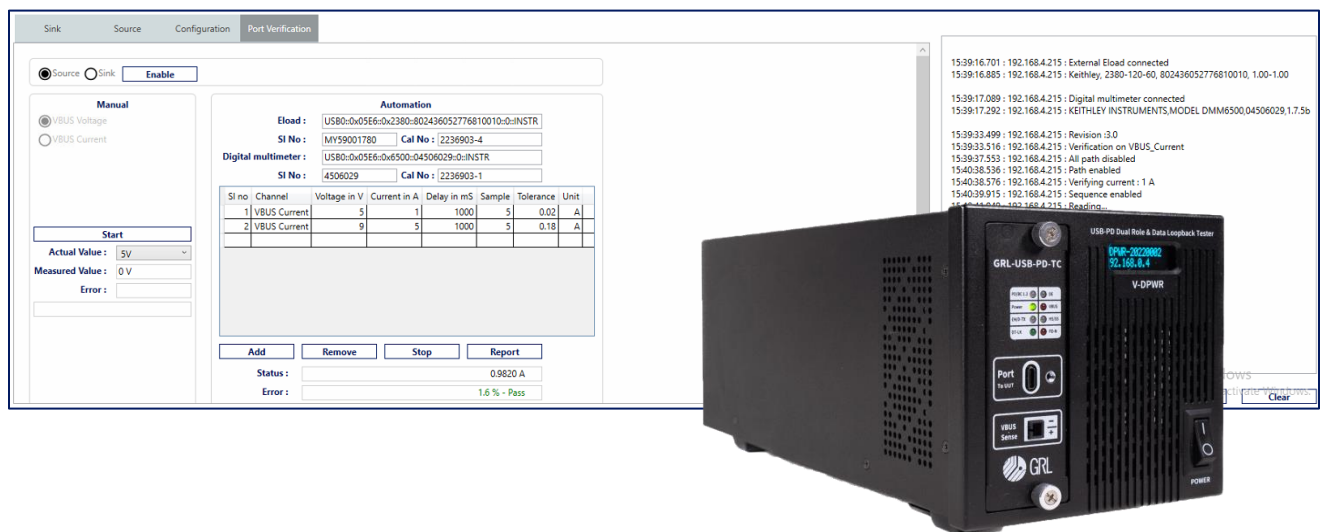# Granite River Labs

Port Verification Guide

for GRL USB Power Delivery Dual Role Power & Data Loopback Tester (GRL-V-DPWR) Using GRL-V-DPWR Functionality API Software

This material is provided as a reference to perform port verification for a connected port on the Granite River Labs (GRL) USB Power Delivery Dual Role Power & Data Loopback Tester (GRL-V-DPWR).

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 verify that a connected port on the GRL-V-DPWR tester hardware is working properly in the Sink or Source power role. The user has the option to perform the port verification test manually or using automation mode.

For more information on GRL-V-DPWR, please refer to https://www.graniteriverlabs.com/en-us/test-solutions/functional-interop-production/grl-v-dpwr.

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

2   Test/Equipment Requirements

GRL-V-DPWR 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
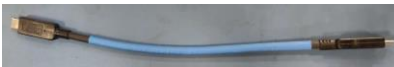
E-Load *(Note: GRL recommends using the Keithley 2380 Series or B&K Precision 8600 Series DC Electronic Load)*

Control Computer (laptop or desktop) with the GRL-V-DPWR API Test software installed *[Note: For more information on the GRL-V-DPWR 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):
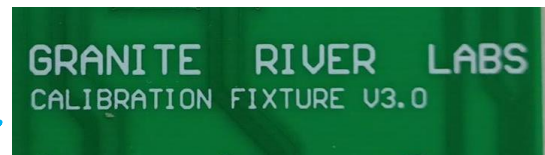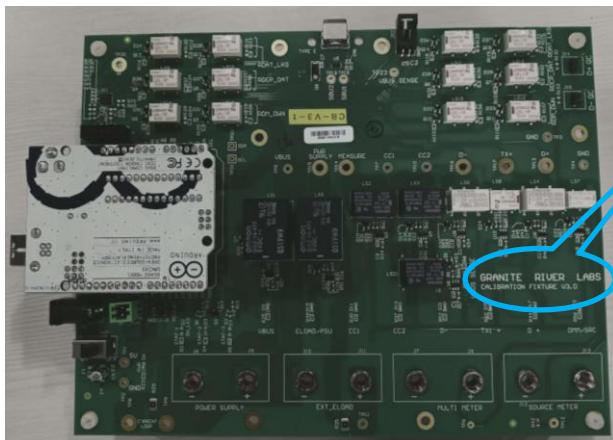
3   Start Up GRL-V-DPWR API Test Software

On the control computer, launch the GRL-V-DPWR 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-DPWR API Test software, refer to the user documentation in http://graniteriverlabs.com/download-center/.

3.1   Connect to the GRL-V-DPWR Tester

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

1. In the "IP Address" pane, select to control any active GRL-V-DPWR tester hardware port(s) connected to the control computer. See Figure 1 below.

2. Enter the **IP Address** of the GRL-V-DPWR tester hardware and click on the **Connect** button. The IP address will be displayed below the Connect button of the respective port when connected successfully.
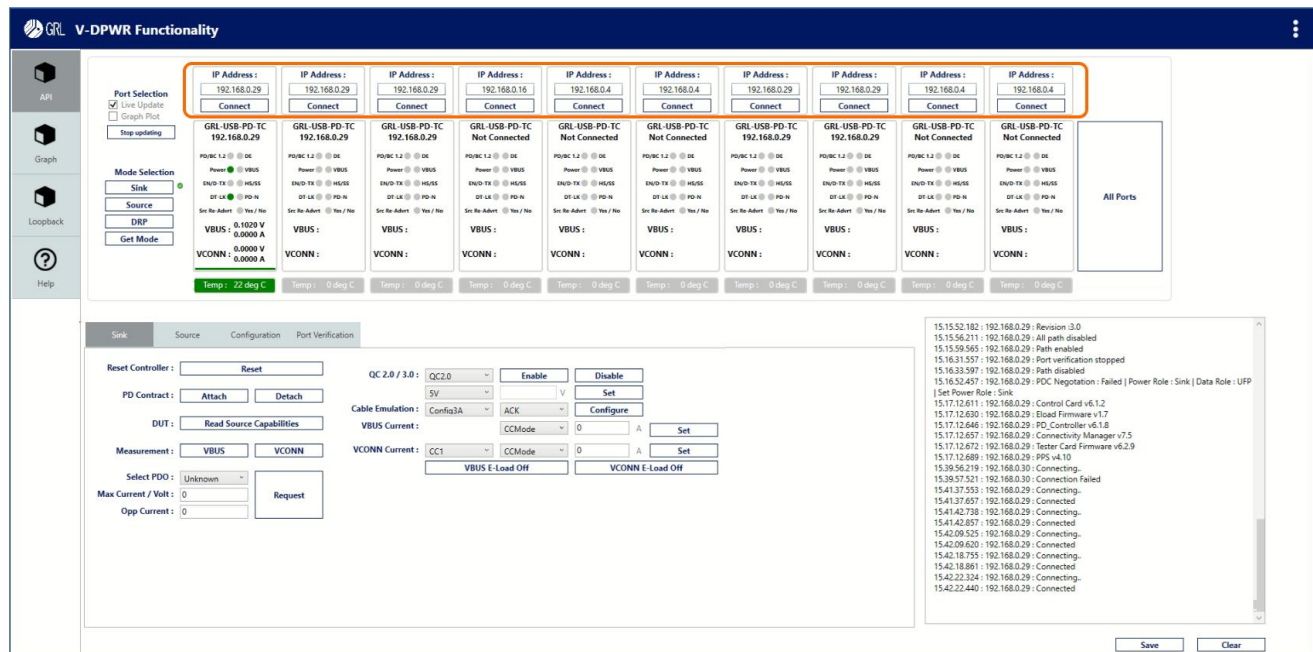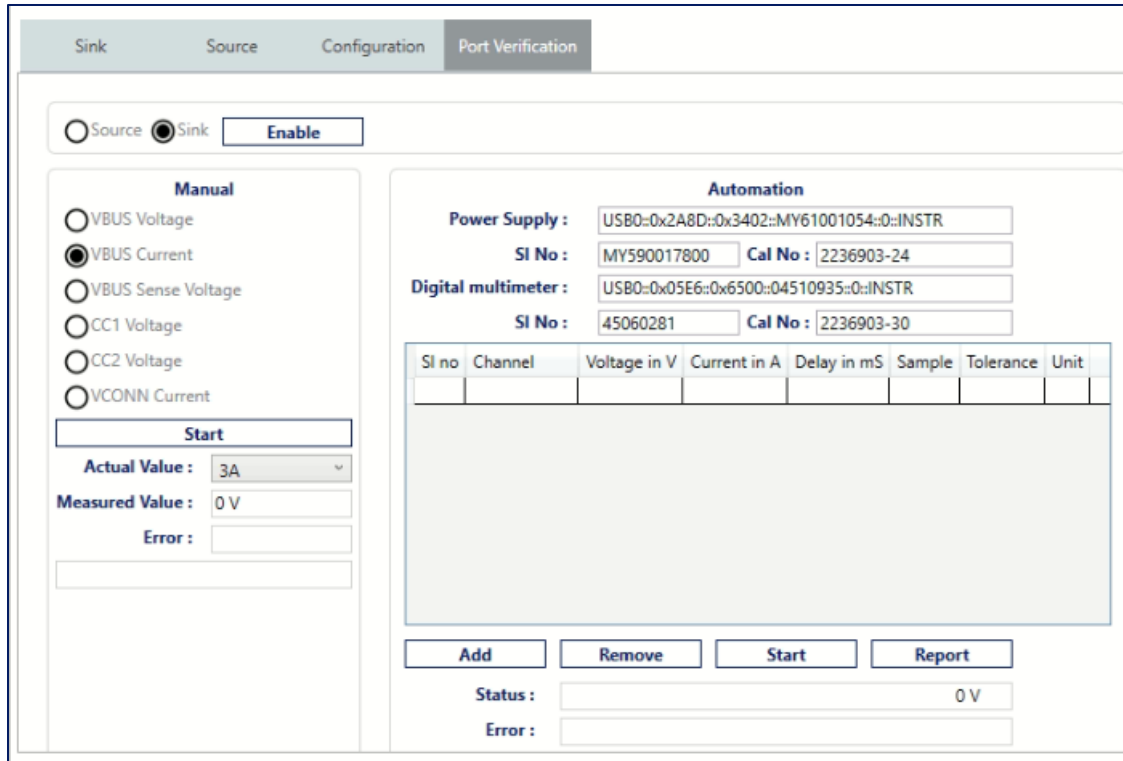

Figure 1.Connect GRL-V-DPWR API Test Software and Tester

3.2 Access the Port Verification Pane

Select the **Port Verification** tab to configure and verify that a connected port on the GRL-V-DPWR hardware tester is working properly in the Sink or Source power role. The user has the option to perform the port verification test manually or using automation mode. See Figure 2 below.

Figure 2.Port Verification Tab

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:

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

3.2.1 Select Source or Sink Mode for Port Verification

To enable the Source mode for GRL-V-DPWR port verification, select the **Source** mode for the connected GRL-V-DPWR tester port as shown in Figure 3 below. Click on the **Enable** button.
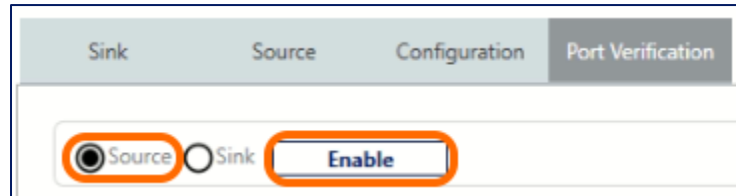
Figure 3.Select & Enable Source Mode for GRL-V-DPWR Port Verification

To enable the Sink mode for GRL-V-DPWR port verification, select the **Sink** mode for the connected GRL-V-DPWR tester port as shown in Figure 4 below. Click on the **Enable** button.
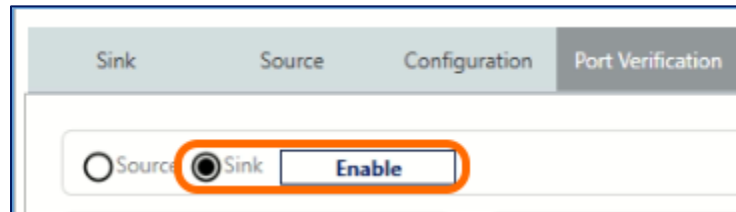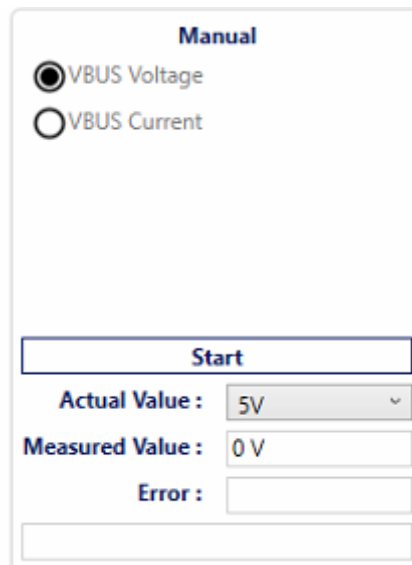
Figure 4.Select & Enable Sink Mode for GRL-V-DPWR Port Verification

4 GRL-V-DPWR Port Verification Procedure

This section describes how to perform the port verification test for the connected GRL-V-DPWR tester port(s) manually or using automation mode.

4.1 Manual Source Port Verification

This section describes how to verify the GRL-V-DPWR tester port on the following measurement channels– VBUS voltage and VBUS current in the Source mode.

Figure 5.Manual Source Port Verification Configuration

- **Actual Value**: This field allows the user to select the voltage/current level that needs to be verified based on the selected measurement channel. The selected current level needs to be set on the E-Load as well.

- **Measured Value**: This field displays the measured values of the GRL-V-DPWR tester port.

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

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

4.1.1 Equipment Requirements

Equipment	Qty.
GRL-V-DPWR tester hardware	1
Digital multimeter	1
E-Load	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 [See (a) Note: below]	1
Banana connectors	2
USB Type-A to Type-B cable	1
Control computer (laptop or desktop) with the GRL-V-DPWR 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 Connection Setup for Voltage Measurements

This section describes the connection diagram to set up the equipment and fixture for manual source port verification for voltage measurements. Set up the hardware connection as shown in Figure 6 below.

