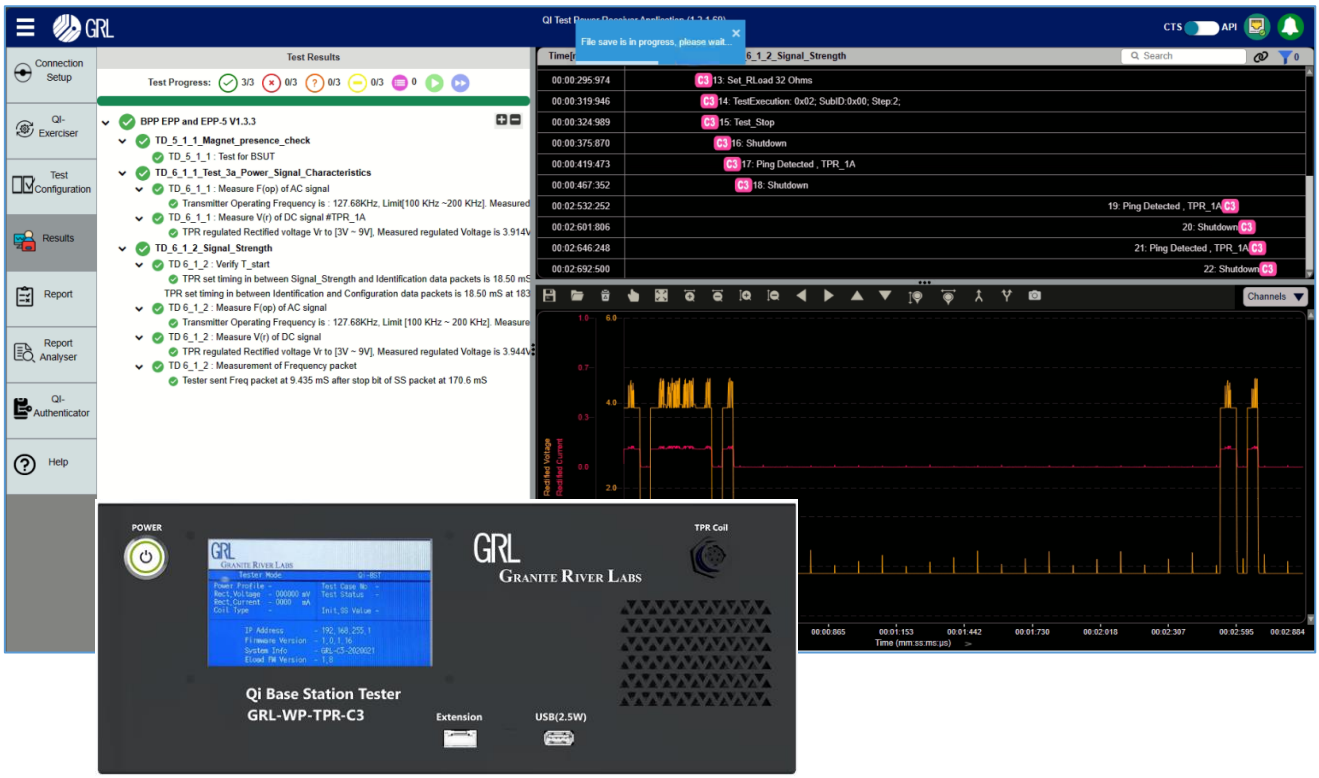
Granite River Labs

User Guide

GRL WPC Qi Wireless Test Power Receiver Tester (GRL-WP-TPR-C3) with Automation Test Browser Application



This material is provided as a reference to get started with the Granite River Labs (GRL) WPC Qi Wireless Test Power Receiver Tester (GRL-WP-TPR-C3) Hardware and the GRL-WP-TPR-C3 Automation Test Browser Application.

For software support, contact support@graniteriverlabs.com.

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TABLE OF CONTENTS

LIST OF FIGURES

1 Reference Documents

The test methods outlined in this document are tests required by the Wireless Power Consortium (WPC) for Qi compliance of a Wireless Power Transmitter/Receiver device. The Qi Wireless Power Transfer System for Power Class 0 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

The Qi Wireless Power Transfer System for Power Class 0 Specification:

Introduction to the Power Class 0 Specification Version 1.2.3 (February 2017)

Parts 1 and 2: Interface Definitions Version 1.2.3 (February 2017)

Part 3: Compliance Testing Version 1.2.4 (February 2018)

Part 4: Reference Designs Version 1.2.3 (February 2017)

2 Acronym/Abbreviation Glossary

TPR	Test Power Receiver
DUT	Device Under Test
OS	Operating System
BSUT	Base Station Under Test
FPGA	Field Programmable Gate Array
BPP	Base Power Profile
EPP	Extended Power Profile
API	Application Programming Interface
CTS	Compliance Test Specification
MOI	Method of Implementation
GP	Guaranteed Power
FOD	Foreign Object Detection
Power Tx	Power Transmitter
ID/Config	Identification & Configuration
RP	Received Power
EPP5	Extended Power Profile 5
Qf	Quality Factor
PRMC	Power Receiver Manufacturer Code

3 Scope of this User Guide

This User Guide serves as the primary user documentation for the GRL-WP-TPR-C3 (aka GRL-C3) WPC Qi Wireless Test Power Receiver Tester Hardware and GRL-C3 Automation Test Browser Application. The subsequent sections describe the GRL-C3 initial setup and each feature provided by the GRL-C3 automation test browser application when connected to the GRL-C3 tester hardware.

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

4.1 GRL-C3 Shipping Box Contents

	**GRL-WP-TPR-C3 –** WPC Qi Wireless Test Power Receiver Tester
	**Power Supply**
	**USB Cable –** Standard Type-A to Type-B Programming cable used to update GRL-C3 firmware. Connects to GRL-C3 upgrade USB port.
	**Ethernet Cable –** 3m Cat 5 cable to connect GRL-C3 test controller to control computer.
	**E-Load Firmware Update Cable**

PicoScope 8-Channel Temperature Datalogger – ThermoMux

TPR #1A Coil Assembly

TPR #1B Coil Assembly

TPR #1C Coil Assembly

TPR #1D Coil Assembly

TPR #1E Coil Assembly

TPR #5 Coil Assembly

TPR #MP1A Coil Assembly

TPR #MP1B Coil Assembly

TPR #MP1C Coil Assembly

TPR #MP3 Coil Assembly

TPR #MP4 Coil Assembly

TPR Thermal 5W Coil Assembly

TPR Thermal 15W Coil Assembly

Foreign Object #1: Steel Disc Centered

Foreign Object #1: Steel Disc Off Centered

Foreign Object #2: Aluminum Ring

Foreign Object #3: Aluminum Foil

Foreign Object #1 for EPP – Steel Disc

Foreign Object #2 for EPP – Aluminum Ring

Foreign Object #3 for EPP – Aluminum Foil

Foreign Object #4 for EPP – Aluminum Disc

Foreign Object Holder #1

Foreign Object Holder #2

Foreign Object Holder #3

2mm Spacer

5mm Spacer

1.5mm Spacer

5 Getting Started with GRL-C3

This section describes how to get started with the GRL-C3 test solution for Qi wireless charging 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 automation test browser application (Browser App) on the host computer (laptop or desktop) connected to the GRL-C3 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 Browser App to run properly. Make sure to clear the browser cache before launching the GRL-C3 Browser App.
2. Make sure the GRL-C3 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@graniteriverlabs.com.

5.1 Install GRL-C3 Browser App

1. Download the GRL-C3 Browser App from http://graniteriverlabs.com/download-center/.
2. Run the installer by double clicking the extracted executable (*GRL_GRL-C3_Browser_App_V1x.x.exe*) and then click on the 'Next' button.

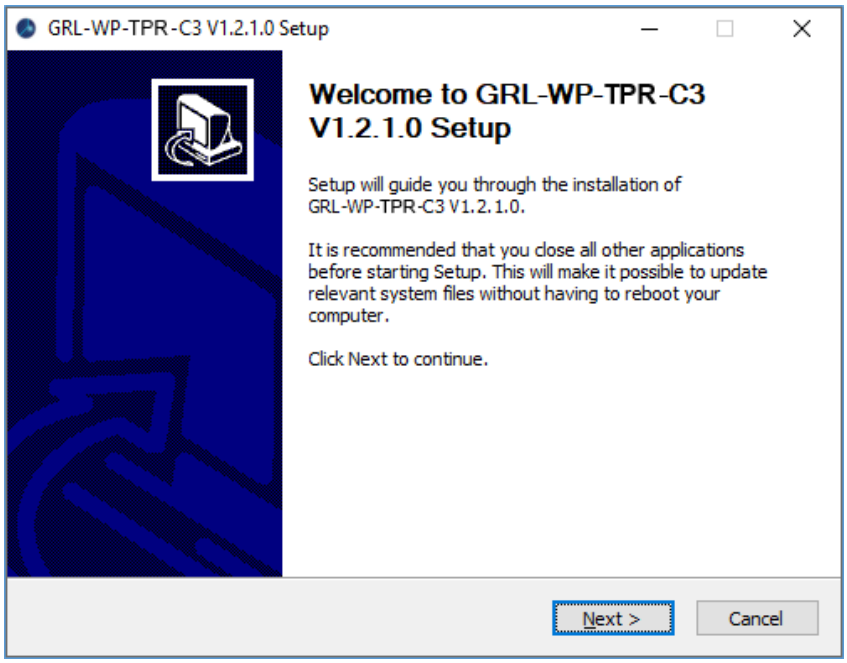


FIGURE 5.1: START GRL-C3 BROWSER APP INSTALLATION

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

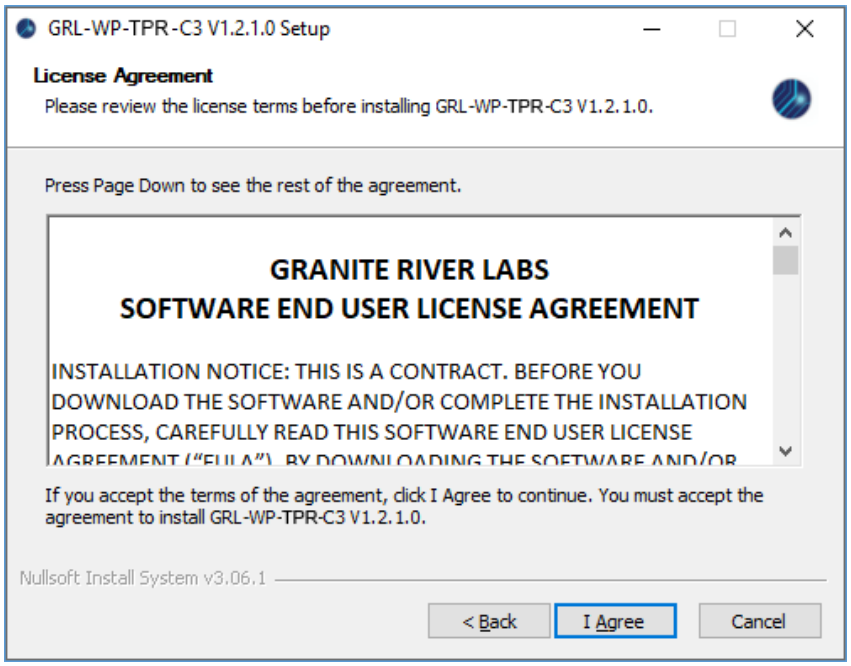


FIGURE 5.2: ACCEPT GRL-C3 BROWSER APP LICENSE AGREEMENT

4. The software installation will then proceed.

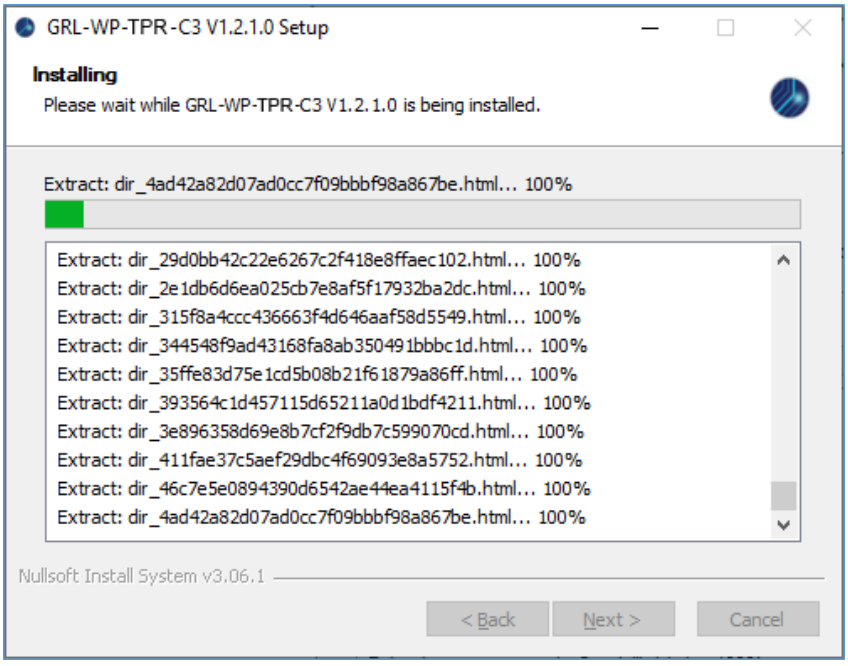


FIGURE 5.3: GRL-C3 BROWSER APP INSTALLATION IN PROGRESS

5. Install the device driver when prompted. Click on the 'Next' button to proceed.

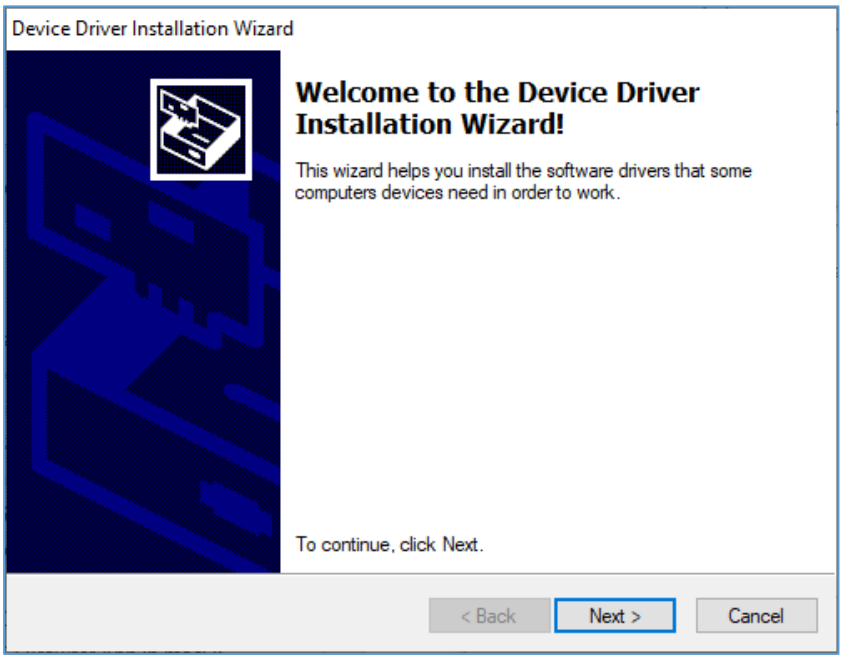


FIGURE 5.4: START GRL-C3 DEVICE DRIVER INSTALLATION

6. The device driver installation will then proceed and upon completion, click on the 'Finish' button.

FIGURE 5.5: GRL-C3 DEVICE DRIVER INSTALLATION COMPLETED

7. Click on the 'Finish' button to complete the software installation.

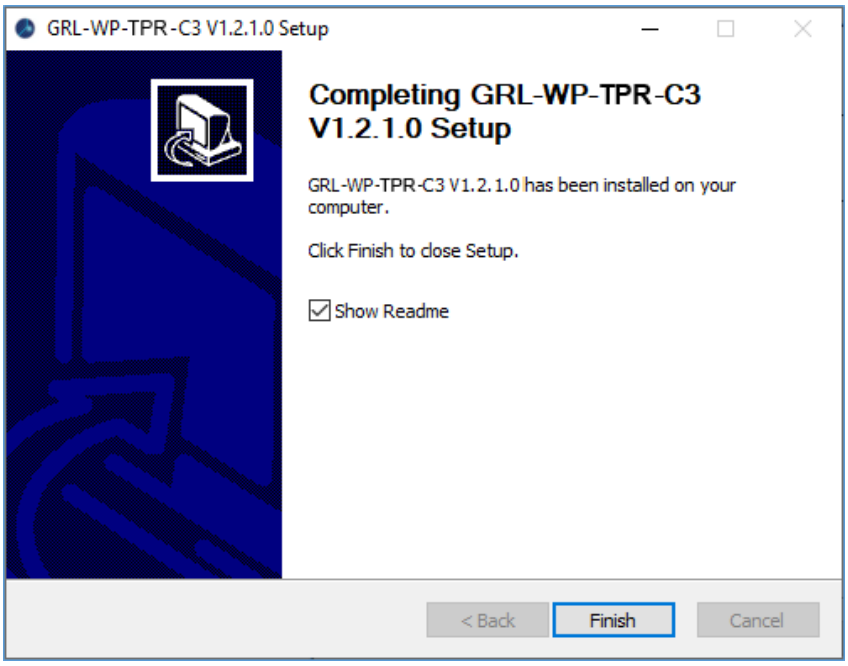


FIGURE 5.6: GRL-C3 BROWSER APP INSTALLATION COMPLETED

8. The GRL-C3 Browser App is now ready for use.

5.2 Start Up and Navigate GRL-C3 Browser App

1. Once installed, you can directly open the GRL-C3 Browser App using the "**GRL-WP-TPR-C3**" Browser App desktop shortcut. This will initiate the App server to run backend operations before launching the GRL-C3 Browser App.

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

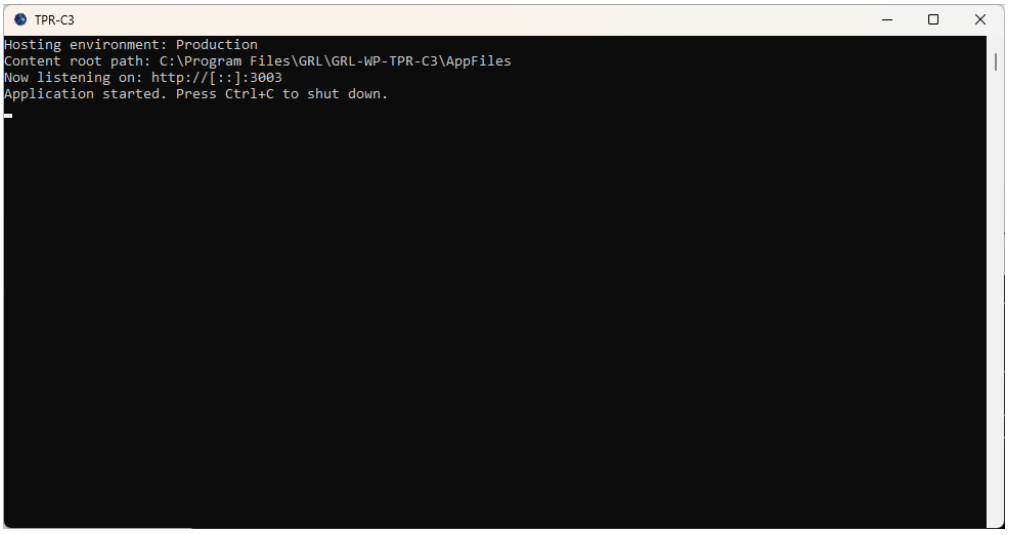


FIGURE 5.7: APP SERVER SCREEN RUNNING BACKEND OPERATIONS

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

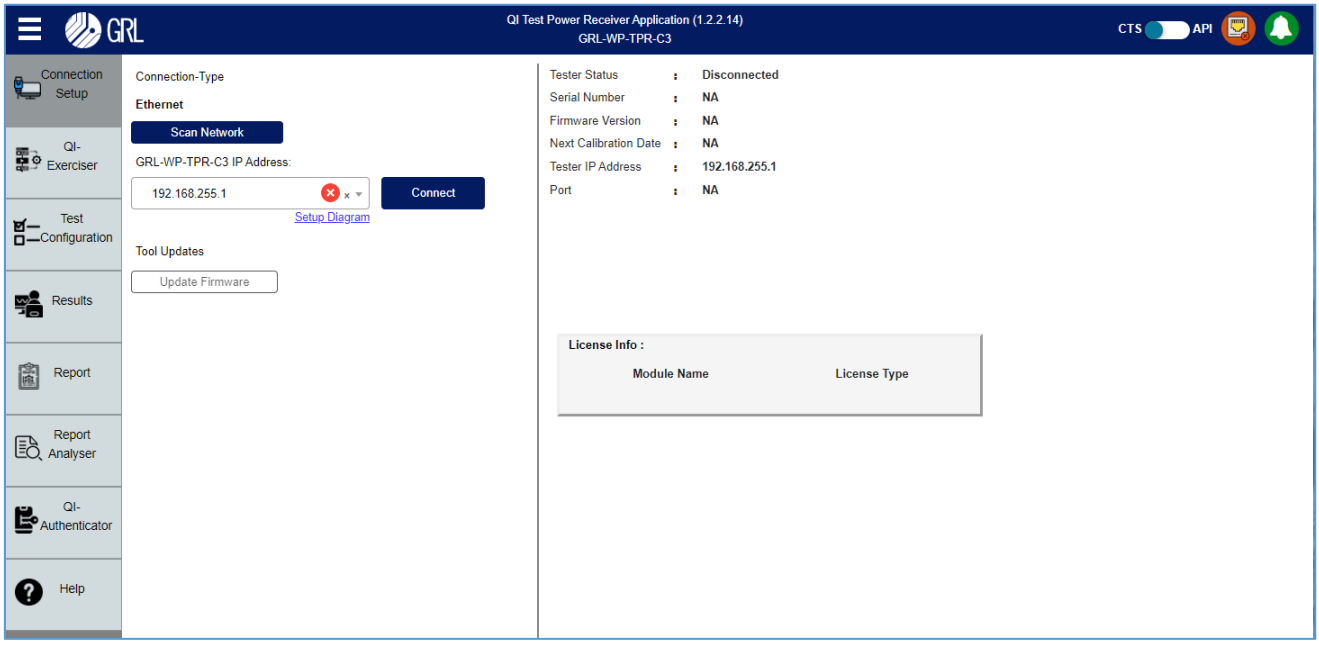


FIGURE 5.8: GRL-C3 BROWSER APP LANDING SCREEN

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

5.2.1 Using GRL-C3 Browser App in Chrome OS

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

1. Install the GRL-C3 Browser App on a Windows 10 control PC connected to the GRL-C3 tester hardware.
2. Once installed, open the GRL-C3 Browser App using the **GRL-C3 - Browser App** 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 5.9 below for an illustration of the above steps.

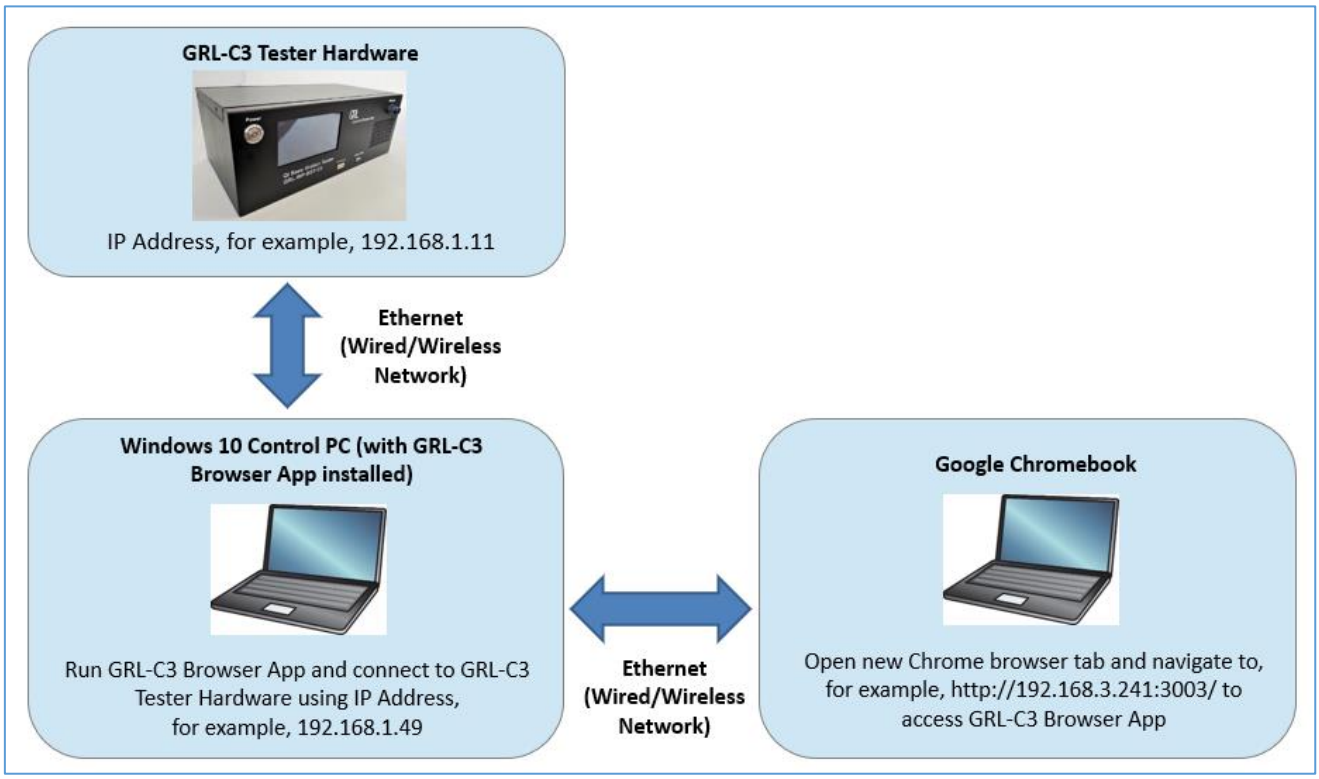


FIGURE 5.9: USING GRL-C3 BROWSER APP IN CHROME OS

5.2.2 Using GRL-C3 Browser App in macOS

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

1. Install the GRL-C3 Browser App on a Windows 10 control PC connected to the GRL-C3 tester hardware.
2. Once installed, open the GRL-C3 Browser App using the **GRL-C3 - Browser App** 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 5.10 below for an illustration of the above steps.

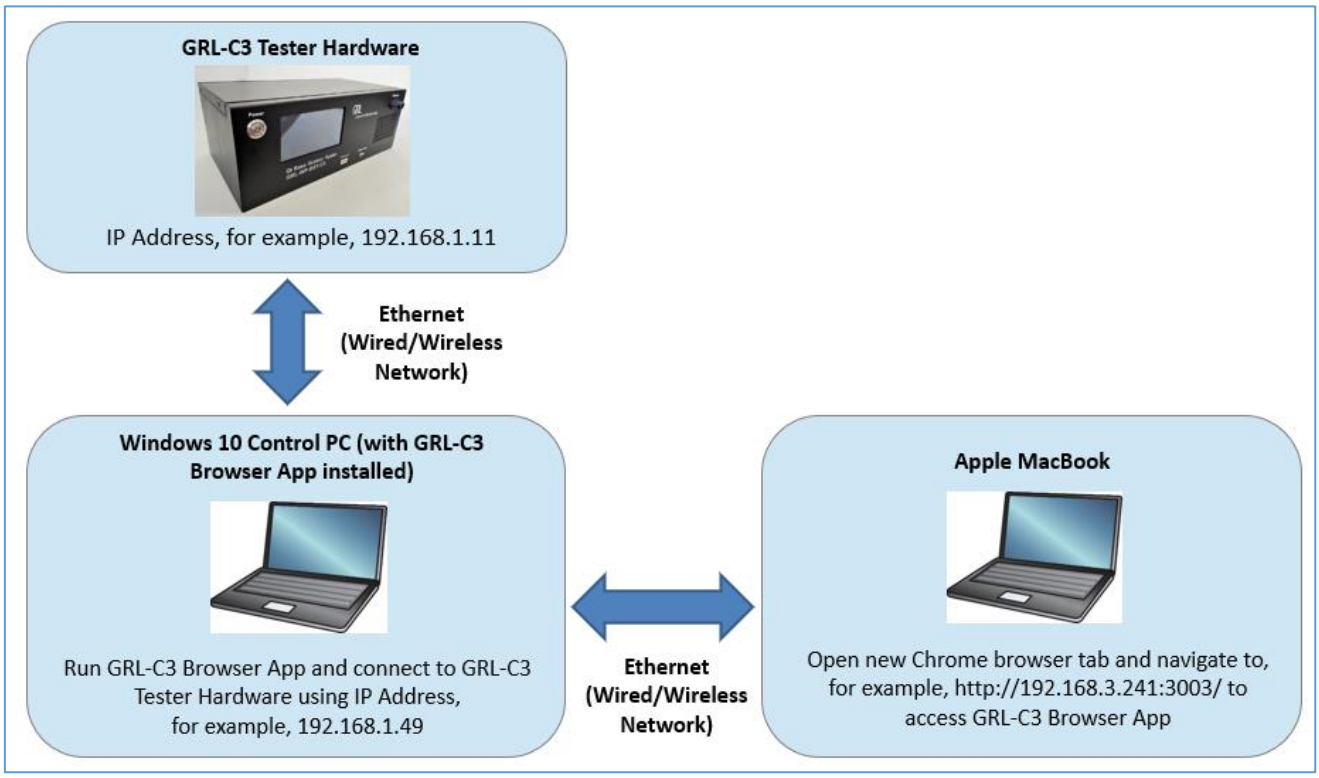


FIGURE 5.10: USING GRL-C3 BROWSER APP IN MACOS

6 Connection and Setup of GRL-C3 Tester Hardware

Figure 6.1 below shows an example setup for testing a Qi wireless base station DUT.

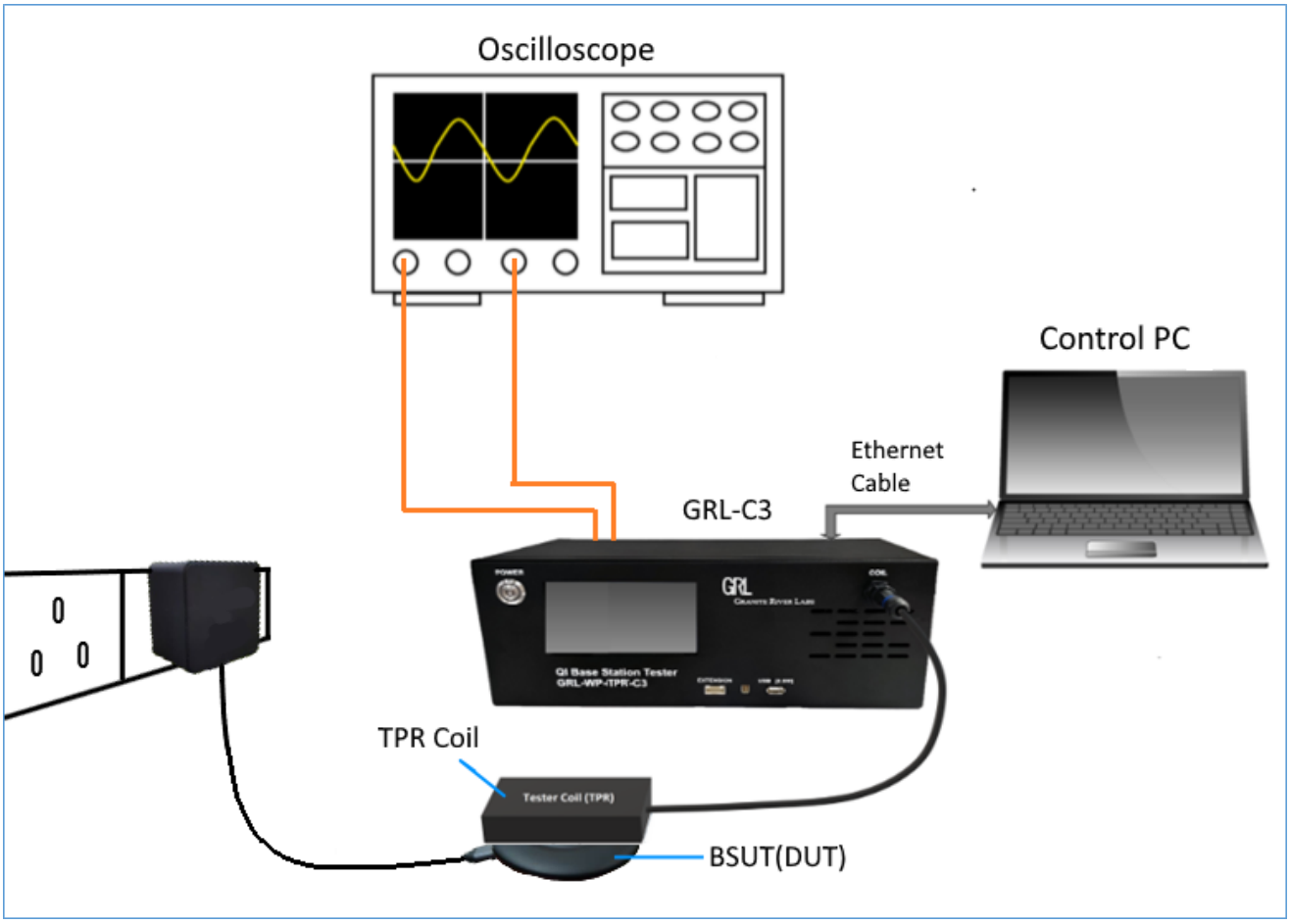


FIGURE 6.1: GRL-C3 HARDWARE SETUP FOR QI WIRELESS BASE STATION DUT

The GRL-C3 Browser App 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 tester hardware.
2. Connect the GRL-C3 tester hardware using a physical Ethernet connection between the control computer and the tester.
3. Connect an external oscilloscope to the GRL-C3 tester hardware. This is useful if the user wants to run measurements on the oscilloscope. Otherwise, the oscilloscope can be omitted from the setup.
4. Connect the Base Station under test (BSUT) / DUT to a power outlet.
5. Connect the Test Power Receiver (TPR) coil assembly to the “TPR Coil” connector on the GRL-C3 tester hardware. Place the TPR coil assembly on the BSUT / DUT.

6.1 Connect Power Supply to GRL-C3 Tester Hardware

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

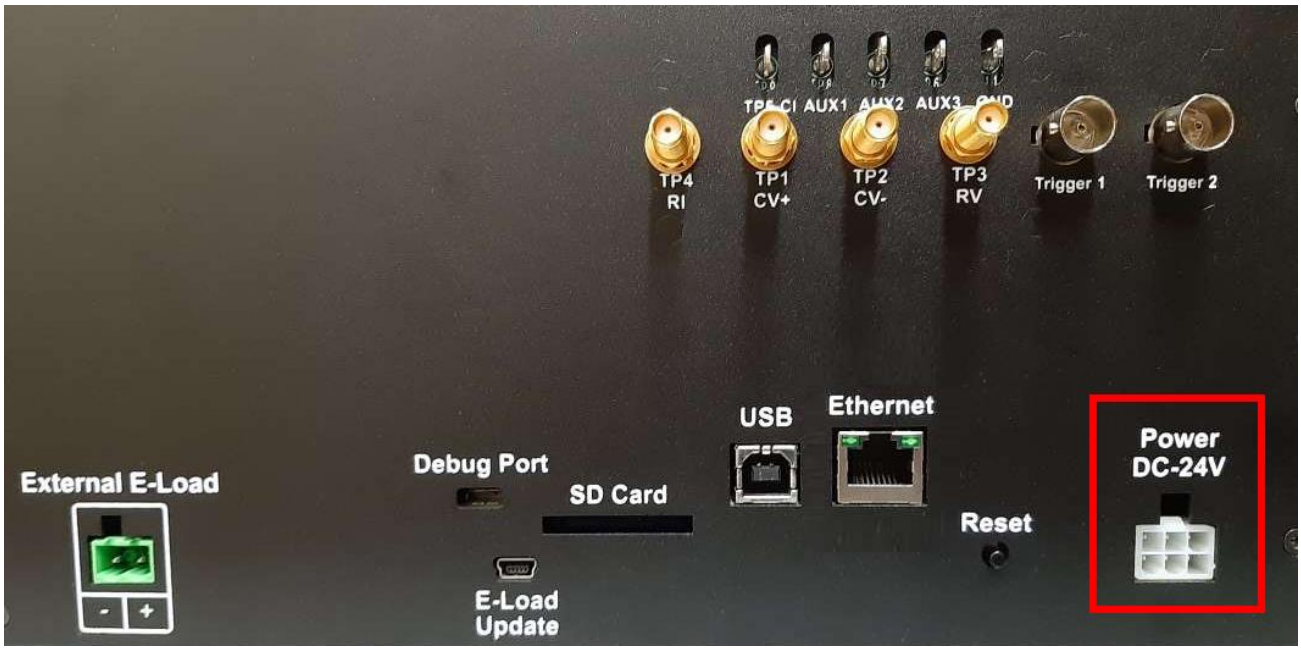


FIGURE 6.2: GRL-C3 POWER INTERFACE

6.2 Connect Ethernet Cable and Turn On GRL-C3 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.

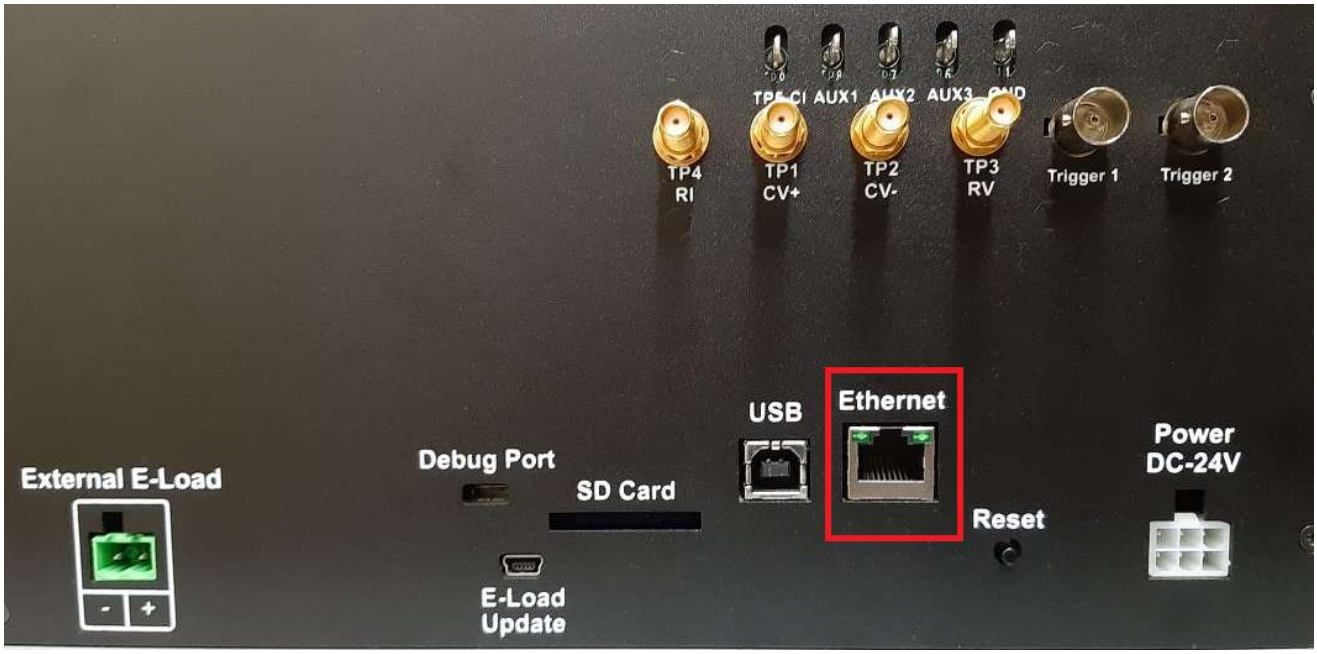


FIGURE 6.3: GRL-C3 ETHERNET CONNECTOR

Turn on the GRL-C3 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 POWER BUTTON

6.2.1 Verify GRL-C3 Tester Hardware Ethernet Connection

The Ethernet port on the control computer needs to be configured correctly for the GRL-C3 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.

