GRL Platform Solutions

PCI Express® 7.0 Base (128 GT/s) Receiver Compliance Test Automation Solution User Guide & MOI

Using Anritsu MP1900A BERT, High-Performance Real Time Oscilloscopes and

Anritsu_GRLPS-PXE7-BASE-RXA Calibration and Test Automation Software

Published on 30 October 2026

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1 Introduction

This MOI & User Guide provides information using the Anritsu_GRLPS-PXE7-BASE-RXA test automation solution to set up and test an electrical receiver (Rx) device to meet PCI Express Base Specification Revision 7.0 compliance for 128.0 GT/s as per PCI Express (PCI-SIG) Standards.

The Anritsu_GRLPS-PXE7-BASE-RXA software automates the Anritsu MP1900A BERT and a high-performance real-time oscilloscope to calibrate the stressed eye opening and test receiver conformance and jitter tolerance. The Anritsu_GRLPS-PXE7-BASE-RXA software uses the Seasim statistical data eye simulator to establish the calibrated test channel DDJ. The final calibrated eye diagram uses the Seasim software to achieve the final stressed eye calibration.

The BERT setup provides the necessary test patterns with jitter, ISI and crosstalk along with the required transmitter (Tx) equalization. Once the stressed receiver eye opening has been calibrated, the receiver jitter tolerance and margin tests can then be performed on the device under test (DUT). The BERT is used to transmit a modified compliance pattern to the receiver DUT and monitors that the loopback pattern conforms to a Bit Error Rate (BER) of 10^{-6}.

Note: As PAM4 signaling is sensitive to noise and burst errors, the BER is also referred as First Bit Error Rate (FBER). FBER refers to Bit Error Rate without accounting for any burst error.

Note: For manual test methodology, refer to Appendix of this documentation or PCI-SIG for approved Method of Implementation (MOIs) as technical reference.

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2 Resource Requirements

Note: Equipment requirements may vary according to the lab setup and DUT. Below are the recommended lists of equipment for the typical test setup.

2.1 Equipment Requirements

Table 1. Equipment Requirements – Systems and Accessories

Equipment	Qty.	Description	Key Specification Requirement
Keysight/Tektronix Oscilloscope	1	High-Performance Real-Time Oscilloscope	• ≥ 65 GHz bandwidth with Windows 7+ OS [a] • Scope measurement software, e.g. Keysight InfiniiSim for Keysight scope or Tektronix DPOJET for Tektronix scope
Anritsu MP1900A BERT	1	MP1900A Signal Quality Analyzer-R, with following modules: • MU191000A Synthesizer • MU181500B Jitter Modulation Source • MU196020C PAM4 Pulse Pattern Generator [b] • MU196050B Noise Generator	
External Refclk Source	1	Required for Receiver DUT testing in the SRIS (independent Refclk) mode	
Pick-off Tee	2	Anritsu J1793A Pick-off Tee (V-connector)	
Variable ISI	1	PCIe Gen7-appropriate ISI channel / fixture	
Computer/PC (laptop or desktop)	1	For automation control Minimum requirements: • Windows 10+ OS • Intel Core i5 processor • 120GB SSD storage • 16GB RAM • Gigabit Ethernet Recommended requirements: • Windows 10+ OS • Intel Core i7+ processor • 200GB SSD storage • 32GB RAM • Gigabit Ethernet	

[a] *Oscilloscope with scope bandwidth as specified in vendor specific MOI's.*

[b] *The Anritsu_GRLPS-PXE7-BASE-RXA software supports PAM4 signaling with FEC modulation.*

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Note: *Cable connector type and length requirements may vary according to the lab setup and the dimensions of the DUT board. Table below is a recommended list. Please also refer to the respective manufacturer for detailed cabling recommendations related to PCI Express.*

Table 2. Equipment Requirements – Cables

Cable	Qty.	Key Specification Requirement / Connection
A. Cables for the calibration and DUT test paths		
Anritsu J1624A SMA-SMA cable (0.3 m) or J1625A SMA-SMA cable (1.0 m)	2 total	50-ohm clock leads, for: • MU191000A Clock OUT 1 to MU181500B Ext Clock Input • MU181500B Jittered Clock OUT 1 to MU196020C Ext Clock In
Anritsu J1948A matched noise cables	1 pair	0.4 m, SMA. MU196050B Noise OUT P / N to the matching J1793A PICK OFF ports. Straight ends at the noise module; right-angle ends at the tees.
Gen7-qualified matched RF cable pair: tee OUT to variable ISI / fixture IN	1 pair	50 ohm, matched P / N electrical lengths; connectors and loss/skew limits per the selected Gen7 setup
Gen7-qualified matched RF cable pair: ISI / fixture OUT to scope or DUT Rx	1 pair	Scope channels during calibration; reconnect the same pair to DUT Rx + / - for BER and jitter tolerance.
RJ45 Ethernet patch cables	3 baseline; +1 if needed	With one LAN switch: PC-to-switch, switch-to-MP1900A, switch-to-scope = 3. For DUT Ethernet readback, reuse the scope patch lead after calibration, or add a fourth lead to keep both connected.
DUT USB management / readback cable	1 if USB is selected	Automation PC to DUT for initialization and DUT error-count import
Anritsu J1627A GND connection lead	1	DUT / fixture GND to MP1900A GND
B. Conditional clock and interface items - select for the actual DUT and scope		
DUT REFCLK lead or matched pair	1 lead or 1 pair*	Selected board reference-clock source to DUT REFCLK. Cable type, connector, impedance and frequency depend on the DUT clock interface. *One lead for single-ended, one pair for differential; no external lead if the board supplies this connection internally.
External 100 MHz reference coaxial lead	1 if used	Additional SMA / approved 50-ohm lead from a compatible shared reference source to MU191000A 100 MHz Ref Input, only when external reference clocking is selected

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Cable	Qty.	Key Specification Requirement / Connection
DUT connector adapter cable pair (e.g. Rosenberger L71-456-102)	1 pair if needed	Two matched interface adapters, one per DUT Rx polarity
Scope input adapters	2 adapters if needed	One per measurement channel, matching the RF pair to the selected scope input connectors

2.2 Software Requirements

Table 3. Software Requirements

Software	Description/Source
Anritsu_GRLPS-PXE7-BASE-RXA	GRL Platform Solutions PCIe® 7.0 (128.0 GT/s) Base Specification Receiver Calibration and Test Automation Software – www.grlps.com Included with Node Locked License to single oscilloscope or PC OS
GRLPS Connection Agent	GRLPS Connection Agent is required to be installed on equipment running Windows OS, including: • Oscilloscope (Keysight/Tektronix) • BERT (Anritsu MP1900A BERT) Download GRLPS Connection Agent
VISA (Virtual Instrument Software Architecture) API Software	VISA Software is required to be installed on the control PC running Anritsu_GRLPS-PXE7-BASE-RXA software. GRL Platform Solution's software framework has been tested to work with all three versions of VISA available on the Market: 1. NI-VISA: http://www.ni.com/download/ni-visa-17.0/6646/en/ 2. Keysight IO Libraries: www.keysight.com *(Search on IO Libraries)* 3. Tektronix TekVISA: www.tek.com *(Downloads > Software > TekVisa)*
Seasim	Seasim tool for post-process analysis of the captured waveform (Eye Opening simulation software at TP2P) – www.pcisig.com

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3 Install and Set Up Anritsu_GRLPS-PXE7-BASE-RXA Software

This section provides the procedures for installing, configuring and verifying the operation of the Anritsu_GRLPS-PXE7-BASE-RXA software.

The software installer automatically creates shortcuts in the Desktop and Start Menu.

3.1 Download Anritsu_GRLPS-PXE7-BASE-RXA Software

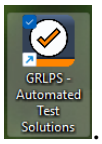
Install, launch and set up the Anritsu_GRLPS-PXE7-BASE-RXA software on the Scope or control PC.

1. Install VISA (Virtual Instrument Software Architecture) on the control PC/Scope where the Anritsu_GRLPS-PXE7-BASE-RXA software is to be used.
2. Download the software ZIP file package from the GRL Platform Solutions support site.

The ZIP file contains:

- **GRLPSPCIEGen7ANBaseSpecTestApplicationxxxxxxxxxSetup.exe** – Run this on the control PC or Scope to install the Anritsu_GRLPS-PXE7-BASE-RXA application.

3.2 Launch and Set Up Anritsu_GRLPS-PXE7-BASE-RXA Software

1. Open the GRL Platform Solutions host application using the "**GRLPS - Automated Test Solutions**" desktop shortcut 

.
2. The GRLPS Host App launcher will appear which allows you to select the desired platform to open the GRL Platform Solutions applications. You can scan the barcode and access the applications on your mobile device, copy and paste the URL address, open on a web browser or on a separate window. Additionally, you can access the user activity/debug logs and run statistics on the results of test executions.

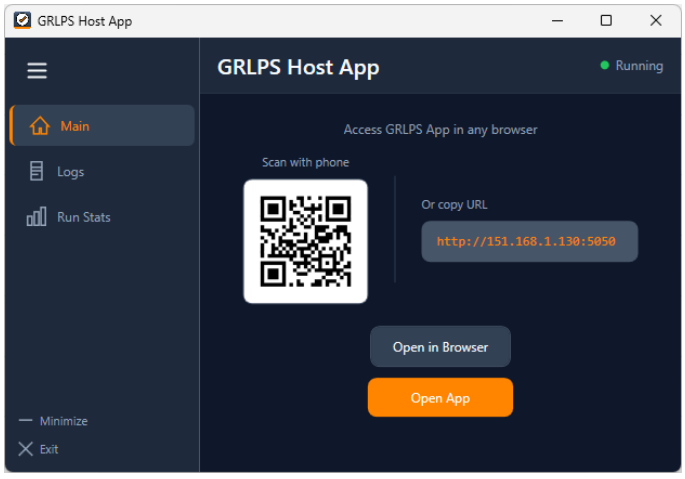


Figure 1. GRLPS Host App Launcher

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3. In the GRLPS Host App main window, all installed applications will be displayed by default. You can search or filter specific applications as required.

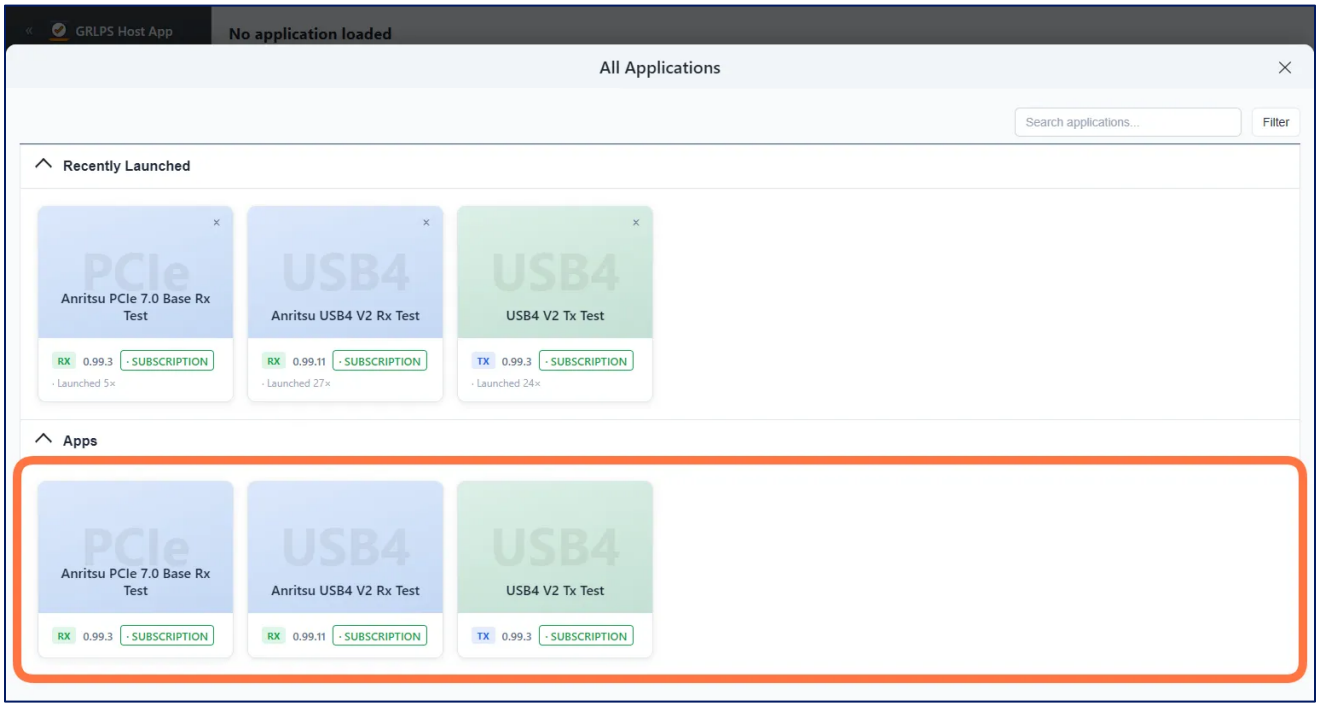


Figure 2. GRLPS Host App Main Window – All Applications

4. Select and open the **Anritsu PCIe 7.0 Base Rx Test** application.



Figure 3. Select and Open Anritsu PCIe 7.0 Base Rx Test application

5. If the application is running without an active license, a red banner will be displayed on top of the app window:



This informs you that the application is non-activated or the license for the application has expired and that some features will be limited.

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6. To restore licensed functionality, request a demo license using the link **Click here to request a demo license**. In the “Request Demo License” pop up, click on the respective buttons to open the link or copy and paste the link in a web browser.