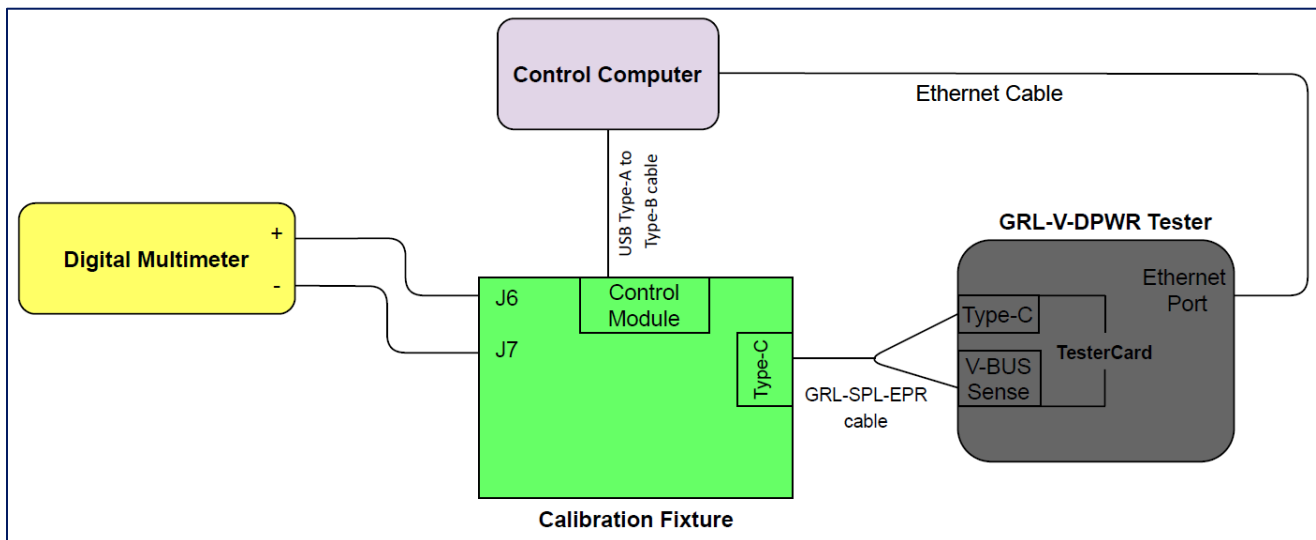Figure 6.Connection Setup for GRL-V-DPWR Manual Source Port Verification for Voltage Measurements

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

1. Connect the digital multimeter (DMM) to the J6 and J7 terminals of the GRL calibration fixture.

2. Connect the Control Module of the GRL calibration fixture to the control computer using a USB Type-A to Type-B cable.

3. 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-DPWR 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-DPWR tester port.

   - Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-DPWR tester.

4. 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-DPWR 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-DPWR tester using a VBUS Sense cable.

5. Connect the GRL-V-DPWR tester hardware to the control computer using an Ethernet cable.

4.1.3   Procedure for VBUS Voltage Measurement

*Note: Make sure that the **Source** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

1. Set up the hardware connection as shown in Figure 6.

2. See Figure 7 for the following procedure:

   i) In the Manual panel, select the VBUS Voltage measurement channel.

   ii) Click on the **Start** button to start the verification process. A pop-up message will appear to warn the user to make sure that the voltage on the VBUS line is ≤ 20 V to avoid any permanent damage to the GRL calibration fixture and tester port.

   iii) Select the voltage level to be verified from the **Actual Value** drop-down menu.

   iv) The **Measured Value** field will display the GRL-V-DPWR measurement value. The **Error** field will display the error percentage with Pass/Fail status.

   v) Repeat the above steps for the rest of the voltage levels (5V, 9V, 12V, 15V, 20V). When completed, set the GRL-V-DPWR voltage to 5 V and click on the **Stop** button.
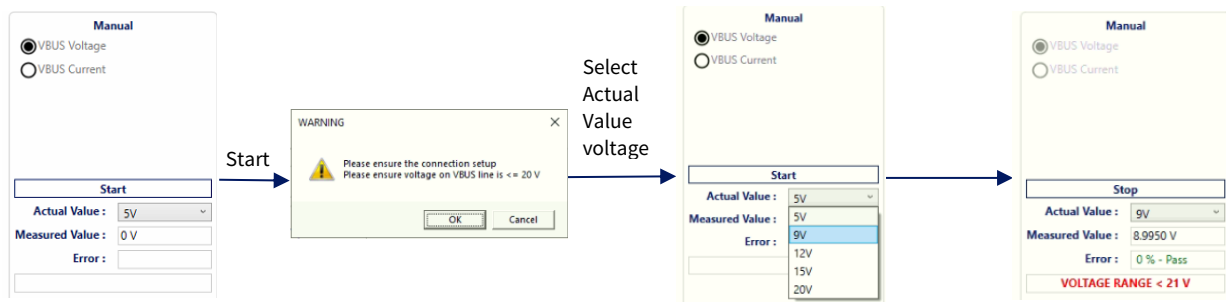
Figure 7.VBUS Voltage Measurement Channel Verification (Source Mode)

Note: If the voltage on this measurement channel exceeds 21 V, the GRL calibration fixture will terminate the connection between the E-Load 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:
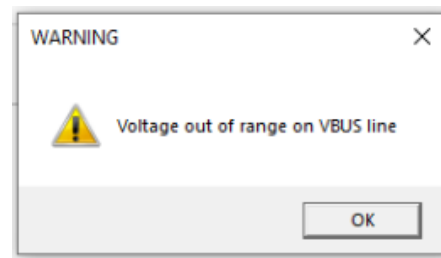
4.1.4   Connection Setup for Current Measurements

This section describes the connection diagram to set up the equipment and fixture for manual source port verification for current measurements. Set up the hardware connection as shown in Figure 8 below.

Figure 8.Connection Setup for GRL-V-DPWR Manual Source Port Verification for Current Measurements

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

1. Connect the E-Load (- terminal) to the digital multimeter (DMM) (+ terminal) and E-Load (+ terminal) to the J11 terminal of the GRL calibration fixture.

2. Connect the DMM (- terminal) to the J10 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-DPWR 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-DPWR tester port.

   - Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-DPWR 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-DPWR 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-DPWR tester using a VBUS Sense cable.

6. Connect the GRL-V-DPWR tester hardware to the control computer using an Ethernet cable.

4.1.5 Procedure for VBUS Current Measurement

*Note: Make sure that the **Source** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

1. Set up the hardware connection as shown in Figure 8.

2. See Figure 9 for the following procedure:

   i) In the Manual panel, select the VBUS Current measurement channel.

   ii) Click on the **Start** button to start the verification process. A pop-up message will appear to warn the user to make sure that the voltage on the VBUS line is ≤ 20 V to avoid any permanent damage to the GRL calibration fixture and tester port.

   iii) Select the current level to be verified from the **Actual Value** drop-down menu. Set the same current level on the E-Load as well. The GRL-V-DPWR tester hardware will source the selected current level on the E-Load.

iv) The **Measured Value** field will display the GRL-V-DPWR measurement value. The **Error** field will display the error percentage with Pass/Fail status.

v) Repeat the above steps for the rest of the current levels (1A, 2A, 3A, 4A, 5A). When completed, click on the **Stop** button.

Figure 9.VBUS Current Measurement Channel Verification (Source Mode)
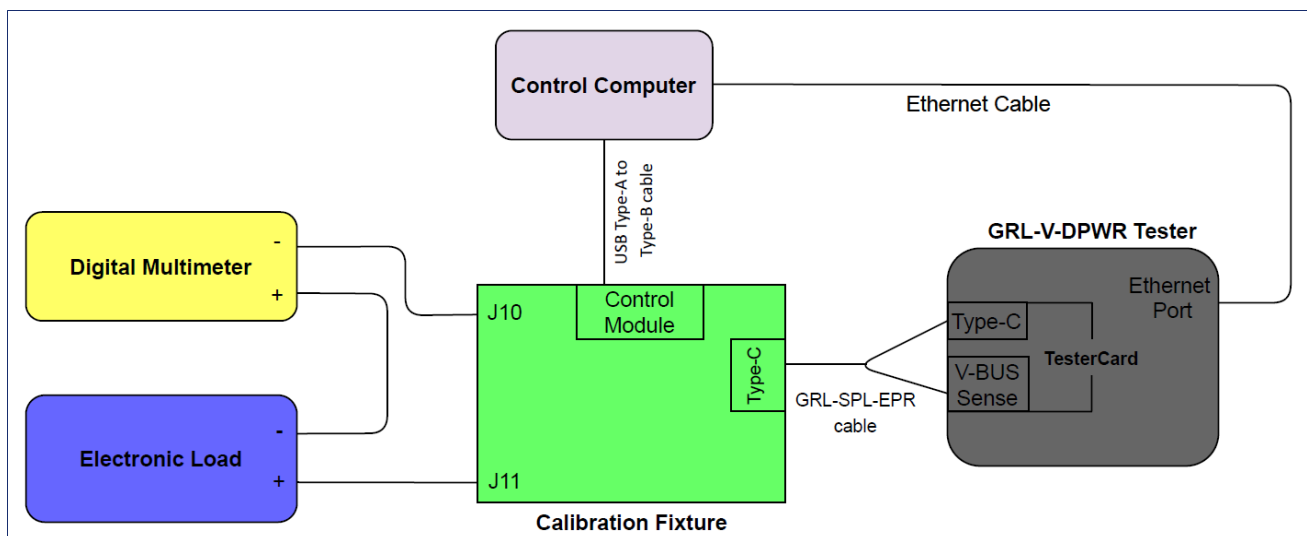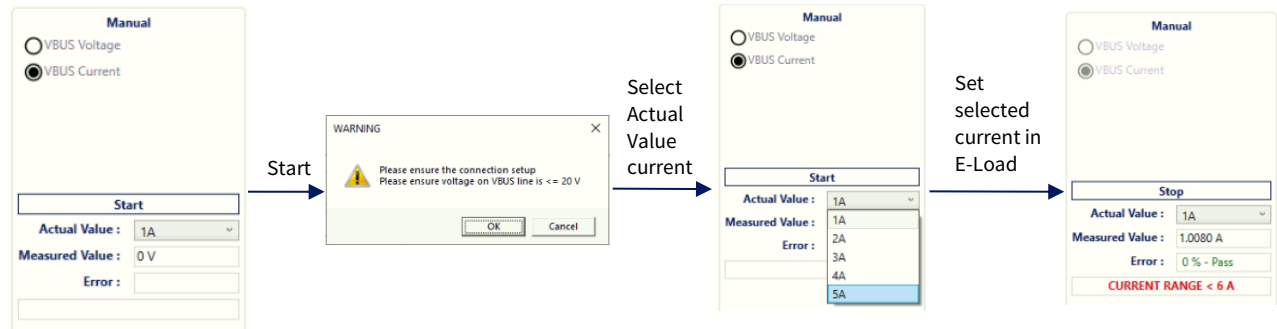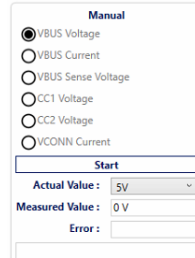
4.2   Manual Sink Port Verification

This section describes how to verify the GRL-V-DPWR tester port on the following measurement channels– VBUS voltage, VBUS current, VBUS sense voltage, CC1 voltage, CC2 voltage and VCONN current in the Sink mode.

Figure 10. Manual Sink Port Verification Configuration

- **Actual Value**: This field allows the user to select the voltage/current level that needs to be verified 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 GRL-V-DPWR tester port.

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

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

4.2.1   Equipment Requirements

Equipment	Qty.
GRL-V-DPWR tester hardware	1
Digital multimeter	1
DC power supply	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 [See (a) Note: below]	1
Banana connectors	2
USB Type-A to Type-B cable	1
Control computer (laptop or desktop) with the GRL-V-DPWR 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).

4.2.2 Connection Setup for Voltage Measurements

This section describes the connection diagram to set up the equipment and fixture for manual sink port verification for voltage measurements. Set up the hardware connection as shown in Figure 11 below.
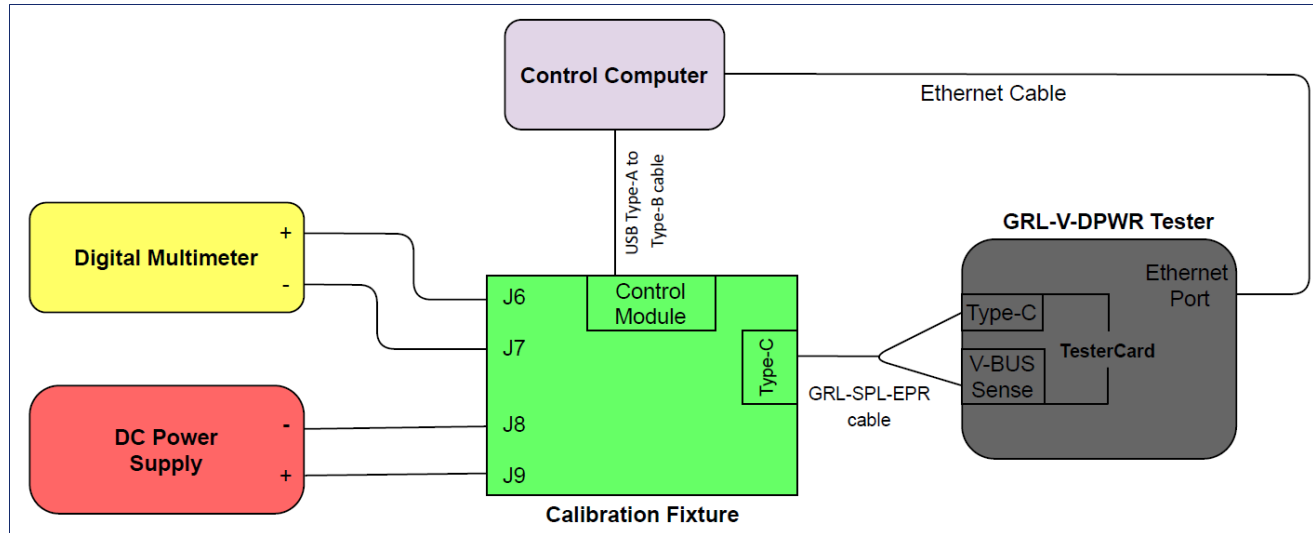
Figure 11. Connection Setup for GRL-V-DPWR Manual Sink Port Verification for Voltage Measurements

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-DPWR 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-DPWR tester port.

   - Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-DPWR 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-DPWR 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-DPWR tester using a VBUS Sense cable.

6. Connect the GRL-V-DPWR tester hardware to the control computer using an Ethernet cable.

4.2.3 Procedure for VBUS Voltage Measurement

Notes:

- *Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

- *Make sure that current on the power supply is not set to 0 A in the following procedure.*

1. Set up the hardware connection as shown in Figure 11.

2. See Figure 12 for the following procedure:

    i) In the Manual panel, select the VBUS Voltage measurement 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 to avoid any permanent damage to the GRL calibration fixture and tester port.