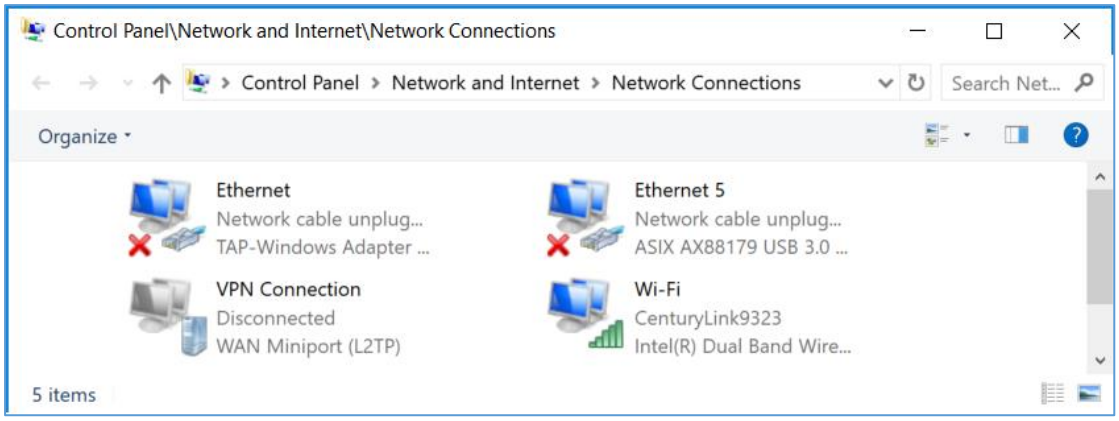


FIGURE 6.5: NETWORK CONNECTIONS BEFORE CONNECTING GRL-C3

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

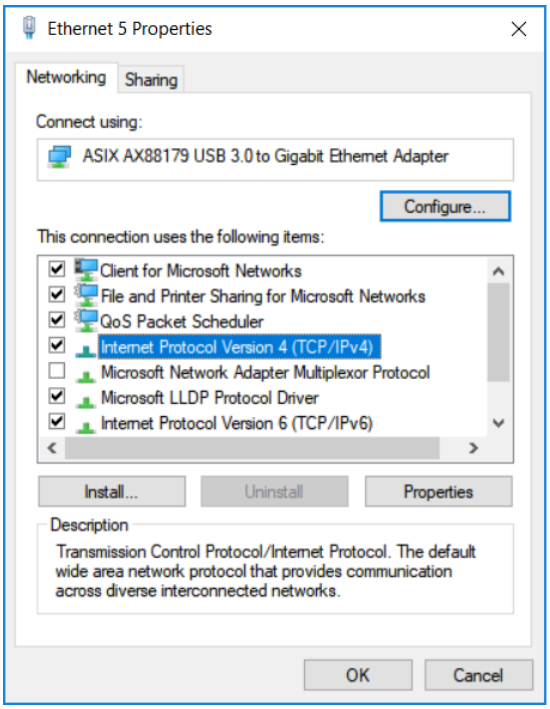


FIGURE 6.6: ETHERNET PROPERTIES

Set up the TCP/IPv4 properties as shown below.

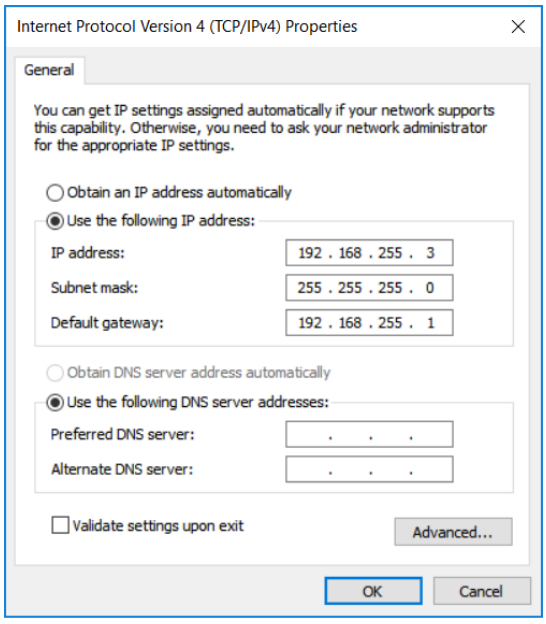


FIGURE 6.7: ETHERNET PROPERTIES WITH TCP/IPV4 SELECTED

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 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 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:

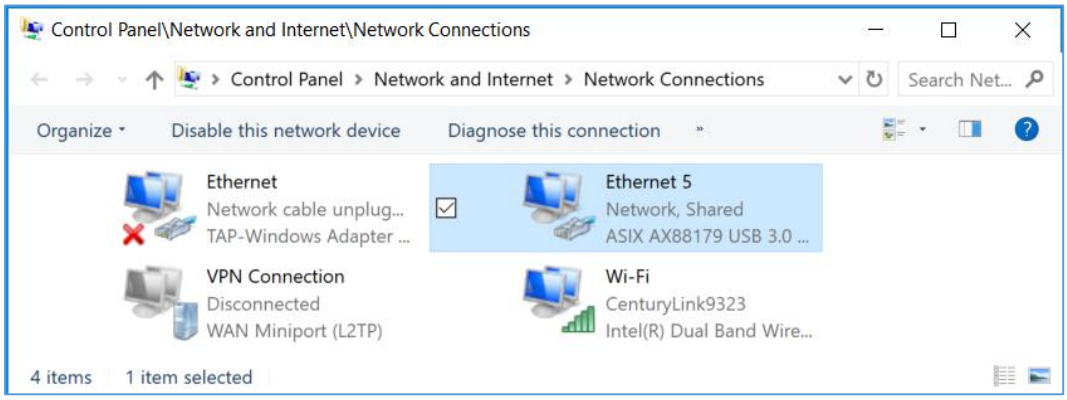


FIGURE 6.8: NETWORK CONNECTIONS AFTER SETUP AND CONNECTION OF GRL-C3

The GRL-C3 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 are communicating by going to the “Connection Setup” screen on the GRL-C3 Browser App 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 Tester Hardware

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

Connect the oscilloscope channels to the “TP1” & “TP2” and “TP3” & “TP4” connector pairs and trigger port to the “Trigger 2” connecter on the back of the GRL-C3 tester hardware.

FIGURE 6.9: OSCILLOSCOPE TO GRL-C3 CONNECTIONS

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

6.4 Connect TPR Coil to GRL-C3 Tester Hardware

Connect the TPR coil assembly to the “TPR Coil” connector as shown in below example:

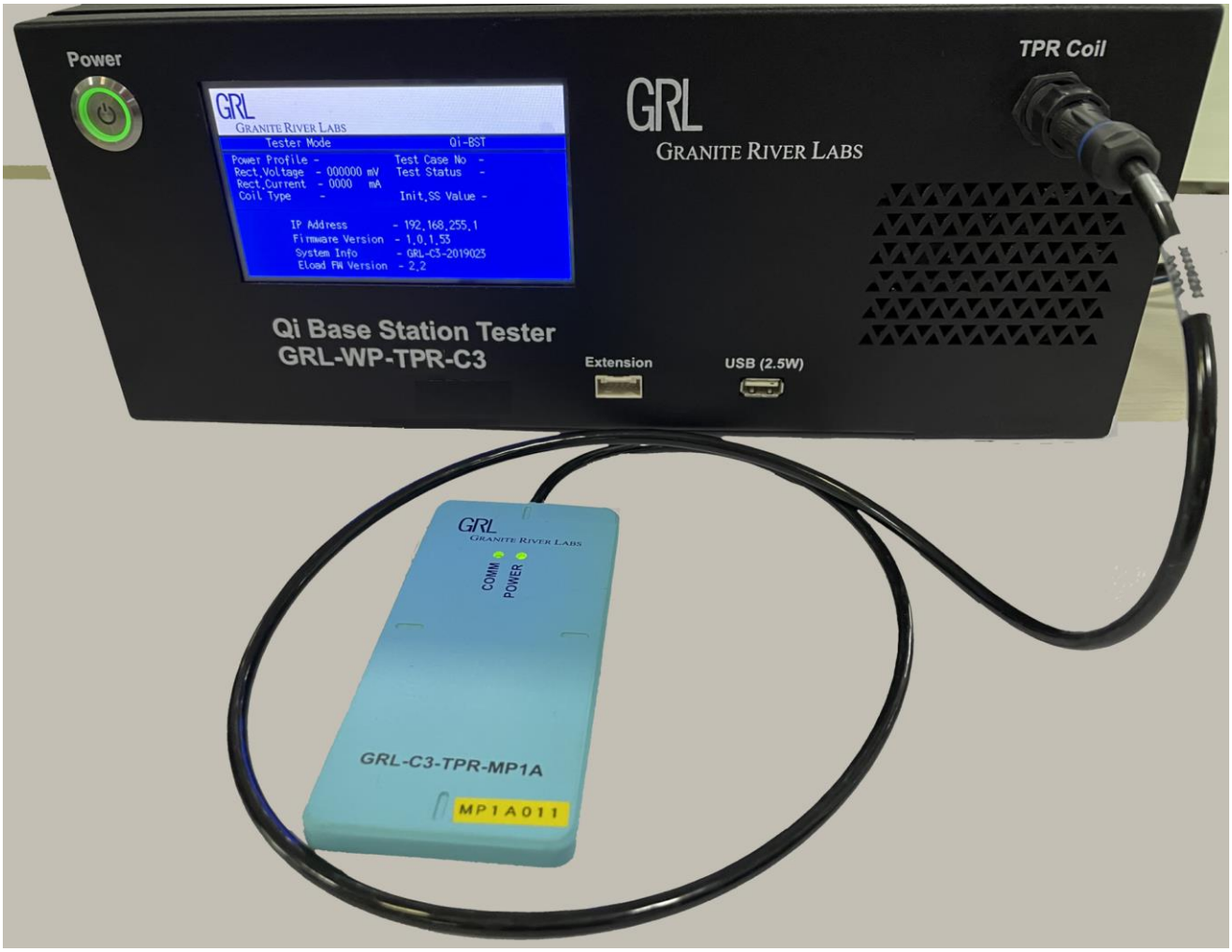


FIGURE 6.10: TPR COIL TO GRL-C3 CONNECTION

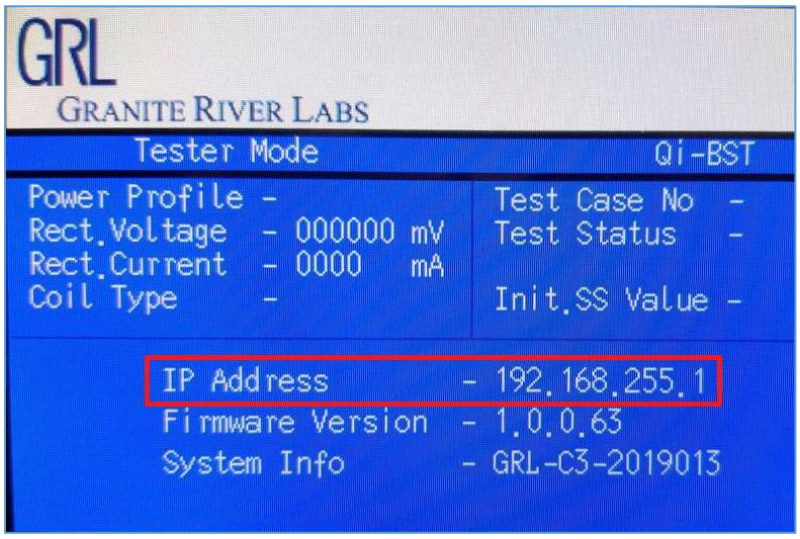
Note: Make sure to place the TPR coil assembly on the BSUT / DUT connected to a power outlet to perform testing.

7 Connection and Setup of GRL-C3 Browser App

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

To connect the GRL-C3 Browser App with the GRL-C3 tester hardware, do the following:

1. On the GRL-C3 Browser App landing page (“Connection Setup” screen), enter the IP address as displayed on the GRL-C3 tester hardware screen and click on the **Connect** button. You can also click on the **Scan Network** button to detect all available GRL-C3 tester hardware connected to the same network.



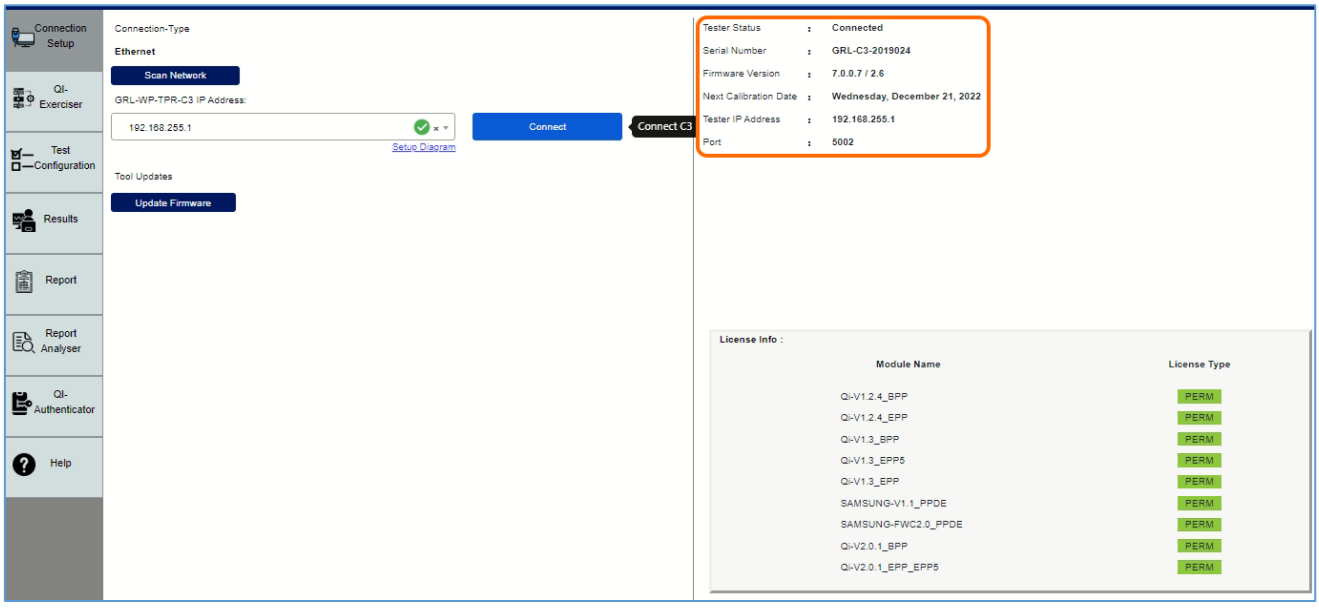


FIGURE 7.1: CONNECTION CONFIGURATION SCREEN AFTER SUCCESSFUL CONNECTION

2. The GRL-C3 tester hardware and Browser App are now connected as indicated by the tester information display (“Tester Status”, “Serial Number”, “Firmware Version”, etc.).
3. 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 TPR coil assembly to the GRL-C3 tester hardware before placing the coil on the DUT and also shows how to connect the tester hardware to the control computer via Ethernet.

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

4. Click on the **Update Firmware** button to update the GRL-C3 tester hardware’s FPGA and E-Load firmware. Clicking 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.

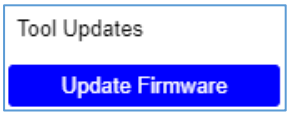


FIGURE 7.2: UPDATE GRL-C3 FIRMWARE BUTTON

7.1 Update GRL-C3 Tester Hardware’s Firmware

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

1. Click on the **Update Firmware** button and the following pop-up message will appear (Figure 7.3 below). Using a standard USB Type-B cable, connect the USB Type-B port (for firmware update as indicated in the image) at the back of the GRL-C3 tester hardware to the control PC (where the GRL-C3 Browser App is running). When connected, click “Ok” to proceed.

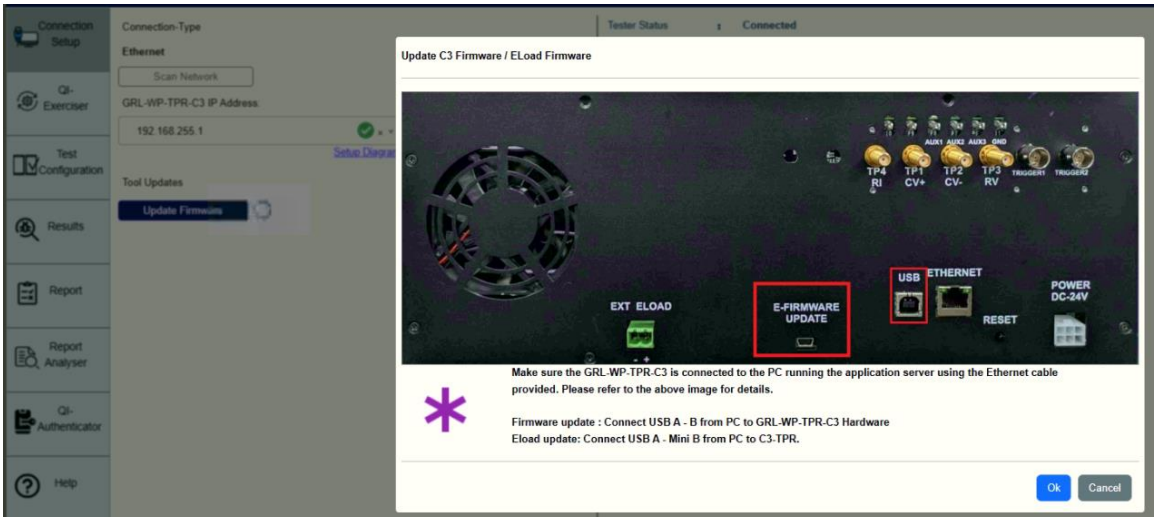


FIGURE 7.3: UPDATE GRL-C3 FIRMWARE– #1

2. The firmware update process will start and may take a few minutes to complete (Figure 7.4 below).

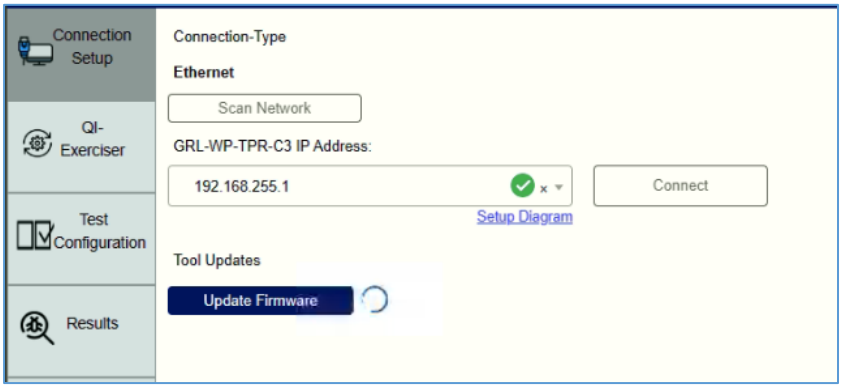


FIGURE 7.4: UPDATE GRL-C3 FIRMWARE– #2

3. 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 firmware update for the GRL-C3 tester hardware.

FIGURE 7.5: UPDATE GRL-C3 FIRMWARE– #3

4. Once the E-Load firmware update process has completed successfully, click “Ok” for the GRL-C3 tester hardware to power cycle and reboot (Figure 7.6 below).

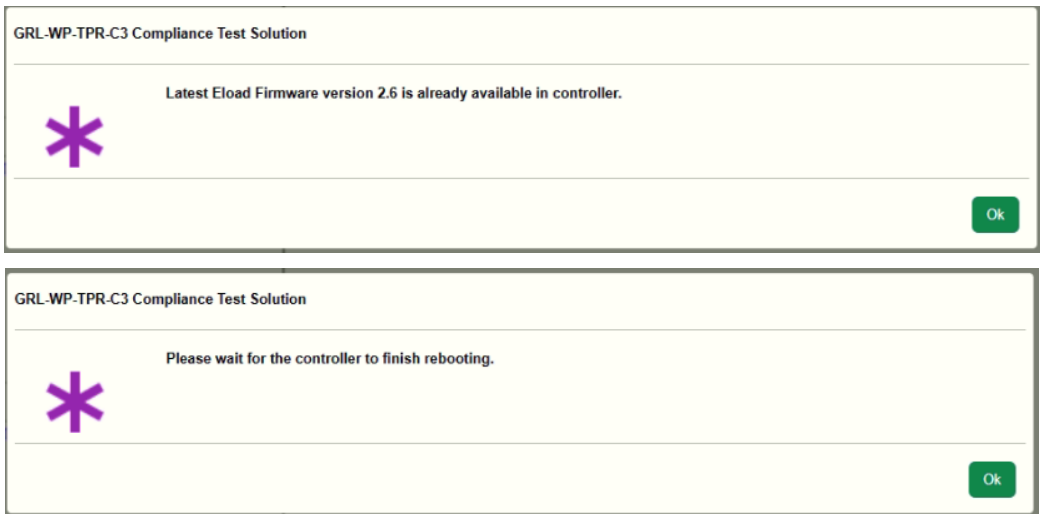


FIGURE 7.6: UPDATE GRL-C3 E-LOAD FIRMWARE

5. After the GRL-C3 tester hardware has rebooted, click on the Connect button to re-establish connection with the Browser App (Figure 7.7 below).

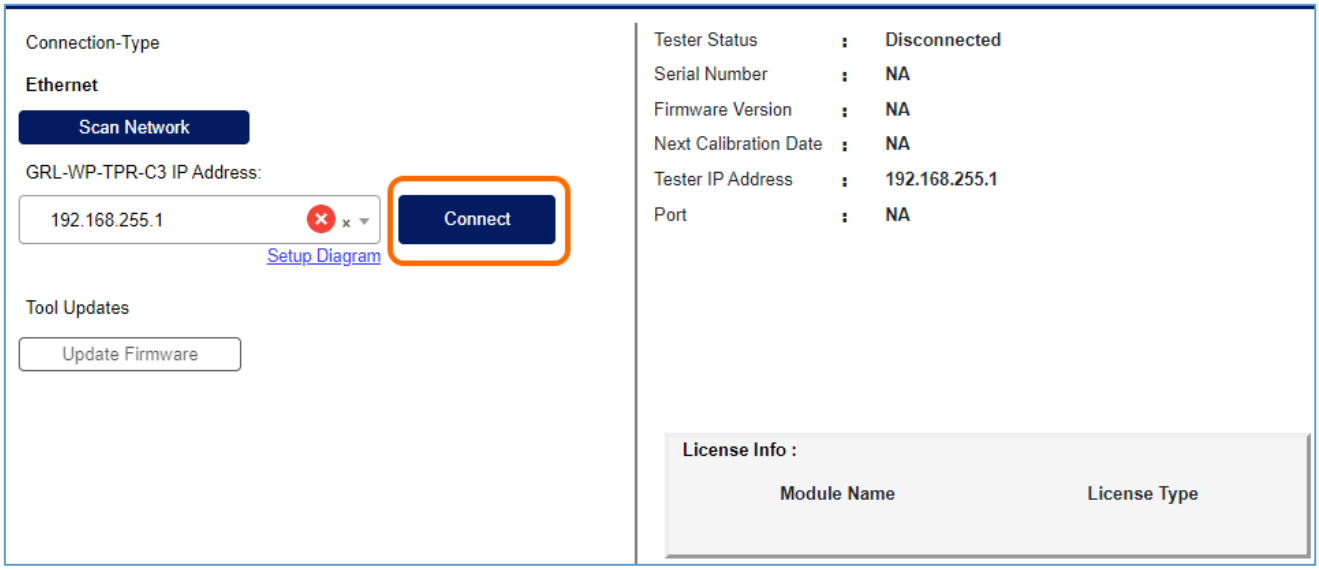


FIGURE 7.7: UPDATE GRL-C3 FIRMWARE– #4

6. The GRL-C3 tester hardware and Browser App should now be connected and ready for use with updated firmware (Figure 7.8 below).

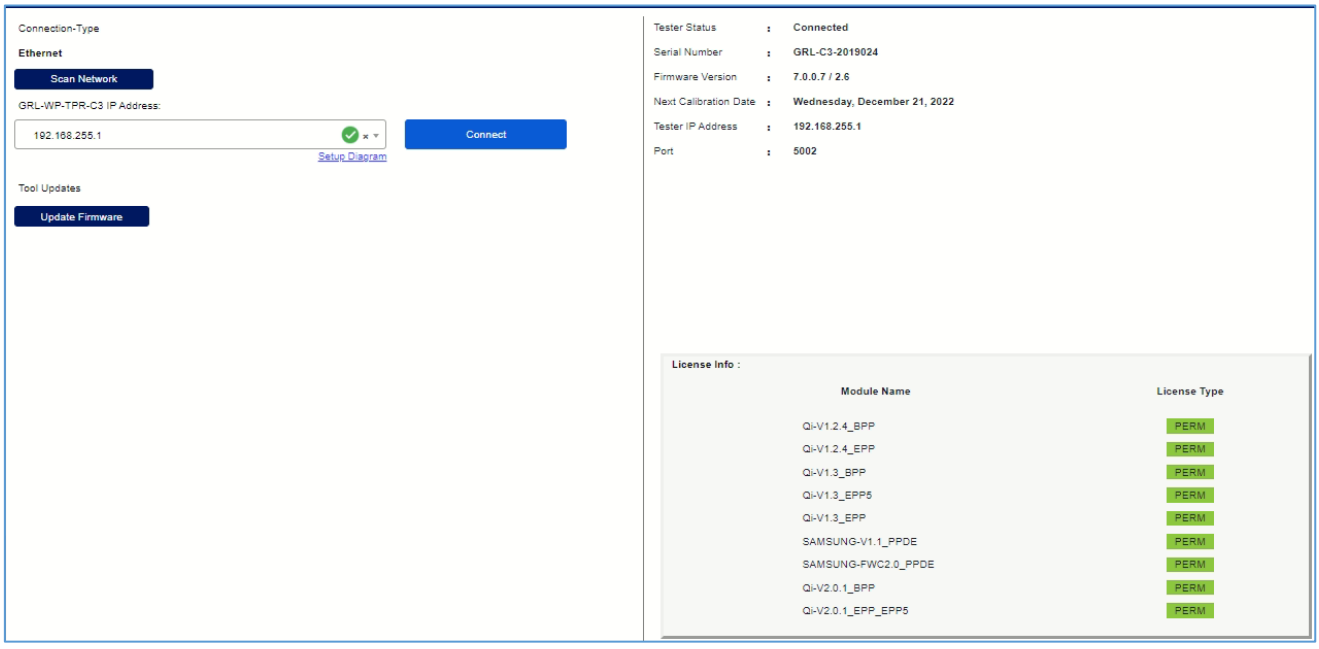


FIGURE 7.8: UPDATE GRL-C3 FIRMWARE– #5

In the event that 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.

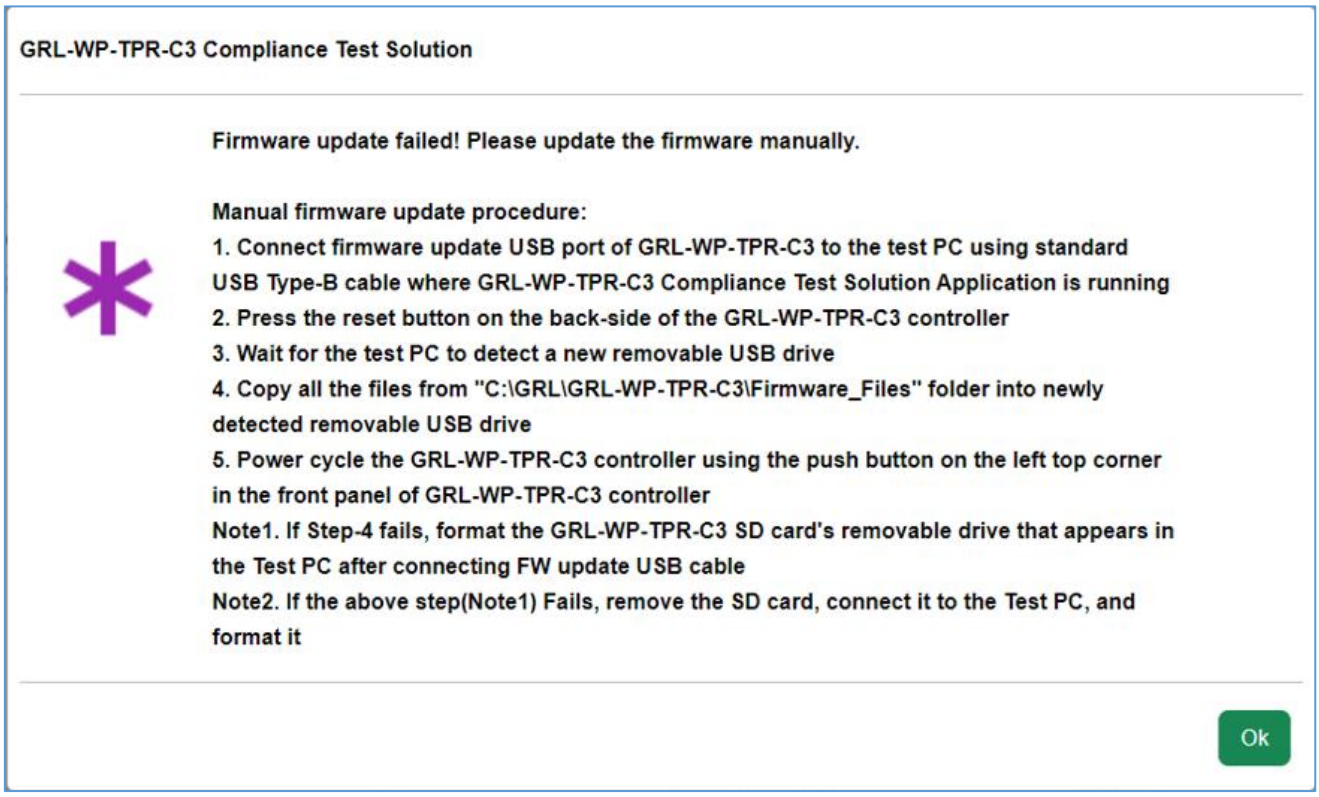


FIGURE 7.9: MANUAL GRL-C3 FIRMWARE UPDATE PROCEDURE

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

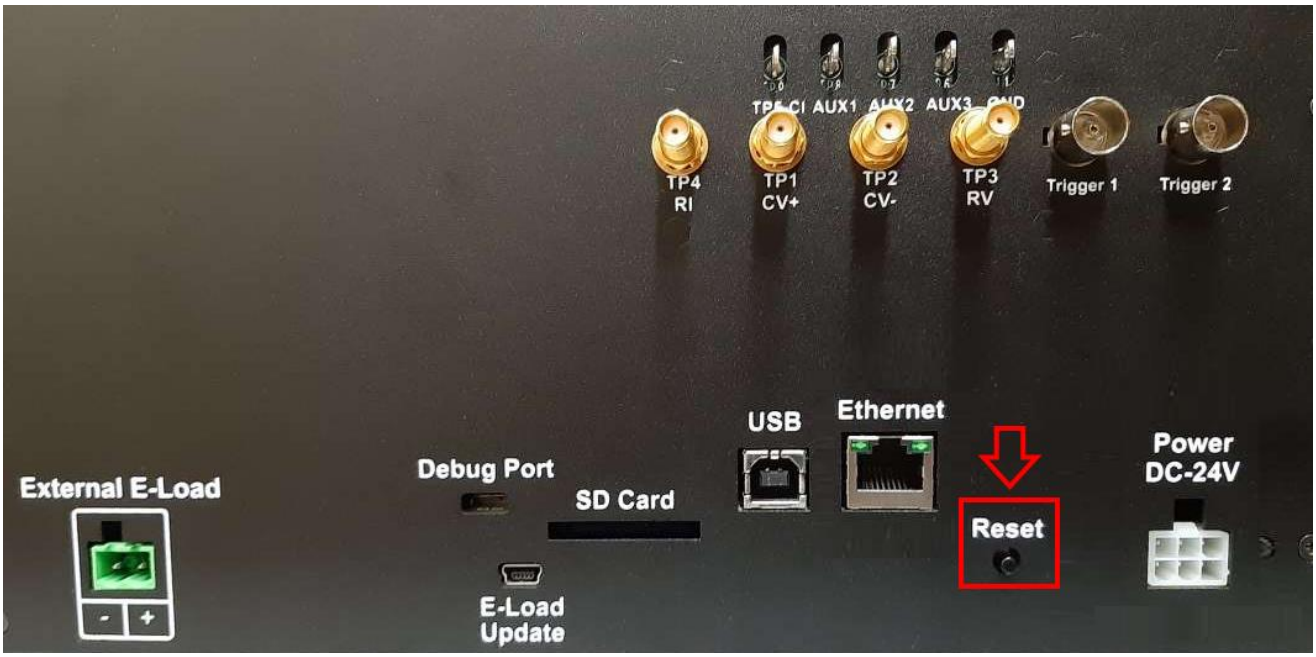


FIGURE 7.10: GRL-C3 RESET BUTTON

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

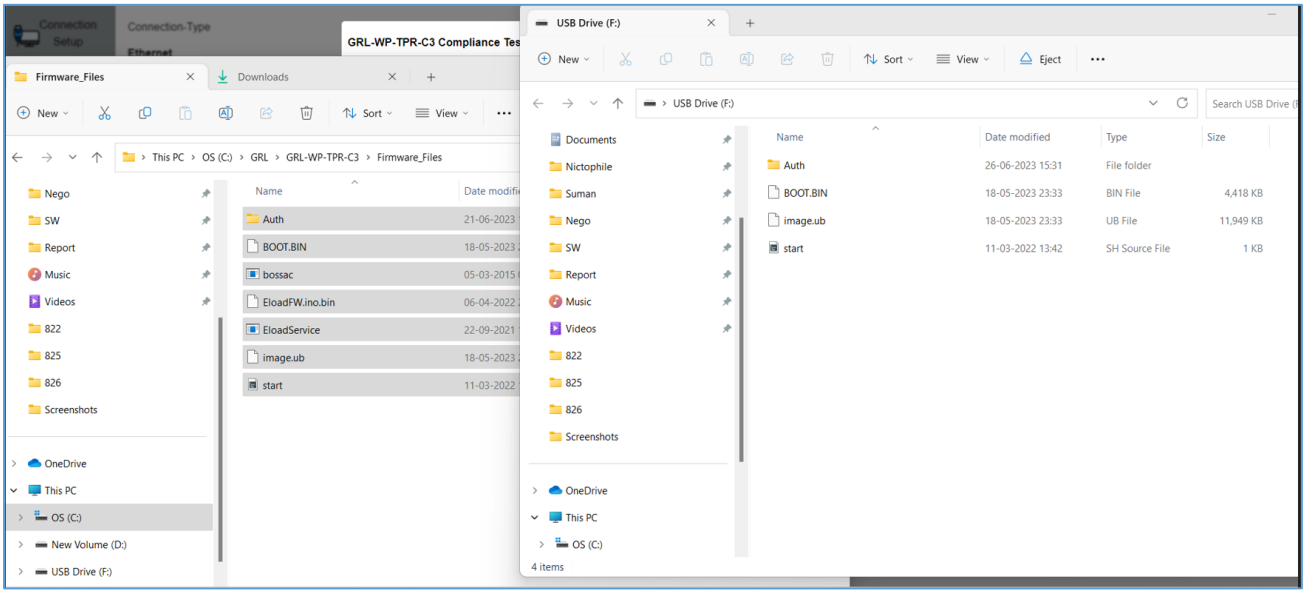


FIGURE 7.11: COPY GRL-C3 FIRMWARE FILES INTO REMOVABLE USB DRIVE

3. When the following pop-message appears, click **Ok** to proceed to the next step.

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

Note 1: If Step-4 fails, format the GRL-C3 SD card's removable drive that appears in the control PC after connecting the firmware update USB cable.

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

8 Compliance Testing with GRL-C3

GRL-C3 supports testing of Qi Base Power Profile (BPP) and Extended Power Profile (EPP) of Qi wireless base stations, for compliance with Qi specification versions 1.2.4 and 1.3 respectively. GRL-C3 also supports compliance testing of proprietary varieties of Qi wireless charging that follows Qi standards. GRL-C3 uses the GRL-C3 Browser App for automated or manual test execution.

GRL-C3 also supports oscilloscope measurements with the Tektronix DPO7000 and PicoScope 6403D oscilloscopes.

Apart from automated testing, the user can also choose to execute tests using custom mode configurations or API's on the GRL-C3.

The various screens presented by the GRL-C3 Browser App allow the user to select, configure, run and generate reports from the tests for a variety of Qi wireless base stations (Devices Under Tests or 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.

8.1 App Mode

The GRL-C3 Browser App allows the user to choose between **CTS** mode and **API** mode for test execution. The CTS mode is applied by default while the user can optionally select the API mode to run tests on the App using a separate GRL API Tool. Use the **Set App Mode** slider at the top right of screen to set the required mode.

FIGURE 8.1: APP MODE SELECTION

If the **API** mode is selected:

The user will be directed to the *Results* screen and all other screens on the GRL-C3 Browser App will not be accessible.