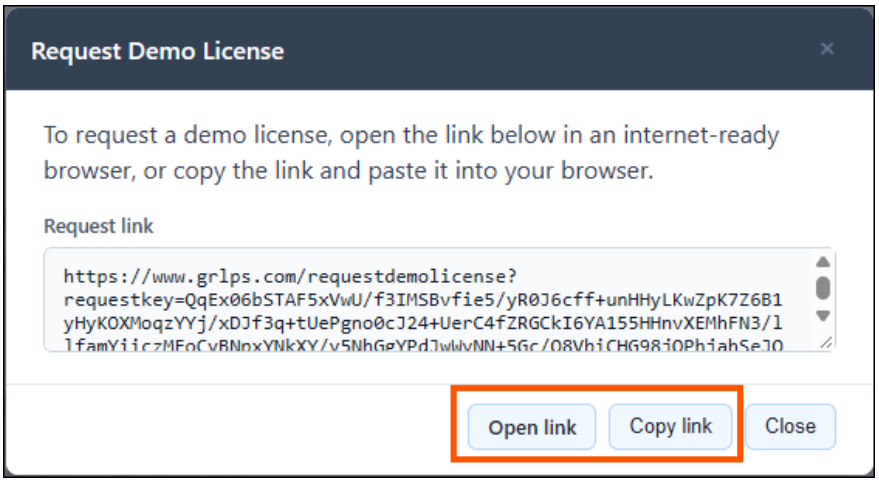


Figure 4. Request Demo License for Anritsu PCIe 7.0 Base Rx Test Application

7. Enter your particulars in the “Request Demo License” form and click on the **Submit** button.

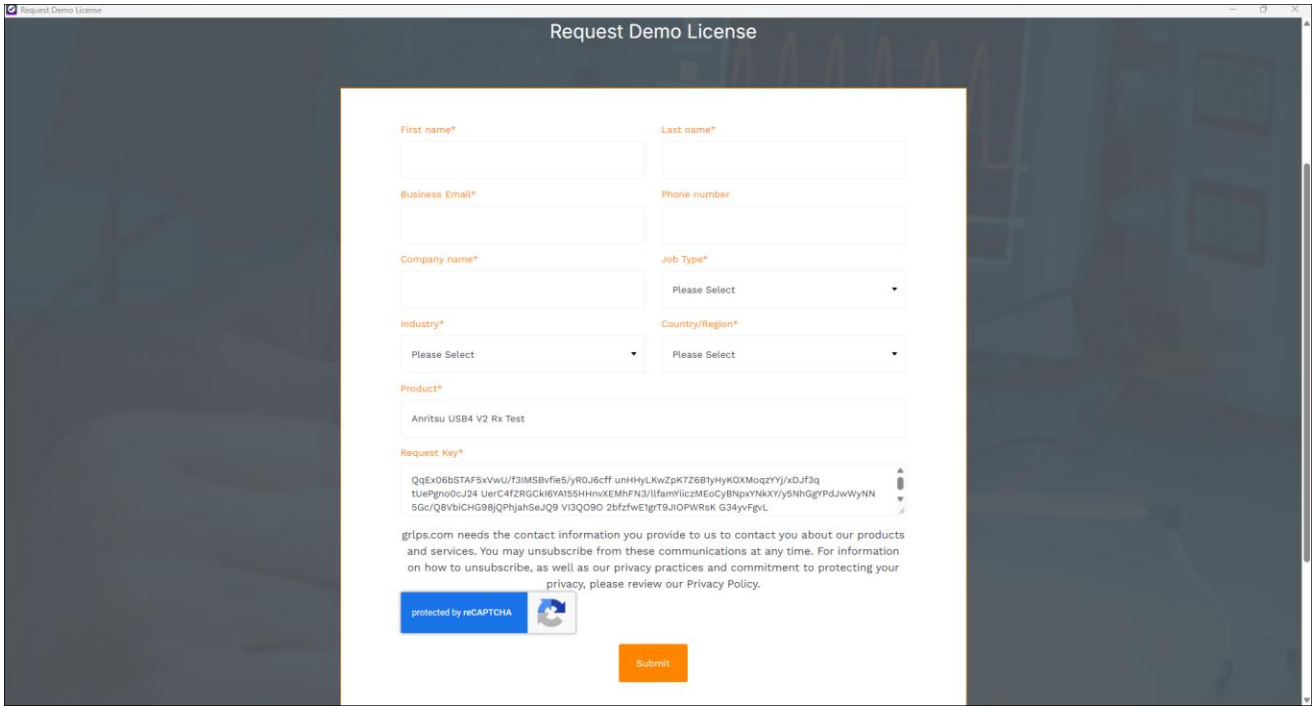


Figure 5. Request Demo License Form Submission

8. You can check the license status for the Anritsu PCIe 7.0 Base Rx Test application by selecting **Menu** → **License Info** on the left panel bar.

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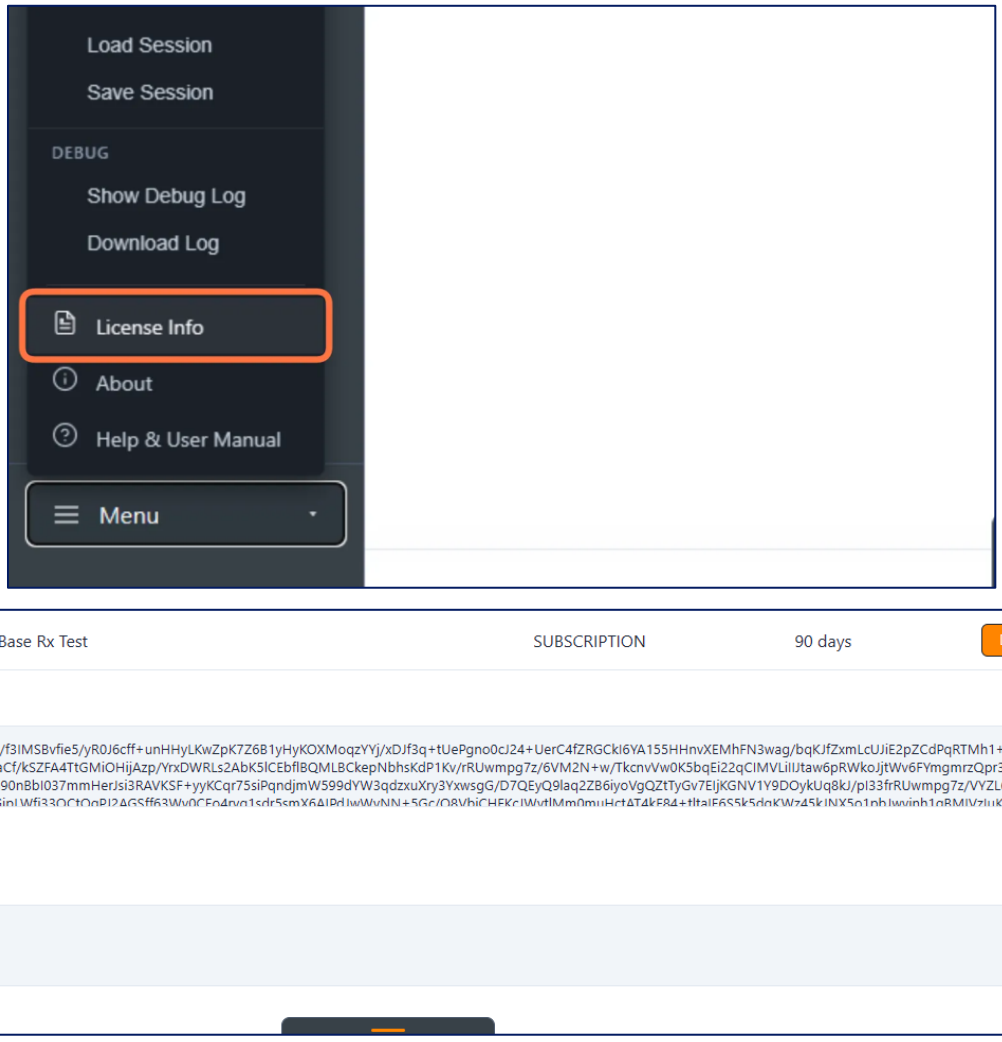


Figure 6. Check License for Anritsu PCIe 7.0 Base Rx Test Application

9. Activate the license for the Anritsu PCIe 7.0 Base Rx Test application by entering the Activation Key in the **License Key** field provided and select **Activate**. The installed application is ready for use upon successful activation.
10. Review the equipment, accessories and software requirements by selecting **Prerequisites** on the left panel bar. Make sure that all these requirements are met before proceeding with equipment setup.

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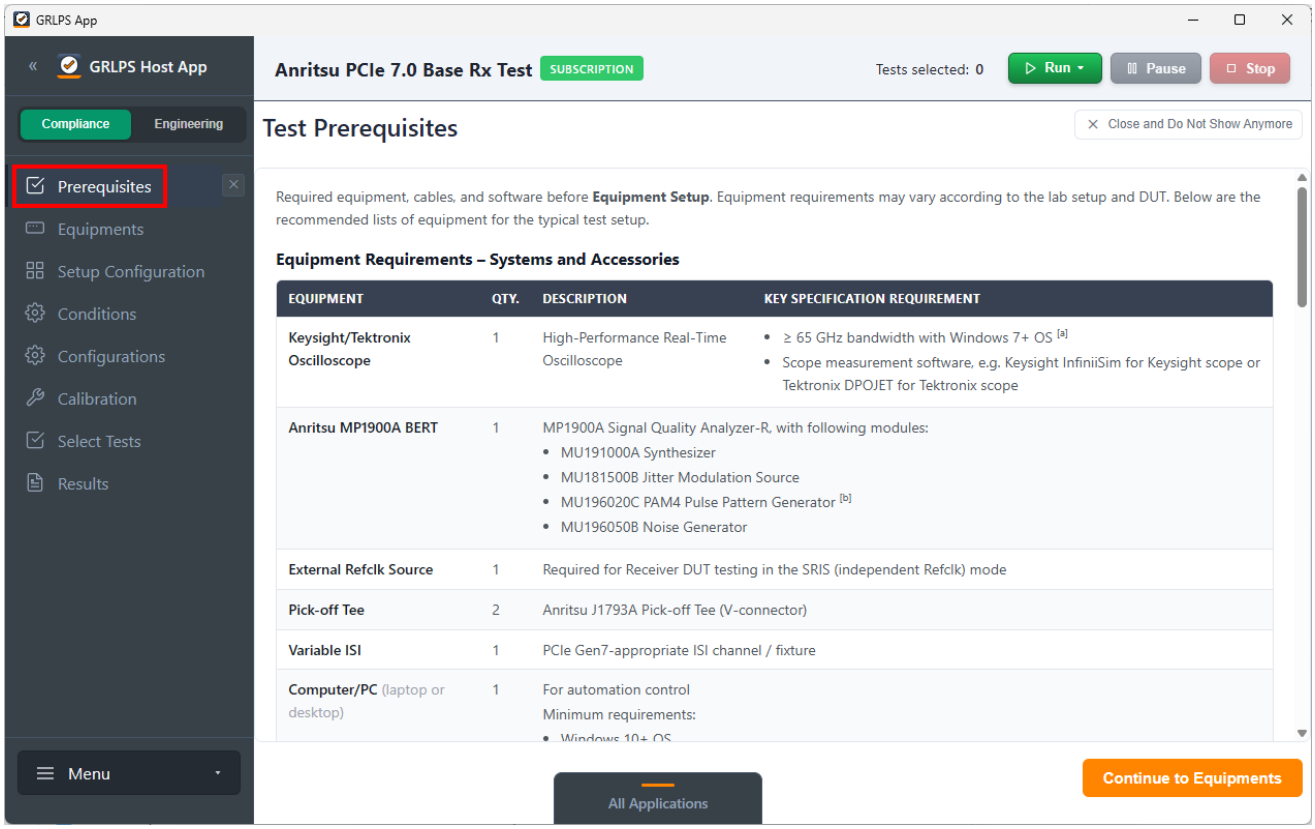
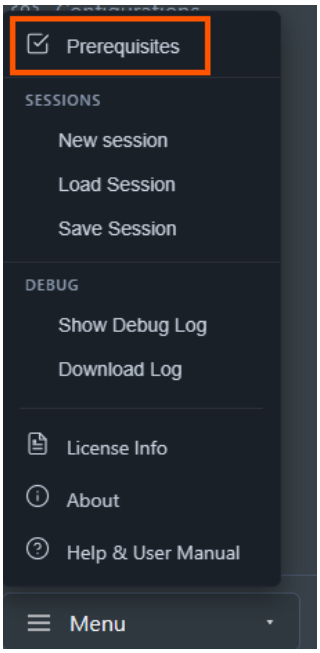


Figure 7. Check PCIe 7.0 Base Rx Test Pre-requisites

11. Once all pre-requisites are verified, click on the **Continue to Equipment Setup** button to set up the equipment connections. To dismiss the Test Prerequisites screen for future sessions, click on the **Close and Do Not Show Anymore** button. In case it is needed again, select it from the Menu options as shown below:



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3.2.1 Set Up GRLPS Connection Agent (Remote File Proxy Server)

The GRLPS Connection Agent connects your lab equipment including BERTs and oscilloscopes to GRLPS test applications over the local network.

The agent enables GRLPS test applications to automatically detect and control the equipment remotely and transfer waveform and test data files.

You can then run GRLPS compliance test suites from a workstation while the instruments remain connected at the test bench.

1. Download the GRLPS Connection Agent application and install it on the control PC and all connected equipment including the Scope and BERT.
2. The GRLPS Connection Agent must be run on the Scope to move large waveform files back to the control PC. The Anritsu_GRLPS-PXE7-BASE-RXA software will then perform post-processing and analysis of these waveforms using Seasim.
3. When running the GRLPS Connection Agent, make sure that the control PC and equipment are connected to the same network, using IP addresses as in the following example:
    - Control PC IP address: 192.168.1.8
    - Scope IP address: 192.168.1.101



Figure 8. Verify Proxy Server Connection for Control PC and Scope

4. On the GRLPS Connection Agent, you can also access remote server information and manage VISA connections of the connected equipment from the **Equipment Server** tab as shown in the example below:

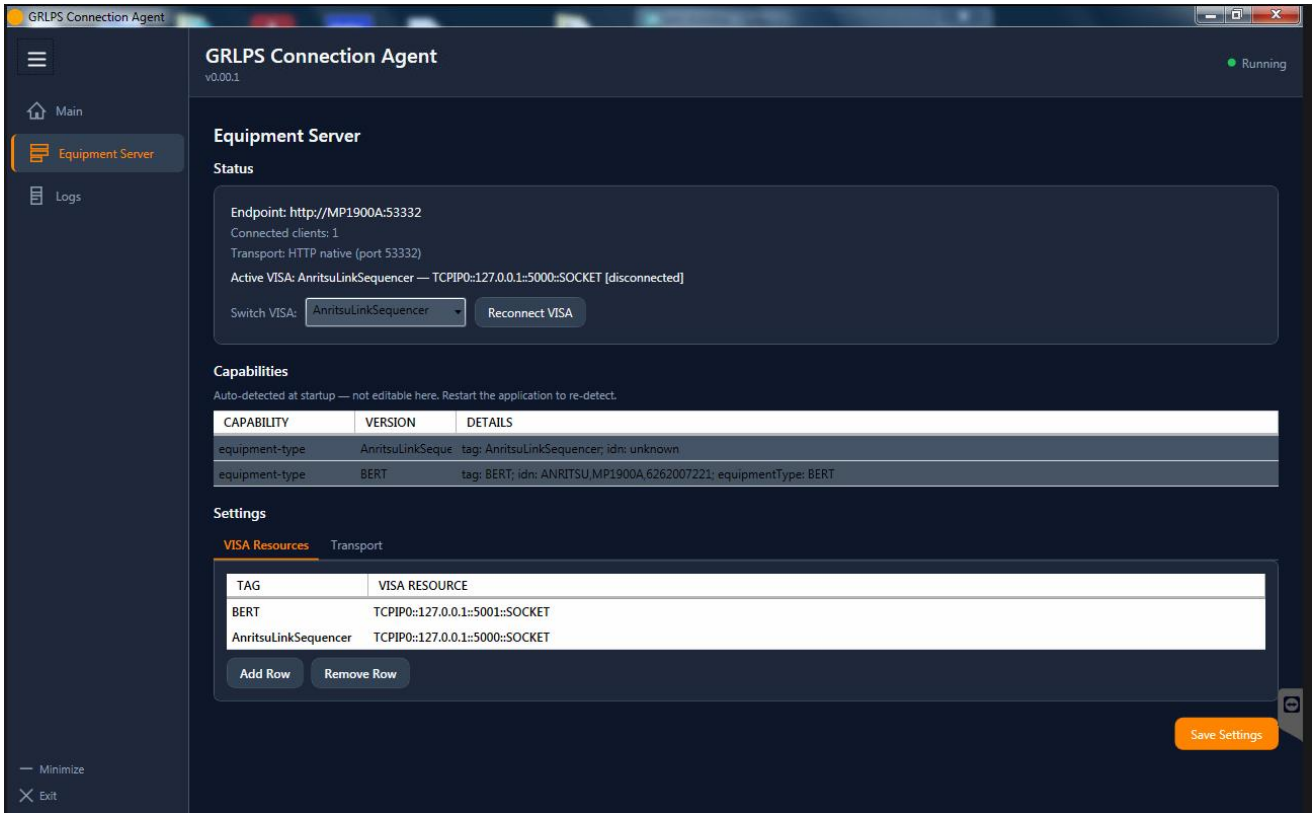


Figure 9. Equipment Server Information

The Equipment Server screen provides access to local HTTP endpoint with live status and connected clients. By allowing the user to manage the active VISA connections of the connected equipment, the user is able to switch between equipment without restarting the GRLPS Host App.

