

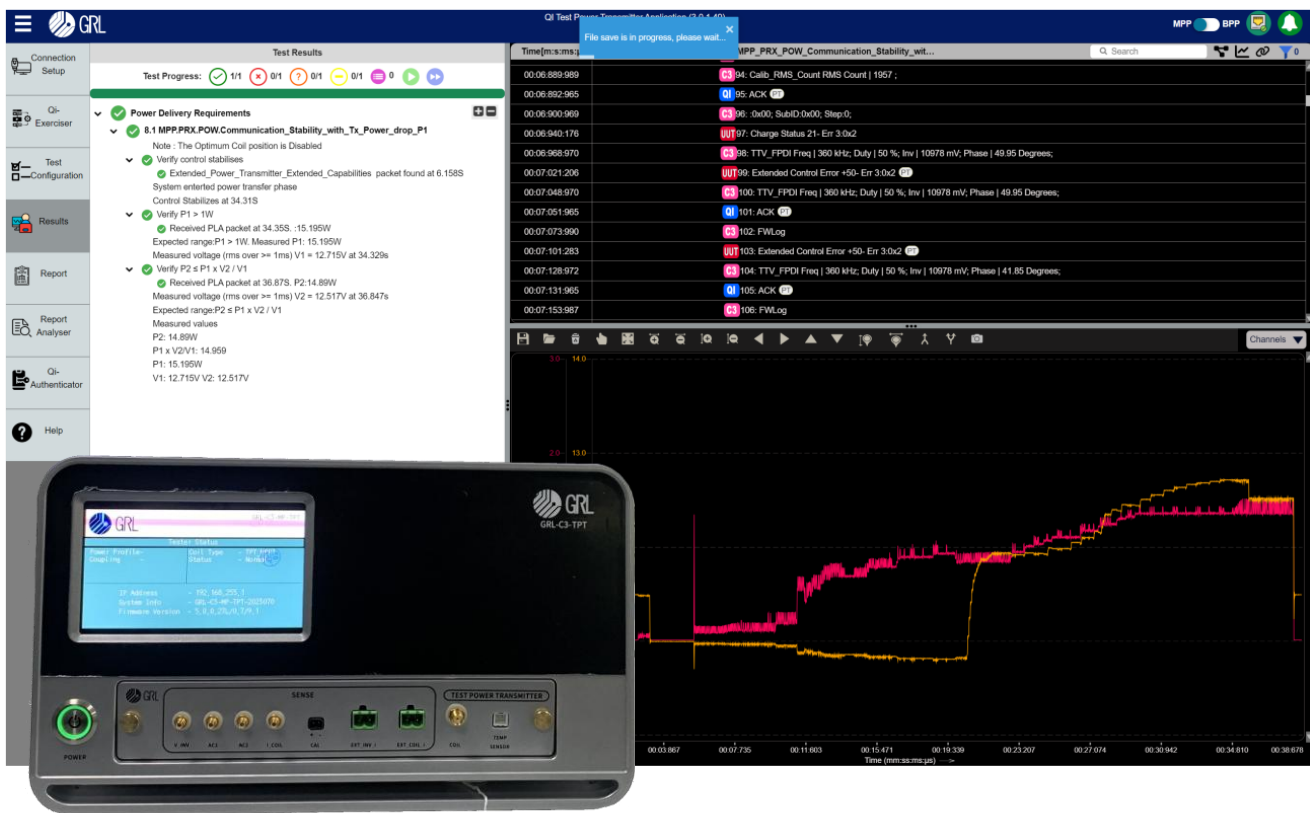


GRL PLATFORM
SOLUTIONS
FOUNDATIONAL - INTELLIGENT - PRECISE

GRL Platform Solutions

User Guide

WPC Qi Wireless Charging Power Receiver [PRx] Tester (GRL-C3-TPT) with Automation Test Application



This material is provided as a reference to get started with the GRL Platform Solutions WPC Qi Wireless Charging Power Receiver [PRx] Tester (GRL-C3-TPT) Hardware and Automation Test Application.

For software support, contact support@grlps.com.

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1 Reference Documents

The test methods outlined in this document are tests required by the Wireless Power Consortium (WPC) for compliance of a Wireless Power Receiver device to the Qi MPP, Qi BPP or Qi EPP Specification. The Qi MPP Specification may be referenced in this document that includes, but is not limited to, the following specification versions.

Note: In order to have access to all specifications, it is required that you are a member of the WPC Web site and have attained the proper permissions.

WPC Specification Compliance Documents are available for download at:

<https://www.wirelesspowerconsortium.com/knowledge-base/specifications/download-the-qi-specifications.html>

- *MPP Communication Protocol Version 2.0 (April 2023)*
- *MPP System Specification Version 2.0 (April 2023)*
- *mpp-prx-compliance-tests.pdf Version 2.0 (October 2023)*
- *mpp-prx-test-tools.pdf Version 2.0 (October 2023)*
- *Qi-v2.0-mpp-comms-protocol-errata-september-2023.pdf*
- *Qi-v2.0-mpp-PRx-compliance-tests-errata_december-2023_draft.pdf*
- *Qi-v2.0-mpp-PRx-test-tools-errata_december_2023_draft.pdf*
- *Qi-v2.0-mpp-system-errata_december-2023_draft.pdf*
- *Qi Specification – Communications Physical Layer Version 2.0.1 (February 2024)*
- *Qi Specification – Communications Protocol Version 2.0.1 (February 2024)*
- *Qi Specification – Foreign Object Detection Version 2.0.1 (February 2024)*
- *Qi Specification – Power Delivery Version 2.0.1 (February 2024)*
- *Qi Specification – Authentication Protocol Version 2.0.1 (February 2024)*
- *Qi Specification – Power Receiver Compliance Tests Version 2.0.1 (February 2024)*
- *Qi Specification – Power Receiver Test Tools Version 2.0.1 (February 2024)*

2 Acronym/Abbreviation Glossary

MPP	Magnetic Power Profile
BPP	Base Power Profile
EPP	Extended Power Profile
TPT	Test Power Transmitter
PRx	Power Receiver
DUT	Device Under Test
OS	Operating System
BSUT	Base Station Under Test
FPGA	Field Programmable Gate Array
API	Application Programming Interface
CTS	Compliance Test Specification
MOI	Method of Implementation
GP	Guaranteed Power

FOD	Foreign Object Detection
Power Tx or PTx	Power Transmitter
ID/Config	Identification & Configuration
RP	Received Power
Qf	Quality Factor
PRMC	Power Receiver Manufacturer Code
PPS	Programmable Power Supply

3 Scope of this User Guide

This User Guide serves as the primary user documentation for the GRL-C3-TPT WPC Qi Wireless Charging Power Receiver (PRx) Tester Hardware and Automation Test Application. The subsequent sections describe the GRL-C3-TPT tester hardware initial setup as well as the features provided by the GRL-C3-TPT automation test application when connected to the GRL-C3-TPT tester hardware.

4 Overview of GRL-C3-TPT Standard Purchase Items and Orderable Accessories

4.1 GRL-C3-TPT Shipping Box Contents

SI No.	Description	Serial Number	Quantity
1	GRL-C3-TPT Tester Hardware	GRL-C3-MP-2024110	1
2	Power Adapter	NA	1
3	Power Cord	NA	1
4	USB Cable (Type-A to Type-B)	NA	1
5	USB Cable (Type-A to mini-B)	NA	1
6	Ethernet Cable	NA	1
7	SMB to BNC Cable	NA	4
8	SMA to BNC Cable	NA	1
9	Jumper Connector	NA	2
10	GRL-C3-TPT-MPP1 / GRL-C3-TPT-MPP4	GRL-MP1-2024124	1
11	GTx Magnetic Force Testing Coil	NA	1
12	Z Spacer – 1 mm	NA	1
13	Z Spacer – 2 mm	NA	1
14	Z Spacer – 3 mm	NA	1
15	Z Spacer – 4 mm	NA	1
16	GRL-C3-BPP-TPT#2 GRL-C3-EPP-TPT#MP1	GRL-EP-2024001	1
17	Probing Board	GRL-PB-2024019	1
18	Calibration Report ISO 17025	NA	1
19	Calibration Report – Internal	NA	1
20	Reference Object RO#1	NA	1
21	Reference Object RO#2	NA	1
22	Reference Object RO#3	NA	1

SI No.	Description	Serial Number	Quantity
23	RFO#MPP1A	NA	1
24	RFO Fixture	NA	1
25	BPP-EPP Coil Enclosure RO Frame	NA	1
26	LCR Fixture Board [SMA]	LFB-2023004	1
27	BNC to SMA Cable for LCR Fixture Board	NA	4
28	Zero-ohm Terminator	NA	1
29	Calibration Report ISO 17025 (Soft Copy)	NA	1
30	GRL Platform Solutions Verification Report (Soft Copy)	NA	1
	Total		35



GRL-C3-TPT – WPC Qi Wireless Charging Power Receiver (PRx) Tester



Power Adapter



USB Cable – Standard USB Type-A to Type-B Programming cable used to update the GRL-C3-TPT firmware. Connects to the GRL-C3-TPT “FW Update” USB port.



Ethernet Cable – 3m Cat 5 cable to connect the GRL-C3-TPT tester hardware to the control computer.



SMB to BNC Cable – Standard SMB to BNC cable used to connect the oscilloscope channels to the SENSE connectors (V_INV/AC1/AC2) on the GRL-C3-TPT tester hardware.



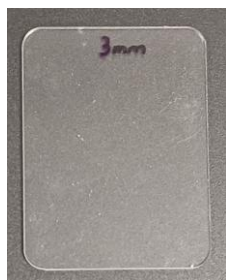
SMA to BNC Cable

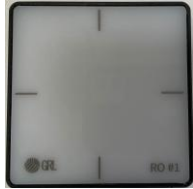
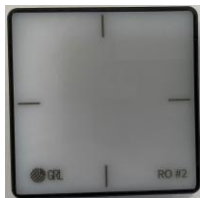


Jumper Connector



GRL-C3-TPT-MPP1 / GRL-C3-TPT-MPP4 (Coil with Glass Surface)

**Gtx Magnetic Force Testing Coil****GRL-C3-BPP-TPT#2**
GRL-C3-EPP-TPT#MP1**GRL Platform Solutions Probing Fixture****E-Load Firmware Update Cable****2mm Spacer****3mm Spacer**

**Positioning Tool****Reference Object RO#1****Reference Object RO#2****Reference Object RO#3****RFO#MPP1A****RFO Fixture**

5 Getting Started with GRL-C3-TPT

This section describes how to get started with the GRL-C3-TPT test solution for Qi MPP / BPP / EPP Specification compliance testing. Whether you are installing for the first time or doing an upgrade, please make sure to follow all the steps in this section to verify your setup prior to testing a Device Under Test (DUT). The procedure is as follows:

1. Install the latest version of GRL-C3-TPT automation test application on the host computer (laptop or desktop) connected to the GRL-C3-TPT tester hardware. It is recommended that the host computer supports the Intel Core i7 processor and 8GB RAM with Google Chrome version 80.0.3987.122 or above (64-bit) for the application to run properly. Make sure to clear the browser cache before launching the GRL-C3-TPT application.
2. Make sure the GRL-C3-TPT tester firmware has been updated to the latest version. Refer to Section 7.

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

5.1 Install GRL-C3-TPT Application

1. Download the GRL-C3-TPT application from <http://grlps.com/download-center/>.
2. Run the installer by double clicking the extracted executable (`GRL_GRL-C3-TPT_App_V1x.x.exe`) and then click on the 'Next' button.

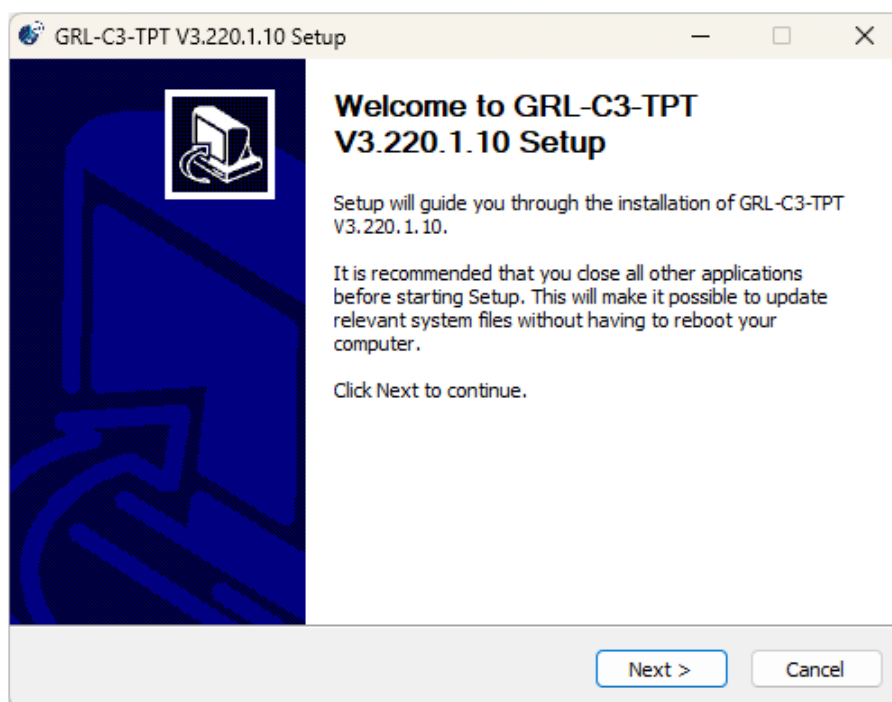


FIGURE 5.1: START GRL-C3-TPT APPLICATION INSTALLATION

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

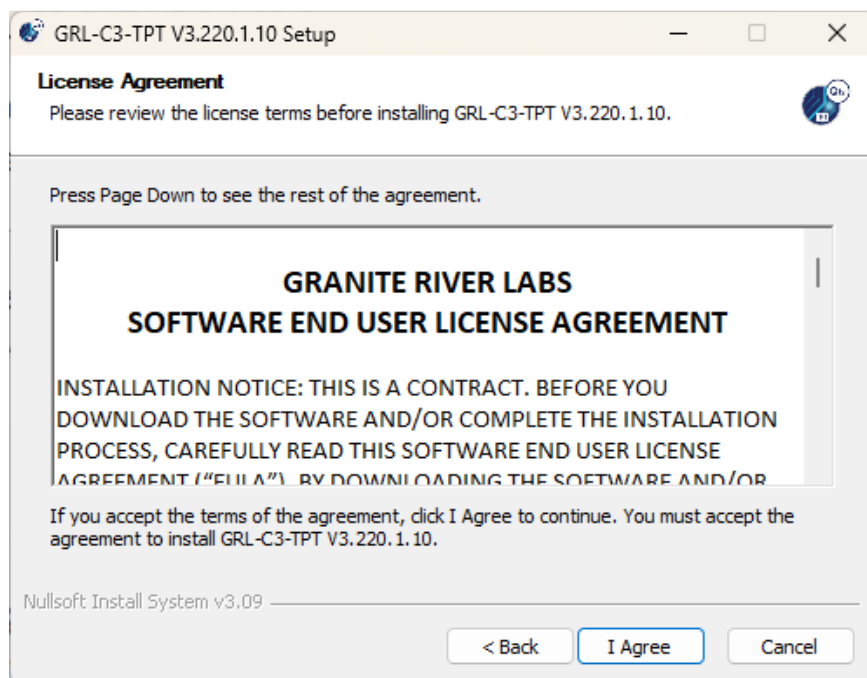


FIGURE 5.2: ACCEPT GRL-C3-TPT LICENSE AGREEMENT

4. The software installation will then proceed.

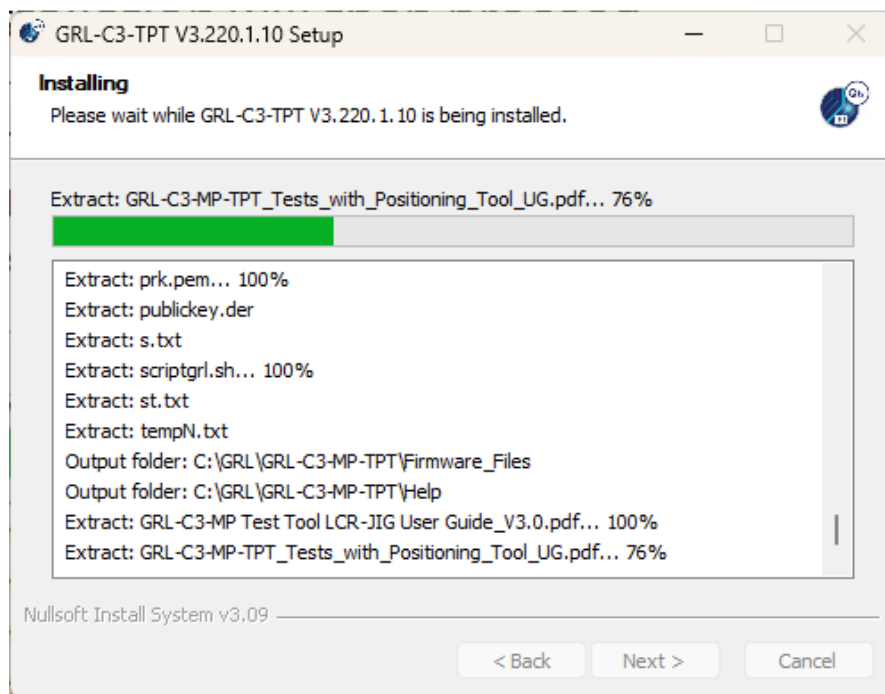


FIGURE 5.3: GRL-C3-TPT APPLICATION INSTALLATION IN PROGRESS

5. Upon completion, click on the 'Finish' button to complete the software installation.

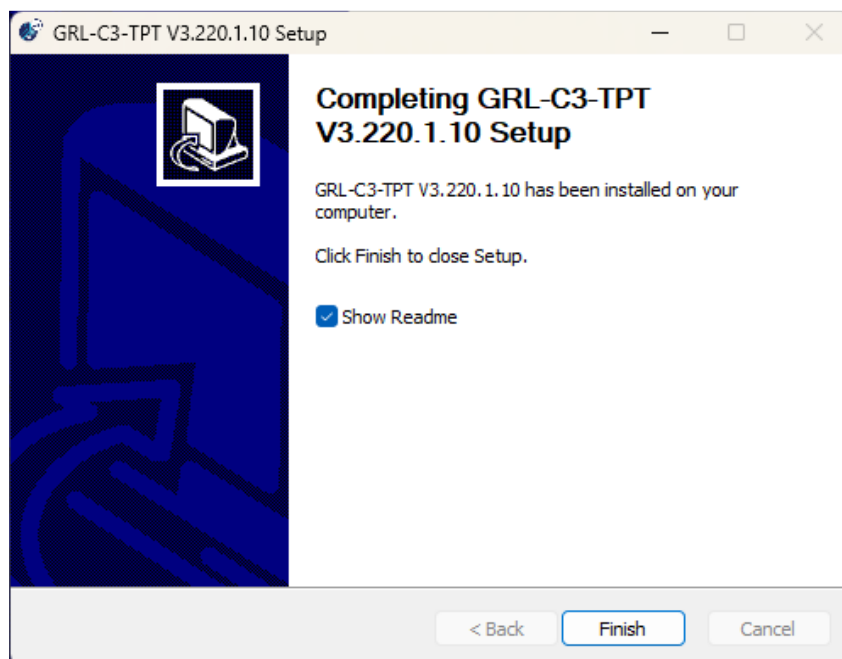


FIGURE 5.4: GRL-C3-TPT APPLICATION INSTALLATION COMPLETED

6. The GRL-C3-TPT application is now ready for use.

5.2 Start Up and Navigate GRL-C3-TPT Application

1. Once installed, you can directly open the GRL-C3-TPT application using the “**GRL-C3-TPT**” application desktop shortcut. This will initiate the App server to run backend operations before launching the GRL-C3-TPT application.

Note: Do not close this window except when you need to exit from the GRL-C3-TPT application.

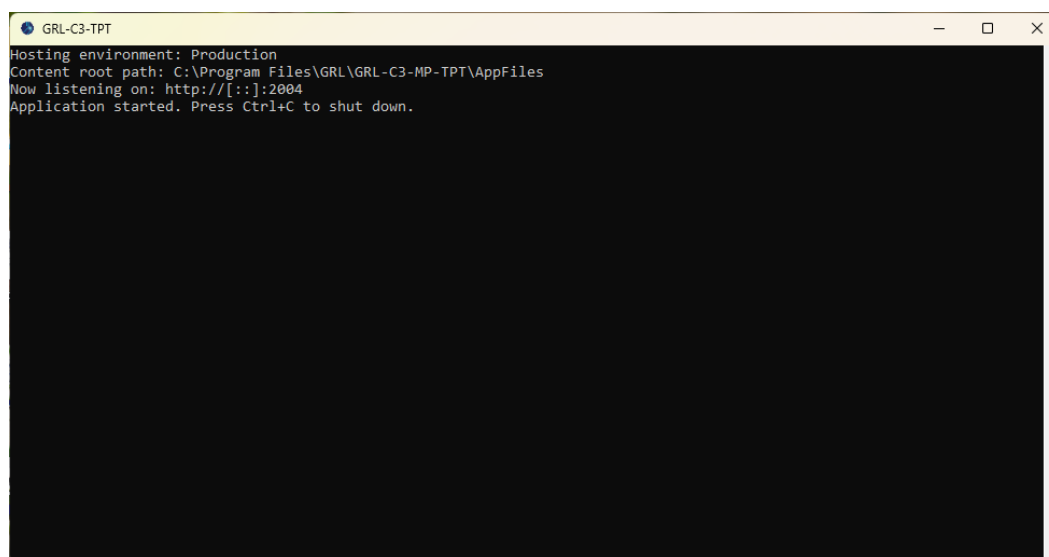


FIGURE 5.5: APP SERVER SCREEN RUNNING BACKEND OPERATIONS

2. The GRL-C3-TPT application should launch after a few seconds on a browser window with the appropriate port number. If for some reason the browser window does not appear after a few minutes, open a new browser tab and navigate to *http://IP address of host PC Windows software:3003/* (for example, *http://192.168.3.241:3003/*).
3. The GRL-C3-TPT application when launched will display “Connection Setup” as the landing screen as follows:

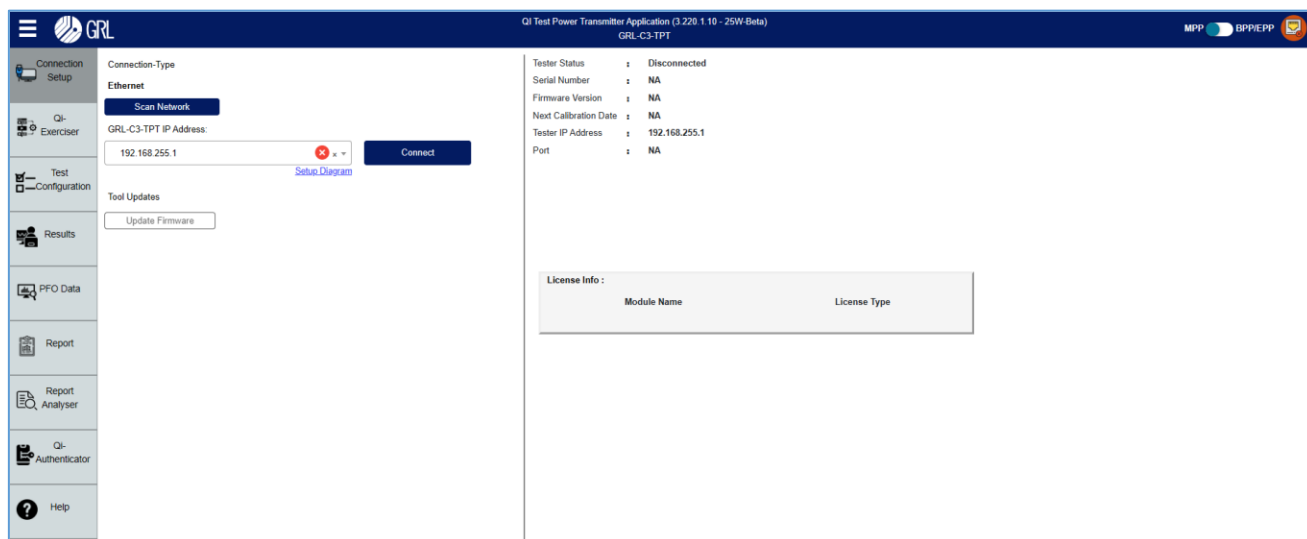


FIGURE 5.6: GRL-C3-TPT APPLICATION LANDING SCREEN

This screen allows you to set up connection between the GRL-C3-TPT application and the GRL-C3-TPT Tester hardware as well as performing firmware/software updates. More details are provided in Section 7.

5.2.1 Using GRL-C3-TPT Application in Chrome OS

Note: Make sure that the GRL-C3-TPT tester hardware is connected to a control PC running Windows 10.

1. Install the GRL-C3-TPT application on a Windows 10 control PC connected to the GRL-C3-TPT tester hardware.
2. Once installed, open the GRL-C3-TPT application using the **GRL-C3-TPT** desktop shortcut.
3. Open a new Chrome browser tab in Chrome OS and navigate to *http://IP address of host PC Windows software:3003/* (for example, *http://192.168.3.241:3003/*).

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

See Figure 5.7 below for an illustration of the above steps.

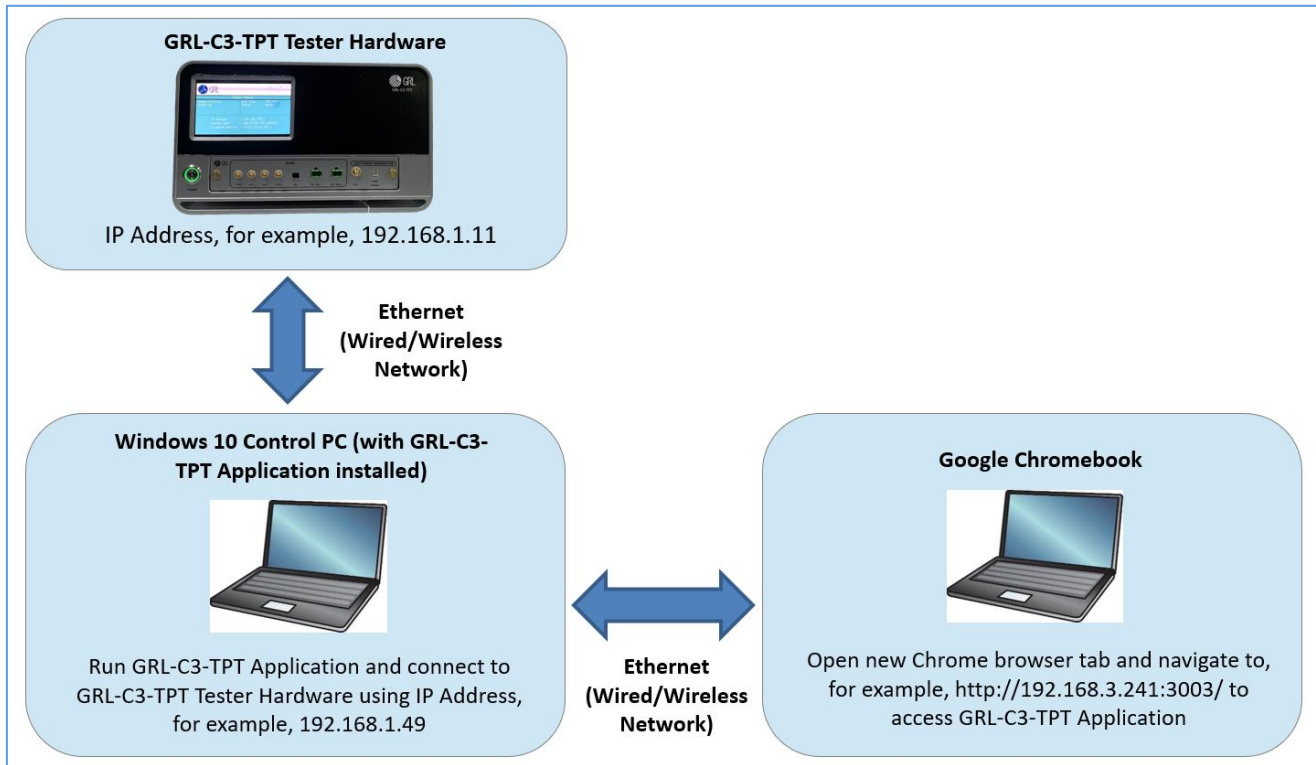


FIGURE 5.7: USING GRL-C3-TPT APPLICATION IN CHROME OS

5.2.2 Using GRL-C3-TPT Application in macOS

Note: Make sure that the GRL-C3-TPT tester hardware is connected to a control PC running Windows 10.

1. Install the GRL-C3-TPT application on a Windows 10 control PC connected to the GRL-C3-TPT tester hardware.
2. Once installed, open the GRL-C3-TPT application using the **GRL-C3-TPT** desktop shortcut.
3. Open a new Chrome browser tab in macOS and navigate to *http://IP address of host PC Windows software:3003/* (for example, <http://192.168.3.241:3003/>).

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

See Figure 5.8 below for an illustration of the above steps.

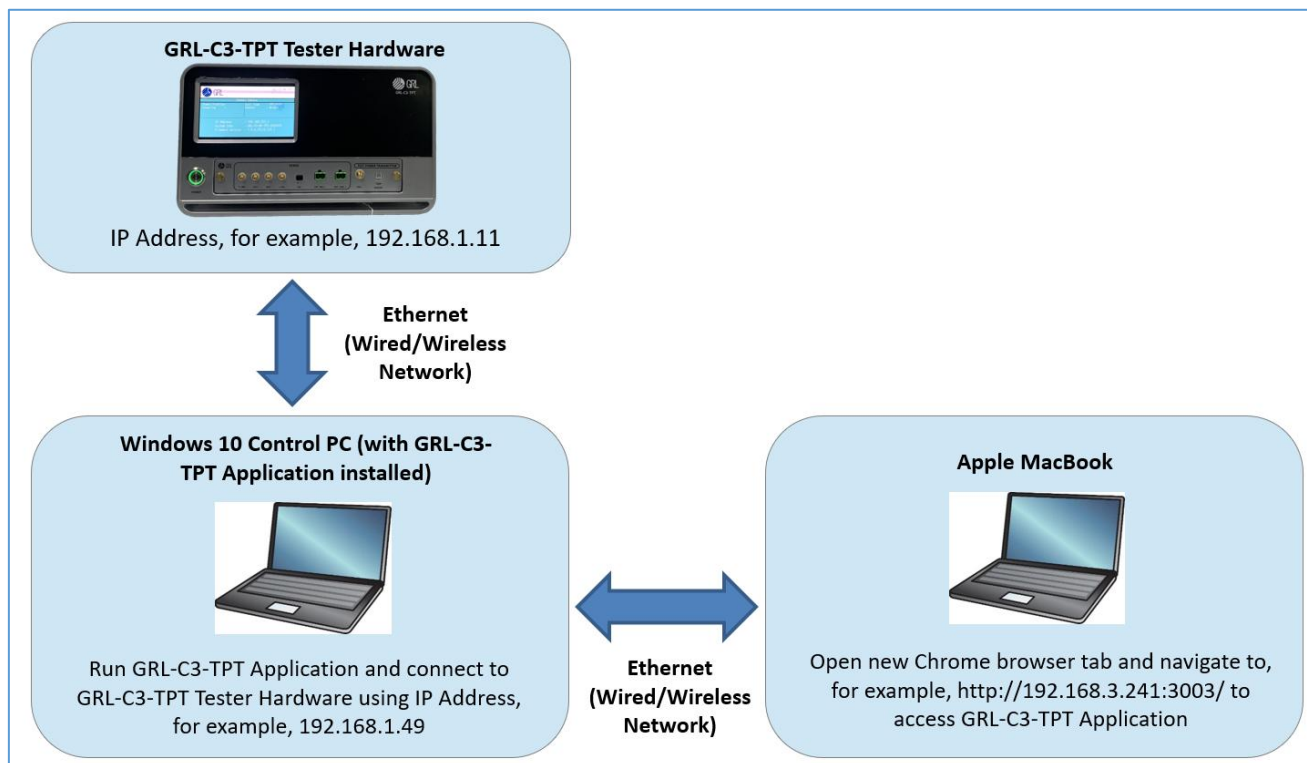


FIGURE 5.8: USING GRL-C3-TPT APPLICATION IN MACOS

6 Connection and Setup of GRL-C3-TPT Tester Hardware

Figure 6.1 below shows an example setup for testing a Qi MPP, BPP or EPP based power receiver (PRx) DUT.

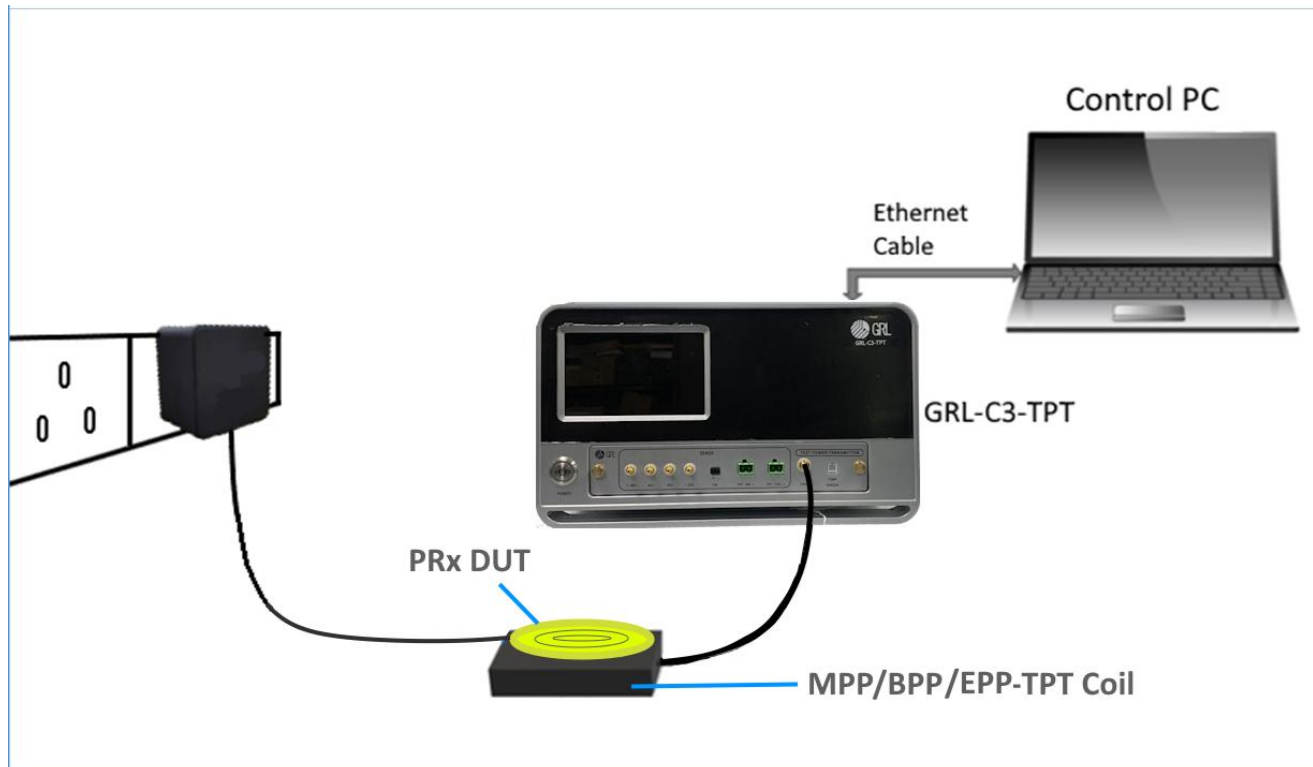


FIGURE 6.1: GRL-C3-TPT HARDWARE SETUP FOR Qi MPP, BPP OR EPP BASED PRx DUT

The GRL-C3-TPT application installed on a Windows 10 (or higher) computer automates the testing process. Below is a procedure for connecting the hardware and verifying proper hardware connections.

1. Connect power supply to the GRL-C3-TPT tester hardware.
2. Connect the GRL-C3-TPT tester hardware using a physical Ethernet connection between the control computer and the tester.
3. Connect the Power Receiver (PRx) DUT to a power outlet.
4. Connect the MPP, BPP or EPP Test Power Transmitter (TPT) coil to the “Coil” connector on the GRL-C3-TPT tester hardware. Place the PRx DUT on top of the MPP/BPP/EPP-TPT coil.

6.1 Connect Power Supply to GRL-C3-TPT Tester Hardware

Connect the GRL-C3-TPT Power interface using the Power Brick included with the tester hardware.



FIGURE 6.2: GRL-C3-TPT POWER INTERFACE

6.2 Connect Ethernet Cable and Turn On GRL-C3-TPT Tester Hardware

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



FIGURE 6.3: GRL-C3-TPT ETHERNET CONNECTOR

Turn on the GRL-C3-TPT tester hardware using the Power On/Off button on the front of the tester as shown in Figure 6.4.



FIGURE 6.4: GRL-C3-TPT POWER BUTTON

6.2.1 Verify GRL-C3-TPT Tester Hardware Ethernet Connection

The Ethernet port on the control computer needs to be configured correctly for the GRL-C3-TPT tester hardware to recognize the control computer and vice versa.

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

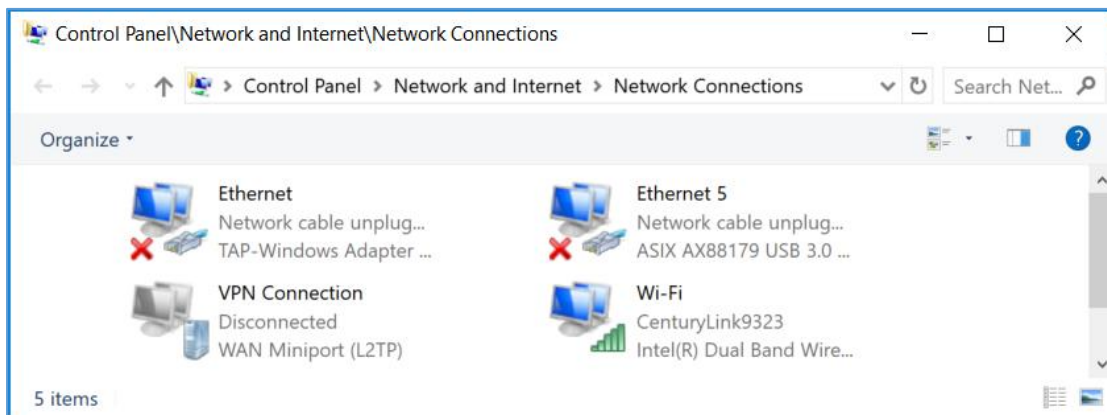


FIGURE 6.5: NETWORK CONNECTIONS BEFORE CONNECTING GRL-C3-TPT

Open the Ethernet panel for the Ethernet port that will connect to the GRL-C3-TPT tester hardware, select “Internet Protocol Version 4 (TCP/IPv4)” and click on the “Properties” button below and to the right.

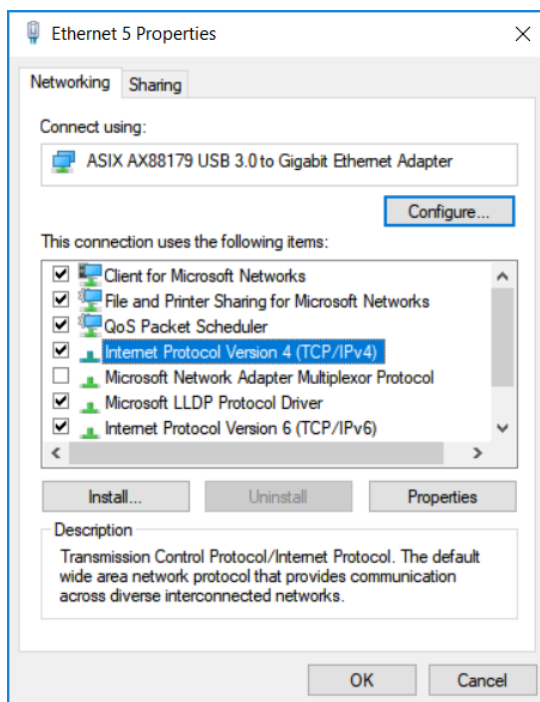


FIGURE 6.6: ETHERNET PROPERTIES

Set up the TCP/IPv4 properties as shown below.

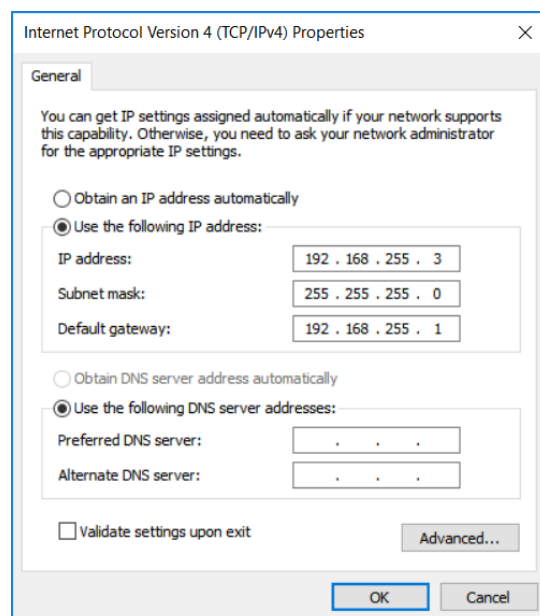


FIGURE 6.7: ETHERNET PROPERTIES WITH TCP/IPv4 SELECTED

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

Click on the “OK” button on the Internet Protocol Properties and close the Ethernet Properties. Make sure the GRL-C3-TPT tester hardware is powered on and completely

booted up (front panel display shows firmware version number) and then connect the Ethernet cable from the GRL-C3-TPT tester hardware to the computer's Ethernet port that was just set up. The network connections window should now look as pictured in Figure 6.8 below:

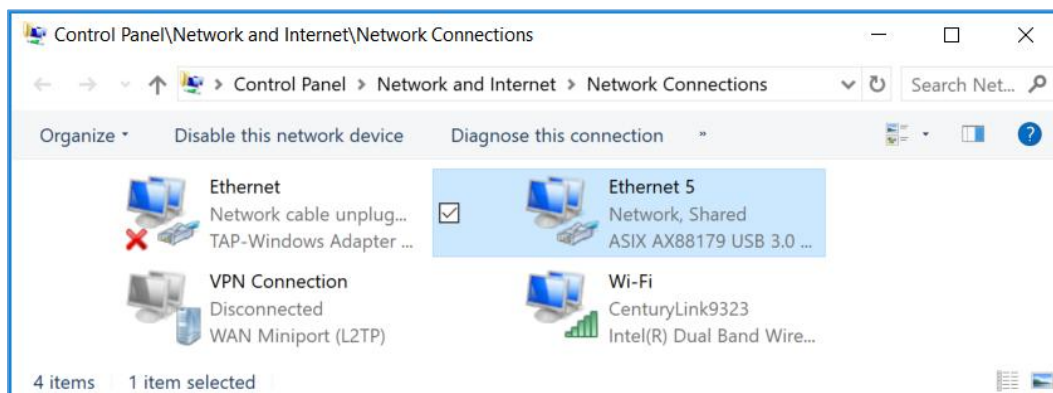


FIGURE 6.8: NETWORK CONNECTIONS AFTER SETUP AND CONNECTION OF GRL-C3-TPT

The GRL-C3-TPT tester hardware is now set up and ready for use.

Before running any tests, it is recommended that you verify that the control computer and the GRL-C3-TPT are communicating by going to the “Connection Setup” screen on the GRL-C3-TPT application and clicking on the “Connect” button. The tester status should display “Connected”. Refer to Section 7 for more information.

6.3 Connect Oscilloscope to GRL-C3-TPT Tester Hardware

An external oscilloscope can be connected to the GRL-C3-TPT tester hardware to perform measurements. The GRL-C3-TPT currently supports oscilloscope measurements with the Tektronix DPO7000 and PicoScope 6403D oscilloscopes.

Connect the oscilloscope channels to the SENSE connectors (V_INV/AC1/AC2) on the front of the GRL-C3-TPT tester hardware as indicated below using the SMB cable.



FIGURE 6.9: OSCILLOSCOPE TO GRL-C3-TPT CONNECTIONS

The user can use the default oscilloscope configuration file, “TekScope Settings” which is available with the GRL-C3-TPT application to load into the TekScope to perform measurements. This config file is located in `C:\GRL\GRL-C3-TPT\TekScopeSettings` on the control computer.

6.4 Connect MPP/BPP/EPP-TPT Coil to GRL-C3-TPT Tester Hardware

Connect the MPP/BPP/EPP-TPT coil to the “Coil” connector on the GRL-C3-TPT tester hardware. Below example shows the MPP-TPT coil connection:



FIGURE 6.10: MPP-TPT COIL TO GRL-C3-TPT CONNECTION

Note: Make sure to place the DUT connected to a power outlet on the MPP/BPP/EPP-TPT coil to perform testing.

6.5 Tx Coil Handling and Connection Guidelines

Make sure to read, follow and adhere to the following guidelines when handling the Tx coil.

1. **Avoid Lifting by the Cable:**

Always lift the Tx coil by its body. Do not pull or lift it using the cable, as this may cause internal damage or affect performance.

2. **Check for Cable Twisting:**

While connecting the Tx coil to the GRL-C3-TPT tester hardware or LCR jig, inspect the cable for any twists. If the cable is twisted, gently straighten it before proceeding to ensure proper operation and to avoid stress on the connectors.

3. **Align SMA Connectors Correctly:**

Carefully align the SMA connector of the GRL-C3-TPT coil with the corresponding mating connector on either the GRL-C3-TPT tester hardware or the LCR test jig. Do not force the connection as misalignment may damage the connectors.

4. **Hand-Tighten with Care:**

Thread the connector onto the mating part and hand-tighten until resistance is felt. Avoid over-tightening during this step to prevent thread damage.

5. **Use the Correct Tool:**

Once hand-tightened, place the SMA torque wrench firmly over the connector. Ensure the wrench is fully seated to avoid slipping or rounding off the connector edges.

6. **Apply the Specified Torque:**

Rotate the wrench clockwise, applying torque to the connector. Tighten until the wrench "clicks", indicating the correct torque of 3.98 in-lbs (0.45 Nm) has been reached. Stop immediately after hearing or feeling the click.

7. **Avoid Side Load on Cables:**

Ensure the cable remains free from tension or bending stress during and after connection. Route cables cleanly to avoid pulling on the connectors.

8. **Handle SMA Connectors with Care:**

Always keep the SMA connector ends clean and capped when not in use. Inspect for debris or wear before each use to maintain signal integrity.