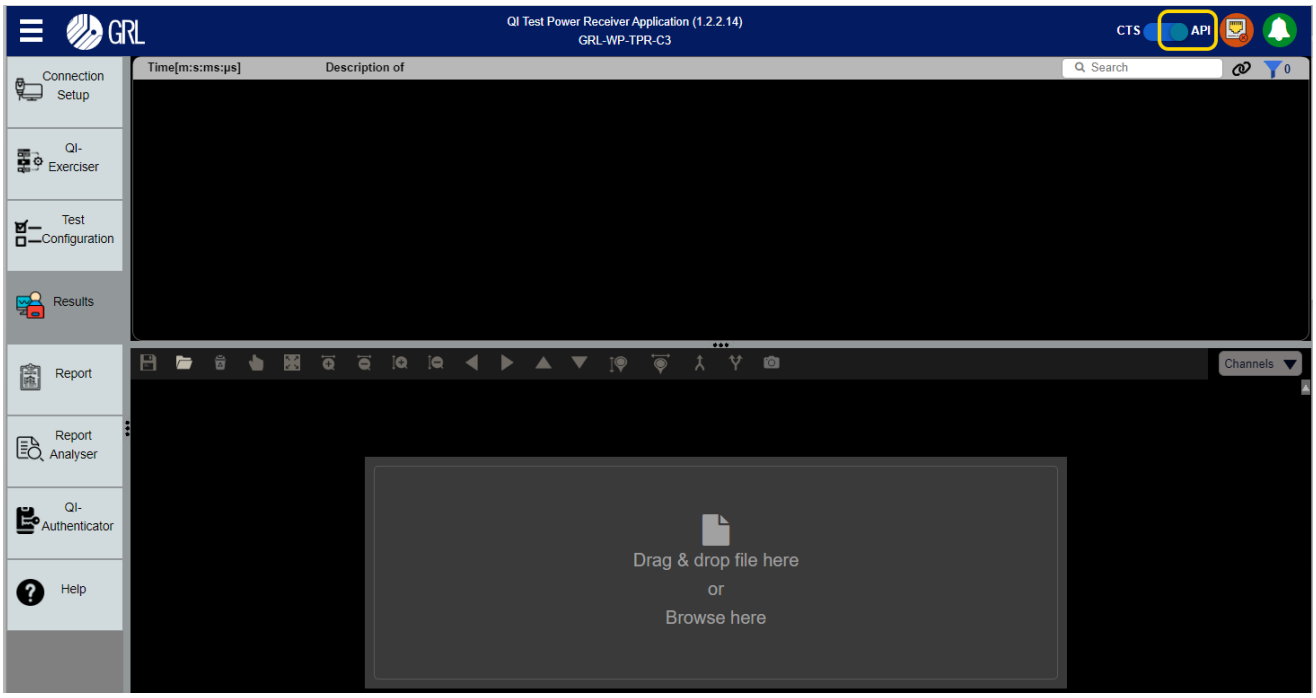


FIGURE 8.2: RESULTS SCREEN IN API MODE

The user can use the GRL API Tool to automate testing for the Qi DUT when in API mode. The API tool will be available in *C:\GRL\GRL-WP-TPR-C3\APILibrary\GRLC3ApiLibTestingTool.exe* once the GRL-C3 Browser App is installed. The user can directly open the **GRLC3ApiLibTestingTool.exe** tool to set up the test environment, perform measurements and acquire test results.

8.1.1 Using GRLC3ApiLibTestingTool in API Mode

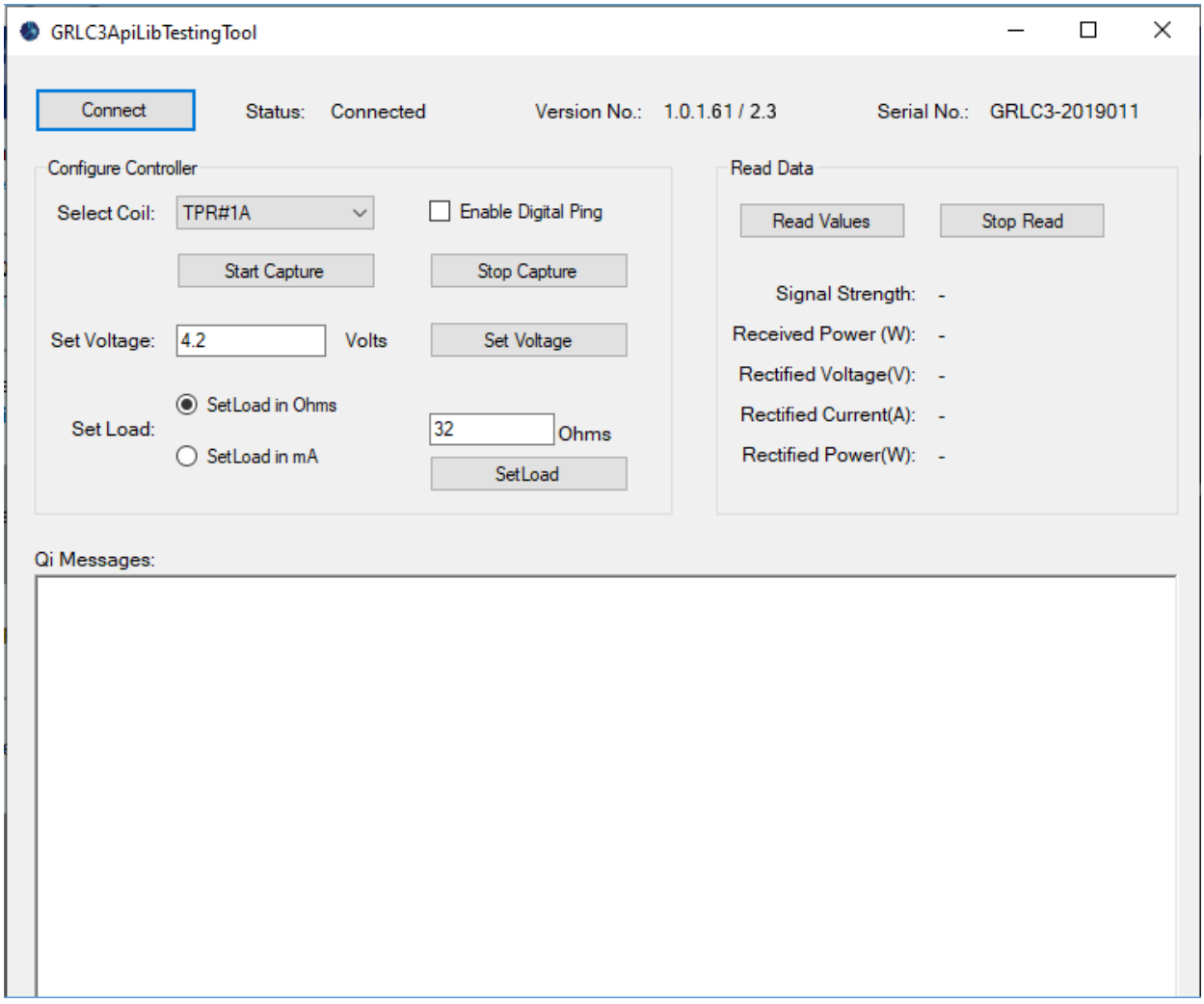


FIGURE 8.3: GRLC3APILIBTESTINGTOOL WINDOW

Click on the **Connect** button to connect the GRLC3ApiLibTestingTool to the GRL-C3 tester hardware. Once connection is established, the tester information ("Status", "Version No." and "Serial No.") will be displayed.

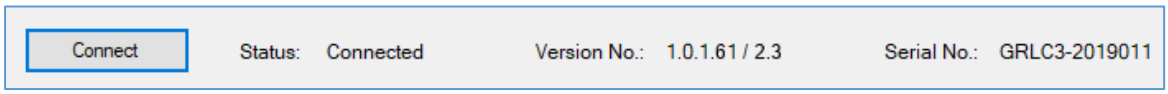


FIGURE 8.4: CONNECT GRLC3APILIBTESTINGTOOL WITH GRL-C3

8.1.1.1 Configure Controller

The Configure Controller panel allows the user to set up and run tests using the GRL-C3 tester hardware.

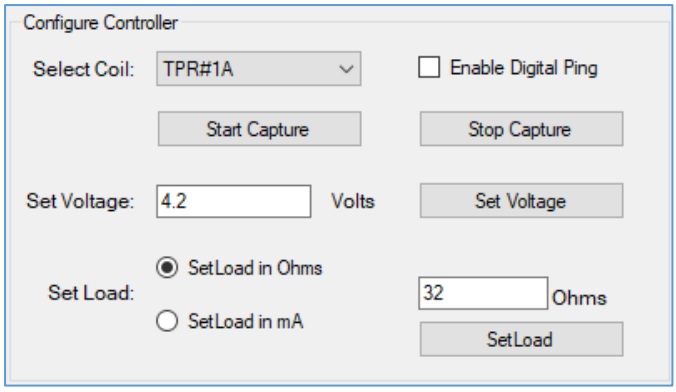


FIGURE 8.5: GRLC3APILIBTESTINGTOOL– CONFIGURE CONTROLLER

- **Select Coil**: The Select Coil drop down selects the coil assembly type of the reference TPR to be used.
- **Set Voltage**: The Set Voltage field displays the default operating voltage for the TPR coil assembly selected in the Select Coil field. The user can also enter a custom coil voltage value if required. Click on the **Set Voltage** button to apply the configured voltage.
- **Set Load**: Depending on which load condition ("SetLoad in Ohms" or "SetLoad in mA" checkbox) is selected, the Set Load field displays the default load resistance value or default variable load current value respectively for the TPR coil assembly selected in the Select Coil field. The user can also enter a custom load value if required. Click on the **Set Load** button to apply the configured load.
- **Enable Digital Ping**: Select the **Enable Digital Ping** checkbox to enable the DUT to send digital pings to provide information about the optimum positioning of the TPR coil.
- **Start Capture**: Click on the **Start Capture** button to start test execution using the configured voltage and load values. The test run along with signal trace acquisition will happen in the *Results* screen as shown in the example below:

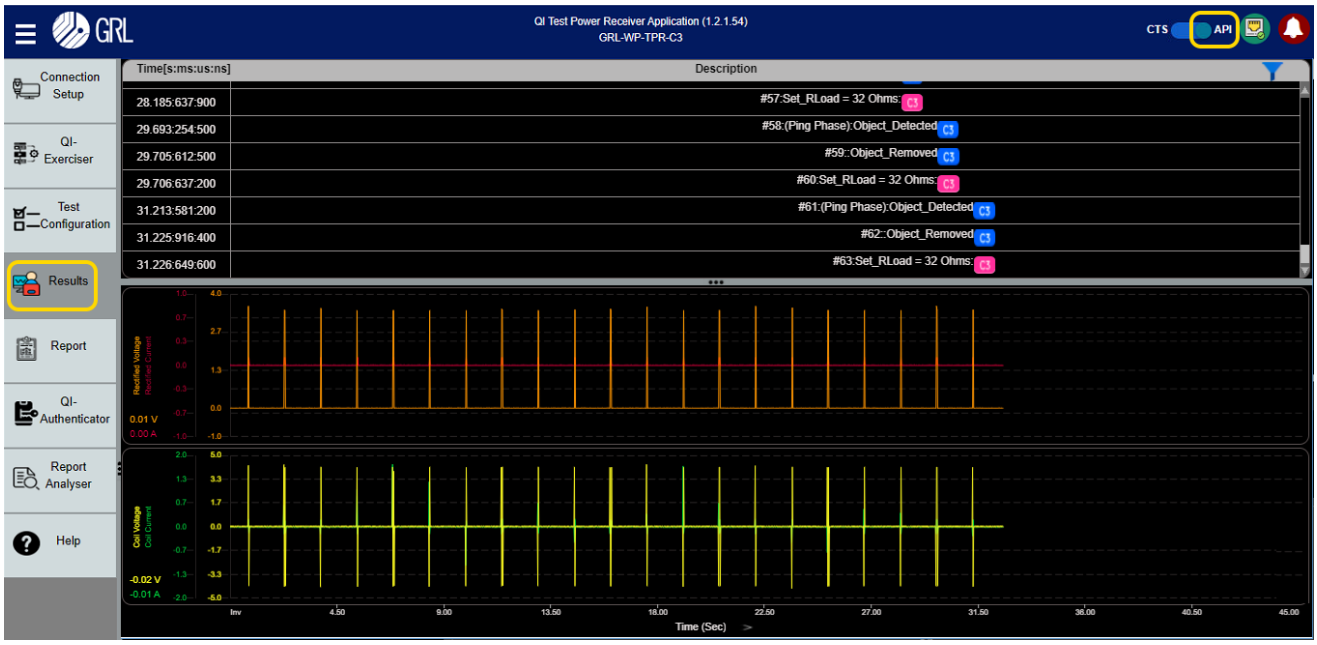


FIGURE 8.6: GRLC3APILIBTESTINGTOOL– TEST EXECUTION EXAMPLE

To terminate the test run, click on the **Stop Capture** button.

Details of the test run will be logged in the **Qi messages** panel as shown in the example below:

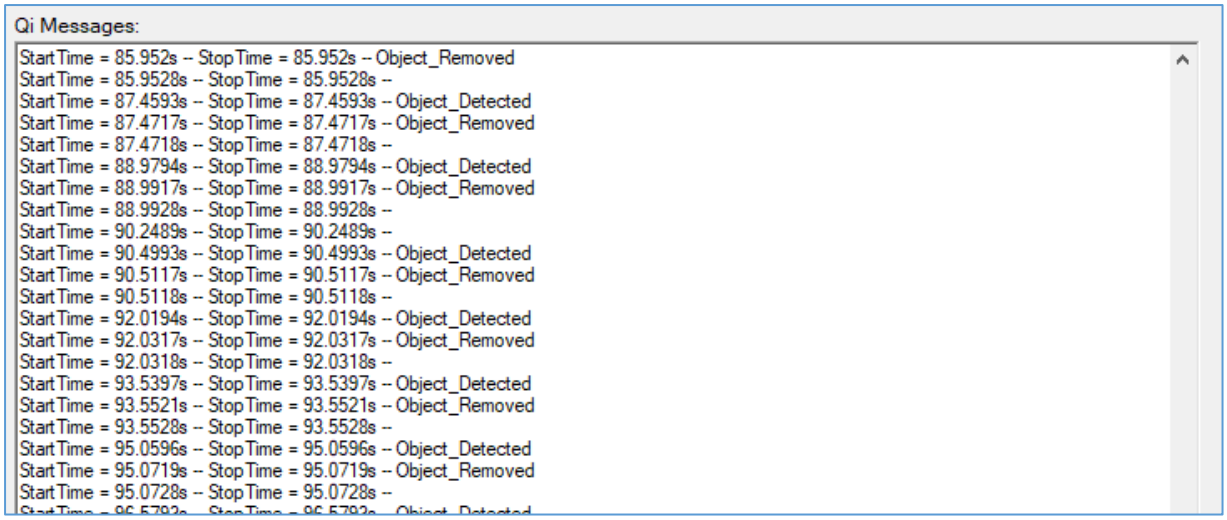


FIGURE 8.7: GRLC3APILIBTESTINGTOOL– TEST EXECUTION QI MESSAGES EXAMPLE

8.1.1.2 Read Data

The Read Data panel allows the user to acquire measurement readings in runtime (while tests are running) by clicking on the **Read Values** button. To stop the data acquisition, click on the **Stop Read** button.

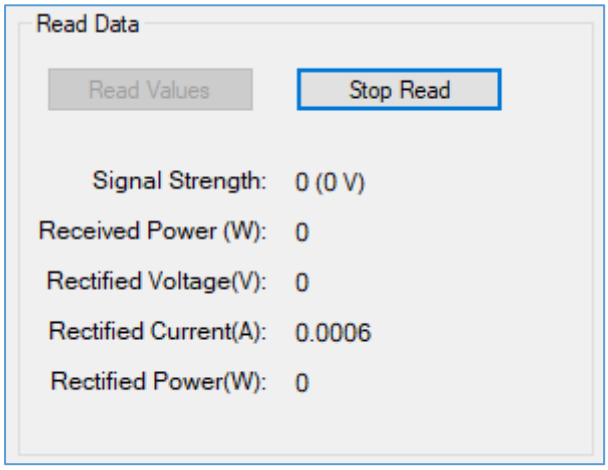


FIGURE 8.8: GRLC3APILIBTESTINGTOOL– READ DATA

8.1.2 Develop Custom Test Cases Via GRL-WP-QI-C3 API Programming

The user can choose to create custom test cases to meet more customized test requirements using a defined list of GRL-WP-QI-C3 API commands. Custom test cases can be written in either C# or Python platform as an independent standalone application. These test cases call the API's defined in GrlC3ApiLib.dll along with all the support functions and helper classes from *C:\GRL\GRL-WP-TPR-C3\APILibrary*. For details, refer to the **GRL-WP-QI-C3 API Documentation** by selecting the **API Guide** shortcut in *C:\GRL\GRL-WP-TPR-C3\APILibrary*.

8.2 Qi-Exerciser

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

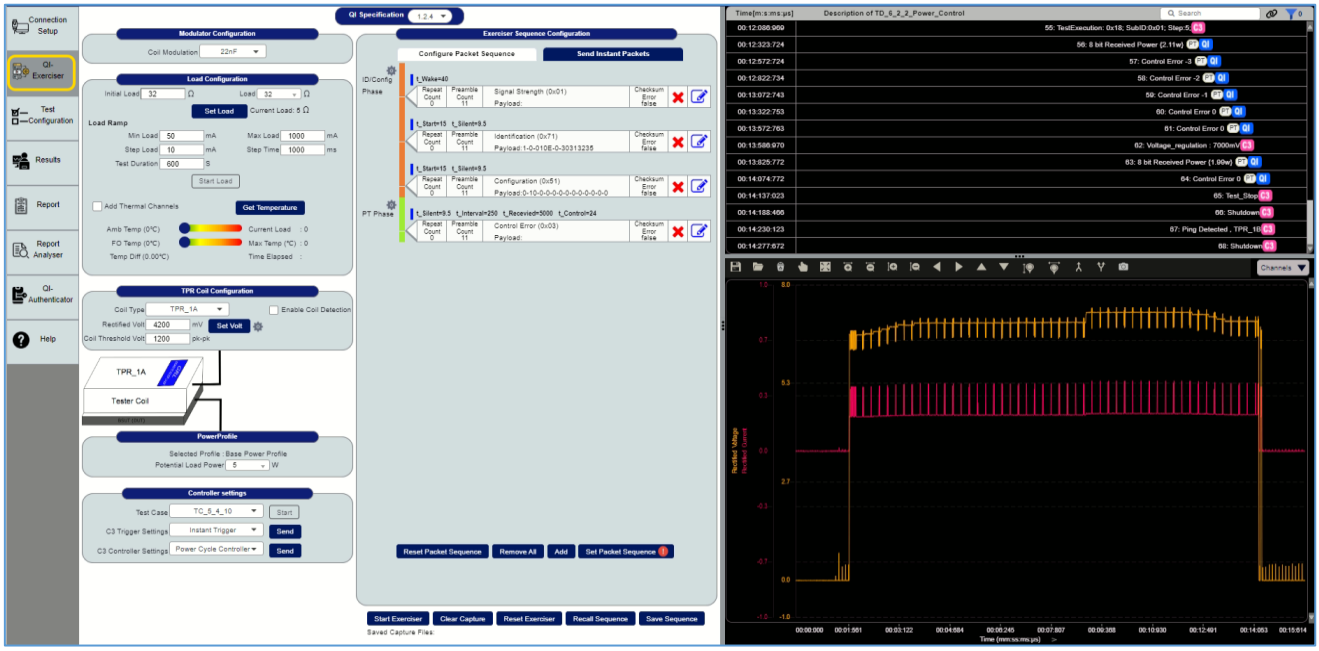


FIGURE 8.9: QI-EXERCISER SCREEN

8.2.1 Set Qi Specification

The Qi-Exerciser allows the user to choose the following Qi specification versions– **1.2.4**, **1.3**, **1.3.3**, **2.0.1** and **Technology Development** for configuration and test execution. Use the **Qi Specification** drop-down menu at the top of screen to set and apply the required spec version.

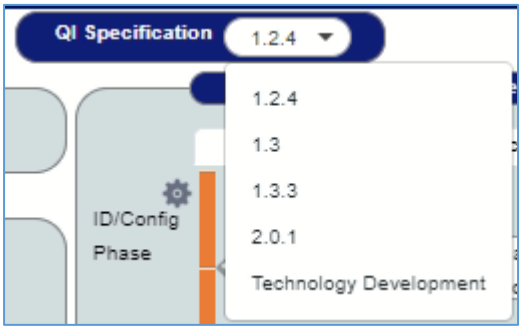


FIGURE 8.10: QI SPECIFICATION SELECTION

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

8.2.2 Configure GRL-C3 Tester Hardware

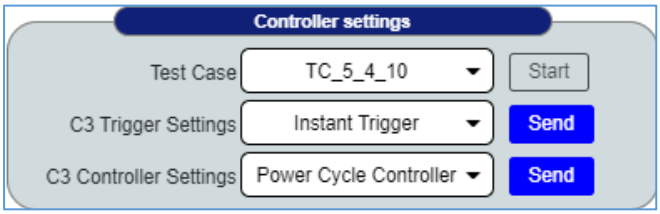


FIGURE 8.11: CONFIGURE GRL-C3

- **Test Case**: The Test Case drop down selects and applies the required MOI test case to be run on the GRL-C3 tester hardware.

  To execute the selected test case, the user FIRST needs to click on the **Start Exerciser** button (below the Qi Exerciser screen; see Section 8.2.8) and then followed by the **Start** button. Details of the test run will be displayed in the Results screen.
- **C3 Trigger Settings**: The C3 Trigger Settings drop down selects the trigger type for the GRL-C3 tester hardware by clicking on the **Send** button.
- **C3 Controller Settings**: The C3 Controller Settings drop down selects to power cycle or perform a reset on the GRL-C3 tester hardware by clicking on the **Send** button.

8.2.3 Set Up DUT Power Transmitter Capability

FIGURE 8.12: SELECT DUT POWER PROFILE

The **DUT Power Profile** panel displays the Baseline Power Profile (BPP) (up to 5W) or the Extended Power Profile (EPP) (up to 15W) as supported by the Base Station under test (BSUT) / DUT. Note: The displayed power profile will follow the TPR coil assembly type selected in the Coil Type field (see Section 8.2.4 below).

- **Potential Load Power**: The Potential Load Power drop down displays the default maximum power supported by the DUT for the TPR coil assembly selected in the Coil Type field (see Section 8.2.4 below). The user can also select an available power value from the drop-down list if required.

8.2.4 Select and Set Up Reference Test Power Receiver (TPR) Coil

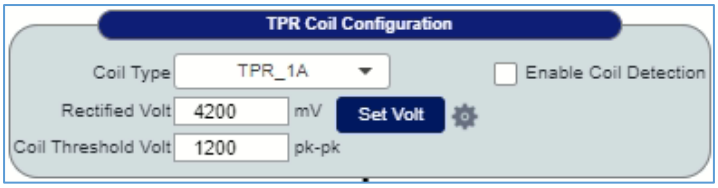


FIGURE 8.13: CONFIGURE TPR COIL

- **Coil Type**: The Coil Type drop down selects the coil type of the reference TPR to be used.
- **Enable Coil Detection**: The Enable Coil Detection check box when selected allows the TPR coil to be detected during testing.
- **Rectified Volt**: The Rectified Volt field displays the default operating voltage for the TPR coil selected in the Coil Type field. The user can also enter a custom coil voltage value if required.
- **Set Volt**: The Set Volt button when clicked applies the configured voltage for testing. If required, the user can select to configure additional parameters as follows:

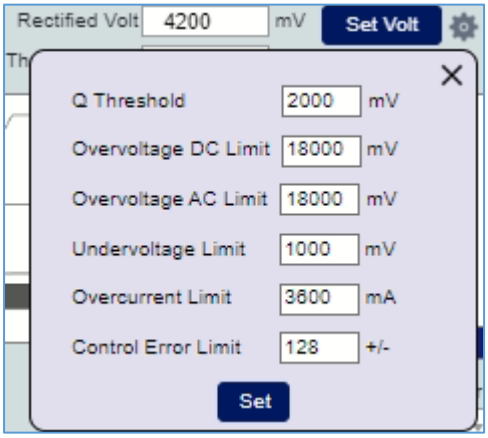


FIGURE 8.14: CONFIGURE ADDITIONAL PARAMETERS

Click on the **Set** button to apply the above configuration for testing.

- **Coil Threshold Volt**: The Coil Threshold Volt field sets the coil voltage limit for the selected TPR coil.

8.2.5 Set Up Load Condition in Load Circuit

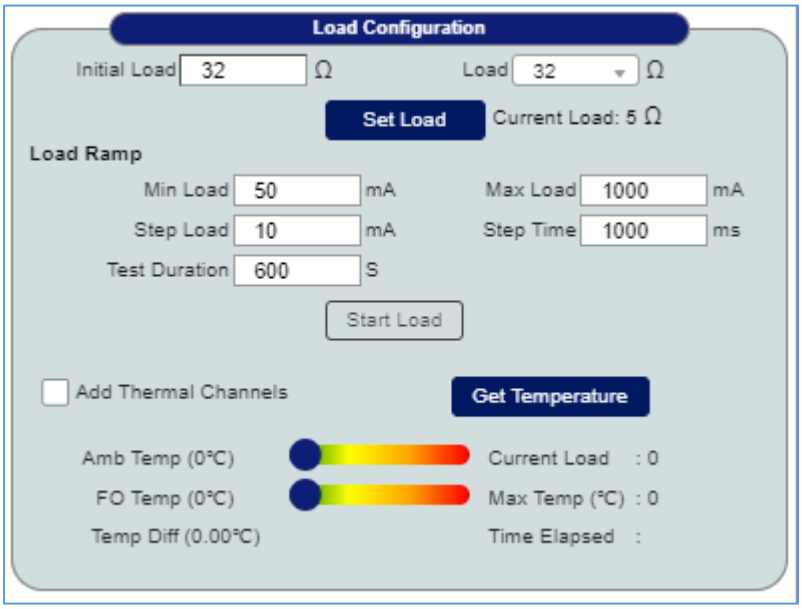


FIGURE 8.15: CONFIGURE LOAD CONDITION

- **Initial Load**: The Initial Load field displays the default initial load resistance value for the TPR coil assembly selected in the Coil Type field under the TPR Coil Configuration panel. The user can also enter a custom initial load value if required.
- **Load**: The Load field displays the default load (with external load added) resistance value to be applied for the TPR coil assembly selected in the Coil Type field under the TPR Coil Configuration panel. The user can also enter a custom load value if required.
- **Set Load**: The Set Load button when clicked applies the configured load while the DUT is in the Power Transfer phase. The user can verify load change of the Guaranteed Power (GP) test using the Set Load function.
- **Min Load & Max Load**: The Min Load and Max Load fields set the range of current values of the variable load used for the Foreign Object Detection (FOD) test.
- **Step Load & Step Time**: The Step Load and Step Time fields set the variable load current step size value and time for stepping across each current over a specified duration during the FOD test.
- **Test Duration**: The Test Duration field sets the time interval in seconds for running the FOD test.
- **Start Load**: *The user FIRST needs to click on the **Start Exerciser** button (below the Qi Exerciser screen; see Section 8.2.8) and then followed by the **Start Load** button* to execute the FOD test for the TPR using the configured load current and step values. Details of the test run will be displayed in the *Results* screen as shown in the below example:

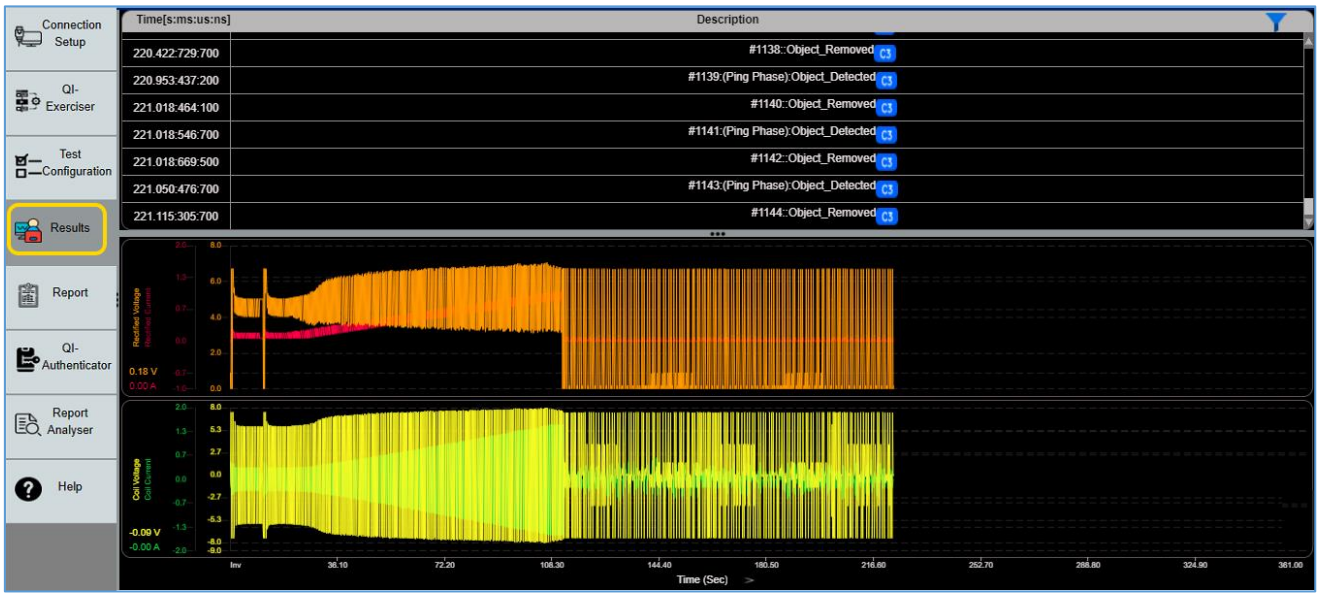


FIGURE 8.16: START LOAD FOD TEST EXECUTION EXAMPLE

To terminate the test run, click on the **Stop Exerciser** button.

- **Add Thermal Channels**: The Add Thermal Channels checkbox when enabled allows you to add heat based channels/devices to the TPR coil assembly.
- **Get Temperature**: The **Get Temperature** checkbox when enabled acquires readings of top-surface temperature of the TPR coil assembly and ambient temperature during the FOD test run.

8.2.6 Set Up Coil Modulation in Modulator Circuit

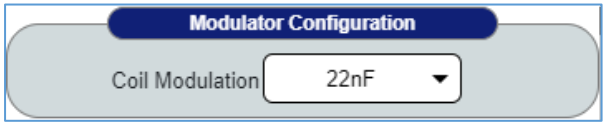


FIGURE 8.17: CONFIGURE COIL MODULATION

The **Coil Modulation** drop down selects the default capacitance value for the capacitive modulator or the default resistance value for the resistive modulator to be applied for the TPR coil assembly selected in the Coil Type field under the TPR Coil Configuration panel. The user can also select a custom value if required.

8.2.7 Set Up Packet Simulation Test Sequence

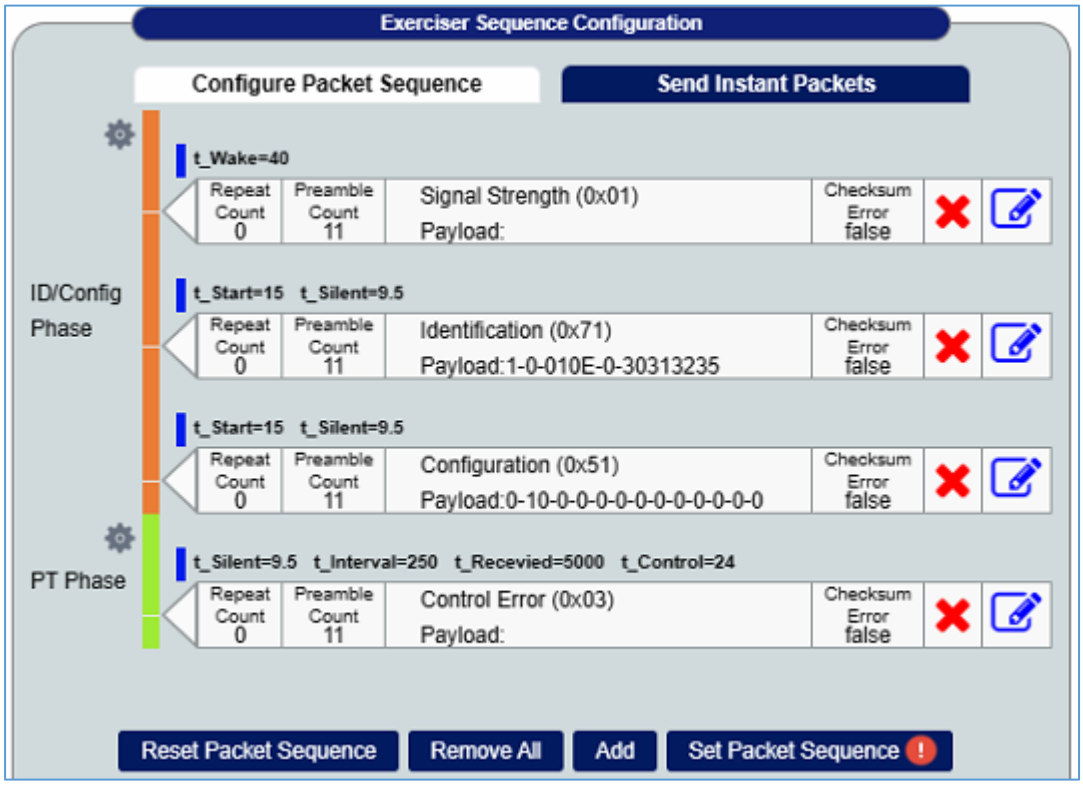


FIGURE 8.18: CONFIGURE PACKET SIMULATION TEST SEQUENCE

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.

8.2.7.1 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:

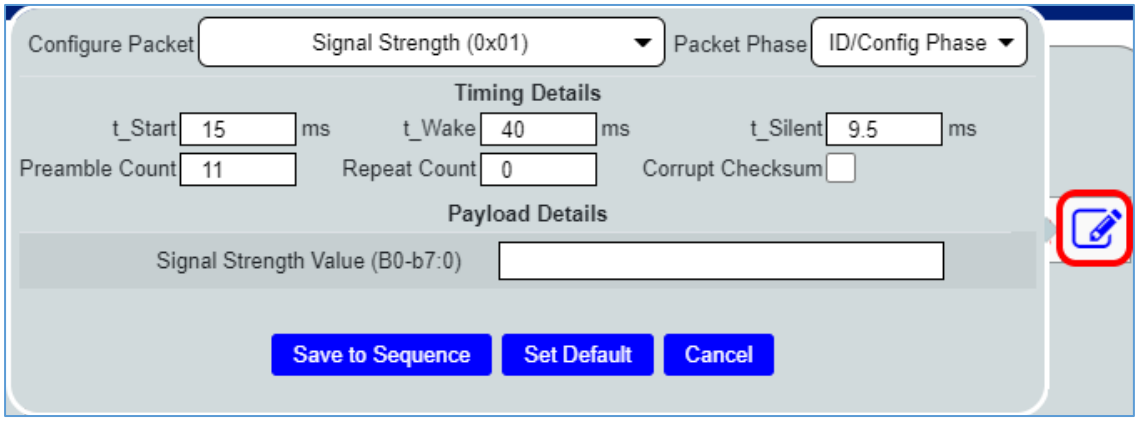


FIGURE 8.19: CONFIGURE PACKET INFORMATION

- **Configure Packet**: The Configure Packet drop down selects the Packet type to be applied.
- **Packet Phase**: The Packet Phase drop down selects the default Phase type of either ID/Config, Power Tx, Negotiation or Calibration 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.
    a) If the **ID/Config Phase** is selected, the following settings are available:
        - **t_Start (ms)**: The t_Start field sets the time that elapses between Packets.
        - **t_Wake (ms)**: The t_Wake field sets the time period after the DUT has initiated the Digital Ping when the GRL-C3 tester hardware needs to initiate the first Packet.
        - **t_Silent (ms)**: The t_Silent field sets the silent time that elapses between the transmission of Packets.
        - **Preamble Count**: The Preamble Count field sets the number of preamble bits of the selected Packet.
        - **Repeat Count**: The Repeat Count field sets the number of times the selected Packet has to be sent.
        - **Corrupt Checksum**: The Corrupt Checksum checkbox when selected enables all bits of the selected Packet checksum to be inverted to obtain an incorrect value.
    b) If the **PT Phase** (Power Transfer Phase) is selected, the following settings are available:
        - **t_Interval (ms)**: The t_Interval field sets the time interval between two consecutive Control Error Packets.
        - **t_Received (ms)**: The t_Received field sets the time interval between two consecutive Received Power Packets.
        - **t_Control (ms)**: The t_Control field sets the time interval between two consecutive Control Error Packets.
        - **t_Silent (ms)**: The t_Silent field sets the silent time that elapses between the transmission of Packets.
        - **t_Charge (ms)**: The t_Charge field sets the time interval between two consecutive Charge Status Packets.

- **Preamble Count**: The Preamble Count field sets the number of preamble bits of the selected Packet.
- **Repeat Count**: The Repeat Count field sets the number of times the selected Packet has to be sent.
- **Corrupt Checksum**: The Corrupt Checksum checkbox when selected enables all bits of the selected Packet checksum to be inverted to obtain an incorrect value.
- **Enable Reserved Bits**: The Enable Reserved Bits checkbox when selected enables all Reserved bits of the selected Packet to be set.
- **Send packet every # ms after 1st**: This checkbox when selected enables the Packet to be sent at every specified time interval and after the start of the first selected Packet type.
- **Insert packet after RP-CE**: This checkbox when selected enables the selected Packet to be inserted after each Received Power Packet and Control Error Packet.

c) If the **Negotiation Phase** is selected, the following settings are available:

- **t_Start (ms)**: The t_Start field sets the time that elapses between Packets.
- **t_Silent (ms)**: The t_Silent field sets the silent time that elapses between the transmission of Packets.
- **t_Responsetimeout (ms)**: The t_Responsetimeout field sets 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.
- **Preamble Count**: The Preamble Count field sets the number of preamble bits of the selected Packet.
- **Repeat Count**: The Repeat Count field sets the number of times the selected Packet has to be sent.
- **Corrupt Checksum**: The Corrupt Checksum checkbox when selected enables all bits of the selected Packet checksum to be inverted to obtain an incorrect value.
- **disableRetry**: The disableRetry checkbox when selected disables retry for the selected Packet.

d) If the **Calibration Phase** is selected, the following settings are available:

- **t_Interval (ms)**: The t_Interval field sets the time interval between two consecutive Control Error Packets.