3.2.2 Connect Anritsu_GRLPS-PXE7-BASE-RXA Software with Equipment

1. Set up the **GRLPS Connection Agent** as described in Section 3.2.1 above.
2. Select the **Equipments** tab on the left panel bar of the Anritsu_GRLPS-PXE7-BASE-RXA Test application.
3. Connect the Keysight Scope or Tektronix DPOJET Series Scope with the control PC through GPIB, USB or LAN. Select the connected oscilloscope from the drop-down option:

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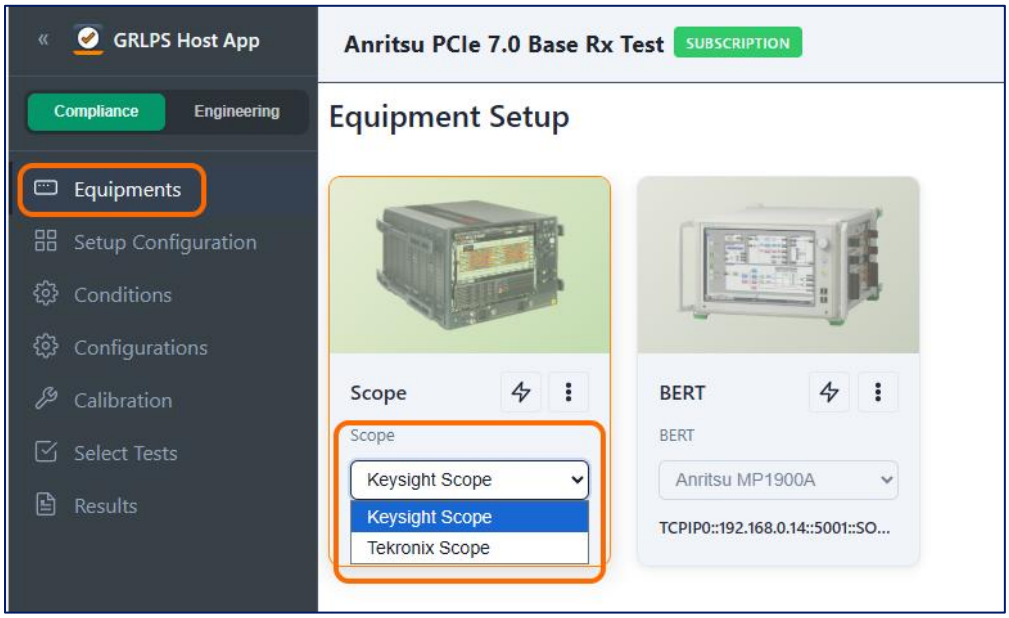


Figure 10. Select Connected Vendor Oscilloscope

4. Click on the ‘Scope’ pane and the GRLPS Connection Agent should automatically detect the connected Scope and display the address when you select the drop-down arrow of the “Address” field.

   Optionally, you can also click on the **Discover** button on the top right of the screen to detect all connected scopes.

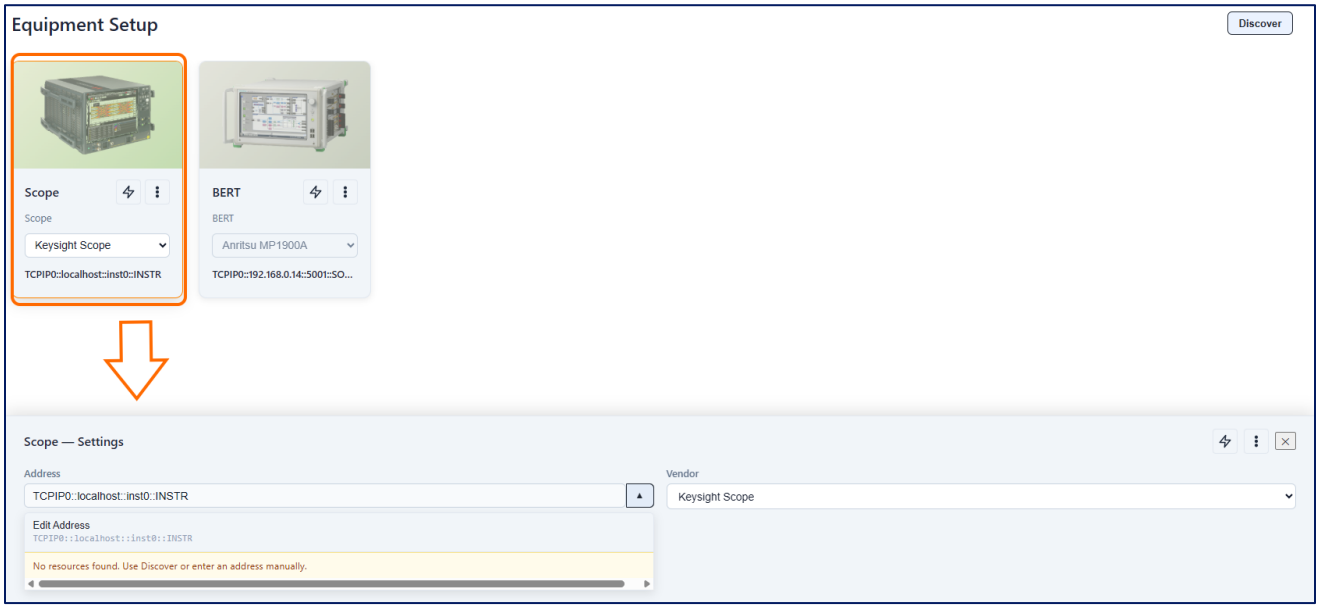


Figure 11. Set Scope IP Address

5. Connect the Anritsu MP1900A BERT via LAN to the GRL Platform Solutions automation control enabled Scope or PC. Click on the ‘BERT’ pane and the GRLPS Connection Agent should automatically detect the connected BERT and display the address when you select the drop-down arrow of the “Address” field.

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Optionally, you can also click on the **Discover** button on the top right of the screen to detect the connected BERT.

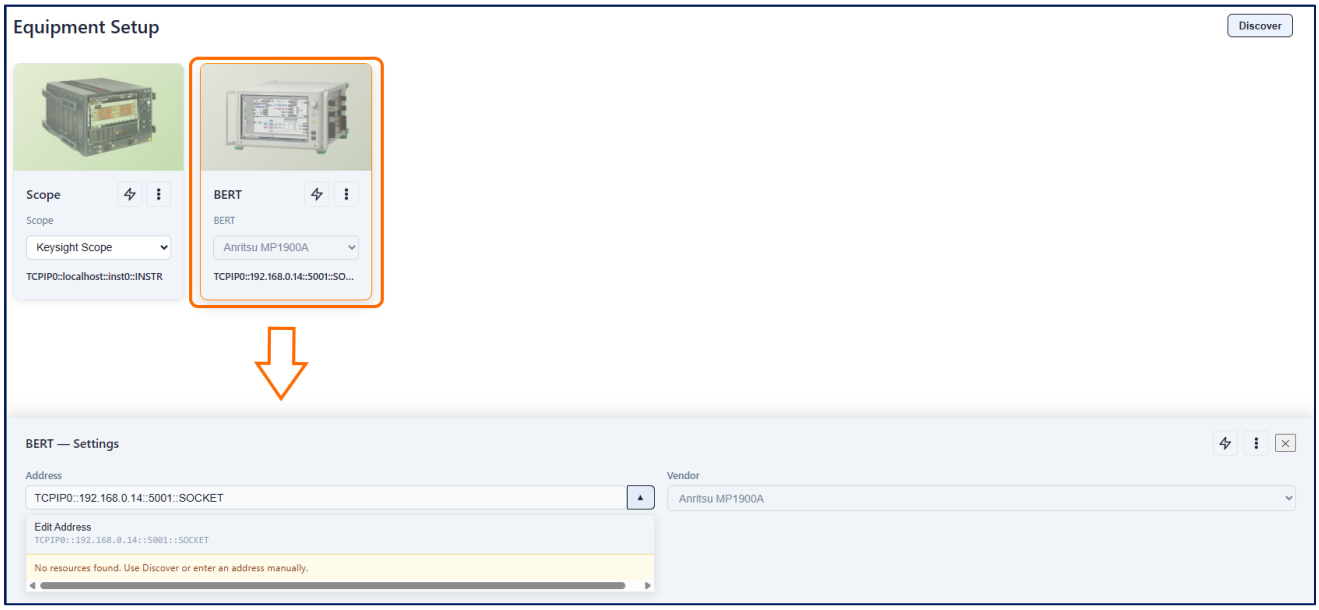
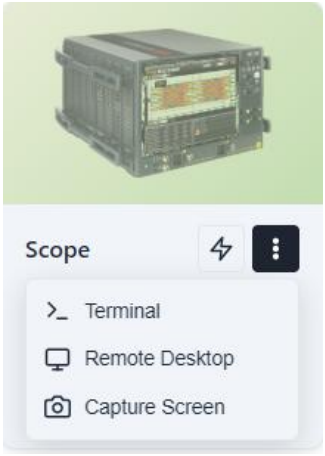


Figure 12. Set BERT Network Address

6. Click on the “lightning” button  which should turn green when successfully connected to each equipment.

7. For each equipment, you can click on to select the options to send remote commands or perform remote desktop control and screen capture for the equipment.



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4 PCIe7 Base Receiver Calibration and Test Connection Setups

Calibration for the PCIe 7.0 Base Specification are performed at two physical test points – TP1 and TP2. TP1 is a physical test point for calibration without the effect of a channel. An adjustable calibration channel is defined that is to be used along with the replica channel for stressed eye calibration. After calibration the signal source will go through the breakout channel to the DUT for Rx compliance testing. TP2 is a physical test point that will affect the eye opening due to trace length. Post processing analysis of the signal is performed at the TP2P test point using the Seasim application to simulate the stressed eye opening after applying Rx Behavioral package, Rx CTLE, DFE and 29-tap Rx FFE (if required).

To calibrate the stressed eye at TP2, the calibration channel shall receive signals with appropriate test patterns generated by the signal source. After calibration the signal source shall be used for testing Rx DUT compliance.

Note: Calibration for the differential voltage swing and Tx equalization of the signal source are performed at the TP3 test point. Overall calibration channel loss shall be determined after the TP3 test point. Calibration channel is 36 dB nominally (informative) for 128.0 GT/s (including Rx package).

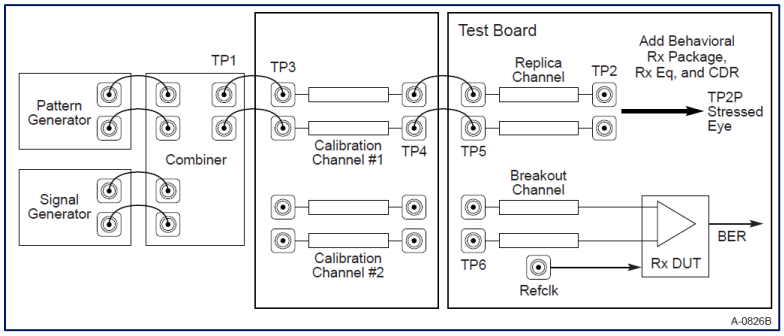


Figure 13. Rx Calibration/Test Schematic Overview from the PCIe 7.0 Base Specification

Data Rate	$F_{LOW-IL-MIN}$	$F_{LOW-IL-MAX}$	$F_{HIGH-IL-MIN}$	$F_{HIGH-IL-MAX}$
128.0 GT/s Root Port	3.2 dB @ 1 GHz	4.2 dB @ 1 GHz	26.5 dB @ 32 GHz	27.5 dB @ 32 GHz
128.0 GT/s Non-Root Port	3.9 dB @ 1 GHz	4.9 dB @ 1 GHz	31.5 dB @ 32 GHz	32.5 dB @ 32 GHz

Figure 14. Calibration Channel IL Limits from the PCIe 7.0 Base Specification

The following return loss mask applies for either end of the 128.0 GT/s calibration channel:

- ≤ -12 dB for ≥ 0 GHz and < 32 GHz
- ≤ -10 dB for ≥ 32 GHz and ≤ 40 GHz

Once the final stressed eye has been calibrated successfully, receiver stress jitter voltage tolerance and margin testing can then be performed on the device under test (DUT). The DUT should have a Replica Channel of the same Insertion Loss as the Replica Channel used for calibration. The Replica Channel is removed when performing the DUT tests.

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The Anritsu_GRLPS-PXE7-BASE-RXA software automates the receiver compliance and jitter tolerance testing, at the spec-defined or user-defined jitter frequency steps. The Anritsu_GRLPS-PXE7-BASE-RXA software also supports nested loop testing of multiple parameters to facilitate silicon PVT testing or testing across multiple test conditions. When testing is completed, the results will be logged in an aggregated test report which can be generated into a PDF format.

Receiver device compliance ensures the receiver DUT is able to correctly interpret data from a received signal with valid voltage and timing characteristics by achieving an acceptable bit error rate (BER) of less than 1E-6. The signal used for verifying receiver tolerance must contain the maximum allowable jitter, noise and signal loss. The stressed receiver tolerance test should include various differential mode sinusoidal interference, minimum transmitter voltage amplitude and jitter which includes random jitter and a sinusoidal periodic jitter component that is swept across specific frequency intervals.

Once the stressed receiver tolerance test setup has been calibrated, the BERT will transmit a modified compliance pattern to the receiver and monitors the loopback pattern has a BER that is less than 1E-6.

The following sections describe the connection diagrams for PCIe7 Base Rx calibration and testing.

4.1 Connection Setup for Scope Intrinsic Noise Measurement (Pre-Calibration)

Pre-calibration will be performed prior to calibration to measure the oscilloscope intrinsic noise. Figure 15 below shows the setup diagram to measure the intrinsic noise generated by the oscilloscope with no external signal applied. The intrinsic noise waveforms will be captured and saved for Seasim processing in subsequent calibration steps.

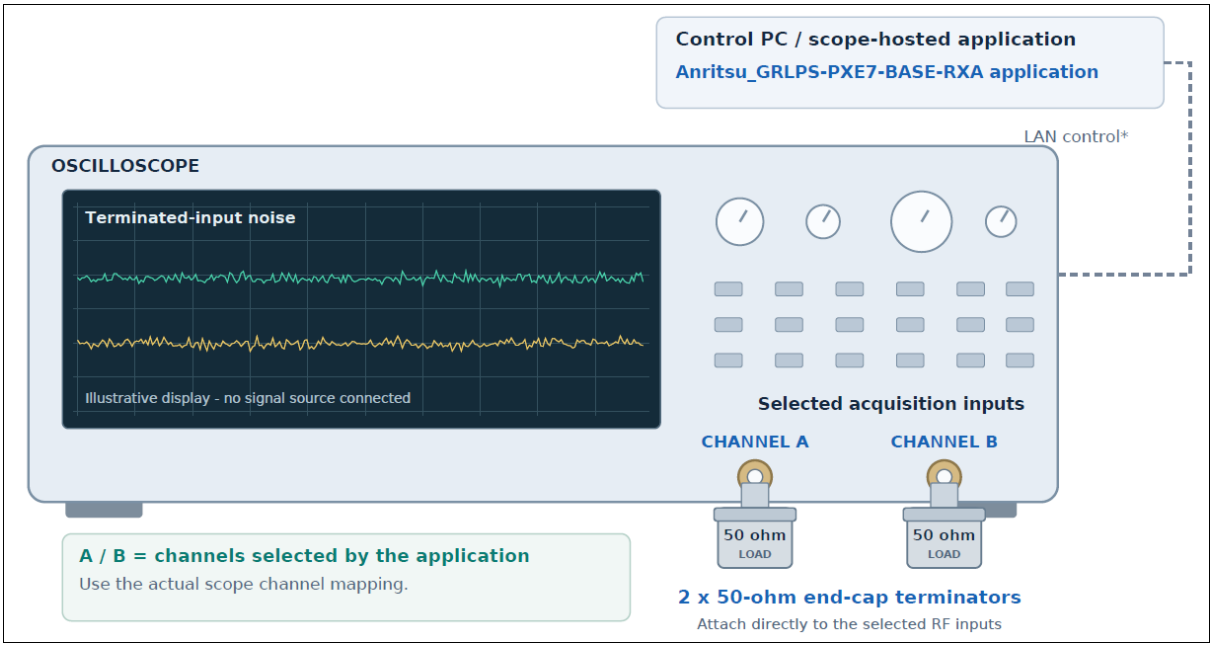


Figure 15. Setup for Scope Intrinsic Noise Measurement

Connection Step:

Connect 50-ohm terminators to the oscilloscope channels.