9. **Use Proper ESD Precautions:**

When handling the coil or connecting to test equipment, follow ESD safety guidelines to prevent electrostatic discharge damage.

10. **Store Coils Properly After Use:**

Place coils in protective cases or designated holders to avoid physical or environmental damage when not in operation.

7 Connection and Setup of GRL-C3-TPT Application

Note: The following procedure assumes that the GRL-C3-TPT tester hardware has been properly set up as described above.

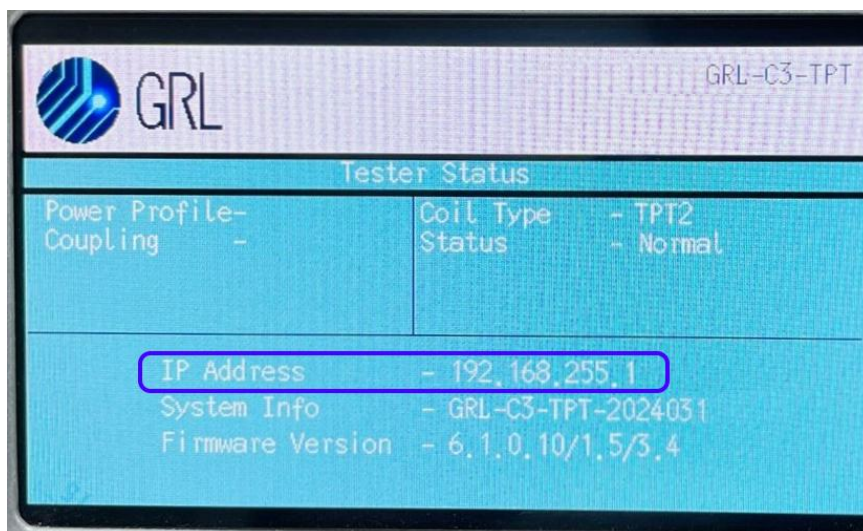
To connect the GRL-C3-TPT application with the GRL-C3-TPT tester hardware using a dynamic IP address, do the following:

1. Connect one end of the Ethernet cable to the Ethernet port at the back of the GRL-C3-TPT tester hardware as indicated in Figure 7.1 below. Connect the other end of the Ethernet cable to an available LAN port.



FIGURE 7.1: CONNECT ETHERNET CABLE TO GRL-C3-TPT ETHERNET PORT

2. After the Ethernet connection has been successfully established, power cycle and restart the GRL-C3-TPT tester hardware.
3. On the GRL-C3-TPT application landing page ("Connection Setup" screen), enter the IP address as displayed on the GRL-C3-TPT tester hardware screen and click on the **Connect** button. You can also click on the **Scan Network** button to detect all available GRL-C3-TPT tester hardware connected to the same network.



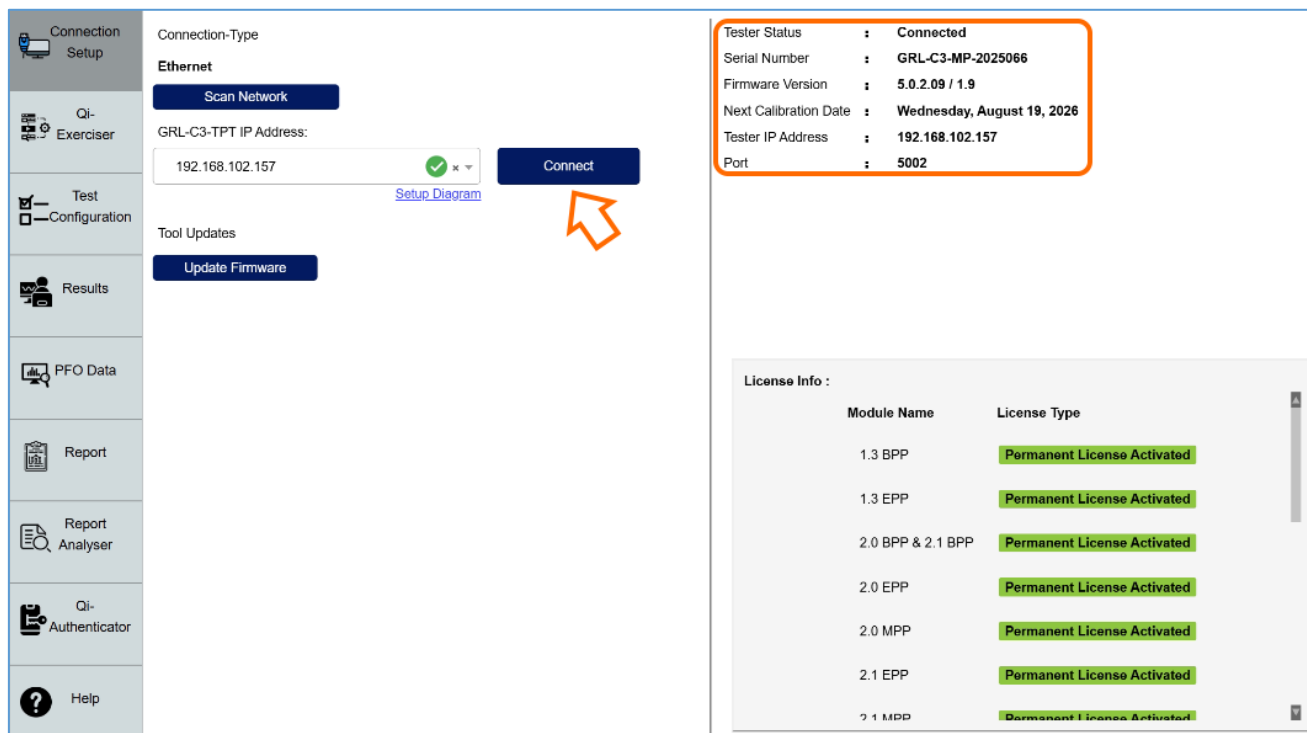


FIGURE 7.2: CONNECTION CONFIGURATION SCREEN AFTER SUCCESSFUL CONNECTION

4. Once the dynamic IP address is verified successfully, the GRL-C3-TPT tester hardware and application should now be connected as indicated by the tester information display (“Tester Status”, “Serial Number”, “Firmware Version”, etc.). You can now proceed with test configuration and execution.
5. Optionally you can also select “[Setup Diagram](#)” below the IP address field to display the test setup connection diagram. This shows how to attach the TPT coil to the GRL-C3-TPT tester hardware before placing the PRx DUT on the coil and also shows how to connect the tester hardware to the control computer via Ethernet.

Along with each GRL-C3-TPT application revision, a new version of FPGA firmware and E-Load code is provided. Use the following procedure to update the GRL-C3-TPT tester hardware’s FPGA and E-Load firmware.

6. Click on the **Update Firmware** button to update the GRL-C3-TPT tester hardware’s FPGA and E-Load firmware. Clicking on this button causes a set of instructions to appear to guide you through the entire updating process. Follow the instructions to perform the updates accordingly.

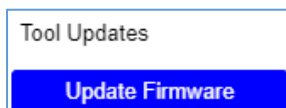


FIGURE 7.3: UPDATE GRL-C3-TPT FIRMWARE BUTTON

7.1 Update GRL-C3-TPT Tester Hardware's Firmware

Follow the steps below to perform firmware update for the GRL-C3-TPT tester hardware:

1. Click on the **Update Firmware** button and the following pop-up message will appear (Figure 7.4 below).
 - a. Using a standard USB Type-A to Type-B cable, connect the USB Type-B port (for firmware update as indicated in the image) at the back of the GRL-C3-TPT tester hardware to the control PC (where the GRL-C3-TPT application is running). When connected, click “Ok” to proceed.



FIGURE 7.4: UPDATE GRL-C3-TPT FIRMWARE- #1

2. The firmware update process will start and may take a few minutes to complete. A pop-up message will appear when the firmware update process has completed successfully (Figure 7.5 below). Click “Ok” to proceed with E-Load/PPS firmware update for the GRL-C3-TPT tester hardware.

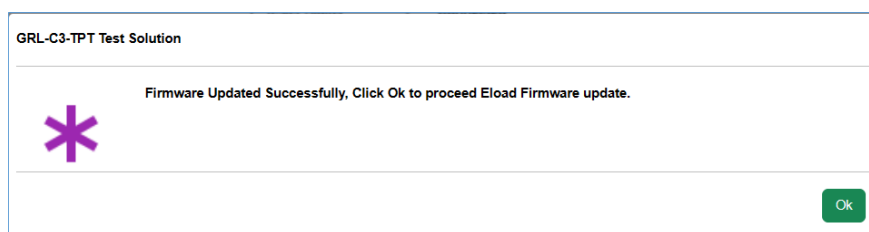
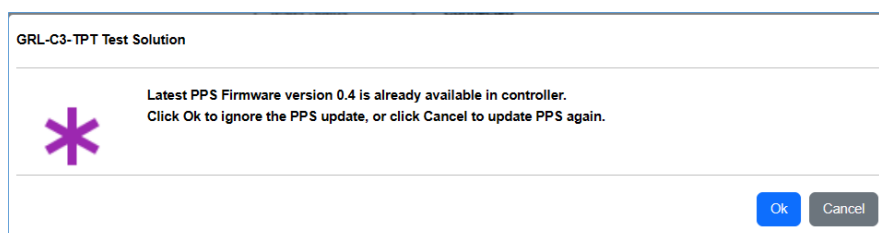


FIGURE 7.5: UPDATE GRL-C3-TPT FIRMWARE- #2

3. The GRL-C3-TPT application will check the existing version of the E-Load/PPS firmware on the GRL-C3-TPT tester hardware before updating. If the latest E-Load/PPS firmware already exists on the tester, click “Ok” to bypass the update process and proceed or otherwise click “Cancel” to update the E-Load/PPS firmware again (Figure 7.6 below).



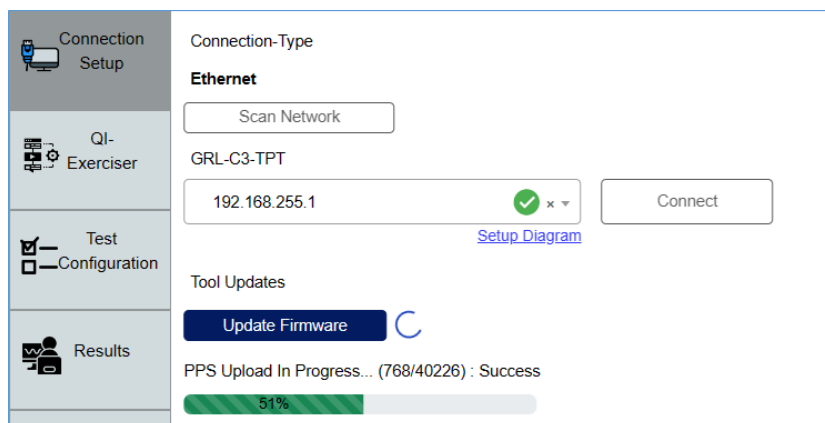


FIGURE 7.6: UPDATE GRL-C3-TPT FIRMWARE- #3

4. Once the firmware update has completed successfully, click “Ok” to power cycle and reboot the GRL-C3-TPT tester hardware (Figure 7.7 below).

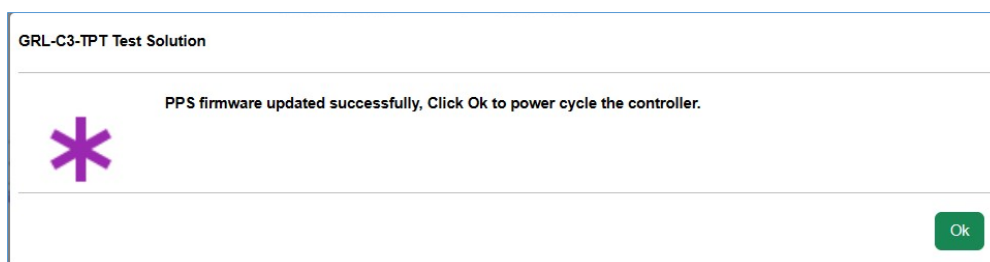


FIGURE 7.7: UPDATE GRL-C3-TPT FIRMWARE- #4

5. After the GRL-C3-TPT tester hardware has rebooted, connect the tester to the application by clicking on the **Connect** button (Figure 7.8 below).

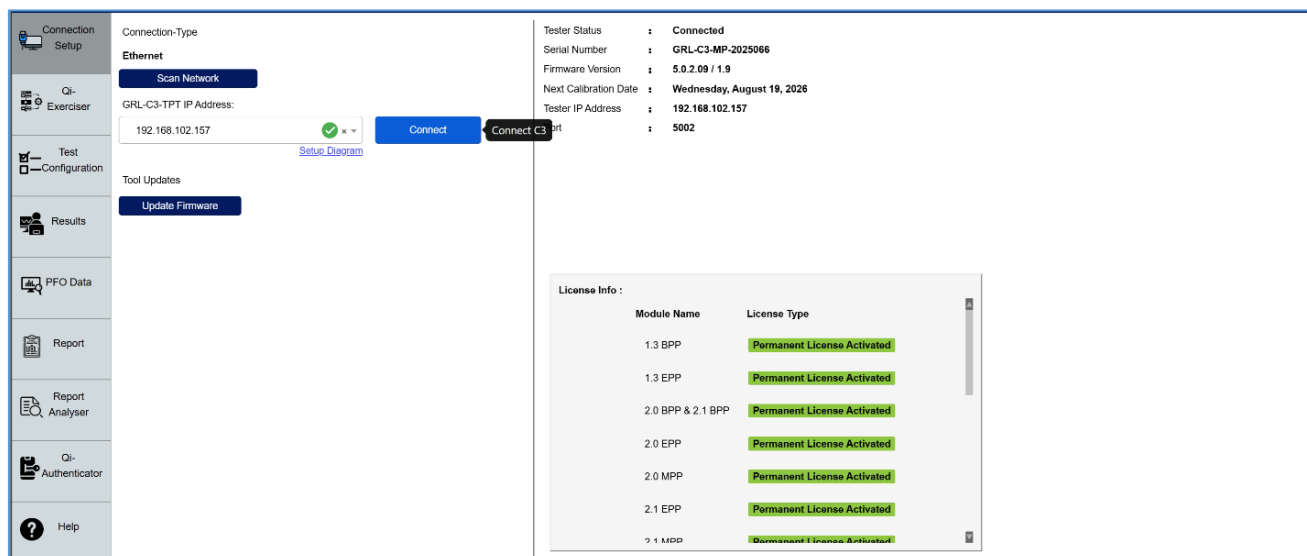


FIGURE 7.8: UPDATE GRL-C3-TPT FIRMWARE- #5

6. The GRL-C3-TPT tester hardware and application should now be connected and ready for use with updated firmware.

If the firmware fails to update automatically, a pop-up message will appear as shown in Figure 7.9 below. Follow the procedure as given in the pop-up message to update the firmware manually.

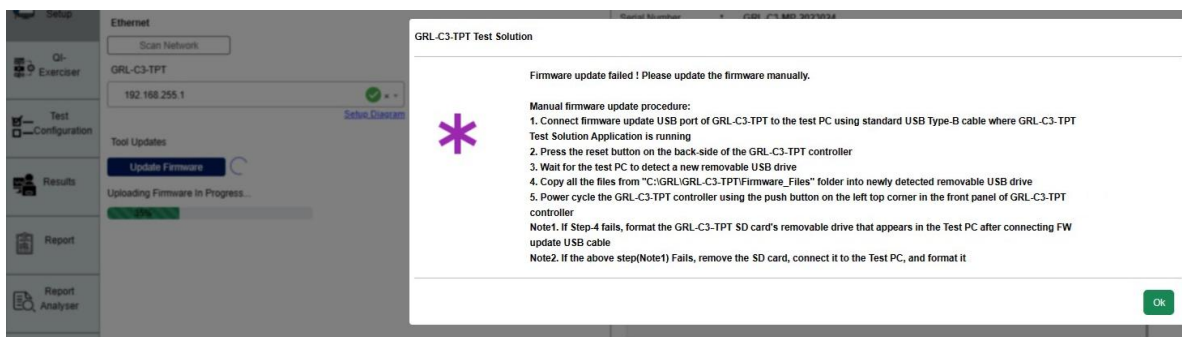


FIGURE 7.9: MANUAL GRL-C3-TPT FIRMWARE UPDATE PROCEDURE

- a) Once the user presses on the **Reset button** at the back of the GRL-C3-TPT tester (as indicated in Figure 7.10 below), the control PC should detect a new removable USB drive.



FIGURE 7.10: GRL-C3-TPT RESET BUTTON

- b) Copy the files from "**C:\GRL\GRL-C3-TPT\Firmware_Files**" into the newly detected removable USB drive. Refer to Figure 7.11 below.

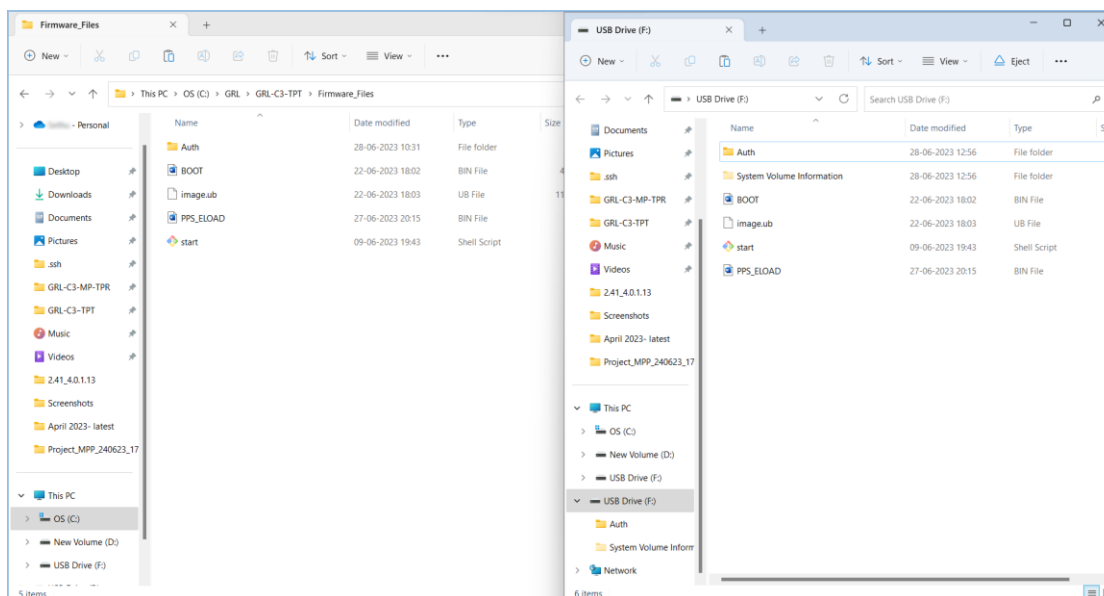


FIGURE 7.11: COPY GRL-C3-TPT FIRMWARE FILES INTO REMOVABLE USB DRIVE

- c) Power cycle the GRL-C3-TPT tester using the Power button on the front of the tester as shown in Figure 6.4.

Note 1: If step (c) fails, format the GRL-C3-TPT SD card's removable drive that appears on the control PC after connecting the firmware update USB cable.

Note 2: If Note 1 fails, remove the SD card, connect it to the control PC and format it.

7.2 Set MPP / BPP / EPP Power Profile for Testing

Using the toggle switch at the top right corner of the browser window as indicated in Figure 7.12 below, the user can set the power profile to **MPP** or **BPP/EPP** to run corresponding tests.

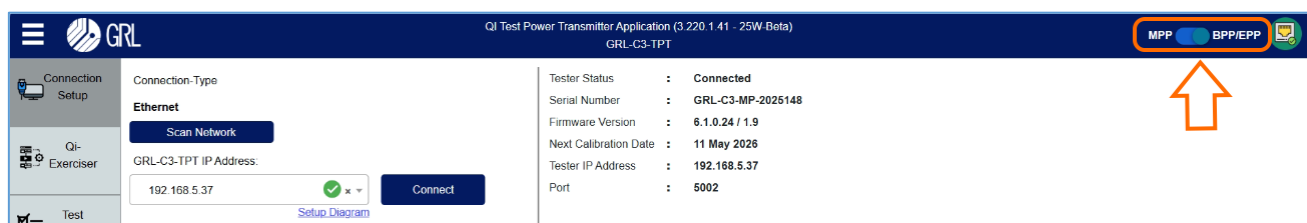


FIGURE 7.12: TOGGLE SWITCH FOR MPP, BPP OR EPP POWER PROFILE

After the GRL-C3-TPT application is installed and connected to the tester hardware:

- The toggle switch will be set to **MPP** if the tester hardware contains MPP firmware files.
- The toggle switch will be set to **BPP/EPP** if the tester hardware contains BPP or EPP firmware files.

If the user wants to switch to the BPP/EPP power profile when the toggle is set to MPP, do the following:

1. Slide the toggle to **BPP/EPP** as indicated in Figure 7.13 below. Check that all external USB drives are disconnected from the Host PC before proceeding with the firmware update and click **Ok**.

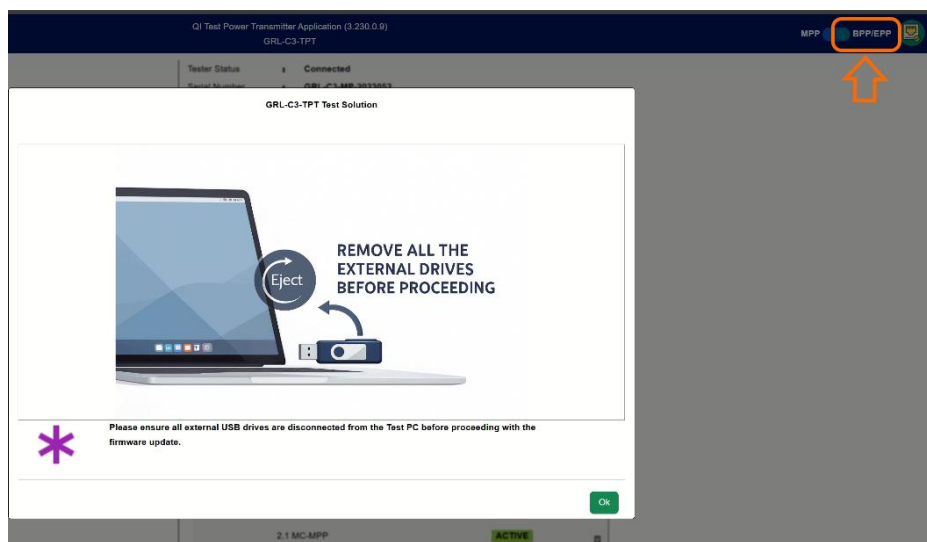


FIGURE 7.13: SWITCH TO BPP/EPP POWER PROFILE

2. Click on the **Firmware Update** button to start the firmware update.
3. Once the firmware update has completed, the GRL-C3-TPT application will be set to the BPP/EPP power profile. The user can then proceed with BPP/EPP testing.

To switch to the MPP power profile when the toggle is set to BPP/EPP, repeat the same steps as above by sliding the toggle to “MPP” and performing firmware update.

8 Compliance Testing with GRL-C3-TPT

The various screens presented by the GRL-C3-TPT application allow the user to select, configure, run and generate reports from the CTS compliance tests for a variety of Qi MPP, BPP or EPP based PRx DUT's. There are also more specific controls that allow the user to perform offline analysis and debug specific DUT features and capabilities using saved waveforms.

Note: GRL-C3-TPT also supports oscilloscope measurements with the Tektronix DPO7000 and PicoScope 6403D scopes.

8.1 Qi-Exerciser

The GRL-C3-TPT application *Qi-Exerciser* screen allows the user to configure and test a specific sequence of Packets.

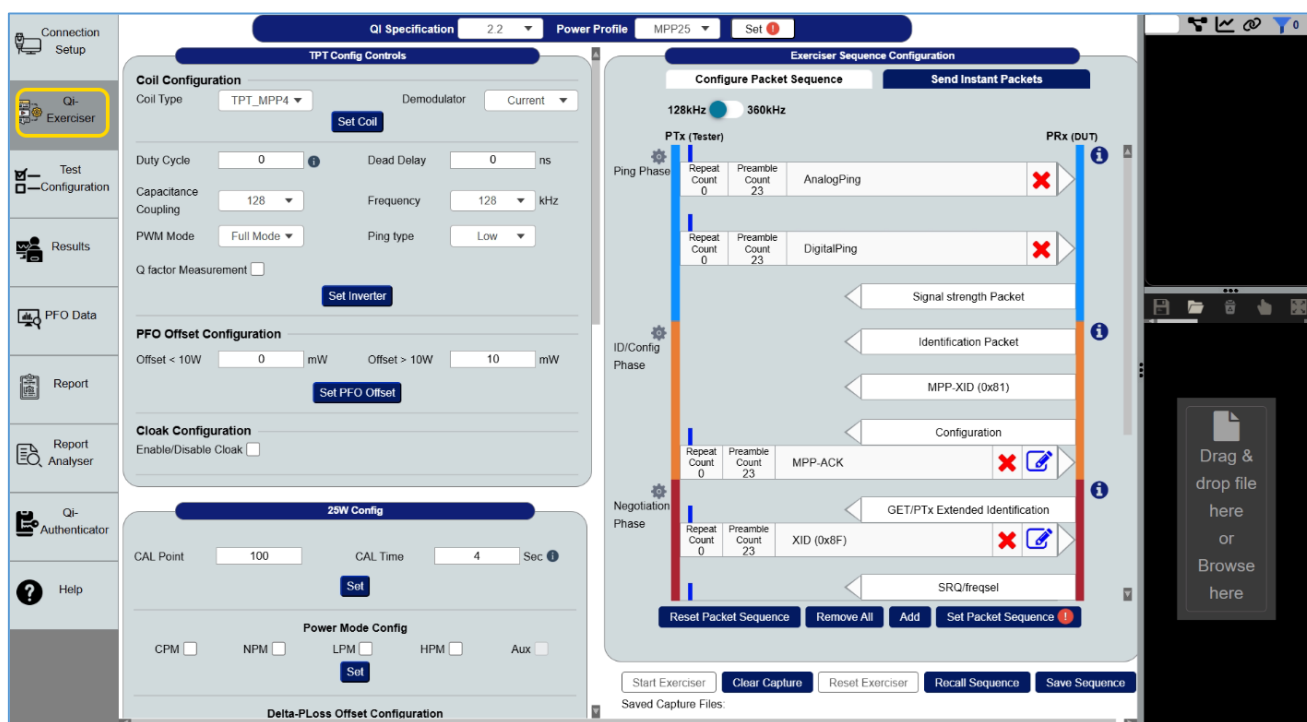


FIGURE 8.1: MPP Qi-EXERCISER SCREEN

Select the required Qi specification and power profile from the **Qi Specification** and **Power Profile** drop-down menus respectively to be applied for the MPP Qi-Exerciser operations and then click on the **Set** button.

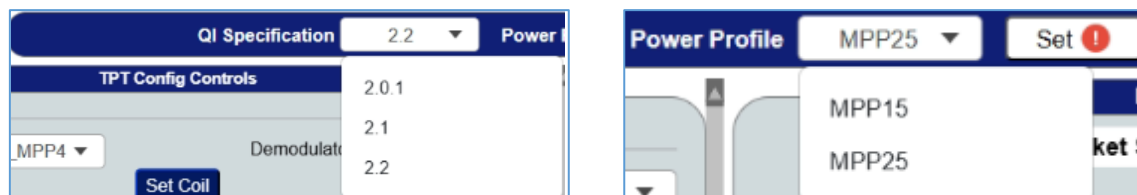


FIGURE 8.2: SELECT MPP SPECIFICATION AND POWER PROFILE FOR Qi-EXERCISER

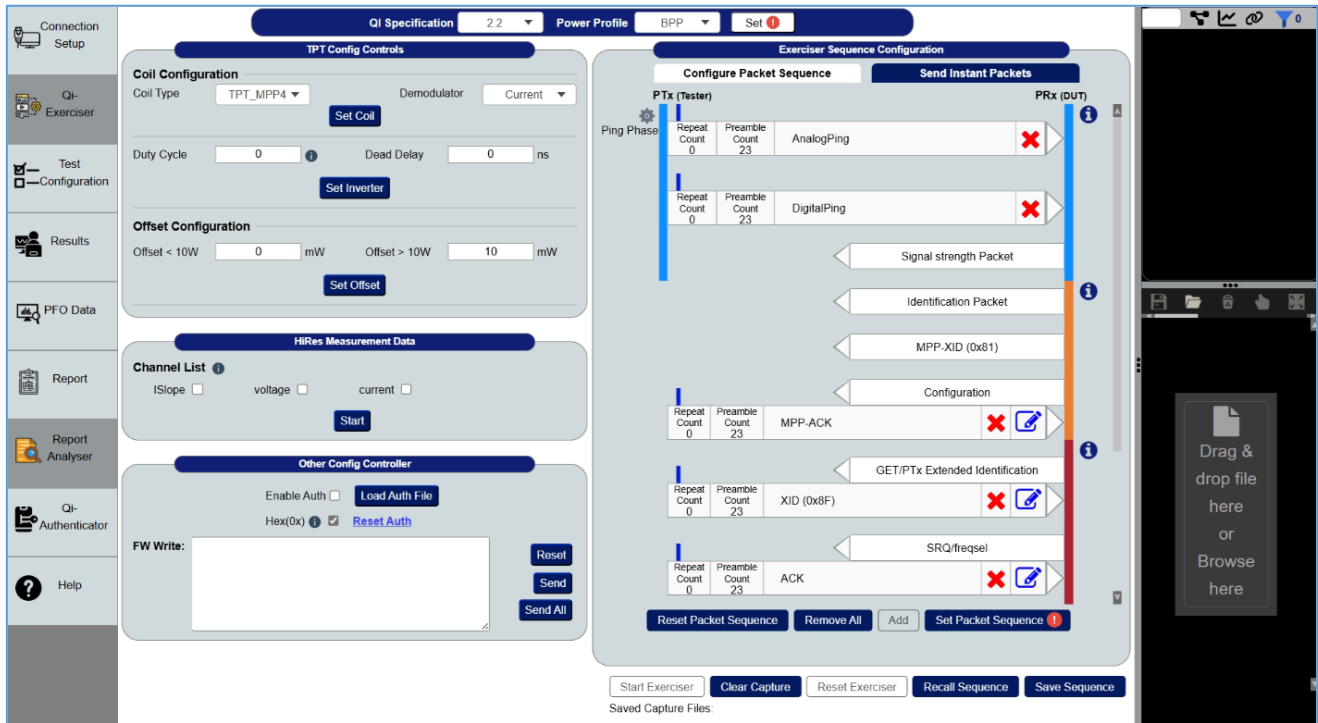


FIGURE 8.3: BPP QI-EXERCISER SCREEN

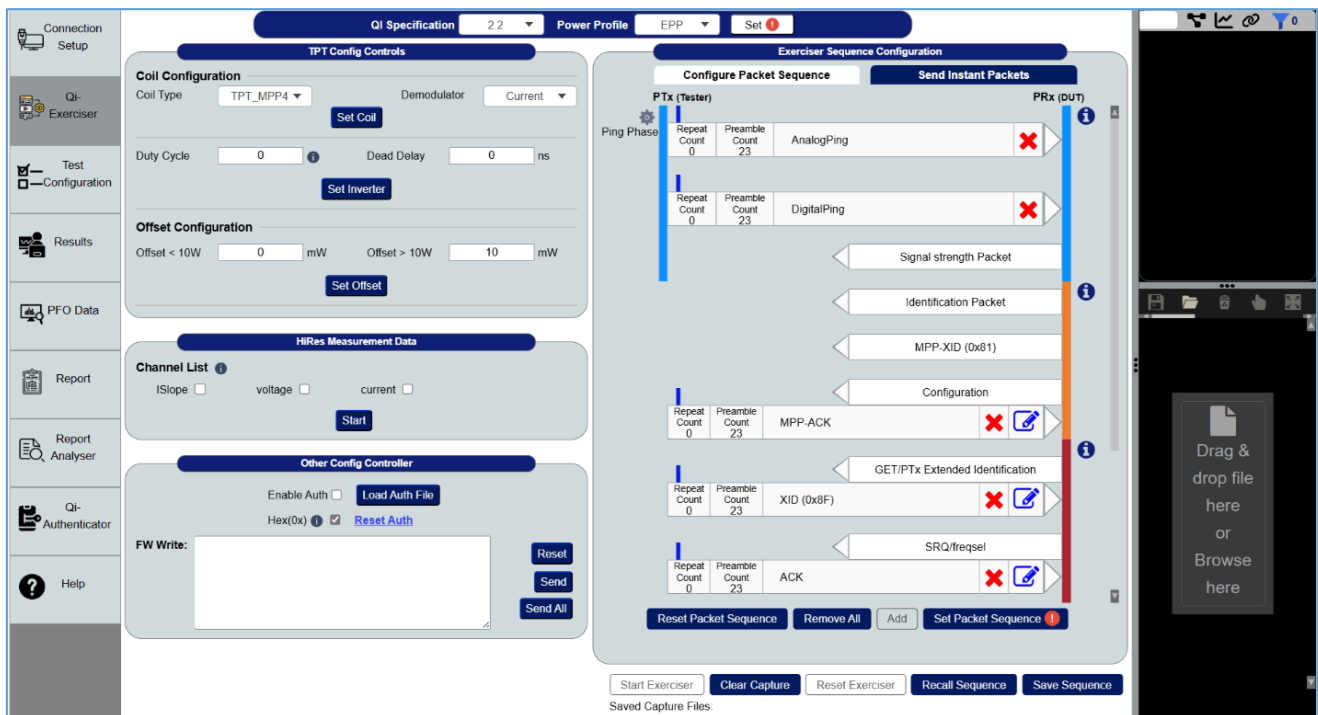


FIGURE 8.4: EPP QI-EXERCISER SCREEN

Select the required Qi specification and power profile from the **Qi Specification** and **Power Profile** drop-down menus respectively to be applied for the BPP/EPP Qi-Exerciser operations and then click on the **Set** button.

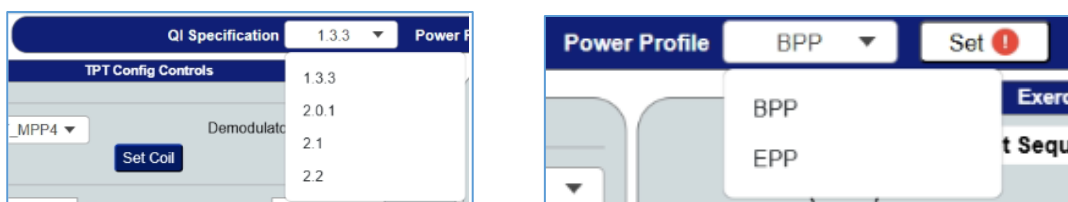


FIGURE 8.5: SELECT BPP/EPP SPECIFICATION AND POWER PROFILE FOR QI-EXERCISER

The following subsections describe how to set up and test the Packet sequence.

8.1.1 Select and Set Up Test Power Transmitter (TPT) Coil



FIGURE 8.6: CONFIGURE TPT COIL

- **Coil Type:** Select the coil type of the reference TPT to be used that is compatible with the MPP Profile.
- **Demodulator:** Select the type of demodulator integrated in the TPT coil consisting of current, voltage, phase or automated. The TPT coil will demodulate the amplitude modulation (AM) packet signal sent by the PRx DUT.
- **Set Coil:** Click on this button to apply the configured coil for testing.

8.1.2 Set Up TPT Coil Inverter

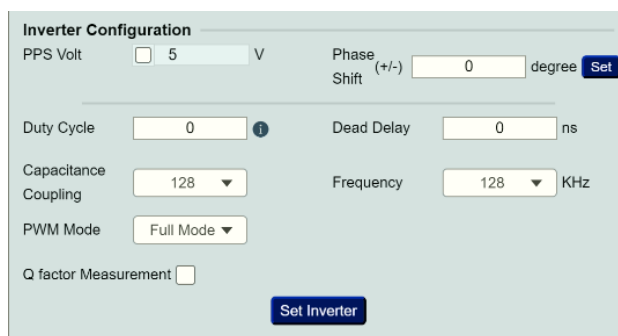


FIGURE 8.7: CONFIGURE TPT COIL INVERTER

- **PPS Volt:** Displays the default initial inverter input voltage value for the TPT coil. The user can also enter a custom value if required by selecting the checkbox.
- **Phase Shift:** Enter the inverter phase shift value in degrees (can be a positive or negative value) for the TPT coil. [Note: 0° means the full-bridge inverter is operating in complementary mode.] Click on the Set button to apply the value.

- **Duty Cycle:** Enter the inverter duty cycle value ('0' or '1') that is used to drive the amplitude of the TPT coil current. [Note: '0' means up to 25% duty cycle and '1' means up to 50% duty cycle from the rising edge of the Pulse Width Modulation (PWM) signal.]
- **Dead Delay:** The Dead Delay (or dead-time) field allows the user to set the delay between two switches which is used in the PWM inverter. During soft-switching, the dead-time is adaptive and concludes when Zero-Voltage Switching (ZVS) is detected on the power device. In cases where the transmitter will not soft-switch, a maximum dead-time is utilized to force the transmitter to switch.
- **Capacitance Coupling:** Select the coupling measurement at 128 kHz or 360 kHz (high or low) for the TPT coil.
- **Frequency:** Select the operating frequency at 128 kHz or 360 kHz for the TPT coil.
- **PWM Mode:** Select either full mode or half mode MPP power transfer during Pulse Width Modulation (PWM) as supported by the PRx DUT.
- **Q factor Measurement:** Select this checkbox to enable the compensated Q factor to be measured by the TPT coil.
- **Set Inverter:** Click on this button to apply all the above TPT inverter configuration.

8.1.3 Set Up P_{Fo} Offset



PFO Offset Configuration

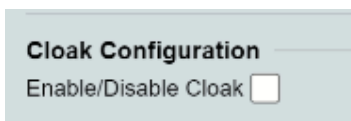
Offset < 10W mW Offset > 10W mW

Set PFO Offset

FIGURE 8.8: CONFIGURE PFO OFFSET

- **Offset < 10W & Offset > 10W:** Enter the PFO limits to be calculated by the TPT coil to ensure that they are within the allowable thresholds for $P_{rect} < 10W$ and $P_{rect} > 10W$ respectively.
- **Set PFO Offset:** Click on this button to apply the above PFO offset configuration.

8.1.4 Set Up Cloaking



Cloak Configuration

Enable/Disable Cloak ☐

FIGURE 8.9: CONFIGURE CLOAKING (FOR MPP)

- **Enable/Disable Cloak:** Select this checkbox to enable or disable power pause or cloaking if supported by the DUT.

8.1.5 Set Up 25 W Power Mode

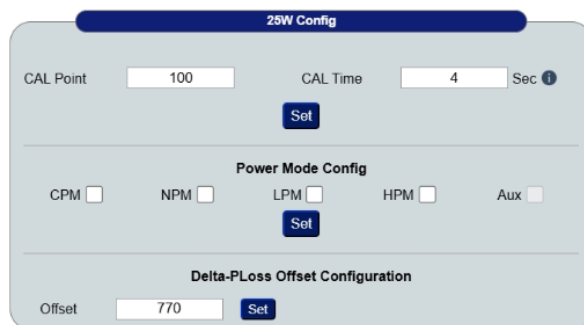


FIGURE 8.10: CONFIGURE 25 W POWER MODE

- **CAL Point and CAL Time:** The CAL Point field allows the user to set the calibration points while the CAL Time field lets the user set the calibration time in seconds. Once configured, click on the **Set** button to apply the values.
- **Power Mode Config:** This field allows the user to select the supported power mode - CPM (Continuous Power Mode), NM (Nominal Power Mode), LPM (Low Power Mode), HPM (High Power Mode) and Auxiliary Mode. *Note: Selecting the CPM checkbox will cause all the other power mode selections except Aux to be disabled. Selecting any power mode other than CPM will cause the CPM power mode selection to be disabled.*

Once configured, click on the **Set** button to apply the values.

- **Delta-Ploss Offset Configuration:** Set the offset value for the Δ Ploss. Once configured, click on the **Set** button to apply the value.

8.1.6 Set Up Mated-Q Parameters

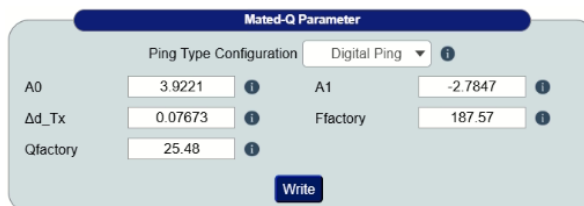


FIGURE 8.11: CONFIGURE MATED-Q PARAMETERS

- **Ping Type Configuration:** Select the Digital Ping, Analog Ping or both Digital and Analog Ping.
- **A0, A1, Δd_{Tx} :** The A0, A1 and Δd_{Tx} fields allow the user to set the A0, A1 and Δd_{Tx} coefficients from $-4.29e^7$ to $4.29e^7$.
- **Qfactory, Ffactory:** The $Q_{factory}$ and $F_{factory}$ fields allow the user to set the $Q_{factory}$ and $F_{factory}$ coefficients from 0 to $4.29e^7$. The $Q_{factory}$ and $F_{factory}$ coefficients represent the results of the Mated Q factory calibration which correspond to the mated measurements of Q and f between the PTx and reference PRx coil respectively.

Once configured, click on the **Write** button to apply the values.

8.1.7 Set Up Power Mode API

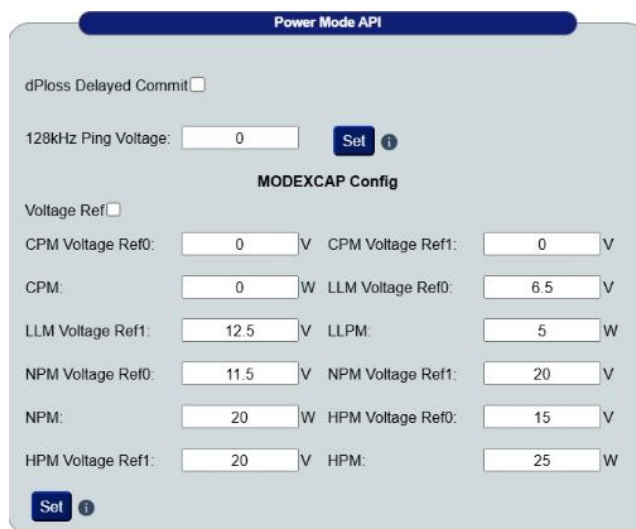


FIGURE 8.12: CONFIGURE POWER MODE API

- **Δ Ploss Delayed Commit:** Select this checkbox to enable the user to verify with the Δ Ploss delayed commit configuration in the PTx TPT. The PTx TPT may take up to 5 minutes after the CAL_CAPTURE packets to send the CAL_CMT response in order to compute the final calculations.
- **128kHz Ping Voltage:** Set the 128 kHz digital ping voltage in Volts up to 65.5 V. Once configured, click on the **Set** button to apply the value.
- **Voltage Ref:** Select this checkbox to enable the reference Vrect range associated with each power mode to be provided by the PTx through the MODEXCAP data packet during negotiation.
- **CPM Voltage Ref0, Ref1:** The CPM Voltage Ref0 and Ref1 fields allow the user to set the reference Vrect range in Volts for the Continuous Power Mode.
- **CPM:** Set the power level for the Continuous Power Mode.
- **LPM Voltage Ref0, Ref1:** The LPM Voltage Ref0 and Ref1 fields allow the user to set the reference Vrect range in Volts for the Low Power Mode.
- **LPM:** Set the power level for the Low Power Mode.
- **NPM Voltage Ref0, Ref1:** The NPM Voltage Ref0 and Ref1 fields allow the user to set the reference Vrect range in Volts for the Nominal Power Mode.
- **NPM:** Set the power level for the Nominal Power Mode.
- **HPM Voltage Ref0, Ref1:** The HPM Voltage Ref0 and Ref1 fields allow the user to set the reference Vrect range in Volts for the High Power Mode.
- **HPM:** Set the power level for the High Power Mode.

Once configured, click on the **Set** button to apply the values for the Power Mode Extended Capabilities.

8.1.8 Set Up High-Resolution Measurement Data

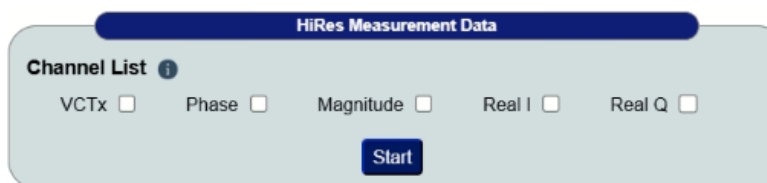


FIGURE 8.13: CONFIGURE HIGH RESOLUTION MEASUREMENT DATA (FOR MPP)



FIGURE 8.14: CONFIGURE HIGH RESOLUTION MEASUREMENT DATA (FOR BPP/EPP)

- **Channel List:** Select the checkboxes to enable the following high-resolution measurement data to be logged – **VCTx** (Measured C_{Tx} voltage), **Phase**, **Magnitude**, **Real I** and **Real Q** for the MPP power profile or **ISlope**, **voltage** and **current** for the BPP/EPP power profile.

Once configured, click on the **Start** button. The GRL-C3-TPT application will capture the selected measurement data of the PRx packet streams for the particular start/stop duration.