    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-DPWR measurement value. The **Error** field will display the error percentage with Pass/Fail status.

    vi) Repeat the above steps for the rest of the voltage levels (5V, 9V, 12V, 15V, 20V). When completed, set the power supply voltage to ≤ 5 V and click on the **Stop** button.

Figure 12. VBUS Voltage Measurement Channel Verification (Sink Mode)

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:

WARNING ✕

⚠ Voltage out of range on VBUS line

OK

4.2.4 Procedure for VBUS Sense Voltage Measurement

Notes:

- *Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

- *Make sure that current on the power supply is not set to 0 A in the following procedure.*

1. Set up the hardware connection as shown in Figure 11.

2. See Figure 13 for the following procedure:

    i)   In the Manual panel, select the VBUS Sense Voltage measurement 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 to avoid any permanent damage to the GRL calibration fixture and tester port.

    iii) Set the voltage on the power supply to 0 V and click **OK**.

    iv) Another pop-up message will appear to prompt the user to check that the VBUS SENS switch is turned ON if the calibration kit revision 3.0 is being used. Otherwise check that the DPLUS switch on the calibration kit revision 2.0 is turned ON. Once done, click **OK**.

    v)   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.

    vi) The **Measured Value** field will display the GRL-V-DPWR measurement value. The **Error** field will display the error percentage with Pass/Fail status.

    vii) Repeat the above steps for the rest of the voltage levels (5V, 9V, 12V, 15V, 20V). When completed, set the power supply voltage to ≤ 5 V and click on the **Stop** button.
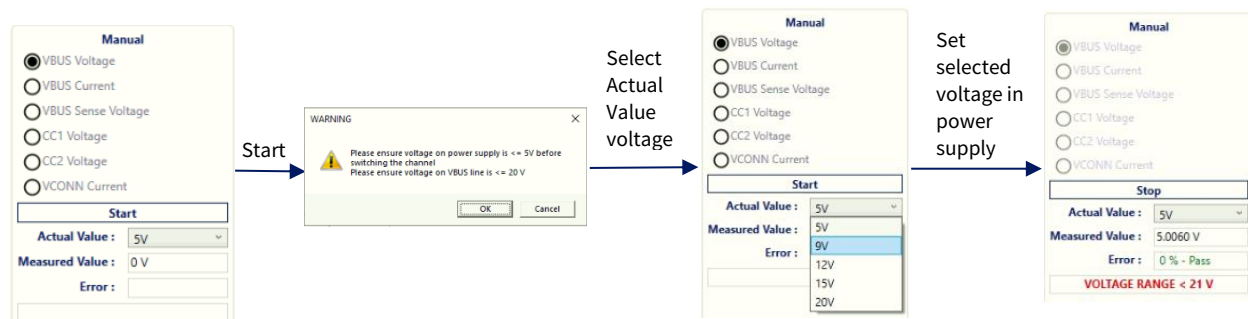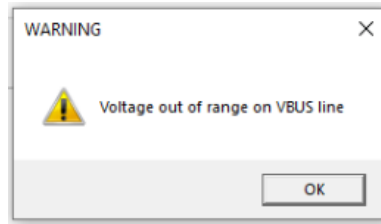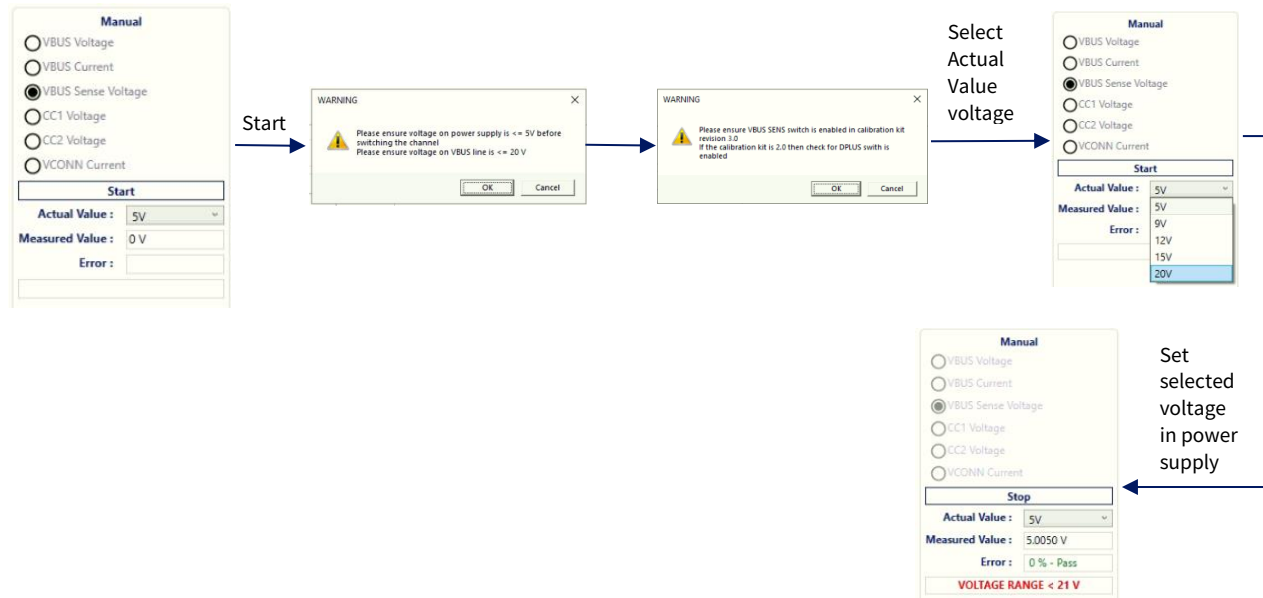
Figure 13.VBUS Sense Voltage Measurement Channel Verification (Sink Mode)

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:
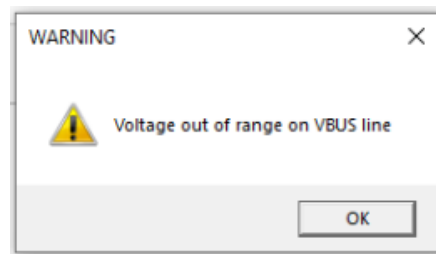
4.2.5   Procedure for CC1 Voltage Measurement

Notes:

- *Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

- *Make sure that current on the power supply is not set to 0 A in the following procedure.*

1. Set up the hardware connection as shown in Figure 11.

2. See Figure 14 for the following procedure:

    i)   In the Manual panel, select the CC1 Voltage measurement 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 to avoid any permanent damage to the GRL calibration fixture and tester port.

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-DPWR measurement value. The **Error** field will display the error percentage with Pass/Fail status.

vi) Repeat the above steps for the rest of the voltage levels (1V, 2V, 3V, 4V, 5V). When completed, click on the **Stop** button.

Figure 14. CC1 Voltage Measurement Channel Verification (Sink Mode)

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:
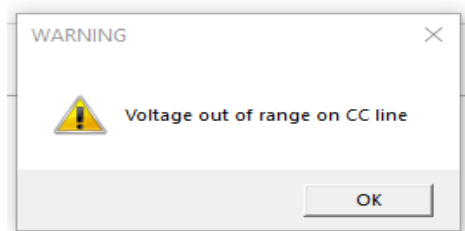
4.2.6 Procedure for CC2 Voltage Measurement

Notes:

- *Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

- *Make sure that current on the power supply is not set to 0 A in the following procedure.*

1. Set up the hardware connection as shown in Figure 11.

2. See Figure 15 for the following procedure:

   i) In the Manual panel, select the CC2 Voltage measurement 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 to avoid any permanent damage to the GRL calibration fixture and tester port.

   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-DPWR measurement value. The **Error** field will display the error percentage with Pass/Fail status.

   vi) Repeat the above steps for the rest of the voltage levels (1V, 2V, 3V, 4V, 5V). When completed, click on the **Stop** button.
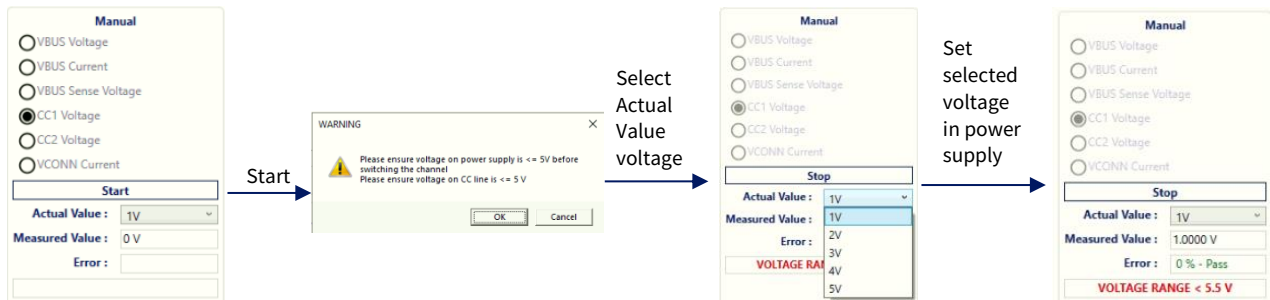

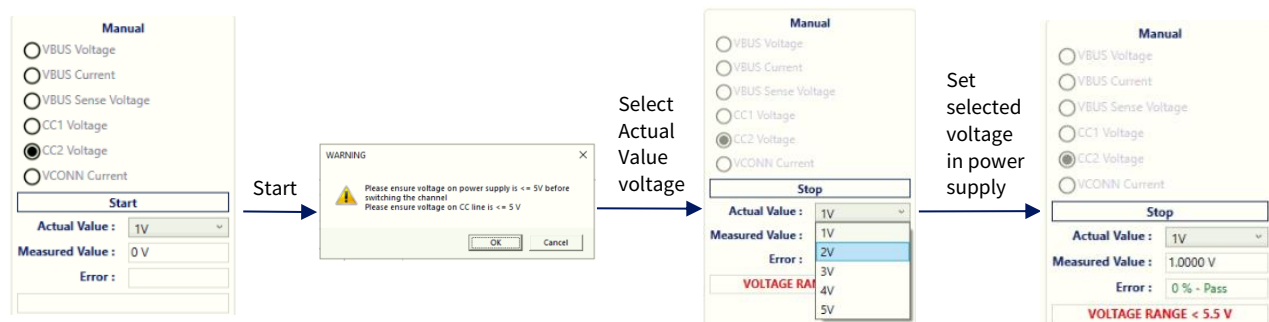Figure 15. CC2 Voltage Measurement Channel Verification (Sink Mode)

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:
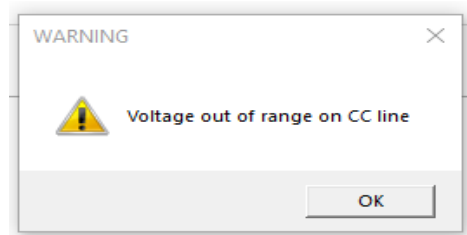
4.2.7 Connection Setup for Current Measurements

This section describes the connection diagram to set up the equipment and fixture for manual sink port verification for current measurements. Set up the hardware connection as shown in Figure 16 below.
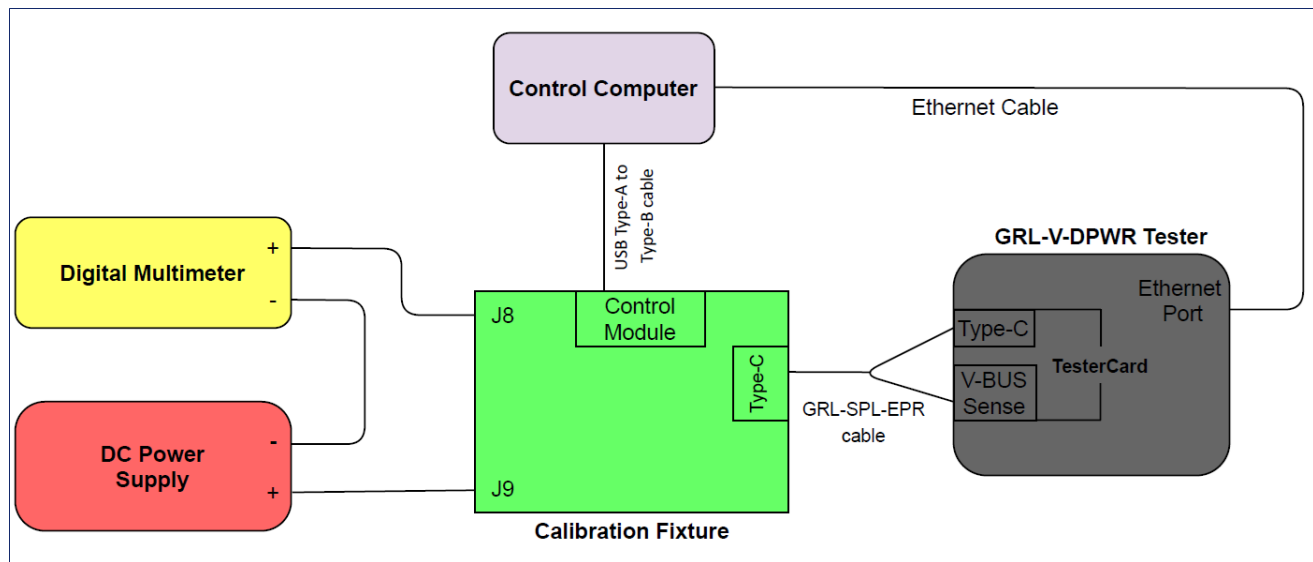

Figure 16.Connection Setup for GRL-V-DPWR Manual Sink Port Verification for Current Measurements

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-DPWR 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-DPWR tester port.

- Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-DPWR 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-DPWR 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-DPWR tester using a VBUS Sense cable.

6. Connect the GRL-V-DPWR tester hardware to the control computer using an Ethernet cable.

4.2.8   Procedure for VBUS Current Measurement

*Note: Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

1. Set up the hardware connection as shown in Figure 16.

2. See Figure 17 for the following procedure:

    i)   In the Manual panel, select the VBUS Current measurement 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 to avoid any permanent damage to the GRL calibration fixture and tester port.