*Note: * External PC: LAN to scope. Scope-hosted software: No separate PC-to-scope LAN cable is required.*

Note: If the Tektronix ATI based oscilloscope is used, connect 50-ohm terminators to the scope channels 1 and 2.

4.2 Set Up Automated Rx Calibration for TP1 (Output of BERT Generator)

Once the scope intrinsic noise measurement has been completed, continue with the following calibration setup at TP1 (output of the BERT generator) using an Anritsu_GRLPS-PXE7-BASE-RXA automation control enabled PC/oscilloscope and Anritsu MP1900A BERT.

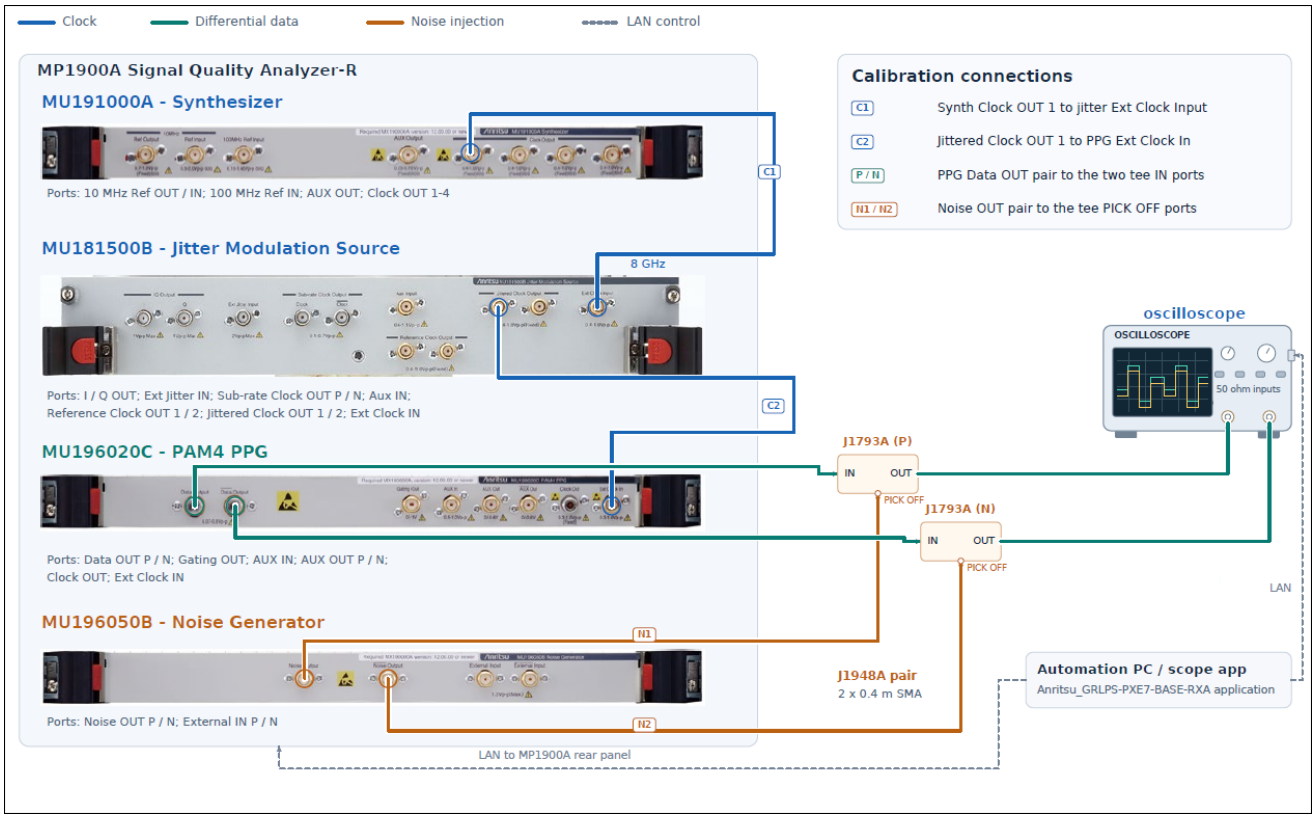


Figure 16. Recommended Setup for TP1 Rx Calibration

1. Using a short SMA–SMA cable, connect MU191000A Clock Output 1 to MU181500B Ext Clock Input.
2. Using a short SMA–SMA cable, connect MU181500B Jittered Clock Output 1 to MU196020C Ext Clock In.
3. Attach one J1793A pick-off tee directly to each MU196020C Data Output P and N connector, using the tee's IN port.

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4. Using the J1948A matched cable pair, connect MU196050B Noise Output P and N to the corresponding tees' PICK OFF ports. Connect the straight cable ends to the noise module and the right-angle ends to the tees.
5. Using a matched cable pair, connect the two J1793A OUT ports to the oscilloscope channels. Use the required scope input adapters and 50-ohm input configuration.
6. Connect the automation PC, MP1900A rear LAN port and oscilloscope LAN port through the instrument-control network.

4.2.1 TP1 Calibration Setup with Tektronix ATI Based Oscilloscope

If the Tektronix ATI based oscilloscope is used, proceed with the following TP1 calibration setup.

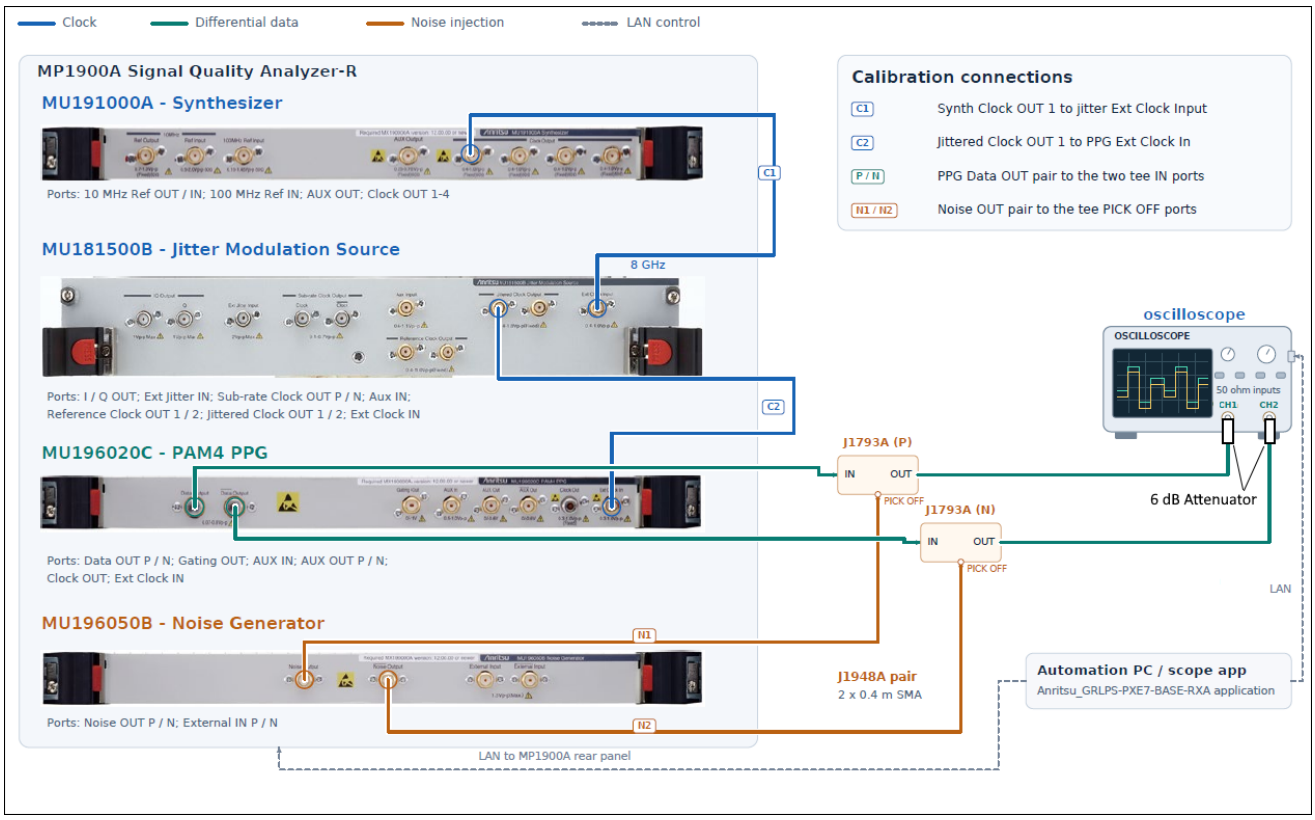


Figure 17. Recommended Setup for TP1 Rx Calibration Using Tektronix ATI Scope

*Note: Make sure that the "Tektronix Scope Type" is set to **Dual ATI** in the Configurations page (see Section 8).*

1. Follow back the same connections in Section 4.2 above.
2. Using a matched cable pair, connect the two J1793A OUT ports to Channels 1 and 2 on the Tektronix ATI based oscilloscope through 6 dB attenuators.

4.3 Set Up Automated Rx Calibration for TP2 (Output of Long Channel)

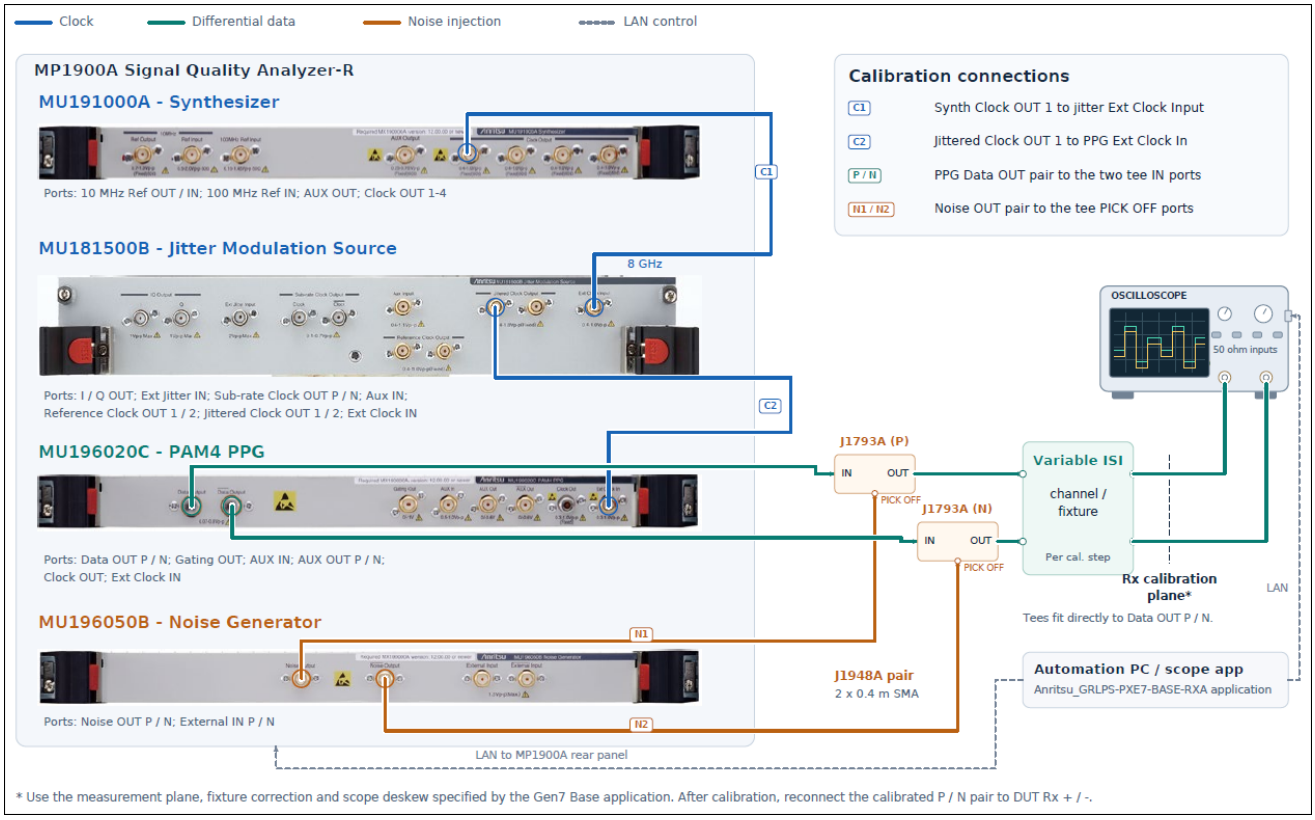


Figure 18. Recommended Setup for TP2 Long Channel Rx Calibration

1. Using a short SMA–SMA cable, connect MU191000A Clock Output 1 to MU181500B Ext Clock Input.
2. Using a short SMA–SMA cable, connect MU181500B Jittered Clock Output 1 to MU196020C Ext Clock In.
3. Attach one J1793A pick-off tee directly to each MU196020C Data Output P and N connector, using the tee's IN port.
4. Using the J1948A matched cable pair, connect MU196050B Noise Output P and N to the corresponding tees' PICK OFF ports. Connect the straight cable ends to the noise module and the right-angle ends to the tees.
5. Using a Gen7-qualified matched RF cable pair, connect the two J1793A OUT ports to the corresponding variable ISI channel / fixture inputs, maintaining P/N polarity.
6. Using a second Gen7-qualified matched RF cable pair, connect the ISI channel / fixture outputs to the oscilloscope channels. Use the required scope input adapters and 50-ohm input configuration.
7. Connect the automation PC, MP1900A rear LAN port and oscilloscope LAN port through the instrument-control network.

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4.3.1 TP2 Calibration Setup with Tektronix ATI Based Oscilloscope

If the Tektronix ATI based oscilloscope is being used, proceed with the following TP2 calibration setup.

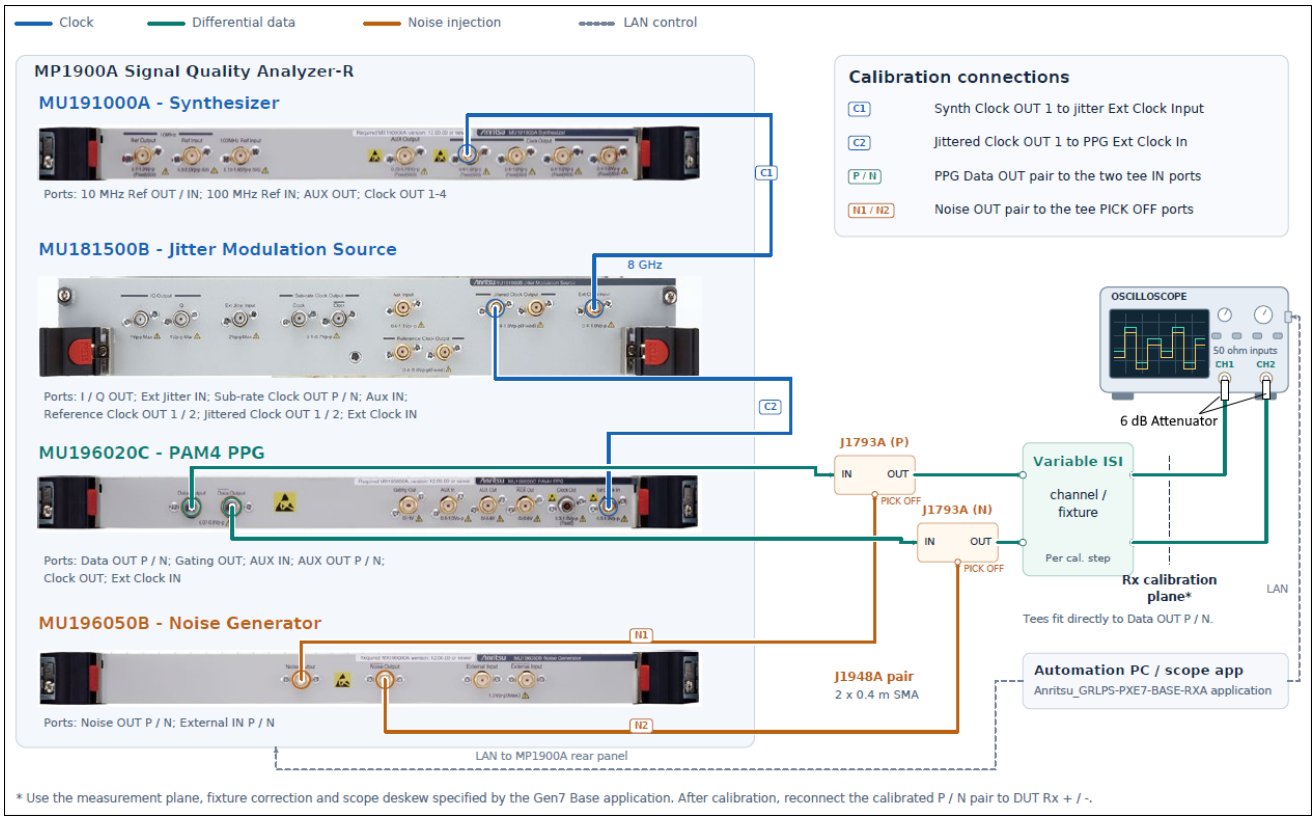


Figure 19. Recommended Setup for TP2 Long Channel Rx Calibration Using Tektronix ATI Scope

*Note: Make sure that the "Tektronix Scope Type" is set to **Dual ATI** in the Configurations page (see Section 8).*

1. Follow back the same connections in Section 4.3 above.
2. Connect the ISI channel / fixture outputs to Channel 1 and 2 on the Tektronix ATI based oscilloscope through 6 dB attenuators.