8.1.9 Set Up Other Configuration Controller Qi Authentication

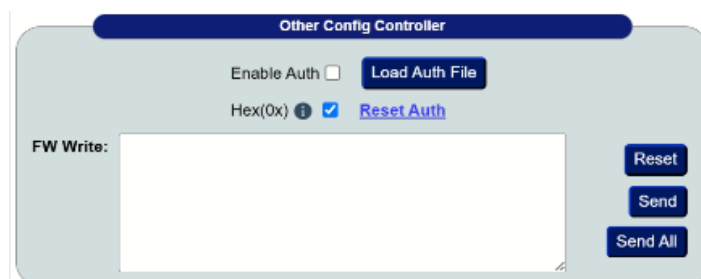


FIGURE 8.15: CONFIGURE HIGH RESOLUTION MEASUREMENT DATA (FOR MPP)

8.1.10 Set Up Packet Simulation Test Sequence

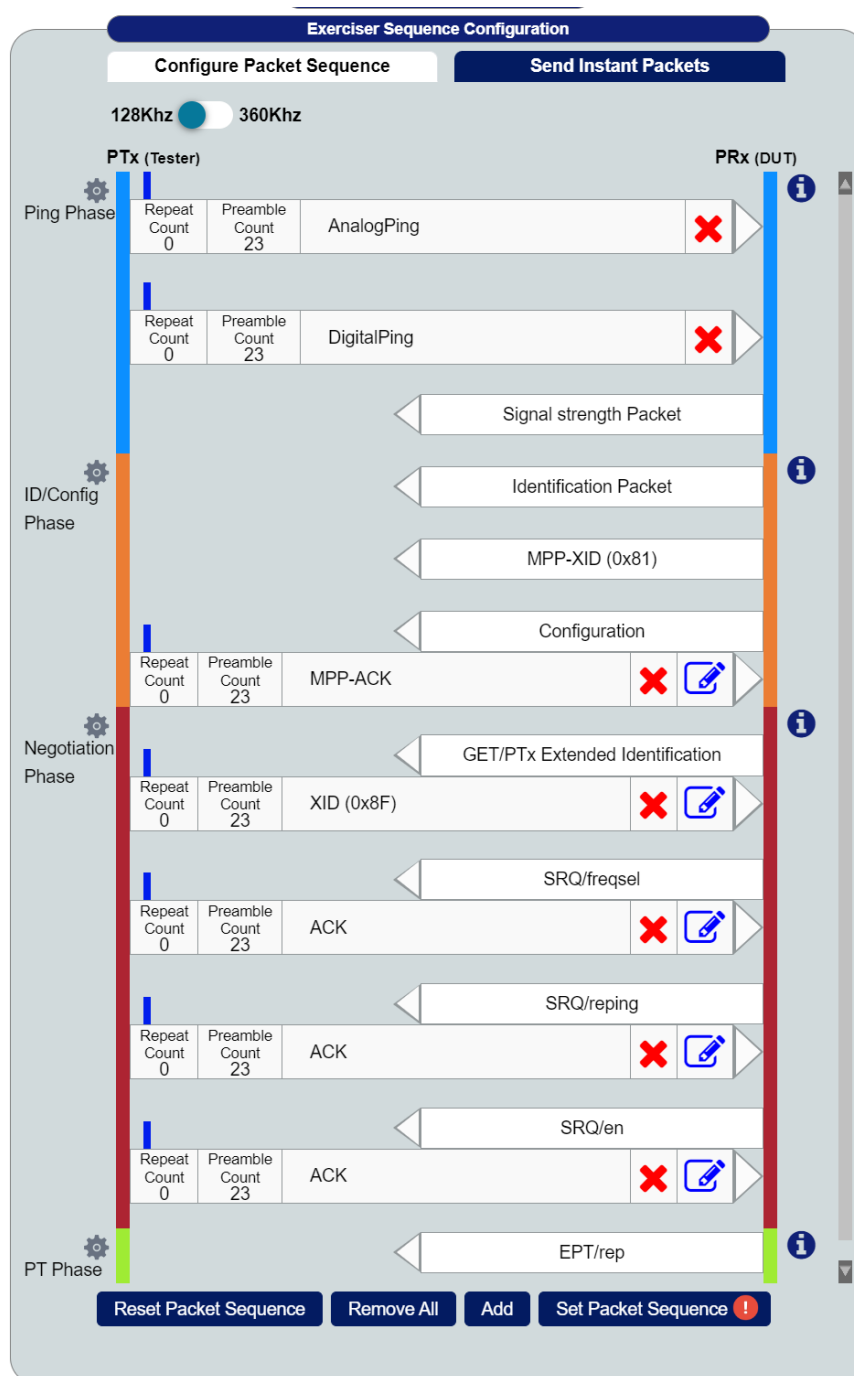


FIGURE 8.16: CONFIGURE PACKET SIMULATION TEST SEQUENCE

The Exerciser Sequence Configuration panel allows the user to configure each Packet Phase & Packet and send Packets as required for running the Packet simulation tests in a particular order.

Note: For the MPP specification, the user can choose to configure the Packet sequence when operating at 128kHz or 360kHz using the 128KHz / 360KHz slider respectively.

8.1.10.1 Configure Packet Sequence

For each Phase, the user can select  to delete an existing Packet. To configure an existing Packet information, select  which opens the following settings panel:

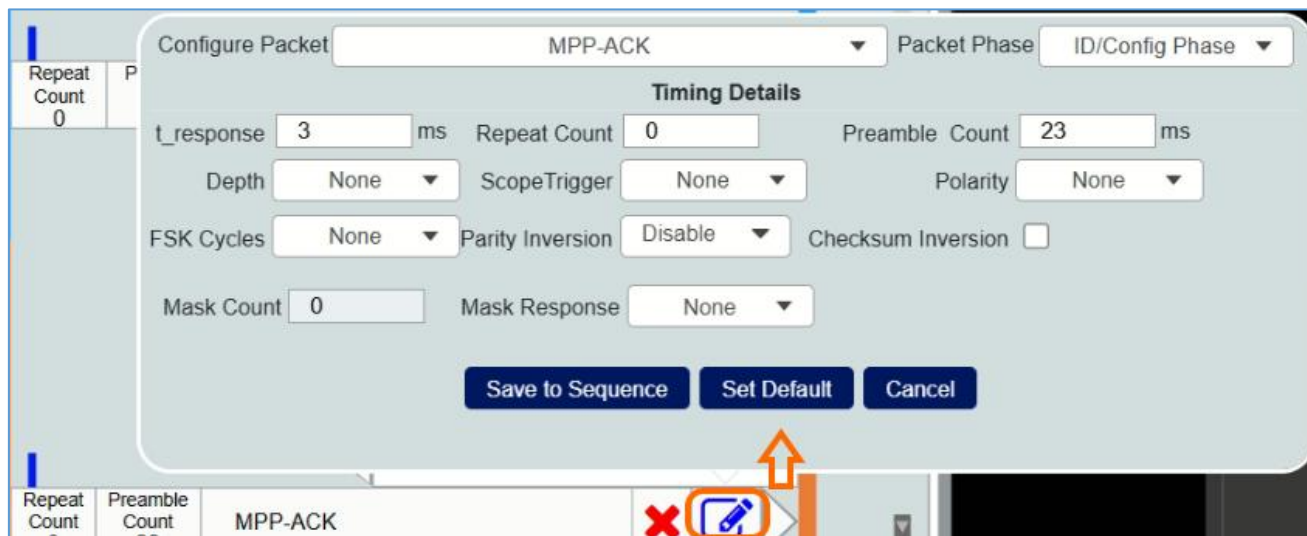


FIGURE 8.17: CONFIGURE PACKET INFORMATION

- **Configure Packet:** The Configure Packet drop down allows the user to select the Packet type to be applied.
- **Packet Phase:** The Packet Phase drop down allows the user to select the default Phase type of either ID/Config, Power Transfer, Negotiation or Ping Phase that corresponds to the selected Packet type.
- **Timing Details:** The Timing Details section displays the default settings for the selected Packet Phase. The user can also choose to enter custom values if required.
 - **t_response (ms):** The t_response field allows the user to set the time period (after the end of a response) after which the power signal is to be removed if a Packet is not correctly received.
 - **Repeat Count:** The Repeat Count field allows the user to set the number of times the selected Packet has to be sent.
 - **Preamble Count (ms):** The Preamble Count field allows the user to set the number of preamble bits of the selected Packet.
 - **Depth:** The Depth field allows the user to select the phase depth to be applied for modulation.
 - **ScopeTrigger:** The ScopeTrigger field allows the user to select either to perform triggering by the oscilloscope at the end of the ASK / FSK modulation or at the start of the FSK modulation or no triggering at all.

- **Polarity:** The Polarity field allows the user to select the positive or negative polarity of the ASK / FSK modulation or no polarity at all.
 - **FSK Cycles:** The FSK Cycles field allows the user to select the FSK switching cycle of 512, 256, 128 or 64 cycles upon entering the respective phase.
 - **Parity Inversion:** The Parity Inversion field allows the user to enable or disable the parity bit of the first payload byte of the Packet from being inverted when sending an Extended Power Transmitter Extended Capabilities (ECAP) Packet to the PRx DUT.
 - **Checksum Inversion:** The Checksum Inversion checkbox when selected enables all bits of the selected Packet checksum to be inverted to obtain an incorrect value.
 - **Mask Response:** The Mask Response field allows the user to select whether or not to set the number of times where the Packet response will not be sent or there will be no response. Only after the set number of times the configured Packet response will be sent.
 - **Mask Count:** If the user has selected to set the count in the Mask Response field, the Mask Count field allows the user to set the count value.
- **Payload Details:** The Payload Details section displays the default settings for the selected Packet Type which set the raw data to be sent in the hex format. The user can also choose to enter custom values if required.

When all the above configurations have been made, click on the **Save to Sequence** button



to apply the configurations and update the existing Packet information in the Configure Packet Sequence panel. Otherwise, click on the **Cancel** button  to keep the existing Packet information and exit the settings panel.

To reset the configurations to default values, click on the **Set Default** button .

8.1.10.2 Manage Packet Simulation Sequence (Configure Packet Sequence)

For the MPP specification, the user can choose to configure the Packet sequence when operating at 128kHz or 360kHz by selecting the **Configure Packet Sequence** tab and toggling the **128Khz / 360Khz** slider respectively. This feature is not applicable for the BPP/EPP specification.

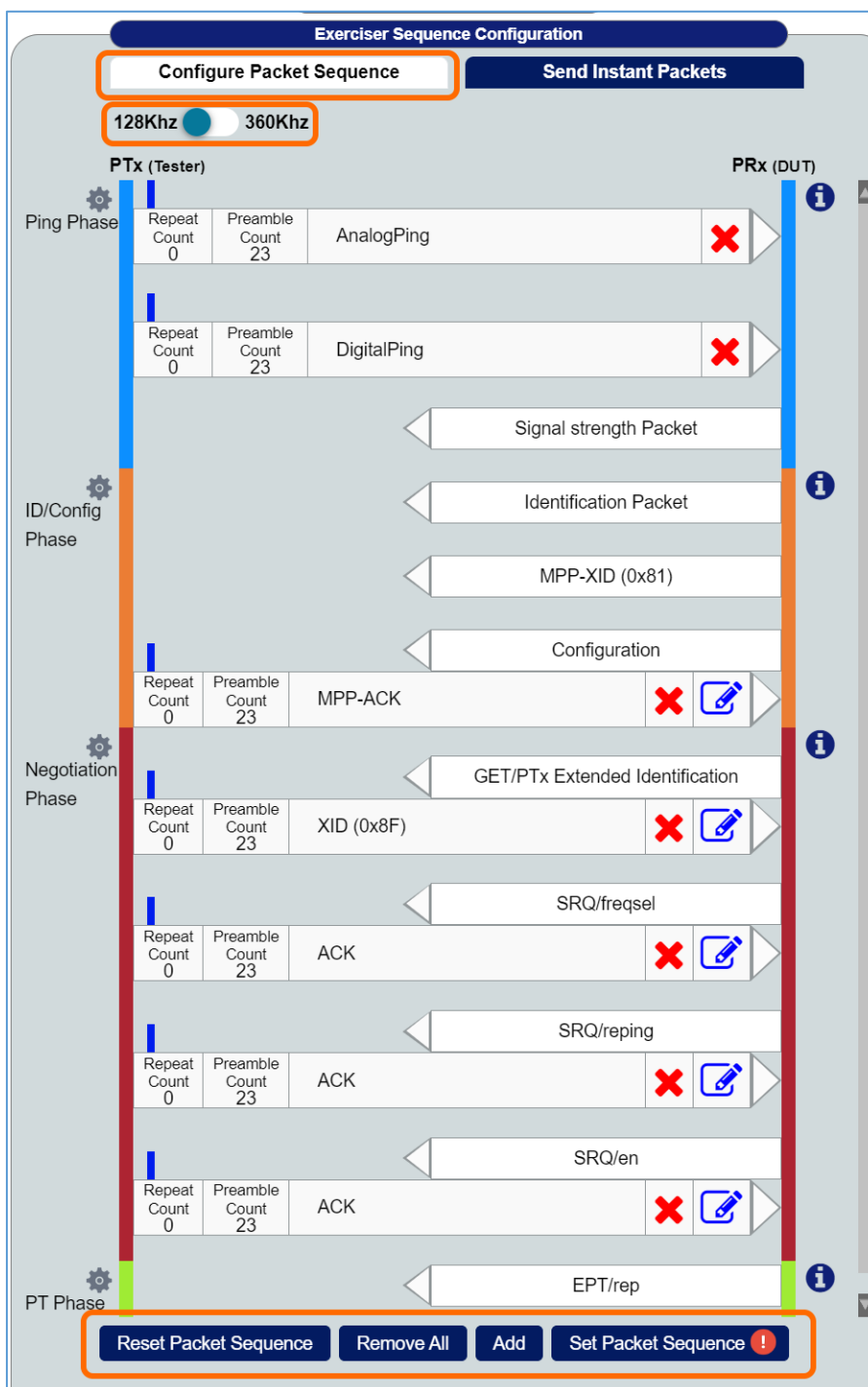


FIGURE 8.18: CONFIGURE PACKET SEQUENCE IN 128KHZ OR 360KHZ FOR MPP SPEC

For the MPP or EPP specification, the Configure Packet Sequence panel allows the user to add a new Phase and/or Packet to the Packet Sequence by clicking on the **Add** button at the bottom of the panel. This will display a settings panel similar to the one described above in Section 8.1.10.1 which is obtained on clicking the edit button to configure Packet information. Once configured, clicking on the **Add to Sequence** button causes the new Phase and/or Packet to be added to the existing Packet Sequence.

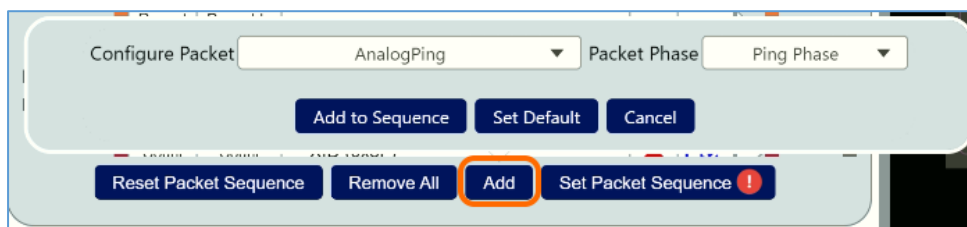


FIGURE 8.19: ADD NEW PHASE & PACKET TO PACKET SEQUENCE

Once the user has confirmed the Packet Sequence, click on the **Set Packet Sequence** button to apply the sequence for testing. In case there is a need to return to the default Packet Sequence, click on the **Reset Packet Sequence** button. To clear the existing Packet Sequence, click on the **Remove All** button.

8.1.10.3 Send Instant Packets

The user can configure and send any Packets in runtime (when Packet simulation test is running) through the **Send Instant Packets** panel.

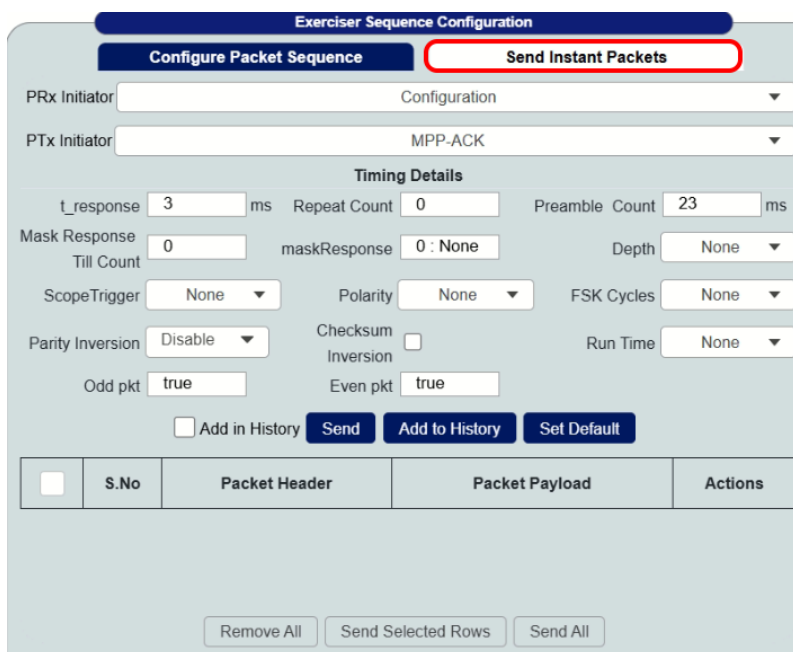


FIGURE 8.20: CONFIGURE AND SEND INSTANT PACKETS

- **PRx Initiator:** The PRx Initiator drop down allows the user to select the Packet type for the PRx DUT to initiate the Qi Authentication data stream.
- **PTx Initiator:** The PTx Initiator drop down allows the user to select the Packet type for the TPT coil to initiate the MPP, BPP or EPP data stream.

- **Timing Details:** The Timing Details section displays the default settings for the selected Packet. The user can also choose to enter custom values if required.
 - **t_response (ms):** The t_response field allows the user to set the time period (after the end of a response) after which the power signal is to be removed if a Packet is not correctly received.
 - **Repeat Count:** The Repeat Count field allows the user to set the number of times the selected Packet has to be sent.
 - **Preamble Count (ms):** The Preamble Count field allows the user to set the number of preamble bits of the selected Packet.
 - **Mask Response Till Count:** The Mask Response Till Count field allows the user to set the number of times where the Packet response will not be sent or there will be no response. Only after the set number of times the configured Packet response will be sent.
 - **Mask Response:** The Mask Response field allows the user to set the mask count if available or otherwise None.
 - **Depth:** The Depth field allows the user to select the phase depth to be applied for modulation.
 - **ScopeTrigger:** The ScopeTrigger field allows the user to select either to perform triggering by the oscilloscope at the end of the ASK / FSK modulation or at the start of the FSK modulation or no triggering at all.
 - **Polarity:** The Polarity field allows the user to select the positive or negative polarity of the ASK / FSK modulation or no polarity at all.
 - **FSK Cycles:** The FSK Cycles field allows the user to select the FSK switching cycle of 512, 256, 128 or 64 cycles upon entering the respective phase.
 - **Parity Inversion:** The Parity Inversion field allows the user to enable or disable the parity bit of the first payload byte of the Packet from being inverted when sending an Extended Power Transmitter Extended Capabilities (ECAP) Packet to the PRx DUT.
 - **Checksum Inversion:** The Checksum Inversion checkbox when selected enables all bits of the selected Packet checksum to be inverted to obtain an incorrect value.
 - **Run Time:** The Run Time field allows the user to select to run the Packet data stream continuously or only once. Otherwise, select “None” if not required.
 - **Odd pkt & Even pkt:** These fields allow the user to set the value to enable the Odd or Even Packet to be sent.
- **Payload Details:** The Payload Details section displays the default settings for the selected Packet which set the raw data to be sent in the hex format. The user can also choose to enter custom values if required.

After taking care of all the above configurations, the user can click on the **Send** button

Send

to send the configured Packet to the GRL-C3-TPT tester hardware. To reset the

configurations to default values, click on the **Set Default** button **Set Default**.

The user can also choose to add or log the configured Packet to the “History” table by selecting the **Add in History** checkbox and then clicking on the **Add to History** button.

☒	Add in History	Send	Add to History	Set Default
☒	S.No	Packet Header	Packet Payload	Actions
☒	0	Prx-Configuration Ptx-CHS (0x1F)	0	  Send

FIGURE 8.21: ADD PACKET TO HISTORY TABLE

Once the Packet is added to the table, the user can make edits to the Packet

configuration by clicking on  in the respective Packet row. When finished, click on the **Save to History** button **Save to History** to apply and update the existing Packet row with the new configuration. To send out the Packet, select the Packet row checkbox and click on the **Send** button. If there is a need to delete a particular Packet row, click on .

To send out Packets for selected Packet rows only, select the desired Packet rows and click on the **Send Selected Rows** button **Send Selected Rows** at the bottom. To send out all Packets in the History table, select all Packet rows and click on the **Send All** button **Send All** at the bottom. If there is a need to clear all Packet rows in the History table, click on the Remove All button **Remove All**.

8.1.10.3.1 Set Up Cloaking

Configure Cloak Phase
Cloak Entry Reason **Send**
Cloak Exit Type **Send**

FIGURE 8.22: CONFIGURE CLOAK PHASE

- **Cloak Entry Reason:** This field allows the user to declare a specific cloak phase of reason is supported by the PRx DUT as stated in self-declaration by selecting the drop-down menu and clicking on the **Send** button to send the selected clock entry reason Packet.
- **Clock Exit Type:** Click on the **Send** button to send the clock exit Packet.

8.1.11 Manage Packet Simulation Test Sequence

The following buttons below the Exerciser Sequence Configuration panel can be used to manage the Packet simulation test sequence:

Start Exerciser

Clear Capture

Reset Exerciser

Recall Sequence

Save Sequence

FIGURE 8.23: MANAGE PACKET SIMULATION TEST SEQUENCE

- **Start Exerciser:** Click on the **Start Exerciser** button to start or repeat the test execution/simulation for the configured Packets. To terminate the test run, click on the **Stop Exerciser** button.
- **Clear Capture:** Click on the **Clear Capture** button to remove existing test run details and signal trace acquisition.
- **Reset Exerciser:** Click on the **Reset Exerciser** button to return all Packet configurations to default values.
- **Recall Sequence:** Click on the **Recall Sequence** button to load and apply information from a saved Packet configuration file.
- **Save Sequence:** Click on the **Save Sequence** button to save the current Packet configuration to a file in the “C:\GRL\GRL-C3-TPT\Report\” directory. See example below:

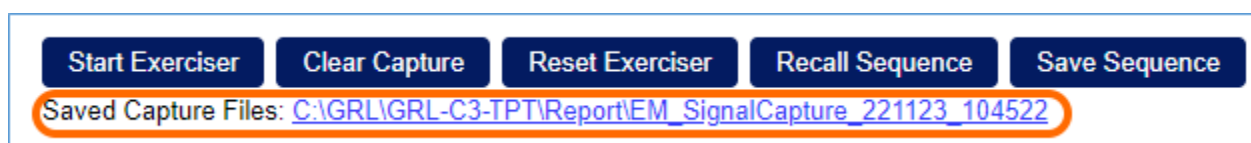


FIGURE 8.24: EXAMPLE OF SAVED CONFIGURATION FILE PATH

8.1.12 Run Packet Simulation Test Sequence

The following example describes how to run a typical Packet simulation test sequence.

1. First, click on the **Reset Exerciser** button below the Exerciser Sequence Configuration panel.



FIGURE 8.25: RESET EXERCISER BUTTON

2. Next, click on the **Start Exerciser** button to start the test execution/simulation for the Packet sequence. The test run details along with the signal trace acquisition will be displayed on the right panel as well as in the Results screen as shown in the example below:

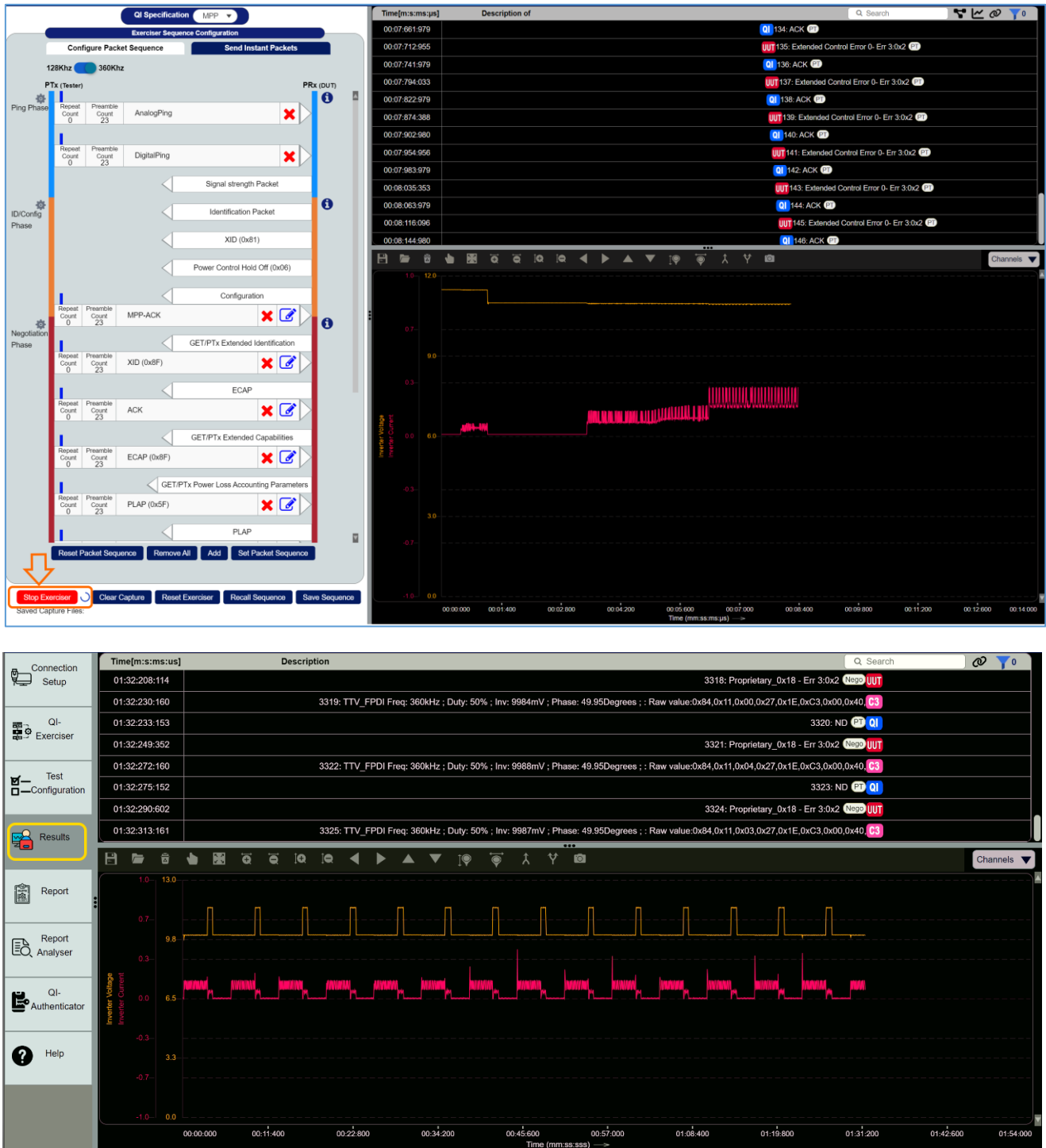


FIGURE 8.26: START RUNNING PACKET SIMULATION TEST SEQUENCE

- When the test run has completed, the results will automatically be saved to the following location— C:\GRL\GRL-C3-TPT\Report\.

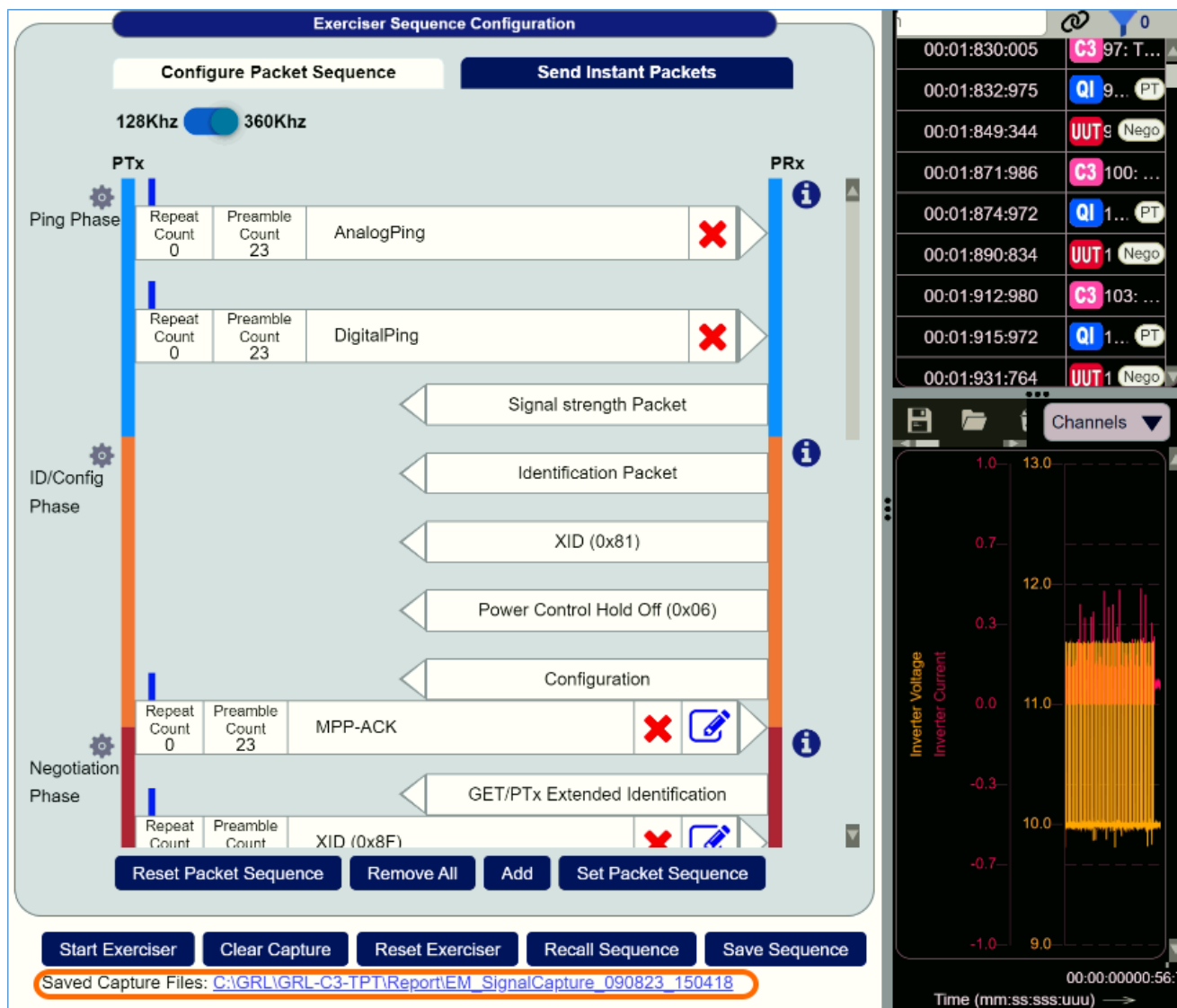


FIGURE 8.27: PACKET SIMULATION TEST SEQUENCE COMPLETED AND SAVED RESULTS PATH

8.2 Test Configuration

The GRL-C3-TPT application *Test Configuration* screen allows the user to select which set of tests is run on the DUT, set up test parameters, run selected tests and generate test reports.

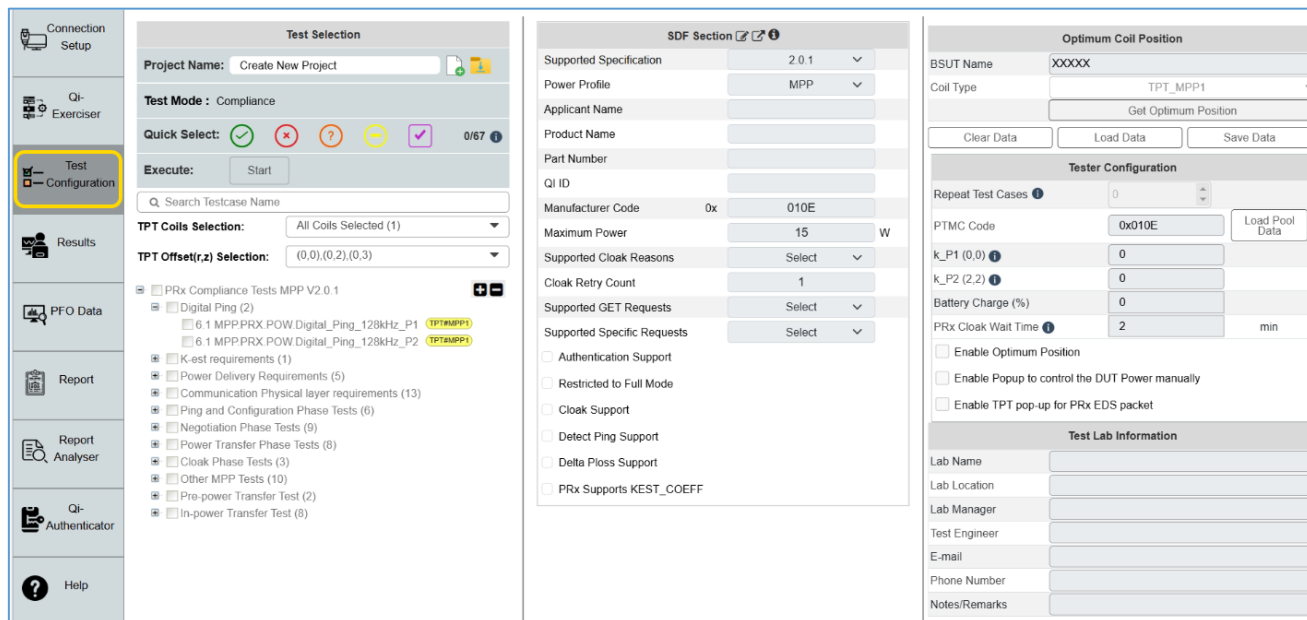


FIGURE 8.28: TEST CONFIGURATION SCREEN (FOR MPP)

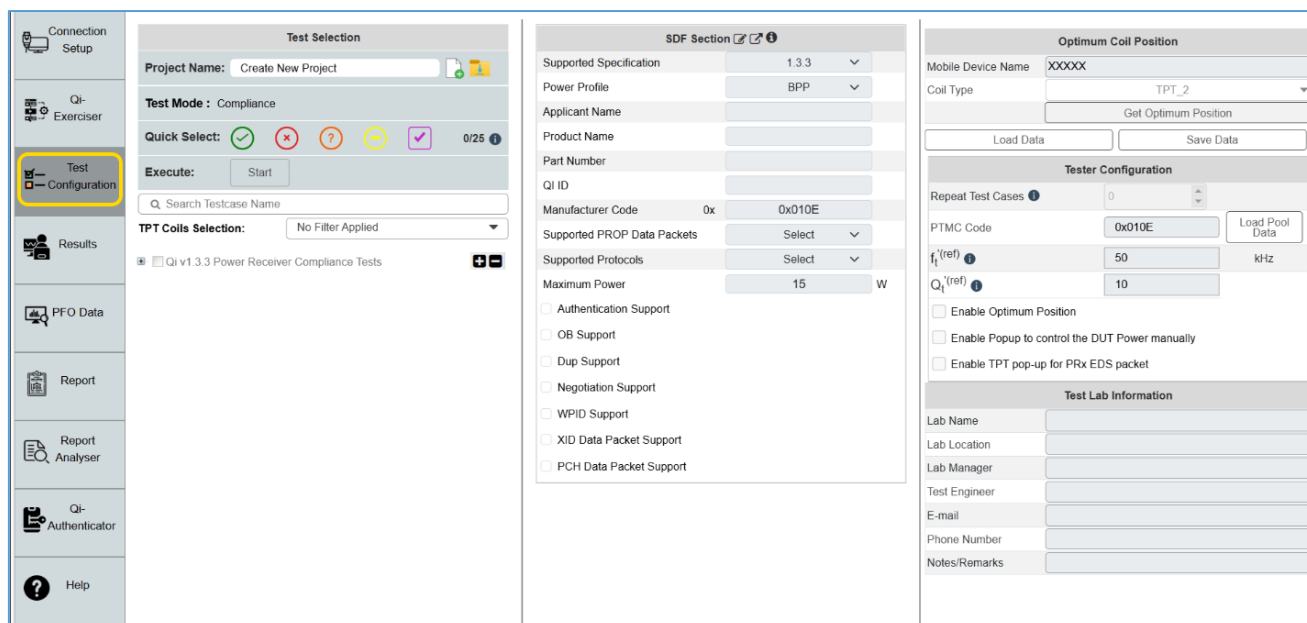


FIGURE 8.29: TEST CONFIGURATION SCREEN (FOR BPP/EPP)

Prior to accessing the test configuration, the user first needs to create a new project or upload an existing project that was saved previously, as described in the following sections.

8.2.1 Create New Test Project

The following procedure describes how to create a new test project:

1. Click on **Create New Project** as indicated in Figure 8.30 below.

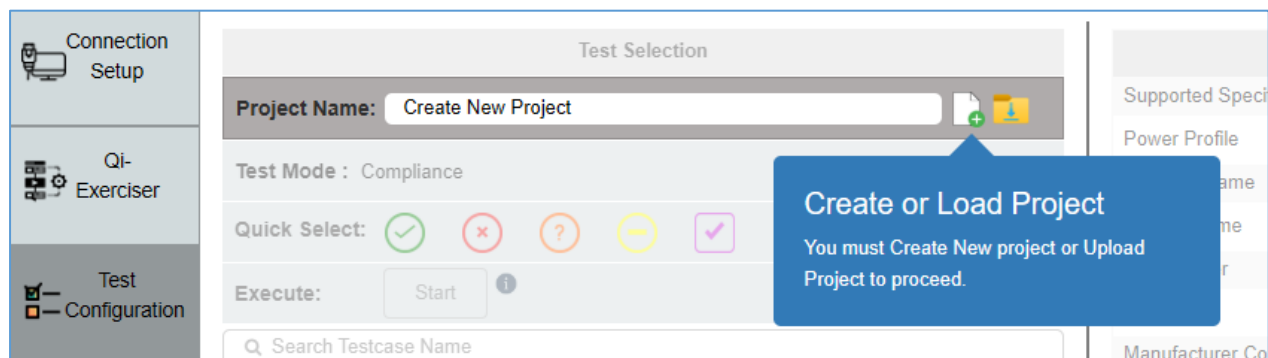


FIGURE 8.30: CREATE NEW PROJECT— #1

2. Set the following:

- a) Enter the **Project Name** (allowed up to 15 letters and special characters) and select the **Test Mode** as “Compliance” or “Pre-Compliance”.

Note: Select the “Compliance” test mode if the eSDF (Electronic Self Declaration Form) file of the DUT is available. If the eSDF is not available, select the “Pre-Compliance” test mode.

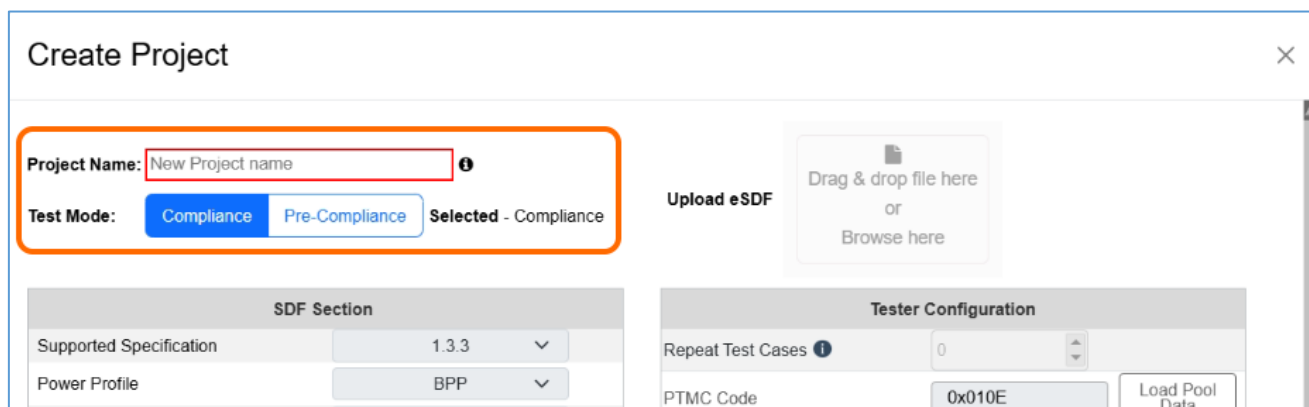


FIGURE 8.31: CREATE NEW PROJECT— #2

- b) If the “**Compliance**” Test Mode is selected, **upload** the **eSDF** file of the DUT by dragging and dropping the file into the panel on the right or clicking on the panel to select the file from the system. Then click on the **Create Project** button at the bottom.

Create Project

Project Name: Sample

Test Mode: Compliance Pre-Compliance

Selected - Compliance

Upload eSDF

Drag & drop file here

or

Browse here

SDF Section

Supported Specification	2.2.0
Power Profile	BPP
Applicant Name	
Product Name	
Part Number	
QI ID	
Manufacturer Code	0x 042
Supported PROP Data Packets	Select
Supported Protocols	Select
Maximum Power	15 W

☐ Authentication Support
 ☐ OB Support
 ☐ Dup Support
 ☐ Negotiation Support
 ☐ WPID Support
 ☐ XID Data Packet Support
 ☐ PCH Data Packet Support

Tester Configuration

Repeat Test Cases

0

PTMC Code

0x010E

Load Pool Data

$f_t^{(ref)}$

50

kHz

$Q_t^{(ref)}$

10

☐ Enable Optimum Position
 ☐ Enable Popup to control the DUT Power manually
 ☐ Enable TPT pop-up for PRx EDS packet

Test Lab Information

Lab Name

Lab Location

Lab Manager

Test Engineer

E-mail

Phone Number

Notes/Remarks

Create Project

FIGURE 8.32: CREATE NEW PROJECT— #3

- c) If the **“Pre-Compliance”** Test Mode is selected, select to either upload the eSDF of the DUT (if available) or generate a default eSDF (**Get Default ESDF**) by clicking on the respective checkboxes.
- i. If the **“Get Default ESDF”** checkbox is selected, select the **Supported Specification** and **Power Profile** of the DUT.

Create Project

Project Name: New Project name

Test Mode: Compliance Pre-Compliance

Selected - Pre-Compliance

☐ Upload ESDF
 ☒ Get Default ESDF

SupportedSpecification

1.3.3

PowerProfile

1.3.3

SupportedSpecification

1.3.3

PowerProfile

BPP

FIGURE 8.33: CREATE NEW PROJECT— #4

- ii. After selecting the power profile, click on the **Get Default ESDF** button. In the SDF Section, Tester Configuration and Test Lab Information panels, configure the following parameters:

Note: Some parameters may change based on the selected power profile and specification.

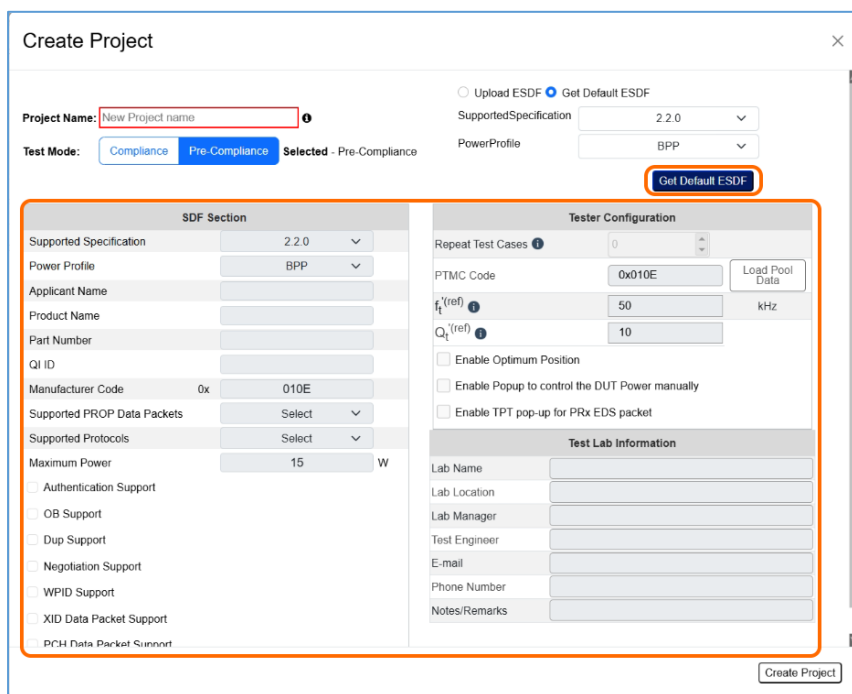


FIGURE 8.34: CREATE NEW PROJECT (FOR BPP/EPP) — #5

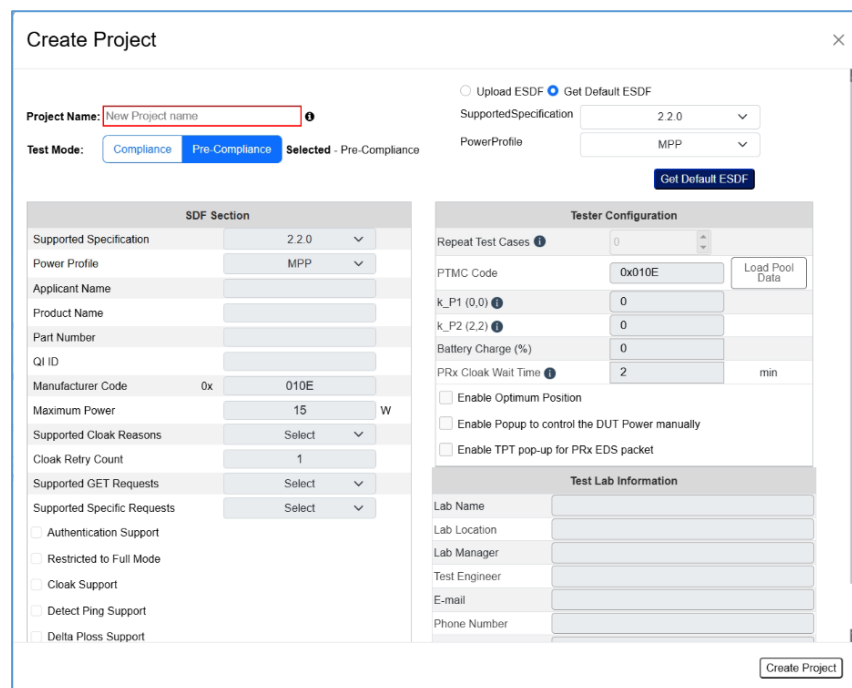


FIGURE 8.35: CREATE NEW PROJECT (FOR MPP) — #5

SDF Section:

- **Applicant Name & Product Name & Serial Number & Part Number:** Enter the name of the test lab personnel and name, serial number & part number of the DUT respectively.
- **Qi ID:** Enter the Qi certified ID number of the DUT.
- **Manufacturer Code:** Enter the manufacturer code of the DUT.
- **Maximum Power:** Set the maximum received power as declared by the PRx DUT.
- **Supported Cloak Reasons:** Select the cloak reason(s) for specific cloak tests.
- **Cloak Retry Count:** Set the PRx DUT retry N-times (up to 100) detecting the ping before abandoning the cloak phase and proceeding to the ping phase.
- **Supported Get Requests:** Enable the PRx DUT to send a GET request for the “Charge Status” packets if supported by the PRx.
- **Supported PROP Data Packets:** Select any proprietary Packets as supported by the DUT.
- **Supported Protocols:** Select the “Extended Protocol” if the DUT supports the Extended Power Profile (EPP).
- **Authentication Support:** Select this checkbox if the DUT supports the Qi Authentication requirements.
- **OB Support:** Select this checkbox if the Out-of-Band (OB) communications functionality is supported by the DUT.
- **Dup Support:** Select this checkbox if the Dup function (simultaneous incoming and outgoing data streams) is supported by the DUT.
- **Negotiation Support:** Select this checkbox if the Negotiation bit is supported by the DUT.
- **WPID Support:** Select this checkbox if the DUT supports WP-ID (optional receiver ID for the Qi wireless charging standard).
- **XID Data Packet Support:** Select this checkbox to execute tests that are applicable for the PRx DUT supporting the Extended identification data packet.
- **PCH Data Packet Support:** Select this checkbox to execute tests that are applicable for the PRx DUT supporting the "Power Control Hold Off " Data packets.
- **Restricted Mode Support:** Select this checkbox to enable the MPP restricted mode which is one-way communications (PRx to PTx) with limited power levels.
- **Restricted to Full Mode:** Select this checkbox for test cases which support transition from the MPP restricted mode to full mode. *[Note: It is*

mandatory to click this checkbox when executing 10.1.4 and 10.3.8 test cases.]