    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-DPWR tester hardware will draw the requested current automatically from the power supply.

    v)   The **Measured Value** field will display the GRL-V-DPWR measurement value. The **Error** field will display the error percentage with Pass/Fail status.

    vi) Repeat the above steps for the rest of the current levels (1A, 2A, 3A, 4A, 5A). When completed, click on the **Stop** button.
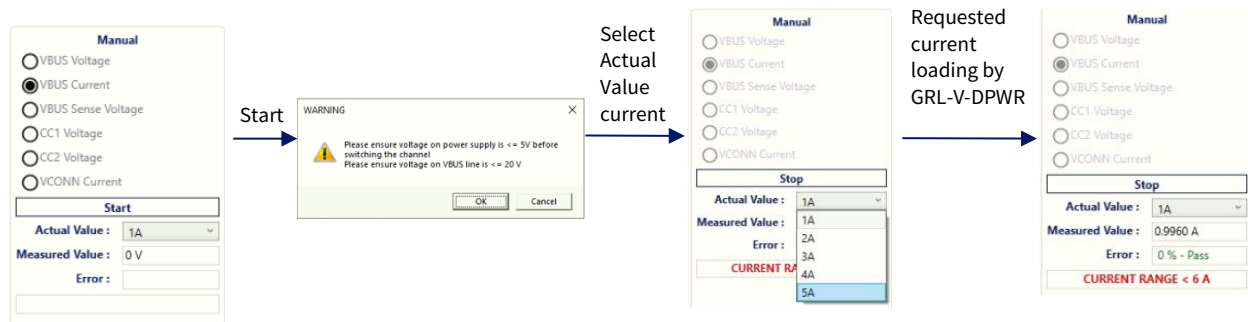
Figure 17.VBUS Current Measurement Channel Verification (Sink Mode)

4.2.9 Procedure for VCONN Current Measurement

*Note: Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

1. Set up the hardware connection as shown in Figure 16.

2. See Figure 18 for the following procedure:

    i) In the Manual panel, select the VCONN Current measurement 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 to avoid any permanent damage to the GRL calibration fixture and tester port.

    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-DPWR tester hardware will draw the requested current automatically from the power supply.

    v) The **Measured Value** field will display the GRL-V-DPWR measurement value. The **Error** field will display the error percentage with Pass/Fail status.

    vi) Repeat the above steps for the rest of the current levels (0A, 250mA, 500mA, 750mA, 1A). When completed, click on the **Stop** button.
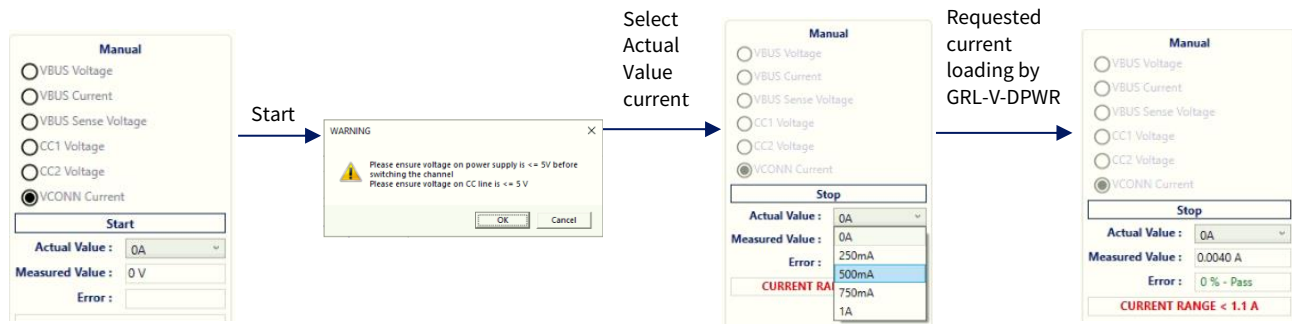
Figure 18.VCONN Current Measurement Channel Verification (Sink Mode)

4.3 Automated Source Port Verification

Note: The VBUS Sense Voltage measurement is not applicable and will not be performed for Source port verification.

4.3.1 Equipment Requirements

Equipment	Qty.
GRL-V-DPWR tester hardware	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 [See (a) Note: below]	1
Banana connectors	4
USB Type-A to Type-B cable	3
E-Load	1
Control computer (laptop or desktop) with the GRL-V-DPWR 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, E-Load and calibration fixture are connected to the GRL-V-DPWR tester hardware over USB, the user needs to note the VISA addresses and identification (ID) of the DMM and E-Load via their respective I/O software, e.g., the Keysight IO Libraries Suite software.

4.3.2 Connection Setup

This section describes the connection diagram to set up the equipment and fixture for automated source port verification. Set up the hardware connection as shown in Figure 19 below.
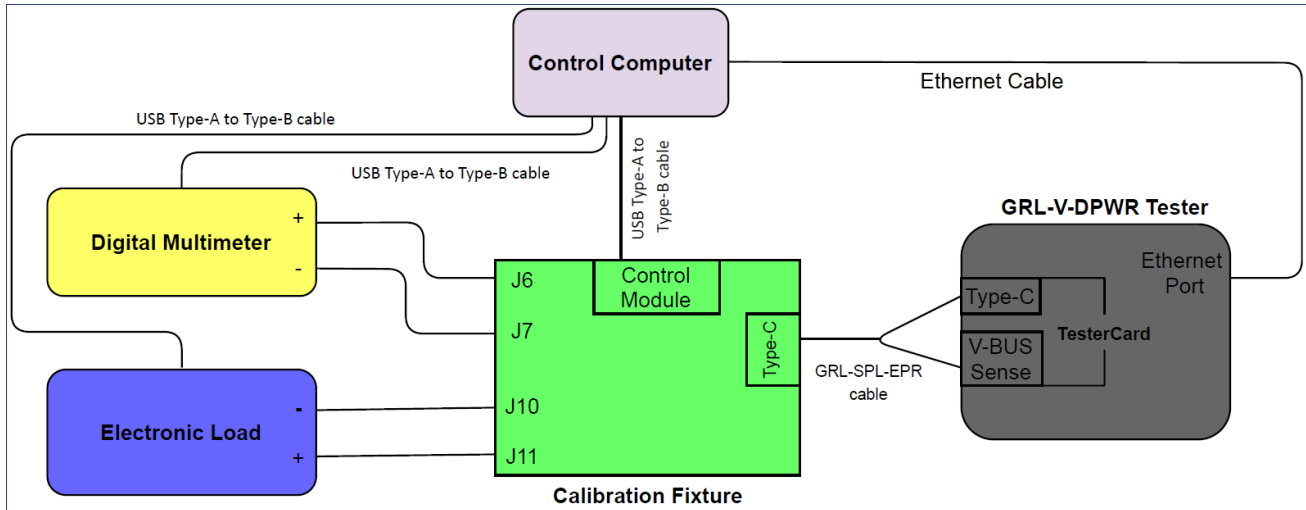

Figure 19. Connection Setup for GRL-V-DPWR Automated Source Port Verification

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

1. Connect the E-Load to the J10 and J11 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-DPWR 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-DPWR tester port.

   - Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-DPWR 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-DPWR 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-DPWR tester using a VBUS Sense cable.

6. Connect the GRL-V-DPWR tester hardware to the control computer using an Ethernet cable.

7. Connect the DMM and E-Load 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 E-Load), 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 E-Load units as shown in the following example:
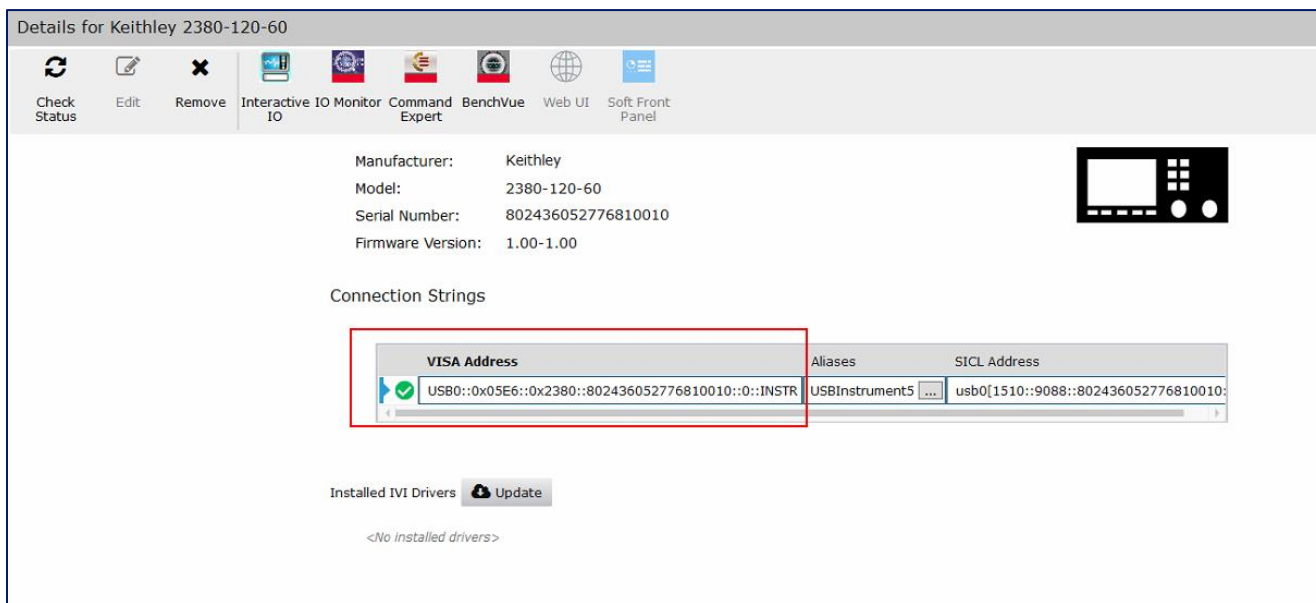
10. Copy the VISA addresses for the DMM and E-Load to be pasted in the Port Verification pane of the GRL-V-DPWR API Test software.
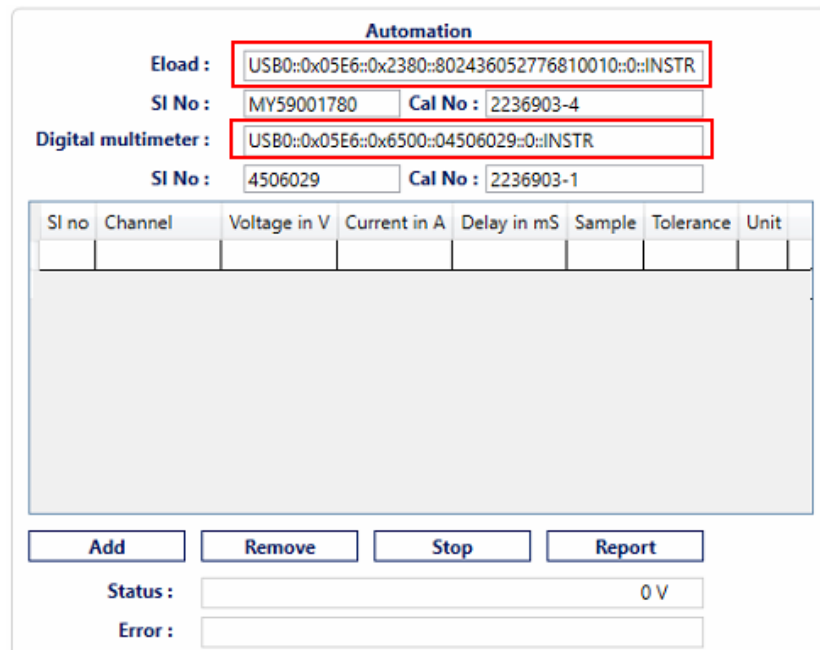
4.3.3 Procedure for VBUS Voltage Measurement

*Note: Make sure that the **Source** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

1. In the Automation panel, enter the VISA addresses along with SI and calibration numbers for the E-Load and DMM units connected to the GRL-V-DPWR 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 0,*

2.

3.

4. Connection Setup.

Figure 20. Set Equipment VISA Address and ID for GRL-V-DPWR Automated Source Port Verification

5. 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, 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 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.

Automation

Eload :	USB0::0x05E6::0x2380::802436052776810010::0::INSTR
SI No :	MY59001780	Cal No :	2236903-4
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 :   0 V

Error :

Figure 21.Add Measurement Configuration

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

7. Click on the **Start** button to execute the automated port verification test.

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

WARNING

Port verification on Port1
Click Yes to continue
Click No to end operation,

| Yes | No |
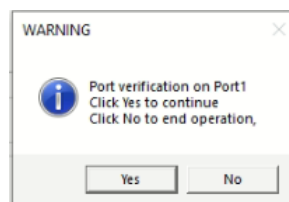
9. The activity log pane will also display the detected E-Load and DMM log.

15:33:40.645 : 192.168.4.215 : External Eload connected
15:33:40.848 : 192.168.4.215 : Keithley, 2380-120-60, 802436052776810010, 1.00-1.00

15:33:41.050 : 192.168.4.215 : Digital multimeter connected
15:33:41.255 : 192.168.4.215 : KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b

15:33:47.406 : 192.168.4.215 : Revision :3.0
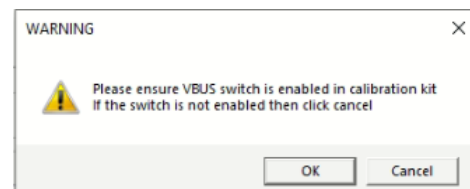15:33:47.422 : 192.168.4.215 : Verification on VBUS_Voltage

10. The connection diagram for the VBUS 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.
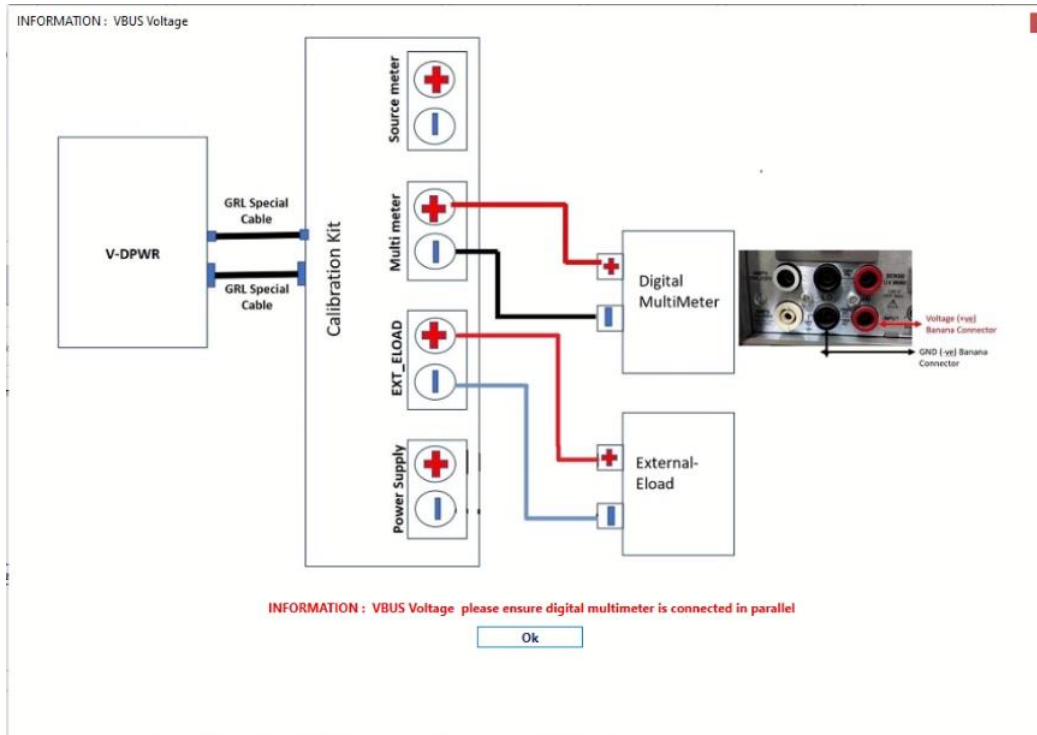
11. The following screen will appear as shown in the example below which requires the user to check the connection setup and VBUS line setting. Click **OK** to proceed.
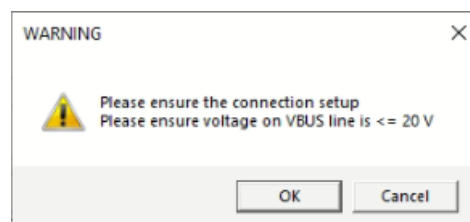
12. Next, the user will need to check that the calibration kit's VBUS switch is turned ON as shown in the example screen below. Click **OK** to proceed.