- **t_Received (ms)**: The t_Received field sets the time interval between two consecutive Received Power Packets.
- **t_Charge (ms)**: The t_Charge field sets the time interval between two consecutive Charge Status Packets.
- **t_Received_Mode1 (ms)**: The t_Received_Mode1 field sets the time interval between two consecutive Received Power Packets in the light-load calibration value mode.
- **t_Received_Mode2 (ms)**: The t_Received_Mode2 field sets the time interval between two consecutive Received Power Packets in the connected-load calibration value mode.
- **Preamble Count**: The Preamble Count field sets the number of preamble bits of the selected Packet.
- **Repeat Count**: The Repeat Count field sets the number of times the selected Packet has to be sent.
- **Corrupt Checksum**: The Corrupt Checksum checkbox when selected enables all bits of the selected Packet checksum to be inverted to obtain an incorrect 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 

.

8.2.7.2 Additional Packet Settings

Additional configuration can be made to the Packet Sequence by selecting the  icon for the Base Power Profile (BPP) or Extended Power Profile (EPP) DUT as follows:

Note that these additional settings apply specifically for the ID/Config Phase and Power Transfer (PT) Phase (for both the BPP and EPP DUT's) as well as the Negotiation Phase and Calibration Phase (for the EPP DUT only).

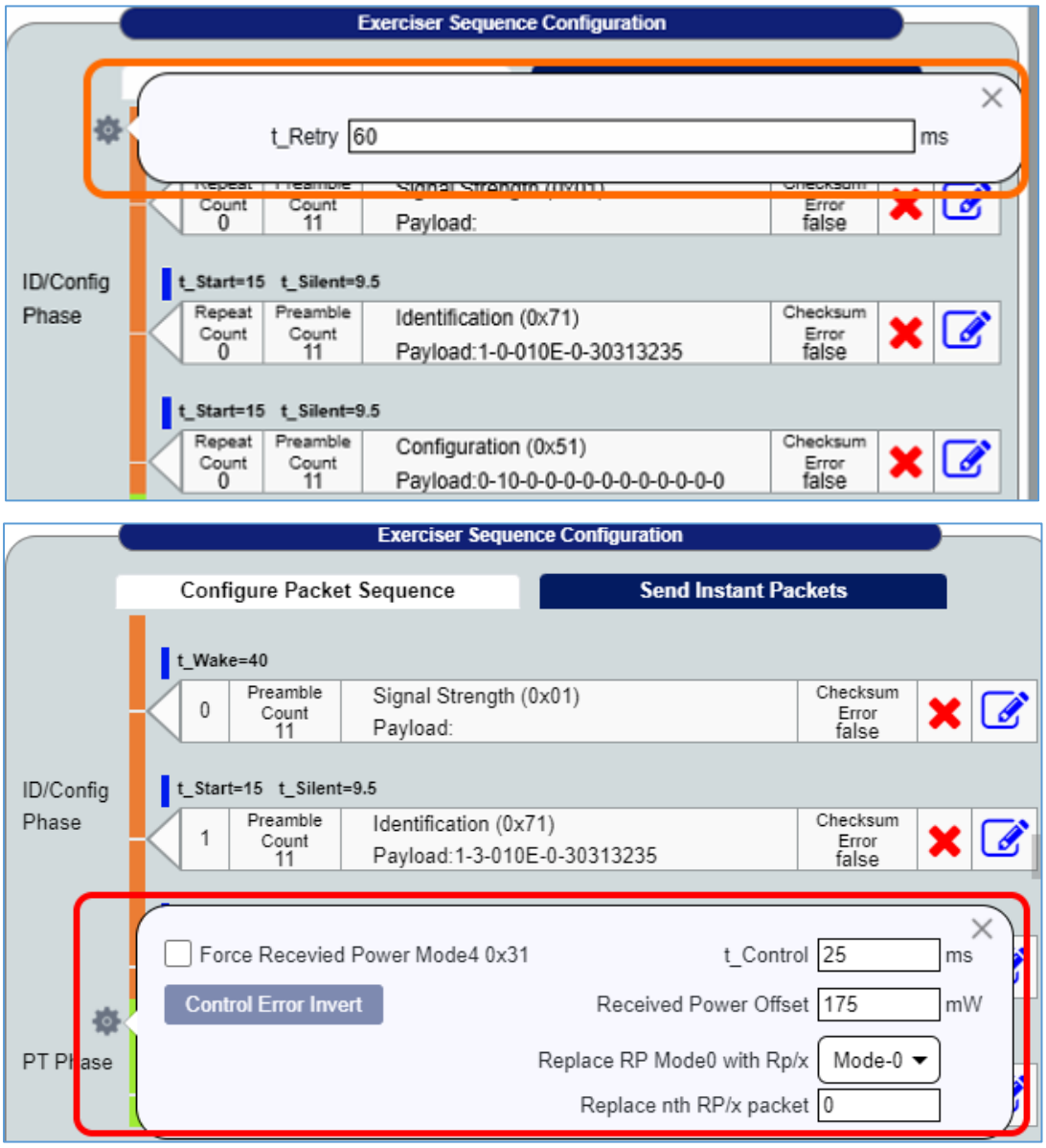


FIGURE 8.20: ADDITIONAL PACKET SETTINGS FOR BPP AND EPP DUT'S (ID/CONFIG PHASE & PT PHASE)

The following additional settings are available for both the **BPP and EPP DUT's**:

- **t_Retry**: The t_Retry field sets the time interval in milliseconds for the TPR to retry the Packet after the end of the last Packet sent.
- **Force Received Power Mode4 0x31**: The Force Received Power Mode4 0x31 checkbox when selected enables the GRL-C3 tester hardware to initiate the TPR to send the Received Power Packets with Mode 4 (instead of the default Mode 0) in the Power Transfer phase for related test cases.
- **Control Error Invert**: The Control Error Invert button when selected inverts the control error value, by enabling the inverter of the power transmitter to be changed to use the

full-bridge topology after receiving the first Control Error Packet. This applies for the case when the power transmitter establishes the Power Transfer Contract at the end of the negotiation phase with a maximum power greater than 5W.

- **t_Control**: The t_Control field sets the time interval between two consecutive Control Error Packets in milliseconds.
- **Received Power Offset**: The Received Power Offset field sets the TPR to use a Received Power Offset value in mW.
- **Replace RP Mode0 with Rp/x**: The Replace RP Mode0 with Rp/x drop down selects the Mode for the Received Power Packets to be sent by the TPR in the Power Transfer phase (instead of the default Mode 0).
- **Replace nth RP/x packet**: The Replace nth RP/x packet field sets the particular Received Power Packets with current existing Mode to be replaced with the ones using the Mode selected from the “Replace RP Mode0 with Rp/x” drop down.

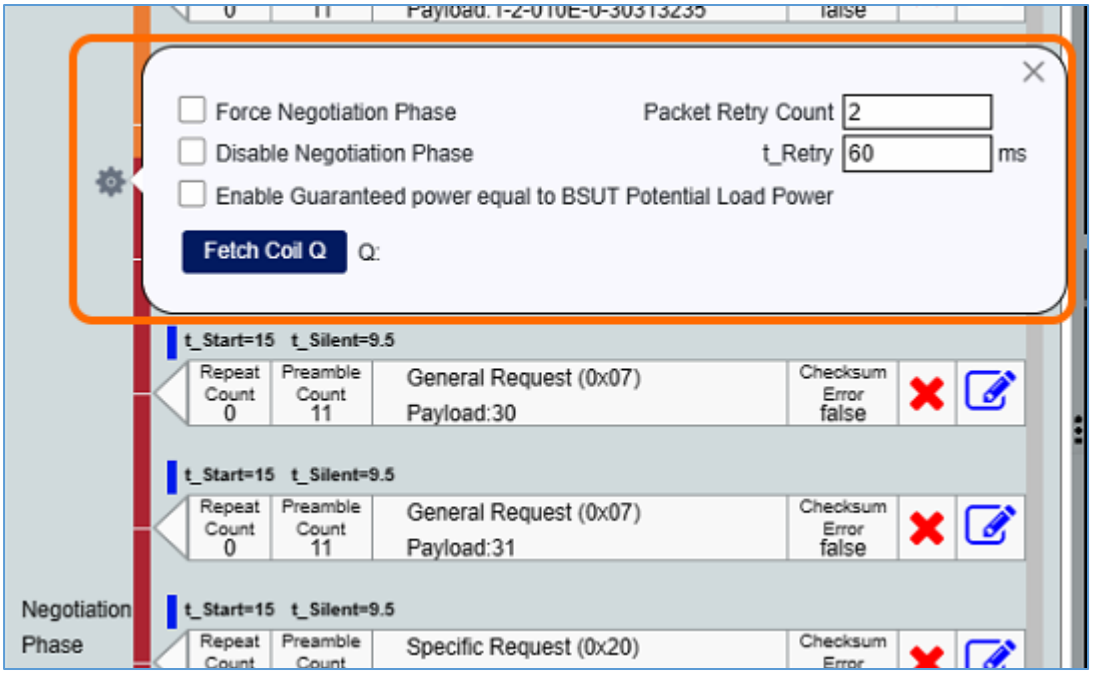


FIGURE 8.21: ADDITIONAL PACKET SETTINGS FOR EPP DUT (NEGOTIATION PHASE)

The following additional settings are available for the **EPP DUT only** for the Negotiation Phase:

- **Force Negotiation Phase**: The Force Negotiation Phase checkbox when selected enables the GRL-C3 tester hardware to initiate the DUT to send its Packets in the Negotiation phase.
- **Disable Negotiation Phase**: The Disable Negotiation Phase checkbox when selected ends Negotiation for the Packets.

- **Enable Guaranteed power equal to BSUT Potential Load Power**: The Enable Guaranteed power equal to BSUT Potential Load Power checkbox when selected sets the content of the Guaranteed Power Value field to be equal to the Potential Power Value field.
- **Packet Retry Count**: The Packet Retry Count field sets the number of times for the TPR to retry the last Packet sent due to communications error in the received Packet.
- **t_Retry**: The t_Retry field sets the time interval in milliseconds for the TPR to retry the Packet after the end of the last Packet sent.
- **Fetch Coil Q**: The Fetch Coil Q button when clicked calculates and displays the Reference Quality Factor value of the reference TPR coil. The Reference Quality Factor value will be applied in the Extended Power Profile tests.

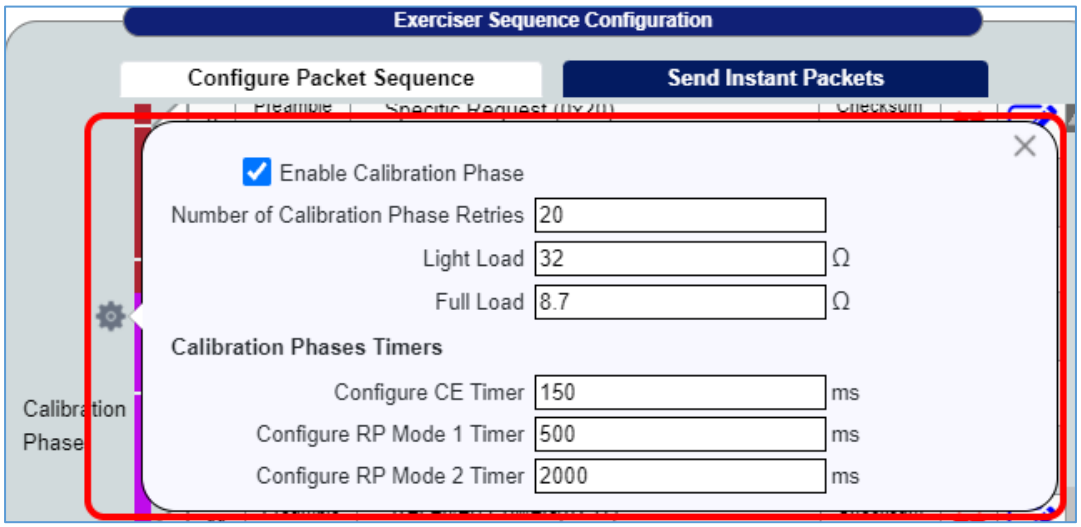


FIGURE 8.22: ADDITIONAL PACKET SETTINGS FOR EPP DUT (CALIBRATION PHASE)

The following additional settings are available for the **EPP DUT only** for the Calibration Phase:

- **Enable Calibration Phase**: The Enable Calibration Phase checkbox when selected enables the GRL-C3 tester hardware to execute the Calibration phase for the Packets.
- **Number of Calibration Phase Retries**: The Number of Calibration Phase Retries field sets the number of times to retry the Packet after the end of the last Packet sent.
- **Light Load**: The Light Load field sets the load resistance of the extended Digital Ping as the light load.
- **Full Load**: The Full Load field sets the load resistance of the Guaranteed Power as the full load.
- **Configure CE Timer**: The Configure CE Timer field sets the time interval between two consecutive Control Error Packets in milliseconds.

- **Configure RP Mode 1 Timer**: The Configure RP Mode 1 Timer field sets the time interval between two Received Power Packets that have their Mode fields set to the light-load calibration value in milliseconds.
- **Configure RP Mode 2 Timer**: The Configure RP Mode 1 Timer field sets the time interval between two Received Power Packets that have their Mode fields set to the connected-load calibration value in milliseconds.

8.2.7.3 Manage Packet Simulation Sequence (Configure Packet Sequence)

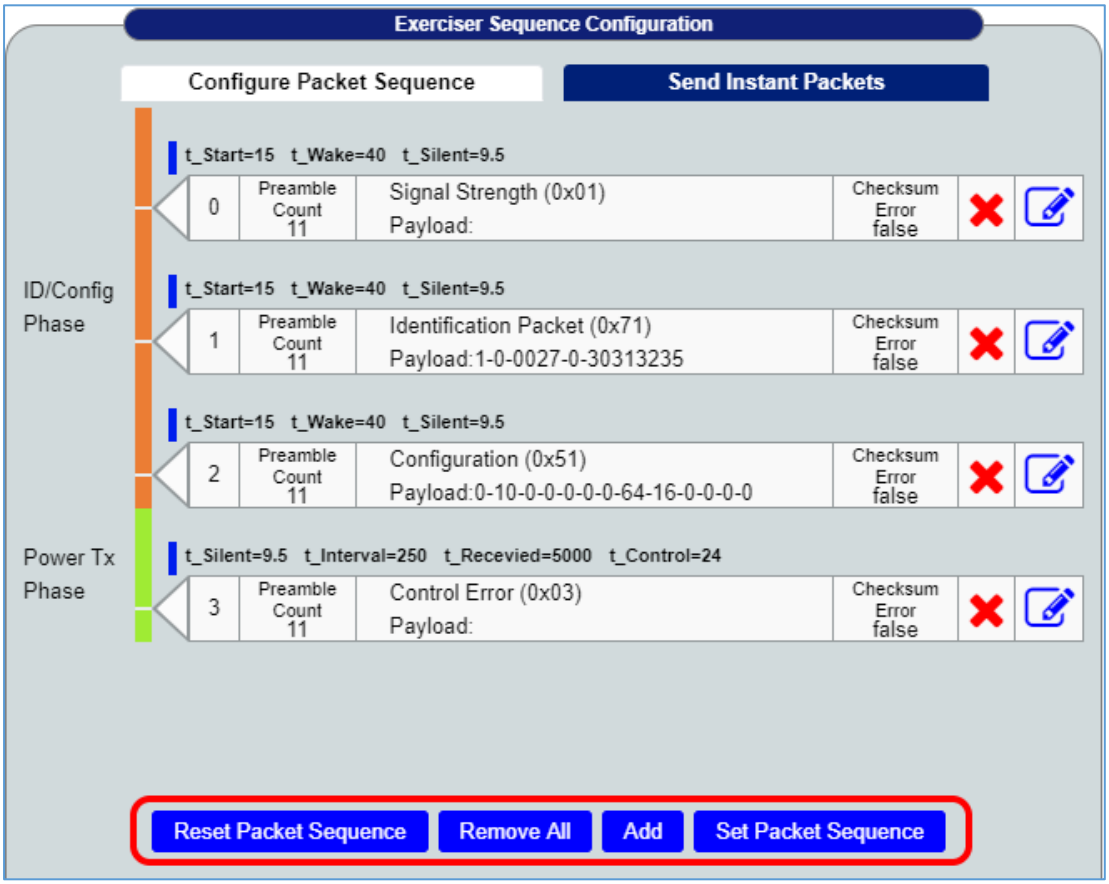


FIGURE 8.23: REMOVE OR ADD PACKETS & RESET OR SET PACKET SEQUENCE

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 8.2.7.1 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.

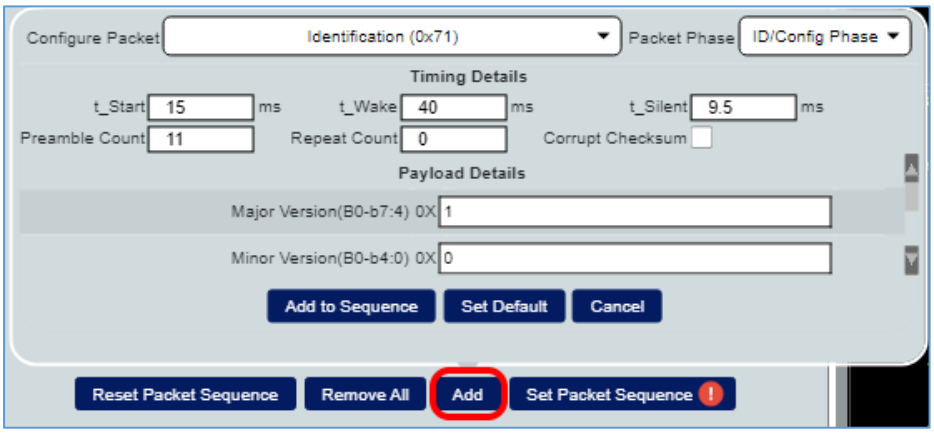


FIGURE 8.24: ADD NEW PHASE & PACKET TO PACKET SEQUENCE

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.

8.2.7.4 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.

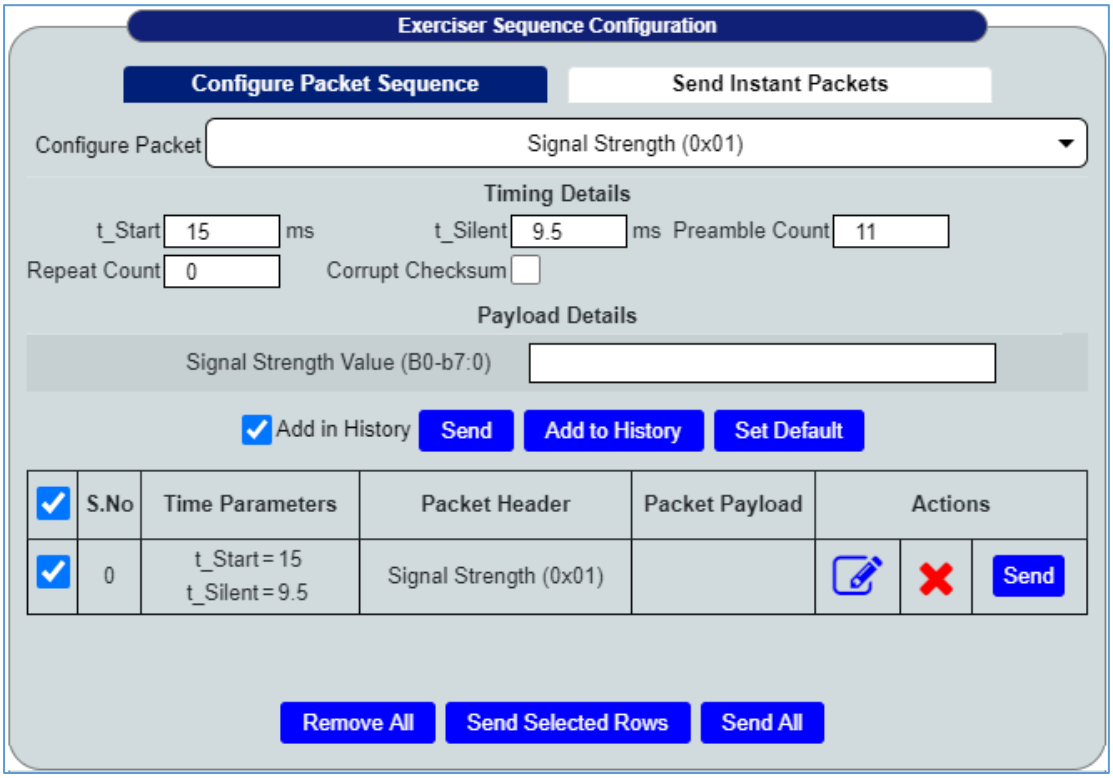


FIGURE 8.25: CONFIGURE AND SEND INSTANT PACKETS

- **Configure Packet**: The Configure Packet drop down selects the Packet type to be applied.
- **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_Start (ms)**: The t_Start field sets the time that elapses between Packets.
  - **t_Silent (ms)**: The t_Silent field sets the silent time that elapses between the transmission of Packets.
  - **Preamble Count**: The Preamble Count field sets the number of preamble bits of the selected Packet.
  - **Repeat Count**: The Repeat Count field sets the number of times the selected Packet has to be sent.
  - **Corrupt Checksum**: The Corrupt Checksum checkbox when selected enables all bits of the selected Packet checksum to be inverted to obtain an incorrect value.
- **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 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.

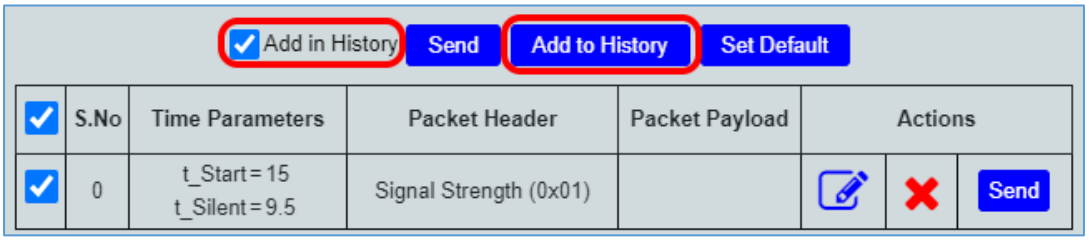


FIGURE 8.26: ADD PACKET TO HISTORY TABLE

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.

8.2.8 Run Packet Simulation Test

FIGURE 8.27: RUN PACKET SIMULATION TEST AND MANAGE CONFIGURATION

- **Start Exerciser**: Click on the **Start Exerciser** button to start test execution/simulation for the configured Packets. The test run details along with signal trace acquisition will be displayed in the Results screen as shown in the example below:

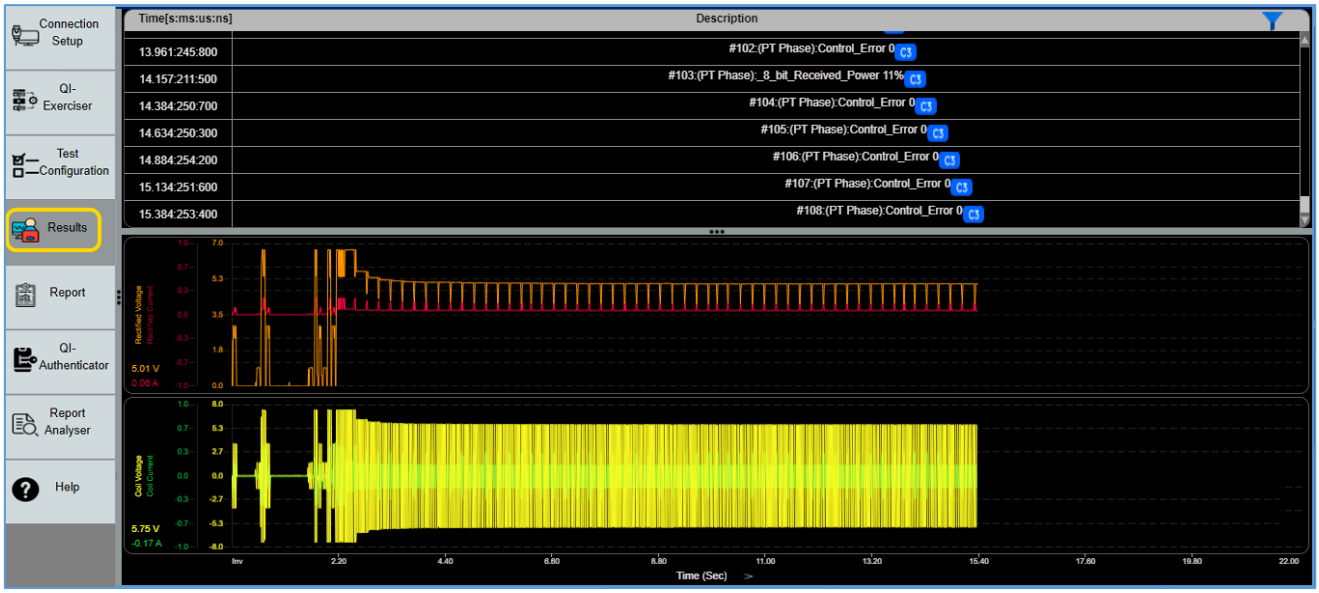


FIGURE 8.28: START EXERCISER PACKET SIMULATION TEST RUN EXAMPLE

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 displayed on the Results screen.
- **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-WP-TPR-C3\Report\" directory. See example below:

FIGURE 8.29: EXAMPLE OF SAVED CONFIGURATION FILE PATH

8.3 Test Configuration

The GRL-C3 Browser App *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.

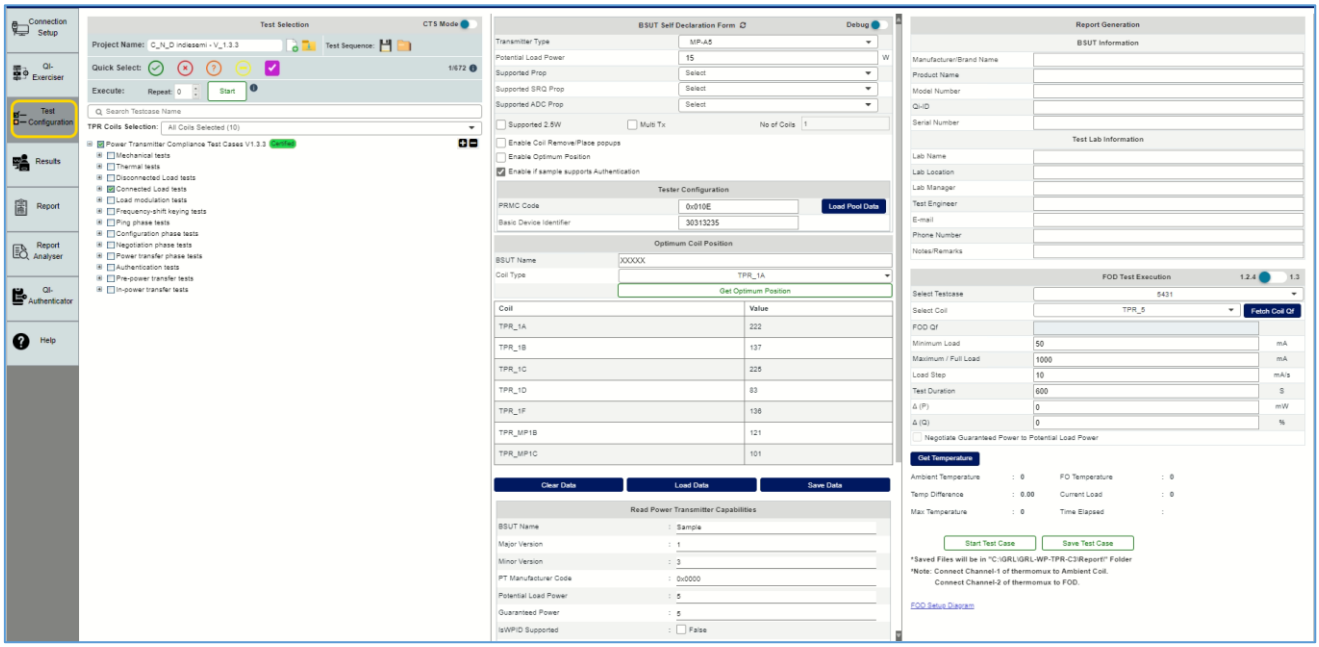
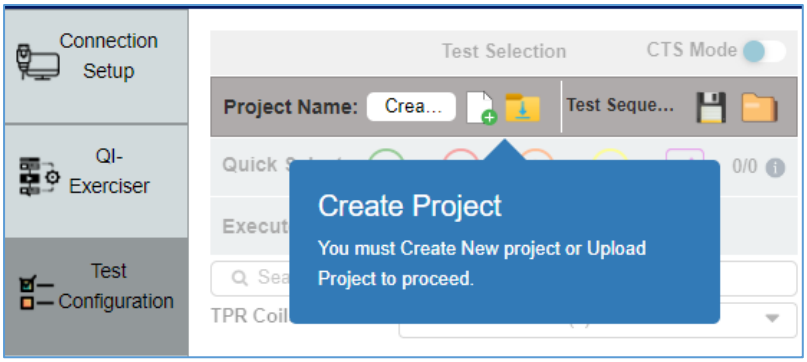


FIGURE 8.30: TEST CONFIGURATION SCREEN

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.



8.3.1 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 8.31 below.

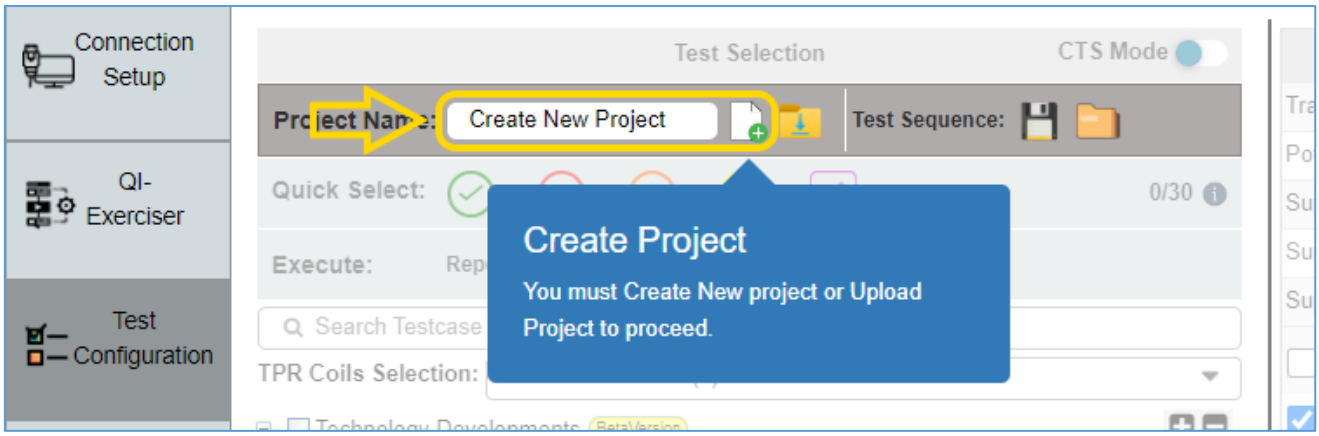


FIGURE 8.31: CREATE NEW PROJECT— #1

2. Enter the **Project Name** (allowed up to 15 letters and special characters) and select the **Certification** standard (as supported by the DUT). Select the **Power Profile** that the DUT supports as the Baseline Power Profile (BPP) (≤ 5 W), Extended Power Profile (EPP5) (≤ 5 W) or the Extended Power Profile (EPP) (≤ 15 W). Then, click on the **Create Project** button.

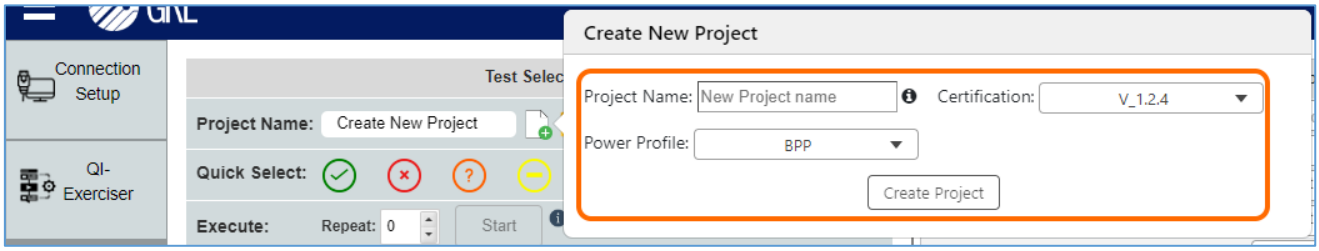


FIGURE 8.32: CREATE NEW PROJECT— #2

3. The new project will be created with the provided project name and selected certification standard as shown in the Figure 8.33 example below. The user can now proceed with the test configuration.

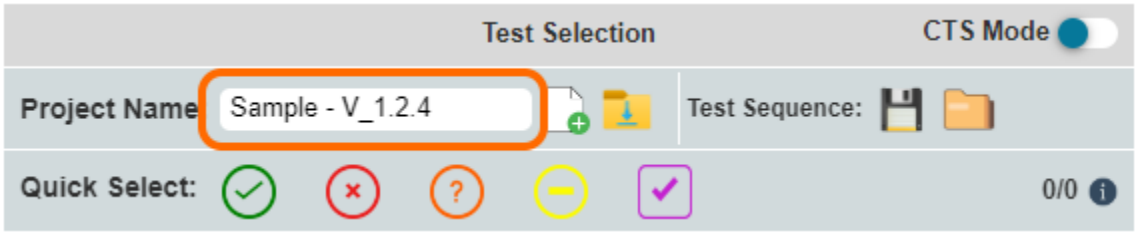


FIGURE 8.33: CREATE NEW PROJECT— #3

8.3.2 Upload Existing Saved Test Project

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

1. Click on the **Upload Project** icon as indicated in Figure 8.34 below.

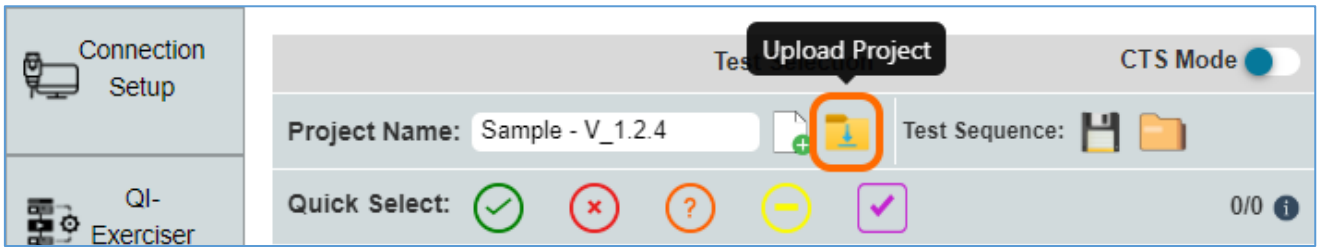


FIGURE 8.34: UPLOAD PROJECT— #1

2. 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 8.35 below.

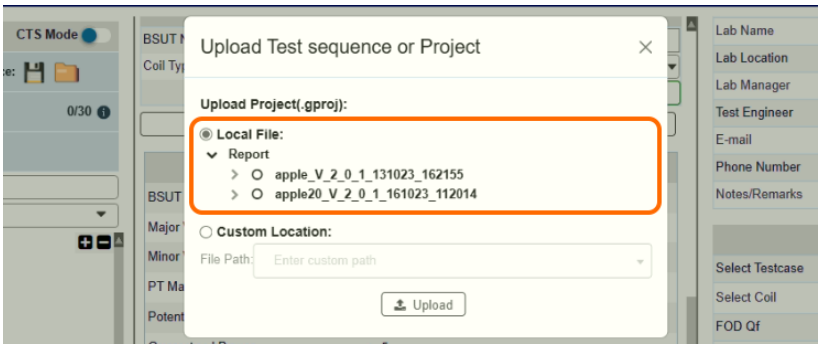


FIGURE 8.35: UPLOAD PROJECT— #2

3. 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-WP-TPR-C3\Report\XYZ_TPR_100823_084915\Run1\ReferenceData**TPR_Run1_TestBackup.gproj***".

*Note: Make sure to provide the project file name (**TPR_Run1_TestBackup.gproj**) in the path.*

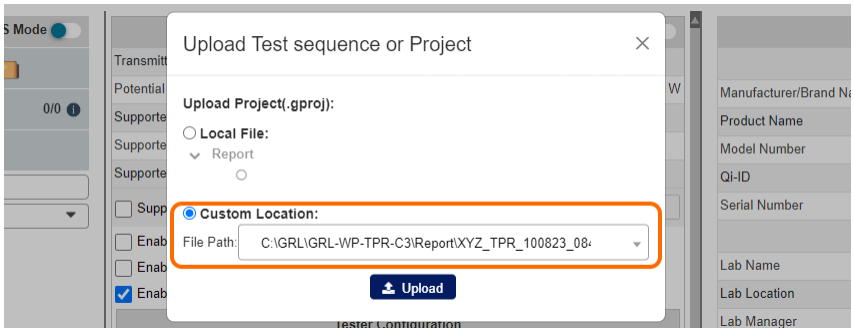


FIGURE 8.36: UPLOAD PROJECT— #3

4. Click on the **Upload** button and the selected project file will be loaded as shown in the Figure 8.37 example below. The user can now proceed to access/configure the project.