- **Cloak Support:** Select this checkbox to enable power pause or cloaking if supported by the DUT.
- **Detect Ping Support:** Select this checkbox to enable analog pings to detect the device.
- **Delta PLoss Support:** Select this checkbox to enable Δ PLOSS measurements.
- **PRx Supports KEST_COEFF:** Select this checkbox if the DUT supports the KEST-COEFF packet.

Tester Configuration:

- **Repeat Test Cases:** Select the number of times to repeat running selected tests.
- **PTMC Code:** Set the Power Transmitter Manufacturer Code (PTMC) ID of the TPT
- **Load Pool Data:** This function allows you to use different power transmitter manufacturer codes (PTMC's) other than the GRL-C3-TPT's own power transmitter manufacturer code (PTMC) in order to obtain expected test results. Click on the Load Pool Data button to load an existing data file and this will enable PTMC codes to be assigned randomly for each test case when running multiple tests.
- **Ki_P1 (0,0) & Ki_P2 (2,2):** Set the inductive coupling factor, K_i , to be calculated in the PTx at the P1 (0,0) position and P2 (2,2) positions respectively.
- **$f_t^{[ref]}$ & $Q_t^{[ref]}$:** Set the Reference Resonance Frequency $f_t^{[ref]}$ and Reference Quality Factor $Q_t^{[ref]}$ which are required for the PRx Compliance Book Pre Power FOD Test 'MP.RX.FOD.REQFODSTATUS.TC2'. See Section 12, Appendix C for more details.
- **Battery Charge:** Set the battery charge level percentage of the TPT.
- **PRx Cloak Wait Time:** Set the time duration to wait for cloak to be sent by the PRx.
- **Enable Optimum Position:** Select this checkbox to enable the coil to be placed at an optimized position for testing. *Note: The Optimum Coil Positioning data is required for this feature.*
- **Enable Popup to Control the DUT Power Manually:** Select this checkbox to enable pop-up instructions to guide the user to control the PRx DUT load manually.
- **Enable TPT pop-up for PRx EDS packet:** Select this checkbox to enable pop-up instructions from the test power transmitter to send the PRx EDS packet.

Test Lab Information:

- The “Test Lab Information” panel allows the user to enter information relevant to the lab specifics used for running tests. Once tests have completed, the test report can be viewed in the *Report* screen (see Section 8.3).

After configuring the above parameters, click on the **Create Project** button.

- The new project will be created with the provided Project Name and Test Mode as shown in the Figure 8.36 example below. The user can now proceed with the test configuration.

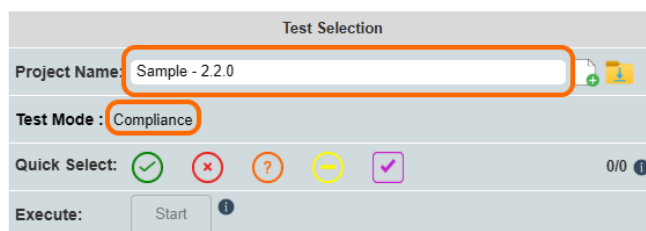


FIGURE 8.36: CREATE NEW PROJECT— #8

8.2.2 Upload Existing Saved Test Project

The following procedure describes how to upload an existing test project that was saved previously:

- Click on the **Upload Project** icon as indicated in Figure 8.37 example below.

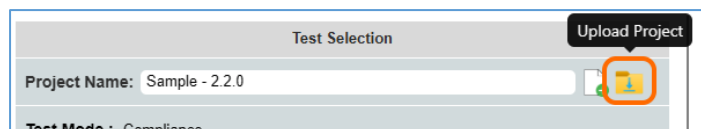


FIGURE 8.37: UPLOAD PROJECT— #1

- If the required project file (.gproj file) was saved in the local file directory, select that project file under “Local File” as shown in Figure 8.38 example below.

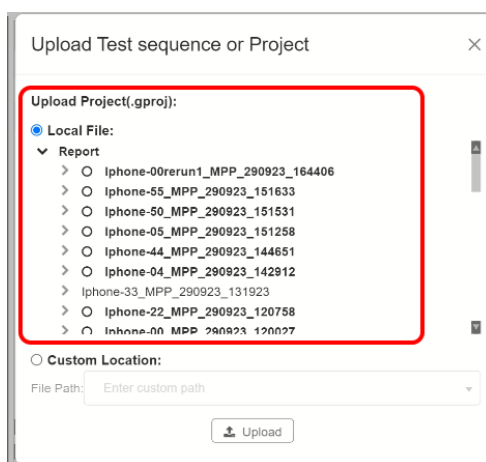


FIGURE 8.38: UPLOAD PROJECT— #2

- If the required .gproj file was saved in another location other than the local file directory, select **Custom Location** and enter the project file path, for example, “C:\GRL\GRL-C3-TPT\Report\Apple_MPP_100823_084915\Run1\ReferenceData\MPP_Run1_TestBackup.gproj”.

Note: Make sure to provide the project file name (MPP_Run1_TestBackup.gproj) in the path.

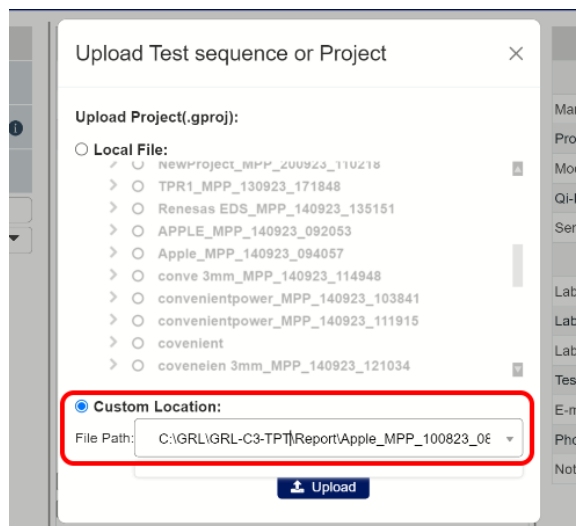


FIGURE 8.39: UPLOAD PROJECT— #3

- Click on the **Upload** button and the selected project file will be loaded as shown in the Figure 8.40 example below. The user can now proceed to access/configure the project.

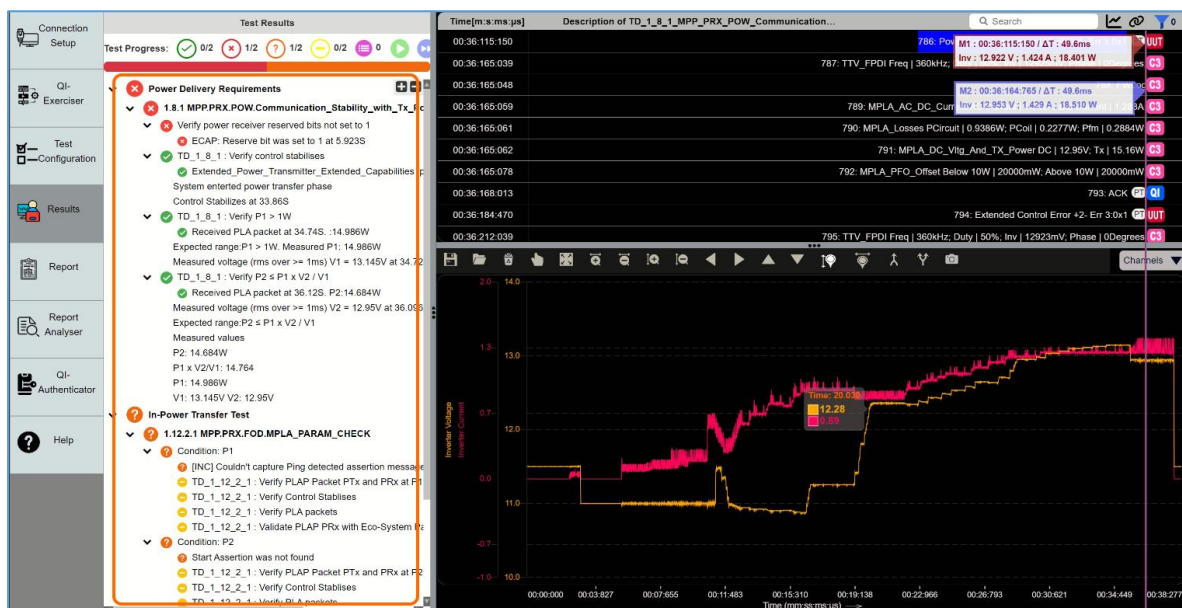


FIGURE 8.40: UPLOAD PROJECT— #4

8.2.3 Test Configuration

Before running any tests, make sure to configure the following main categories:

- SDF Section
- Optimum Coil Position
- Tester Configuration

8.2.3.1 SDF (Self Declaration Form) Section

SDF Section  		
Supported Specification	2.2.0	▼
Power Profile	MPP25	▼
Applicant Name		
Product Name		
Part Number		
QI ID		
Manufacturer Code	0x	010E
Maximum Power	25	W
Supported Cloak Reasons	5 Selected	▼
Cloak Retry Count	5	
Supported GET Requests	Select	▼
Supported Specific Requests	verSel	▼
☒ Authentication Support		
☒ Restricted to Full Mode		
☒ Cloak Support		
☒ Detect Ping Support		
☒ Delta Ploss Support		
☐ PRx Supports KEST_COEFF		

FIGURE 8.41: DUT SELF DECLARATION FORM MANAGEMENT EXAMPLE (FOR MPP)

SDF Section  		
Supported Specification	2.2.0	▼
Power Profile	BPP	▼
Applicant Name		
Product Name		
Part Number		
QI ID		
Manufacturer Code	0x	042
Supported PROP Data Packets	Select	▼
Supported Protocols	Select	▼
Maximum Power	15	W
☐ Authentication Support		
☐ OB Support		
☐ Dup Support		
☐ Negotiation Support		
☐ WPID Support		
☐ XID Data Packet Support		
☐ PCH Data Packet Support		

FIGURE 8.42: DUT SELF DECLARATION FORM MANAGEMENT EXAMPLE (FOR BPP/EPP)

When creating a new project, once the user has uploaded the eSDF file or created a default eSDF file, the SDF Section will be auto populated with the eSDF data read from

the respective eSDF file. The user can edit or export the eSDF data by clicking on  respectively.

To edit the eSDF data, click on  and the following pop-up window will allow the user to make the required edits. Once done, click on the **Update** button to apply the changes.

Project Configuration

SDF Section

Supported Specification2.2.0
Power ProfileMPP
Applicant Name
Product Name
Part Number
QI ID
Manufacturer Code0x010E
Maximum Power15W
Supported Cloak ReasonsSelect
Cloak Retry Count1
Supported GET RequestsSelect
Supported Specific RequestsSelect
Authentication Support
Restricted to Full Mode
Cloak Support
Detect Ping Support
Delta Ploss Support
PRx Supports KEST_COEFF

Tester Configuration

Repeat Test Cases0
PTMC Code0x010E
Load Pool Data
k_P1 (0,0)0
k_P2 (2,2)0
Battery Charge (%)0
PRx Cloak Wait Time2min
Enable Optimum Position
Enable Popup to control the DUT Power manually
Enable TPT pop-up for PRx EDS packet

Test Lab Information

Lab Name
Lab Location
Lab Manager
Test Engineer
E-mail
Phone Number
Notes/Remarks

Update

To export the eSDF data, click on  to save the data to a JSON file in the system.

8.2.3.2 NOTAL Test Case Selection

*Note: The NOTAL test case selection is only applicable for the **BPP/EPP V_2.0.1 Certification**. It will not be displayed when the BPP/EPP V1.3.3 or V2.1 Certification is selected.*

Notal Testcase

☐ 240420-1 8.2.4 PRX.CPX.CFG.S03.XID.001

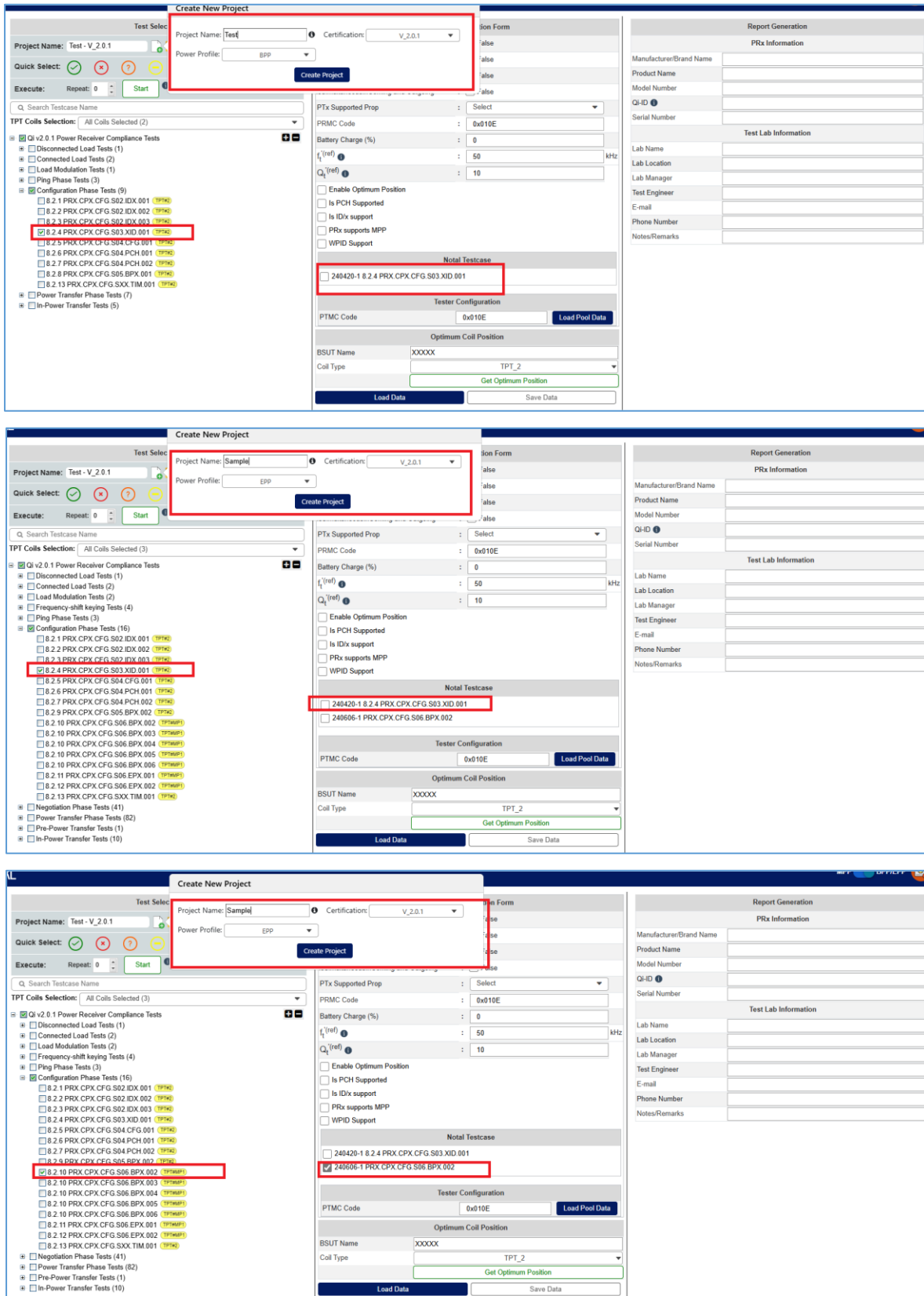
FIGURE 8.43: NOTAL TEST CASE SELECTION FOR BPP V2.0.1

Notal Testcase

☐ 240420-1 8.2.4 PRX.CPX.CFG.S03.XID.001
☐ 240606-1 PRX.CPX.CFG.S06.BPX.002

FIGURE 8.44: NOTAL TEST CASE SELECTION FOR EPP V2.0.1

To access the NOTAL test case selection panel, click on “Create New Project” and select Certification as “V_2.0.1” and Power Profile as “BPP / EPP”. To apply the notal changes in test execution for BPP/EPP V2.0.1 certification, select the checkbox for the respective NOTAL test case and its corresponding tests as highlighted in Figure 8.45 below.



The figure consists of three screenshots of the 'Create New Project' dialog in the GRL-C3-TPT User Guide, showing the selection of test cases for BPP/EPP V_2.0.1 certification.

Top Screenshot: The 'Project Name' is 'Test - V_2.0.1'. The 'Certification' is 'V_2.0.1'. The 'Power Profile' is 'BPP'. The 'Test Select' section shows 'TPT Coils Selection' with 'All Coils Selected (2)'. The 'Test Case Selection' section shows 'Configuration Phase Tests (9)' with '8.2.4 PRX.CPX.CFG.S03.XID.001' selected. The 'Tester Configuration' section shows 'PTMC Code' as '0x010E' and 'Optimum Coil Position' as 'TPT_2'.

Middle Screenshot: The 'Project Name' is 'Sample'. The 'Certification' is 'V_2.0.1'. The 'Power Profile' is 'EPP'. The 'Test Select' section shows 'TPT Coils Selection' with 'All Coils Selected (3)'. The 'Test Case Selection' section shows 'Configuration Phase Tests (16)' with '8.2.4 PRX.CPX.CFG.S03.XID.001' selected. The 'Tester Configuration' section shows 'PTMC Code' as '0x010E' and 'Optimum Coil Position' as 'TPT_2'.

Bottom Screenshot: The 'Project Name' is 'Sample'. The 'Certification' is 'V_2.0.1'. The 'Power Profile' is 'EPP'. The 'Test Select' section shows 'TPT Coils Selection' with 'All Coils Selected (3)'. The 'Test Case Selection' section shows 'Configuration Phase Tests (16)' with '8.2.4 PRX.CPX.CFG.S03.XID.001' selected. The 'Tester Configuration' section shows 'PTMC Code' as '0x010E' and 'Optimum Coil Position' as 'TPT_2'.

FIGURE 8.45: SELECT NOTAL TEST CASES FOR BPP/EPP V_2.0.1

- **240420-1 8.2.4 PRX.CPX.CFG.S03.XID.001:** Select this checkbox to apply the NOTAL changes in BPP/EPP V_2.0.1 test execution for the 8.2.4 PRX.CPX.CFG.S03.XID.001 test.
- **240606-1 PRX.CPX.CFG.S06.BPX.002:** Select this checkbox to apply the NOTAL changes in EPP V_2.0.1 test execution for the 8.2.10 PRX.CPX.CFG.S06.BPX.002 test.

8.2.3.3 Optimum Coil Position

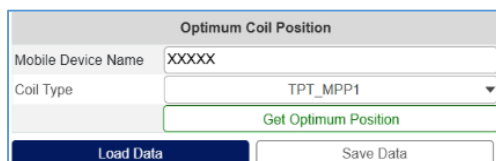


FIGURE 8.46: CONFIGURATION FOR OPTIMUM COIL POSITION

- **Mobile Device Name:** Set the name of the mobile DUT for the coil positioning test.
- **Coil Type:** Select the type of TPT coil assembly to be positioned under the DUT such that the DUT can achieve the maximum signal strength value.
- **Get Optimum Position:** Click on this button to start the coil positioning test once the TPT coil is placed under the DUT. During this process, adjust the coil in various positions under the DUT to obtain the maximum signal strength value. When the test has completed, the results will be displayed below this button. The *Results* screen will also display the results/details of the test case that is running in real-time.

Refer to the following procedure on how to perform the coil positioning test using the Get Optimum Coil feature.

- Once the **Get Optimum Position** button is clicked, pop-up instructions will appear. Position the DUT according to the X and Y parameters as mentioned to obtain the maximum signal strength value in the optimum position. Once done, click **Ok** to proceed with the test.
 - The GRL-C3-TPT application will record all the test measurements and update the values in the following file directory— **“C:\GRL\GRL-C3-TPT\Report\Sample\ActiveAlignment.xlsx”**.
 - The trace file will be available in the following directory— **“C:\GRL\GRL-C3-TPT\SignalFiles\GetCoilOptimumPosition.grltrace”**.
- **Load Data:** Click on this button to load and use data from a saved configuration file.
 - **Save Data:** Click on this button to save the current configuration to a file.

8.2.3.4 Tester Configuration

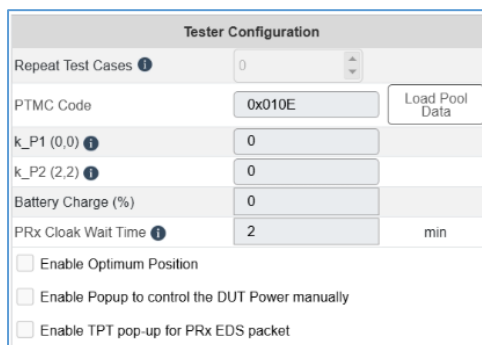


FIGURE 8.47: CONFIGURE TESTER (FOR MPP)

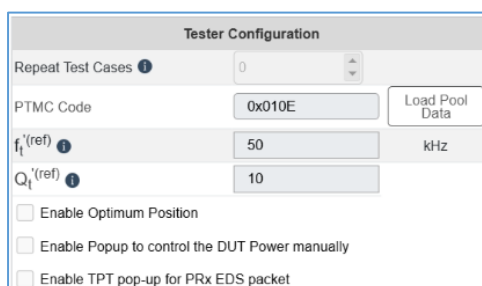


FIGURE 8.48: CONFIGURE TESTER (FOR BPP/EPP)

- **Repeat Test Cases:** Select the number of times to repeat running selected tests.
- **PTMC Code:** Set the Power Transmitter Manufacturer Code (PTMC) ID of the TPT.
- **Load Pool Data:** This function allows you to use different power transmitter manufacturer codes (PTMC's) other than the GRL-C3-TPT's own power transmitter manufacturer code (PTMC) in order to obtain expected test results. Click on the Load Pool Data button to load an existing data file and this will enable PTMC codes to be assigned randomly for each test case when running multiple tests.

Note: The PTMC_pool data is available in the WPC website.

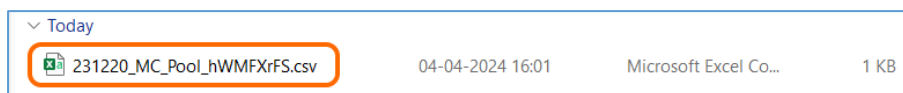
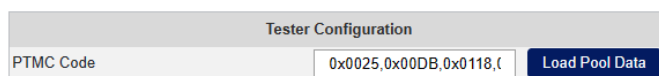



FIGURE 8.49: LOAD PRMC CODE FROM SELECTED POOL DATA FILE

- **Ki_P1 (0,0) & Ki_P2 (2,2):** Set the inductive coupling factor, Ki, to be calculated in the PTx at the P1 (0,0) position and P2 (2,2) positions respectively.
- **$f_t^{[ref]}$ & $Q_t^{[ref]}$:** Set the Reference Resonance Frequency $f_t^{[ref]}$ and Reference Quality Factor $Q_t^{[ref]}$ which are required for the PRx Compliance Book Pre

Power FOD Test 'MP.RX.FOD.REQFODSTATUS.TC2'. See Section 12, Appendix C for more details.

- **Battery Charge:** Set the battery charge level percentage of the TPT.
- **PRx Cloak Wait Time:** Set the time duration to wait for cloak to be sent by the PRx.
- **Enable Optimum Position:** Select this checkbox to enable the PRx DUT to be placed at an optimized position on top of the TPT coil for testing. *Note: The Optimum Coil Positioning data is required for this feature.*
- **Enable Popup to Control the DUT Power Manually:** Select this checkbox to enable pop-up instructions to guide the user to control the PRx DUT load manually.
- **Enable TPT pop-up for PRx EDS packet:** Select this checkbox to enable pop-up instructions from the test power transmitter to send the PRx EDS packet.

8.2.4 Test Selection

The tests available to be run are shown on the “Test Selection” panel.

8.2.4.1 Select Tests

Individual tests are grouped together based on their definition in a specific version of specification. Selecting a group will cause all tests in that group to be selected. Selecting individual tests within a group will lead to just those individual tests to be selected.

Tests that comply with all or certain combination of positions and TPT coil type can be selected by clicking on the drop-down menu:

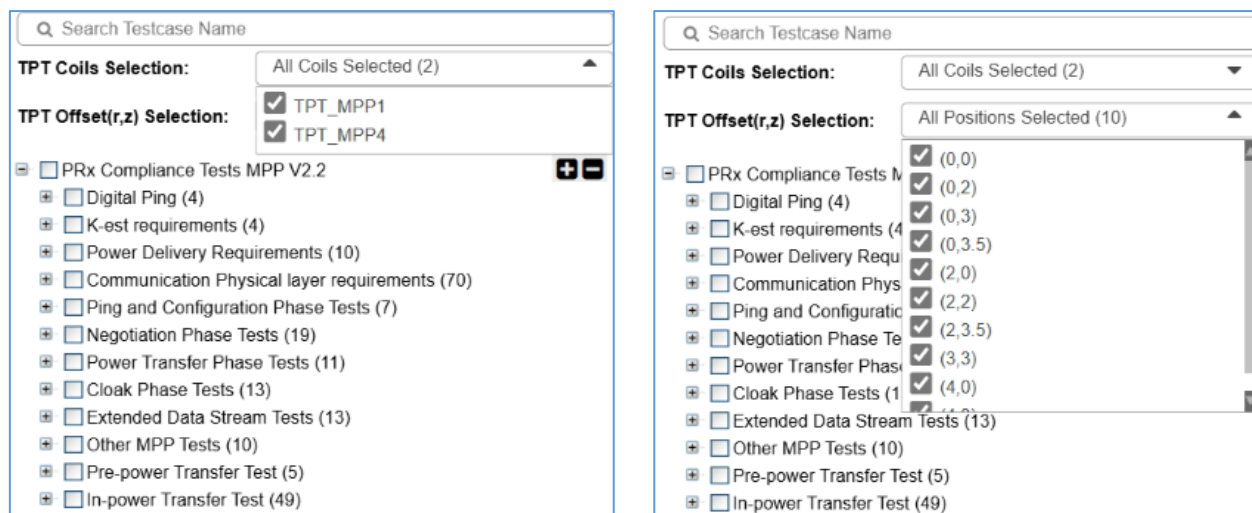


FIGURE 8.50: SELECT TESTS BASED ON TPT COIL TYPE AND POSITIONS FOR MPP TESTING (USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

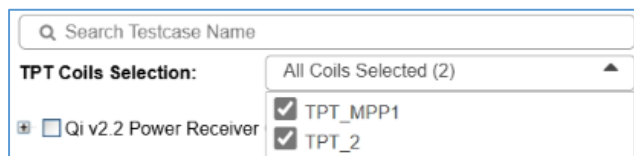


FIGURE 8.51: SELECT TESTS BASED ON TPT COIL TYPE FOR BPP TESTING

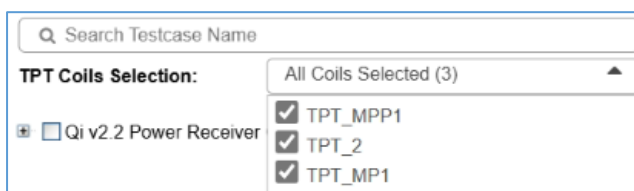


FIGURE 8.52: SELECT TESTS BASED ON TPT COIL TYPE FOR EPP TESTING

Note: For a detailed listing of all the tests and test methodology, please refer to the specification documents referenced in Section 1.

8.2.4.1.1 For MPP testing (using MPP V2.2 Certification & MPP 25W Power Profile), select from the following tests based on the TPT_MPP1 coil type and positioning of the DUT:

8.2.4.1.1.1 All Positions

Run the compliance tests for all positions of DUT placement.

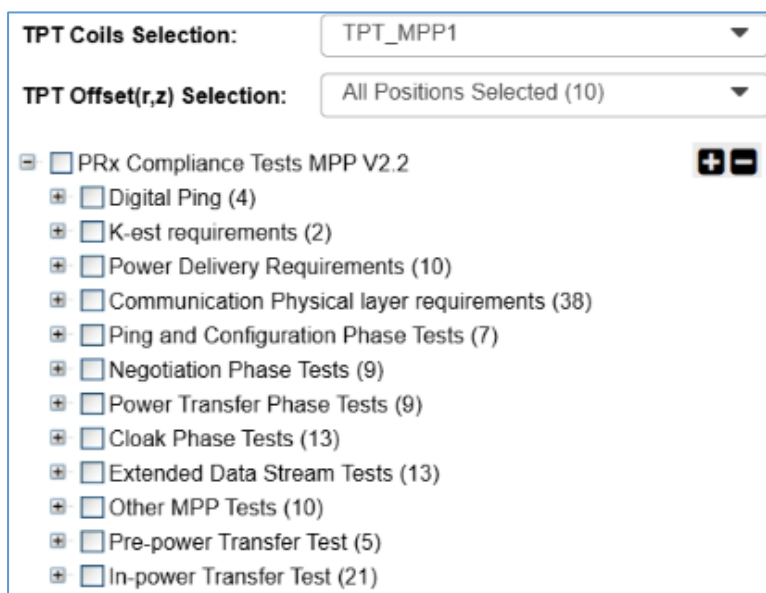


FIGURE 8.53: TEST SELECTION FOR TPT MPP1 COIL AND ALL DUT POSITIONS (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.1.2 (0,0) Position

Run compliance tests for the (0,0) position of DUT placement.

TPT Coils Selection:

TPT_MPP1

TPT Offset(r,z) Selection:

(0,0)

☐ PRx Compliance Tests MPP V2.2

+

-

☐ Digital Ping (1)
 ☐ K-est requirements (1)
 ☐ Power Delivery Requirements (5)
 ☐ Communication Physical layer requirements (13)
 ☐ Ping and Configuration Phase Tests (7)
 ☐ Negotiation Phase Tests (9)
 ☐ Power Transfer Phase Tests (9)
 ☐ Cloak Phase Tests (13)
 ☐ Extended Data Stream Tests (13)
 ☐ Other MPP Tests (10)
 ☐ Pre-power Transfer Test (1)
 ☐ In-power Transfer Test (8)

FIGURE 8.54: TEST SELECTION FOR TPT MPP1 COIL AND (0,0) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.1.3 (0,2) Position

Run the compliance tests for the (0,2) position of DUT placement.

TPT Coils Selection:

TPT_MPP1

TPT Offset(r,z) Selection:

(0,2)

☐ PRx Compliance Tests MPP V2.2

+

-

☐ Digital Ping (1)
 ☐ 7.1 MPP.PRX.POW.Digital_Ping_128kHz_P2 TPT#MPP1

FIGURE 8.55: TEST SELECTION FOR TPT MPP1 COIL AND (0,2) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.1.4 (0,3) Position

Run the compliance tests for the (0,3) position of DUT placement.

TPT Coils Selection:

TPT_MPP1

TPT Offset(r,z) Selection:

(0,3)

☐ PRx Compliance Tests MPP V2.2

+

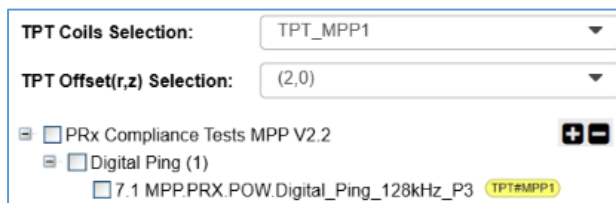
-

☐ Pre-power Transfer Test (1)
 ☐ 13.1.1 MPP.PRX.FOD.BEFOREPOWER_DEVICEDET_Q_DEF_

FIGURE 8.56: TEST SELECTION FOR TPT MPP1 COIL AND (0,3) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.1.5 (2,0) Position

Run compliance tests for the (2,0) position of DUT placement.



TPT Coils Selection: TPT_MPP1

TPT Offset(r,z) Selection: (2,0)

☐ PRx Compliance Tests MPP V2.2

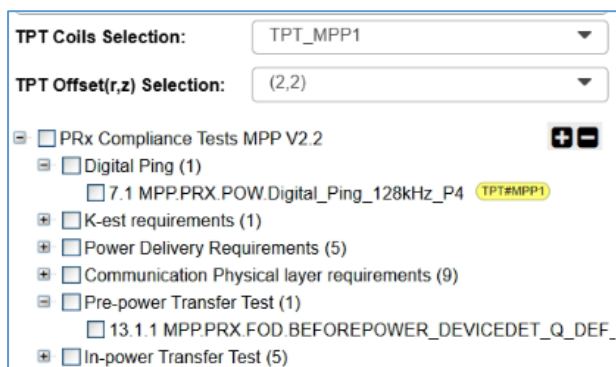
☒ Digital Ping (1)

☐ 7.1 MPP.PRX.POW.Digital_Ping_128kHz_P3 TPT#MPP1

FIGURE 8.57: TEST SELECTION FOR TPT MPP1 COIL AND (2,0) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.1.6 (2,2) Position

Run compliance tests for the (2,2) position of DUT placement.



TPT Coils Selection: TPT_MPP1

TPT Offset(r,z) Selection: (2,2)

☒ PRx Compliance Tests MPP V2.2

☒ Digital Ping (1)

☐ 7.1 MPP.PRX.POW.Digital_Ping_128kHz_P4 TPT#MPP1

☒ K-est requirements (1)

☒ Power Delivery Requirements (5)

☒ Communication Physical layer requirements (9)

☒ Pre-power Transfer Test (1)

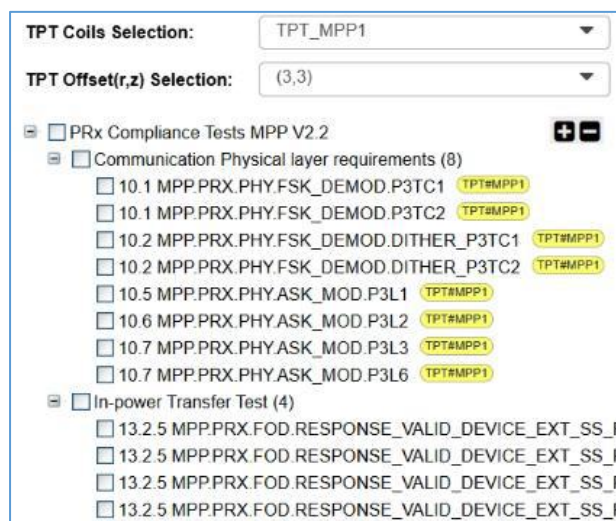
☐ 13.1.1 MPP.PRX.FOD.BEFOREPOWER_DEVICEDET_Q_DEF_

☒ In-power Transfer Test (5)

FIGURE 8.58: TEST SELECTION FOR TPT MPP1 COIL AND (2,2) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.1.7 (3,3) Position

Run compliance tests for the (3,3) position of DUT placement.



TPT Coils Selection: TPT_MPP1

TPT Offset(r,z) Selection: (3,3)

☒ PRx Compliance Tests MPP V2.2

☒ Communication Physical layer requirements (8)

☐ 10.1 MPP.PRX.PHY.FSK_DEMOD.P3TC1 TPT#MPP1

☐ 10.1 MPP.PRX.PHY.FSK_DEMOD.P3TC2 TPT#MPP1

☐ 10.2 MPP.PRX.PHY.FSK_DEMOD.DITHER_P3TC1 TPT#MPP1

☐ 10.2 MPP.PRX.PHY.FSK_DEMOD.DITHER_P3TC2 TPT#MPP1

☐ 10.5 MPP.PRX.PHY.ASK_MOD.P3L1 TPT#MPP1

☐ 10.6 MPP.PRX.PHY.ASK_MOD.P3L2 TPT#MPP1

☐ 10.7 MPP.PRX.PHY.ASK_MOD.P3L3 TPT#MPP1

☐ 10.7 MPP.PRX.PHY.ASK_MOD.P3L6 TPT#MPP1

☒ In-power Transfer Test (4)

☐ 13.2.5 MPP.PRX.FOD.RESPONSE_VALID_DEVICE_EXT_SS_I

☐ 13.2.5 MPP.PRX.FOD.RESPONSE_VALID_DEVICE_EXT_SS_I

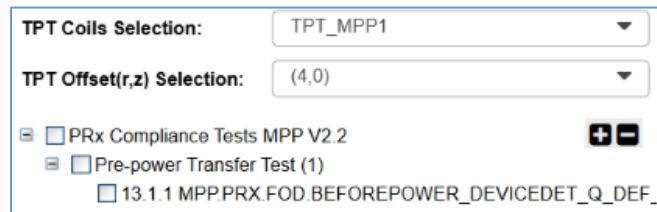
☐ 13.2.5 MPP.PRX.FOD.RESPONSE_VALID_DEVICE_EXT_SS_I

☐ 13.2.5 MPP.PRX.FOD.RESPONSE_VALID_DEVICE_EXT_SS_I

FIGURE 8.59: TEST SELECTION FOR TPT MPP1 COIL AND (3,3) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.1.8 (4,0) Position

Run compliance tests for the (4,0) position of DUT placement.



TPT Coils Selection: TPT_MPP1

TPT Offset(r,z) Selection: (4,0)

☐ PRx Compliance Tests MPP V2.2

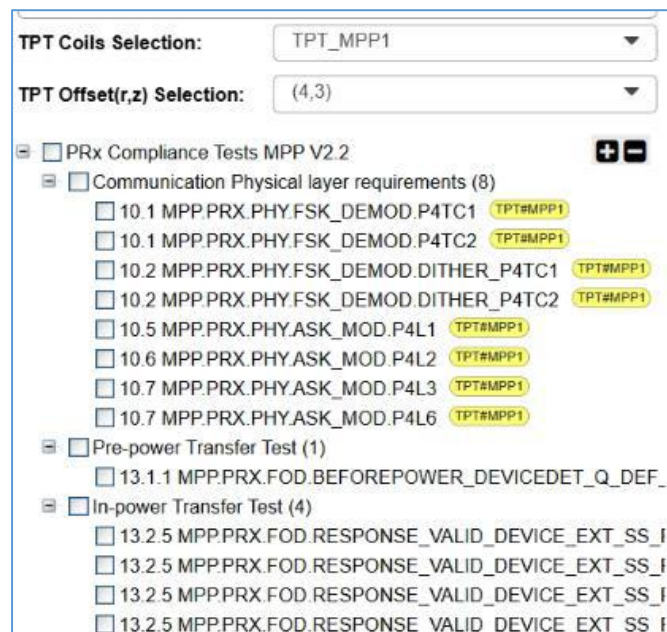
☒ Pre-power Transfer Test (1)

☐ 13.1.1 MPP.PRX.FOD.BEFOREPOWER_DEVICEDET_Q_DEF_

FIGURE 8.60: TEST SELECTION FOR TPT MPP1 COIL AND (4,0) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.1.9 (4,3) Position

Run compliance tests for the (4,3) position of DUT placement.



TPT Coils Selection: TPT_MPP1

TPT Offset(r,z) Selection: (4,3)

☐ PRx Compliance Tests MPP V2.2

☒ Communication Physical layer requirements (8)

☐ 10.1 MPP.PRX.PHY.FSK_DEMOD.P4TC1 TPT#MPP1

☐ 10.1 MPP.PRX.PHY.FSK_DEMOD.P4TC2 TPT#MPP1

☐ 10.2 MPP.PRX.PHY.FSK_DEMOD.DITHER_P4TC1 TPT#MPP1

☐ 10.2 MPP.PRX.PHY.FSK_DEMOD.DITHER_P4TC2 TPT#MPP1

☐ 10.5 MPP.PRX.PHY.ASK_MOD.P4L1 TPT#MPP1

☐ 10.6 MPP.PRX.PHY.ASK_MOD.P4L2 TPT#MPP1

☐ 10.7 MPP.PRX.PHY.ASK_MOD.P4L3 TPT#MPP1

☐ 10.7 MPP.PRX.PHY.ASK_MOD.P4L6 TPT#MPP1

☒ Pre-power Transfer Test (1)

☐ 13.1.1 MPP.PRX.FOD.BEFOREPOWER_DEVICEDET_Q_DEF_

☒ In-power Transfer Test (4)

☐ 13.2.5 MPP.PRX.FOD.RESPONSE_VALID_DEVICE_EXT_SS_I

☐ 13.2.5 MPP.PRX.FOD.RESPONSE_VALID_DEVICE_EXT_SS_I

☐ 13.2.5 MPP.PRX.FOD.RESPONSE_VALID_DEVICE_EXT_SS_I

☐ 13.2.5 MPP.PRX.FOD.RESPONSE_VALID_DEVICE_EXT_SS_I

FIGURE 8.61: TEST SELECTION FOR TPT MPP1 COIL AND (4,3) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.2 For MPP testing (using MPP V2.2 Certification & MPP 25W Power Profile), select from the following tests based on the TPT_MPP4 coil type and positioning of the DUT:

8.2.4.1.2.1 All Positions

Run the compliance tests for all positions of DUT placement.

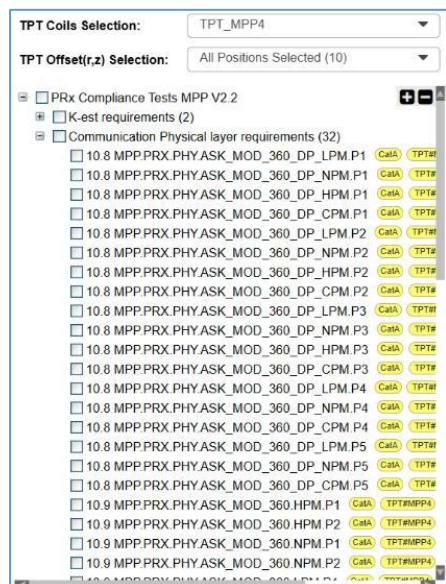


FIGURE 8.62: TEST SELECTION FOR TPT_MPP4 COIL AND ALL DUT POSITIONS (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.2.2 (0,0) Position

Run compliance tests for the (0,0) position of DUT placement.

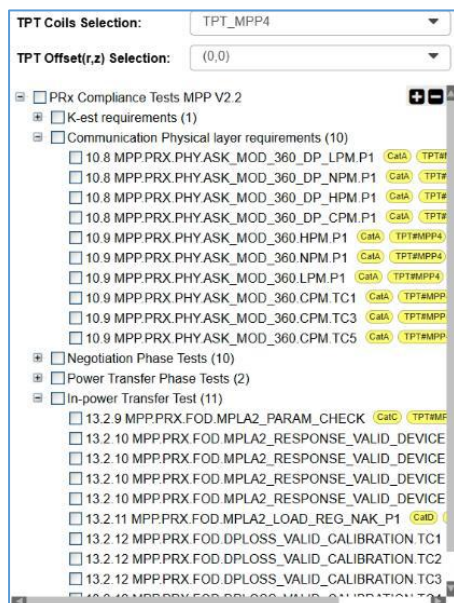
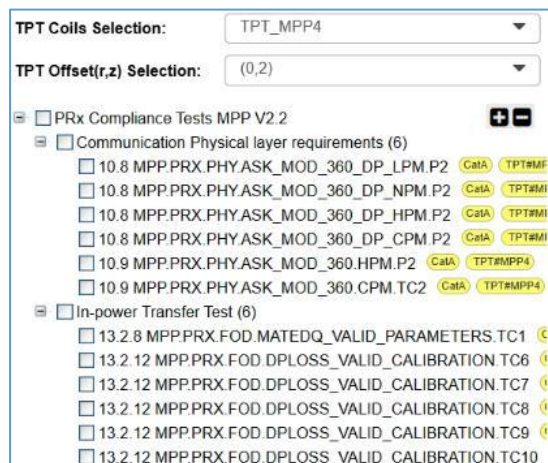


FIGURE 8.63: TEST SELECTION FOR TPT_MPP4 COIL AND (0,0) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.2.3 (0,2) Position

Run the compliance tests for the (0,2) position of DUT placement.



TPT Coils Selection: TPT_MPP4

TPT Offset(r,z) Selection: (0,2)

☐ PRx Compliance Tests MPP V2.2

☒ Communication Physical layer requirements (6)

- ☐ 10.8 MPP.PRX.PHY.ASK.MOD_360_DP_LPM.P2 CatA TPT#MF
- ☐ 10.8 MPP.PRX.PHY.ASK.MOD_360_DP_NPM.P2 CatA TPT#MI
- ☐ 10.8 MPP.PRX.PHY.ASK.MOD_360_DP_HPM.P2 CatA TPT#MI
- ☐ 10.8 MPP.PRX.PHY.ASK.MOD_360_DP_CPM.P2 CatA TPT#MI
- ☐ 10.9 MPP.PRX.PHY.ASK.MOD_360_HPM.P2 CatA TPT#MPP4
- ☐ 10.9 MPP.PRX.PHY.ASK.MOD_360_CPM.TC2 CatA TPT#MPP4

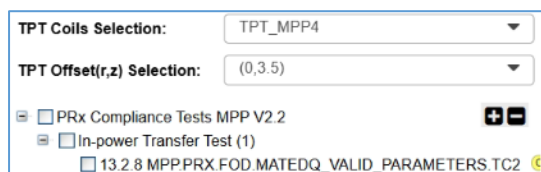
☒ In-power Transfer Test (6)

- ☐ 13.2.8 MPP.PRX.FOD.MATEDQ_VALID_PARAMETERS.TC1 C
- ☐ 13.2.12 MPP.PRX.FOD.DPLOSS_VALID_CALIBRATION.TC6 i
- ☐ 13.2.12 MPP.PRX.FOD.DPLOSS_VALID_CALIBRATION.TC7 i
- ☐ 13.2.12 MPP.PRX.FOD.DPLOSS_VALID_CALIBRATION.TC8 i
- ☐ 13.2.12 MPP.PRX.FOD.DPLOSS_VALID_CALIBRATION.TC9 i
- ☐ 13.2.12 MPP.PRX.FOD.DPLOSS_VALID_CALIBRATION.TC10 i

FIGURE 8.64: TEST SELECTION FOR TPT_MPP4 COIL AND (0,2) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.2.4 (0,3) Position

Run the compliance tests for the (0,3) position of DUT placement.