13. While the port verification test is running, the GRL-V-DPWR 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.

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

GRL-VD-RWP0007 - Validation Report - 08-03-2023 4.48.08 PM

Equipment details

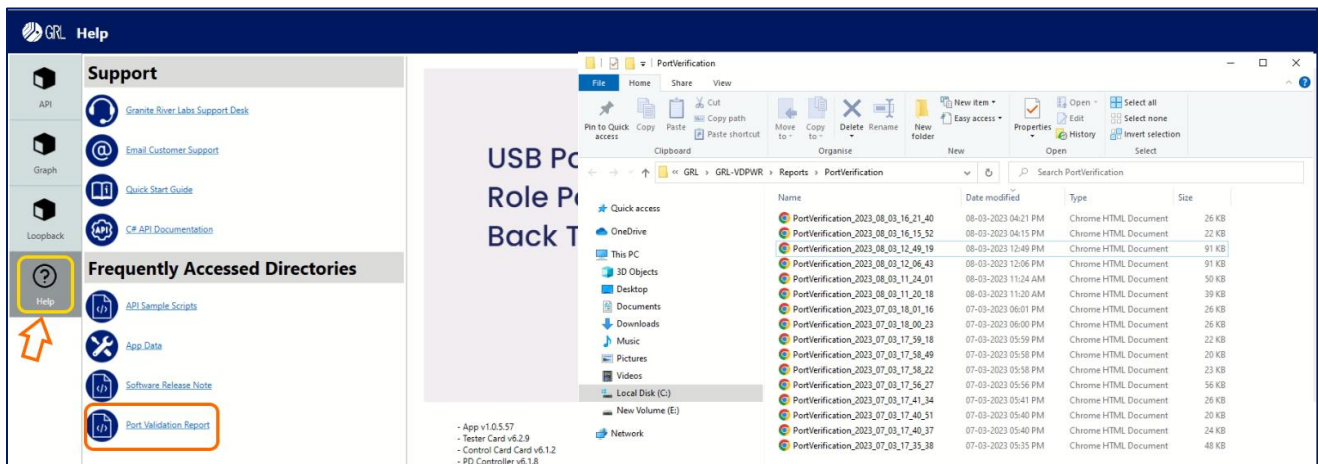| Sl.No	Equipment	ID	Serial number	CERT NO
1	Ext ELoad	Keithley, 2380-120-60, 802436052776810010, 1.00-1.00	MY59001780	2236903-2
2	Digital multimeter	KEITHLEY INSTRUMENTS,MODEL DMM6500,04510935,1.7.5b	4506028	2236903-3

Source Mode - VBUS Voltage Verification for Port1

Sl.No	Set VBUS Voltage in V	V-DPWR Voltage Measurement in V	V-DPWR Current Measurement in A	Ext ELoad Voltage in V	Ext ELoad Current in A	DMM Measurement in V	Deviation percentage / Result
1	5	5.001	0	4.96925	0	4.97	0.62 % - Pass
2	5	4.994	0	4.97017	0	4.971	0.46 % - Pass
3	5	4.995	0.001	4.97063	0	4.97	0.5 % - Pass
4	5	5.001	0	4.96971	0	4.971	0.6 % - Pass
5	5	4.993	0.001	4.97017	0	4.97	0.46 % - Pass
6	9	8.987	0.003	8.96794	0.000198364	8.968	0.21 % - Pass
7	9	8.994	0.004	8.96861	0.000198364	8.969	0.28 % - Pass
8	9	8.991	0.004	8.96846	0.000198364	8.969	0.25 % - Pass
9	9	8.993	0.004	8.96869	0.000198364	8.969	0.27 % - Pass
10	9	8.997	0.004	8.96861	0.000198364	8.968	0.32 % - Pass

15. 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.
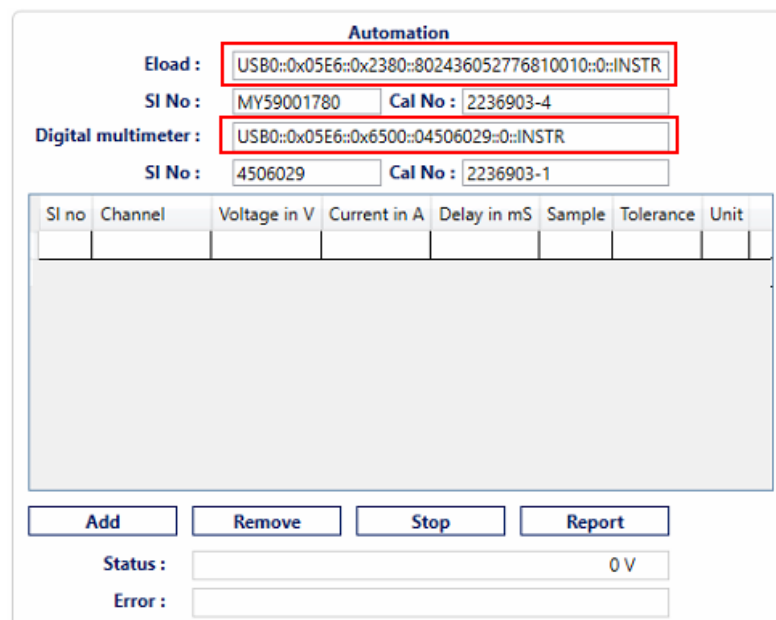

4.3.4   Procedure for VBUS Current Measurement

*Note: Make sure that the **Source** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

1. *In the Automation panel, enter the VISA addresses along with SI and calibration numbers for the E-Load and DMM units connected to the GRL-V-DPWR 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 0,*

2.

3.

4. Connection Setup.

Figure 22. Set Equipment VISA Address and ID for GRL-V-DPWR Automated Source Port Verification

5. 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 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.

Figure 23.Add Measurement Configuration

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

7. Click on the **Start** button to execute the automated port verification test.

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

9. The activity log pane will also display the detected E-Load and DMM log.
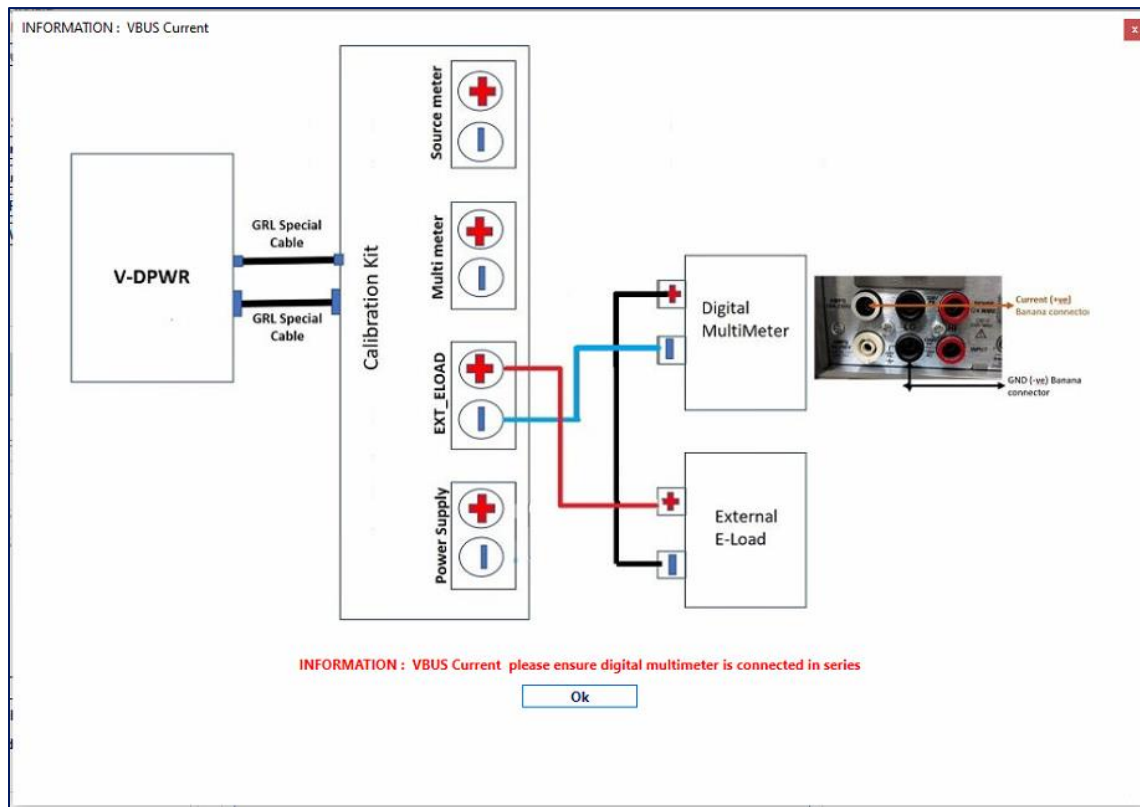
```
15:39:16.701 : 192.168.4.215 : External Eload connected
15:39:16.885 : 192.168.4.215 : Keithley, 2380-120-60, 802436052776810010, 1.00-1.00

15:39:17.089 : 192.168.4.215 : Digital multimeter connected
15:39:17.292 : 192.168.4.215 : KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b

15:39:33.499 : 192.168.4.215 : Revision :3.0
15:39:33.516 : 192.168.4.215 : Verification on VBUS_Current
```
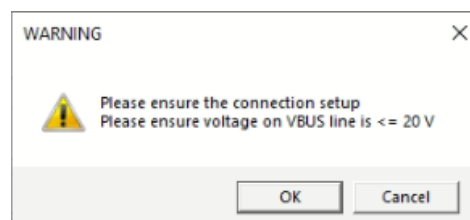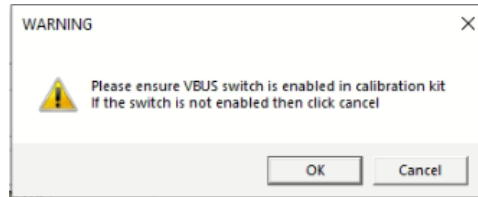
10. The connection diagram for the VBUS current measurement will then appear as shown in the example below. Confirm that all devices are properly connected following the diagram and click **Ok** to proceed.
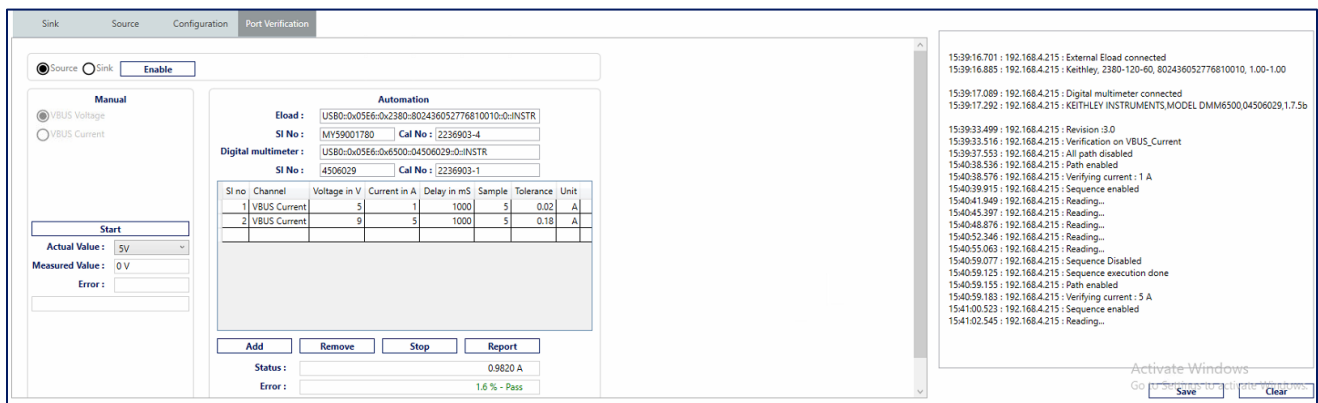

11. The following screen will appear as shown in the example below which requires the user to check the connection setup and VBUS line setting. Click **OK** to proceed.

12. 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.