4.4 Receiver DUT Compliance Test Setup

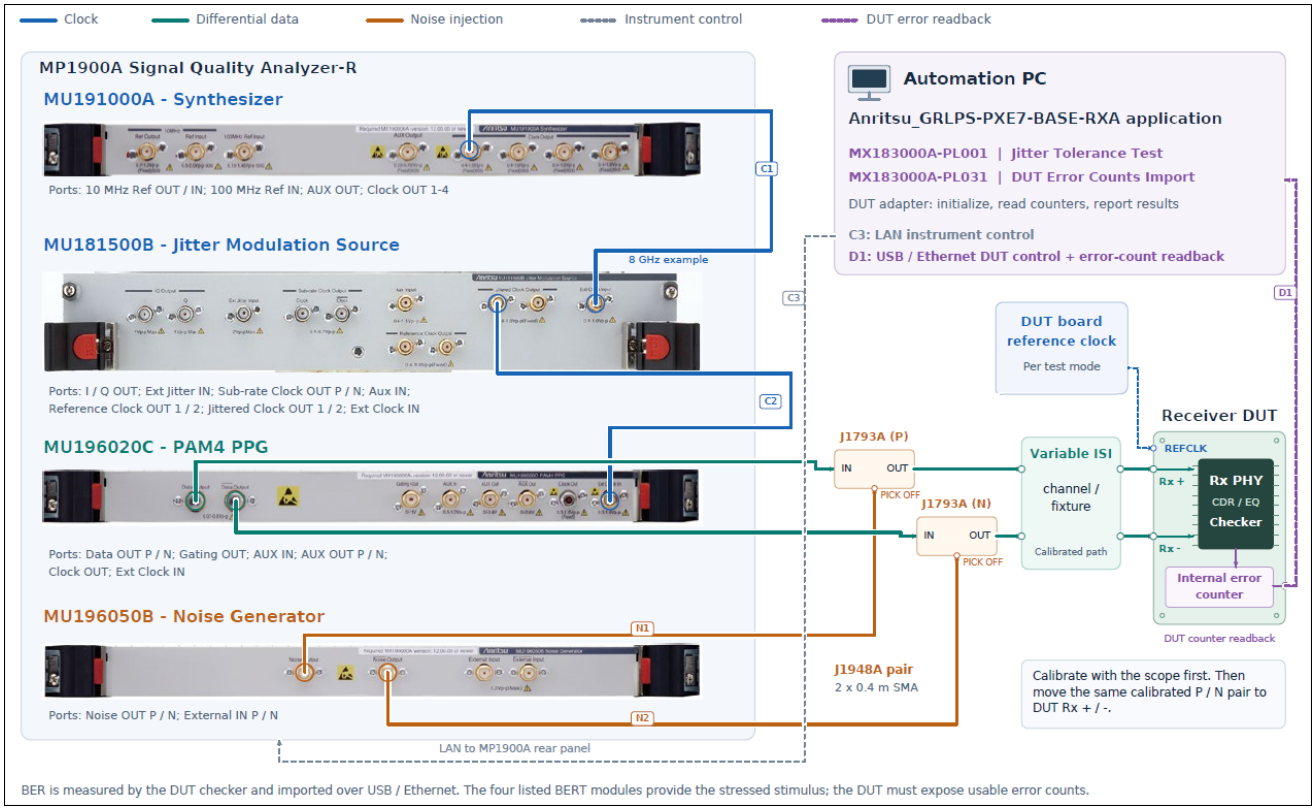


Figure 20. Recommended Test Setup for Receiver DUT

Note: Clocking is DUT / test-mode dependent. If external 100 MHz clocking is required, connect the DUT REFCLK to the MU191000A 100 MHz Ref Input, e.g.:

- *If using an Add-in card DUT, connect the MU181500B sub-rate clock outputs to the DUT REFCLK using coaxial cables.*
- *If using a System DUT, connect the DUT REFCLK to the MU191000A 100 MHz Ref Input with a BNC cable.*

1. Using a short SMA–SMA cable, connect MU191000A Clock Output 1 to MU181500B Ext Clock Input.
2. Using a short SMA–SMA cable, connect MU181500B Jittered Clock Output 1 to MU196020C Ext Clock In.
3. Attach one J1793A pick-off tee directly to each MU196020C Data Output P and N connector, using the tee's IN port.
4. Using the J1948A matched cable pair, connect MU196050B Noise Output P and N to the corresponding tees' PICK OFF ports. Maintain the same connections used during calibration.
5. Connect the two J1793A OUT ports to the corresponding variable ISI channel / fixture inputs, using the same matched RF pair used during calibration.

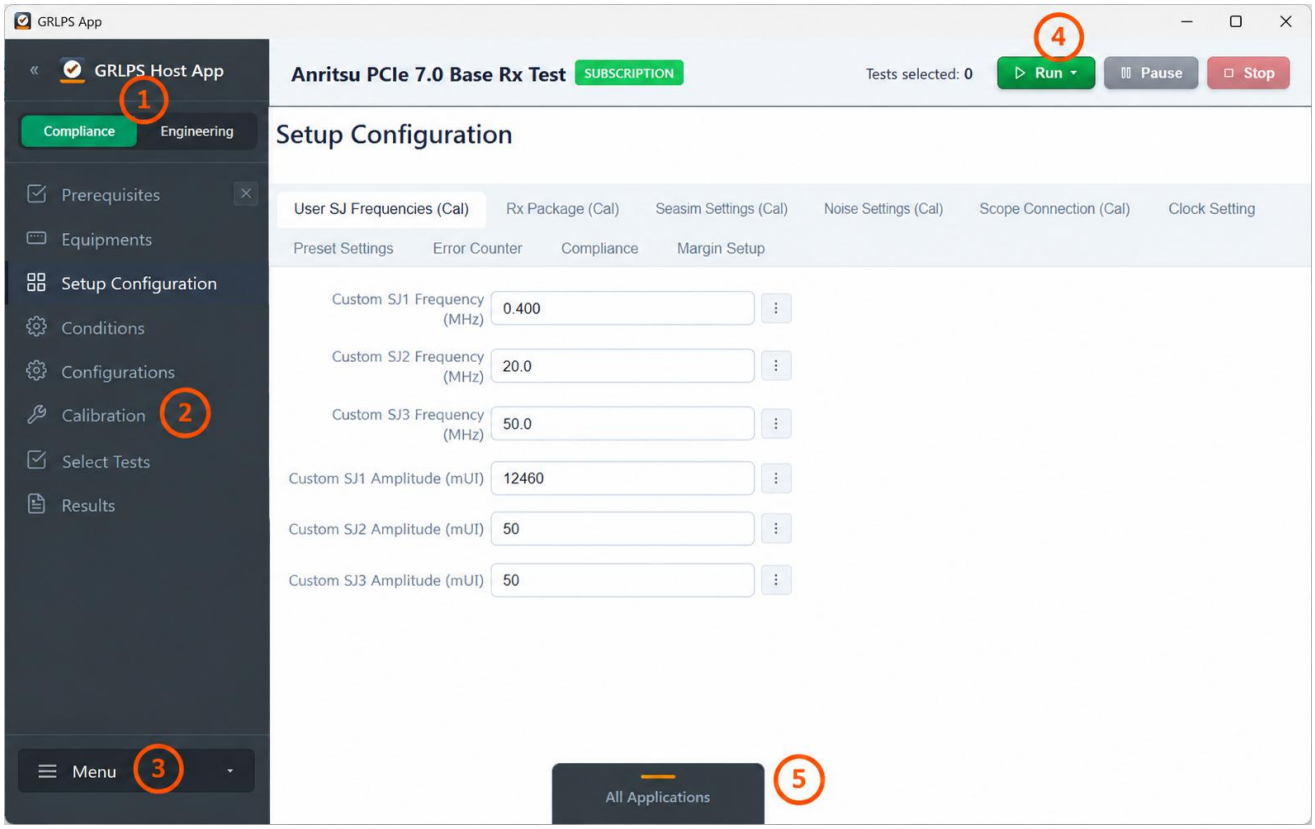
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6. Disconnect the calibrated output cable pair from the oscilloscope and connect it to DUT Rx+ and Rx–, maintaining P/N polarity and the calibrated measurement plane.
7. Configure the DUT reference-clock connection according to the selected test mode. If external 100 MHz reference clocking is required, connect the DUT REFCLK to MU191000A 100 MHz Ref Input (see Note above).
8. Connect the DUT / fixture ground to the MP1900A GND using the specified ground lead.
9. Connect the automation PC to the MP1900A through LAN, and connect the DUT management interface to the PC through USB or Ethernet for DUT control and error-count readback.
10. Initialize the DUT receiver and checker, confirm pattern synchronization and verify error-count readback. Use MX183000A-PL031 DUT Error Counts Import and MX183000A-PL001 Jitter Tolerance Test, as configured by the test application.

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5 GRLPS App Common Controls

The following common controls of the GRLPS App stay accessible as you navigate through the main functional screens.



1. Compliance / Engineering Mode Selection

a) The **Compliance** mode allows you to perform measurements following the CTS requirements. Some configurations will be disabled in the Compliance mode as the values have been defined by the CTS and cannot be changed.

b) The **Engineering** mode acts like a debugging tool which allows you to make configurations outside of the CTS requirements.

2. Main Function Tabs

Select each of the main function tabs to access its respective functional screen. You can establish equipment connections (see Section 3.2), make configurations, select tests and view test results. More information is available in the following sections.

3. Options Menu

Select “Menu” to access the Save and Load test sessions, debug logs, and license, software and help information. More information on saving and loading test sessions are provided in Section 13.

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4. Run/Pause/Stop Test Buttons

Select these buttons to control the test run for selected tests. Refer to Section 11 for more information.

5. Applications Accessibility

Select this tab to display all installed GRL Platform Solutions applications. You can select to open, search or filter specific applications as required.

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6 Setup Configuration

Select the **Setup Configuration** tab on the left side panel bar to access the Setup Configuration screen.

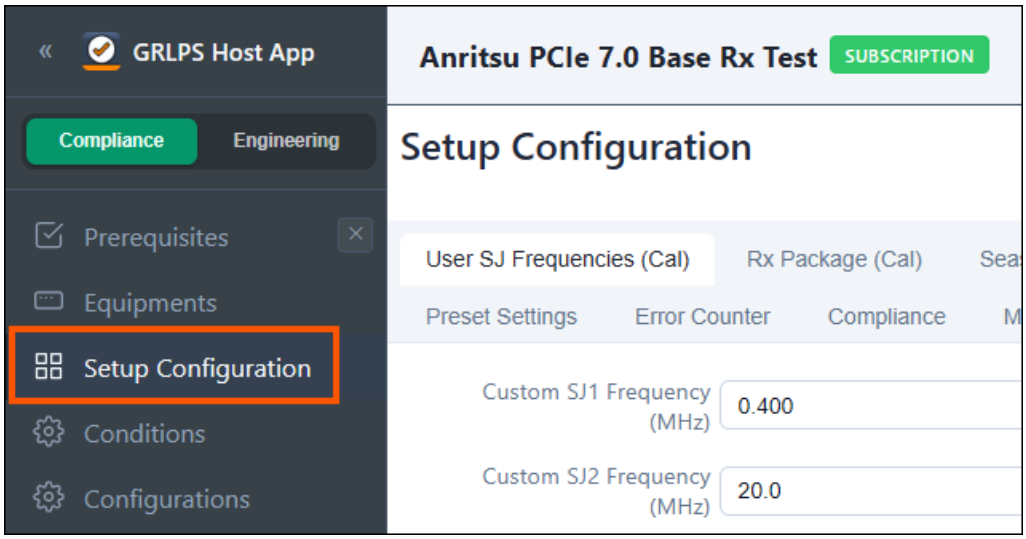


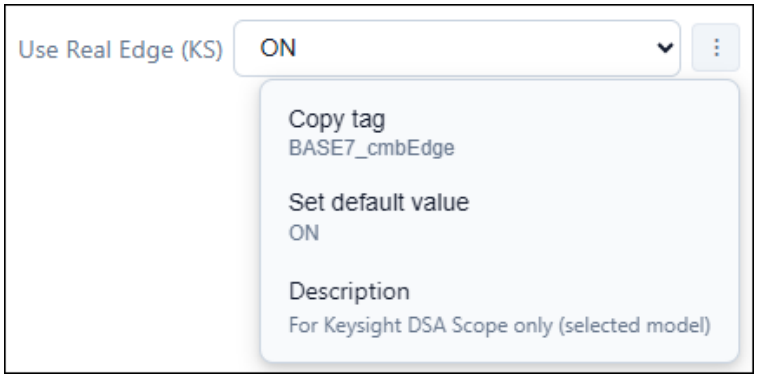
Figure 21. Setup Configuration Screen

Note that you can click on ⋮ next to each parameter field to:

- set the value to default.
- display and copy the property tag/variable.
- view the parameter description (where applicable)

Examples as shown below:





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6.1 Set Up User SJ Frequencies

Select the **User SJ Frequencies (Cal)** tab and set custom SJ frequencies and amplitude for calibration.