TPT Coils Selection: TPT_MPP4

TPT Offset(r,z) Selection: (0,3.5)

☐ PRx Compliance Tests MPP V2.2

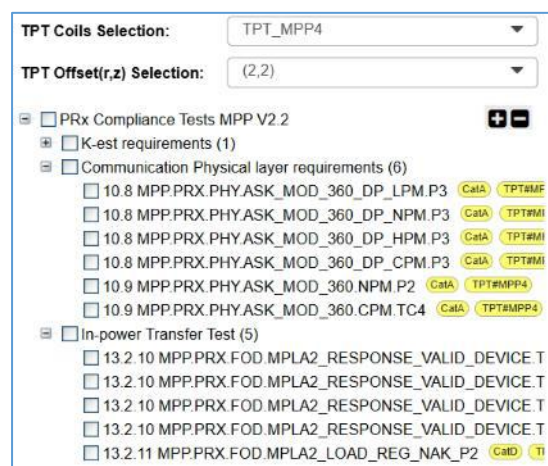
☒ In-power Transfer Test (1)

- ☐ 13.2.8 MPP.PRX.FOD.MATEDQ_VALID_PARAMETERS.TC2 C

FIGURE 8.65: TEST SELECTION FOR TPT_MPP4 COIL AND (0,3) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.2.5 (2,2) Position

Run compliance tests for the (2,2) position of DUT placement.



TPT Coils Selection: TPT_MPP4

TPT Offset(r,z) Selection: (2,2)

☐ PRx Compliance Tests MPP V2.2

☒ K-est requirements (1)

☒ Communication Physical layer requirements (6)

- ☐ 10.8 MPP.PRX.PHY.ASK.MOD_360_DP_LPM.P3 CatA TPT#MF
- ☐ 10.8 MPP.PRX.PHY.ASK.MOD_360_DP_NPM.P3 CatA TPT#MI
- ☐ 10.8 MPP.PRX.PHY.ASK.MOD_360_DP_HPM.P3 CatA TPT#MI
- ☐ 10.8 MPP.PRX.PHY.ASK.MOD_360_DP_CPM.P3 CatA TPT#MI
- ☐ 10.9 MPP.PRX.PHY.ASK.MOD_360_NPM.P2 CatA TPT#MPP4
- ☐ 10.9 MPP.PRX.PHY.ASK.MOD_360_CPM.TC4 CatA TPT#MPP4

☒ In-power Transfer Test (5)

- ☐ 13.2.10 MPP.PRX.FOD.MPLA2_RESPONSE_VALID_DEVICE.T
- ☐ 13.2.10 MPP.PRX.FOD.MPLA2_RESPONSE_VALID_DEVICE.T
- ☐ 13.2.10 MPP.PRX.FOD.MPLA2_RESPONSE_VALID_DEVICE.T
- ☐ 13.2.10 MPP.PRX.FOD.MPLA2_RESPONSE_VALID_DEVICE.T
- ☐ 13.2.11 MPP.PRX.FOD.MPLA2_LOAD_REG_NAK_P2 CatD TI

FIGURE 8.66: TEST SELECTION FOR TPT_MPP4 COIL AND (2,2) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.2.6 (2,3.5) Position

Run compliance tests for the (2,3.5) position of DUT placement.

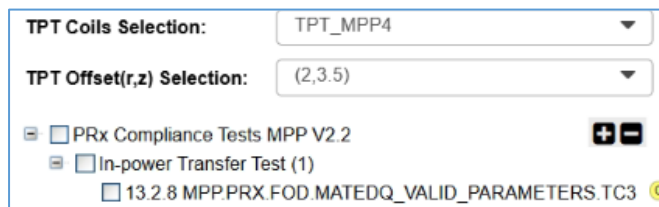


FIGURE 8.67: TEST SELECTION FOR TPT_MPP4 COIL AND (2,3.5) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.2.7 (3,3) Position

Run compliance tests for the (3,3) position of DUT placement.

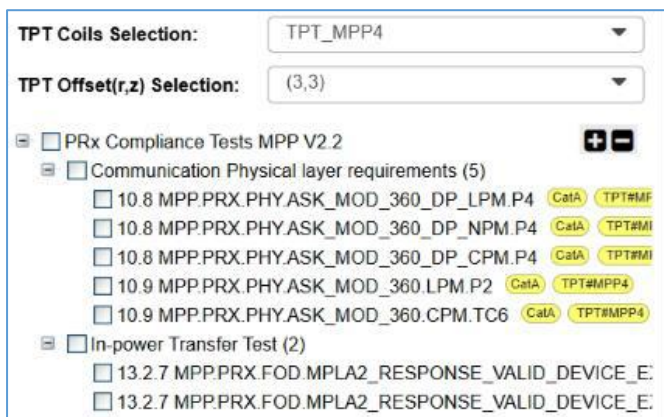


FIGURE 8.68: TEST SELECTION FOR TPT_MPP4 COIL AND (3,3) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.2.8 (4,3) Position

Run compliance tests for the (4,3) position of DUT placement.

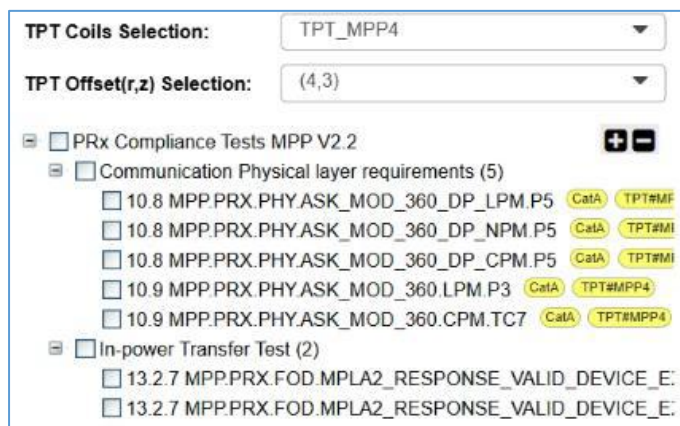


FIGURE 8.69: TEST SELECTION FOR TPT_MPP4 COIL AND (4,3) DUT POSITION (FOR MPP TESTING USING MPP V2.2 CERTIFICATION & MPP 25W POWER PROFILE)

8.2.4.1.3 For BPP testing (using V_2.2.0 Certification), select from the following tests based on the TPT coil type:

8.2.4.1.3.1 All TPT Coils

Run the compliance tests for all types of TPT coils.

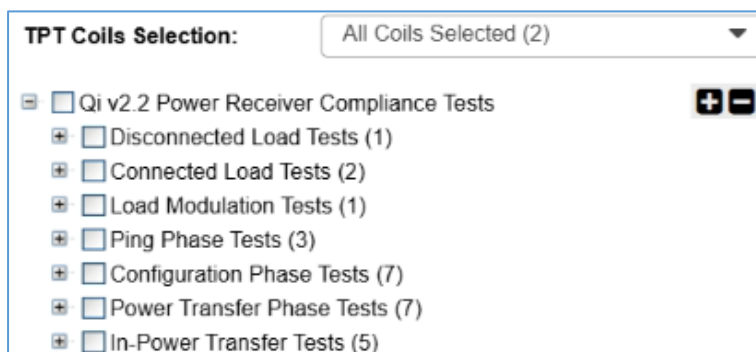


FIGURE 8.70: TEST SELECTION FOR ALL TPT COILS (USING BPP V_2.2.0 CERTIFICATION)

8.2.4.1.3.2 TPT_MPP1 Coil

Run compliance tests for the TPT_MPP1 coil.



FIGURE 8.71: TEST SELECTION FOR TPT_MPP1 COIL (USING BPP V_2.2.0 CERTIFICATION)

8.2.4.1.3.3 TPT_2 Coil

Run the compliance tests for the TPT_2 coil.

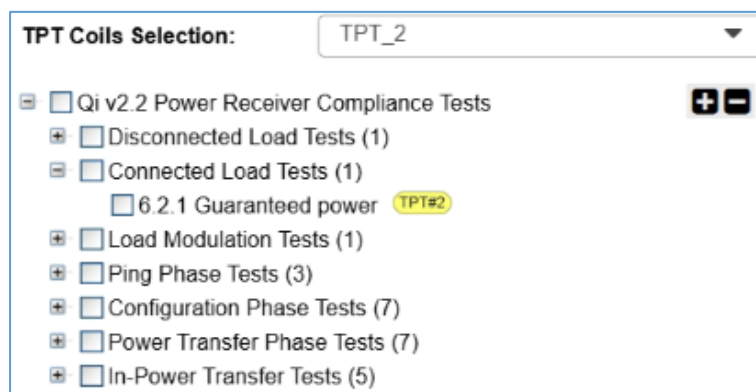
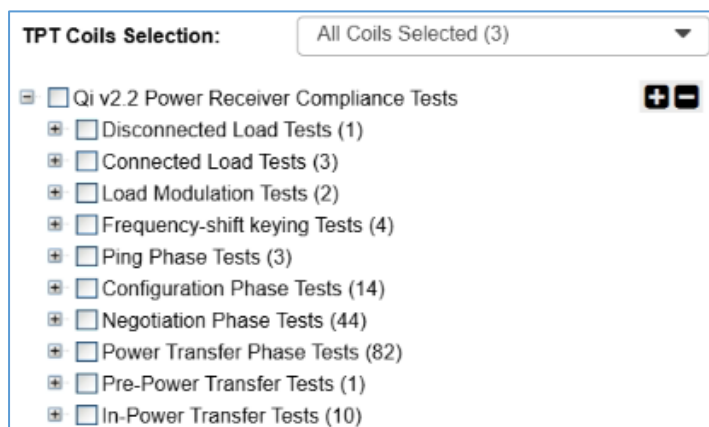


FIGURE 8.72: TEST SELECTION FOR TPT_2 (USING BPP V_2.2.0 CERTIFICATION)

8.2.4.1.4 For EPP testing (using V_2.2.0 Certification), select from the following tests based on the TPT coil type:

8.2.4.1.4.1 All TPT Coils

Run the compliance tests for all types of TPT coils.



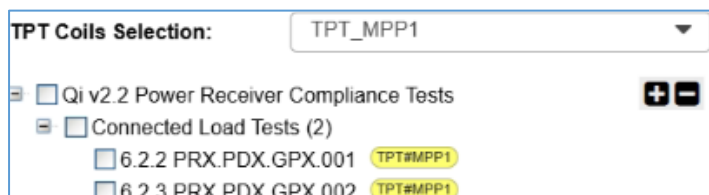
TPT Coils Selection: All Coils Selected (3)

- ☒ Qi v2.2 Power Receiver Compliance Tests
 - ☒ Disconnected Load Tests (1)
 - ☒ Connected Load Tests (3)
 - ☒ Load Modulation Tests (2)
 - ☒ Frequency-shift keying Tests (4)
 - ☒ Ping Phase Tests (3)
 - ☒ Configuration Phase Tests (14)
 - ☒ Negotiation Phase Tests (44)
 - ☒ Power Transfer Phase Tests (82)
 - ☒ Pre-Power Transfer Tests (1)
 - ☒ In-Power Transfer Tests (10)

FIGURE 8.73: TEST SELECTION FOR ALL TPT COILS (USING EPP V_2.2.0 CERTIFICATION)

8.2.4.1.4.2 TPT_MPP1 Coil

Run the compliance tests for the TPT_MPP1 coil.



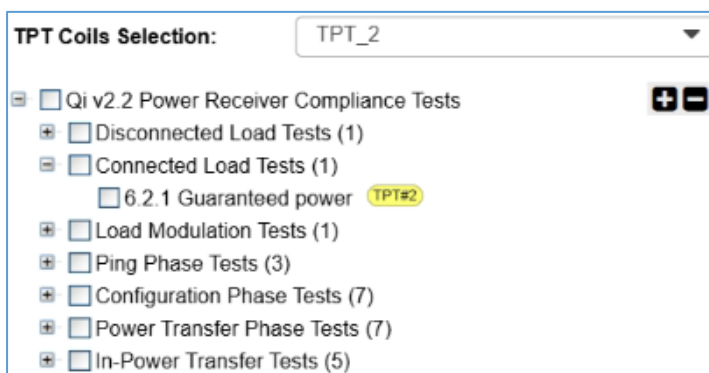
TPT Coils Selection: TPT_MPP1

- ☒ Qi v2.2 Power Receiver Compliance Tests
 - ☒ Connected Load Tests (2)
 - ☒ 6.2.2 PRX.PDX.GPX.001 TPT#MPP1
 - ☒ 6.2.3 PRX.PDX.GPX.002 TPT#MPP1

FIGURE 8.74: TEST SELECTION FOR TPT_MPP1 (USING EPP V_2.2.0 CERTIFICATION)

8.2.4.1.4.3 TPT_2 Coil

Run compliance tests for the TPT_2 coil.



TPT Coils Selection: TPT_2

- ☒ Qi v2.2 Power Receiver Compliance Tests
 - ☒ Disconnected Load Tests (1)
 - ☒ Connected Load Tests (1)
 - ☒ 6.2.1 Guaranteed power TPT#2
 - ☒ Load Modulation Tests (1)
 - ☒ Ping Phase Tests (3)
 - ☒ Configuration Phase Tests (7)
 - ☒ Power Transfer Phase Tests (7)
 - ☒ In-Power Transfer Tests (5)

FIGURE 8.75: TEST SELECTION FOR TPT_2 COIL (USING EPP V_2.2.0 CERTIFICATION)

8.2.4.1.4.4 TPT_MP1 Coil

Run the compliance tests for the TPT_MP1 coil.

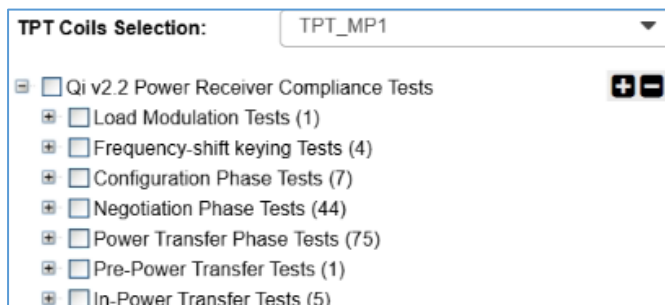
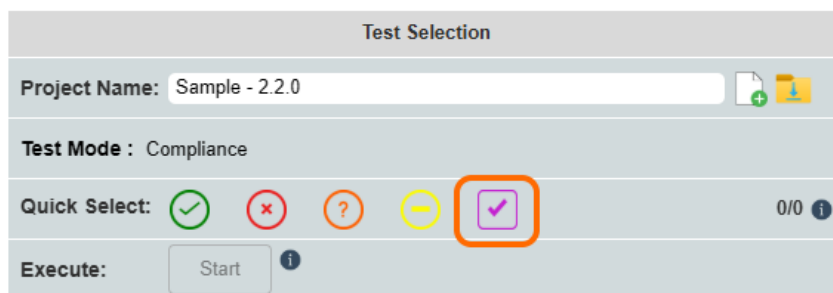


FIGURE 8.76: TEST SELECTION FOR TPT_MP1 (USING EPP V_2.2.0 CERTIFICATION)

8.2.4.2 Manage Test Selection

You can click on the  icon to select all the test cases in the list.



8.2.5 Report Generation

The “Test Lab Information” panel allows full reports to be created after running a set of tests.

Test Lab Information	
Lab Name	GRL Platform Solutions
Lab Location	India
Lab Manager	John
Test Engineer	David
E-mail	
Phone Number	
Notes/Remarks	

FIGURE 8.77: REPORT GENERATION PANEL

The “Test Lab Information” panel allows the user to enter information relevant to the lab specifics used for running tests. Once tests have completed, the test report can be viewed in the *Report* screen (see Section 8.3).

8.2.6 Run Tests

Once the desired test cases have been selected, they can be run by clicking on the **Start** button as indicated in Figure 8.78 below. Click on this button (**Stop**) again to terminate the test run.

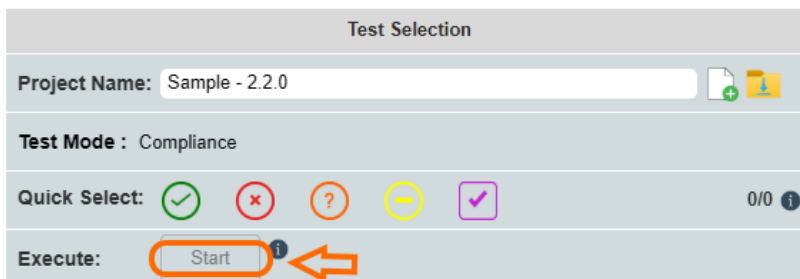


FIGURE 8.78: RUN TESTS

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

a) For MPP testing example:

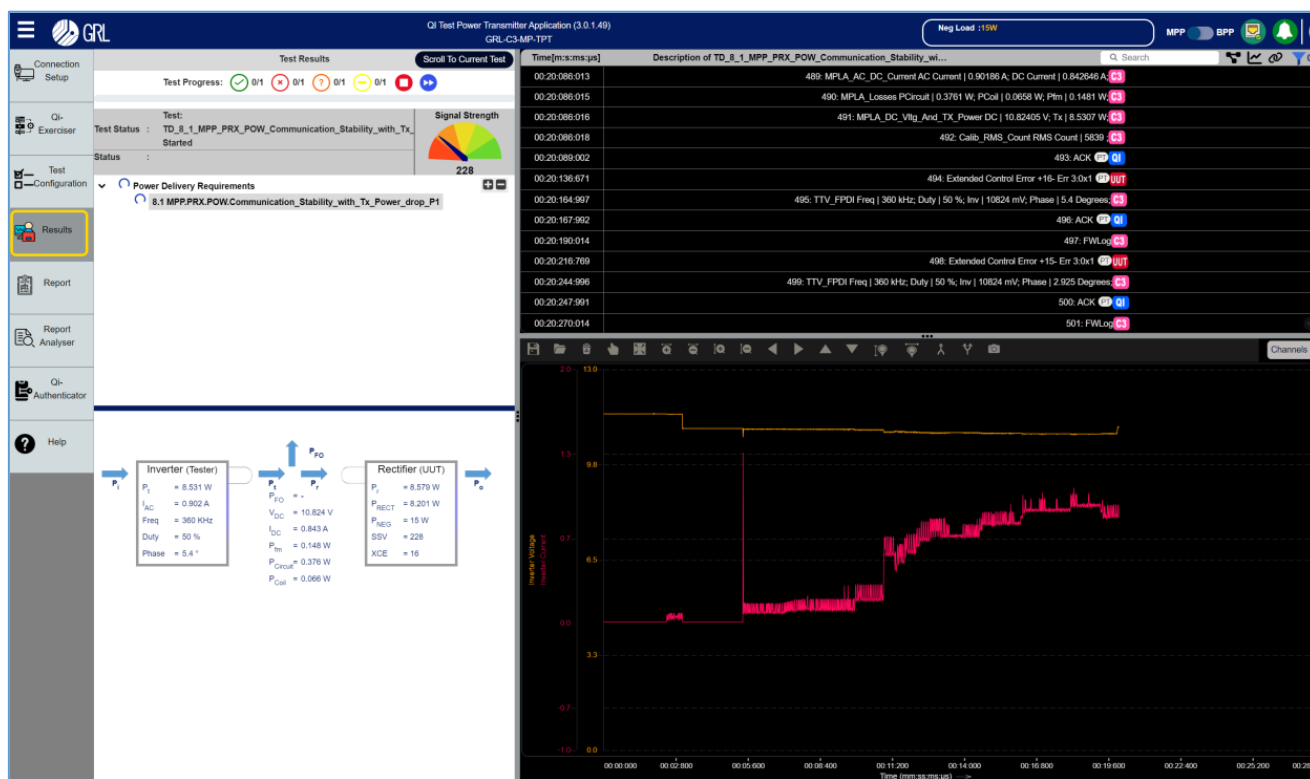


FIGURE 8.79: RESULTS SCREEN – TEST RUN IN PROGRESS (MPP TESTING)

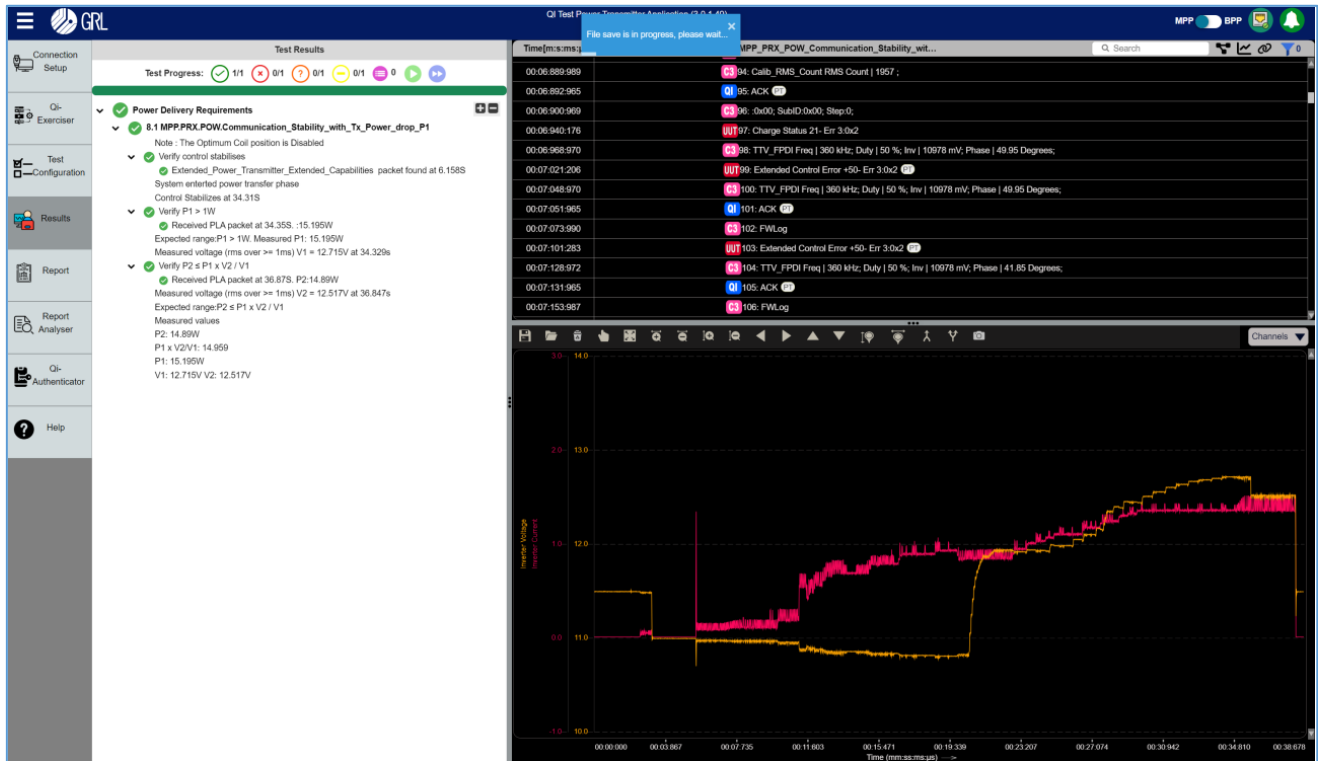


FIGURE 8.80: RESULTS SCREEN – TEST RUN COMPLETED (MPP TESTING)

b) For BPP testing example:

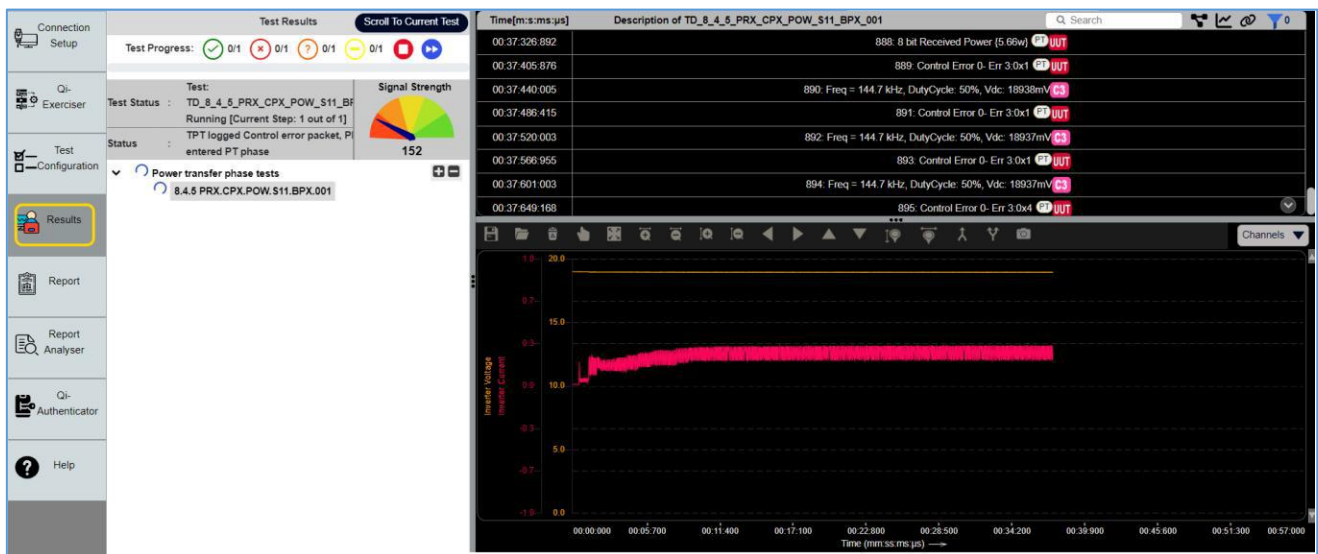


FIGURE 8.81: RESULTS SCREEN – TEST RUN IN PROGRESS (BPP TESTING)

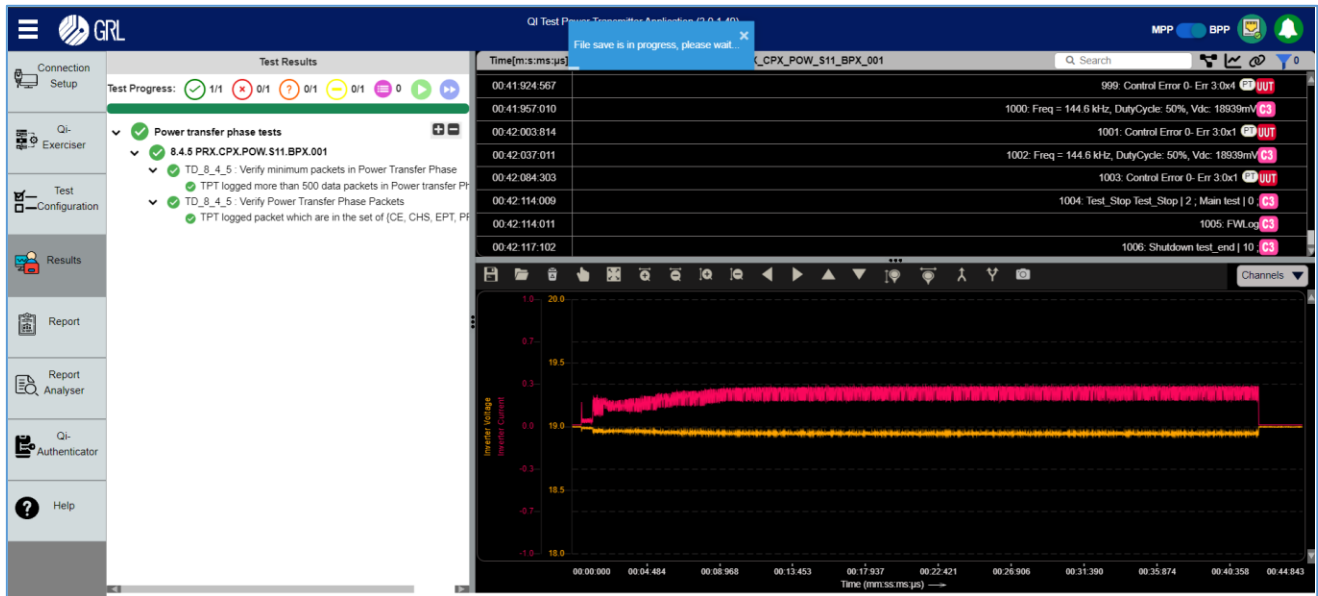


FIGURE 8.82: RESULTS SCREEN – TEST RUN COMPLETED (BPP TESTING)

c) For EPP testing example:



FIGURE 8.83: RESULTS SCREEN – TEST RUN IN PROGRESS (EPP TESTING)

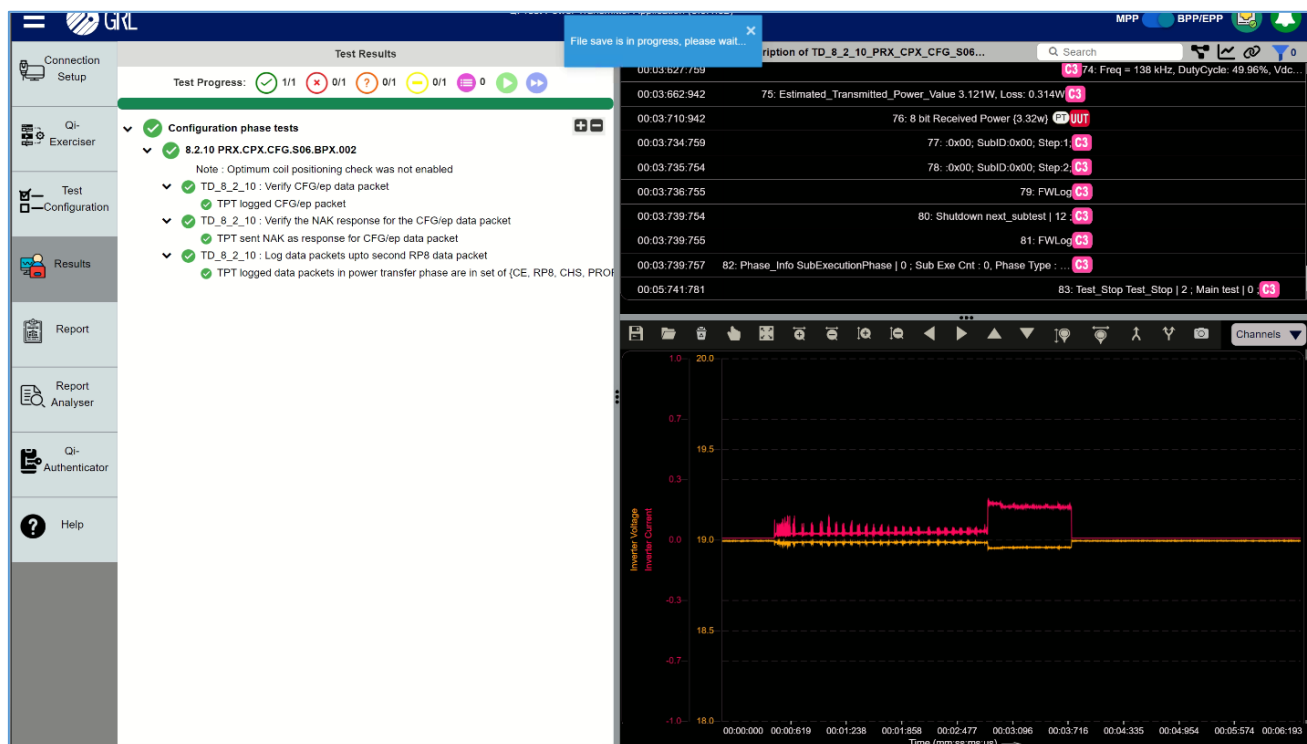


FIGURE 8.84: RESULTS SCREEN – TEST RUN COMPLETED (EPP TESTING)

While tests are running, several pop-up messages will appear to guide the user through the test run. The Test Results panel will display the pass/fail/inconclusive/incomplete status of each test as well as each subtest which you can view by clicking the drop-down arrow of the test group if applicable. The Packet communications exchange protocol and waveform displays next to the Test Results panel allow you to scroll to the section representing the start of the selected test– this allows you to trace failing test to determine the cause of the test failure.

If you only want to view specific measurement channels on the trace plot, select the “Channels” drop down option and click/unclick on the checkbox(s) of the desired channels.

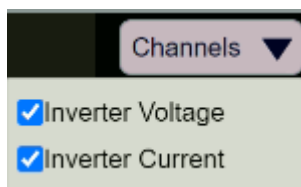
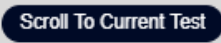


FIGURE 8.85: SELECT MEASUREMENT CHANNELS EXAMPLE

When the Packet communications exchange protocol is running, click on the **Stop Test Case Execution** button  under the Test Results panel at any time to end or pause the process respectively. To skip a test case that is currently running to the next test case, click on the **Skip Current Running Test Case** button . To select specific test cases in the test sequence, click on the  icon. To quickly navigate to the test case that is currently running, click on the **Scroll To Current Test** button .

Test results and configuration of any test run will automatically be saved to a JSON file in the Report folder of your PC's local file path.

To view a specific portion of the Packet communications exchange, click on the “Filter”  drop down to filter out the communications list by selecting the available options:

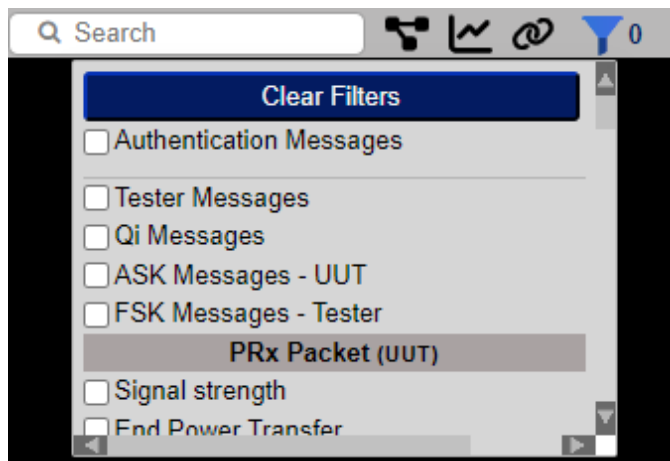


FIGURE 8.86: FILTER PACKET COMMUNICATIONS OPTIONS

To enable syncing of the Packet timings, click on the  icon and vice versa. To display or hide the graph plots from view, click on the  icon. To view multiple graph charts and test logs, click on the  icon.

The common plot specific buttons can be used to control the trace view as desired which includes panning, merge/unmerge, fit and zooming in/out of the trace plots. You can use your mouse cursor to hover on top of each plot specific button to view the description of each button function.



FIGURE 8.87: TRACE PLOT CONTROL BUTTONS

The  buttons in particular can be selected to enable cursors for a test/subtest which lets you turn on/off vertical and horizontal markers at certain areas of the plot. You can also click on a test/subtest to navigate to the exact time stamp and packet details of the plot.

When the testing is complete, the screen displays all the data gathered during the testing process. Select the **Save trace file**  button to save the trace plot to a .trace (grltrace) file or a CSV file, as shown in the example below.

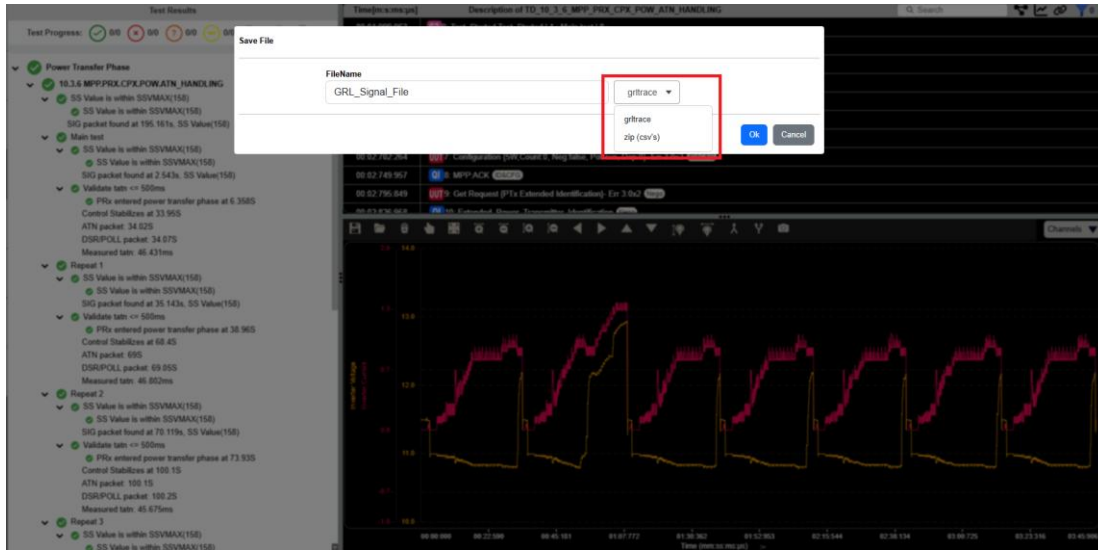


FIGURE 8.88: SAVE TRACE PLOT AFTER TEST RUN COMPLETION

Select the **Load trace file**  button to open and use an existing saved trace file (refer to Section 8.2.6.1 for the procedure).

You can then also return to the *Test Configuration* screen to filter out the test selection list for those tests with Pass/Fail/Inconclusive/Incomplete status. This allows you to

easily determine the status of each test using the respective icons  under the Test Selection panel.

8.2.6.1 Load Previously Saved Trace Files for Test Capture Verification

1. In the Results screen, click on the **Load trace file**  button as indicated in Figure 8.89 below.

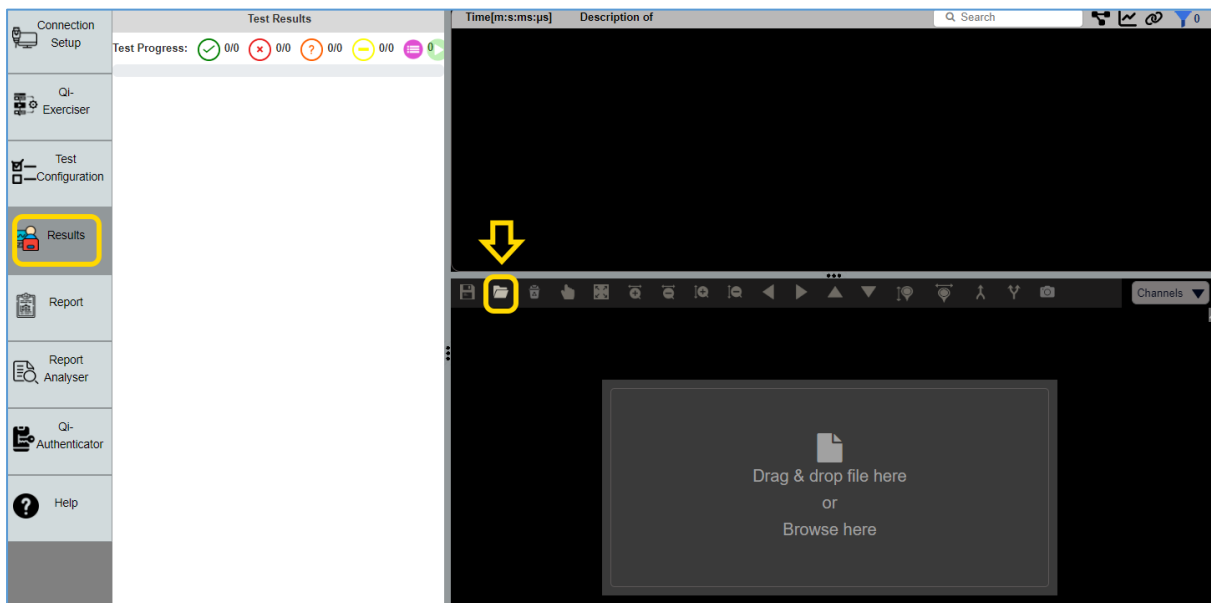
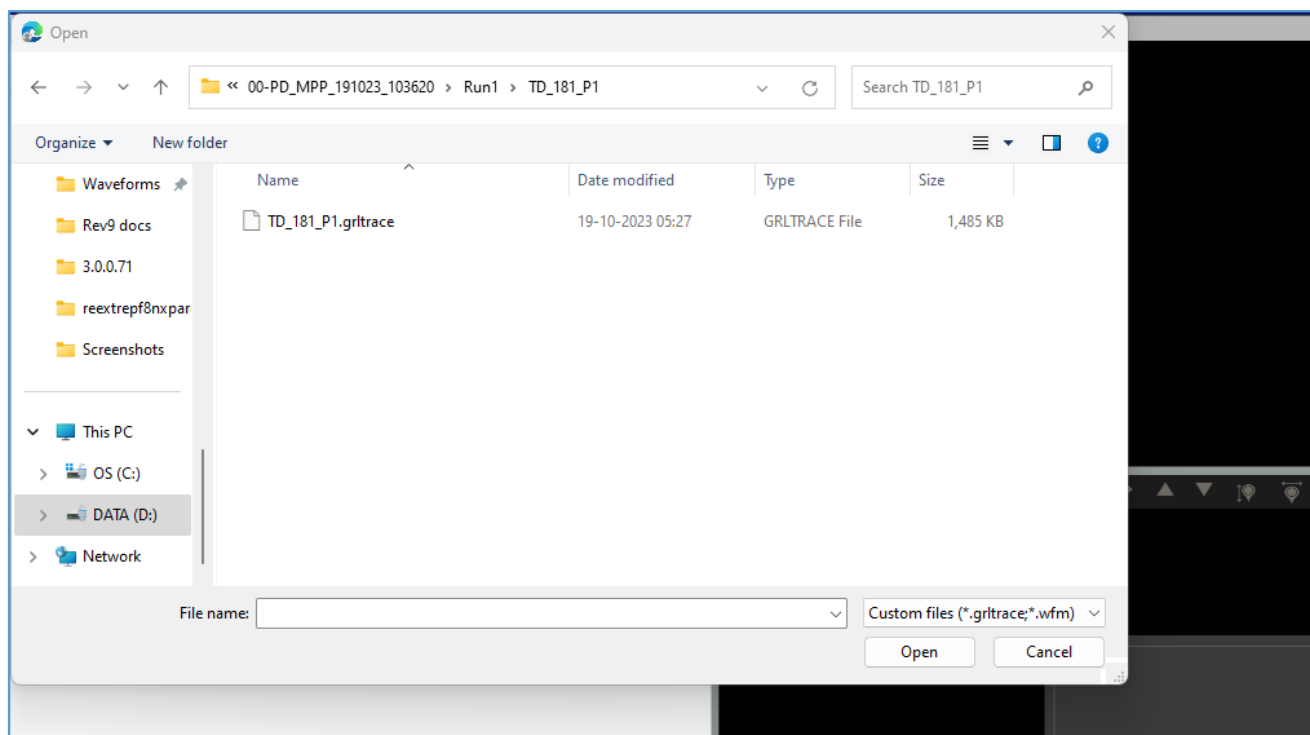


FIGURE 8.89: LOAD TRACE FILE BUTTON

2. Select the required **.grltrace** file (that was saved from a previous test run) from the dialog box window as shown in the example in Figure 8.90 below.

a) For MPP testing example:



b) For BPP/EPP testing example:

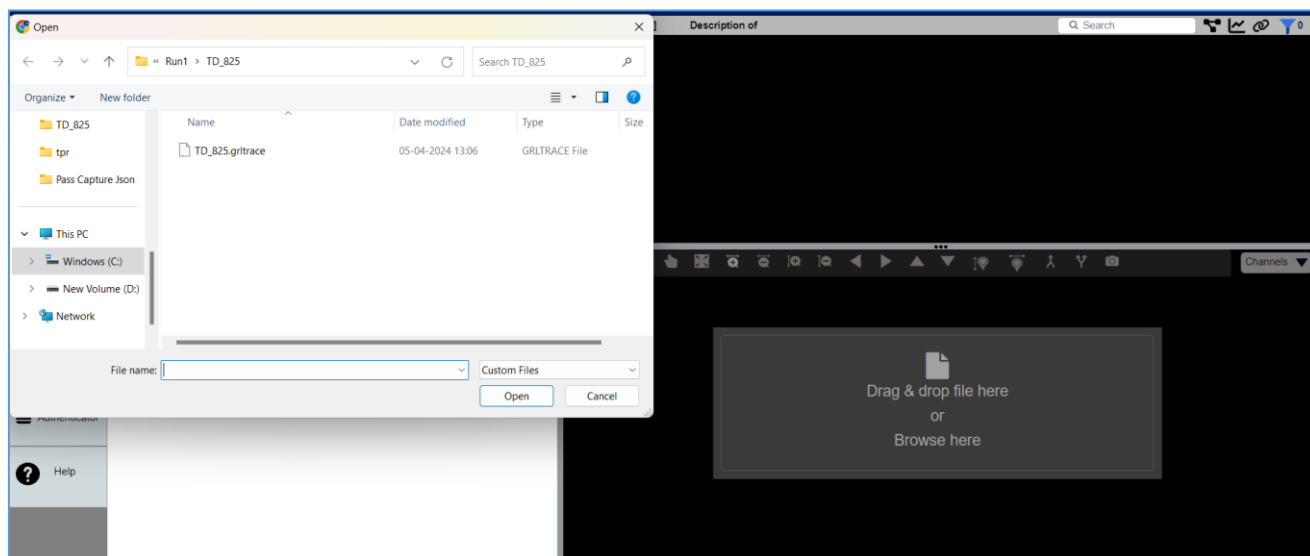
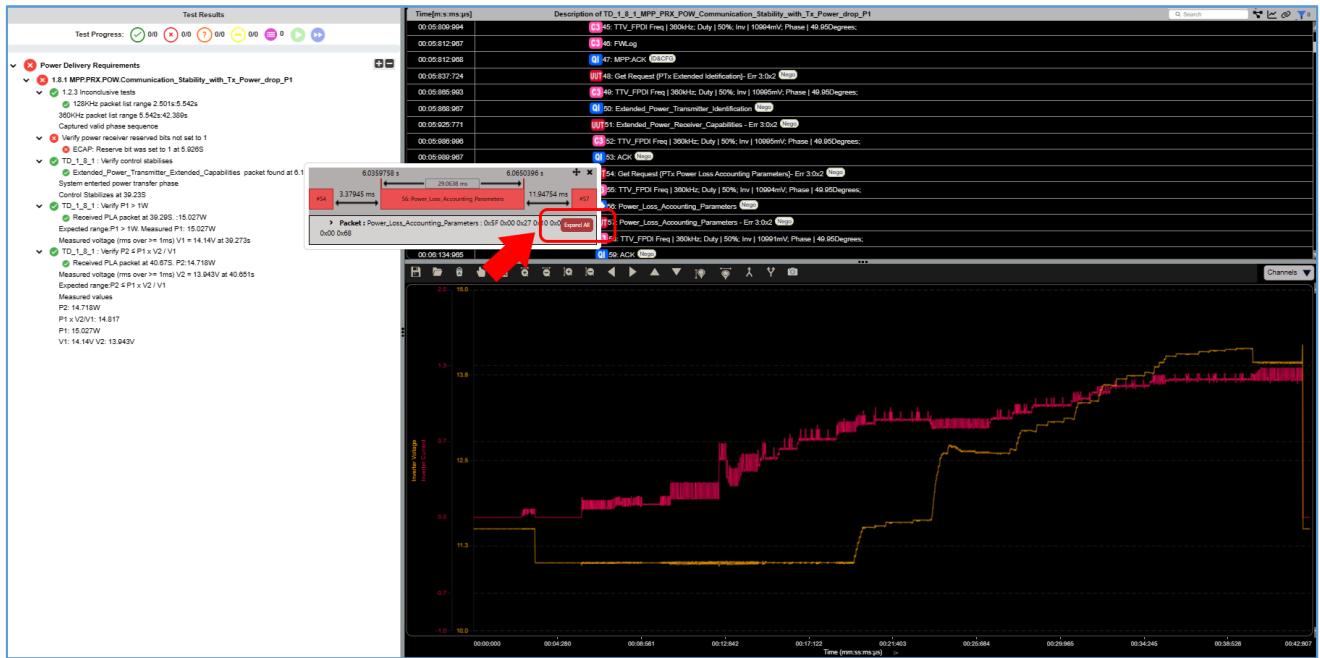