> **WARNING** ✕
>
> ⚠ Please ensure VBUS switch is enabled in calibration kit
> If the switch is not enabled then click cancel
>
> [OK] [Cancel]

13. While the port verification test is running, the GRL-V-DPWR 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.

14. The test report will be automatically generated and displayed once the test is completed, as shown in the example below.
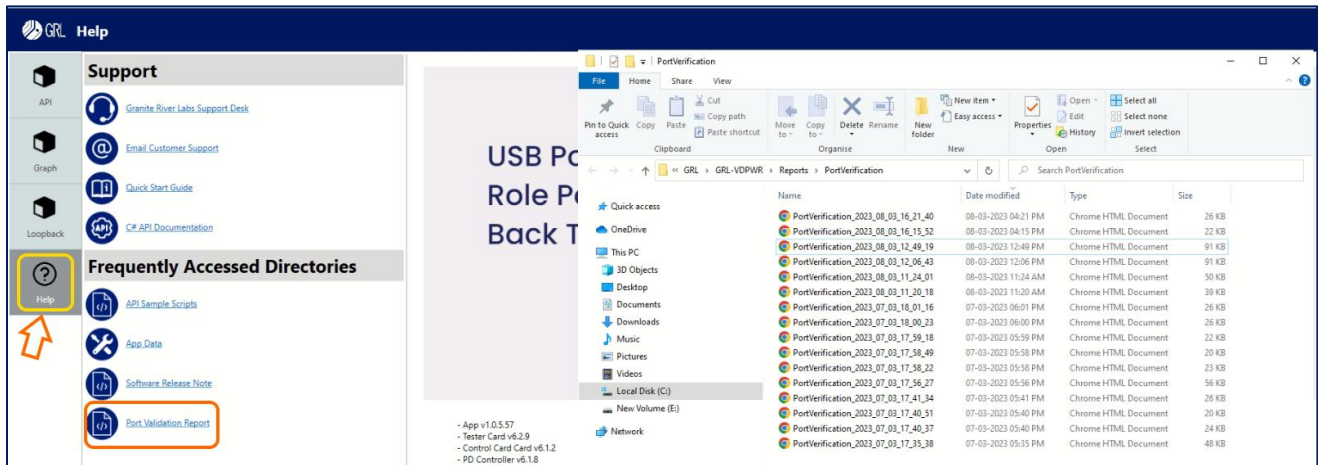
GRL-VDPWR-20230007 - Validation Report - 11-05-2023 15:43:21

Equipment details

Sl.No	Equipment	ID	Serial number	CERT NO
1	Ext ELoad	Keithley, 2380-120-60, 802436052776810010, 1.00-1.00	MY59001780	2236903-4
2	Digital multimeter	KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b	4506029	2236903-1

Source Mode - VBUS Current Verification for Port1

Sl.No	Set VBUS Current in A	V-DPWR Voltage Measurement in V	V-DPWR Current Measurement in A	Ext ELoad Voltage in V	Ext ELoad Current in A	DMM Measurement in A	Deviation percentage / Result
1	1	4.982	1.001	4.59615	0.999557	0.9981	0.29 % - Pass
2	1	4.996	0.993	4.59773	0.999557	0.9982	0.52 % - Pass
3	1	4.984	0.985	4.60477	0.999557	0.9981	1.31 % - Pass
4	1	4.986	0.992	4.60522	0.999557	0.9981	0.61 % - Pass
5	1	4.991	0.99	4.60567	0.999557	0.998	0.8 % - Pass
6	5	9	5.01	7.9144	4.99931	4.9965	0.27 % - Pass
7	5	9.001	5.009	7.92484	4.99931	4.9966	0.25 % - Pass
8	5	9.003	5.009	7.95488	4.99931	4.9966	0.25 % - Pass
9	5	8.996	4.968	7.92749	4.99931	4.9964	0.57 % - Pass
10	5	9.002	5.01	7.95859	4.99931	4.9964	0.27 % - Pass

15. 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.

4.4   Automated Sink Port Verification

4.4.1   Equipment Requirements

Equipment	Qty.
GRL-V-DPWR 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 [See (a) Note: below]	1
Banana connectors	4
USB Type-A to Type-B cable	3
Control computer (laptop or desktop) with the GRL-V-DPWR API Test software installed	1

(b)   Note:

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

(c)   Note:

As the DMM, power supply and calibration fixture are connected to the GRL-V-DPWR 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.

4.4.2   Connection Setup

This section describes the connection diagram to set up the equipment and fixture for automated sink port verification. Set up the hardware connection as shown in Figure 24 below.
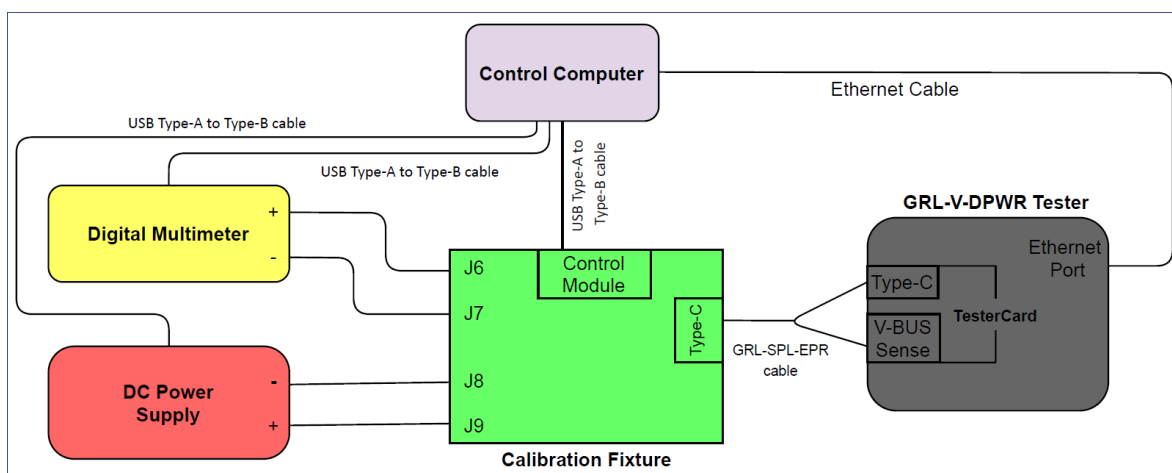

Figure 24. Connection Setup for GRL-V-DPWR Automated Sink Port Verification

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-DPWR 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-DPWR tester port.

   - Connect the VBUS Sense pin of the GRL-SPL-EPR cable to the VBUS Sense port on the GRL-V-DPWR 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-DPWR 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-DPWR tester using a VBUS Sense cable.

6. Connect the GRL-V-DPWR tester hardware to the control computer using an Ethernet 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:
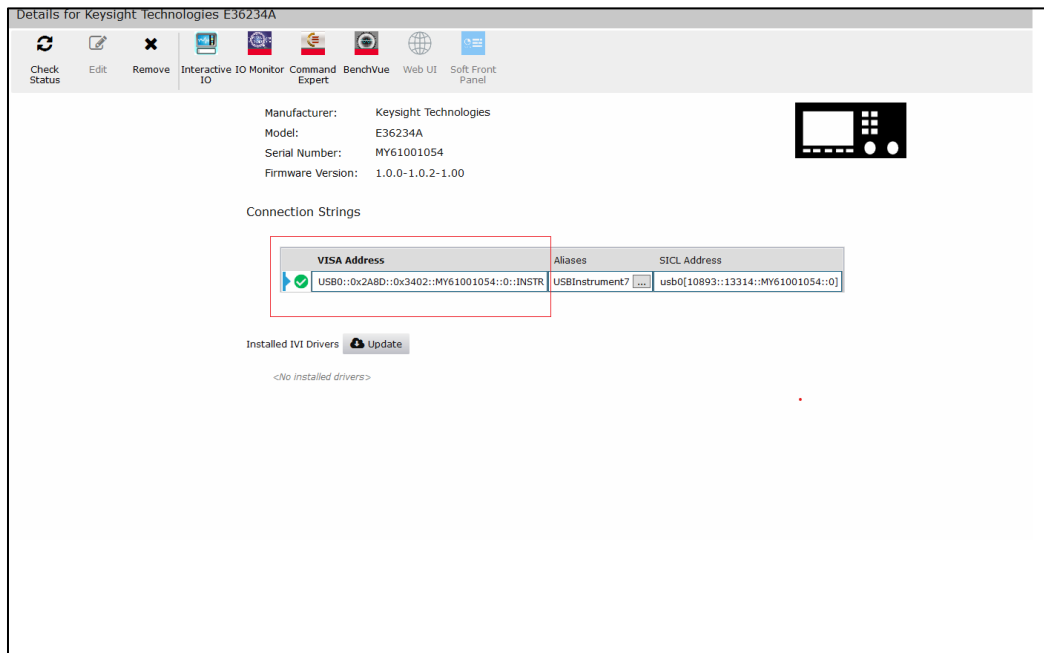
10. Copy the VISA addresses for the DMM and power supply to be pasted in the Port Verification pane of the GRL-V-DPWR API Test software.

4.4.3   Procedure for VBUS Voltage Measurement

*Note: Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

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-DPWR 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 4.4.2, Connection Setup.*
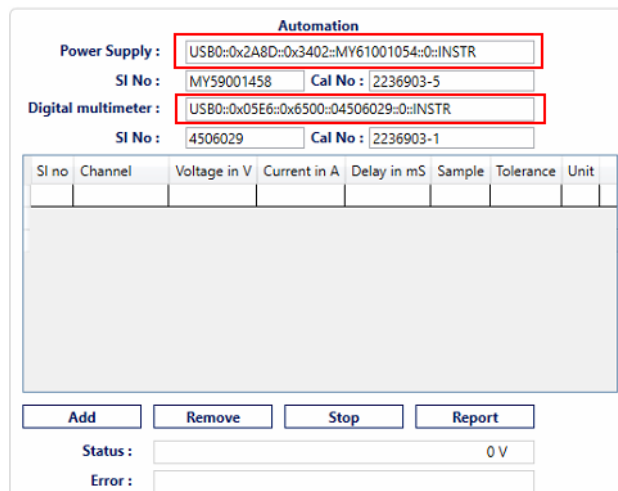

Figure 25. Set Equipment VISA Address and ID for GRL-V-DPWR Automated Sink Port Verification

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.

Figure 26.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.


```
16:11:16.947 : 192.168.4.215 : Power supply connected
16:11:17.571 : 192.168.4.215 : Keysight Technologies,E36234A,MY61001054,1.0.0-1.0.2-1.00

16:11:17.756 : 192.168.4.215 : Digital multimeter connected
16:11:17.944 : 192.168.4.215 : KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b

16:11:25.247 : 192.168.4.215 : Revision :3.0
16:11:25.268 : 192.168.4.215 : Verification on VBUS_Voltage
```

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.

WARNING ✕

⚠ Please ensure voltage on power supply is <= 5V before switching the channel
Please ensure voltage on VBUS line is <= 20 V

OK   Cancel

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.

WARNING ✕

⚠ Please ensure VBUS switch is enabled in calibration kit
If the switch is not enabled then click cancel

OK   Cancel

10. While the port verification test is running, the GRL-V-DPWR 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.

Sink   Source   Configuration   Port Verification

○ Source ● Sink   Enable

Manual
○ VBUS Voltage
● VBUS Current
○ VBUS Sense Voltage
○ CC1 Voltage
○ CC2 Voltage
○ VCONN Current

Start
Actual Value : 3A
Measured Value : 0 V
Error :

Automation
Power Supply : USB0::0x2A8D::0x3402::MY61001054::0::INSTR
Sl No : MY59001780   Cal No : 2236903-2
Digital multimeter : USB0::0x05E6::0x6500::04510935::0::INSTR
Sl No : 4506028   Cal No : 2236903-3

Sl 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

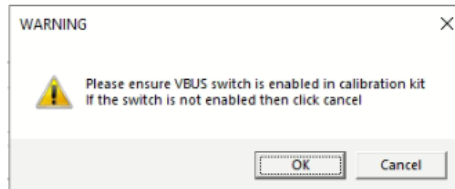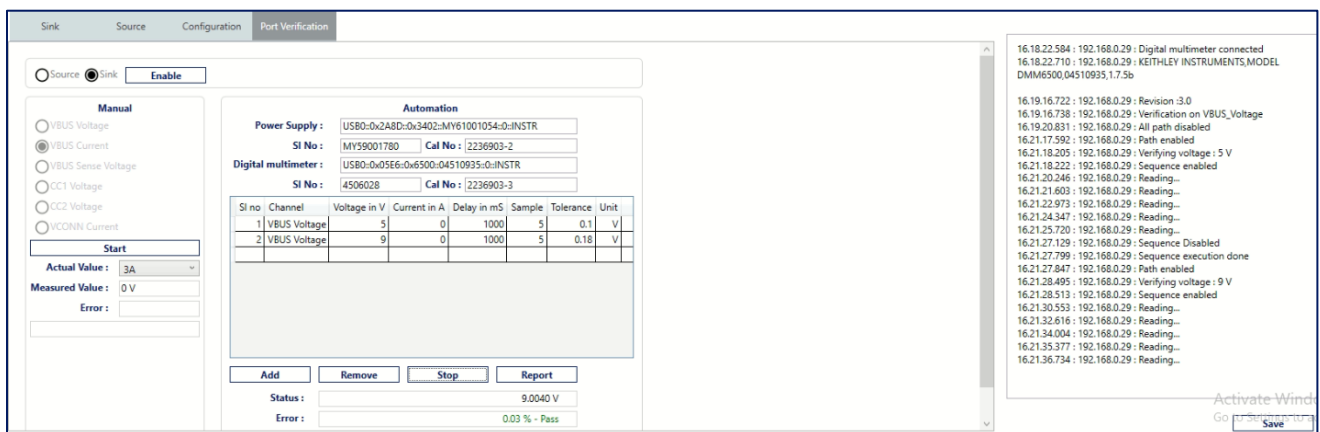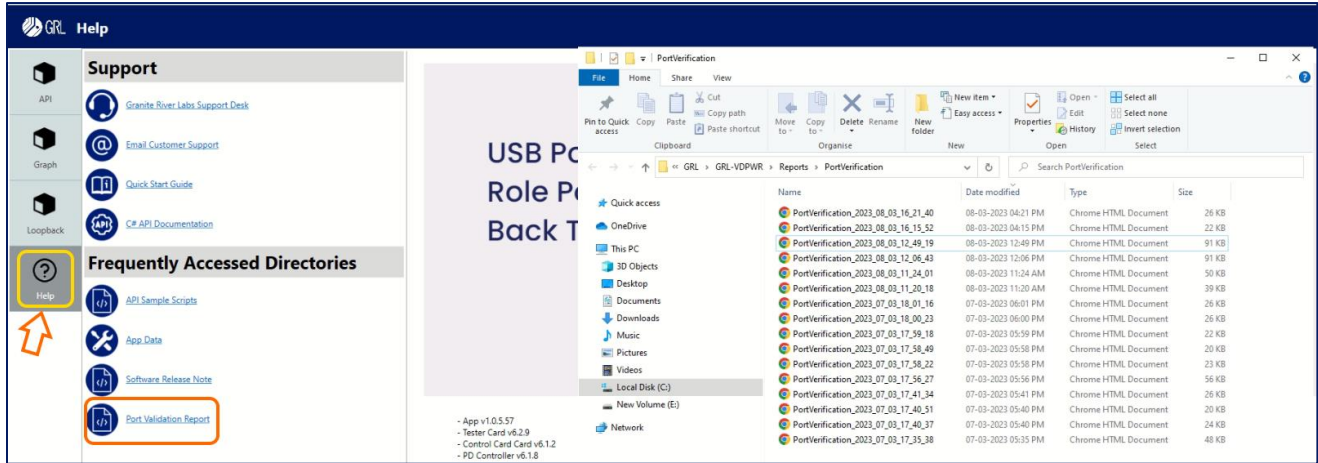Add   Remove   Stop   Report
Status : 9.0040 V
Error : 0.03 % - Pass

16.18.22.584 : 192.168.0.29 : Digital multimeter connected
16.18.22.710 : 192.168.0.29 : KEITHLEY INSTRUMENTS,MODEL DMM6500,04510935,1.7.5b
16.19.16.722 : 192.168.0.29 : Revision :3.0
16.19.16.738 : 192.168.0.29 : Verification on VBUS_Voltage
16.19.20.831 : 192.168.0.29 : All path disabled
16.21.17.592 : 192.168.0.29 : Path enabled
16.21.18.205 : 192.168.0.29 : Verifying voltage : 5 V
16.21.18.222 : 192.168.0.29 : Sequence enabled
16.21.20.246 : 192.168.0.29 : Reading...
16.21.21.603 : 192.168.0.29 : Reading...
16.21.22.973 : 192.168.0.29 : Reading...
16.21.24.347 : 192.168.0.29 : Reading...
16.21.25.720 : 192.168.0.29 : Reading...
16.21.27.129 : 192.168.0.29 : Sequence Disabled
16.21.27.799 : 192.168.0.29 : Sequence execution done
16.21.27.847 : 192.168.0.29 : Path enabled
16.21.28.495 : 192.168.0.29 : Verifying voltage : 9 V
16.21.28.513 : 192.168.0.29 : Sequence enabled
16.21.30.553 : 192.168.0.29 : Reading...
16.21.32.616 : 192.168.0.29 : Reading...
16.21.34.004 : 192.168.0.29 : Reading...
16.21.35.377 : 192.168.0.29 : Reading...
16.21.36.734 : 192.168.0.29 : Reading...