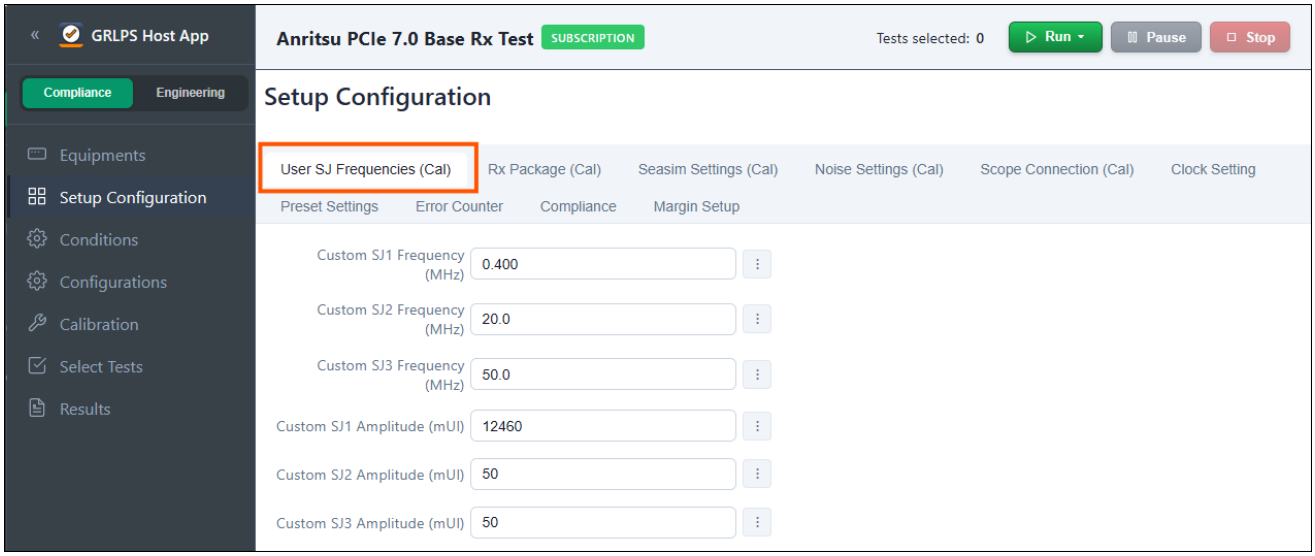


Figure 22. User SJ Frequencies Tab

6.2 Set Up Rx Package

Select the **Rx Package (Cal)** tab to set up user-defined Rx Behavioral package to be applied during post processing analysis for the Eye Height and Eye Width Calibration.

Note: To enable the "Pause Calibration To Apply Rx Behavioral Package" checkbox, "False" must be selected in the "Use Rx Package" field.

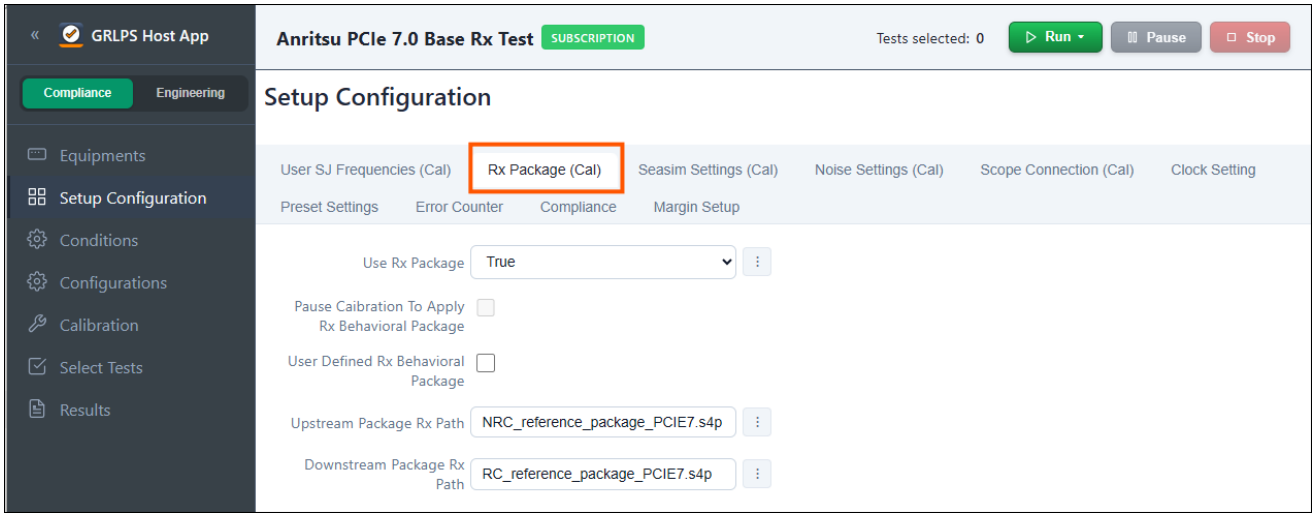


Figure 23. Rx Package Tab

6.3 Set Up Seasim Settings

Select the **Seasim Settings (Cal)** tab to set the intrinsic noise and jitter (if required) to be used in the Seasim calculation.

Note: To enable the "Intrinsic Noise", "PW_Rj (ps)" and "PW DDj" fields, "False" must be selected in the "Auto Measure Parameters" field.

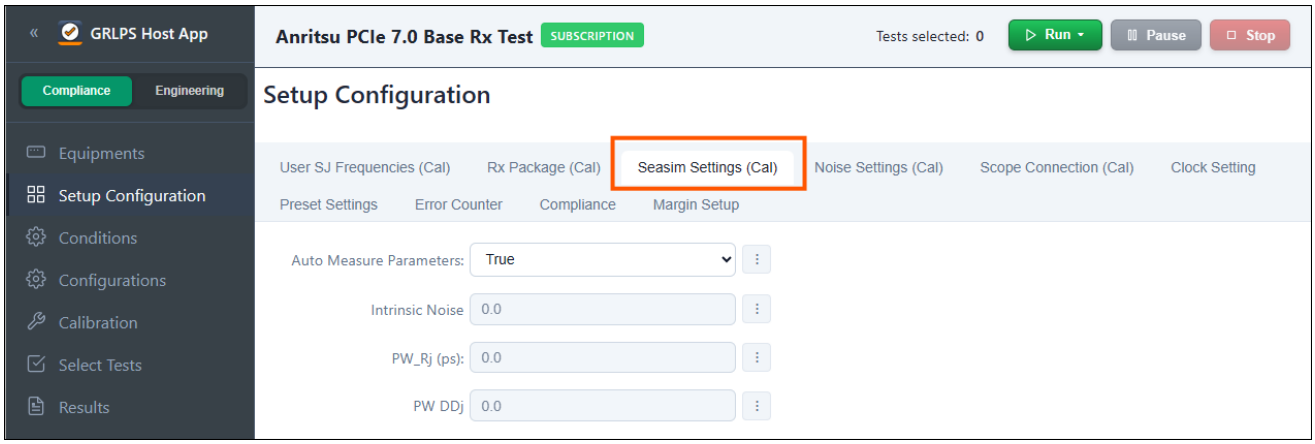


Figure 24. Seasim Settings Tab

6.4 Set Up DM and CM Calibration Settings

Select the **Noise Settings (Cal)** tab to set or use the default frequency values for Differential Mode (DM) and Common Mode (CM) calibration.

To use the default transmitter calibration values, select the "Default Value" checkbox.

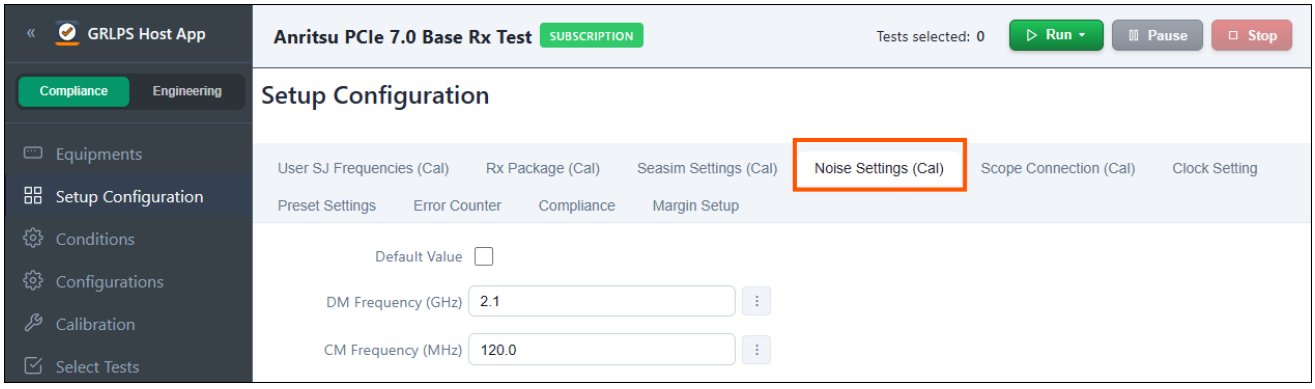


Figure 25. DM and CM Calibration Settings Tab

6.5 Set Up Scope Real Edge Connection

Select the **Scope Connection (Cal)** tab and select the option to use Real Edge connection for the calibration setup on the Oscilloscope. *Note: This setting is only applicable for the Keysight Scope and will be disabled when the Tektronix Scope is used.*

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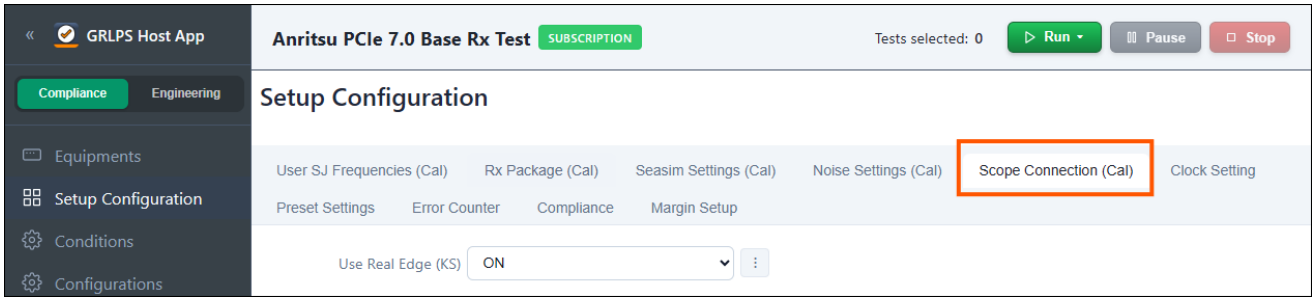


Figure 26. Real Edge Connection Setup Tab

6.6 Set Up Spread Spectrum Clock (SSC) and Reference Clock

Select the **Clock Settings** tab and select the “Enable SSC” checkbox to enable Spread Spectrum Clock (SSC) capabilities for calibration and receiver testing (if supported by the DUT) for informative purpose. Set the Frequency and Deviation values for SSC.

Select the type of Rx Reference Clock architecture/mode to be used when testing the Rx DUT (depending on which clock mode is supported by the DUT). For the Common Clock (CC) Refclk mode, a single Refclk source is applied for both the BERT signal generator and the DUT along with SSC and SJ mask. For the Independent Refclk (IR) mode, or in this case “Separate” Refclk mode, two Refclk sources are applied for both the BERT signal generator and the DUT along with independent SSC and SJ mask.

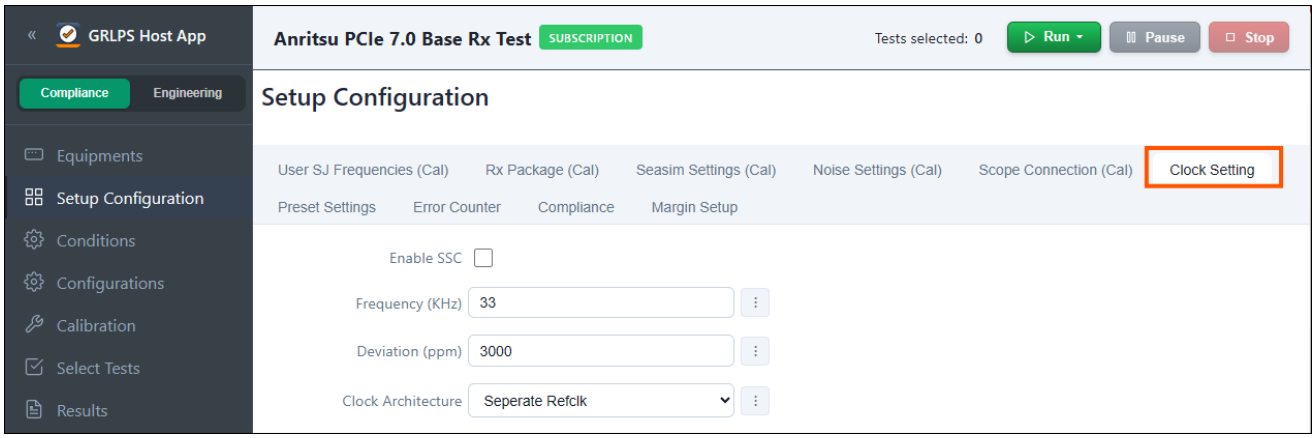


Figure 27. SSC and Refclk Settings Tab

6.7 Set Up Preset

Select the **Preset Settings** tab and select the preset to use, and optionally custom Pre-shoot and De-emphasis settings.

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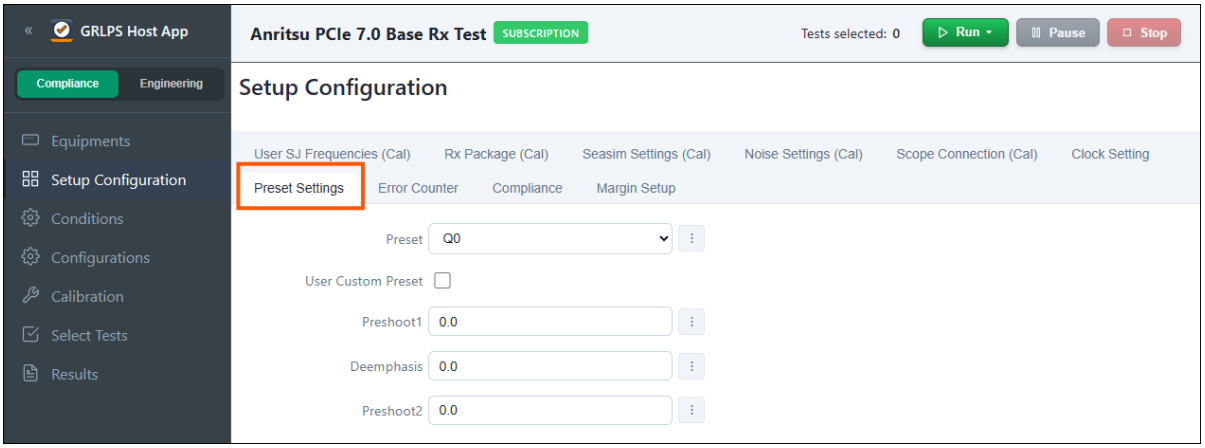


Figure 28. Preset Settings Tab

6.8 Set Up Error Counter

Select the **Error Counter** tab and select the method for DUT error detection. If the DUT can be configured to loopback mode, select “LoopBack”, if not select “Manual”.

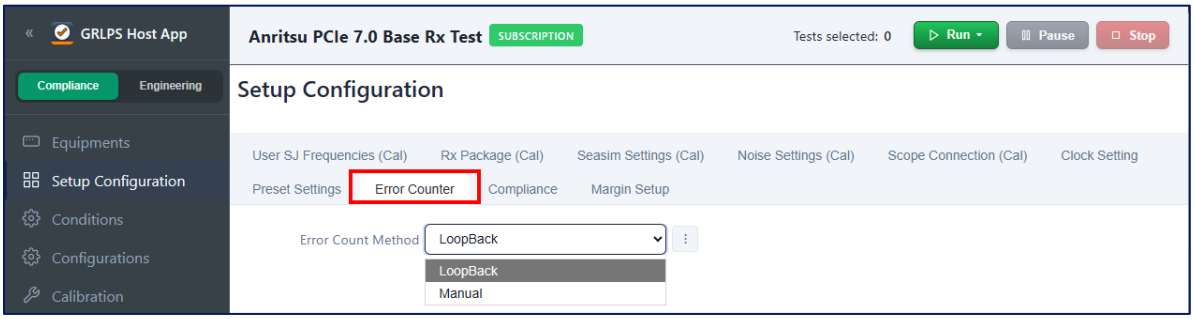


Figure 29. Error Counter Tab

6.9 Set Up BER Compliance

Select the **Compliance** tab to set the allowable BER, Gating Time and Maximum Error limits to be tested for compliance. By default, these limits are set to Specification but can be defined by the user.