FIGURE 8.90: SELECT SAVED TRACE FILE

3. The selected trace file will be loaded as shown in the example in Figure 8.91 below. After loading the capture, the test data with packet, waveform & description details will be updated and to verify the packet details, the user can click on the respective packet and select the **Expand All** button.

a) For MPP testing example:



b) For BPP/EPP testing example:

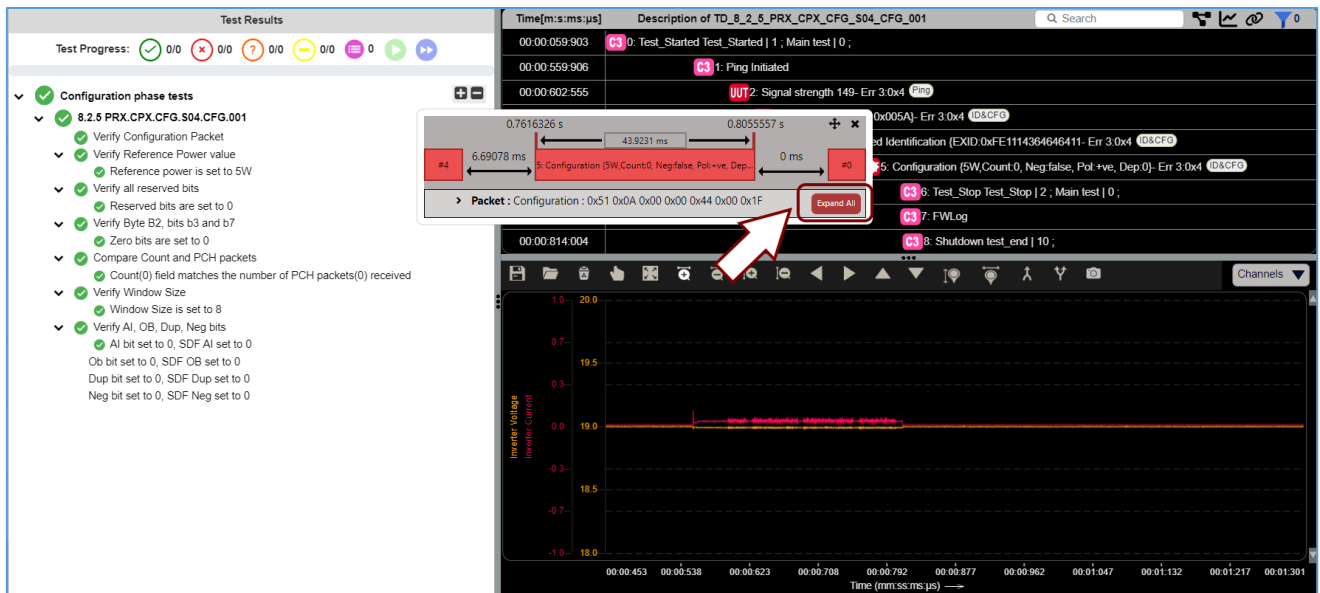
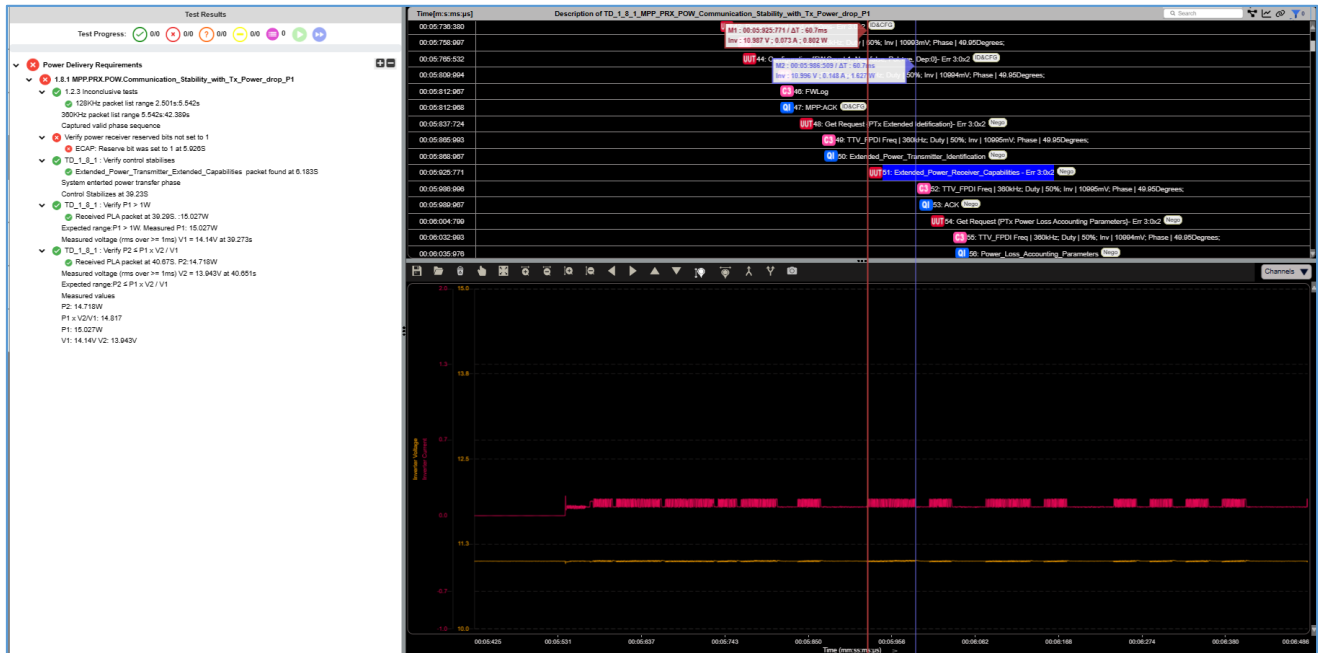


FIGURE 8.91: SELECTED TRACE FILE LOADED FOR VERIFICATION

4. To verify the exact failure packet, the user can just select the failure description and the GRL-C3-TPT application will automatically map the respective packet as shown in the example in Figure 8.92 below.

a) For MPP testing example:



b) For BPP/EPP testing example:



FIGURE 8.92: VERIFY FAILURE PACKET

- To remove the trace file from the screen, the user can click on the **Clear Capture** button as indicated in Figure 8.93 below.

a) For MPP testing example:



b) For BPP/EPP testing example:



FIGURE 8.93: CLEAR CAPTURE BUTTON

8.3 PFO Data

The GRL-C3-TPT application *PFO Data* screen allows the user to access the PFO distribution chart along with the received power information of the PRx. The PFO data will be auto generated after loading any executed PFO test case trace of the BPP/EPP power profile or any MPLA test case trace of the MPP power profile in the *Results* screen.

To access the PFO data, follow the steps below:

1. Go to the *Results* screen and load any saved .grltrace file of the MPP MPLA test case or BPP/EPP PFO test case (see Section 8.2.6.1). An example of the loaded trace is as shown below:

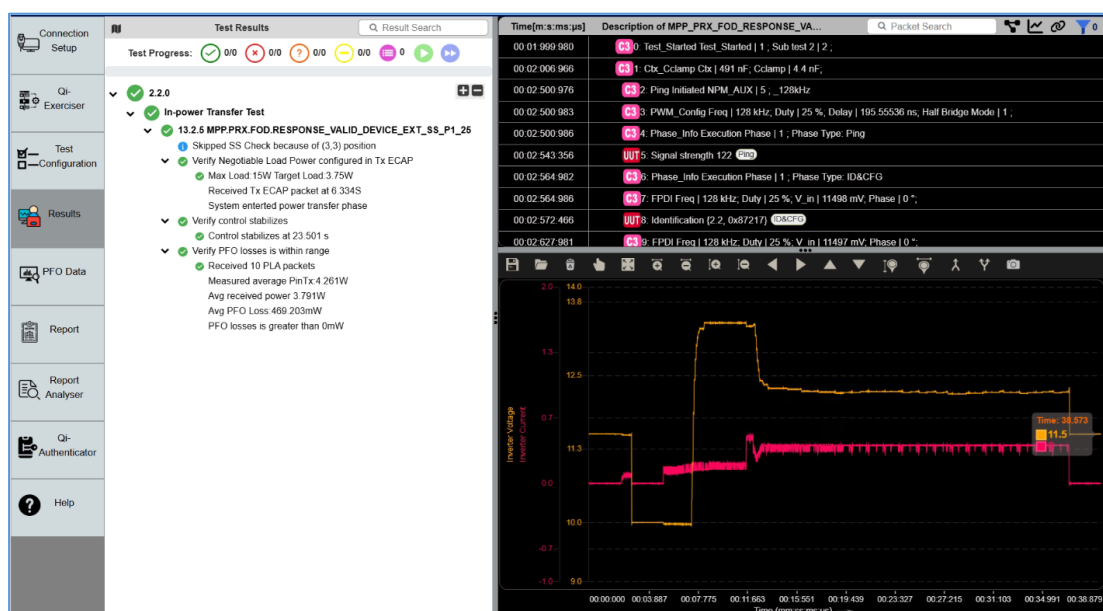


FIGURE 8.94: EXAMPLE OF LOADED MPP TRACE FILE

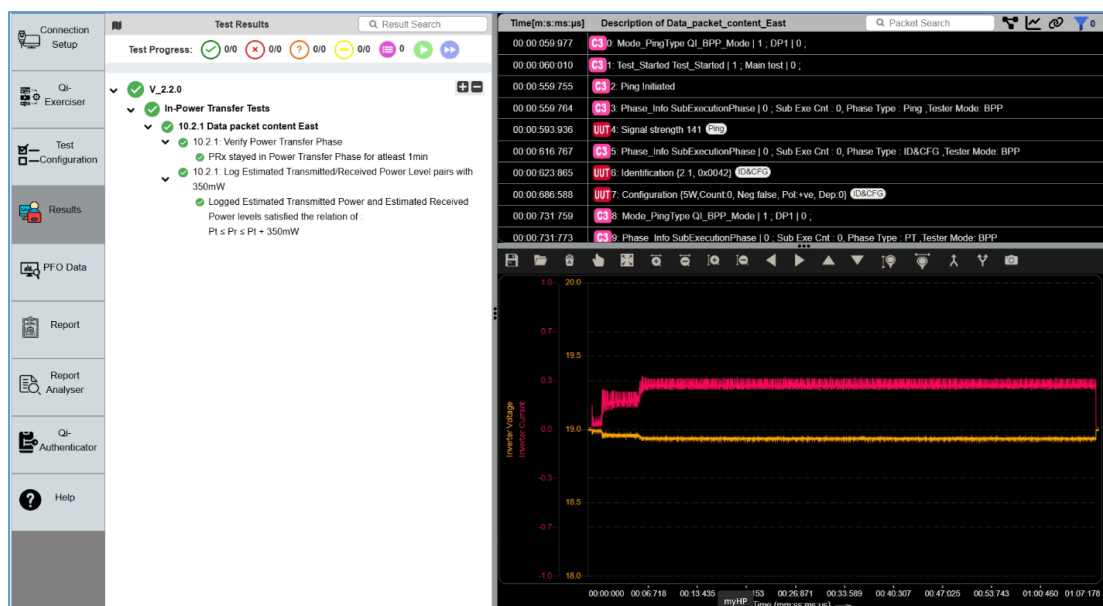


FIGURE 8.95: EXAMPLE OF LOADED BPP/EPP TRACE FILE

- Once the trace is loaded, the corresponding PFO chart along with the PRx received power information will be auto generated in the *PFO Data* screen as shown in the example below:

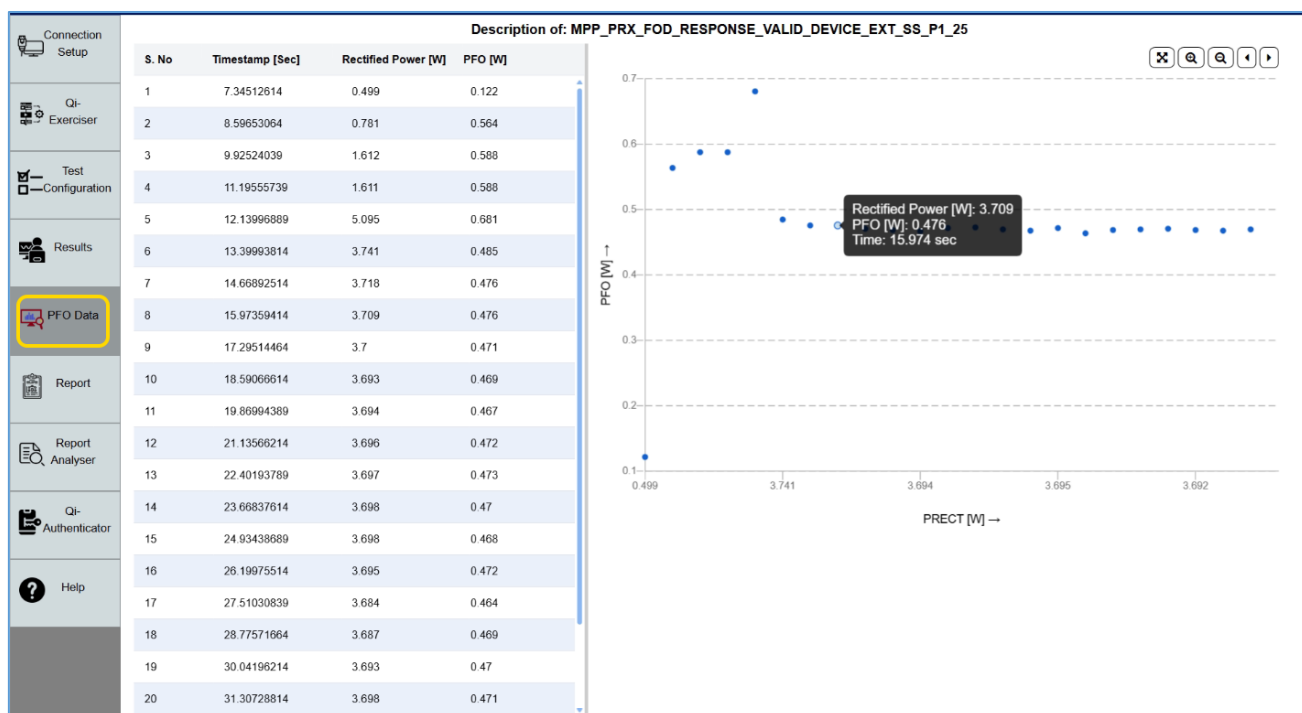


FIGURE 8.96: EXAMPLE OF MPP PFO DATA

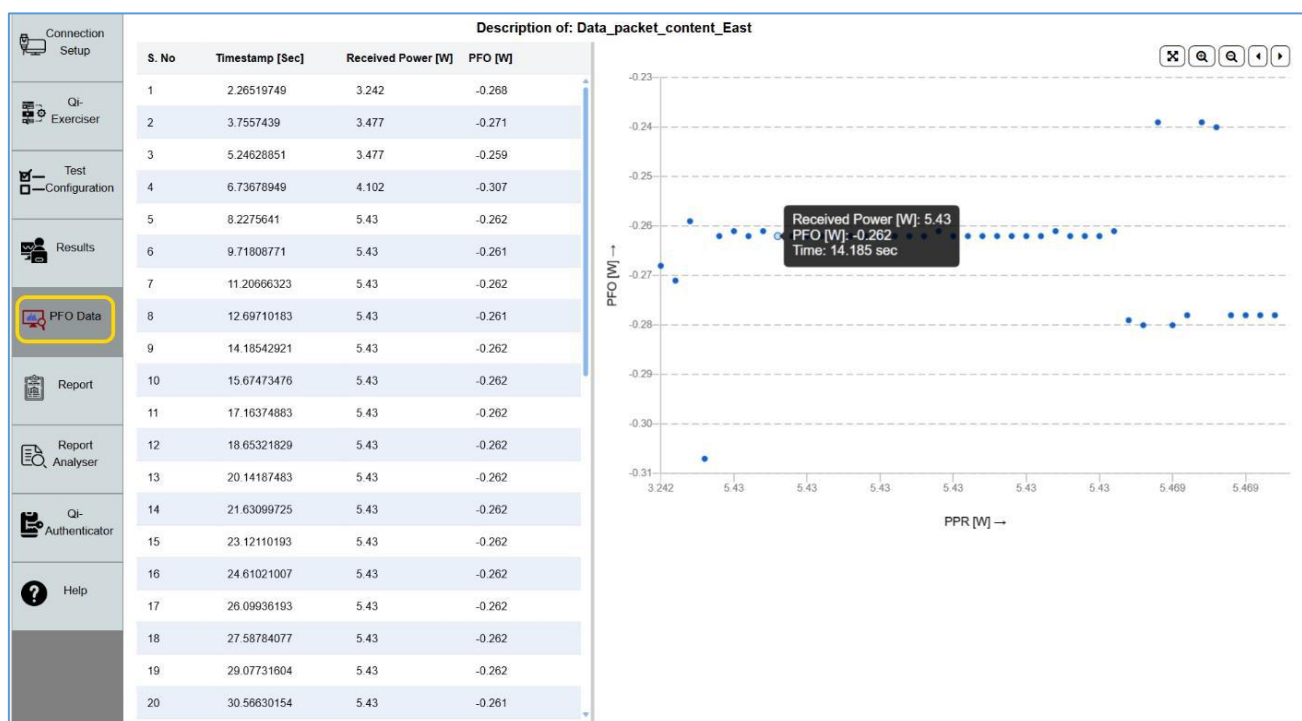
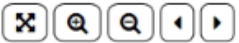


FIGURE 8.97: EXAMPLE OF BPP/EPP PFO DATA

3. In the PFO Data screen, the left panel displays the received or rectified power and PFO measured at specific timestamps which can be scrolled from the start to the end of the test run. The panel on the right displays the corresponding PFO graph plot where each point represents the respective measured power values and timestamp.
4. The common plot specific buttons  can be used to pan, fit and zoom in/out of the graph plot. You can use your mouse cursor to hover on top of each plot specific button to view the description of each button function.

8.4 Test Report View

After running a set of tests, the GRL-C3-TPT application *Report* screen allows full reports to be created:



View Report **Download Current HTML Report** **Download Current BSUT Report Data** **Report Data Management** **Synthetic File**

GRL
GRL-C3-MP-TPT Compliance Test Report

PRx Information

BrandName	iphone
Product Name	iphone
Serial Number	
Qi-ID	

Test Information

Test Lab	GRL Platform Solutions
Test Location	India
Test Manager	John
Test Engineer	David
Email Id	
Phone Number	
Remarks	
Date and Time	21-04-2026 11:54:23
Is Optimum coil Position Enabled	False
Optimum Position Data	

Controller and Instrument Information

Parameter	Value
MPP-TPT Software Version	3.231.0.2
MPP-TPT Firmware Version	5.0.2.09
MPP-TPT HW PPS Version	1.9
DUT Name	iphone
Next Calibration Date	Wednesday, August 19, 2026
Board Calibration	Calibration Success.
Serial Number	GRL-C3-MP-2025066
Exclude DUT PTMC	False
Random PTMC	False
PTMC Source	Use Pool Data
PTMC Code	0x01BD, 0x01BF, 0x007C, 0x0016, 0x00AF, 0x0051, 0x0097, 0x013F, 0x0082, 0x0131, 0x7846, 0x562A, 0x8E50, 0x44F7, 0x77F1, 0x7FDB, 0x03FB, 0x074E, 0x7851, 0x8E06, 0x666C, 0x0116, 0x0116, 0x0136, 0x018E, 0x00A6, 0x0108

FIGURE 8.98: REPORT SCREEN

If the report is not displayed when accessing the Report screen, click on the **View Report** button  at the top of screen to refresh the report view.

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

- **Configuration** – The product configuration information for the DUT.
- **Packet List** – A list of all the packets exchanged during testing.
- **Test Results** – The individual test Pass / Fail results.
- **Saved Images** – Any other images created during the test process.

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

Scroll down to view the full report as shown in the example (Figure 8.100) below.
The buttons at the top of the Report screen perform the following functions:

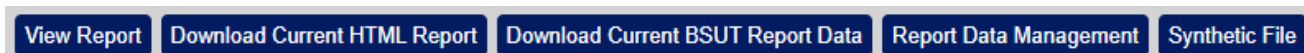


FIGURE 8.99: REPORT MANAGEMENT FUNCTIONS

- **View Report** – Click on the View Report button at any time you want to jump to the beginning of the report or refresh the report view.
- **Download Current HTML Report** – Click on the Download Current HTML Report button to save the test report in the HTML format.
- **Download Current BSUT Report Data** – Click on the Download Current DUT Report Data button to save all the result information to a ZIP folder.
- **Report Data Management** – Click on the Report Data Management button to access other test reports including from previous test runs. This allows you to delete or save the reports as desired from the database.
- **Synthetic File** – Click on the Synthetic File button to access test reports for the Eye diagram data from the Physical Layer Magnetic and Phase tests in the CSV format.

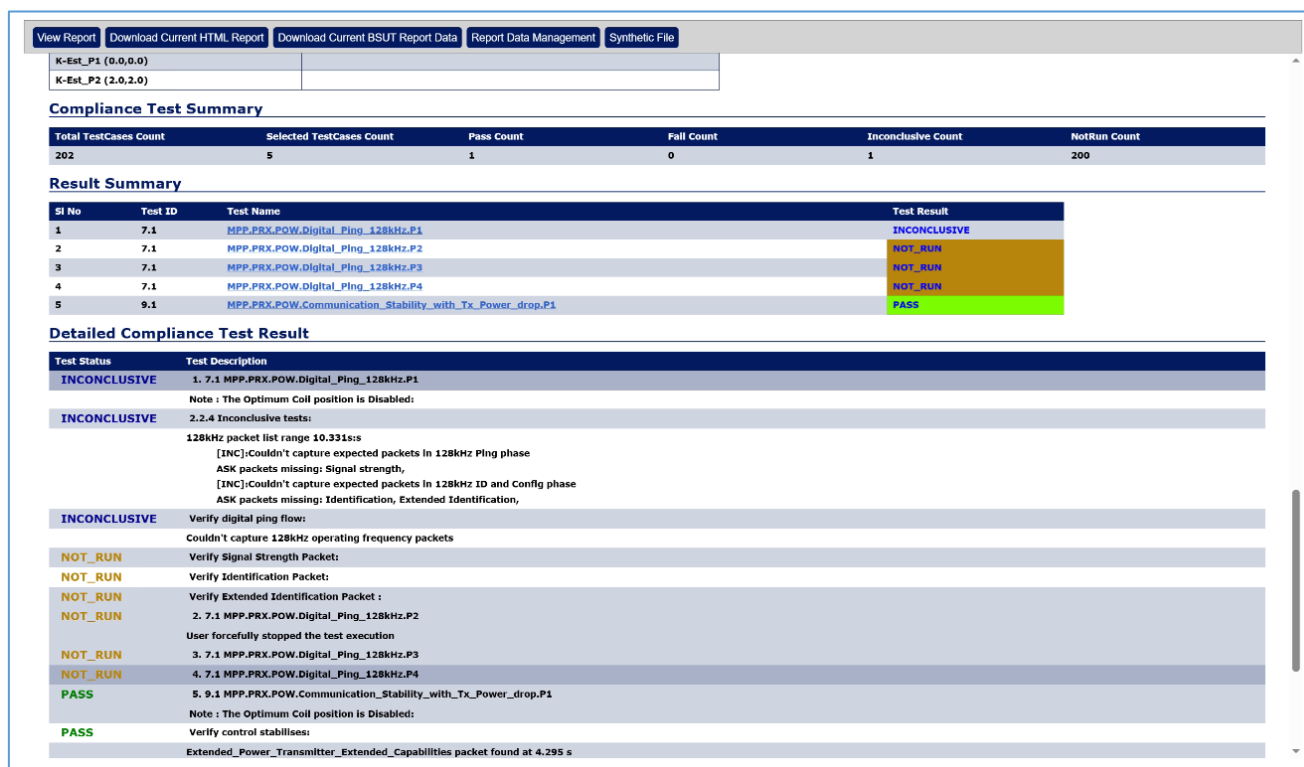


FIGURE 8.100: SCROLL DOWN TO VIEW FULL REPORT

8.5 JSON Report Analyzer

The GRL-C3-TPT application *Report Analyzer* screen allows the user to view, configure and manage report logs in the JSON file format. The JSON report log will be automatically generated after completion of a test run.

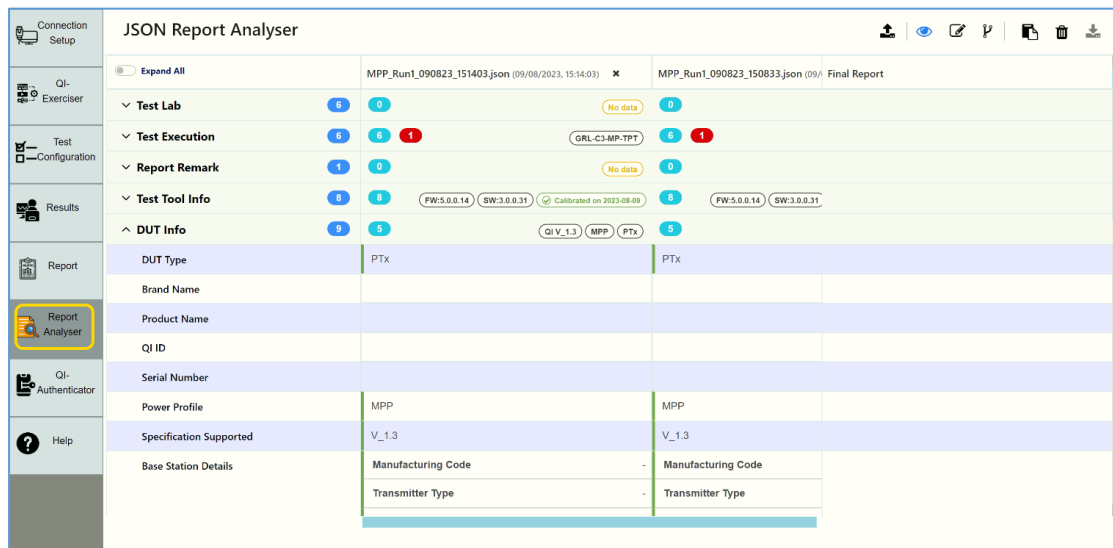


FIGURE 8.101: JSON REPORT ANALYZER SCREEN

The JSON Report Analyzer screen will display the results and configuration log of the most recent test run as shown in the Figure 8.101 example above.

8.5.1 Expand Data Fields in JSON Report

The report log has multiple fields that the user can expand to view data under each field.

To expand all fields, slide the  toggle button as shown in the Figure 8.102 example below.

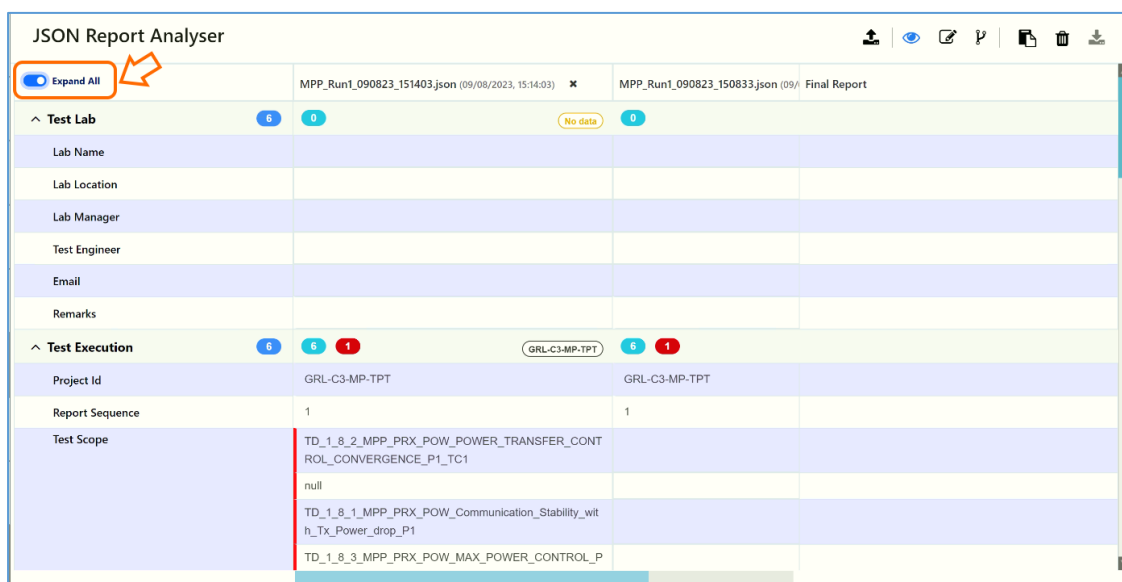


FIGURE 8.102: EXPAND ALL DATA FIELDS EXAMPLE

To expand only a certain field, just click on the drop-down arrow of the respective field to view the data under that field only.

8.5.2 JSON Report Data Fields Definition

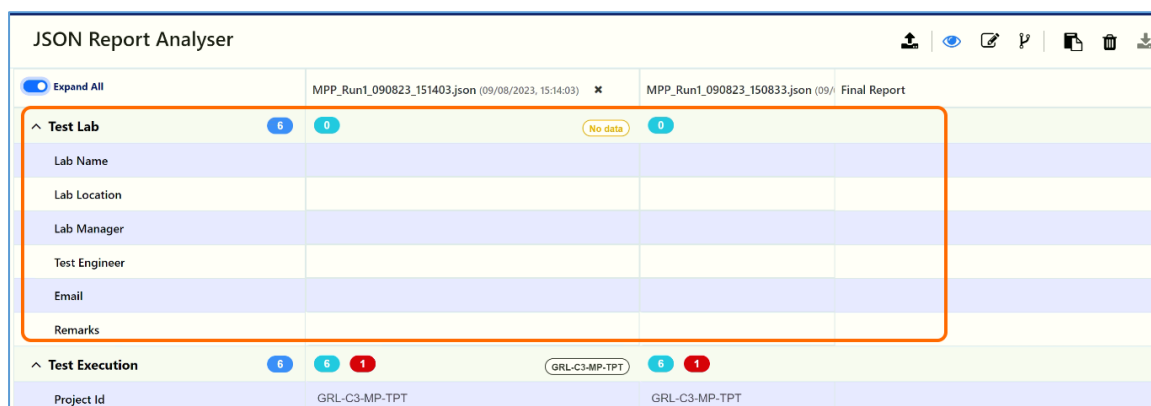
The data fields in the JSON report log are based on the test configuration made by the user in *Section 8.2, Test Configuration*. Each of these data fields can be defined as follows:

8.5.2.1 Test Lab Field

Under the Test Lab field, the user can view details of the test laboratory used to run the test cases which includes the following:

- Lab Name: Name of the test laboratory.
- Lab Location: Location of the test laboratory.
- Lab Manager: Name of the personnel in charge of the test laboratory.
- Test Engineer: Name of the engineer running the tests.
- Email: E-mail contact of the personnel to be reached in regard to the test run.
- Remarks: Any remarks made on the test run.

See example in Figure 8.103 below.



JSON Report Analyser	
Expand All	MPP_Run1_090823_151403.json (09/08/2023, 15:14:03) × MPP_Run1_090823_150833.json (09/ Final Report)
Test Lab	5 0 No data 0
Lab Name	
Lab Location	
Lab Manager	
Test Engineer	
Email	
Remarks	
Test Execution	5 1 GRL-C3-MP-TPT 5 1
Project Id	GRL-C3-MP-TPT GRL-C3-MP-TPT

FIGURE 8.103: TEST LAB DATA FIELD

8.5.2.2 Test Execution Field

Under the Test Execution field, the user can view details of the test run and related information. These include the following:

- Project ID: Name of the test project.
- Report Sequence: Sequence in which is the test report was created.
- Test Scope: List of test cases that have been run.
- Test Result: Aggregate of the overall test results (% pass, fail, etc.).
- Creation Time: Time when the test report was created.
- Spec Version: Version of the Qi specification that the test cases referred to.

See example in Figure 8.104 below.

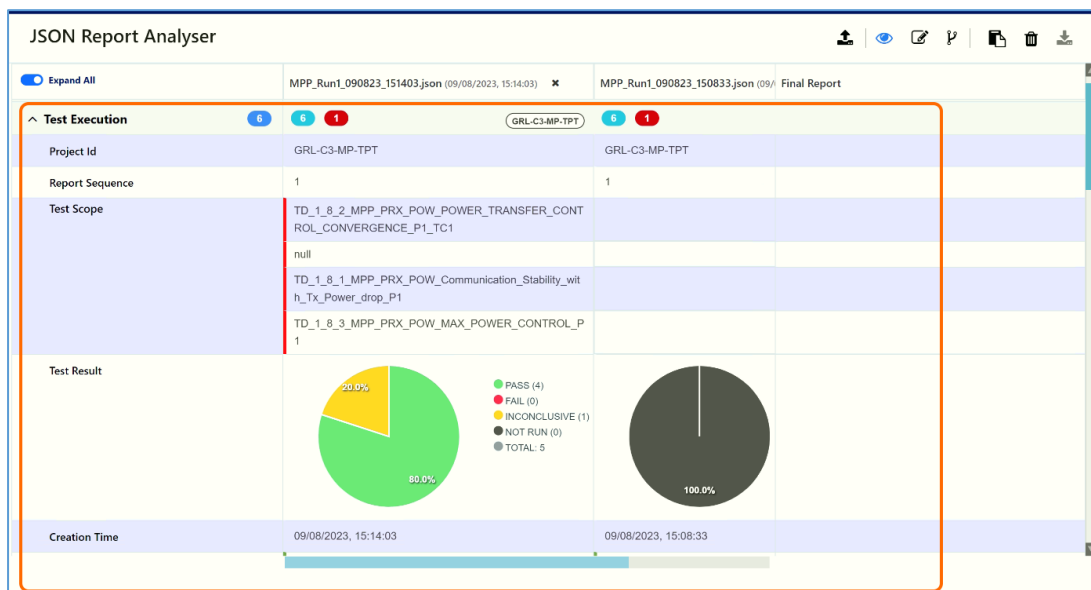


FIGURE 8.104: TEST EXECUTION DATA FIELD

8.5.2.3 Report Remark Field

Under the Report Remark field, the user can view remarks of the test run that have been added to the test report. See example in Figure 8.105 below.

Note: Report Remark is the only data field that can be edited by the user. Refer to Section 8.5.4 on how to edit the data field.



FIGURE 8.105: REPORT REMARK DATA FIELD

8.5.2.4 Test Tool Info Field

Under the Test Tool Info field, the user can view details of the tester hardware used for testing (e.g., GRL-C3-TPT). These include the following:

- Test Tool Manufacturer: Manufacturer of the tester hardware.
- Model Name: Tester hardware model.
- Serial Number: Serial number of the tester hardware.
- Last Calibration Date: When the tester hardware was last calibrated.
- Is Calibrated: Whether or not the tester hardware has been calibrated.
- Software / Firmware / Hardware Version: Software, firmware & hardware version numbers of the tester hardware.

See example in Figure 8.106 below.

JSON Report Analyser			
☒ Expand All	MPP_Run1_090823_151403.json (09/08/2023, 15:14:03) ✕	MPP_Run1_090823_150833.json (09/08/2023, 15:08:33)	Final Report
Test Execution	5 6 1	GRL-C3-MP-TPT 5 1	
Report Remark	1 0	No data 0	
Report Remark			
Test Tool Info	8 8	FW:5.0.0.14 SW:3.0.0.31 Calibrated on 2023-08-09 8	FW:5.0.0.14 SW:3.0.0.31
Test Tool Manufacturer	Granite River Labs	Granite River Labs	
Model Name	GRL-C3-MP-TPT	GRL-C3-MP-TPT	
Serial Number	GRL-C3-MP-2023024	GRL-C3-MP-2023024	
Last CalibrationDate	2023-08-09	2023-08-09	
Is Calibrated	✓	✓	
Software Version	3.0.0.31	3.0.0.31	
Firmware Version	5.0.0.14	5.0.0.14	
Hardware Version	E-4	E-4	
DUT Info	9 5	Qi V_1.3 MPP PTx 5	

FIGURE 8.106: TEST TOOL INFO DATA FIELD

8.5.2.5 DUT Info Field

Under the DUT Info field, the user can find details of the device under test, which include the following:

- DUT Type: DUT type of either power transmitter or receiver.
- Brand Name: Brand of the DUT.
- Product Name: Vendor-defined name of the DUT.
- Qi-ID: Qi identification of the DUT.
- Serial Number: Serial number of the DUT.
- Power Profile: Power profile of either MPP or BPP as supported by the DUT.
- Specification Supported: Qi specification as supported by the DUT.
- Base Station Details: Capabilities of the Base Station under test DUT.
- Mobile Device Info: Capabilities of the Mobile Device under test DUT.

See example in Figure 8.107 below.

Expand All	MPP_Run1_090823_151403.json (09/08/2023, 15:14:03) ✕	MPP_Run1_090823_150833.json (09/08/2023, 15:08:33) ✕	Final Report
DUT Info 9 5 Qi V_1.3 MPP PTx 5			
DUT Type	PTx	PTx	
Brand Name			
Product Name			
QI ID			
Serial Number			
Power Profile	MPP	MPP	
Specification Supported	V_1.3	V_1.3	
Base Station Details	Manufacturing Code - Transmitter Type - Potential Load Power 5 Is WPID Supported ✕ Is Authentication Supported ✕ Is Simultaneous Incoming and Outgoing Supported ✕	Manufacturing Code - Transmitter Type - Potential Load Power Is WPID Supported Is Authentication Supported Is Simultaneous Incoming and Outgoing Supported	

FIGURE 8.107: DUT INFO DATA FIELD

8.5.2.6 Testing Scopes Field

Under the Testing Scopes field, the user can view the list of executed test cases with their respective results, overall test results and the option to view details of each test case. See example in Figure 8.108 below.

Expand All	MPP_Run1_090823_151403.json (09/08/2023, 15:14:03) ✕	MPP_Run1_090823_150833.json (09/08/2023, 15:08:33) ✕	Final Report
Test Lab	6 0	No data	0
Test Execution	6 6 1	GRL-C3-MP-TPT	6 1
Report Remark	1 0	No data	0
Test Tool Info	8 8	FW:5.0.0.14 SW:3.0.0.31 Calibrated on 2023-08-09	8 8
DUT Info	9 5	Qi V_1.3 MPP PTx	5
Testing Scopes	4	4 3 0 1 0 Overall results 0 0 0 0 0	
TD_1_8_2_MPP_PRX_POW_POWER_TRANSFER_CONTROL_CONVERGENCE_P1_TC1	Pass		
null	Pass		
TD_1_8_1_MPP_PRX_POW_Communication_Stability_with_Tx_Power_drop_P1	Pass		
TD_1_8_3_MPP_PRX_POW_MAX_POWER_CONTROL_P1	Inconclusive		
Digital Signature Info	2 2		2

FIGURE 8.108: TESTING SCOPES DATA FIELD

To view details of a test case, click on the View Details icon  of the respective test case. This will display the signal trace plot along with the Packet transaction log for the test case. An example is shown in Figure 8.109 below.

Also see Section 8.5.3, Load Multiple JSON Report Files for more details when loading and comparing between multiple JSON files.

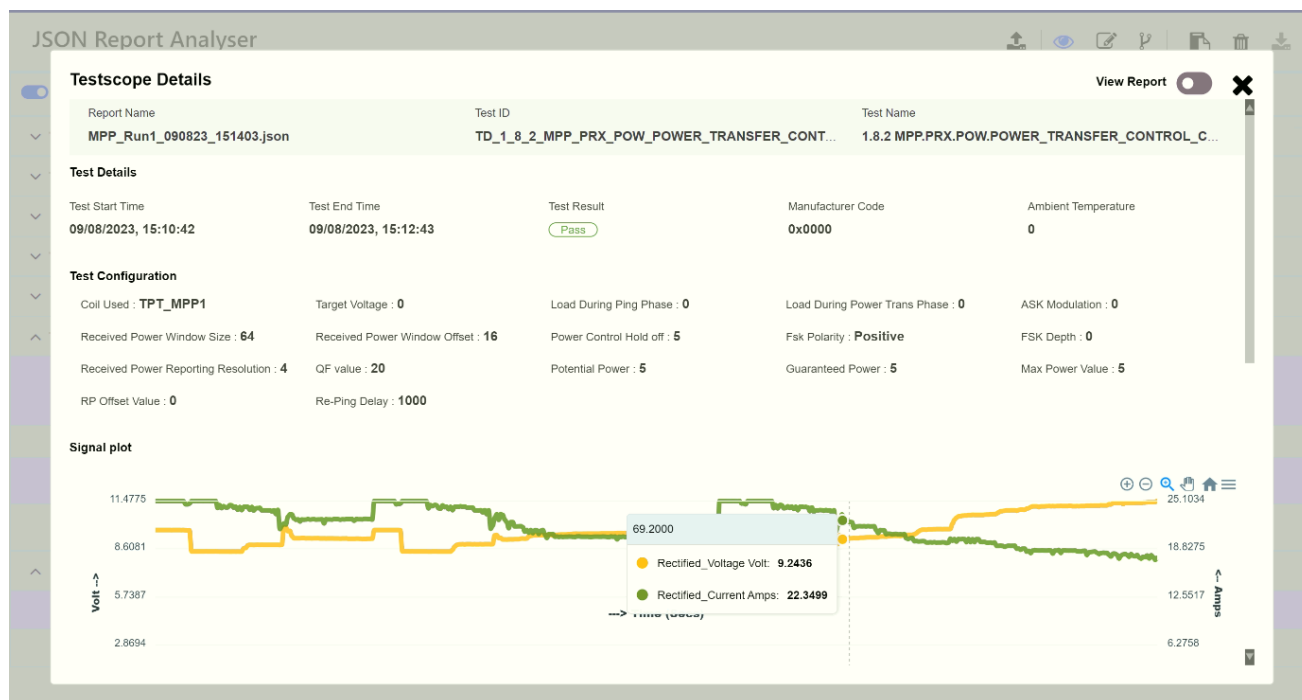


FIGURE 8.109: VIEW TEST CASE DETAILS

8.5.2.7 Digital Signature Info Field

Under the Digital Signature Info field, the user can find the Encrypted Hash 256 Bits algorithm and Test tool public key of the Qi DUT.

JSON Report Analyser			
☒ Expand All	MPP_Run1_090823_151403.json (09/08/2023, 15:14:03)	MPP_Run1_090823_150833.json (09/08/2023, 15:08:33)	Final Report
Test Lab	6	0	No data
Test Execution	6	6	1
Report Remark	1	0	No data
Test Tool Info	8	8	FW:5.0.0.14 SW:3.0.0.31 Calibrated on 2023-08-09
DUT Info	9	5	Qi V_1.3 MPP PTx
Testing Scopes	4	4	3 0 1 0
Digital Signature Info	2	2	
Encrypted Hash 256 Bits	twC9u7mQThA0SC1KDwSylaw7z6zjXRE1vnmCGPqMTd...	B9Zw/fArOHZNIB8ljhnKANJHhJlQ8mc	
Test Tool Public Key	vSPpZZ4r5zhM3rlaS75i33l6wgQjk9YR1y/QV6+r2NoJS8l...	vSPpZZ4r5zhM3rlaS75i33l6wgQjk9YI	

FIGURE 8.110: DIGITAL SIGNATURE INFO DATA FIELD

8.5.3 Load Multiple JSON Report Files

The user can load multiple JSON reports from existing JSON files and compare the results. To load the JSON report files, follow the steps below.

1. Click on the Upload icon  at the top right of the *JSON Report Analyzer* screen as shown in Figure 8.111 below.

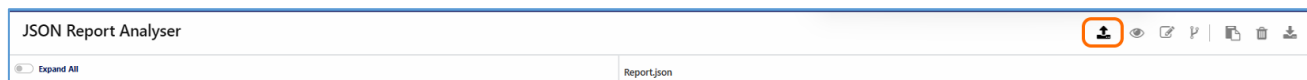


FIGURE 8.111: UPLOAD JSON REPORT ICON

2. The following pop-up window will appear as shown in Figure 8.112. The “Local File” panel on the left will show the list of all JSON report files that have been generated from previous test runs and stored in the default file location. The user can select one or more of these files and click on the **Upload** button on the bottom right of the window.

Alternatively, the user can drag and drop JSON files from the list on to the “Drag and drop” box on the right and then click on the **Upload** button.

If the required JSON files are stored in another directory other than the default file location, click on the “Drag and drop” box to browse for the files. After selecting the required JSON files, click on the **Upload** button.