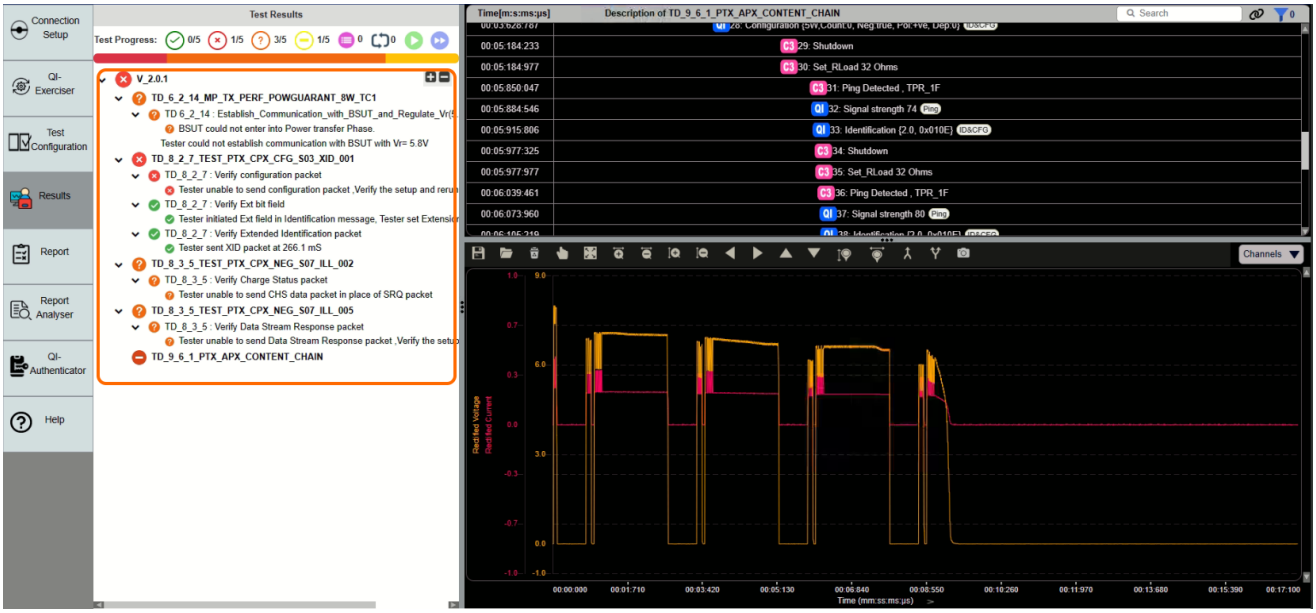


FIGURE 8.37: UPLOAD PROJECT— #4

8.3.3 Test Configuration

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

- BSUT Self Declaration Form
- Tester Configuration
- Read Power Transmitter Capabilities
- Read Certificate

8.3.3.1 BSUT Self Declaration Form

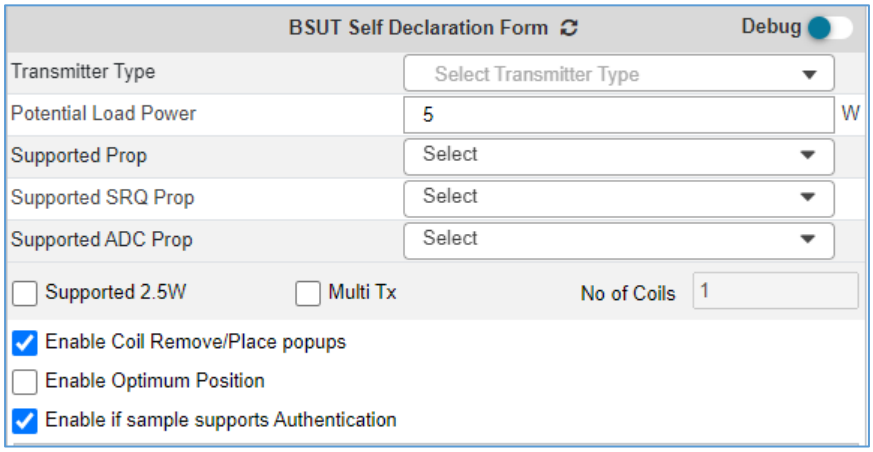


FIGURE 8.38: CONFIGURE BSUT (DUT)

- **Debug**: Toggle the Debug slider to perform debugging for the DUT capabilities.
- **Transmitter Type**: The Transmitter Type drop down selects the type of Power Transmitter of the DUT.
- **Potential Load Power**: The Potential Load Power field sets the maximum power supported by the DUT.
- **Supported Prop**: The Supported Prop drop down selects the Proprietary Packets supported by the DUT.
- **Supported SRQ Prop**: The Supported SRQ Prop drop down selects the SRQ Proprietary Packets supported by the DUT.
- **Supported ADC Prop**: The Supported ADC Prop drop down selects the ADC Proprietary Packets supported by the DUT.
- **Supported 2.5W**: Select the Supported 2.5W checkbox if the DUT supports a 2.5 W USB power supply.
- **Multi Tx**: Select the Multi Tx checkbox if the DUT supports multiple coils.
- **No of Coils**: If the Multi Tx checkbox is selected, specify the number of coils supported by the DUT in the No of Coils field.
- **Enable Coil Remove/Place popups**: Select this checkbox to allow removal of coils or placement of device accessories during testing.
- **Enable Optimum Position**: Select the Enable Optimum Position checkbox to enable the coil to be placed at an optimized position for testing.
- **Enable if sample supports Authentication**: Select this checkbox if the DUT supports the Qi Authentication requirements.

8.3.3.2 Tester Configuration

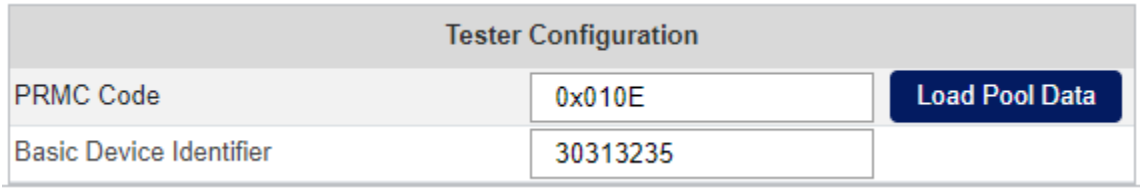


FIGURE 8.39: CONFIGURE TESTER

- **PRMC Code**: The PRMC Code field sets the Power Receiver Manufacturer Code (PRMC) ID of the TPR.
- **Basic Device Identifier**: The Basic Device Identifier field sets the Basic Device Identifier ID of the TPR.
- **Load Pool Data**: This function allows you to use different power receiver manufacturer codes (PRMC's) other than the GRL-C3's own power receiver manufacturer code (PRMC)

in order to obtain expected test results. Click on the Load Pool Data button to load an existing data file and this will enable PRMC codes to be assigned randomly for each test case when running multiple tests.

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

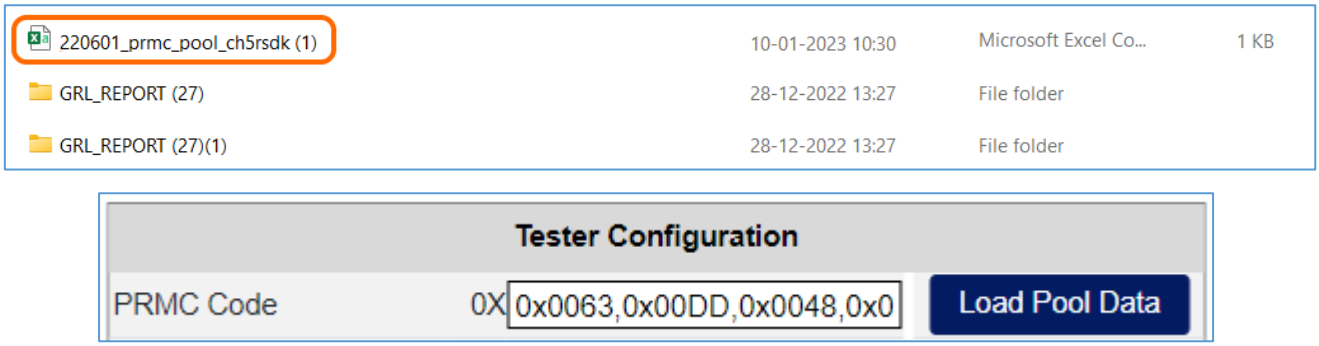


FIGURE 8.40: LOAD PRMC CODE FROM SELECTED POOL DATA FILE

8.3.3.3 Read Power Transmitter Capabilities

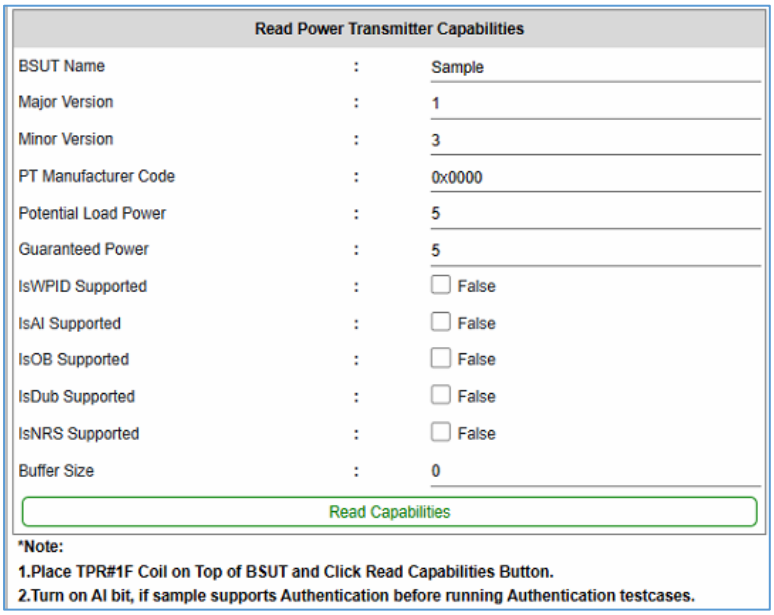


FIGURE 8.41: READ POWER TRANSMITTER CAPABILITIES

- **Read Capabilities**: The Read Capabilities button when clicked reads and displays the capabilities of the DUT. Before clicking on this button, make sure to place the mentioned TPR coil on top of the DUT. Once the capabilities are read, the information from the DUT will be populated in each field above the button.
- **Is WPID / AI / OB / Dub / NRS Supported**: Select these checkboxes if WPID, AI, OB, Dub and/or NRS is supported by the DUT. If the DUT supports Qi Authentication, make sure to turn on the AI bit before running Authentication tests.

8.3.3.4 Read DUT Qi Authentication

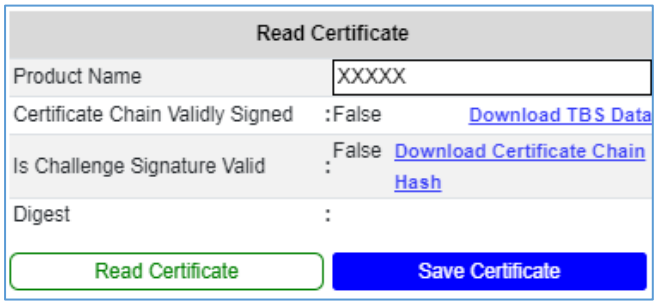


FIGURE 8.42: READ DUT QI AUTHENTICATION

- **Product Name**: Enter the vendor defined name of the DUT in the Product Name field.
- **Read Certificate**: The Read Certificate button when clicked reads and displays the Qi authentication details of the DUT above the button. The user can download certain authentication data by clicking on **Download TBS Data** and **Download Certificate Chain Hash**.
- **Save Certificate**: Click on the Save Certificate button to save the displayed authentication details to a file.

After all the above configuration has completed, additional configuration can be made as follows:

8.3.3.5 Optimum Coil Position

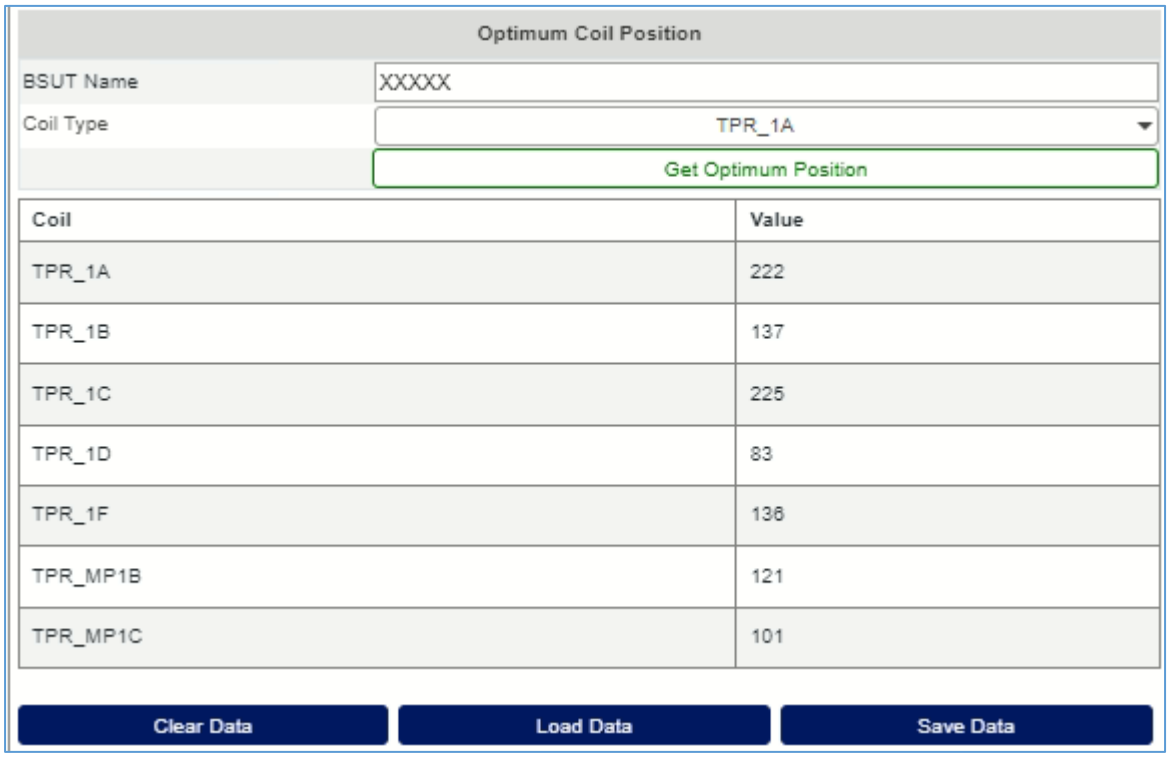


FIGURE 8.43: CONFIGURATION FOR OPTIMUM COIL POSITION

- **BSUT Name**: The BSUT Name field sets the name of the DUT (BSUT) for the coil positioning test.
- **Coil Type**: The Coil Type drop down selects the type of TPR coil assembly to be positioned on the Interface Surface of the DUT such that the DUT can achieve the maximum signal strength value.
- **Get Optimum Position**: Click on the Get Optimum Position button to start the coil positioning test once the TPR coil is placed on the Interface Surface of the DUT. During this process, adjust the coil in various positions on the DUT surface 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 as shown in the example below:

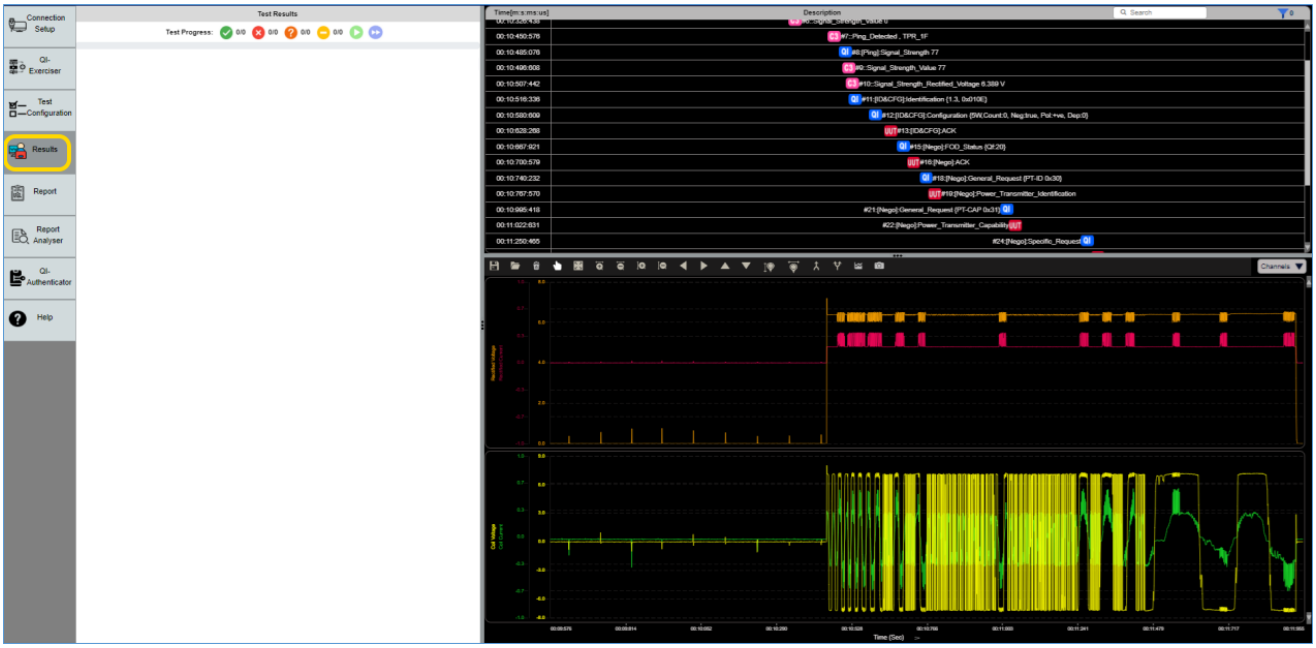


FIGURE 8.44: OPTIMUM COIL POSITION TEST EXECUTION EXAMPLE

- **Clear Data**: Click on the Clear Data button to clear existing test results or details.
- **Load Data**: Click on the Load Data button to load and use data from a saved configuration file.
- **Save Data**: Click on the Save Data button to save the current configuration to a file.

8.3.3.6 FOD Test Execution

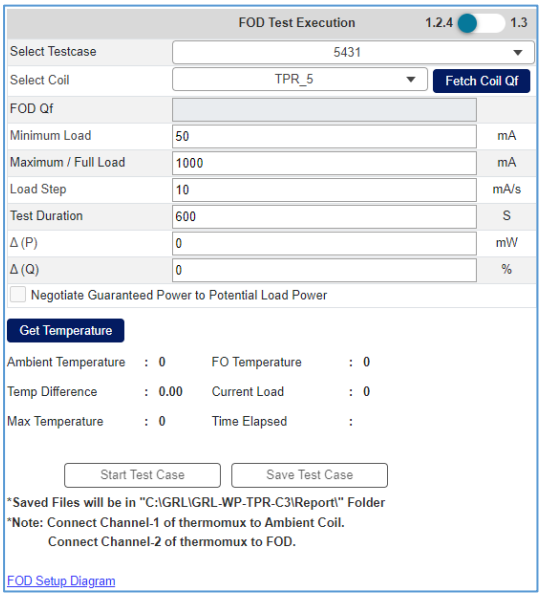


FIGURE 8.45: CONFIGURE MANUAL FOD TEST EXECUTION METHOD

The **FOD Test Execution** panel allows the user to perform manual Foreign Object Detection (FOD) test execution. The FOD test is executed by a Power Transmitter or Power Receiver to detect the presence of a foreign object on the Interface Surface of the DUT. During the FOD test, the lateral distance (offset) between the centers of the representative foreign object and the TPR coil assembly on the Interface Surface of the DUT will be varied.

The user can refer to an example of the FOD test setup by clicking on FOD Setup Diagram at the bottom of the FOD Test Execution panel.

- **Set Qi Specification**: The 

slider allows the user to choose and apply Qi specification version **1.2.4** or **1.3** for FOD configuration and test execution.
- **Select Testcase**: The Select Testcase drop down selects the FOD test to execute based on the Qi specification version selected.
- **Select Coil**: The Select Coil drop down selects the TPR coil assembly type to be used in the test setup.
- **Fetch Coil Qf**: The Fetch Coil Qf button when clicked calculates and displays the Reference Quality Factor value of the reference TPR coil at the **FOD Qf** field. The Reference Quality Factor value will be applied in the Extended Power Profile tests.
- **Fetch Coil Rf** *(for spec V1.3 only)*: The Fetch Coil Rf button when clicked calculates and displays the Resonance Frequency value of the reference TPR coil at the **FOD Rf** field.
- **Minimum Load & Maximum/Full Load**: The Minimum Load and Maximum Load fields set the minimum and maximum (full) load conditions to be used by the selected TPR coil assembly respectively.

- **Load Step**: The Load Step field sets the variable load rate which would be the rate at which load current would continuously increase in the power transfer phase from the minimum load to the maximum load.
- **Test Duration**: The Test Duration field sets the time interval (in seconds) for which the DUT would be in the power transfer phase after initiating power transfer.
- **Resonance Frequency** *(for spec V1.3 only)*: The Resonance Frequency field sets the resonance frequency (in percentage) of the resonant circuit.
- **Δ (P)**: The Δ (P) field sets the Received Power Offset (in milliwatts) to be used by the TPR.
- **Δ (Q)**: The Δ (Q) field sets the Reference Quality Factor offset (in percentage) to be used by the TPR.
- **Negotiate Guaranteed Power to Potential Load Power**: This checkbox when selected enables negotiation of the Guaranteed Power to be equal to the Potential Load Power.
- **Get Temperature**: Click on the Get Temperature button to acquire the temperature of the representative foreign object and ambient temperature.
- **Start Test Case**: Click on the Start Test Case button to start the FOD test execution and stream data on the trace plot in the *Results* screen. If changes are made to the test configuration, e.g., applying load or setting coil voltages, these changes can be viewed in the Results screen.

  An example of the Results screen after clicking on the "Start Test Case" button is as shown below:

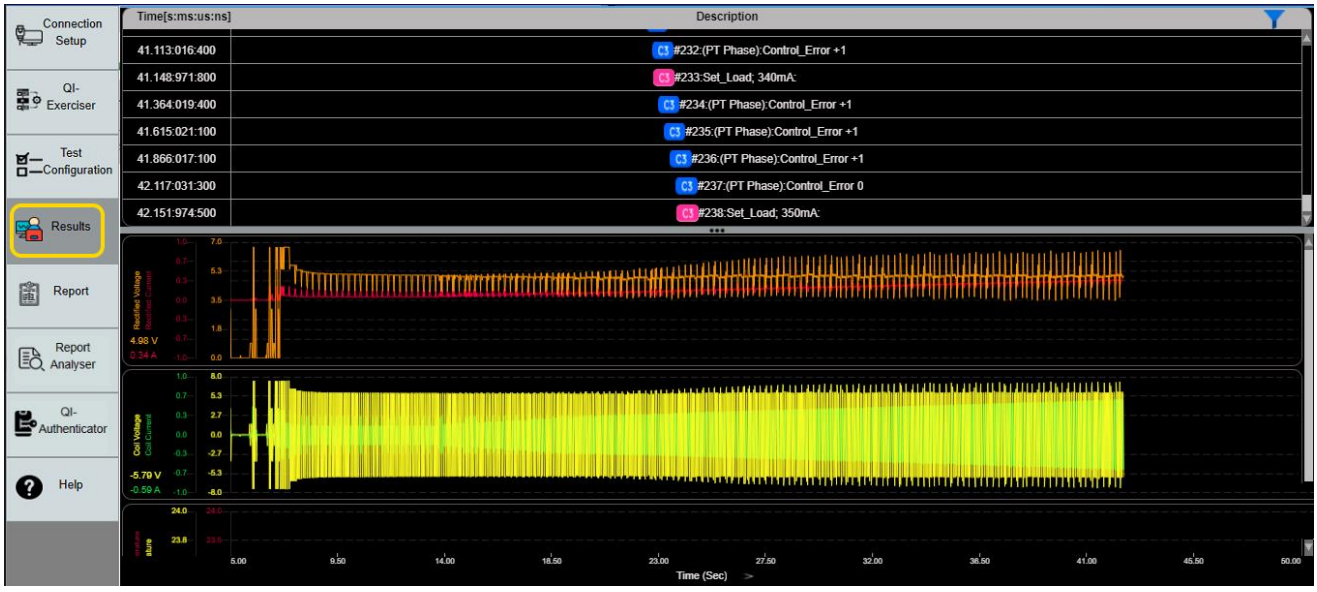


FIGURE 8.46: FOD START TEST CASE RESULTS SCREEN EXAMPLE

To terminate data capture, click on the **Stop Test Case** button.

- **Save Test Case**: Click on the Save Test Case button to save the FOD test data to a file in the "C:\GRL\GRL-WP-TPR-C3\Report\" folder.

8.3.3.7 Thermal Performance Measurement

The PicoScope 8-Channel Temperature Datalogger (or ThermoMux) acts as a thermometer with data logging capability that is used to determine the DUT thermal performance by measuring the top-surface temperature of the TPR-THERMAL that is positioned on the Interface Surface of the DUT.

Note: The ThermoMux is included in the list of accessories shipped with the GRL-C3 tester hardware.

The user will need to connect the ThermoMux to the control computer to measure the temperature while running the 5.4.2 Thermal Performance test cases. Once connected the GRL-C3 Browser App will read the channel information of the ThermoMux as required. Make sure that the respective channels of the ThermoMux are connected to the appropriate coil assembly or foreign object according to the specific test case:

- Connect Channel 1 of the ThermoMux to an ambient temperature probe.
- Connect Channel 2 of the ThermoMux to a foreign object.

Figure 8.47 below shows the GRL-C3 connection setup which includes the ThermoMux and TPR Thermal coil assembly.

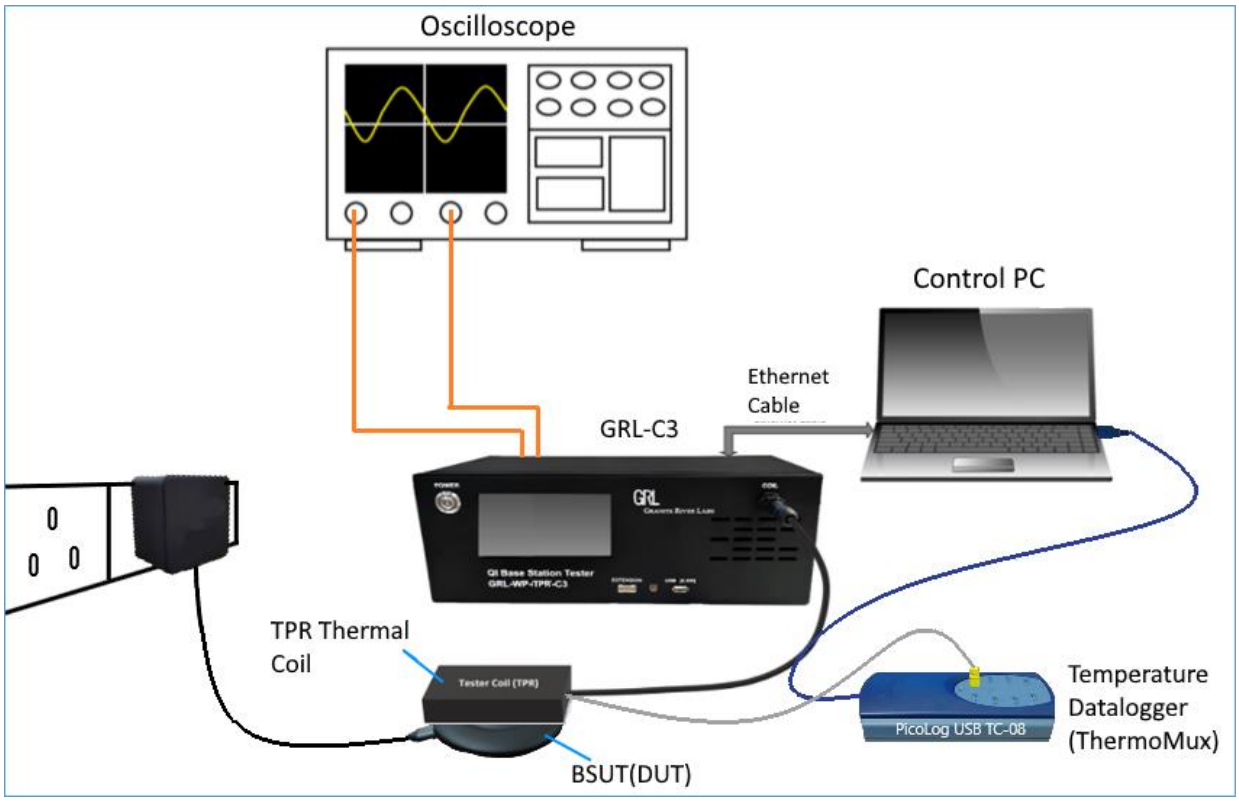


FIGURE 8.47: THERMOMUX CONNECTION SETUP DIAGRAM

Once the TPR Thermal coil assembly is connected to the GRL-C3 tester hardware, attach the coil's cable with the yellow pin to one of the numbered slots/channels (e.g., Channel 2) of the ThermoMux. Then connect the ThermoMux's USB cable to the control computer's USB port.

When running tests that require the use of ThermoMux, several pop-up messages will appear to guide the user through the test run. See example below:

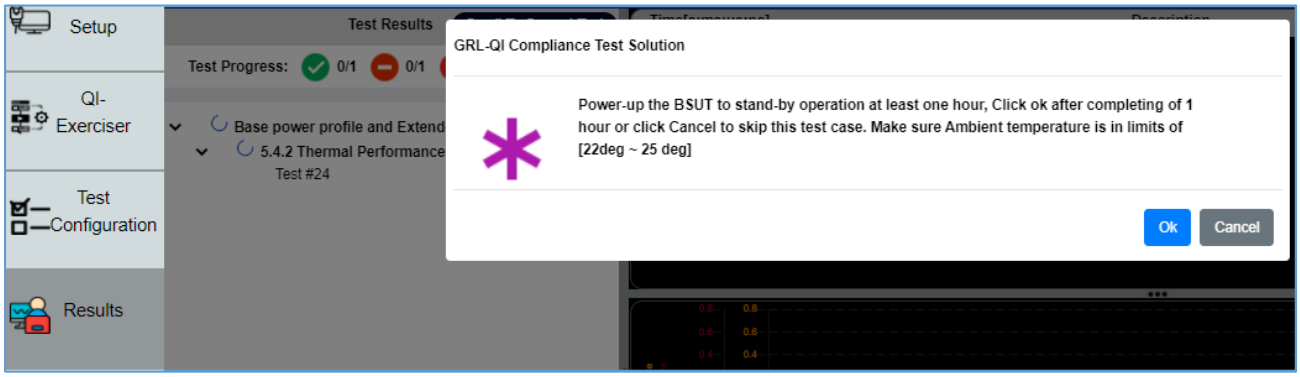


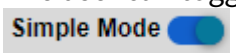
FIGURE 8.48: THERMAL TEST RUN POP-UP MESSAGE EXAMPLE

8.3.4 Test Selection

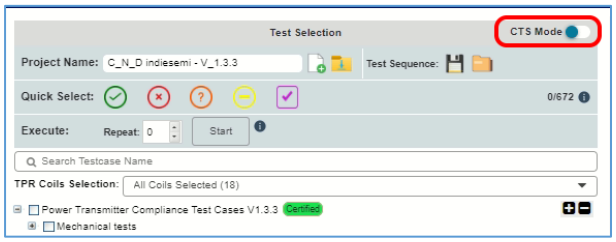
The tests available to be run are shown on the "Test Selection" panel.

8.3.4.1 Select CTS Mode or Simple Mode

The user can toggle between the CTS Mode and Simple Mode using the 

or 

slider.



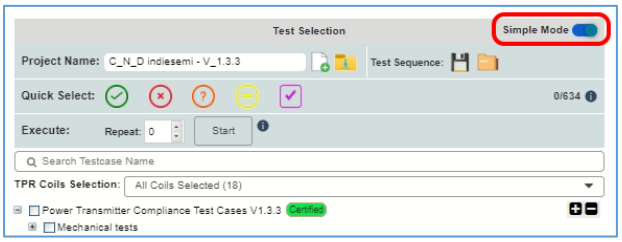


FIGURE 8.49: SELECT CTS MODE OR SIMPLE MODE

The CTS Mode is applied by default while the user can optionally select the Simple Mode to run tests for pre-compliance testing, to ensure the communication is happening properly between the transmitter and receiver.

- For compliance testing, tests need to be performed using the **CTS Mode**.

If the **Simple Mode** is selected:

- Test timings will not be followed accurately as per the compliance test specification.
- The signal trace plot will not be displayed during test runs.

- Voltage measurements will be handled internally by the GRL-C3 tester hardware.
- Thermal performance test cases and FOD test cases will not be available in the test selection.

8.3.4.2 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 a certain certification standard can be selected by clicking on the **Certification** drop-down menu along with the **Power Profile** of the DUT from the "Create New Project" pop-up panel:

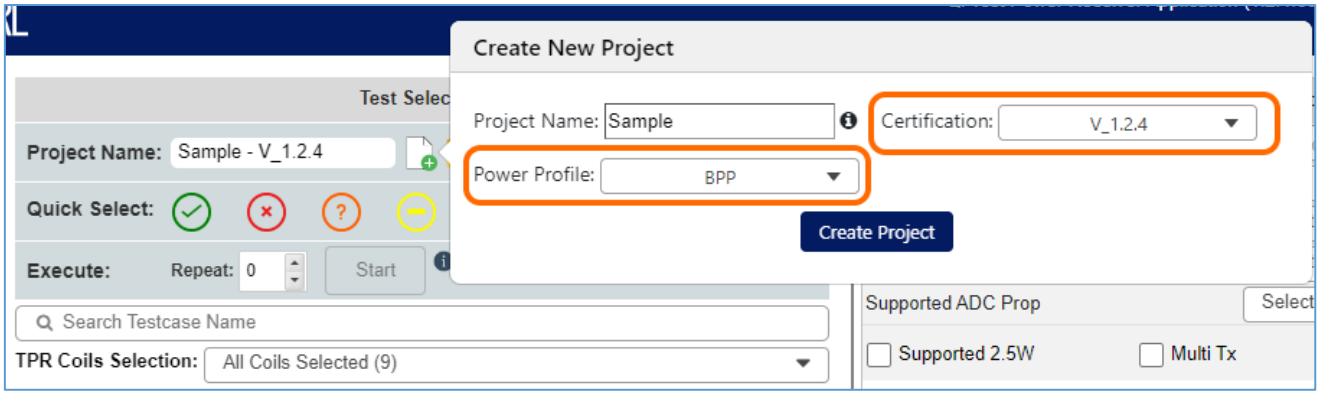


FIGURE 8.50: SELECT TESTS BASED ON CERTIFICATION AND POWER PROFILE

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

8.3.4.2.1 V_1.2.4 Tests

Run the Base Stations compliance tests based on the Qi Wireless Specification Version 1.2.4 for DUT's supporting the Baseline Power Profile, Extended Power Profile (≤ 5 W) and the Extended Power Profile (≤ 15 W).

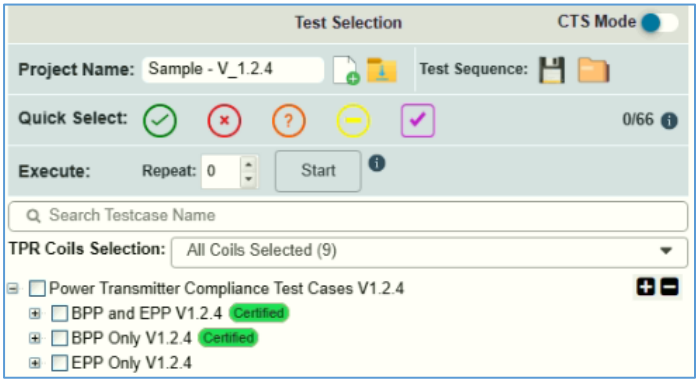


FIGURE 8.51: V_1.2.4 SPECIFICATION TEST SELECTION

8.3.4.2.2 V_1.3 Tests

Run the Base Stations compliance tests based on the Qi Wireless Specification Version 1.3.

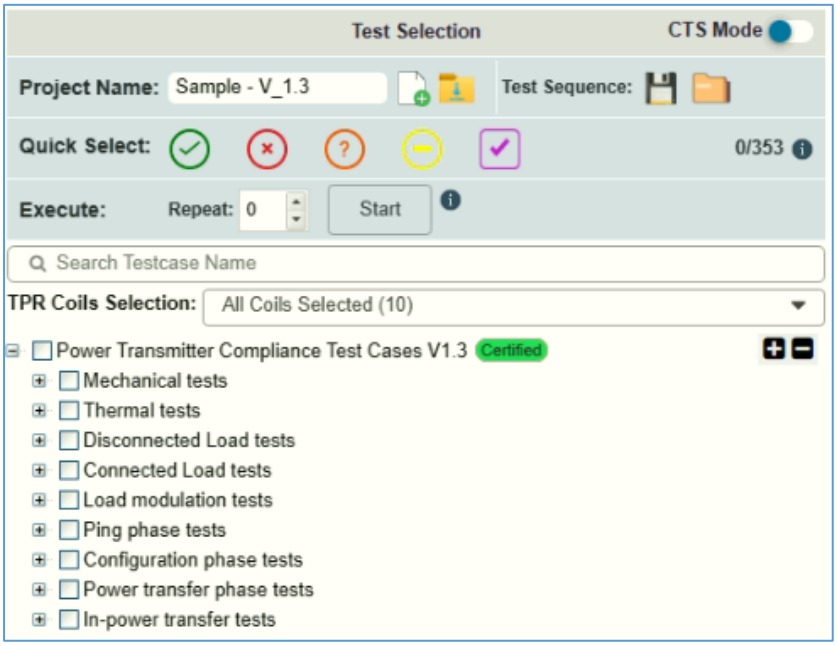


FIGURE 8.52: V_1.3 SPECIFICATION TEST SELECTION

8.3.4.2.3 V_1.3.3 Tests

Run compliance tests for DUT's supporting the Qi Wireless Specification Version 1.3.3.

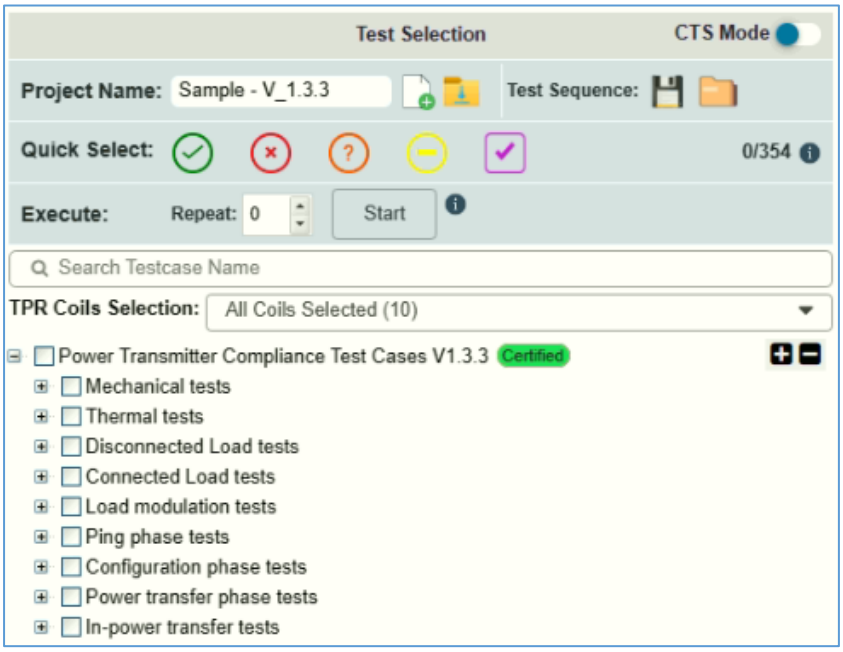


FIGURE 8.53: V_1.3.3 SPECIFICATION TEST SELECTION

8.3.4.2.4 Technology Development Tests

Run compliance tests for DUT's supporting the Qi Wireless Specification for technology development purposes.