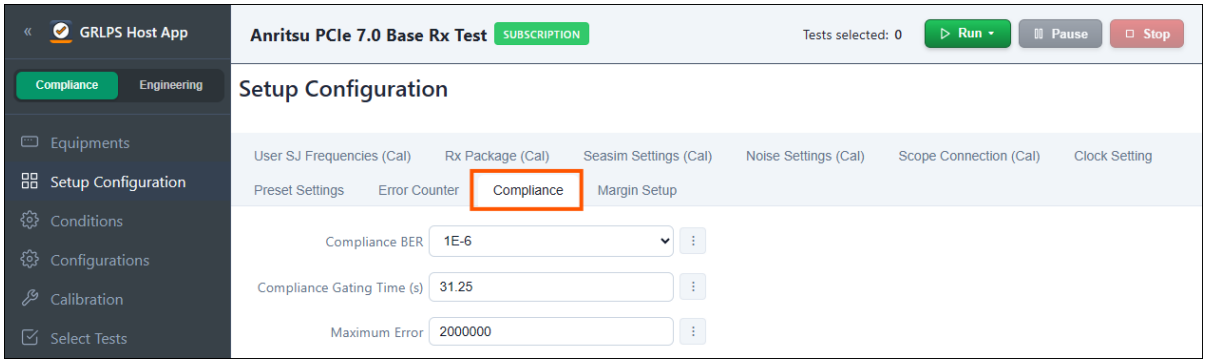


Figure 30. Compliance BER, Gating Time and Maximum Errors Setup Tab

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6.10 Set Up Margin Search Parameters

Select the **Margin Setup** tab and set the target BER, step size, gating time and limits to be applied in the margin search test.

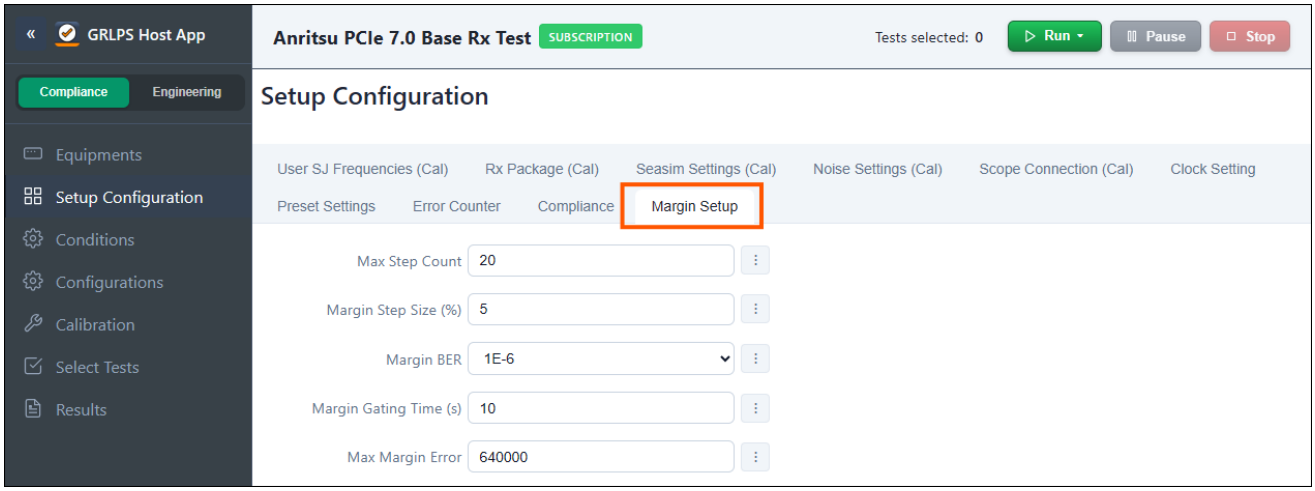


Figure 31. Margin Search Parameters Setup Tab

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7 Test Conditions

Select the **Conditions** tab on the left side panel bar to access the Test Conditions screen.

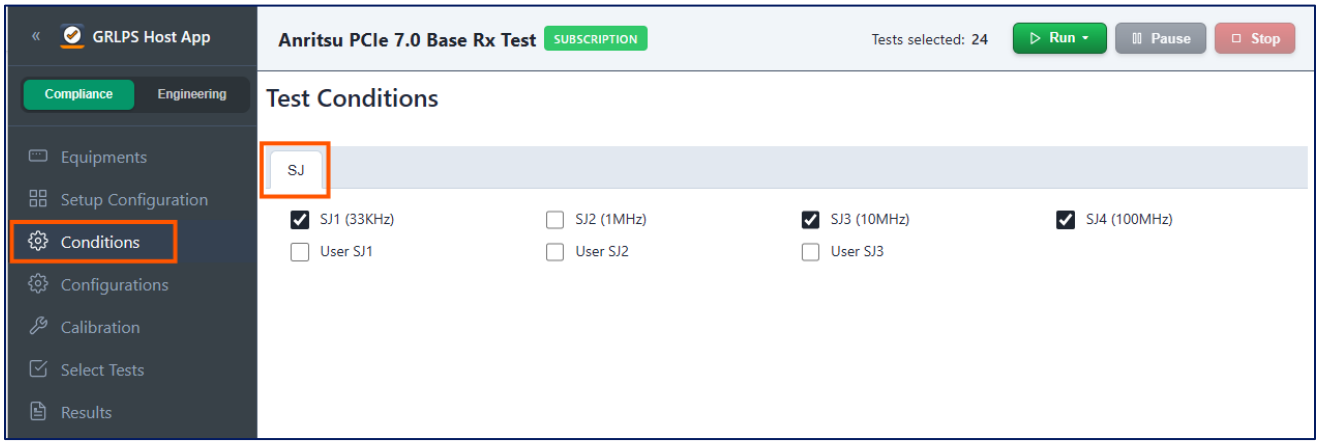


Figure 32. Test Conditions Screen

SJ tab: Select SJ Frequencies as defined by the Specification (SJ1, SJ2, SJ3, SJ4) for calibration or testing. If custom SJ frequencies have been set up in “User SJ Frequencies” (Setup Configuration tab), select User SJ1, User SJ2 or User SJ3.

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8 Calibration Parameters Configuration

Select the **Configurations** tab on the left side panel bar to access the Configuration Variables screen.

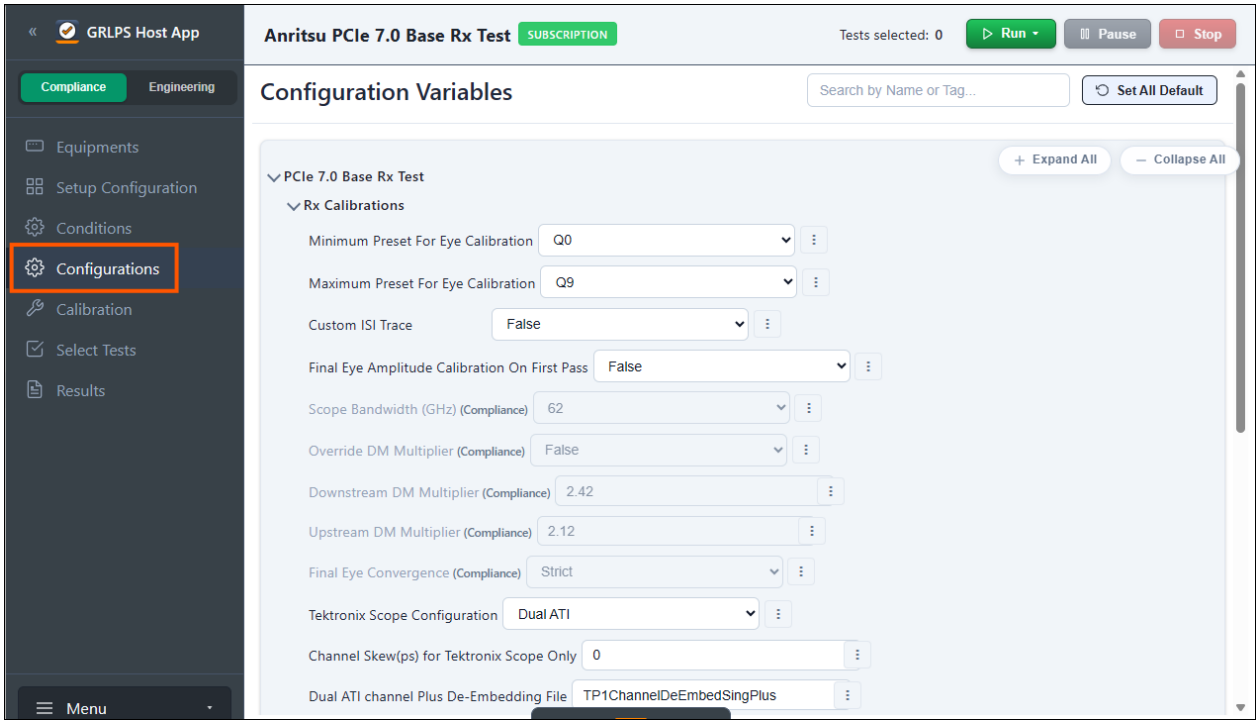


Figure 33. Configuration Variables Screen

Set the parameters required for calibration as described in Table 4 below. To return all parameters to their default values, click on the **Set All Default** button.

Note that you can click on ⋮ next to each parameter value to:

- set the value to default.
- display and copy the property tag/variable.
- view the parameter description (where applicable)

Example as shown below:

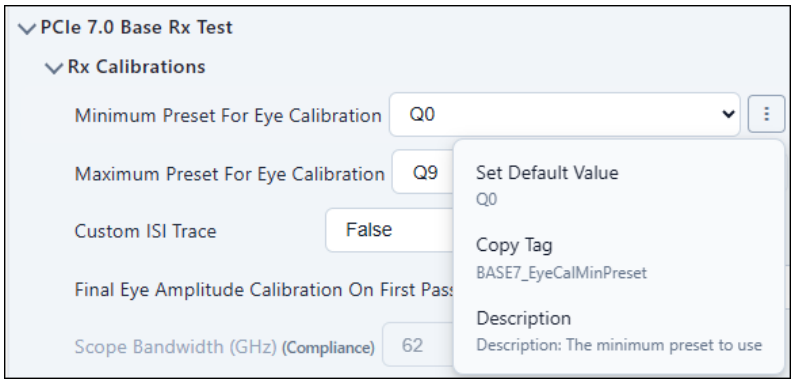
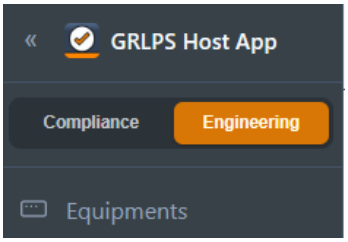
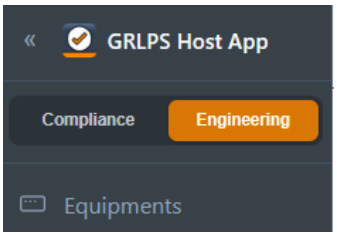
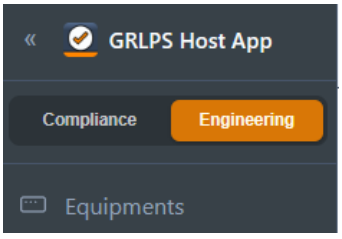
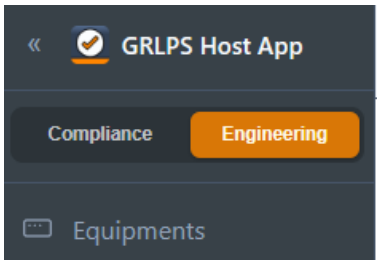


Table 4. Calibration Parameters

Parameter	Description
Rx Calibration	
Minimum & Maximum Preset for Eye Calibration	Select the range of presets to be applied for stressed eye calibration.
Custom ISI Trace	Select 'True' to enable generating custom ISI trace for ISI calibration.
Final Eye Amplitude Calibration On First Pass	Select 'True' to allow the final stressed voltage/jitter eye to be calibrated over the first attempt of calibration run.
Scope Bandwidth (GHz) (Compliance)	*Note: Configuration for this parameter is disabled in the "Compliance" mode. To enable it, select the "Engineering" mode:*  Select the bandwidth supported by the oscilloscope in use.
Override DM Multiplier (Compliance)	*Note: Configuration for this parameter is disabled in the "Compliance" mode. To enable it, select the "Engineering" mode:*  Select 'True' to use the upstream/downstream multiplier value for estimation of Differential Mode (DM) at TP2.
Downstream & Upstream DM Multiplier (Compliance)	*Note: Configuration for this parameter is disabled in the "Compliance" mode. To enable it, select the "Engineering" mode:* 

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	Enter the multiplier value for conversion of DM at TP2P to TP2 for downstream and upstream devices.
Final Eye Convergence (Compliance)	*Note: Configuration for this parameter is disabled in the "Compliance" mode. To enable it, select the "Engineering" mode:*  Select 'Strict' to ensure that final eye width and height from eye calibration converge within specification beyond prediction curve.
Tektronix Scope Configuration	If the Tektronix Scope is to be used for measurements, select either the Single-shot based Scope or the Tektronix' owned Dual Asynchronous Time Interleaving (Dual ATI) based Scope.
Channel Skew (ps) for Tektronix Scope Only	If the Tektronix ATI based Scope is to be used for measurements, enter the channel skew or timing to perform alignment of the Scope channels.
Dual ATI Channel Plus & Minus De-Embedding File	If the Tektronix ATI based Scope is to be used for measurements, specify the file name for de-embedding on the respective Scope channel.
SJ/RJ Calibration Method	Select the Scope measurement or SigTest-based method to be used for the SJ or RJ calibration.
Scope Rj (ps RMS)	Set the random jitter (RJ) of the Scope in ps RMS.
Seasim Version	Select the version of Seasim to be used.
SigTest Version	Set the version of SigTest to be used for LFPR measurements.
Q0-Q10 Preset Calibration Max Iteration	Select the maximum number of runs or iterations to perform the Preset Q0 to Q10 calibration.
Q0-Q10 Preset Calibration Limit	Select the threshold limit value for the Preset Q0 to Q10 calibration.
Feedback Gain Order	Select the CTLE gain value adjustment in controlled steps or variable mode to determine the lowest CTLE gain value that gives zero errors.
Amplitude Trigger Setting	Select the Auto or Manual trigger mode to be set for the amplitude signal.
Amplitude Trigger Level (mV)	Set the trigger level for the amplitude signal.

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9 Configure Calibration Target Values

Select the **Calibration** tab on the left side panel bar to access the Calibration target screen.

For debugging purposes ONLY, the default calibration target values can be changed for the respective calibration.

Note: By default, the calibration target values are those defined in the specification.