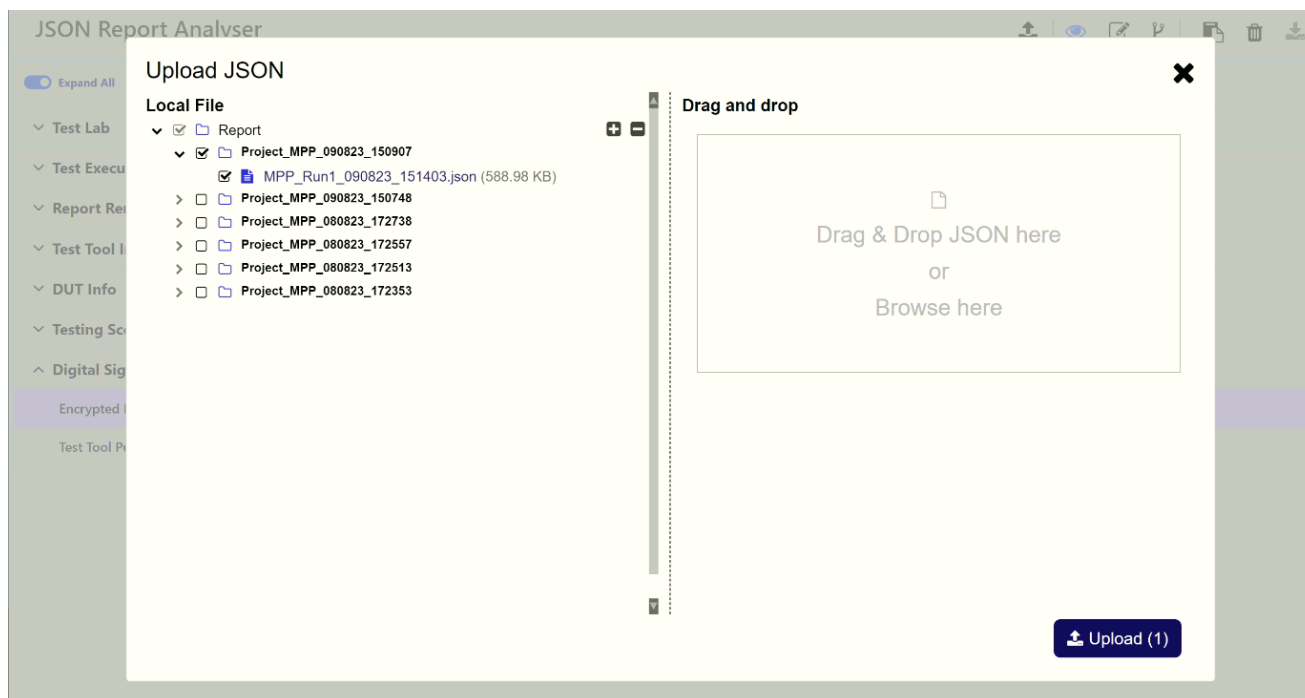


FIGURE 8.112: SELECT JSON FILES TO UPLOAD

3. After clicking on the **Upload** button, the selected JSON files will be loaded on to the *JSON Report Analyzer* screen as shown in the example in Figure 8.113 below.

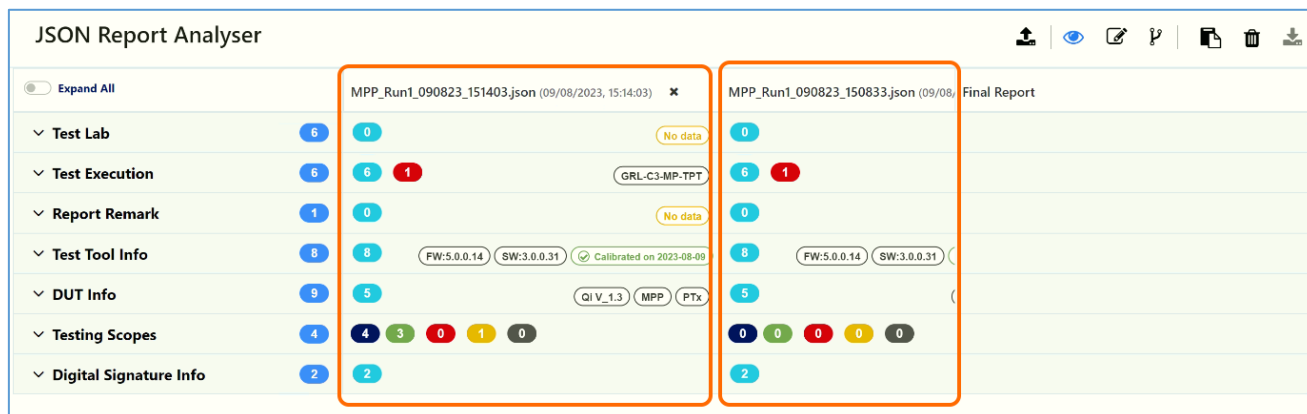


FIGURE 8.113: JSON FILES LOADED ON SCREEN EXAMPLE

8.5.3.1 Compare Multiple JSON Report Files Results

When expanding the Testing Scopes data field (as described in Section 8.5.2.6) and clicking on the View Details icon  of the respective test case, the user can slide the **Compare Reports** toggle button  to compare the results between the loaded JSON files.

In the example in Figure 8.114 below, the user can select any of the loaded JSON files (as indicated by “1” and “2”) to view and compare the results for a particular test case.



FIGURE 8.114: SELECT AND COMPARE MULTIPLE JSON FILES RESULTS

8.5.4 Manage JSON Reports

Use the following icons  on the top right of the *JSON Report Analyzer* screen to configure and manage the JSON reports.

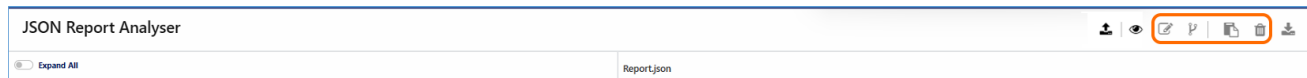


FIGURE 8.115: MANAGE JSON REPORT ICONS

-  – Click on this icon to edit the JSON report. *Note: Only the Report Remark field can be edited (refer Section 8.5.2.3, Report Remark Field).*
-  – Click on this icon to merge two or more JSON reports (refer Section 8.5.5 below).
-  – Click on this icon to view a summary of the JSON report. An example is as shown in Figure 8.120 below which displays the number of test cases with their respective test run results for each JSON report.

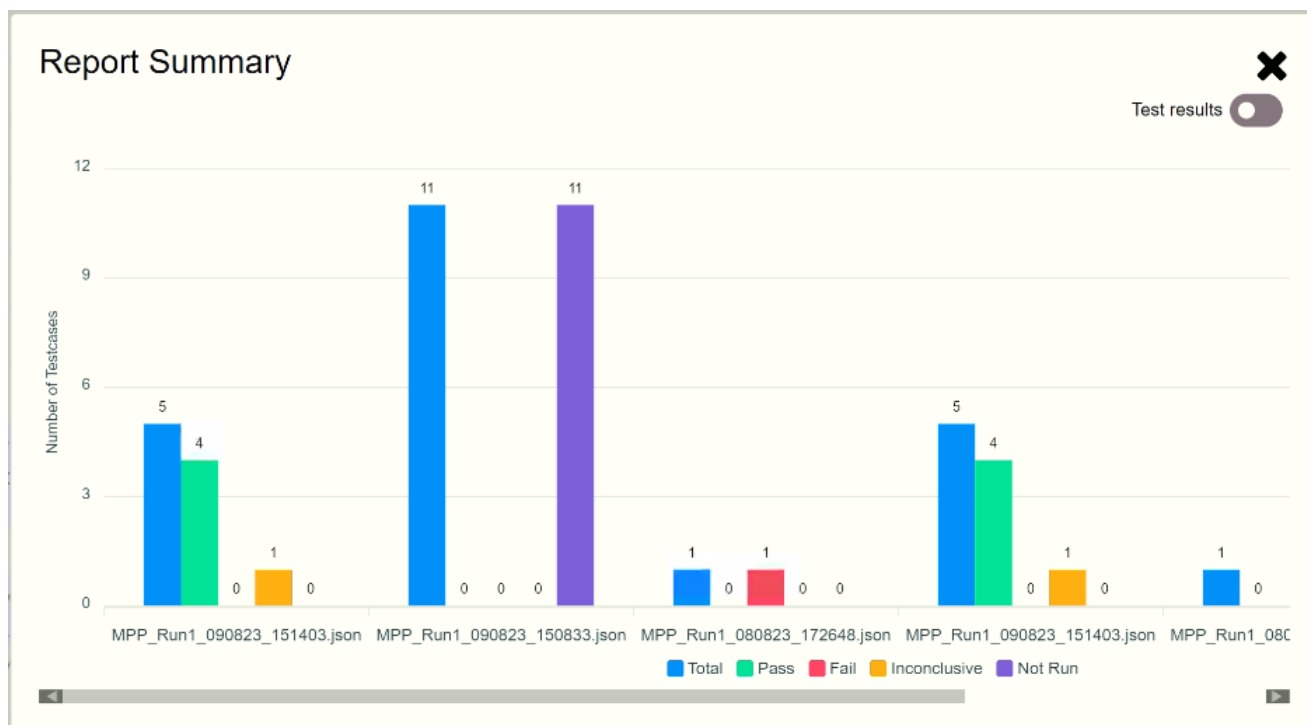
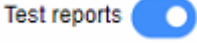


FIGURE 8.116: JSON REPORT TEST RESULTS SUMMARY EXAMPLE

The user can also switch to view the cumulative results for the test cases of each JSON report by sliding the “Test Results” toggle button to .

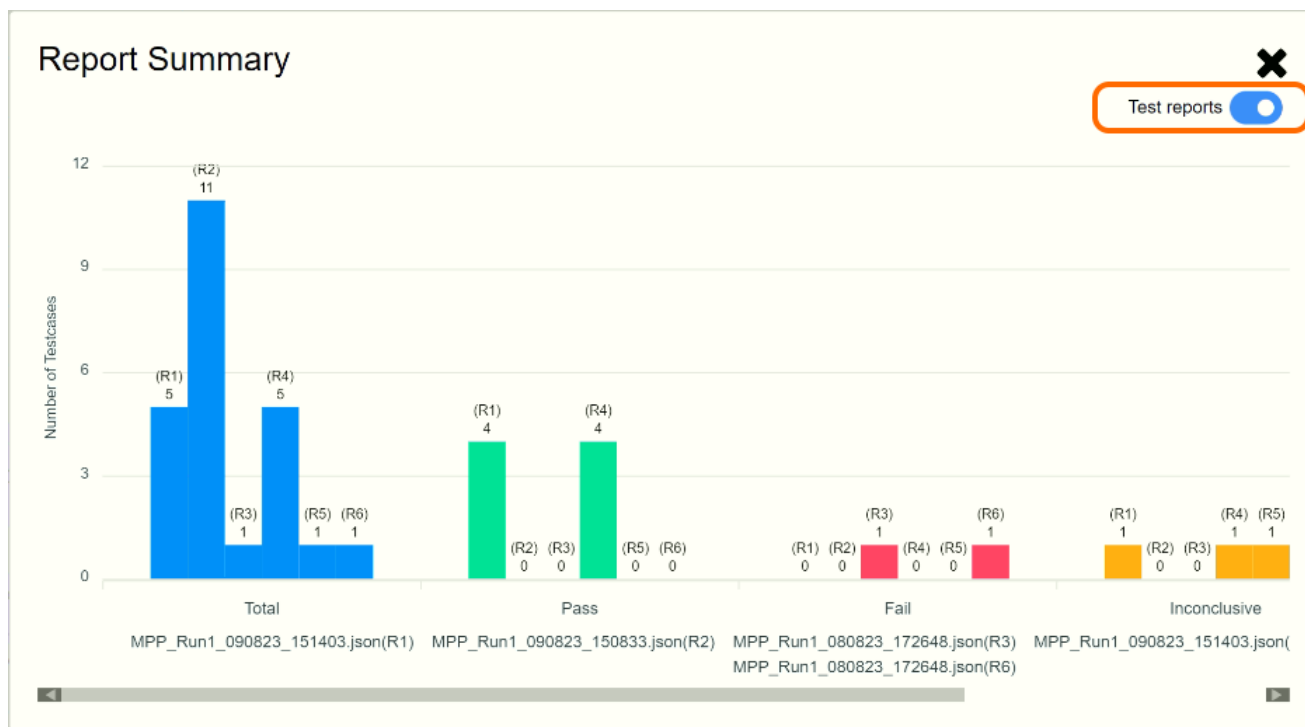


FIGURE 8.117: JSON REPORT TEST REPORTS SUMMARY EXAMPLE

The user can download/save the report summary to an SVG, PNG or CSV file by clicking on  and selecting the file type as shown in Figure 8.118 below. The user can find the saved report file in the Downloads folder.

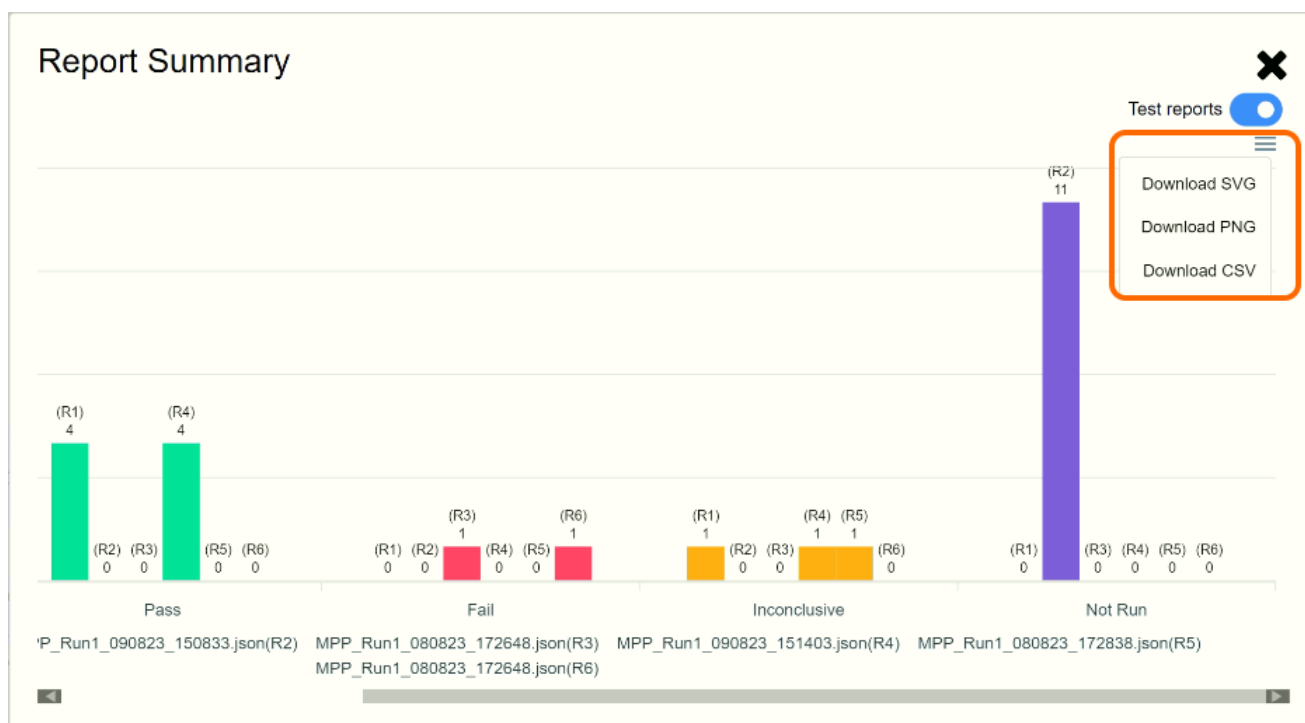


FIGURE 8.118: JSON REPORT TEST REPORTS SUMMARY EXAMPLE

-  – Click on this icon to delete the JSON report.

8.5.5 Merge Results of Multiple JSON Report Files

After loading two or more JSON report files, the user can merge the results of these files into one report as required. Follow the instructions below:

1. Click on the Merge icon  as shown in Figure 8.119.

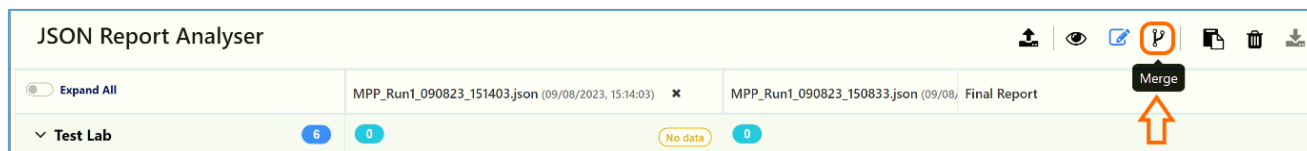


FIGURE 8.119: MERGE ICON

2. Then click on the Testing Scopes data field and select the test results from JSON Report #1 and JSON Report #2 as indicated in the Figure 8.120 example below. The selected test results will be reflected under “Final Report” as merged results.

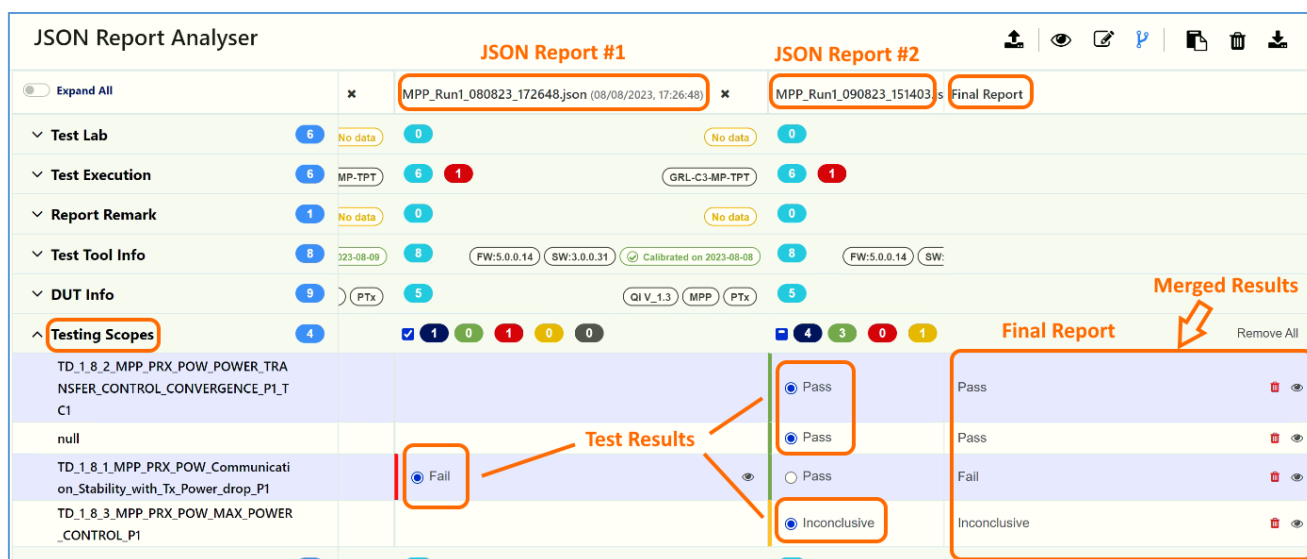


FIGURE 8.120: MERGED TEST RESULTS FROM MULTIPLE JSON REPORT FILES

3. If the user wants to delete certain results in the final merged report, click on the Delete icon  for the respective result. The user can also delete all merged results by selecting “Remove All”.

8.5.6 Download/Export JSON Reports

The user can download the JSON reports or export the reports to HTML or PDF files using the following steps:

1. Click on the Download icon  at the top right of the JSON Report Analyser screen as shown in Figure 8.121 below.

2. Select “JSON” to download/save the reports as JSON files, or select “HTML” and “PDF” to export the reports to HTML and PDF files respectively. Otherwise select “All” to save the reports in all these three file formats.
3. Then, click on the **Export** button. The user can find the exported/downloaded report files in the Downloads folder.

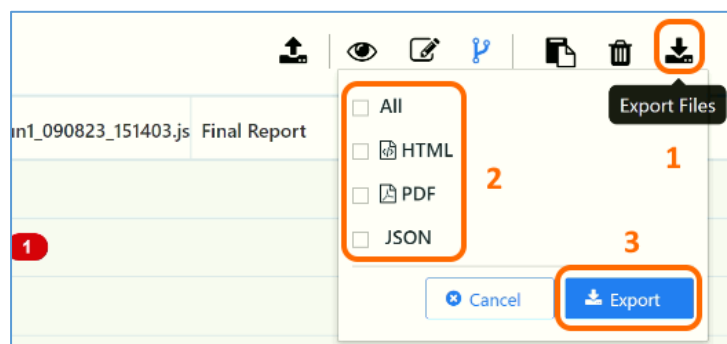


FIGURE 8.121: DOWNLOAD/EXPORT JSON REPORT FILES

9 GRL-C3-TPT Information and Help

The GRL-C3-TPT application *Help* screen allows the user to view the current version of the GRL-C3-TPT application as well as a brief description of the GRL-C3-TPT tester hardware. The user can also access customer support or download debug logs using the links provided.

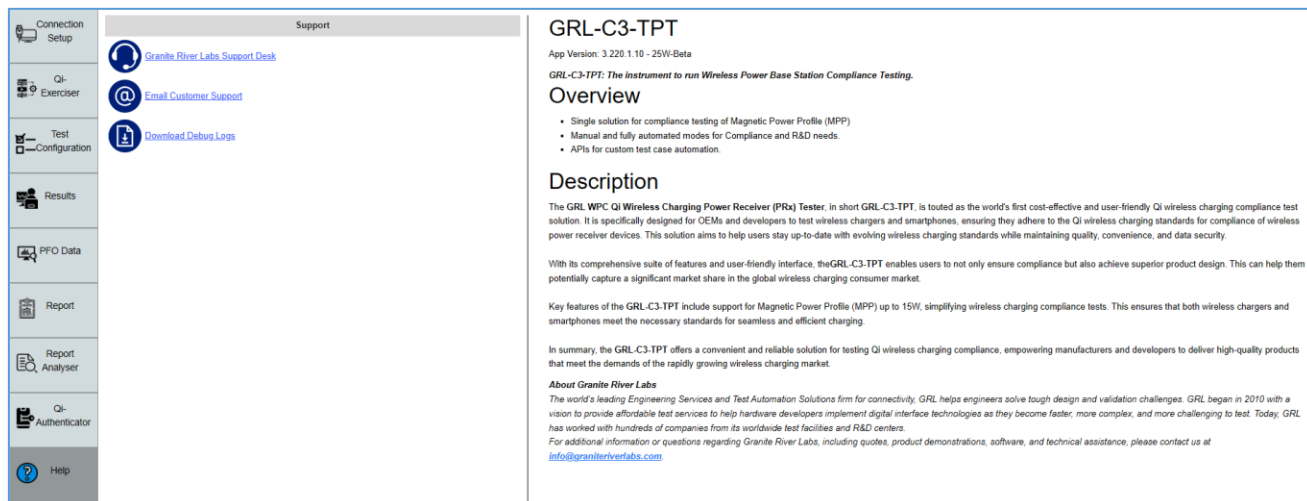


FIGURE 9.1: HELP SCREEN

10 Appendix A: Manual Procedure to Switch from BPP/EPP to MPP Power Profile (Software & Firmware)

If the GRL-C3-TPT software & firmware is operating under the BPP/EPP power profile, the user can switch over to the MPP power profile using the following steps.

After the GRL-C3-TPT (MPP) application has been installed:

1. Open the GRL-C3-TPT application by double-clicking on the GRL-C3-TPT desktop icon.
2. Connect the firmware update cable to the GRL-C3-TPT tester hardware and press the “Reset” button on the back of the tester hardware.
3. When the file dialog box appears, copy and paste all firmware files from “C:\GRL\GRL-C3-TPT\Firmware_Files\MPP” to the GRL-C3-TPT internal directory.

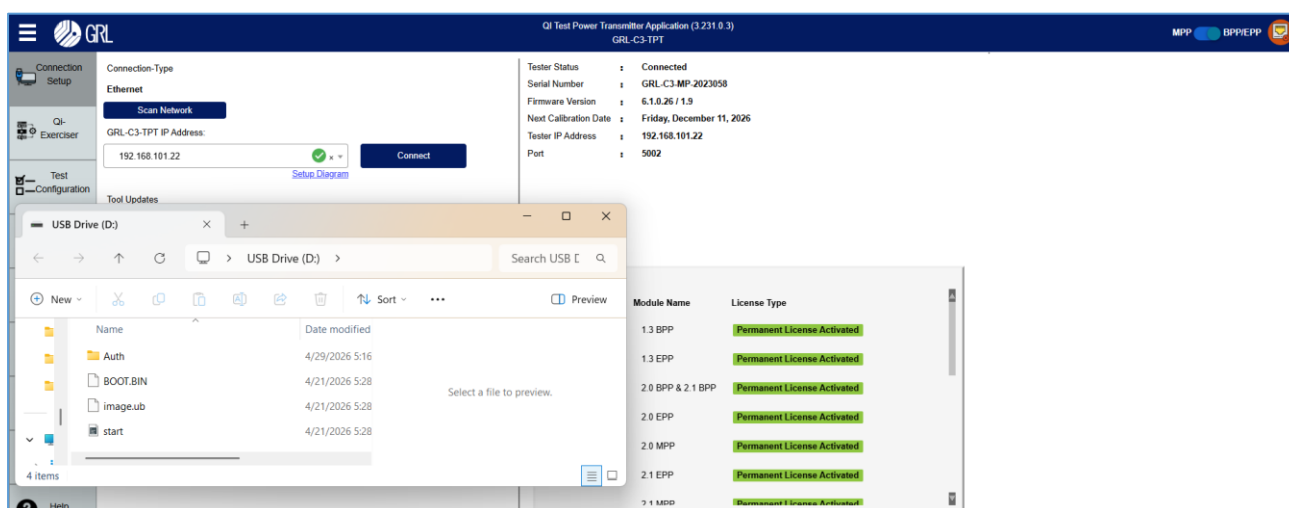
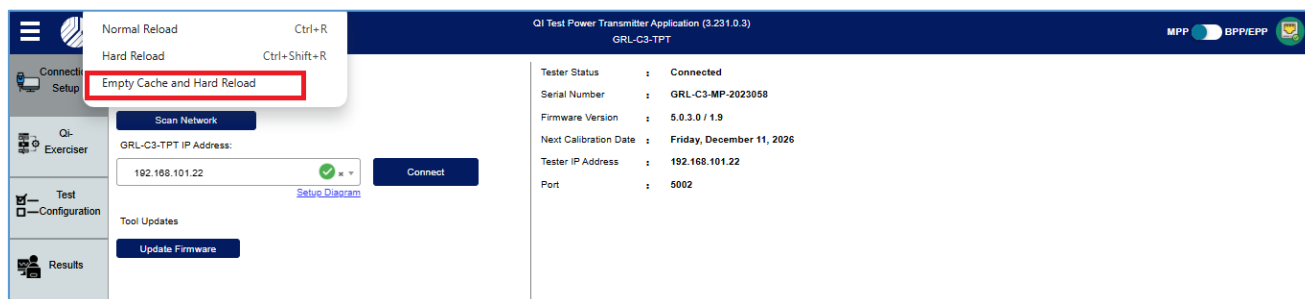


FIGURE 10.1: COPY AND PASTE MPP FIRMWARE FILES

4. Reboot the GRL-C3-TPT tester hardware.
5. Open the GRL-C3-TPT application and click on the “Refresh” icon above the browser menu and select **Empty Cache and Hard Reload** to clear the browser cache, and to display the correct version of software. See Figure 10.2 below.



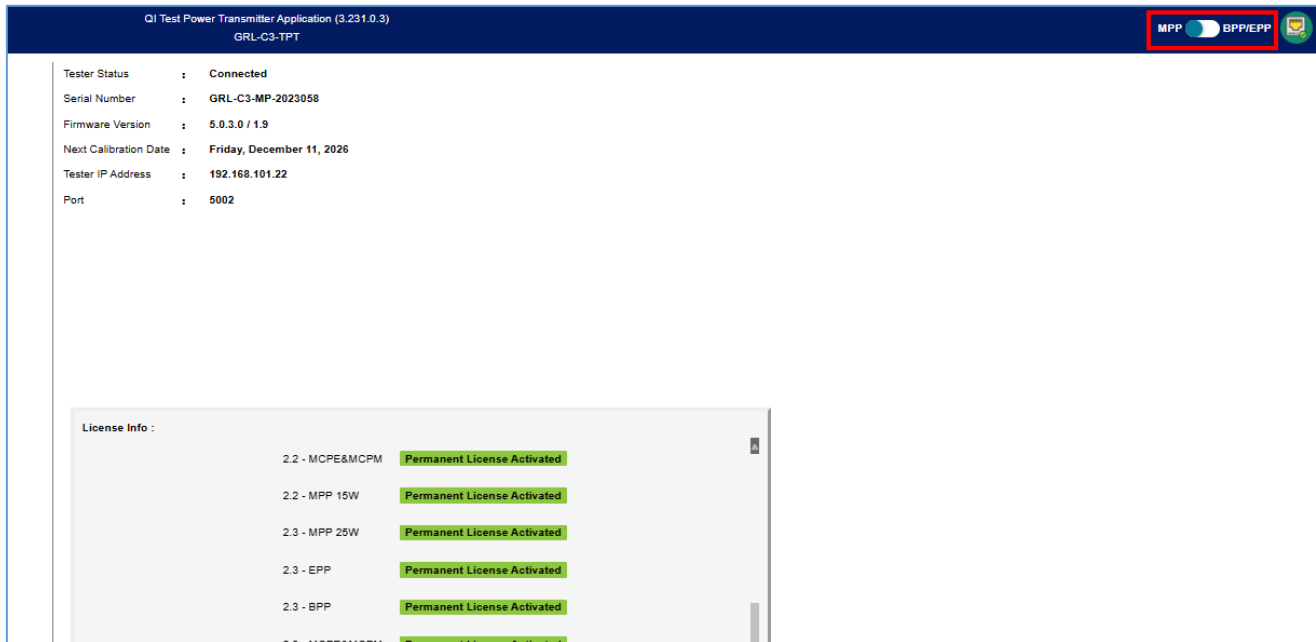


FIGURE 10.2: CLEAR BROWSER CACHE AND DISPLAY CORRECT SOFTWARE VERSION

At this point, the GRL-C3-TPT software & firmware has been returned to the MPP power profile.

6. With the manual firmware update, the PPS version will not change for the MPP power profile. In this case, after completing the above procedure, the user needs to click on the **Update Firmware** button in the “Connection Setup” screen and proceed with further steps using the pop-up instructions for PPS update.
7. After the PPS update is completed, the user will be able to take optimum positioning for the GRL-C3-TPT-MPP1 coil and run test cases.

11 Appendix B: Manual Procedure to Switch from MPP to BPP/EPP Power Profile (Software & Firmware)

If the GRL-C3-TPT software & firmware is operating under the MPP power profile, the user can switch over to the BPP/EPP power profile using the following steps.

After the GRL-C3-TPT (BPP/EPP) application has been installed:

1. Open the GRL-C3-TPT application by double-clicking on the GRL-C3-TPT desktop icon.
2. Switch the power profile from **MPP** to **BPP/EPP** using the toggle switch at the top right corner of the browser window, as indicated in Figure 11.1 below.

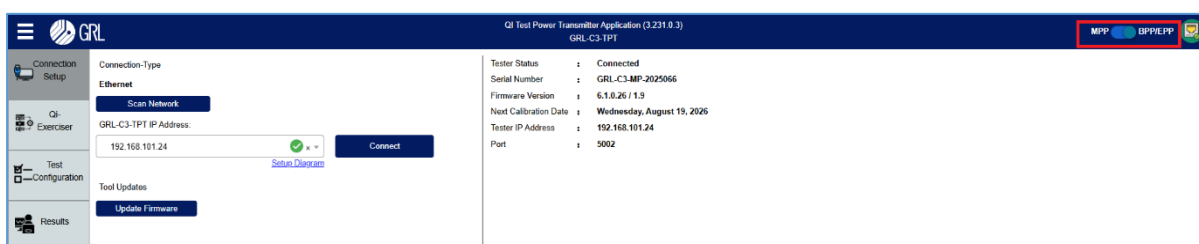


FIGURE 11.1: TOGGLE MPP TO BPP/EPP POWER PROFILE

3. Connect the firmware update cable to the GRL-C3-TPT tester hardware and press the “Reset” button on the back of the tester hardware.
4. When the file dialog box appears, copy and paste all firmware files from “C:\GRL\GRL-C3-TPT\Firmware_Files\BPP or EPP” to the GRL-C3-TPT internal directory.

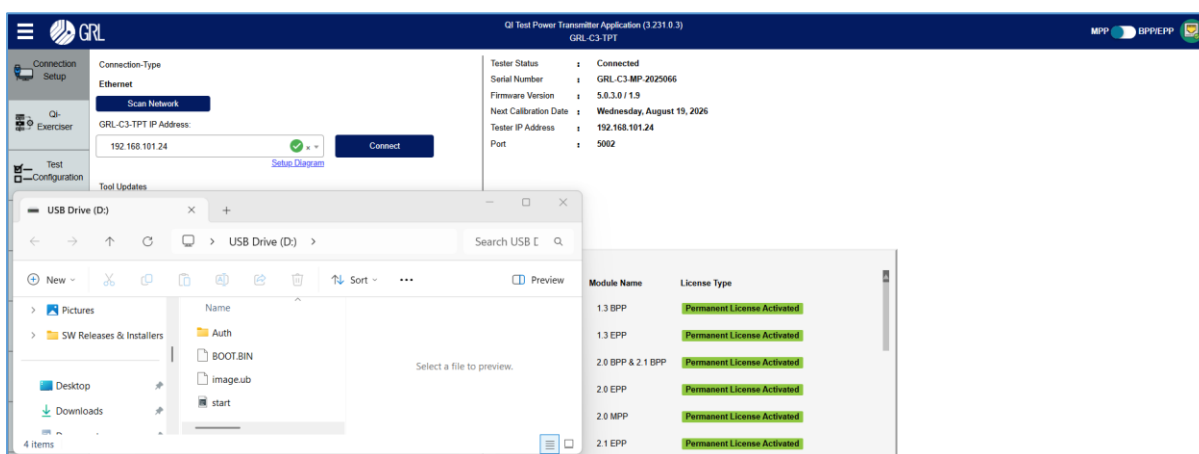


FIGURE 11.2: COPY AND PASTE BPP/EPP FIRMWARE FILES

5. Reboot the GRL-C3-TPT tester hardware.
6. Open the GRL-C3-TPT application and click on the “Refresh” icon above the browser menu and select **Empty Cache and Hard Reload** to clear the browser cache, and to display the correct version of software. See Figure 11.3 below.

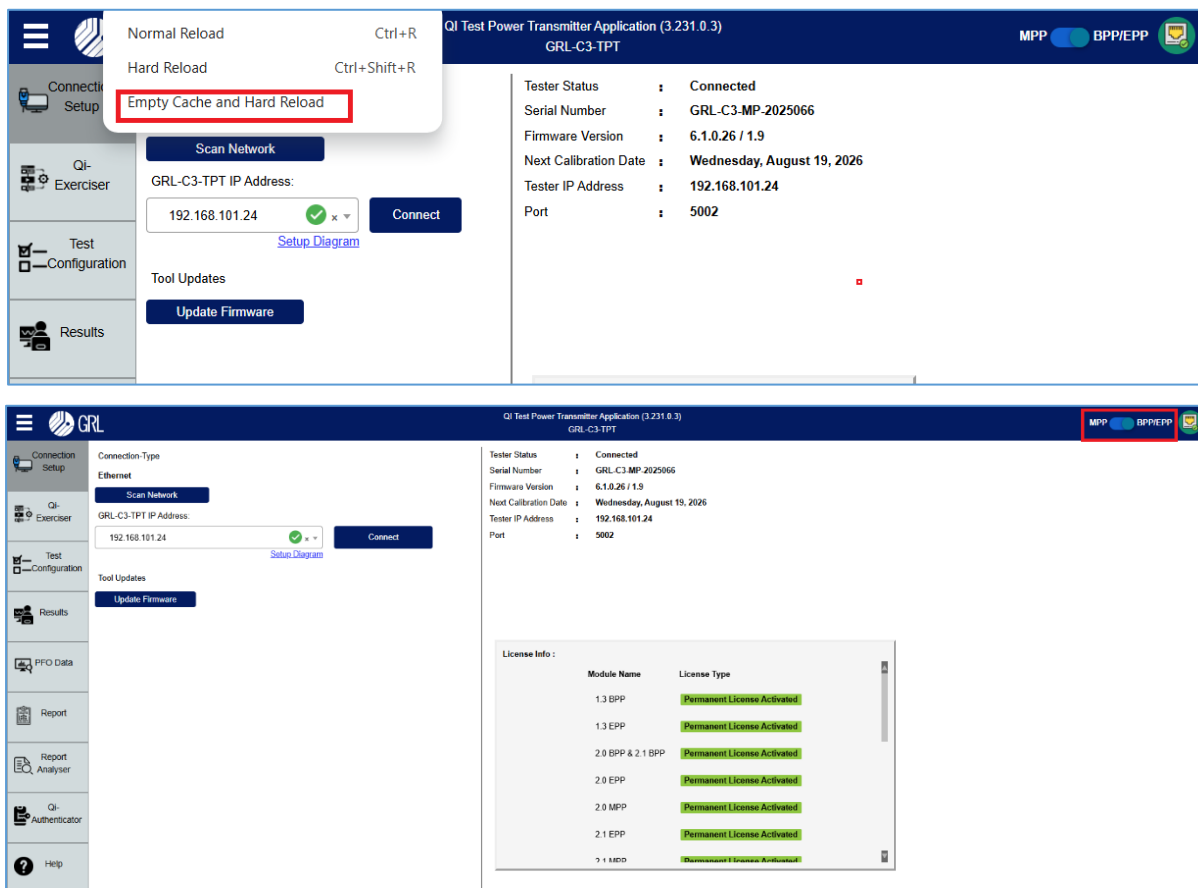


FIGURE 11.3: CLEAR BROWSER CACHE AND DISPLAY CORRECT SOFTWARE VERSION

At this point, the GRL-C3-TPT software & firmware has been returned to the BPP/EPP power profile.

7. With the manual firmware update, the PPS version will not change for the BPP/EPP power profile. In this case, after completing the above procedure, the user needs to click on the **Update Firmware** button in the “Connection Setup” screen and proceed with further steps using the pop-up instructions for PPS update.
8. After the PPS update is completed, the user will be able to take optimum positioning for the BPP/EPP-TPT coil and run test cases.

12 Appendix C: Reference Quality Factor [$Q_t'^{[ref]}$] & Reference Resonance Frequency [$f_t'^{[ref]}$] Measurements using LCR Meter

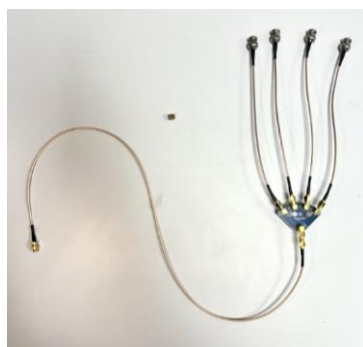
This section describes the procedure to measure Reference Quality Factor $Q_t'^{[ref]}$ and Reference Resonance Frequency $f_t'^{[ref]}$ which are required for the PRx Compliance Book Pre Power FOD Test 'MP.RX.FOD.REQFODSTATUS.TC2'.

12.1 Equipment Requirements

- LCR Meter
- Test Jig with SMA Connector End [provided by GRL Platform Solutions along with GRL-C3-TPT]
- SMA Short End [provided by GRL Platform Solutions along with GRL-C3-TPT]
- Reference Coil Assembly [provided by GRL Platform Solutions along with GRL-C3-TPT]
- Unit Under Test (UUT)



LCR Meter – The Keysight E4980AL LCR Meter is used in this case



Test Jig and SMA Short End



Reference Coil Assembly – GRL-C3-TPT-QFACTOR (GRL-EPP- TPT Coil)

12.2 Calibration of LCR Meter

Before performing any measurements, the LCR Meter must be calibrated as follows:

1. Turn on the LCR Meter and allow it to warm up for an allocated period of time as per the manufacturer's instructions.
2. Configure the LCR Meter with the following settings:
 - Measurement Option: Ls-Rs
 - Test signal voltage level: 1.0 V
 - Measurement frequency, f^{REF} : 100 kHz
3. Connect the GRL Platform Solutions Test Jig's SMA cables to the LCR Meter's "H CUR", "H POT", "L CUR" and "L POT" BNC connectors as shown in Figure 12.1 below.



FIGURE 12.1: CONNECT GRL PLATFORM SOLUTIONS TEST JIG TO LCR METER BNC CONNECTORS

4. Press on the **Meas Setup** button on the LCR Meter.



FIGURE 12.2: LCR METER'S MEAS SETUP BUTTON

5. Press on **Correction** from amongst the side buttons of the LCR Meter's display.



FIGURE 12.3: LCR METER'S CORRECTION FUNCTION

6. Use the Navigation arrow keys on the LCR Meter and select the required Function, **$L_s - R_s$** . Set the Frequency to **100 kHz** and Cable Length to **0 m**.

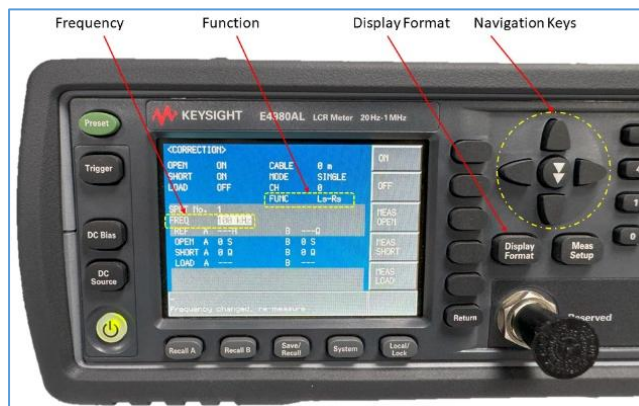


FIGURE 12.4: SET UP LCR METER'S FUNCTIONS

7. Calibrate the LCR Meter as follows:

- Open Calibration

- a. Do not connect anything to the SMA Short End cable.
- b. Run the Open calibration on the LCR Meter using Spot correction at 100 kHz.



FIGURE 12.5: PERFORM OPEN CALIBRATION FOR LCR METER

- Short Calibration
 - a. Connect the SMA Short End cable to an SMA connector. Make sure the SMA Short End is connected properly.
 - b. Run the Short calibration on the LCR Meter using Spot correction at 100 kHz.



FIGURE 12.6: PERFORM SHORT CALIBRATION FOR LCR METER

8. Press on the **Display Format** button to go to the measurement section and verify the calibration.
 - Keep the SMA Short End cable connected to the SMA connector.

- The L_s value appears in ranges of nH or even smaller.
- The R_s appears close to zero to almost negative.

Note: Options, calibration procedure or graphical user interface may vary based on the LCR Meter's model. Refer to the LCR Meter's user guide for more information.

12.3 Measurement & Calculations of $Q_t^{[ref]}$, $f_t^{[ref]}$

1. Set the LCR Meter's Function to **$L_s - R_s$** .
2. Connect the GRL-C3-TPT-QFACTOR Reference Coil Assembly to the SMA Short End cable.
3. Measure the Open-Air Inductance of the Reference Coil Assembly, L_t^{REF} as follows:
 - *Note: Open-Air measurements are to be made in the absence of the Calibration Objects or any other material in the vicinity of the coil.*



FIGURE 12.7: PERFORM OPEN-AIR MEASUREMENTS OF THE GRL PLATFORM SOLUTIONS REFERENCE COIL ASSEMBLY

4. Place the UUT at the Center Position on the Reference Coil Assembly.
 - **Tip:** *Adjust the UUT on the Reference Coil Assembly to locate the Minimum L_s value. Once located, mark that position as Center.*

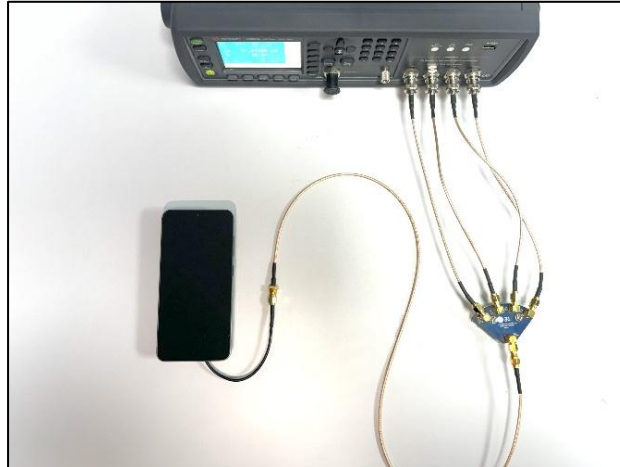


FIGURE 12.8: UUT PLACED ON GRL PLATFORM SOLUTIONS REFERENCE COIL ASSEMBLY

5. Measure the *Mated Inductance* $L'_{t[Center]}$ and *Mated Resistance* $R'_{t[Center]}$
6. Move the UUT to the required directions [North, East, South, West] by 5 mm and repeat the measurements, $L'_{t[position]}$ and $R'_{t[position]}$ for the respective positional measurements.
 - Mark the North Position values as $L'_{t[North]}$, $R'_{t[North]}$
 - Mark the South Position values as $L'_{t[South]}$, $R'_{t[South]}$
 - Mark the West Position values as $L'_{t[West]}$, $R'_{t[West]}$
 - Mark the East Position values as $L'_{t[East]}$, $R'_{t[East]}$

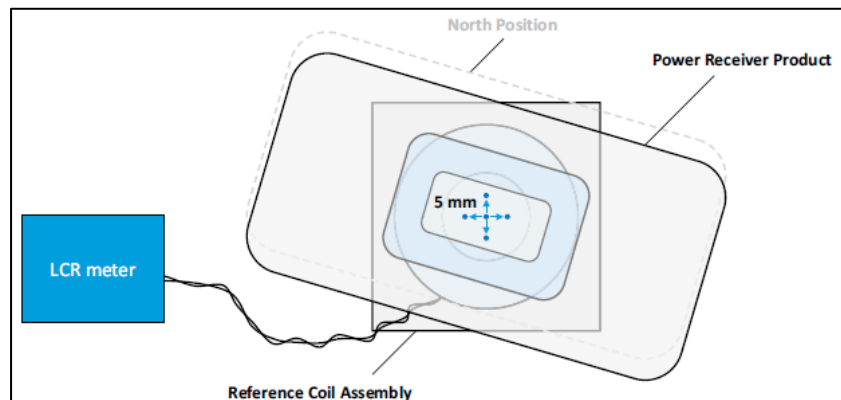


FIGURE 12.9: MEASURE UUT AT DIFFERENT POSITIONS

7. Refer to the FOD Specification Book, Annex A for more information related to these measurements.

12.4 Annex A

- The governing formulae for Quality Factor of a Coil is the ratio between its inductance and the AC Resistance. i.e.

$$Q = 2\pi f * \frac{L}{R} \quad \text{..... Eqn 1}$$

$Q \rightarrow$ *Quality Factor*; $f \rightarrow$ *Frequency*; $L \rightarrow$ *Inductance*; $R \rightarrow$ *AC Resistance*

- The GRL Platform Solutions Reference Coil Assembly provides additional cables for easy connection to the LCR Meter. For the measurements, parasitic values need to be accounted for in the calculations. Hence the Inductance L_{cable_par} , and Cable Resistance, R_{cable_par} are to be considered to get the final values.
- The Open-Air Compensated Inductance of the GRL Platform Solutions Reference Coil Assembly,

$$L_t^{REF [Compensated]} = L_t^{REF} - L_{cable_par} \quad \text{..... Eqn 2}$$

$L_t^{REF} \rightarrow$ *Open-Air Inductance*

$L_{cable_par} \rightarrow$ *Cable Inductance*

$L_t^{REF [Compensated]} \rightarrow$ *Open-Air Compensated Inductance of Reference Coil Assembly.*

- For each of the positions, the reference values $L_t' [position]$ and $R_t' [position]$ are measured and the compensated values are calculated as follows:

$$L_t' [Compensated] = L_t' [position] - L_{cable_par} \quad \text{..... Eqn 3}$$

with Eqn 2 & Eqn 3,

$$f_t' [position] = 100 * \sqrt{\frac{L_t^{REF [Compensated]}}{L_t' [Compensated]}} \quad \text{..... Eqn 4}$$

$$R_t' [Compensated] = R_t' [position] - R_{cable_par} \quad \text{..... Eqn 5}$$

With reference to Eqn1, substitute using Eqn 3 & Eqn 5,

$$Q_t' [position] = 2\pi * f^{REF} * \left(\frac{L_t' [Compensated]}{R_t' [Compensated]} \right) \quad \text{..... Eqn 6}$$

$L_t' [position] \rightarrow$ *Mated Inductance Measurement with the UUT*

$L_t' [Compensated] \rightarrow$ *Mated Compensated Inductance with the UUT*

$R_t' [position] \rightarrow$ *Mated Resistance Measurement with the UUT*

$R_t' [Compensated] \rightarrow$ *Mated Compensated Resistance Measurement with the UUT*

$Q'_t[position] \rightarrow$ Mated Quality Factor with the UUT

- Calculate the Final Mated Compensated Values by Averaging the values at all positions.

$$f_t^{REF} = \text{AVERAGE} [f'_{t[Center]}, f'_{t[North]}, f'_{t[South]}, f'_{t[West]}, f'_{t[East]}]$$

$$Q_t^{REF} = \text{AVERAGE} [Q'_{t[Center]}, Q'_{t[North]}, Q'_{t[South]}, Q'_{t[West]}, Q'_{t[East]}]$$

12.5 Annex B

- Use the GRL Platform Solutions-Tabular sheet for readily available calculations.
- For the measurements, parasitic values need to be accounted for in the calculations.
- L_{cable_par} and R_{cable_par} are provided by GRL Platform Solutions in the calibration report. Refer to the calibration report for the values.
- Open-Air Inductance, L_t^{REF} of the GRL Platform Solutions Reference Coil Assembly is to be inserted.