Activate Windows
Go to Settings to activate
Save

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

GRL-VDPWR-0007 - Validation Report - 08-03-2023 4.21.40 PM

Equipment details

Sl.No	Equipment	ID	Serial number	CERT NO
1	Power supply	Keysight Technologies,E36234A,MY61001054,1.0.0-1.0.2-1.00	MY59001780	2236903-2
2	Digital multimeter	KEITHLEY INSTRUMENTS,MODEL DMM6500,04510935,1.7.5b	4506028	2236903-3

Sink Mode - VBUS Voltage Verification for Port1

Sl.No	Set VBUS Voltage in V	V-DPWR Voltage Measurement in V	V-DPWR Current Measurement in A	Power supply Voltage in V	Power supply Current in A	DMM Measurement in V	Deviation percentage / Result
1	5	5.003	0.002	5	0.002	5	0.06 % - Pass
2	5	5	0.002	5	0.002	5	0 % - Pass
3	5	5.003	0.003	5	0.002	5	0.06 % - Pass
4	5	5.005	0.001	5	0.002	5.001	0.08 % - Pass
5	5	5.003	0.002	5	0.002	5	0.06 % - Pass
6	9	9.004	0	9.002	0.003	9.002	0.02 % - Pass
7	9	9.002	0.001	9.002	0.003	9.001	0.01 % - Pass
8	9	9.005	0.002	9.002	0.003	9.001	0.04 % - Pass
9	9	9.004	0.001	9.002	0.003	9.001	0.03 % - Pass
10	9	9.012	0.002	9.002	0.003	9.001	0.12 % - 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.

4.4.4   Procedure for VBUS Sense Voltage Measurement

*Note: Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

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-DPWR 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 4.4.2, Connection Setup.*

Figure 27. Set Equipment VISA Address and ID for GRL-V-DPWR Automated Sink 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.

Figure 28.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.

16:11:16.947 : 192.168.4.215 : Power supply connected
16:11:17.571 : 192.168.4.215 : Keysight Technologies,E36234A,MY61001054,1.0.0-1.0.2-1.00

16:11:17.756 : 192.168.4.215 : Digital multimeter connected
16:11:17.944 : 192.168.4.215 : KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b

16:11:25.247 : 192.168.4.215 : Revision :3.0
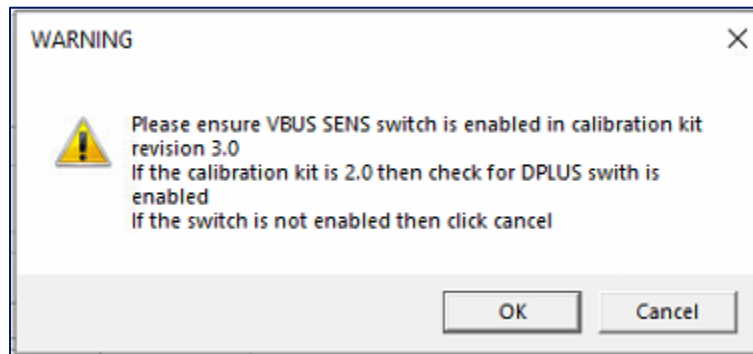16:11:25.268 : 192.168.4.215 : Verification on VBUS_Voltage

7. 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.

INFORMATION : VBUS Sens Voltage please ensure digital multimeter is connected in parallel
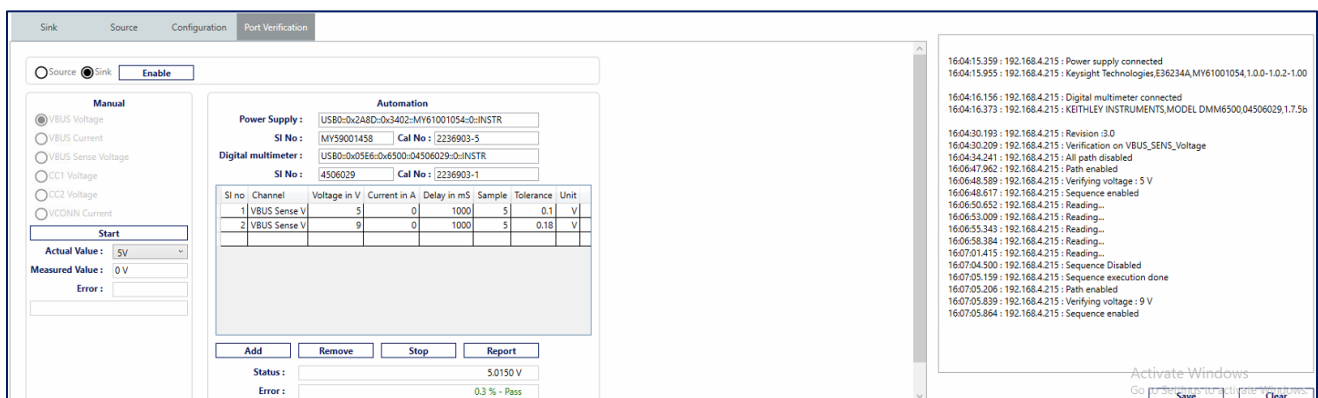
Ok
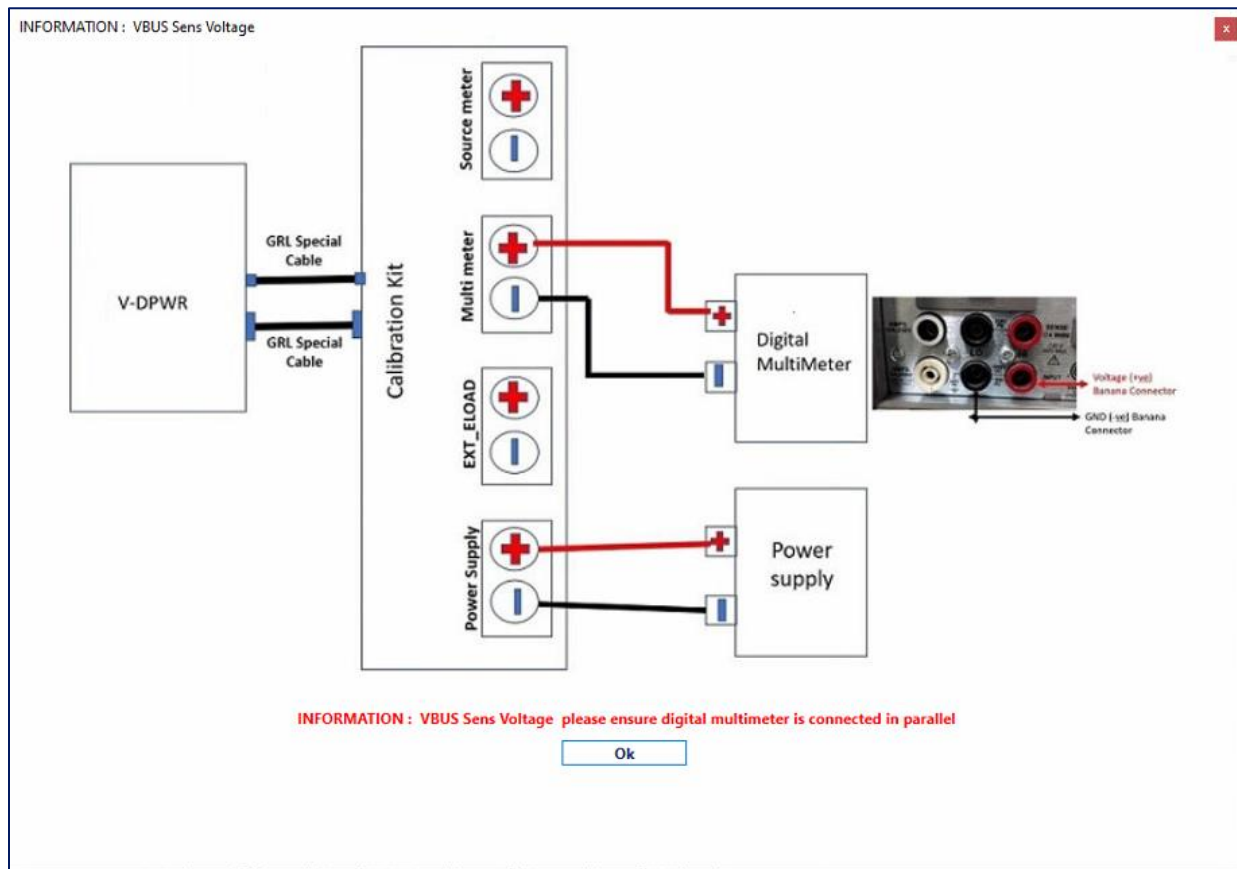
8. The following screen will appear as shown in the example below which requires the user to check the power supply voltage and VBUS line settings. Click **OK** to proceed.
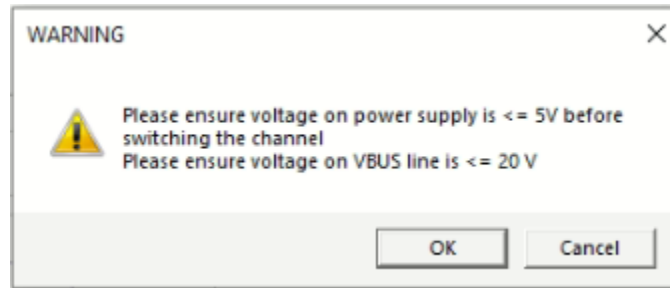
9. Next, the user will need to check that the VBUS SENS switch of calibration kit revision 3.0 is turned ON as shown in the example screen below. If revision 2.0 of the calibration kit is being used, then check that the DPLUS switch on the kit is turned ON. Once done, click **OK** to proceed.

10. While the port verification test is running, the GRL-V-DPWR 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.
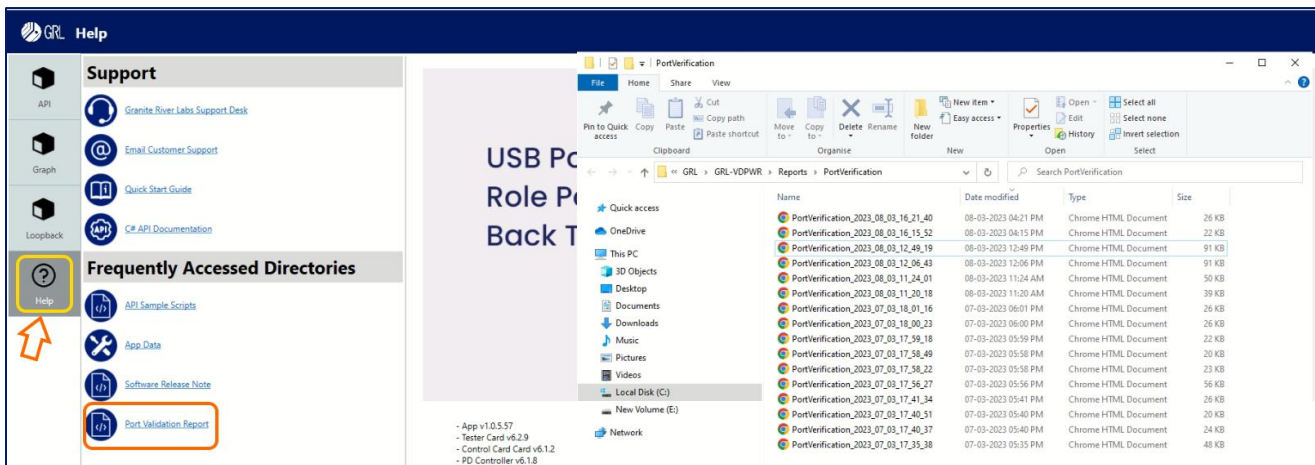
GRL-VDPWR-20230007 - Validation Report - 11-05-2023 16:07:24

Equipment details

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

Sink Mode - VBUS Sense Verification for Port1

Sl.No	Set VBUS Sense Voltage in V	V-DPWR Voltage Measurement in V	V-DPWR Current Measurement in A	Power supply Voltage in V	Power supply Current in A	DMM Measurement in V	Deviation percentage / Result
1	5	5.019	0.007	5	0.002	5	0.38 % - Pass
2	5	5.014	0.003	5	0.002	5.001	0.26 % - Pass
3	5	5.017	0.005	5	0.002	5.001	0.32 % - Pass
4	5	5.021	0.005	5	0.002	5.001	0.4 % - Pass
5	5	5.015	0.004	5	0.002	5	0.3 % - Pass
6	9	9.017	0.006	9.002	0.003	9.002	0.17 % - Pass
7	9	9.016	0.005	9	0.003	9.002	0.16 % - Pass
8	9	9.012	0.005	9.002	0.003	9.002	0.11 % - Pass
9	9	9.011	0.005	9	0.003	9.002	0.1 % - Pass
10	9	9.016	0.006	9.002	0.003	9.002	0.16 % - 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.
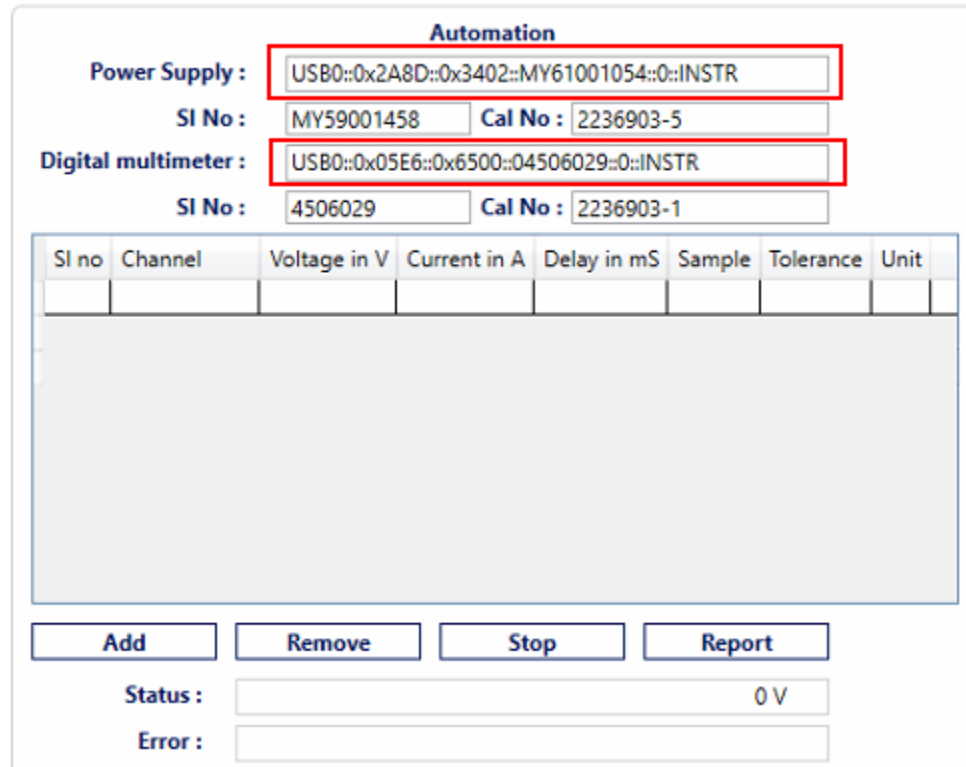
4.4.5   Procedure for VBUS Current Measurement