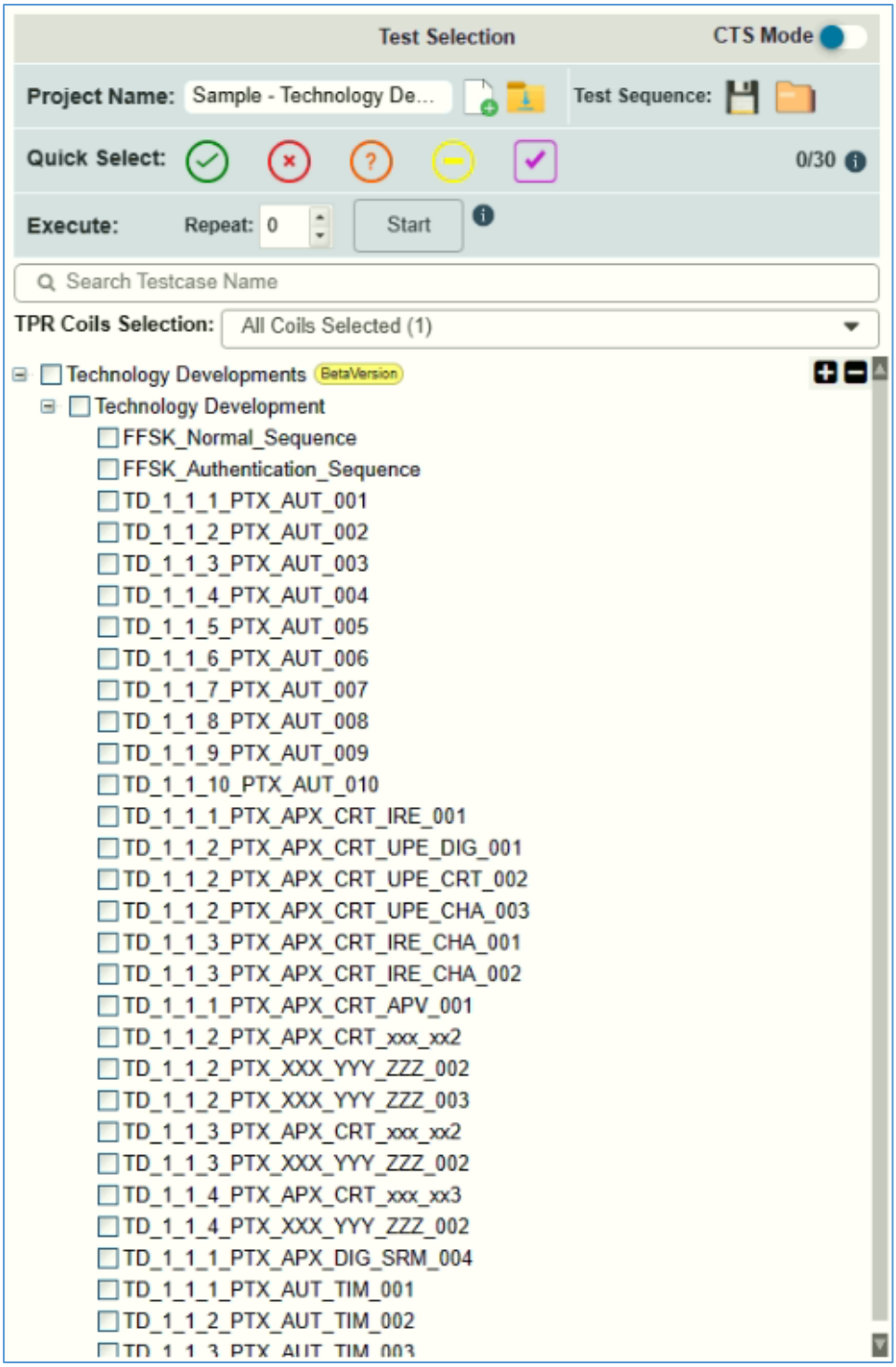


FIGURE 8.54: TECHNOLOGY DEVELOPMENT SPECIFICATION TEST SELECTION

8.3.4.2.5 V_2.0.1 Tests

Run compliance tests for DUT's supporting the Qi Wireless Specification Version 2.0.1.

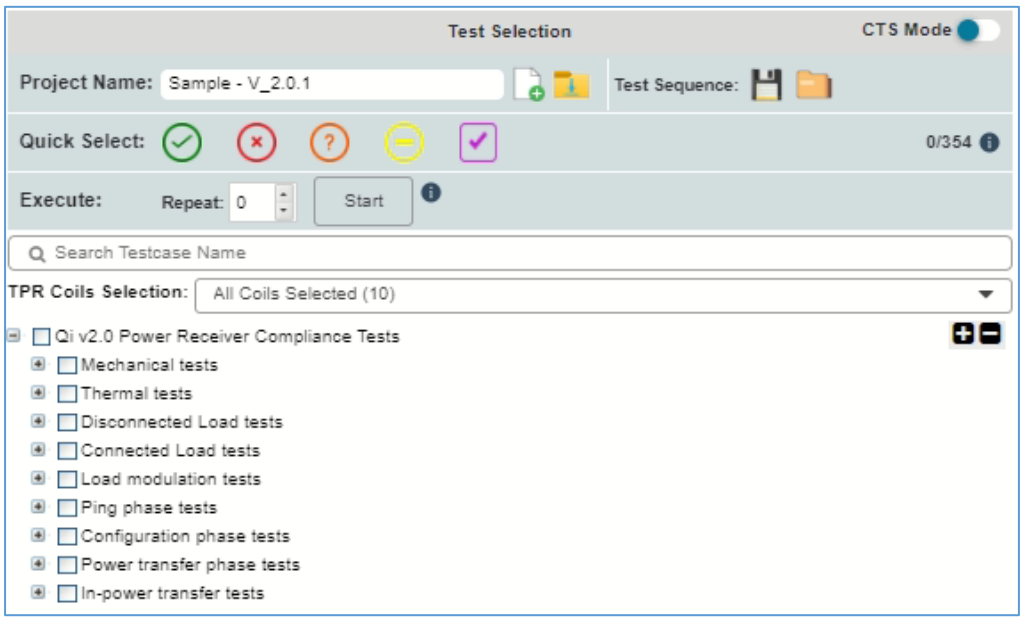


FIGURE 8.55: V_2.0.1 SPECIFICATION TEST SELECTION

Tests that are applicable for a certain TPR coil that comply with a certain certification standard and power profile can be selected by clicking on the drop-down menu:

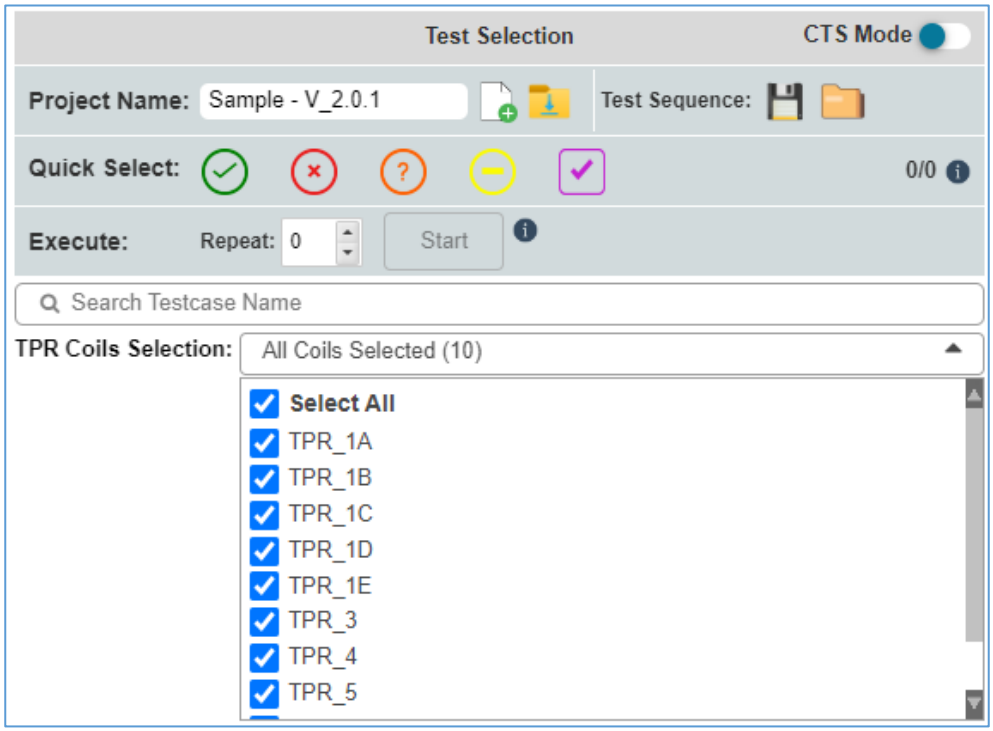
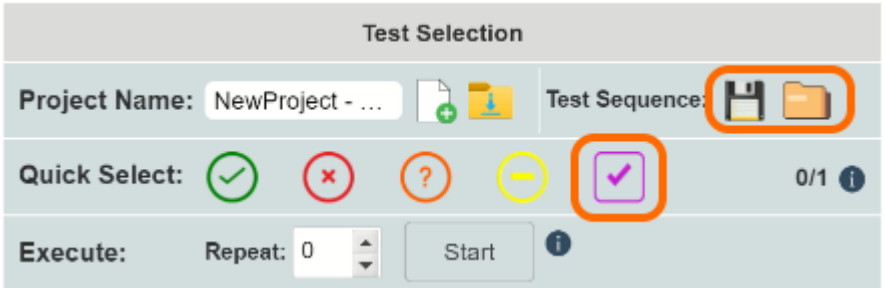


FIGURE 8.56: SELECT TESTS BASED ON TPR COIL, CERTIFICATION AND POWER PROFILE

8.3.4.3 Manage Test Selection

You can click on the icon to select all the test cases in the list or to load an existing saved test case sequence file for running specific tests or to save the existing test case sequence to a JSON file.



8.3.5 Report Generation

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

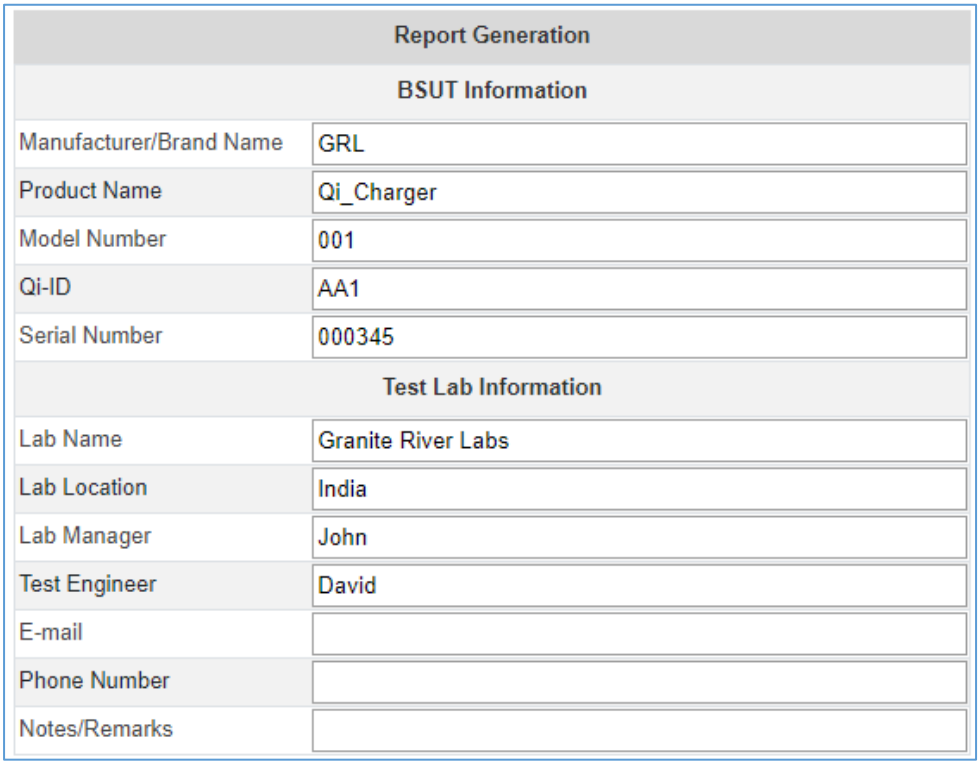


FIGURE 8.57: REPORT GENERATION PANEL

The “BSUT Information” and “Test Lab Information” sections are text entry fields in which the user can enter information relevant to the specific DUT and the specific set of tests about to be run. Once tests have completed, the test report can be viewed in the *Report* screen (see Section 8.4).

8.3.6 Run Tests

Once the desired test cases have been selected, they can be run by clicking on the **Start** button as indicated in Figure 8.58 below. Click on this button (**Stop**) again to terminate the test run.

FIGURE 8.58: RUN TESTS

You can also select the number of times to repeat running the selected tests by clicking on the **Repeat** up/down button 

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

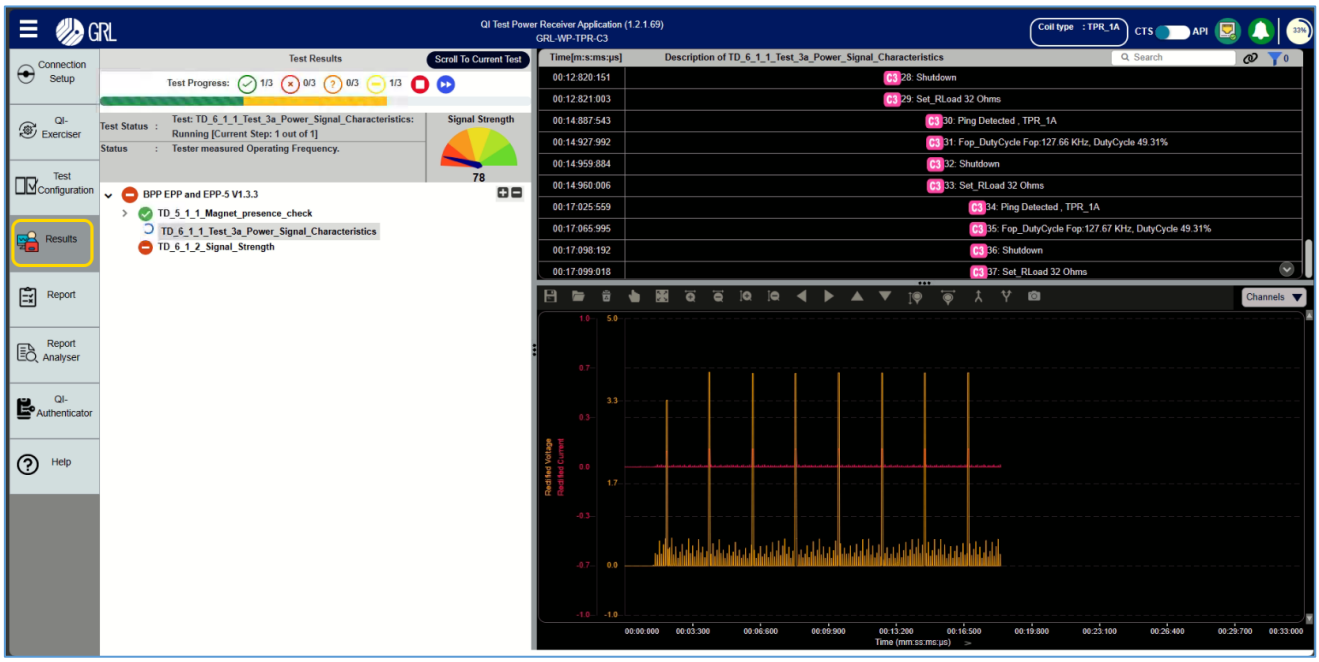


FIGURE 8.59: RESULTS SCREEN – TEST RUN IN PROGRESS

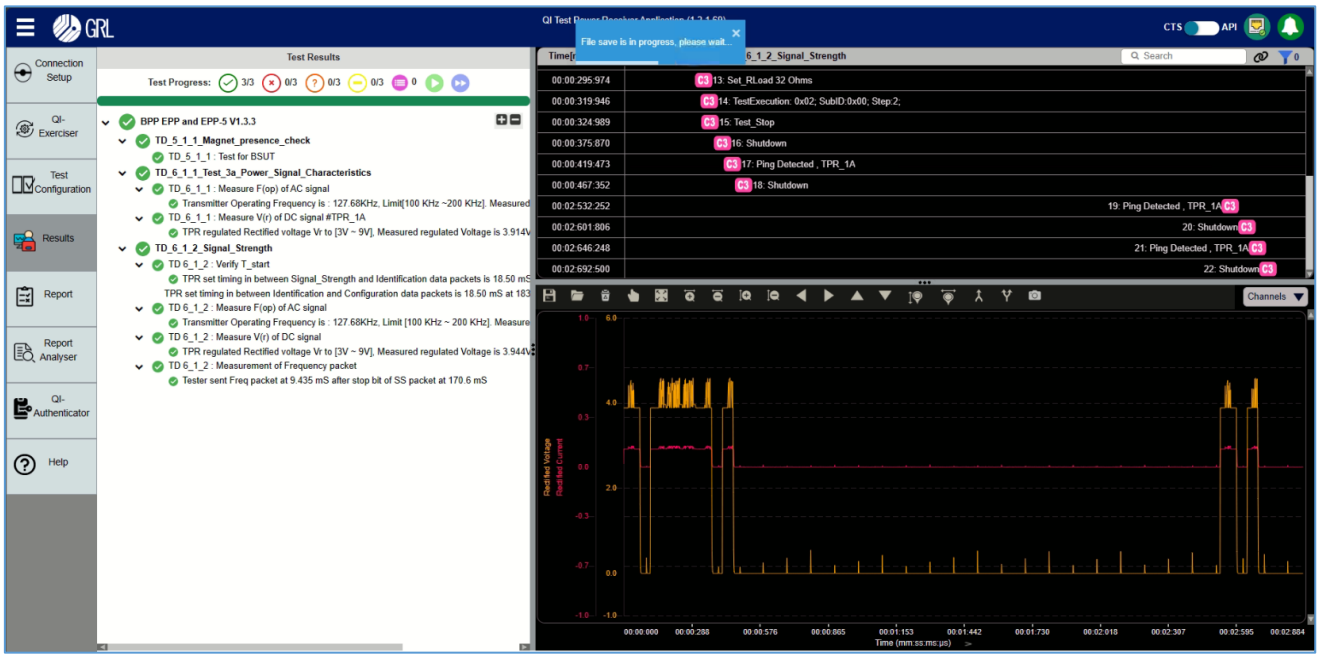


FIGURE 8.60: RESULTS SCREEN – TEST RUN COMPLETED

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/warning 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.

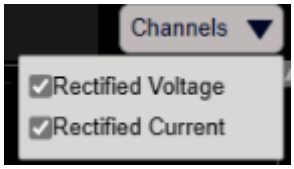


FIGURE 8.61: SELECT MEASUREMENT CHANNELS EXAMPLE

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 Scroll To Current Test.

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:

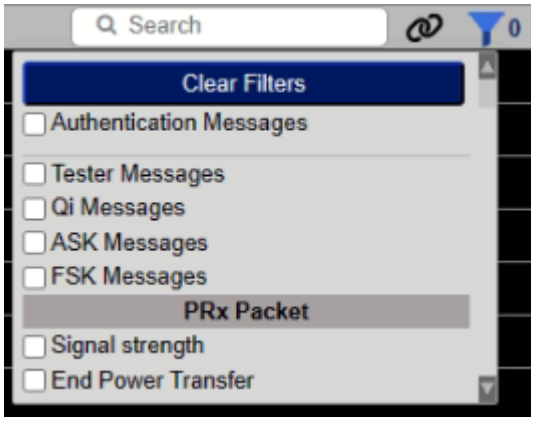


FIGURE 8.62: FILTER PACKET COMMUNICATIONS OPTIONS

To enable syncing of the Packet timings, click on the icon and vice versa.

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 8.63: 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 file and the **Load trace file** button to open and use an existing saved trace file (refer to Section 8.3.6.1 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.

8.3.6.1 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 8.64 below.

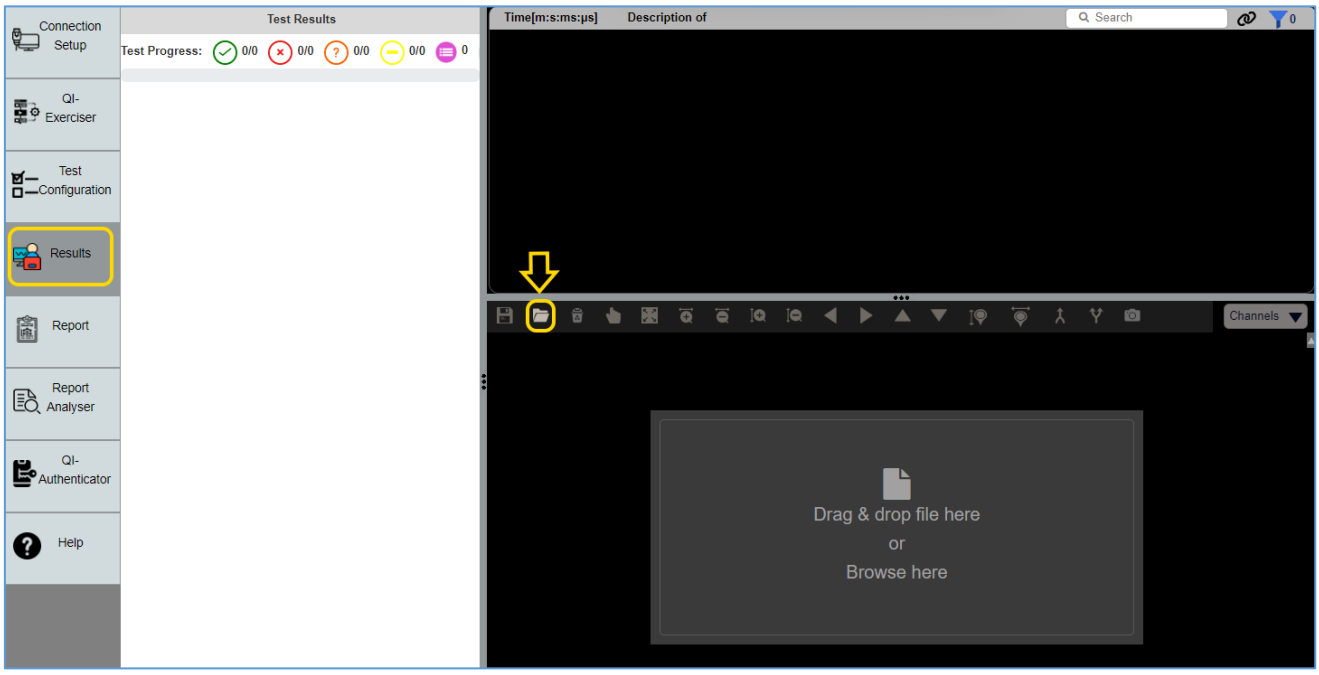


FIGURE 8.64: LOAD TRACE FILE BUTTON

2. Select the required **.grltrace** file (that was saved from a previous test run) as shown in the example in Figure 8.65 below.

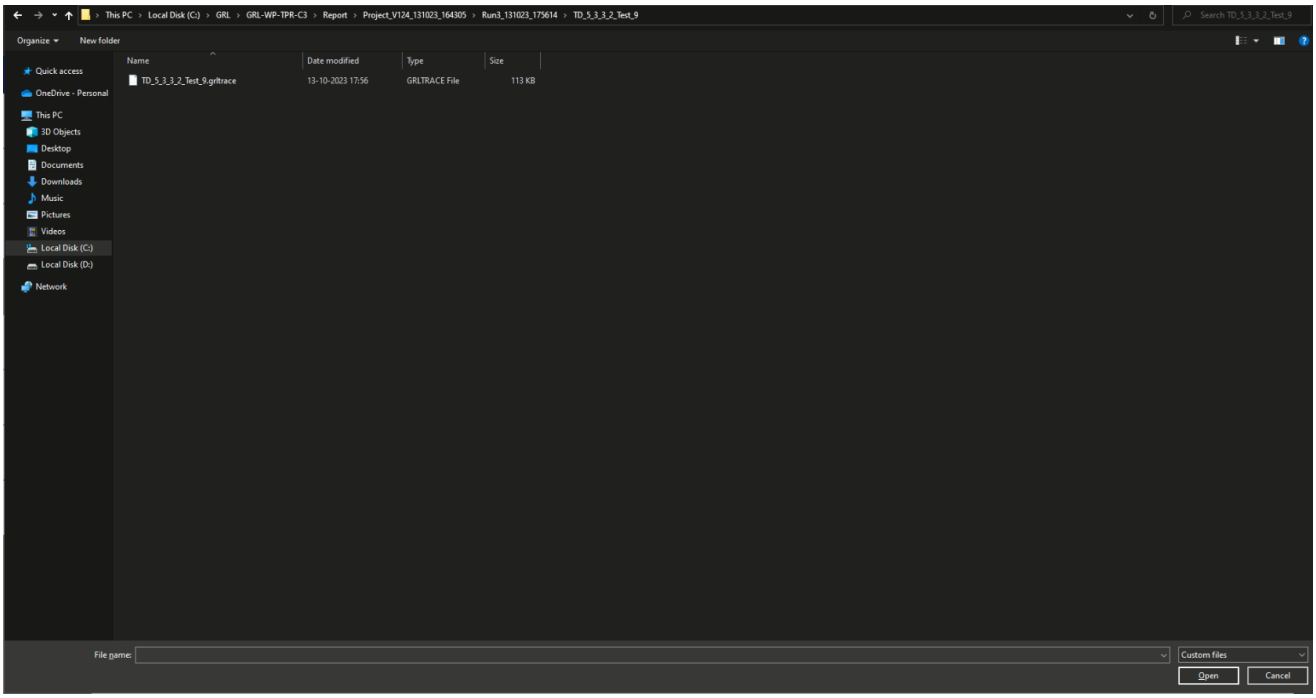


FIGURE 8.65: SELECT SAVED TRACE FILE

3. The selected trace file will be loaded as shown in the example in Figure 8.66 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.

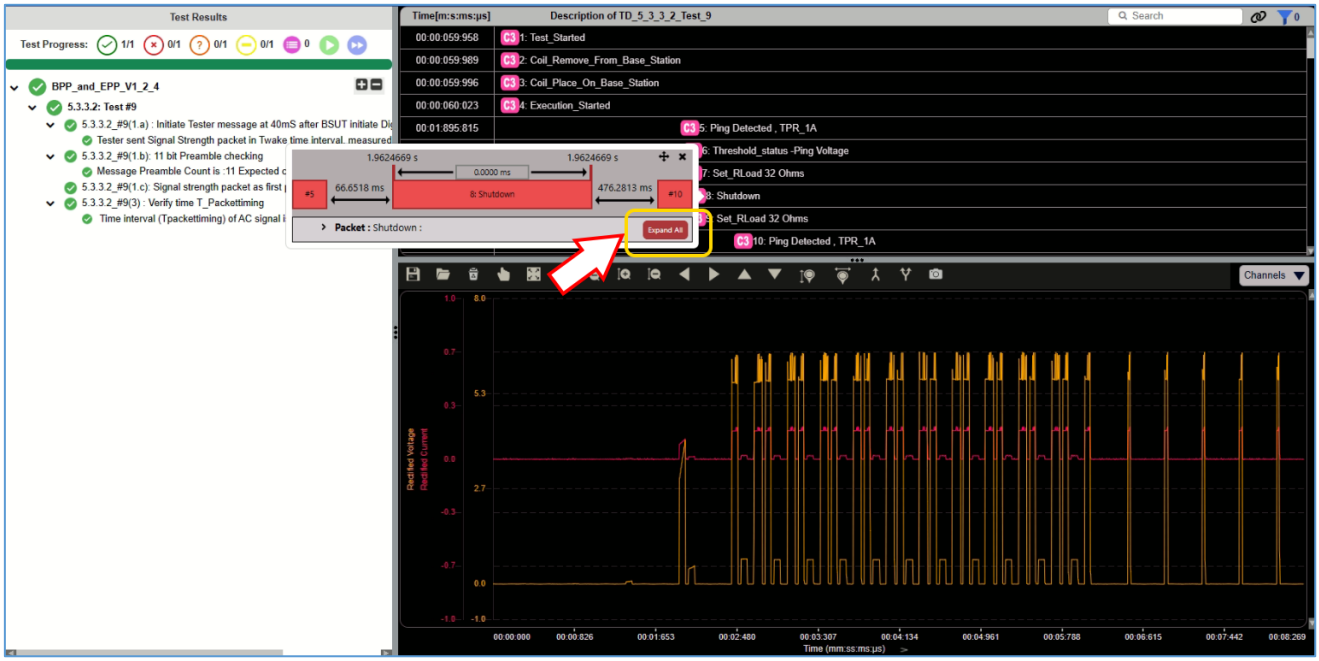


FIGURE 8.66: SELECTED TRACE FILE LOADED FOR VERIFICATION

4. To verify the exact failure packet, the user can just select the failure description and the GRL-C3-MP-TPT Browser App will automatically map the respective packet as shown in the example in Figure 8.67 below.

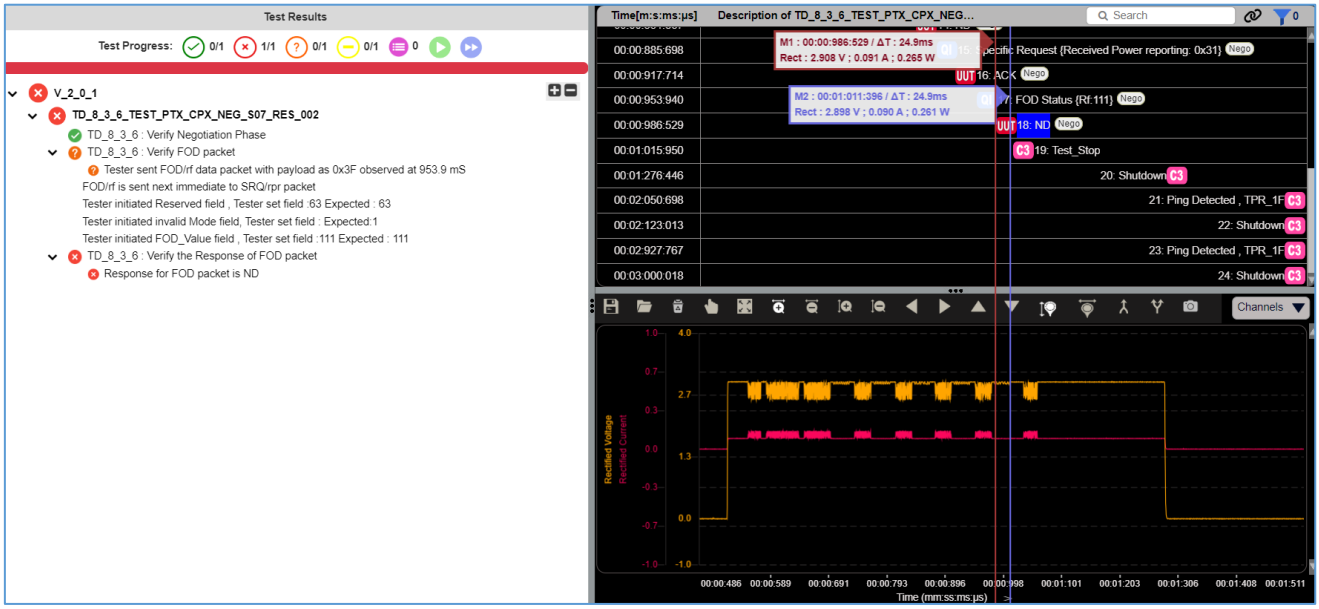


FIGURE 8.67: VERIFY FAILURE PACKET

5. To remove the trace file from the screen, the user can click on the **Clear Capture** button as indicated in Figure 8.68 below.

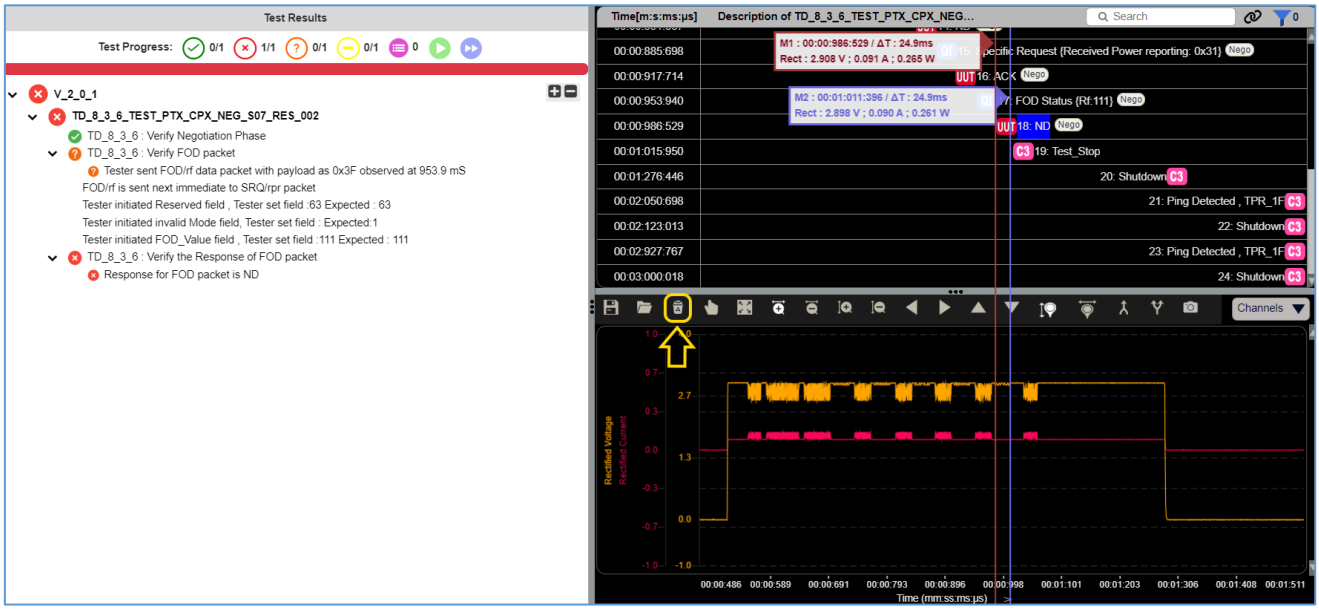


FIGURE 8.68: CLEAR CAPTURE BUTTON

8.4 Test Report View

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

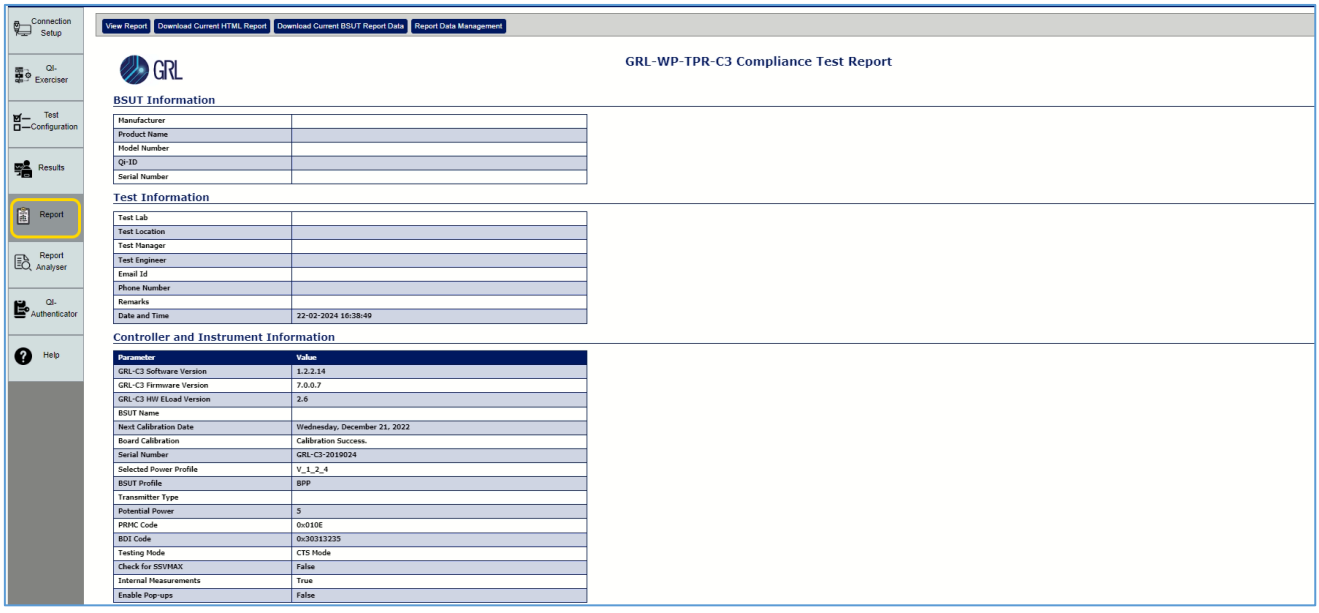


FIGURE 8.69: REPORT SCREEN

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 8.70) below.