Position	Measurement	Symbol	Value	Units	Notes
Open Air	Inductance	L_t^{REF}	24.577	uH	Measured Open air Value from LCR Meter
	Cable Inductance at 100kHz	L_{cable_Par}	66.8	nH	TPT#MP1 Coil lead to Connector Parasitic Value
	Cable Resistance at 100kHz	R_{cable_Par}	27	mOhm	TPT#MP1 Coil lead to Connector Parasitic Value
	Inductance	$L_t^{REF \text{ Compensated}}$	24.5102	uH	Measured Open air Value from LCR Meter

- For each of the positions, the reference values $L'_t[position]$ and $R'_t[position]$ are measured and inserted in the yellow cells of the respective positions. The Mated Resonance Frequency $f'_{t[position] \text{ Compensated}}$, Mated Resonance Quality Factor $Q'_t[position]$ are auto calculated and averaged for the five positions f_t^{REF} and Q_t^{REF} respectively.

Position	Measurement	Symbol	Value	Units	Notes
Open Air	Inductance	L_{REF}	24.524	uH	Measured Open air Value from LCR Meter
	Cable Inductance at 100kHz	L_{Cable_Par}	66.8	nH	Value
	Measurement Frequency	f_{REF}	100	kHz	
	Cable Resistance at 100kHz	R_{Cable_Par}	27	mOhm	Value
	Inductance	$L_{REF_Compensated}$	24.4572	uH	Measured Open air Value from LCR Meter
Center	Measured Mated Inductance	L_t'	28.45666	uH	Coil
	Measured Quality Factor	Q_t'	131.123	mOhm	Quality factor measured from LCR Meter
	Mated Resonance Frequency	$f_t'_{Compensated}$	92.81576362	kHz	Resonance
	Inductance Compensated	$L_t'_{Compensated}$	28.38986	uH	
	Resistance Compensated	$R_t'_{Compensated}$	104.123	mOhm	
North - 5mm	Quality Factor	Q_t'	171.3154166	-	
	Measured Mated Inductance	L_t'	28.404	uH	Coil
	Measured Quality Factor	Q_t'	131.168	-	Quality factor measured from LCR Meter
	Mated Resonance Frequency	$f_t'_{Compensated}$	92.90196496	kHz	Resonance
	Inductance Compensated	$L_t'_{Compensated}$	28.3372	uH	
West - 5mm	Resistance Compensated	$R_t'_{Compensated}$	104.168	mOhm	
	Quality Factor	Q_t'	170.9237757	-	
	Measured Mated Inductance	L_t'	28.411	uH	Coil
	Measured Quality Factor	Q_t'	131.176	-	Quality factor measured from LCR Meter
	Mated Resonance Frequency	$f_t'_{Compensated}$	92.89049253	kHz	Resonance
South - 5mm	Inductance Compensated	$L_t'_{Compensated}$	28.3442	uH	
	Resistance Compensated	$R_t'_{Compensated}$	104.176	mOhm	
	Quality Factor	Q_t'	170.9528692	-	
	Measured Mated Inductance	L_t'	28.445	uH	Coil
	Measured Quality Factor	Q_t'	131.178	-	Quality factor measured from LCR Meter
East - 5mm	Mated Resonance Frequency	$f_t'_{Compensated}$	92.83482967	kHz	Resonance
	Inductance Compensated	$L_t'_{Compensated}$	28.3782	uH	
	Resistance Compensated	$R_t'_{Compensated}$	104.178	mOhm	
	Quality Factor	Q_t'	171.1546481	-	
	Measured Mated Inductance	L_t'	28.44	uH	Coil
	Measured Quality Factor	Q_t'	131.205	-	Quality factor measured from LCR Meter
	Mated Resonance Frequency	$f_t'_{Compensated}$	92.84300911	kHz	Resonance
	Inductance Compensated	$L_t'_{Compensated}$	28.3732	uH	
	Resistance Compensated	$R_t'_{Compensated}$	104.205	mOhm	
	Quality Factor	Q_t'	171.0801529	-	
	Final Resonance Frequency	f_t^{REF}	92.85721198	kHz	Average data of all the five Position
	Final Quality Factor	Q_t^{REF}	171.0853725	-	Average data of all the five Position
	Mated Inductance Compensated	$L_t'_{Compensated}$	28.364532	uH	Average data of all the five Position

- Enter the final values, f_t^{REF} and Q_t^{REF} (values highlighted in Green in the Excel sheet) in the GRL-C3-TPT application under the PRx Self Declaration Form panel (as indicated in the image below). GRL-C3-TPT will use these values for the Pre Power FOD Test as defined in the CTS.

12.6 References

- Qi Specification PRx Compliance Book, Pre Power-Transfer Tests
- Qi Specification FOD Book Annex

13 Appendix D: MPP, BPP & EPP Test Power Transmitter Tester Hardware Reference Test Points

This section describes the reference test points available on the GRL-C3-TPT Test Power Transmitter Tester to which probes can be connected for MPP/BPP/EPP testing.

13.1 Hardware Reference Test Point Connectors

The following table describes the connectors on the GRL-C3-TPT tester with their respective reference test points.

No.	Name	Description	Connector Type
1	TP1	Buck Voltage (Scaled 1:1)	SMB (V_INV)
2	TP2	Buck Current (Scaled 1:1)	Front Fascia Rectangular Connector (EXT_INV_I)
3	TP3	Coil Voltage (Scaled 1:1)	SMB (V_COIL)
4	TP5	Coil Current (Scaled 1:4)	SMB (I_COIL)
5	TP8	Half Bridge 1 Switch Node (Scaled 1:1)	SMB (AC2)
6	TP8b	Half Bridge 2 Switch Node (Scaled 1:1)	SMB (AC1)
7	TP4	Voltage Demodulation	Probing Fixture
8	TP6	Phase Demodulation	Probing Fixture
9	TP7	Current Demodulation	Probing Fixture

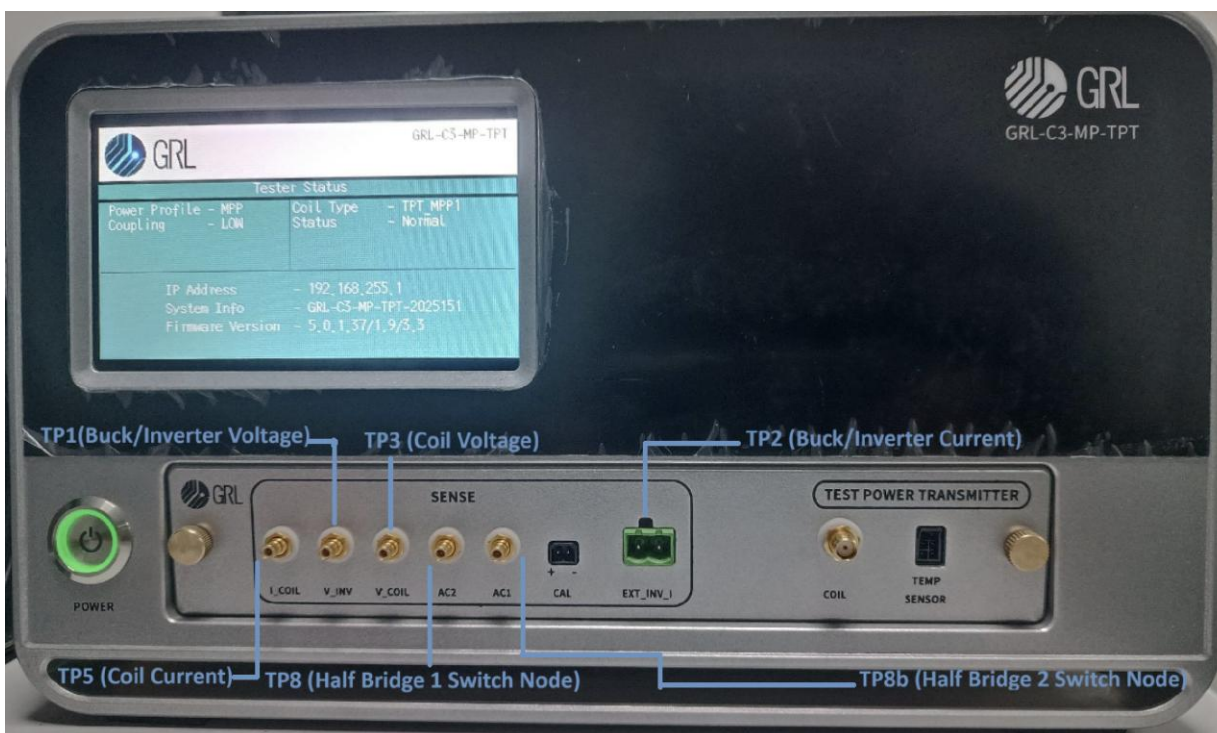


FIGURE 13.1: HARDWARE REFERENCE TEST POINTS CONNECTORS

13.2 Hardware Reference Test Points

This section describes each test point from the above table.

13.2.1 TP1: Buck Voltage

The Buck Voltage (V_INV) test point is used to probe the Buck voltage or Inverter voltage.

- Scaled (1:1)

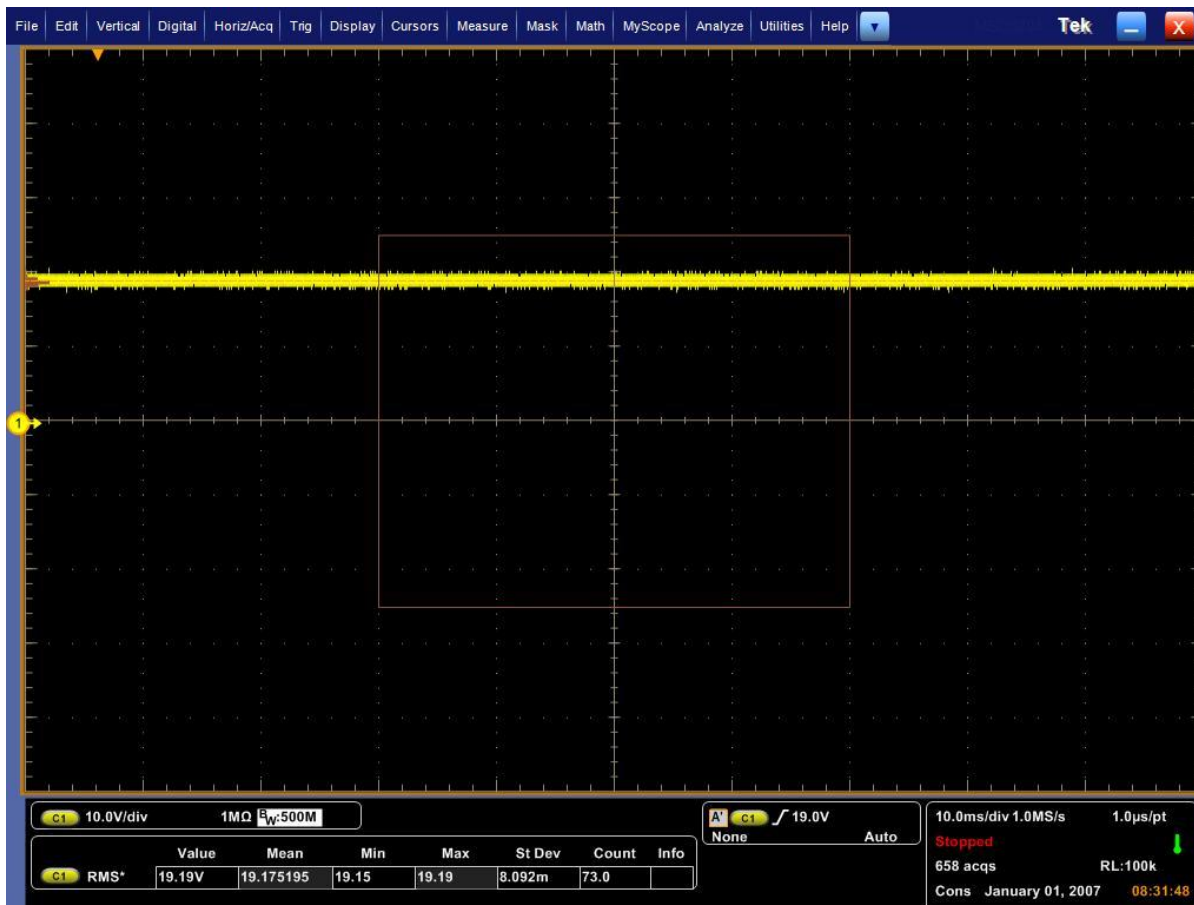


FIGURE 13.2: TP1 BUCK VOLTAGE (V_INV) TEST POINT 1:1 PROBING

13.2.2 TP2: Buck Current

The Buck Converter Current (EXT_INV_I) test point is used to probe the Buck current or Inverter current.

- Scaled (1:1)

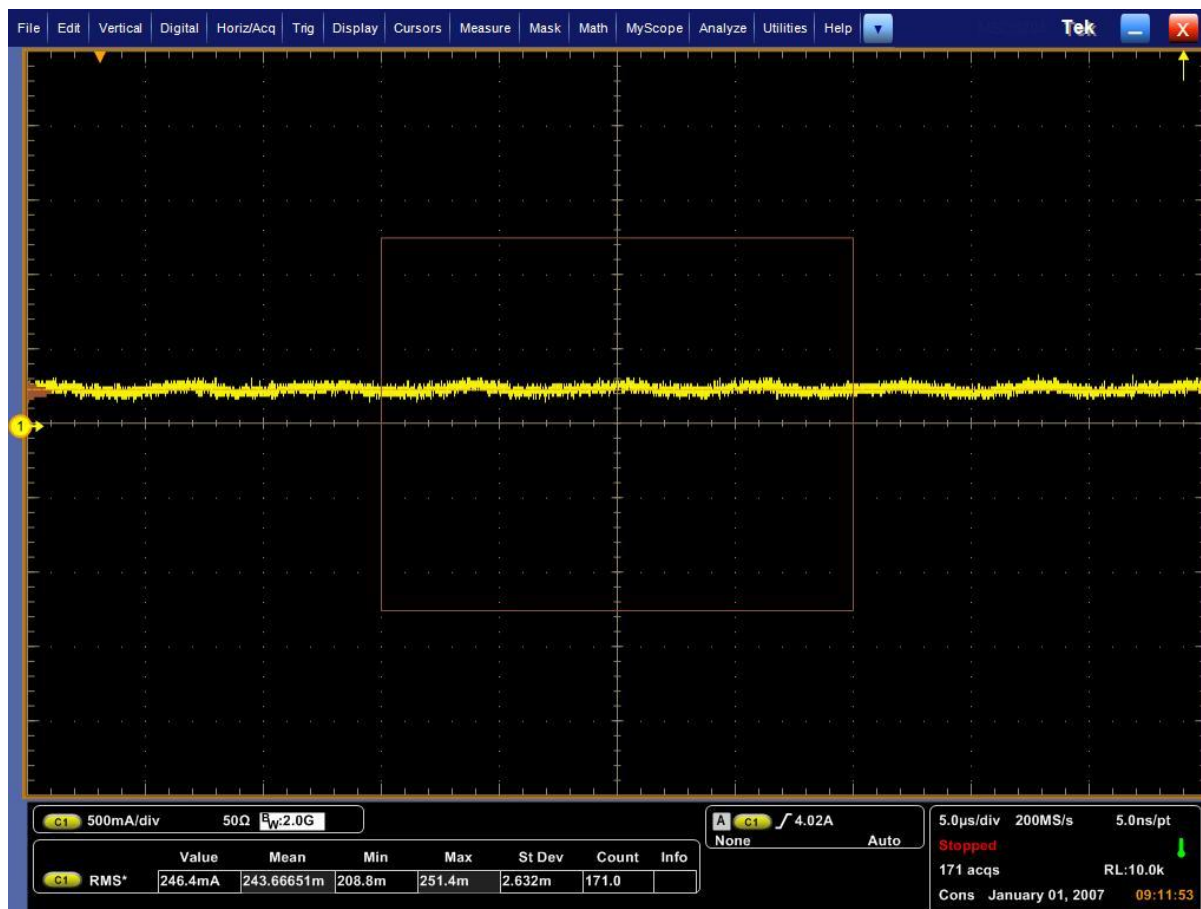


FIGURE 13.3: TP2 BUCK CONVERTER CURRENT (EXT_INV_I) TEST POINT 1:1 PROBING

13.2.3 TP3: Coil Voltage

The Coil Voltage (EXT_COIL_I) test point is used to probe the Coil voltage.

- Scaled (1:1)



FIGURE 13.4: TP3 COIL VOLTAGE (EXT_COIL_I) TEST POINT 1:1 PROBING

13.2.4 TP5: Coil Current

The Coil Current (I_{COIL}) test point is used to probe the Coil current.

- Scaled (1:4)

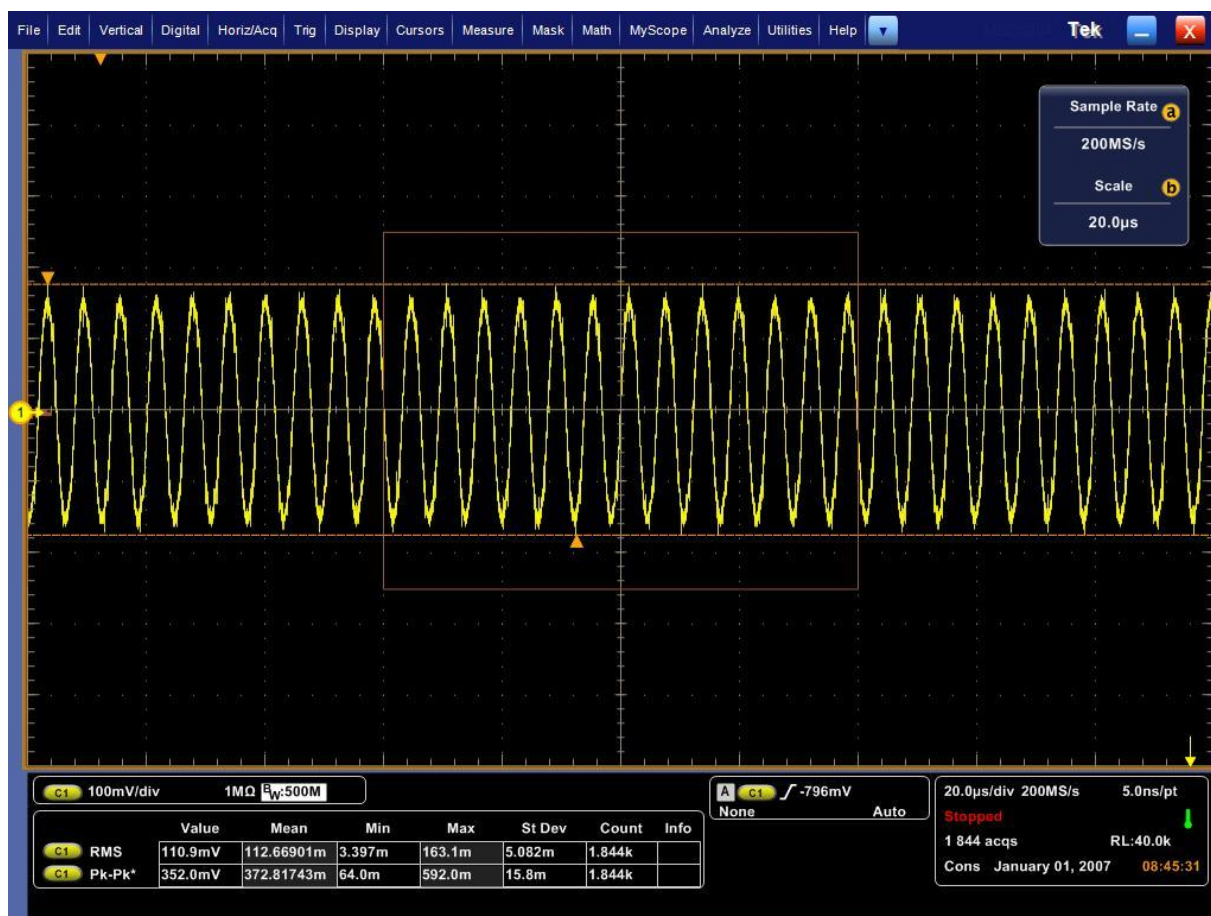


FIGURE 13.5: TP5 COIL CURRENT (I_{COIL}) TEST POINT 1:4 PROBING

13.2.5 TP8: Half Bridge 1 Switch Node

The Half Bridge 1 Switch Node (AC2) test point is used to measure the Duty cycle, etc.

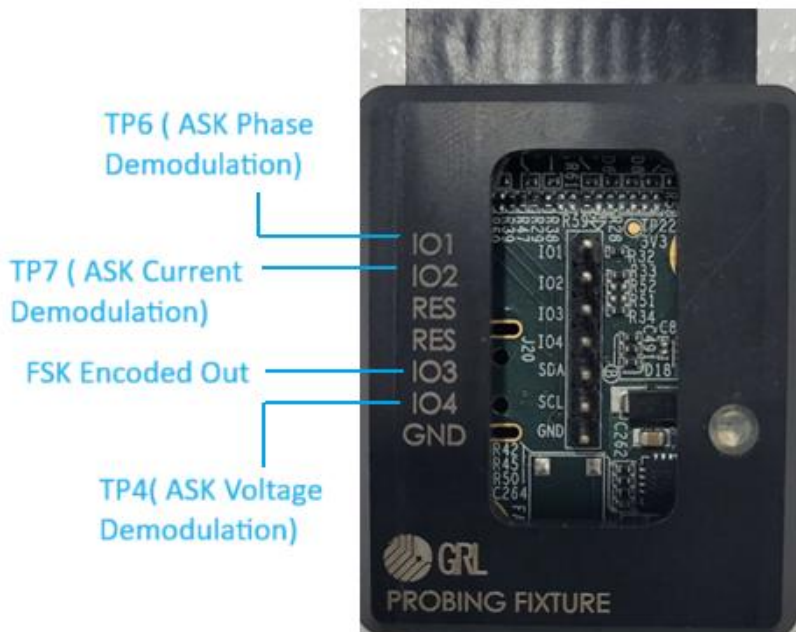
- Scaled (1:1)



FIGURE 13.6: TP8 HALF BRIDGE 1 SWITCH NODE (AC2) TEST POINT 1:1 PROBING

13.3 GRL Platform Solutions Probing Fixture

The GRL Platform Solutions probing fixture as described below is used to connect the TP4, TP6 and TP7 test points when attached to the GRL-C3-BPP-EPP tester hardware.



Purpose	Hardware Net Name
ASK Phase Demodulation / TP6	IO1
ASK Current Demodulation / TP7	IO2
Reserved IO	RES
Reserved IO	RES
FSK Encoded Out	IO3
ASK Voltage Demodulation / TP4	IO4
Ground	GND

Below shows how to connect the GRL Platform Solutions probing fixture to the GRL-C3-TPT tester hardware. The probing fixture should be attached at the back of the GRL-C3-TPT tester as follows.



FIGURE 13.7: CONNECT GRL PLATFORM SOLUTIONS PROBING FIXTURE TO GRL-C3-TPT TESTER HARDWARE

To probe the test points, connect female to male jumpers to the oscilloscope **OR** directly connect the oscilloscope probes to the required test points and group respectively. See images below for examples:

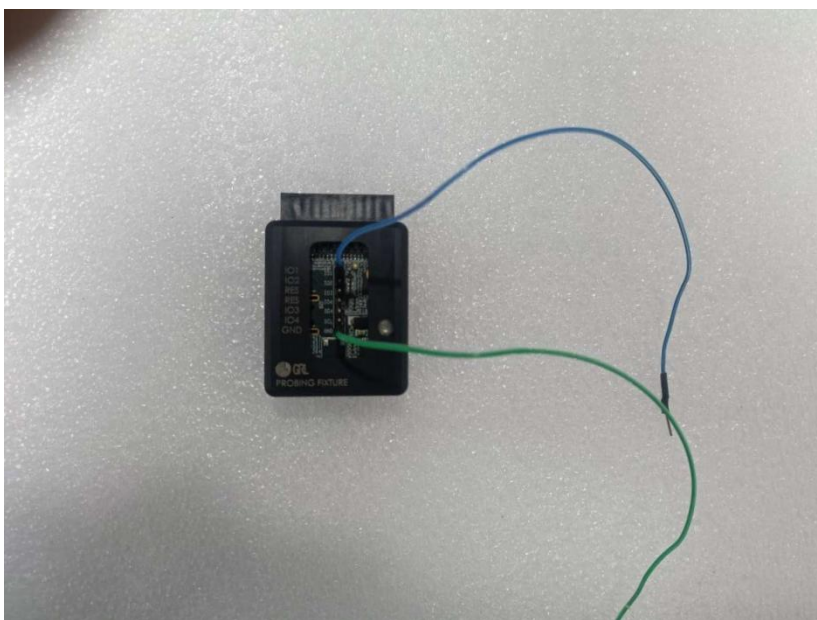


FIGURE 13.8: CONNECT JUMPER WIRES OR PROBES TO GRL PLATFORM SOLUTIONS PROBING FIXTURE



FIGURE 13.9: GRL PLATFORM SOLUTIONS PROBING FIXTURE WITH OSCILLOSCOPE CONNECTION EXAMPLE #1



FIGURE 13.10: GRL PLATFORM SOLUTIONS PROBING FIXTURE WITH OSCILLOSCOPE CONNECTION EXAMPLE #2

13.4 TP4: Voltage Demodulation

The TP4 test point is used to check for ASK voltage demodulation.



FIGURE 13.11: TP4 ASK VOLTAGE DEMODULATION TEST POINT PROBING

13.5 TP6: Phase Demodulation

The TP6 test point is used to check for ASK phase demodulation.



FIGURE 13.12: TP6 PHASE DEMODULATION TEST POINT PROBING

13.6 TP7: Current Demodulation

The TP7 test point is used to check for ASK current demodulation.



FIGURE 13.13: TP7 ASK CURRENT DEMODULATION TEST POINT PROBING

14 Appendix E: TPT Mated-Q Testing with FO Fixture

This section provides the procedure on how to set up the FO fixture, TPT coil and DUT for TPT Mated-Q testing.

14.1 FO Fixture Placement in the GRL Platform Solutions Positioning Tool

1. Place the FO fixture in the GRL Platform Solutions positioning tool as shown in Figure 14.1 below.



FIGURE 14.1: PLACEMENT OF FO FIXTURE IN GRL PLATFORM SOLUTIONS POSITIONING TOOL

14.2 DUT and TPT Coil Placement

1. Place the TPT coil on top of the surface and secure it by applying the screw at the bottom of the coil as shown in Figure 14.2 below.

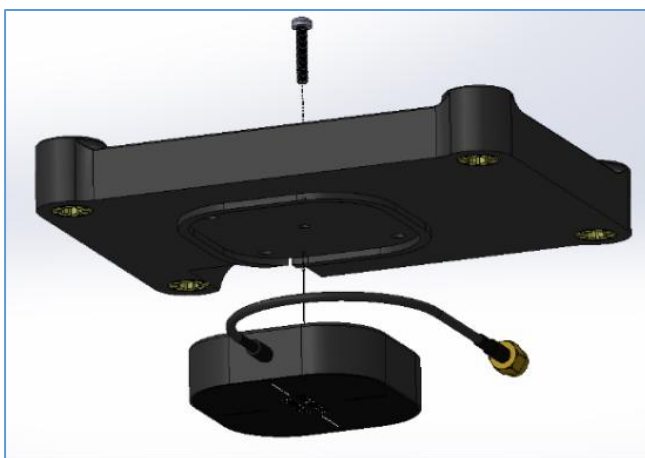


FIGURE 14.2: PLACEMENT OF TPT COIL

2. Insert the top layer of the FO fixture into the bottom layer as shown in Figure 14.3 below.



FIGURE 14.3: INSERT TOP LAYER OF FO FIXTURE INTO BOTTOM LAYER

3. Place the RFO at the required distance (in mm) from the center as shown in Figure 14.4 below.

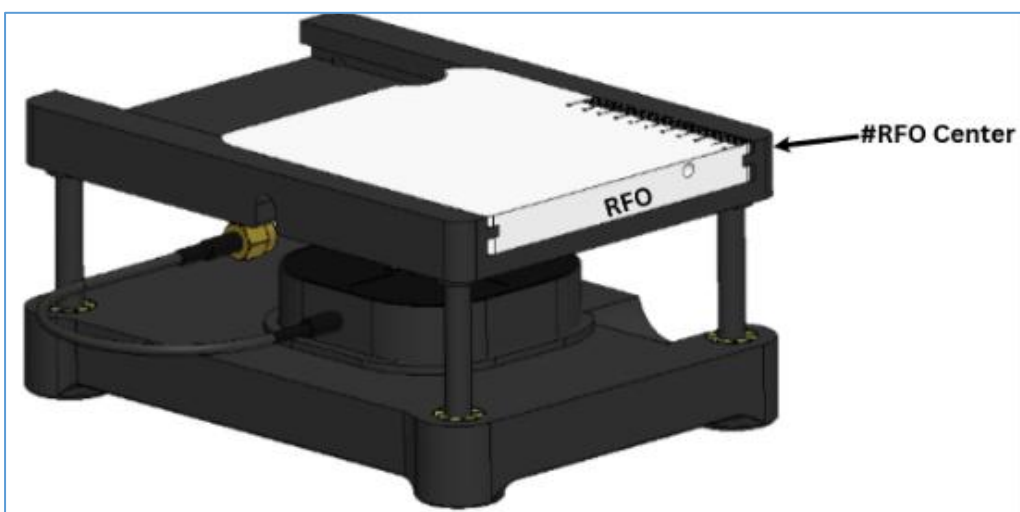


FIGURE 14.4: PLACEMENT OF RFO

Note: "Center" refers to the edge of the FO fixture.

4. Mate the DUT to the TPT coil by placing it on top of the RFO as shown in Figure 14.5 below.



FIGURE 14.5: MATE DUT TO TPT COIL

15 Appendix F: FAQ's on LQK Measurements with GRL-C3-MP-LCR-JIG

1. Question:

Where to find the reference video on the LQK measurement process?

Answer:

Refer to <https://youtu.be/0o3l04mXHnw?si=qSmxklt0Wrig8ELp> to understand how the entire LQK measurement process is carried out.

2. Question:

How to calibrate the LCR meter, and how to ensure that it is properly calibrated?

Answer:

After completing the calibration process, the final step involves performing the OPEN and SHORT measurements.

Once the SHORT calibration is done, do not remove the cap connected to the SMB wire. Then, check the values displayed on the LCR meter. If the L_s (inductance) value is in pico henries (pH) and the R_s (resistance) value is in micro ohms ($\mu\Omega$), we can confirm that the calibration has been completed correctly.



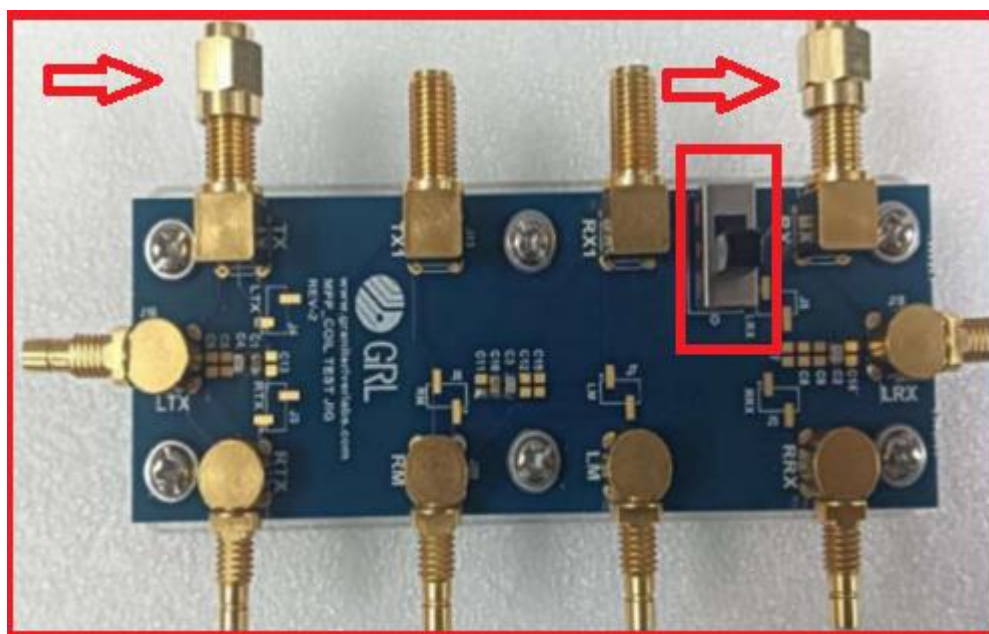
3. **Question:**

What are the jig measurement precautions and how should the jig connection be set up?

Answer:

Before measuring the jig values, connect 0-ohm terminators to both TX and RX ports of the jig, as indicated in the image below.

Ensure that the jig slider switch is turned off throughout the LQK measurement process. If the jig does not have a switch, you may ignore this step.


4. **Question:**

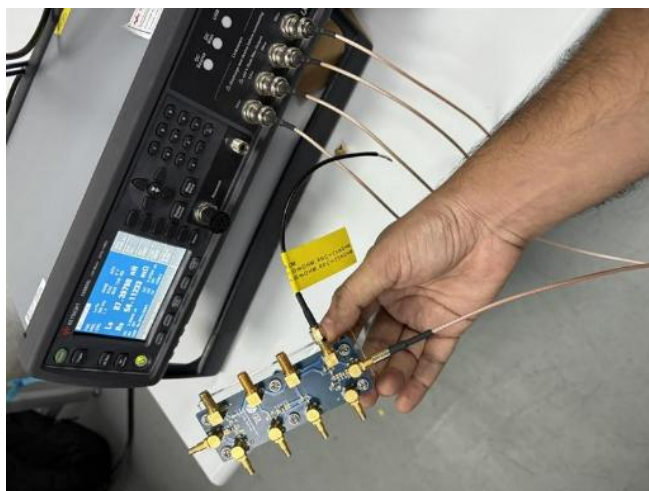
What are Steps 3a, 4a, 9a and 10a, and how are these values measured?

Answer:

If the Tx coil does not have any external leads, for example, in the case of a GRL Platform Solutions Tx coil where the wire is directly connected to the coil, you can simply connect the Tx coil cable wire to the jig and measure L_txl and R_txl. Record these values under Step 3a.

For example, when connecting the Rx coil cable to the test jig — if you connect the SMB wire to the LRX port — only the Ls (inductance) value from the LCR meter should be considered.

Do not consider the Rs (resistance) value in this case.



Note: For the GRL Platform Solutions coil cable values, there is no need to measure them manually, as GRL Platform Solutions has already measured and documented these values in the calibration report.

For example, if you have an Rx device, you must use a GRL Platform Solutions Tx coil. In such cases, the coil number will be printed on the back of the GRL Platform Solutions Tx coil. Using this coil number, the corresponding calibration report should be opened, and the pre-measured values from GRL Platform Solutions should be noted in Step 3a.

For instance, if you are using coil 'GRL-MP1-2024655', then you will need to record the corresponding values for 360 kHz and 128 kHz from the calibration report in Step 3a.

Coil Cable+LCR JIG Parasitic Measurements			
Coil Type	Parameter	Measured @360kHz	Measured @128kHz
ID: GRL-C3-TPT-MP1	L_{tx1} (nH)	60+21=81	62+22=84
Sl. No.: GRL-MP1-2024655	R_{tx1} (mΩ)	35+20=55	30+21=51

STEP 3a Measure the ATL's TPT cable at 360k, enter values in this step.				
Variable	Description	Unit	360 kHz	Corrected
L_{tx1}	Inductance of the TPT coil leads (ATL cable)	nH	81.000	0.081
R_{tx1}	AC resistance of the TPT coil leads (ATL cable)	mΩ	55.000	0.055

STEP 9a Measure the ATL's TPT cable at 128k, enter values in this step.				
Variable	Description	Unit	128 kHz	Corrected
L_{tx1}	Inductance of the TPT coil leads (ATL cable)	nH	84.000	0.084
R_{tx1}	AC resistance of the TPT coil leads (ATL cable)	mΩ	51.000	0.051

For GRL Platform Solutions cables, you can refer to the calibration report to obtain the cable values for the GRL Platform Solutions Tx and Rx coils. These values should be recorded in Steps 3a, 9a and Steps 4a, 10a of the sheet.

If you are a Tx or Rx vendor and do not have the cable values, connect your cable to the jig the same way it is done for the GRL Platform Solutions coils. Measure the values and enter them into the sheet accordingly.

Note: When connecting the cable wire, ensure that the other end of the cable is shorted during the measurement.

5. **Question:**

What are Steps 3b, 4b, 9b and 10b, and how should these values be filled in?

Answer:

If an external bridge wire is connected along with the coil, the first wire needs to be measured separately by connecting it to the jig.

After obtaining the measured value, subtract the previously measured jig value from it.

For example:

If the first wire gives a reading of 80, and the jig measurement (already noted in the sheet) is 24, then the actual value to be recorded is:

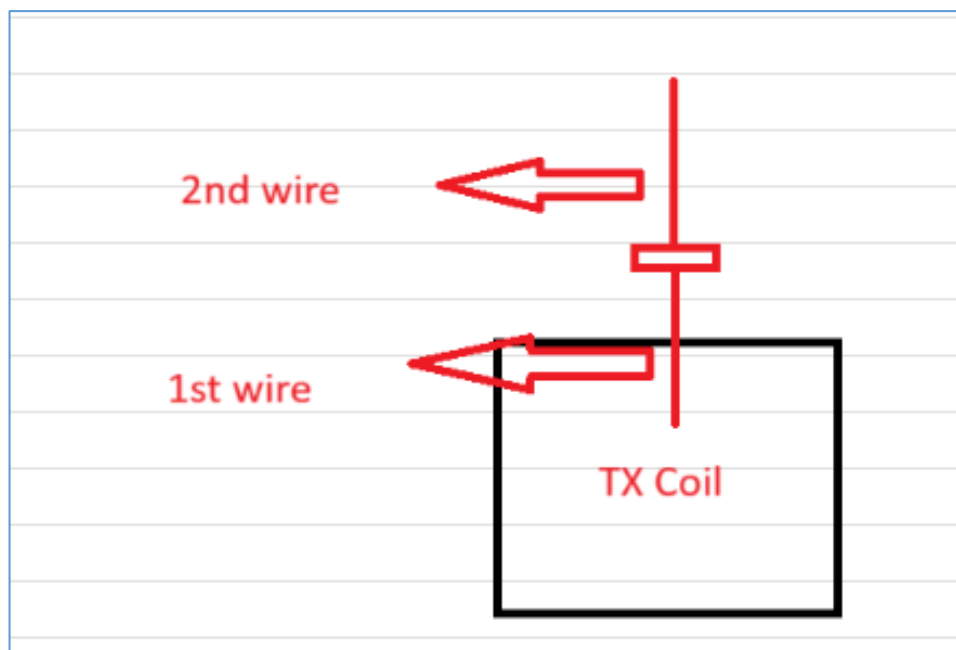
$$80 - 24 = 56$$

The resulting value (56) — whether it is L_{rxl2} or R_{rxl2} — should be updated under Step 3b, 9b, 4b or 10b, based on the type of coil measured.

For example, after noting the L_{rxl2} value, you need to measure the R_{rxl2} value in the same way and record it in the R_{rxl2} field.

STEP 3b Enter TPR vendor's coil lead values for 360k in this step.					
TPR	Variable	Description	Unit	360 kHz	Corrected
internal coil conn.	L _{rxl2}	Inductance of the TPR coil leads (TPR internal)	nH	56.0000	0.0560
	R _{rxl2}	AC resistance of the TPR coil leads (TPR internal)	mΩ		0.0000

Note: If there is no additional lead, you can ignore these steps — it is not required to fill in Steps 3b, 9b, 4b and 10b.



6. **Question:**

When do the other ports of the test jig need to be shorted and used?

Answer:

In real-world scenarios, test engineers typically do not have visibility into how the coil windings are designed.

In such cases, as recommended, you can short the TX and RX ports as shown in the reference video and outlined in the guidance questions, and then proceed with the measurements.

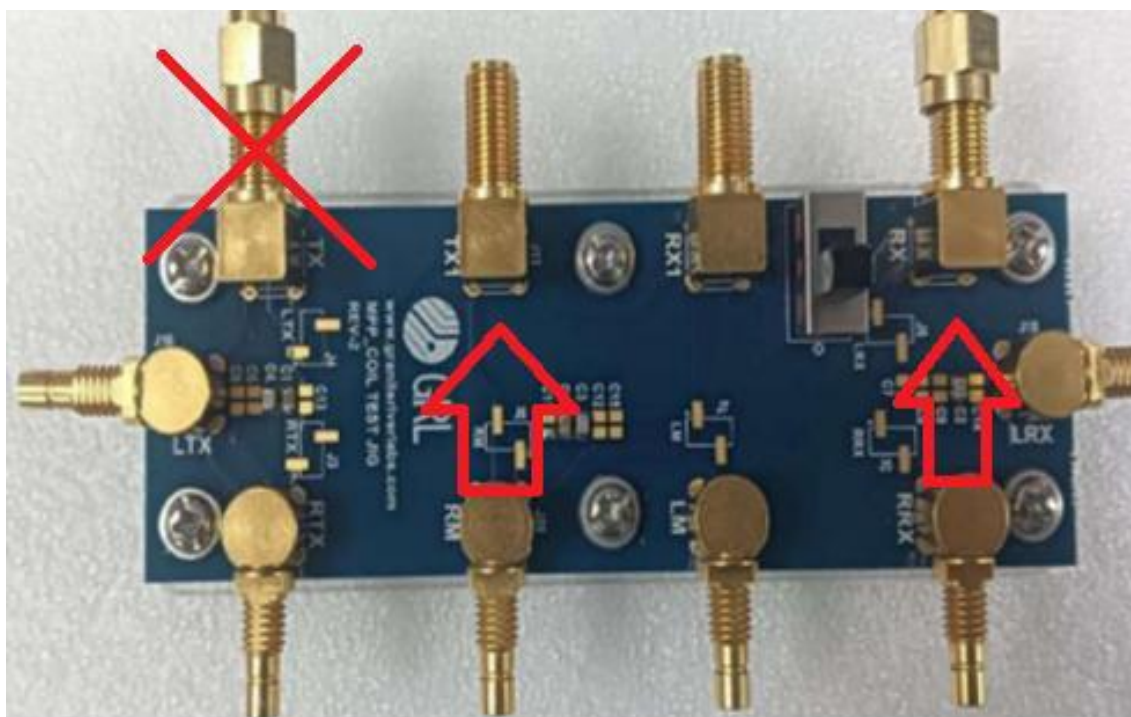
After measuring the values using the LCR meter, if the readings are significantly different (such as the highlighted L'm value shown below), the issue may be due to the coil winding polarity.

STEP 5 Follow LCR meter Coil measurement Procedure at 360k, enter results here.

Variable	Description	Unit	360 kHz	Corrected
L'tx	Inductance at the coil terminals of the DUT	μH	16.183	16.113
L'rx	Inductance at the coil terminals of the TPR	μH	20.329	20.258
R'tx	AC resistance at the coil terminals of the DUT	m Ω	1392.800	1.347
R'rx	AC resistance at the coil terminals of the TPR	m Ω	2257.000	2.215
L'm	Inductance at the coil terminals of the mated DUT and TPR	μH	69.542	-16.473
R'm	AC resistance at the coil terminals of the mated DUT and TPR	m Ω	6704.000	-1.472
Ki	Magnetic coupling between the DUT and TPR			-0.912
Kr	Resistive coupling between the DUT and TPR			-0.852

No Offset (r=0, z=0)

To resolve this, short the TX1 port and RX port as shown in the image below, and restart the procedure from the beginning — including re-measuring the jig values.



7.

Question:**In the WPC LQK spreadsheet, is it allowed to edit fields such as units or formulas?**

Answer:

Ensure that no part of the WPC LQK spreadsheet is modified except the yellow highlighted input boxes, where the readings are typically entered.

Modifying other areas, such as units, formulas, or protected cells can affect the overall calculations and may lead to incorrect results throughout the sheet.

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