*Note: Make sure that the **Sink** mode has been selected and enabled for the connected port of the GRL-V-DPWR tester hardware as described in Section 3.2.1.*

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-DPWR 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 4.4.2, Connection Setup.*

Figure 29. Set Equipment VISA Address and ID for GRL-V-DPWR Automated Sink Port Verification
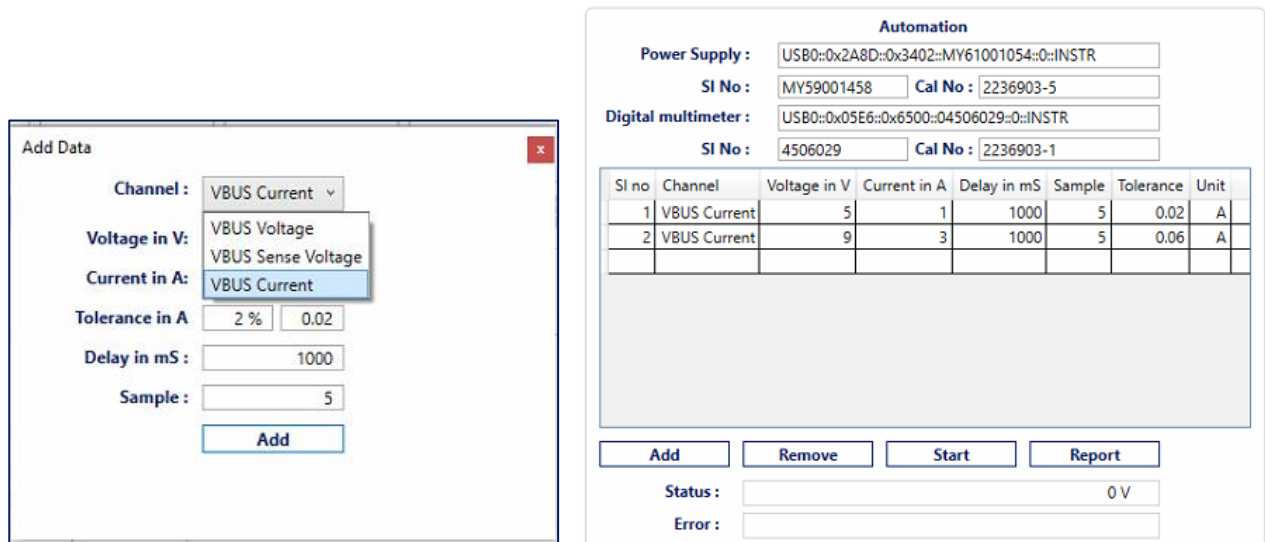
2. Click on the **Add** button and configure the following parameters:

    *   **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.

Figure 30.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.
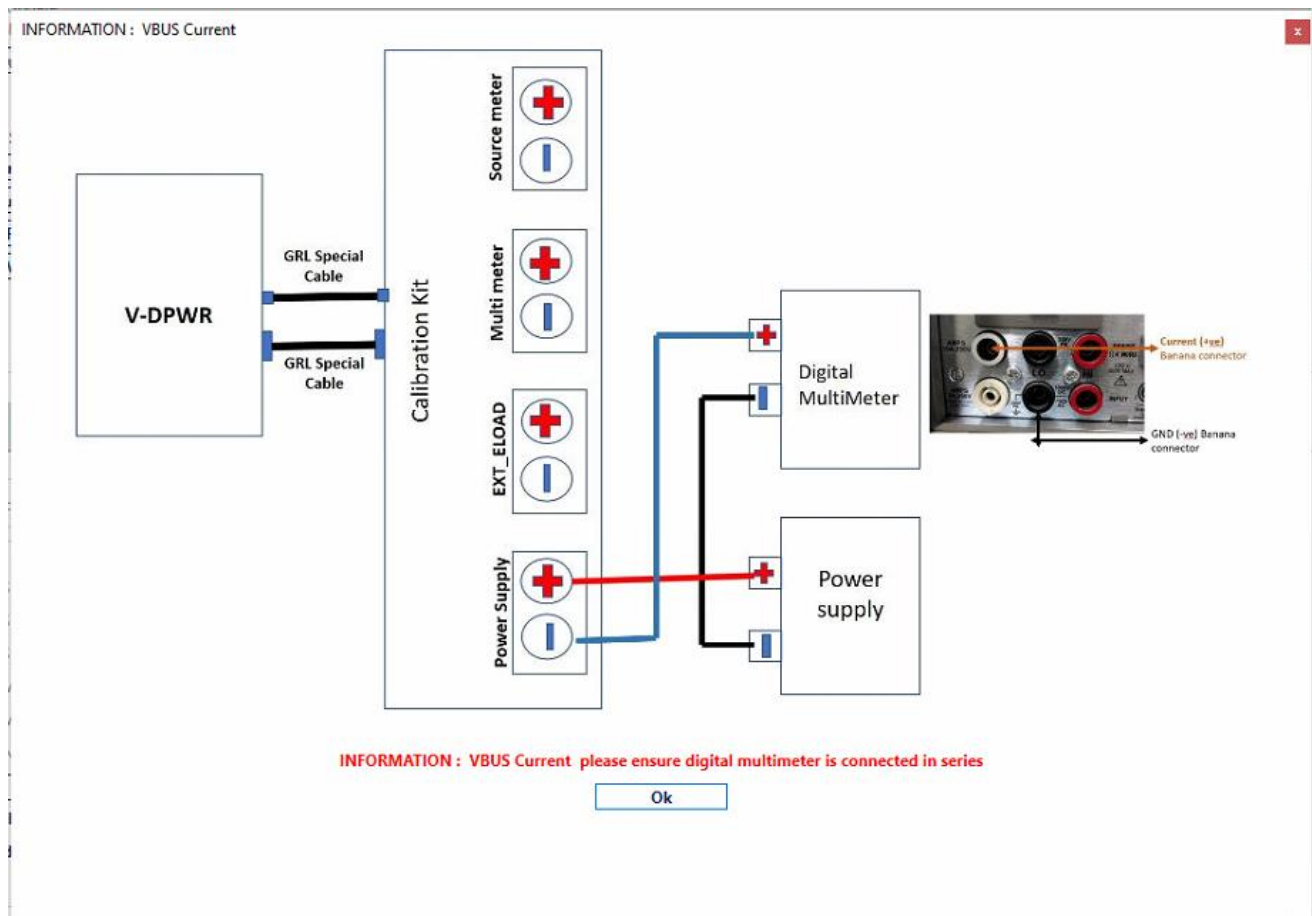
```
16:15:11.729 : 192.168.4.215 : Power supply connected
16:15:12.325 : 192.168.4.215 : Keysight Technologies,E36234A,MY61001054,1.0.0-1.0.2-1.00

16:15:12.516 : 192.168.4.215 : Digital multimeter connected
16:15:12.738 : 192.168.4.215 : KEITHLEY INSTRUMENTS,MODEL DMM6500,04506029,1.7.5b

16:15:28.567 : 192.168.4.215 : Revision :3.0
16:15:28.583 : 192.168.4.215 : Verification on VBUS_Current
```
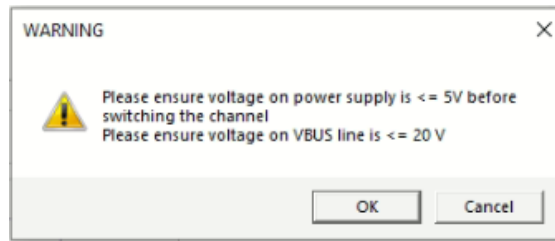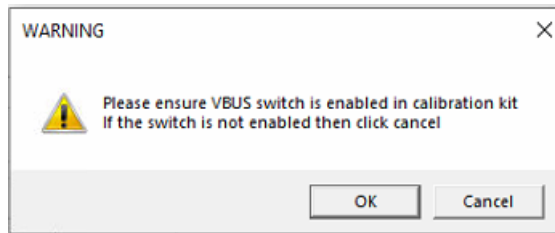
7. The connection diagram for the VBUS current measurement will then appear as shown in the example below. Confirm that all devices are properly connected following the diagram and click **Ok** to proceed.
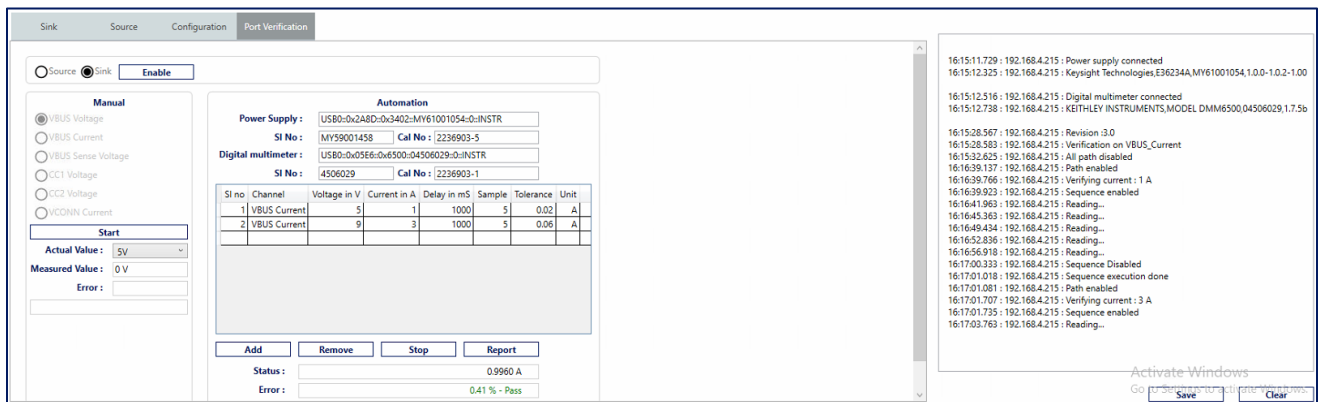

8. The following screen will appear as shown in the example below which requires the user to check the power supply voltage and VBUS line settings. Click **OK** to proceed.

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-DPWR 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.
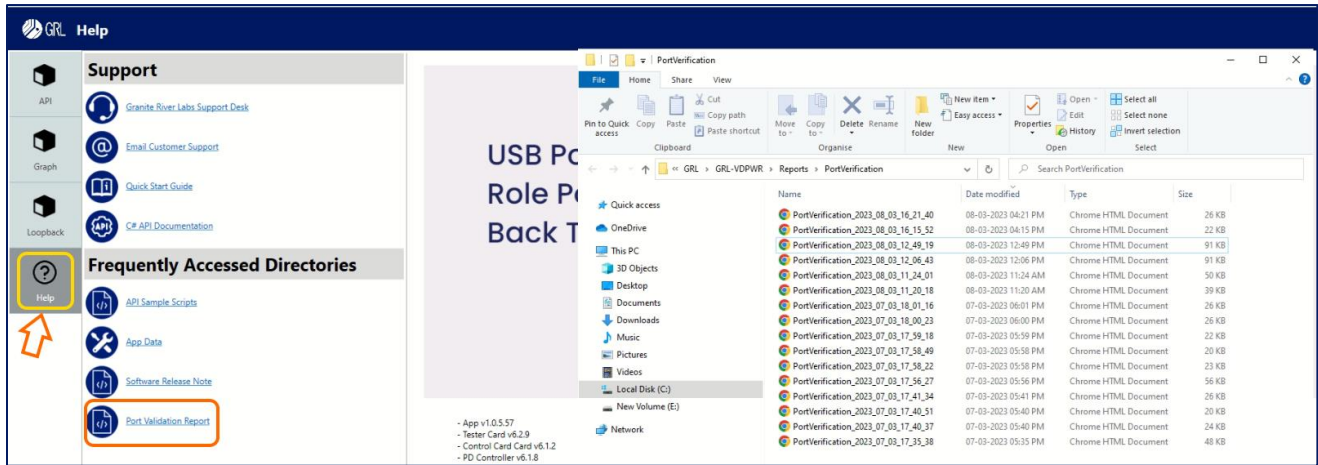
GRL-VDPWR-20230007 - Validation Report - 11-05-2023 16:17:24

Equipment details

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

Sink Mode - VBUS Current Verification for Port1

Sl.No	Set VBUS Current in A	V-DPWR Voltage Measurement in V	V-DPWR Current Measurement in A	Power supply Voltage in V	Power supply Current in A	DMM Measurement in A	Deviation percentage / Result
1	1	4.842	0.998	5	0.992	0.9916	0.65 % - Pass
2	1	4.838	0.996	5	0.992	0.992	0.4 % - Pass
3	1	4.838	0.997	5	0.992	0.9917	0.53 % - Pass
4	1	4.835	0.996	5	0.992	0.9917	0.43 % - Pass
5	1	4.839	0.996	5	0.992	0.9919	0.41 % - Pass
6	3	8.492	2.995	9	2.993	2.993	0.07 % - Pass
7	3	8.492	2.997	8.998	2.995	2.9946	0.08 % - Pass
8	3	8.491	2.996	9	2.995	2.9947	0.04 % - Pass
9	3	8.487	2.996	9	2.995	2.9948	0.04 % - Pass
10	3	8.49	2.997	9	2.995	2.9948	0.07 % - 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