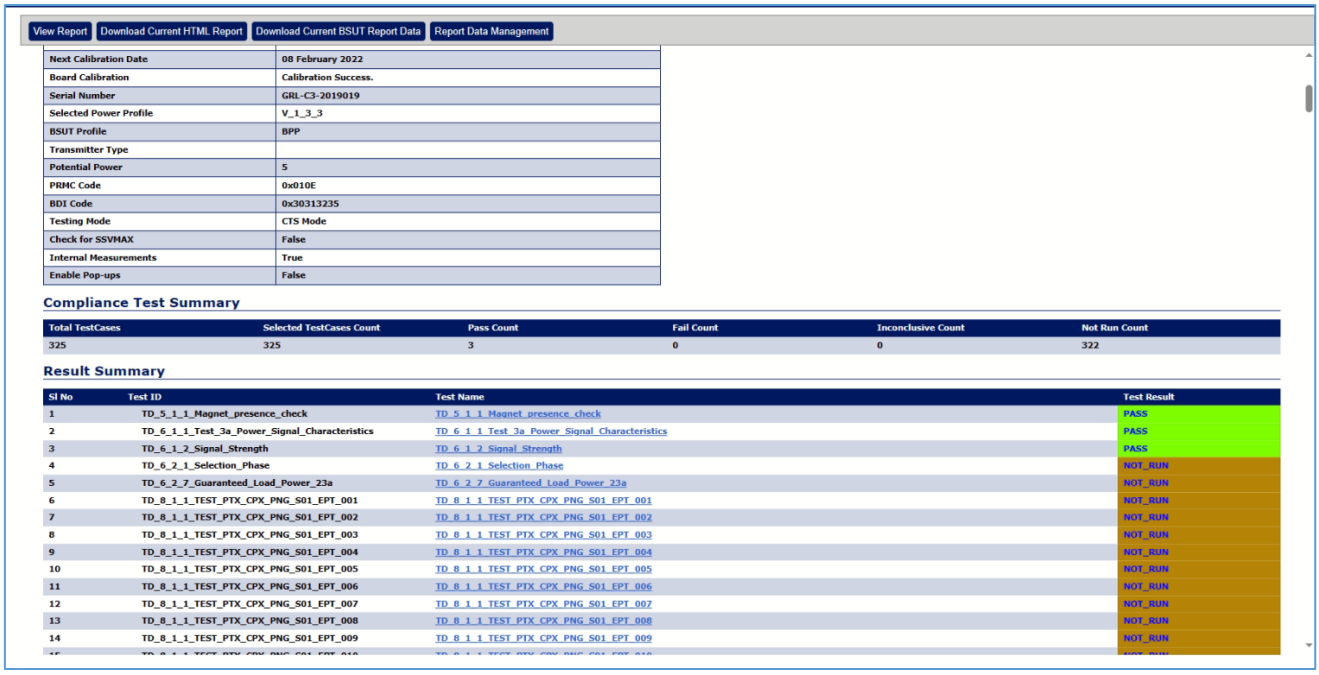


FIGURE 8.70: SCROLL DOWN TO VIEW FULL REPORT

The buttons at the top of the Report screen perform the following functions:

FIGURE 8.71: 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 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.

8.5 JSON Report Analyzer

The GRL-C3 Browser App *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.

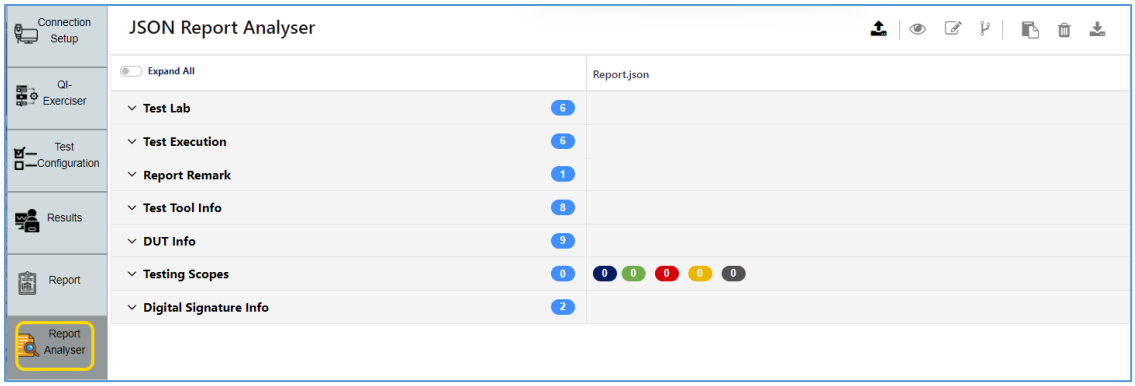


FIGURE 8.72: JSON REPORT ANALYZER SCREEN

The JSON Report Analyzer screen will display the results and configuration log of the most recent test run as shown in the Figure 8.72 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 8.73 example below.

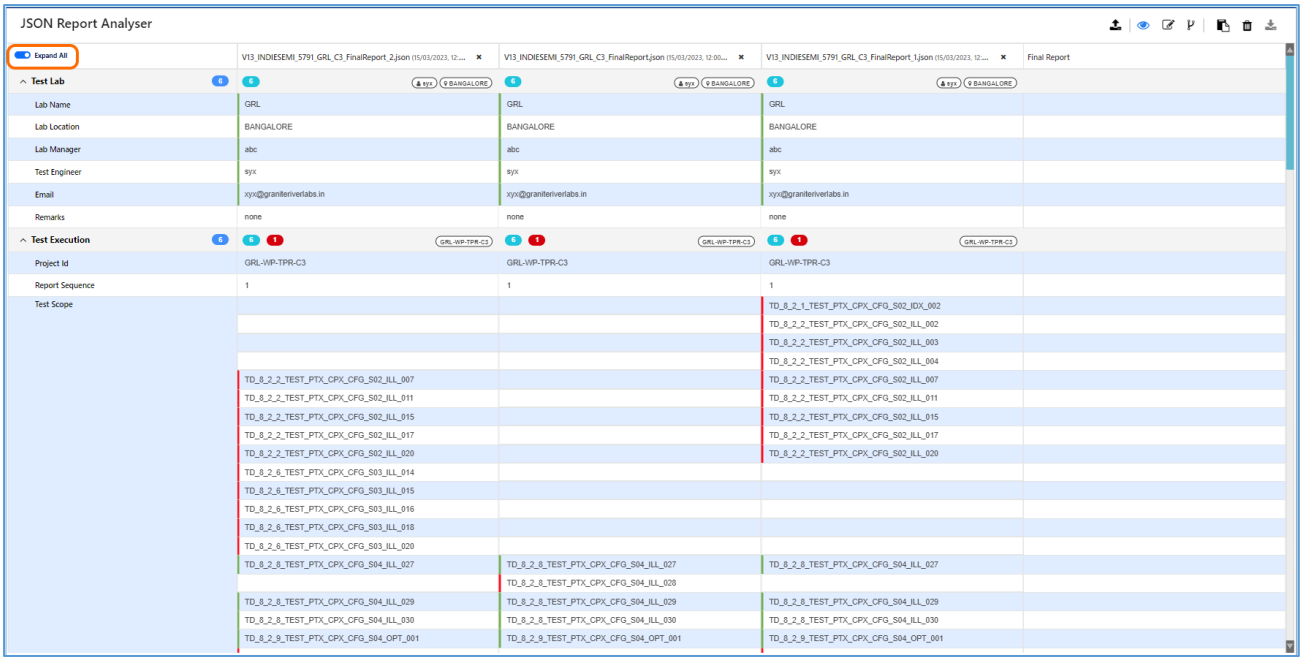


FIGURE 8.73: EXPAND ALL DATA FIELDS EXAMPLE

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 8.3, 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 8.74 below.

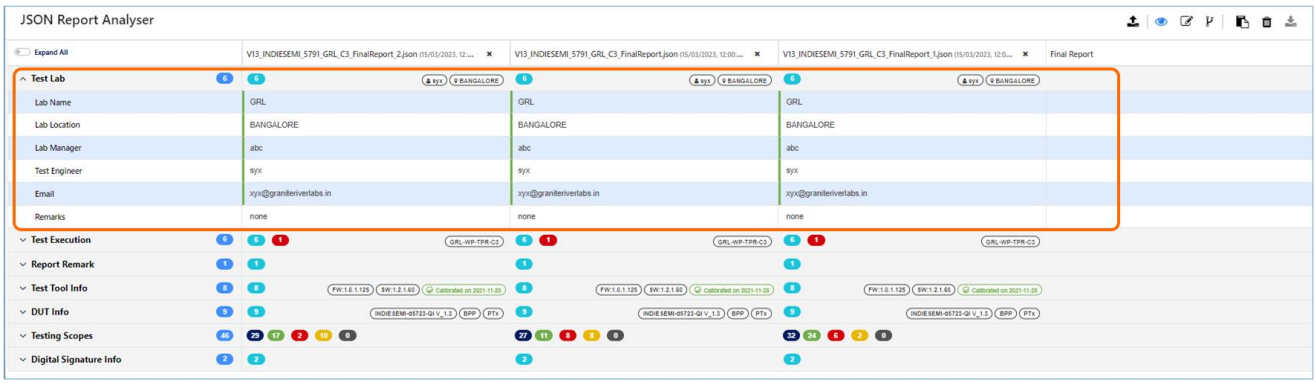


FIGURE 8.74: TEST LAB DATA FIELD

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 8.75 below.

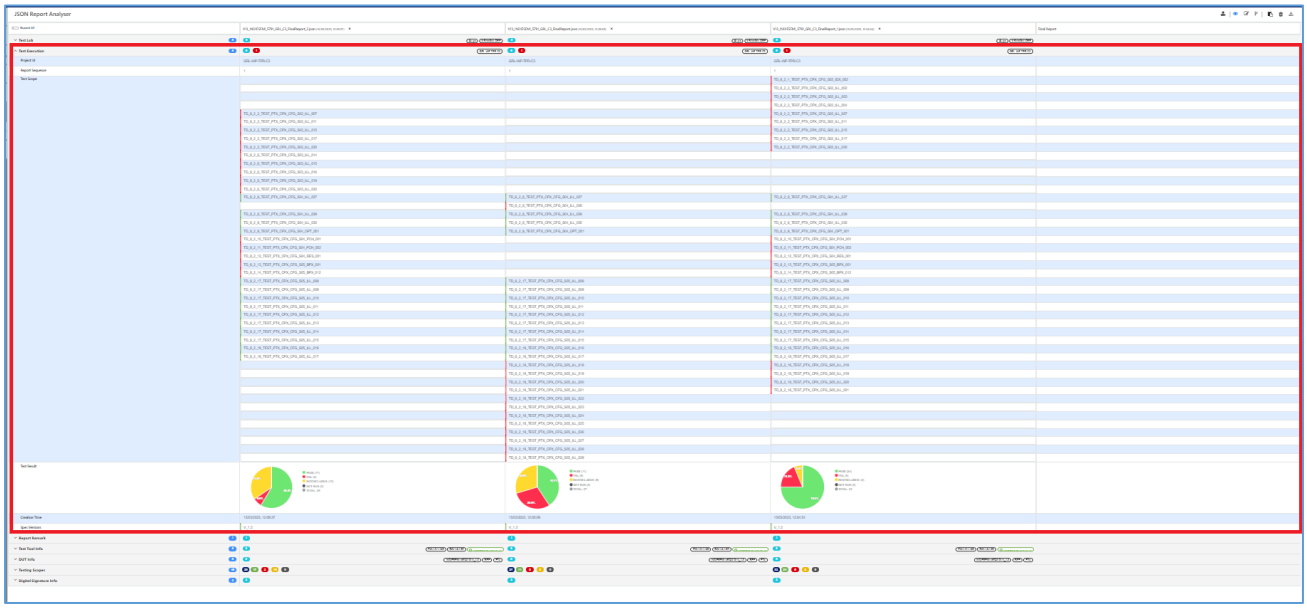


FIGURE 8.75: TEST EXECUTION DATA FIELD

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 8.76 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.

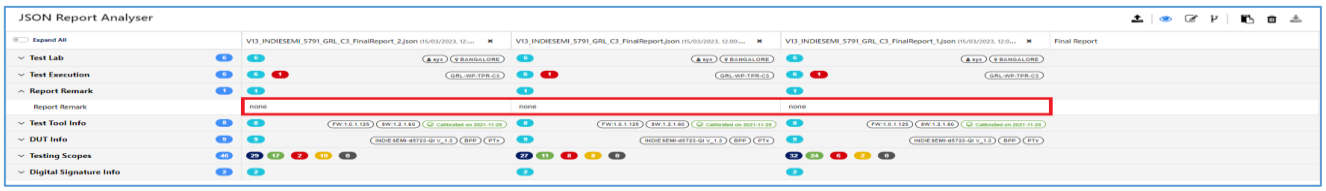


FIGURE 8.76: REPORT REMARK DATA FIELD

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). 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 8.77 below.

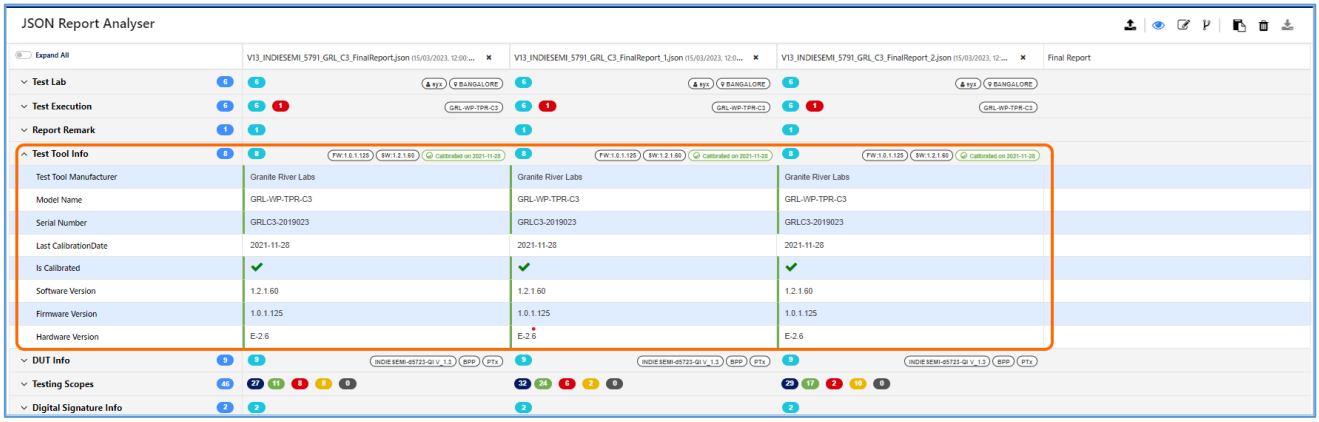


FIGURE 8.77: TEST TOOL INFO DATA FIELD

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 “BPP” (Baseline Power Profile), “EPP” (Extended Power Profile) or “EPP5” (Extended Power Profile 5) 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 8.78 below.

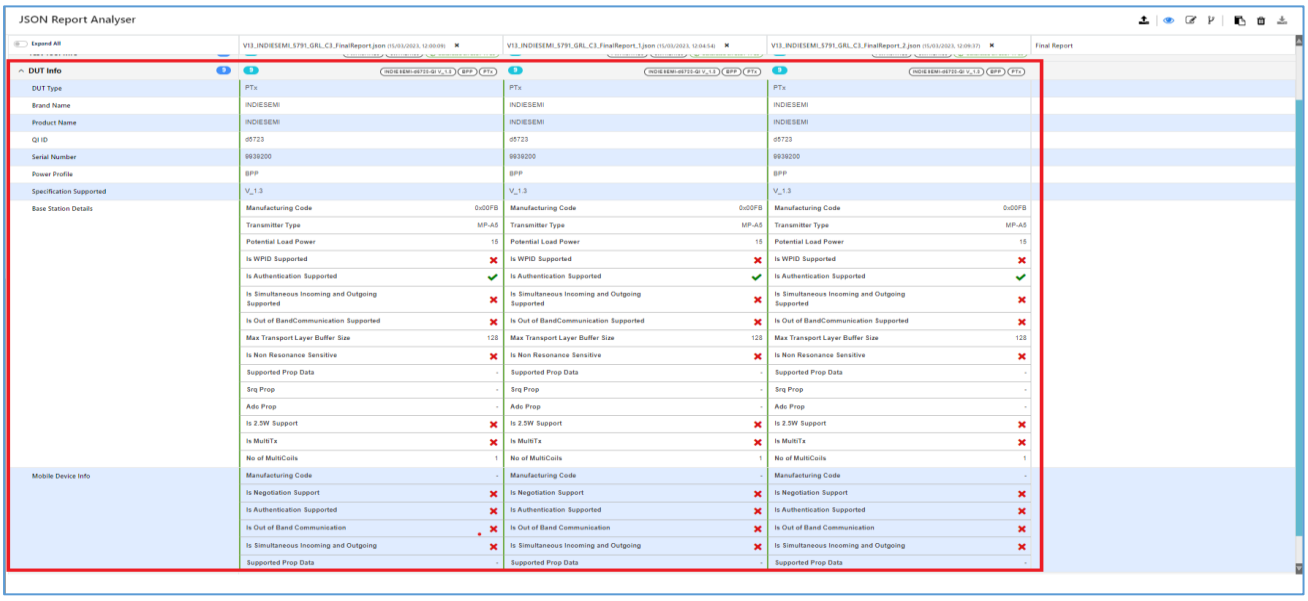


FIGURE 8.78: DUT INFO DATA FIELD

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 8.79 below.

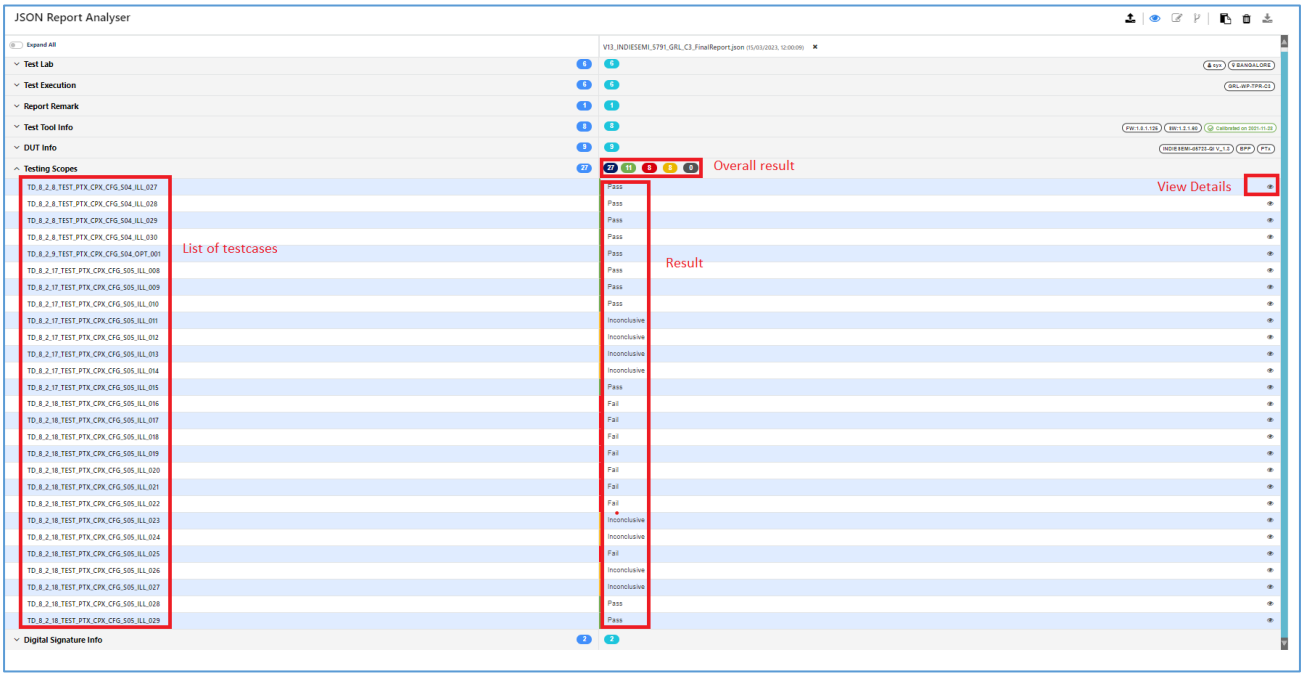


FIGURE 8.79: TESTING SCOPES DATA FIELD

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 8.80 below.

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

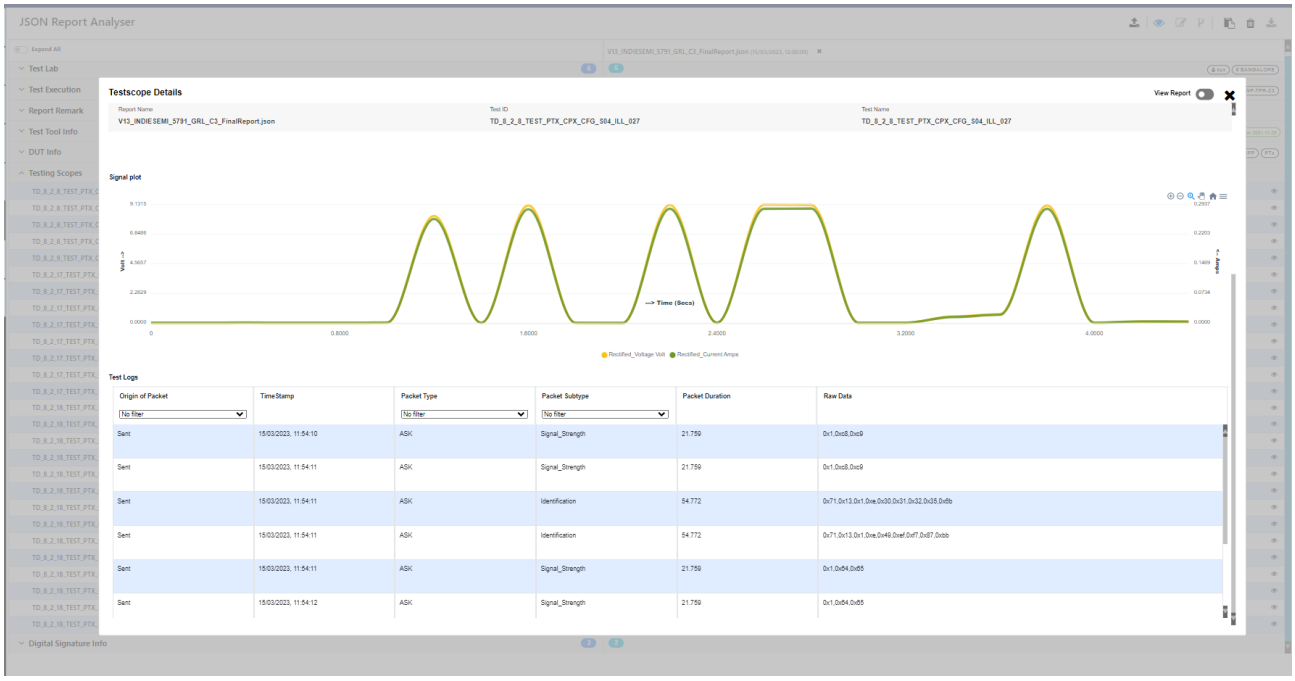


FIGURE 8.80: VIEW TEST CASE DETAILS

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.

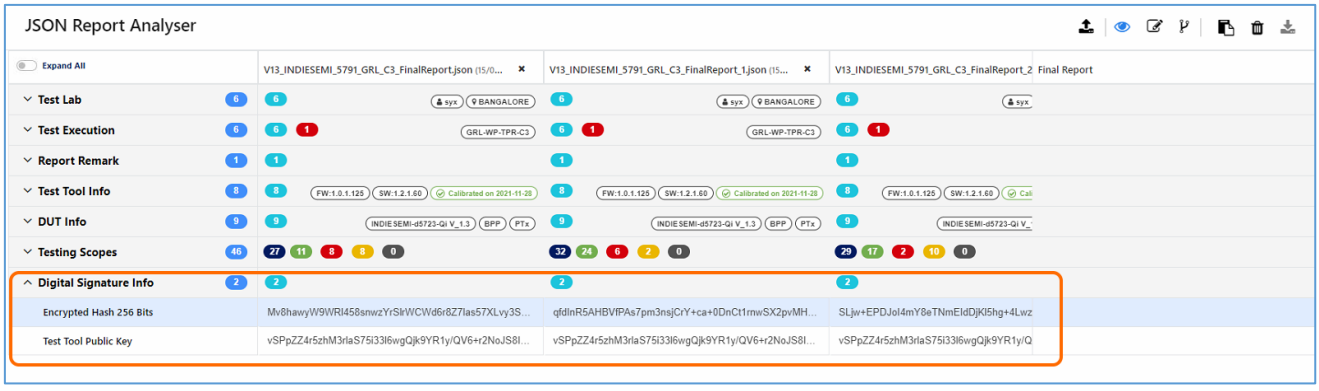


FIGURE 8.81: DIGITAL SIGNATURE INFO DATA FIELD

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 8.82 below.

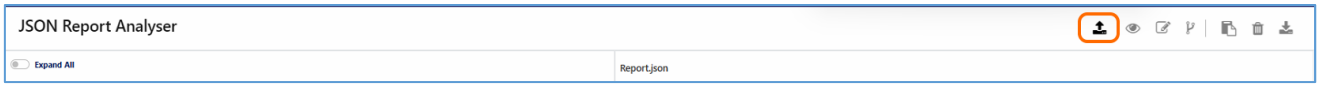


FIGURE 8.82: UPLOAD JSON REPORT ICON

2. The following pop-up window will appear as shown in Figure 8.83. 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.

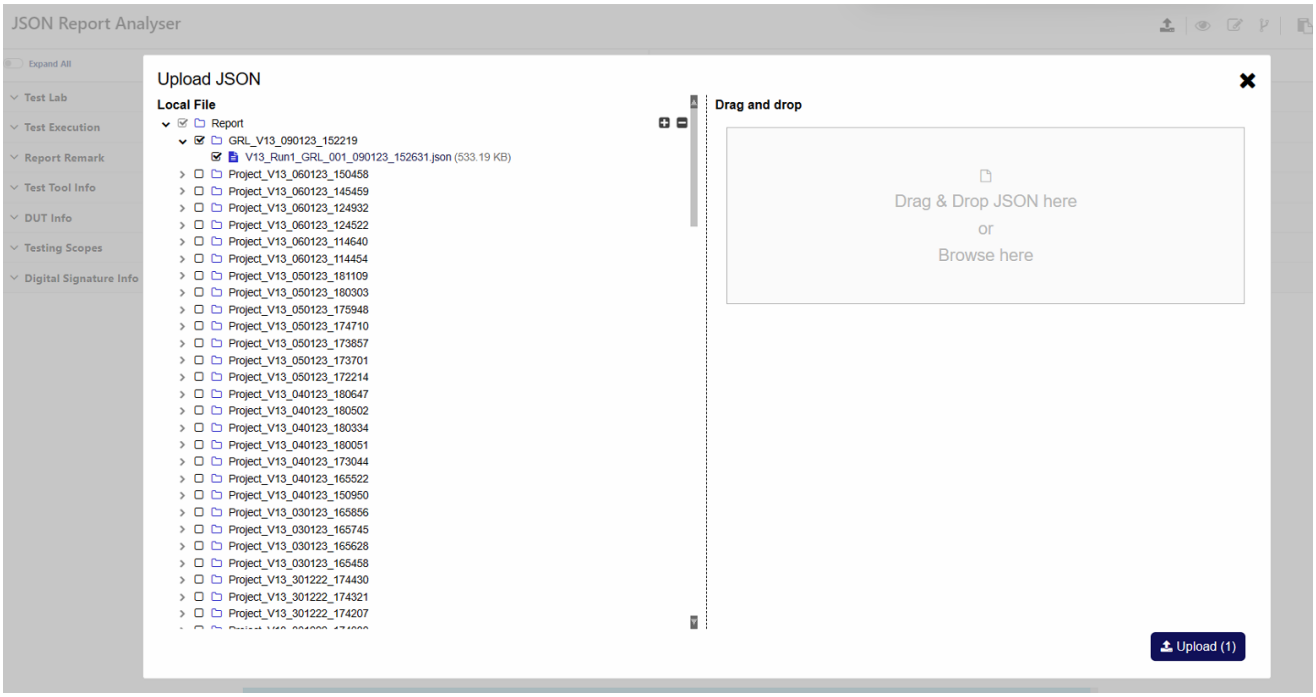


FIGURE 8.83: SELECT JSON FILES TO UPLOAD

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 8.84 below.

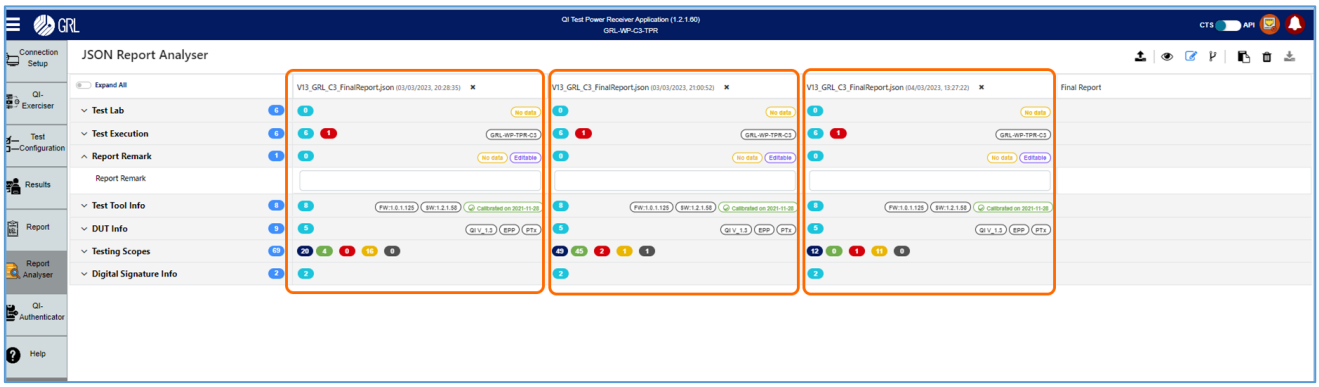


FIGURE 8.84: JSON FILES LOADED ON SCREEN EXAMPLE

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 Compare Reports to compare the results between the loaded JSON files.

In the example in Figure 8.85 below, the user can select any of the loaded JSON files (as indicated by “1”, “2” and “3”) to view and compare the results for a particular test case.

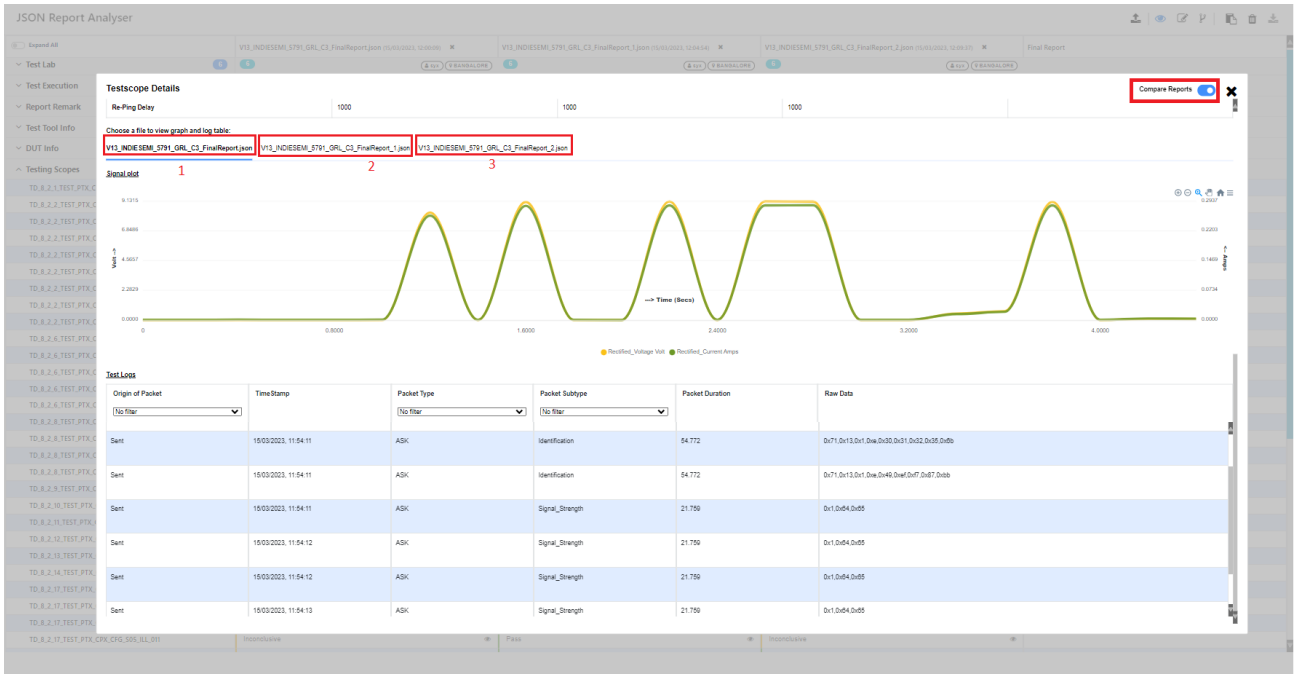


FIGURE 8.85: SELECT AND COMPARE MULTIPLE JSON FILES RESULTS

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 8.86: 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 8.91 below which displays the number of test cases with their respective test run results for each JSON report.

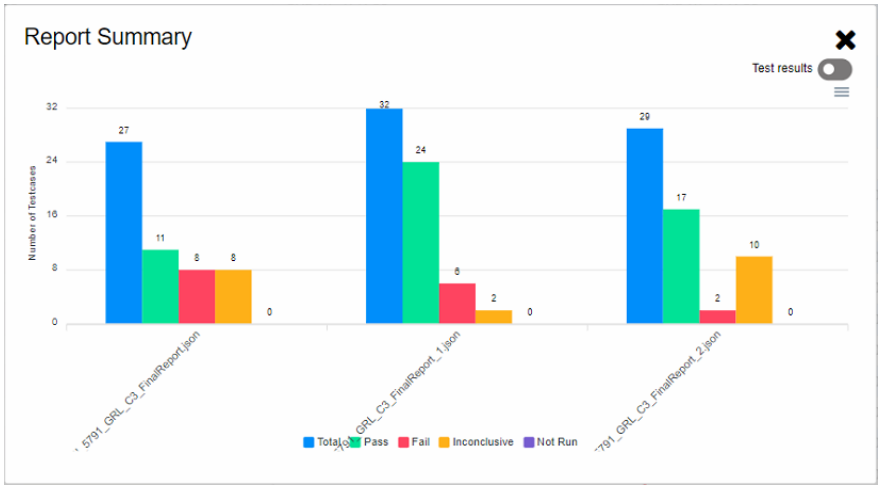


FIGURE 8.87: JSON REPORT TEST RESULTS SUMMARY EXAMPLE

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 Test reports .

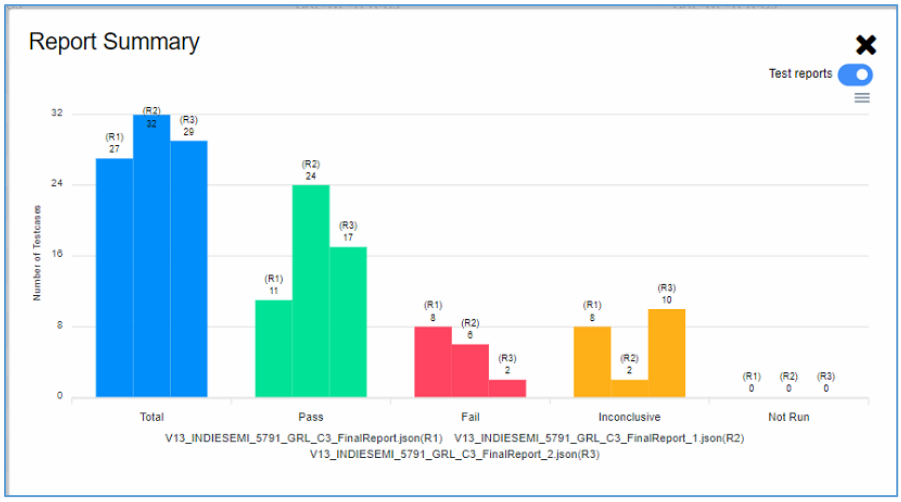


FIGURE 8.88: JSON REPORT TEST REPORTS SUMMARY EXAMPLE

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 8.89 below. The user can find the saved report file in the Downloads folder.

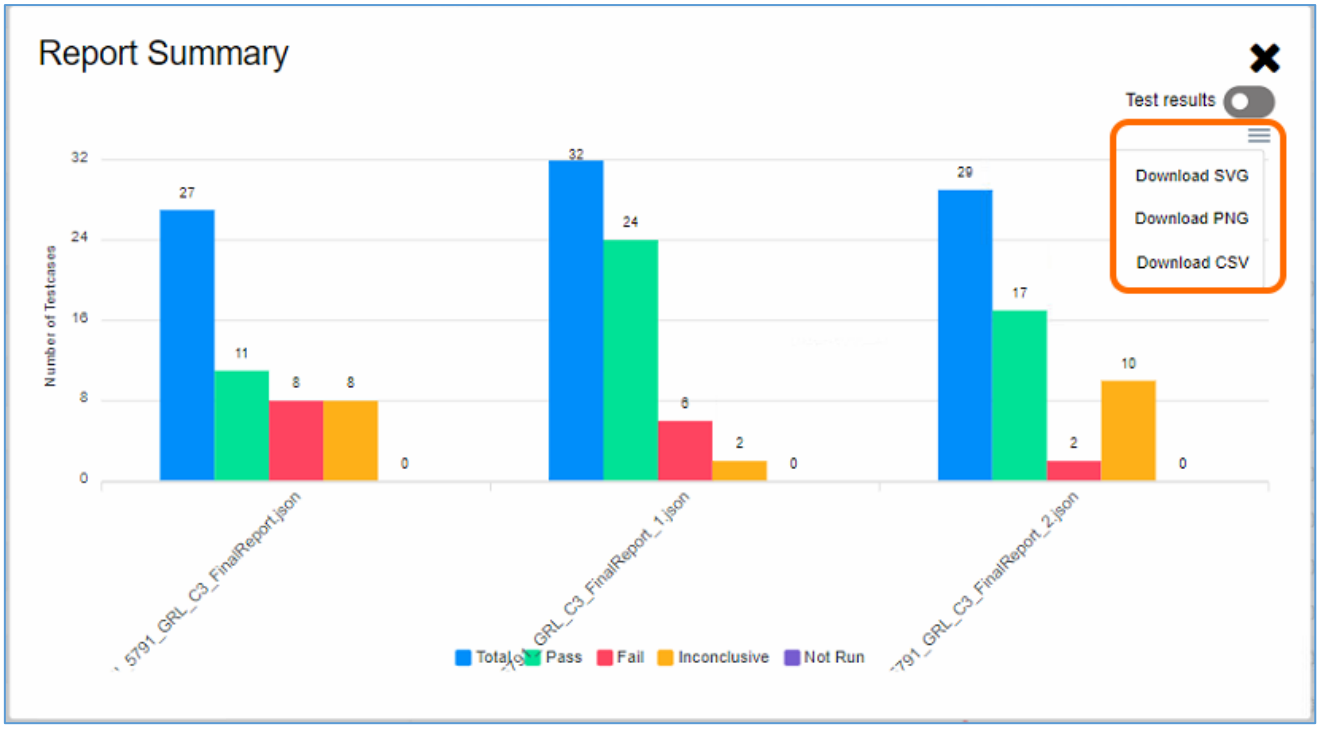


FIGURE 8.89: JSON REPORT TEST REPORTS SUMMARY EXAMPLE

- 🗑 – 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 8.90.

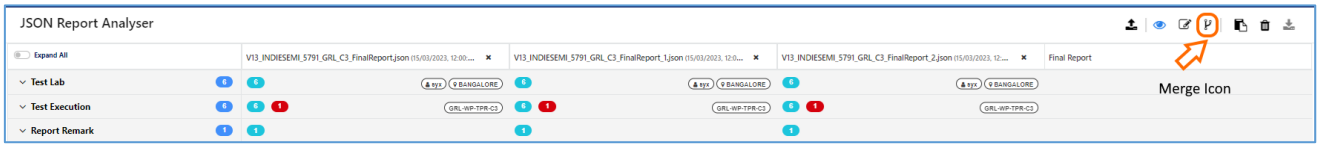


FIGURE 8.90: MERGE ICON

2. Then click on the Testing Scopes data field and select the test results from JSON Report #1, JSON Report #2 and JSON Report #3 as indicated in the Figure 8.91 example below. The selected test results will be reflected under “Final Report” as merged results.

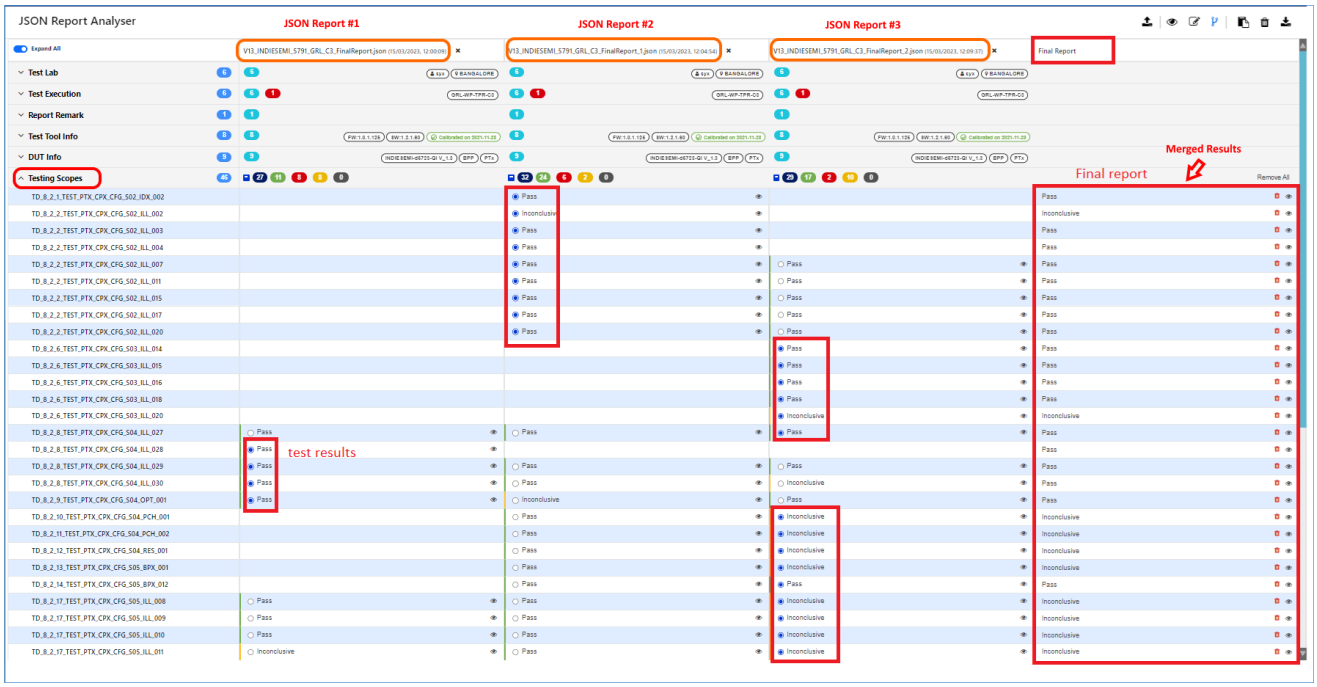


FIGURE 8.91: MERGED TEST RESULTS FROM MULTIPLE JSON REPORT FILES

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 Analyzer screen as shown in Figure 8.92 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 of these three file formats.
3. Then, click on the **Export** button. The user can find the exported/downloaded report files in the Downloads folder.

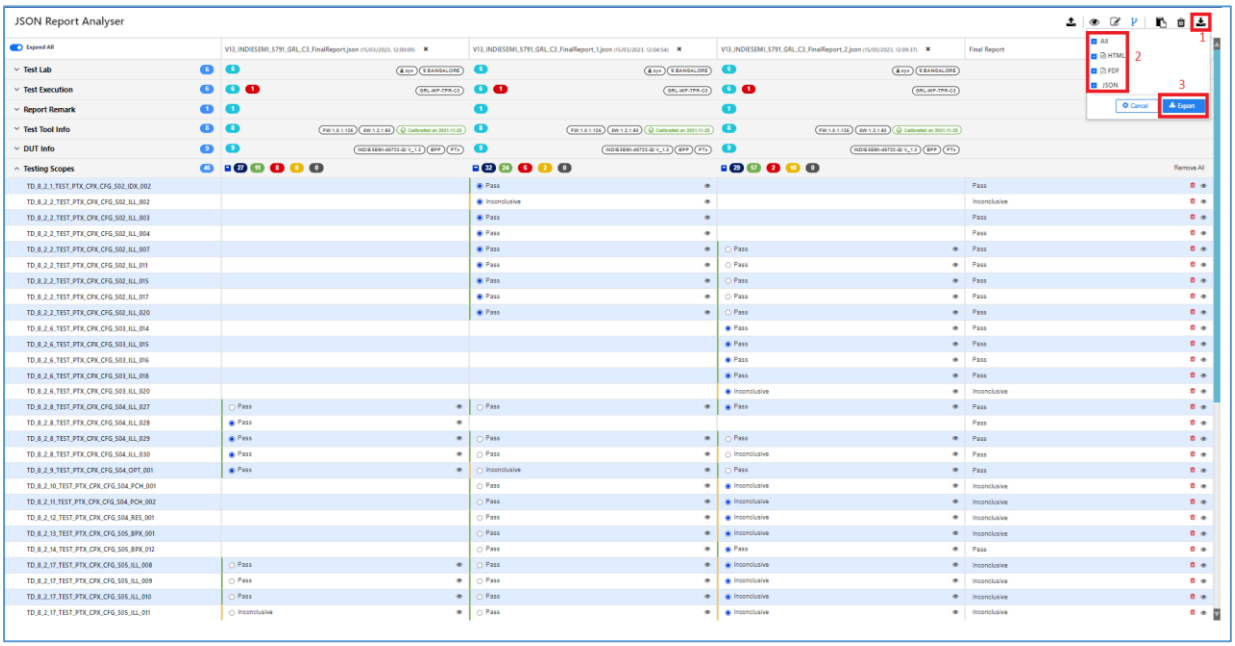


FIGURE 8.92: DOWNLOAD/EXPORT JSON REPORT FILES

8.6 Qi Authenticator Configuration & Validation

The GRL-C3 Browser App *Qi-Authenticator* screen allows the user to configure and validate the Qi certification of a power transmitter and receiver to ensure compliance to the WPC Qi Specification Version 1.3. This is important to ensure that wireless devices are Qi certified for wireless transmission and charging.

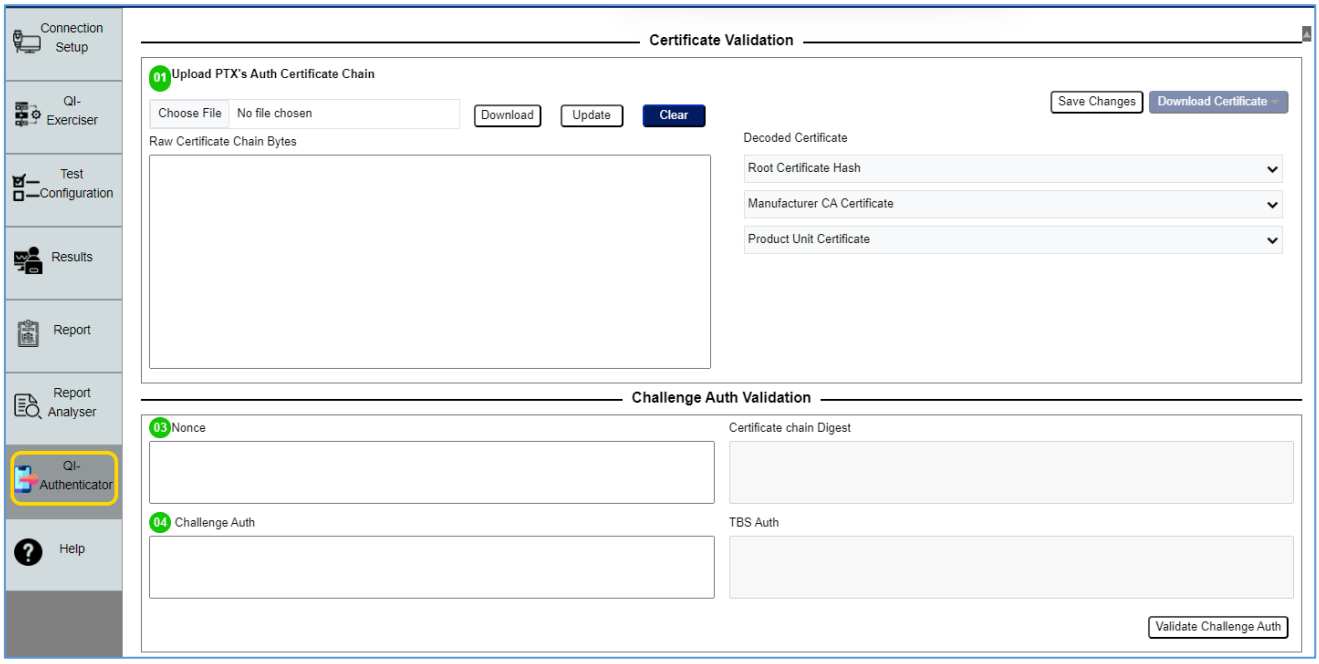


FIGURE 8.93: QI-AUTHENTICATOR SCREEN

8.6.1 Validate Qi Certificate of Power Transmitter

Use the **Certificate Validation** panel to select and perform decoding/configuration of an existing certificate of a Qi wireless power transmitter.

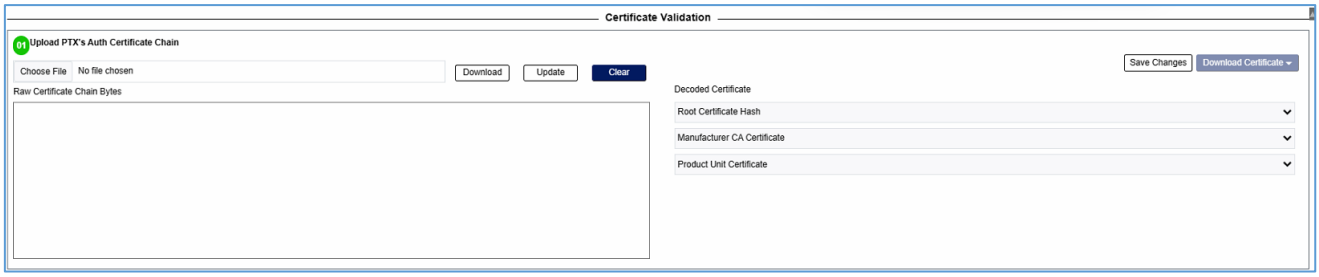


FIGURE 8.94: CERTIFICATE VALIDATION PANEL FOR POWER TRANSMITTER

1. Click on **Choose File** to select an existing Auth Certificate Chain file of the power transmitter to be evaluated. The raw certificate chain bytes of the selected file will then be populated. See example below:

*Note: Make sure the **Header byte** is removed from the chain bytes when populating the raw certificate chain bytes.*

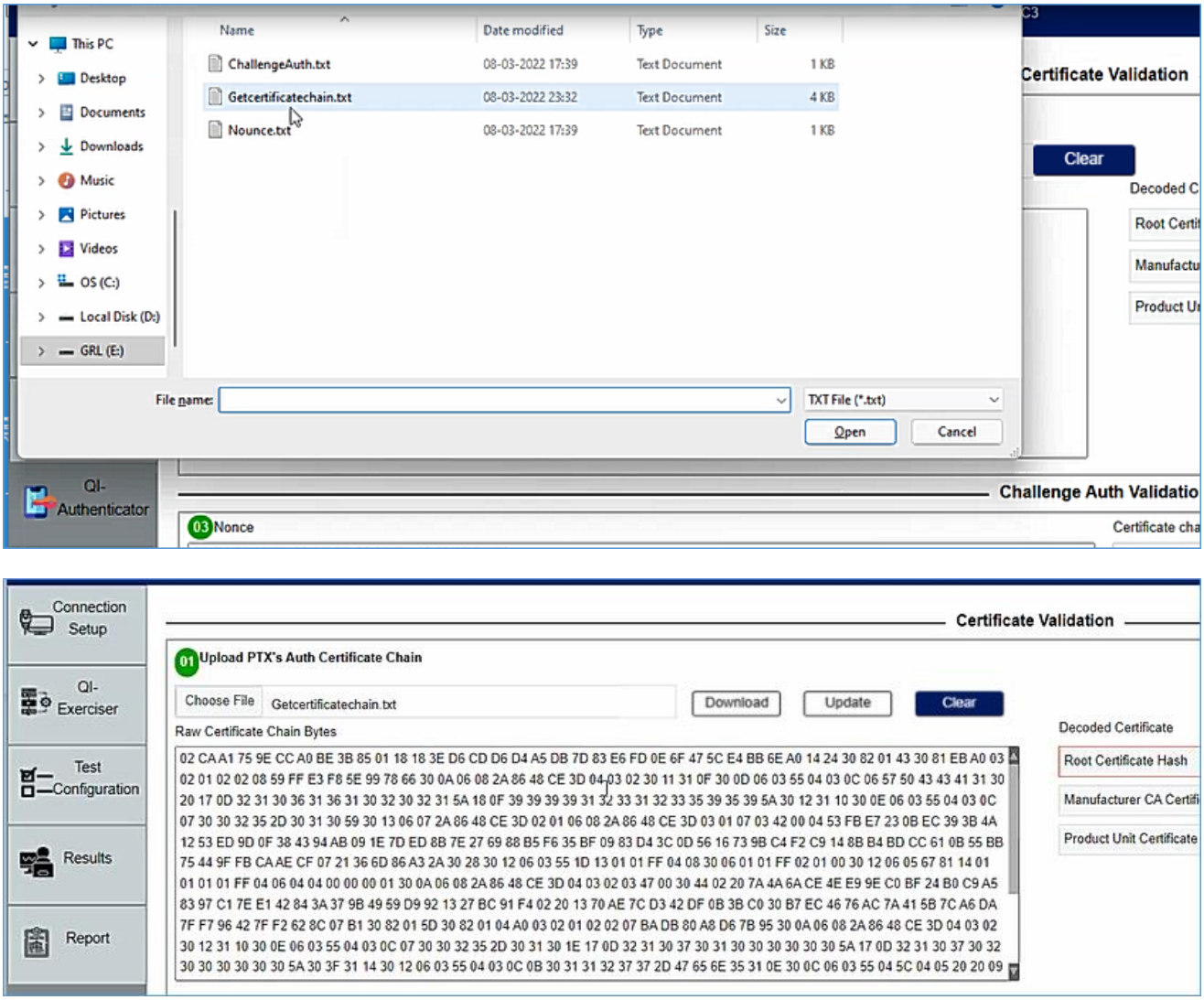


FIGURE 8.95: UPLOAD POWER TRANSMITTER AUTH CERTIFICATE CHAIN FILE EXAMPLE

2. To remove the selected Auth Certificate Chain file in any case, click on the **Clear** button. To download or update the file, click on the **Download** button or **Update** button respectively.

3. User can configure or perform decoding of the selected Auth Certificate Chain file in the "Decoded Certificate" panel on the right. Select from the **Root Certificate Hash**, **Manufacturer CA Certificate** or **Product Unit Certificate** drop-down panel to configure each respective field as required.

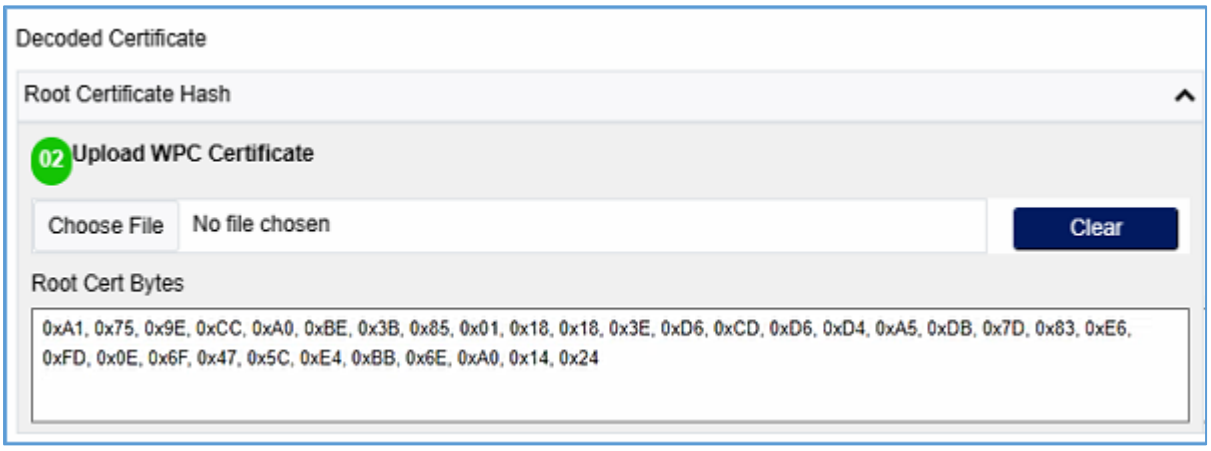


FIGURE 8.96: ROOT CERTIFICATE HASH DROP-DOWN PANEL

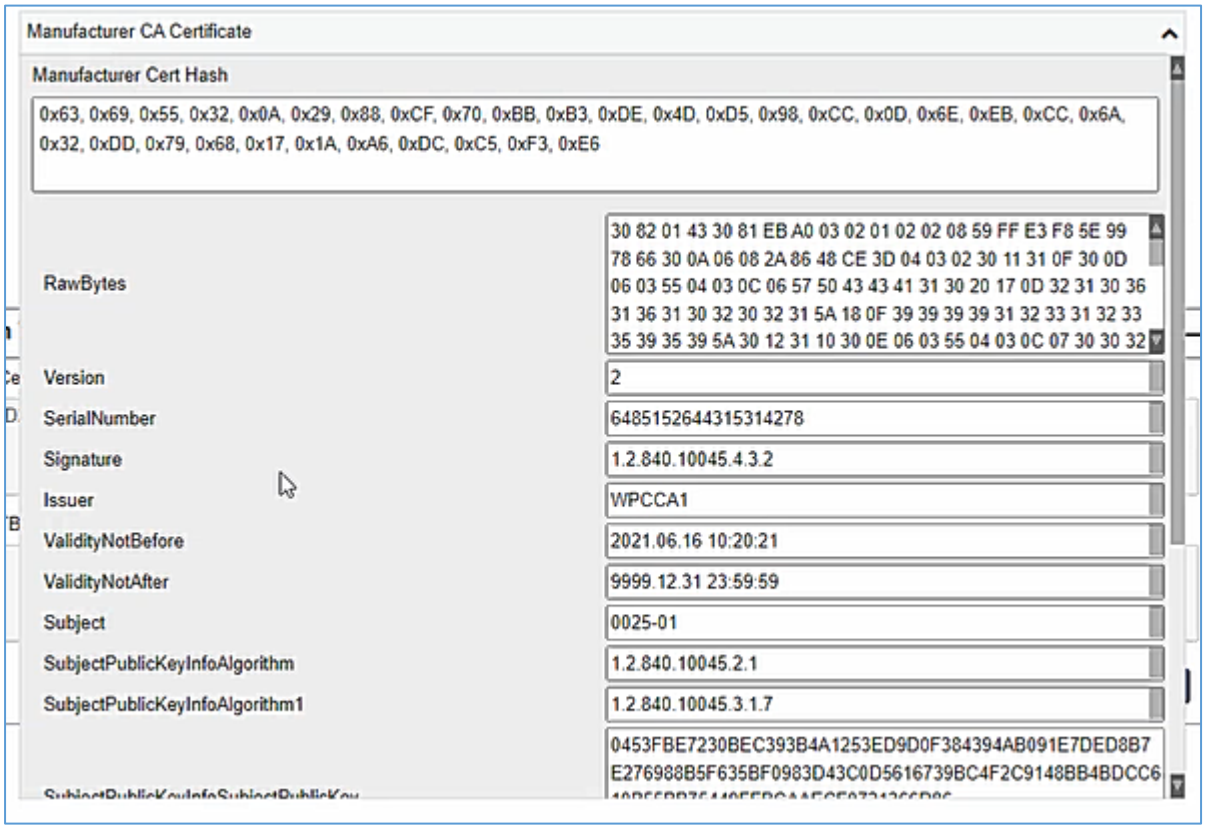


FIGURE 8.97: MANUFACTURER CA CERTIFICATE DROP-DOWN PANEL

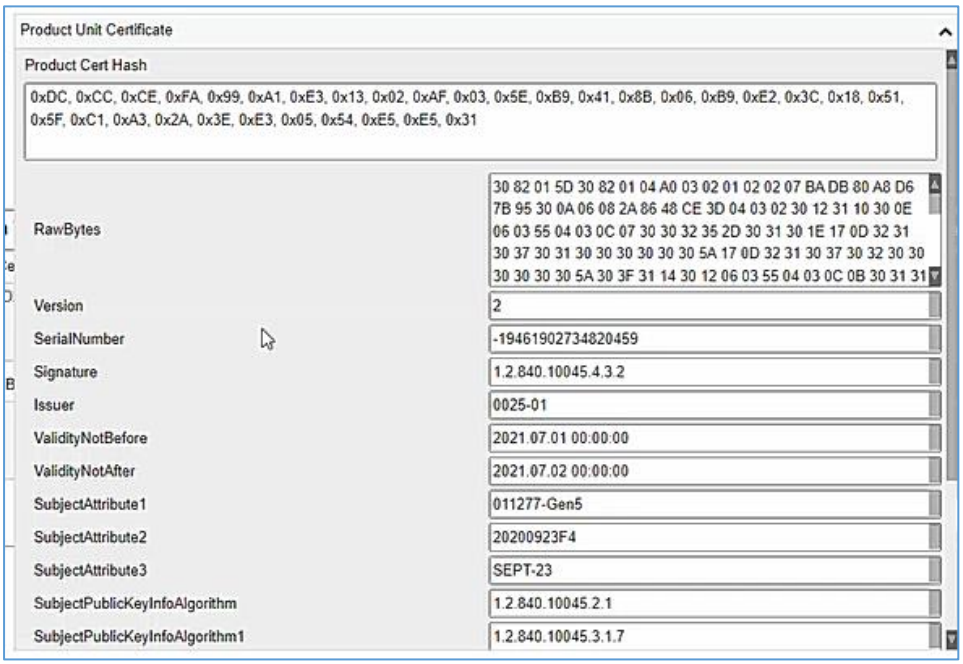


FIGURE 8.98: PRODUCT UNIT CERTIFICATE DROP-DOWN PANEL

4. Once configured, click on the **Save Changes** button at the top right of the screen. This will overwrite the existing certificate details with the new configuration/changes. The new changes will also be reflected in the “Raw Certificate Chain Bytes” panel where applicable.
5. User can download the newly configured certificate file by clicking on the **Download Certificate** button at the top right of the screen.

8.6.2 Validate Challenge Authentication for Power Receiver

Use the **Challenge Auth Validation** panel to validate the Challenge-Response Authentication which is authentication based on a challenge/response principle. This is to ensure that a wireless power receiver is connected to a recognized power transmitter.

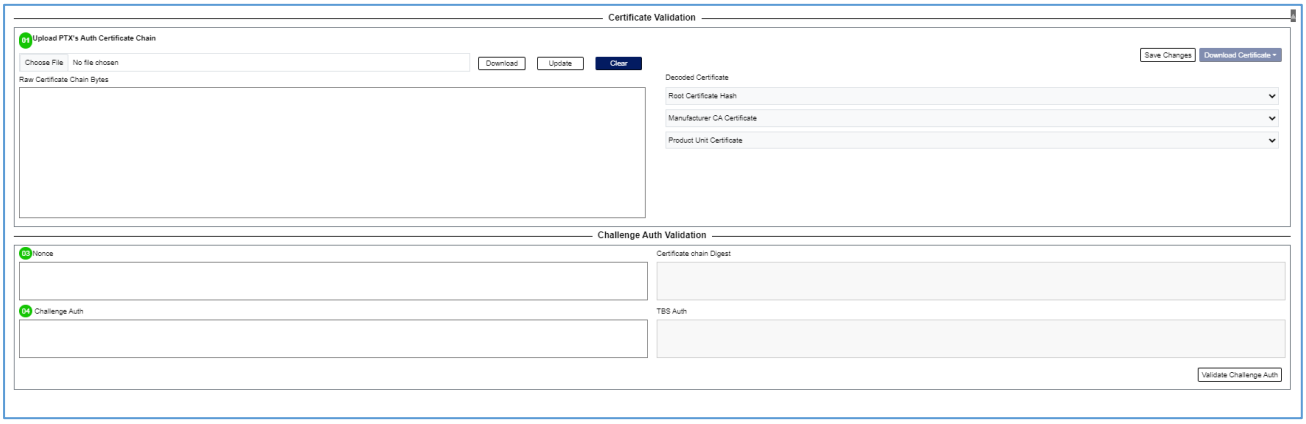


FIGURE 8.99: CHALLENGE AUTH VALIDATION PANEL

1. Select and open an existing **Nonce** file of the wireless device to be evaluated. Copy the contents of the Nonce file and paste them into the “Nonce” panel. See example below:

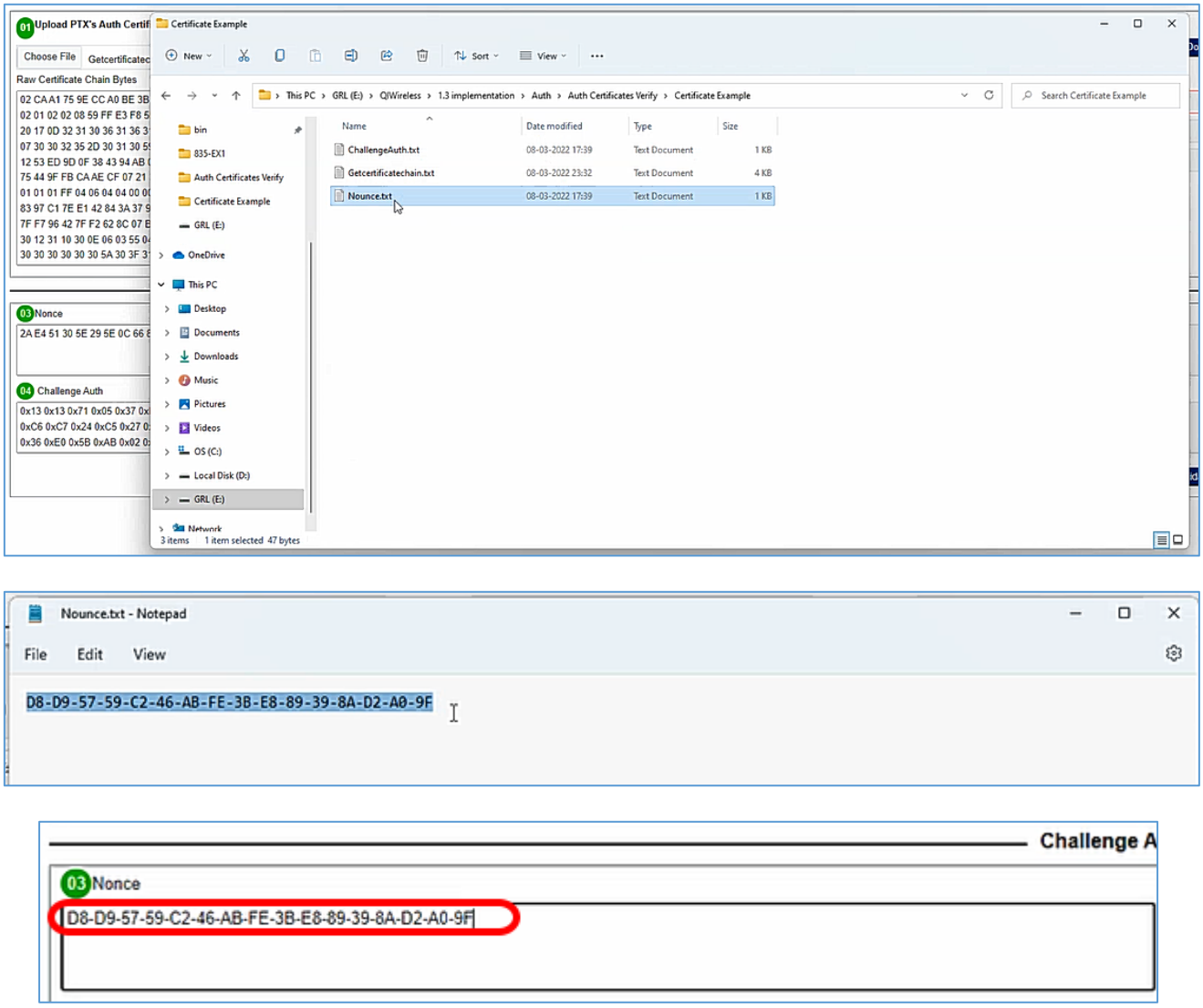
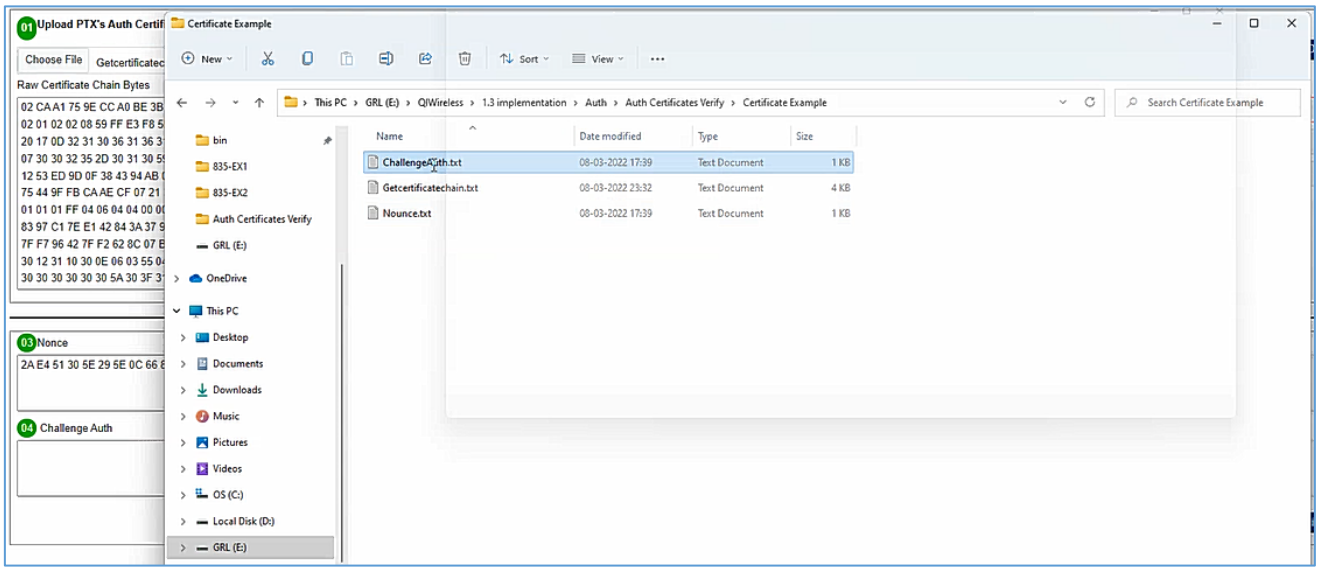
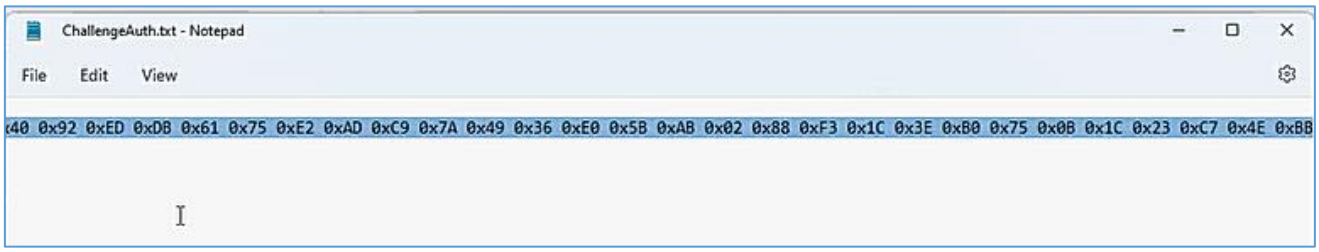


FIGURE 8.100: SELECT AND PASTE CONTENTS OF NONCE FILE

2. The “Certificate Chain Digest” panel on the right of the Nonce panel will be auto populated.
3. Select and open an existing **Challenge Auth** file, and copy the contents of the Challenge Auth file and paste them into the “Challenge Auth” panel. See example below:





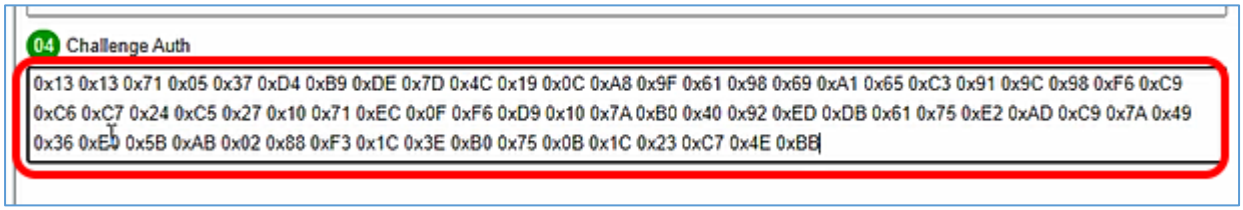


FIGURE 8.101: SELECT AND PASTE CONTENTS OF CHALLENGE AUTH FILE

4. Click on the **Validate Challenge Auth** button at the bottom right of the screen. Upon successful validation, the “TBS Auth” panel will be auto populated, and the **Challenge Signature Valid** status will appear. See example below:

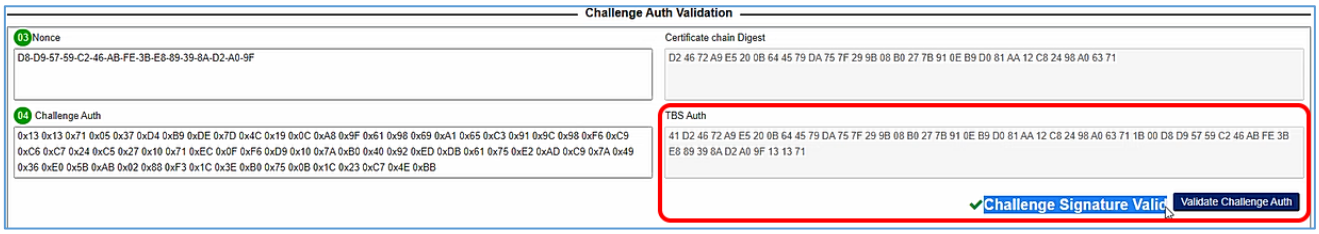


FIGURE 8.102: SUCCESSFUL CHALLENGE AUTH VALIDATION

9 GRL-C3 Information and Help

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

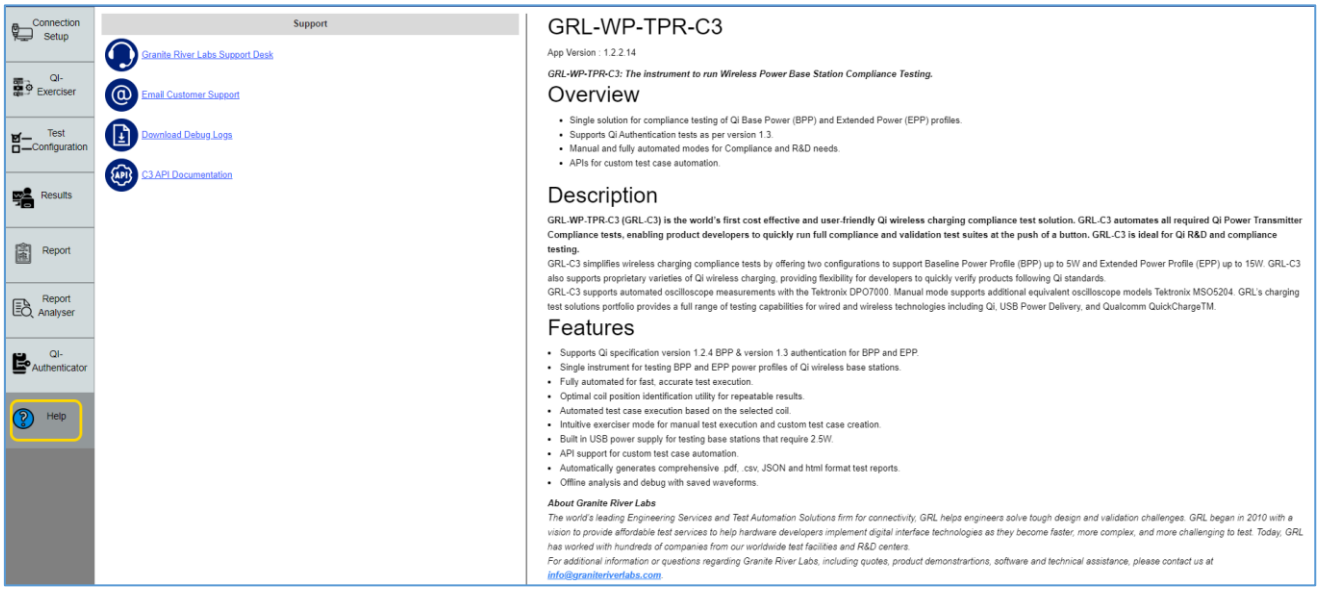


FIGURE 9.1: HELP SCREEN

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