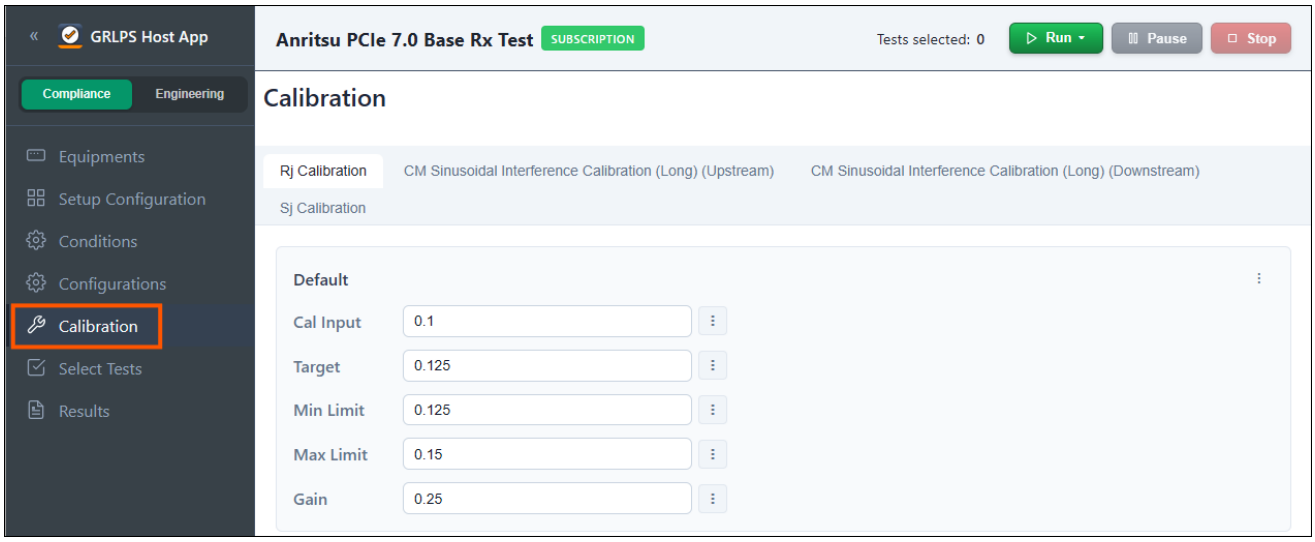


Figure 34. Calibration Target Screen

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10 Select Calibration and DUT Tests

Select the **Select Tests** tab on the left side panel bar to access the calibration & test selection screen. This screen allows calibration and tests that need to be performed to be selected for the DUT.

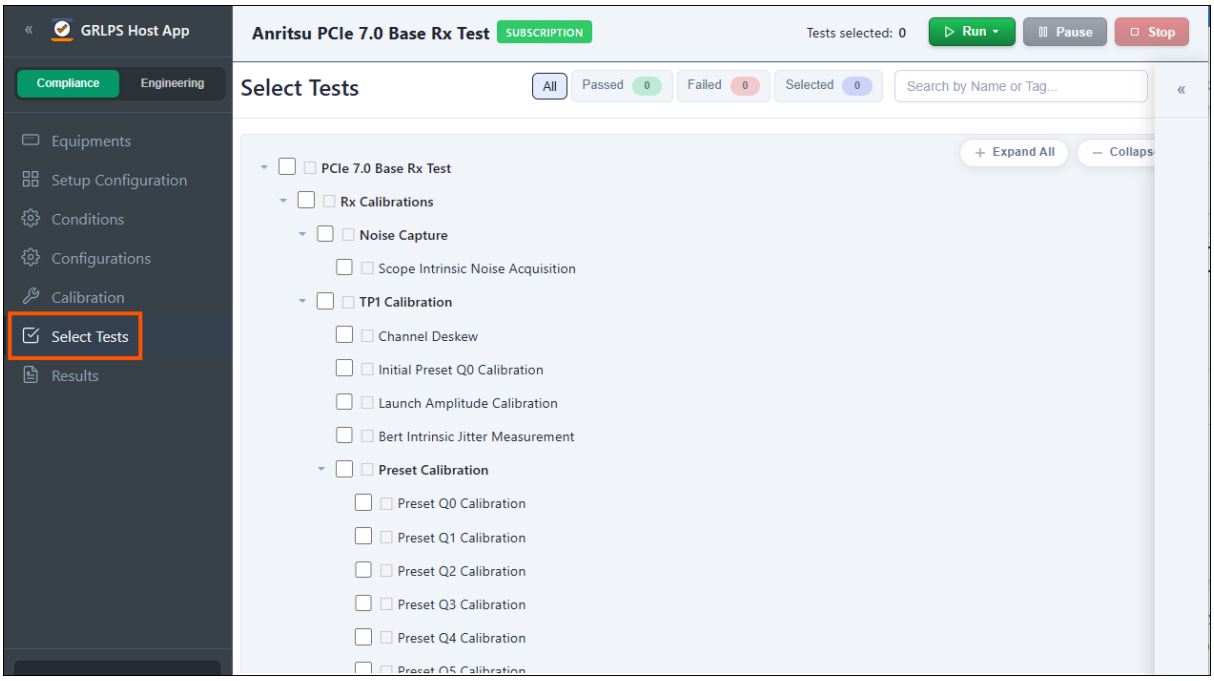
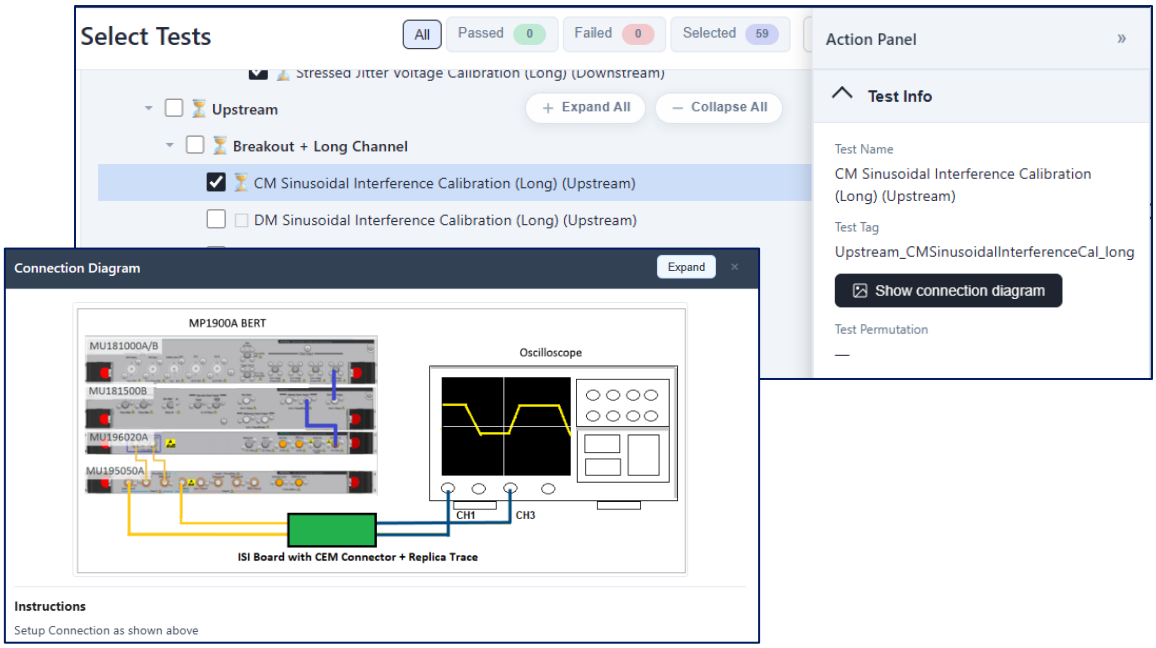


Figure 35. Select Tests Screen

When you select a calibration/test, the “Action Panel” on the right of the screen will let you view the information and connection diagram for the respective calibration/test. If the calibration/test has been run, the results will also be displayed.



Follow the software instructions step by step to set up the connections and perform the selected tests. You can check the Pass/Fail status of the test run using



at the top of the screen. See Section 11 on how to execute tests.

Note: Initially when starting for the first time or changing anything in the setup, it is suggested to run Calibration first. If the calibration is not completed, the Rx Tests will throw an error message.

Once tests have completed, the test results will be saved automatically and populated on the Test Report screen. See Section 12 for details.

Note: The marking shown on the left of each calibration/test parameter indicates the status of the calibration/test result of the parameter:

- *indicates that calibration/testing has not been run for the specific calibration/test parameter.*
- *indicates when calibration/testing has been run and completed successfully for the specific calibration/test parameter with a Pass result.*
- *indicates when calibration/testing has been run and completed for the specific calibration/test parameter with a Fail result.*

10.1 Supported Calibration and Tests

The following table lists all calibration and tests supported by the Anritsu_GRLPS-PXE7-BASE-RXA software with reference to the PCI Express Base Specification Revision 7.0.

Table 5. List of Supported Receiver Calibration and Tests

Calibration/Test Item	Calibration/Test	PCI Express Base Specification Revision 7.0 Section Heading(s)	Parameter/Requirement
Channel Deskew	Calibration	§4.2.5.12 Lane-to-Lane De-skew	Lane-to-lane skew/de-skew across the Lanes of a Link.
Initial Preset Q0 Calibration	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; §8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Initial Tx equalization preset is selected/calibrated as part of stressed-eye setup; Q0 is one of the defined presets.
Launch Amplitude Calibration	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	VRX-LAUNCH / launch-related stressed-eye voltage calibration; Tx EQ and differential voltage swing calibration are performed at TP3.
Bert Intrinsic Jitter Measurement	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-	Characterizes the BERT generator's baseline jitter to support accurate jitter-stress calibration for receiver testing. The related parameter is T_RX-ST-RJ (random jitter); Note 6 specifies Rj

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		11, particularly Notes 6 and 7	measurement at TP1 to avoid channel effects on calibration accuracy.
Preset Calibration Q0	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q0 characterization/measurement.
Preset Calibration Q1	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q1 characterization/measurement.
Preset Calibration Q2	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q2 characterization/measurement.
Preset Calibration Q3	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q3 characterization/measurement.
Preset Calibration Q4	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q4 characterization/measurement.
Preset Calibration Q5	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0,	Tx equalization preset Q5 characterization/measurement.

		32.0, 64.0, and 128.0 GT/s	
Preset Calibration Q6	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q6 characterization/measurement.
Preset Calibration Q7	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q7 characterization/measurement.
Preset Calibration Q8	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q8 characterization/measurement.
Preset Calibration Q9	Calibration	§8.3.3.3 Tx Equalization Presets for 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s	Tx equalization preset Q9 characterization/measurement.
RJ Calibration	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	TRX-ST-RJ / random-jitter component used in stressed-eye calibration.
SJ Calibration	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	TRX-ST-SJ / swept sinusoidal-jitter component; Sj is initially set to 100 MHz and swept during stressed-eye calibration.
SJ Tone Calibration	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; §8.4.2.2 Procedure for Testing Rx DUT	Sinusoidal-jitter tone used for stressed-eye/Rx testing.

CM Sinusoidal Interference Calibration (Long) (Downstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	VRX-CM-INT common-mode sinusoidal interference stress.
DM Sinusoidal Interference Calibration (Long) (Downstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	VRX-DIFF-INT differential sinusoidal interference stress.
Stress Cal (Downstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye	Overall stressed EH/EW eye calibration procedure.
Seasim Calibration (Downstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye	Stressed-eye calibration and post-processing; downstream direction.
Optimized Preset (Long) (Downstream)	Calibration	§8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye	Tx equalization is fixed to the preset giving optimal eye area during eye calibration.
Stressed Jitter Voltage Calibration (Long) (Downstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	Calibration of stressed voltage/jitter eye to simultaneously present worst-case margins.
CM Sinusoidal Interference Calibration (Long) (Upstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	VRX-CM-INT common-mode sinusoidal interference stress; upstream direction.
DM Sinusoidal Interference Calibration (Long) (Upstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	VRX-DIFF-INT differential sinusoidal interference stress; upstream direction.
Stress Cal (Upstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye	Overall stressed EH/EW eye calibration procedure; upstream direction.
Seasim Calibration (Upstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye	Stressed-eye calibration and post-processing; upstream direction.
Optimized Preset (Long) (Upstream)	Calibration	§8.3.3.5 Measuring Presets at 8.0, 16.0, 32.0, 64.0, and 128.0 GT/s; §8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye	Tx equalization preset selected for optimal eye area during calibration; upstream direction.

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Stressed Jitter Voltage Calibration (Long) (Upstream)	Calibration	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	Calibration of stressed voltage/jitter eye; upstream direction.
Apply Stress Voltage Param (long) (Downstream)	Calibration value application	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	Applies calibrated stressed-eye voltage parameters; relevant stress parameters include VRX-LAUNCH, VRX-DIFF-INT and VRX-CM-INT.
Apply Stress Voltage Param (long) (Upstream)	Calibration value application	§8.4.2.1 Procedure for Calibrating a Stressed EH/EW Eye; Table 8-11	Applies calibrated stressed-eye voltage parameters in upstream test direction.
Stress Jitter Voltage Test (Long) (Downstream)	Test	§8.4.2.2 Procedure for Testing Rx DUT	Rx stressed-eye test using the calibrated stress; downstream direction.
Stress Jitter Voltage Test (Long) (Upstream)	Test	§8.4.2.2 Procedure for Testing Rx DUT	Rx stressed-eye test using the calibrated stress; upstream direction.
Stress Jitter Voltage Margin Test (Long) (Downstream)	Test / Margining	§8.4.2.1, Procedure for Calibrating a Stressed EH/EW Eye; §8.4.2.2.1, Sj Mask Long-channel requirements: §8.4.1.2, Table 8-8	Apply a calibrated stressed voltage/jitter signal through the long calibration channel to the receiver under test in the downstream direction; verify receiver BER against the applicable swept-SJ mask.
Stress Jitter Voltage Margin Test (Long) (Upstream)	Test / Margining	§8.4.2.1, Procedure for Calibrating a Stressed EH/EW Eye; §8.4.2.2.1, Sj Mask Long-channel requirements: §8.4.1.2, Table 8-8	Apply a calibrated stressed voltage/jitter signal through the long calibration channel to the receiver under test in the upstream direction; verify receiver BER against the applicable swept-SJ mask.

11 Run Calibration and DUT Tests

After selecting the calibration/tests to be run, click on the Run button as indicated below:

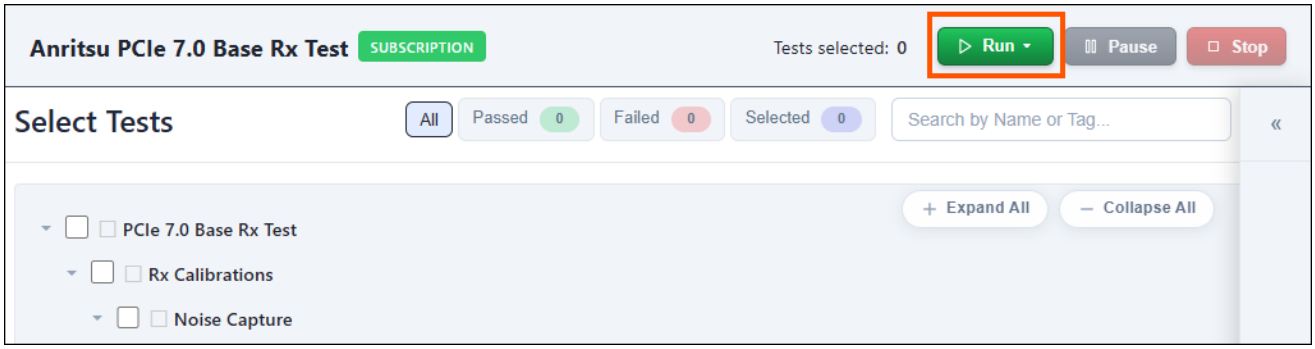


Figure 36. Run Calibration/Tests Button

11.1 Run Options

Select the Run options from the drop-down menu of the Run button:

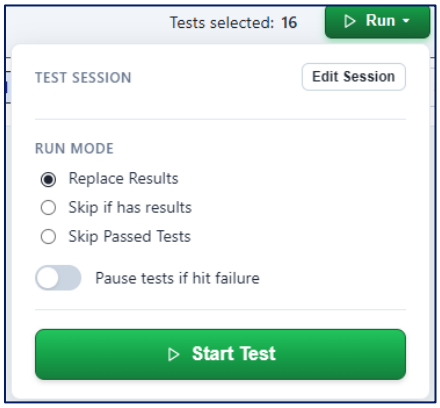


Figure 37. Run Options

Run Option	Description
Replace Results	If previous test results exist, the software will replace each step in the tests with new results.
Skip if has results	If previous test results exist, the software will *skip* the tests steps that have existing results.
Skip Passed Tests	If previous tests with Passed results exist, the software will *skip* the tests steps that have existing Passed results.
Pause tests if hit failure	Toggle this switch to pause the test run if any test fails during the test run.

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11.2 Test Session Information

Click on the **Edit Session** button to access the Test Session Info form.

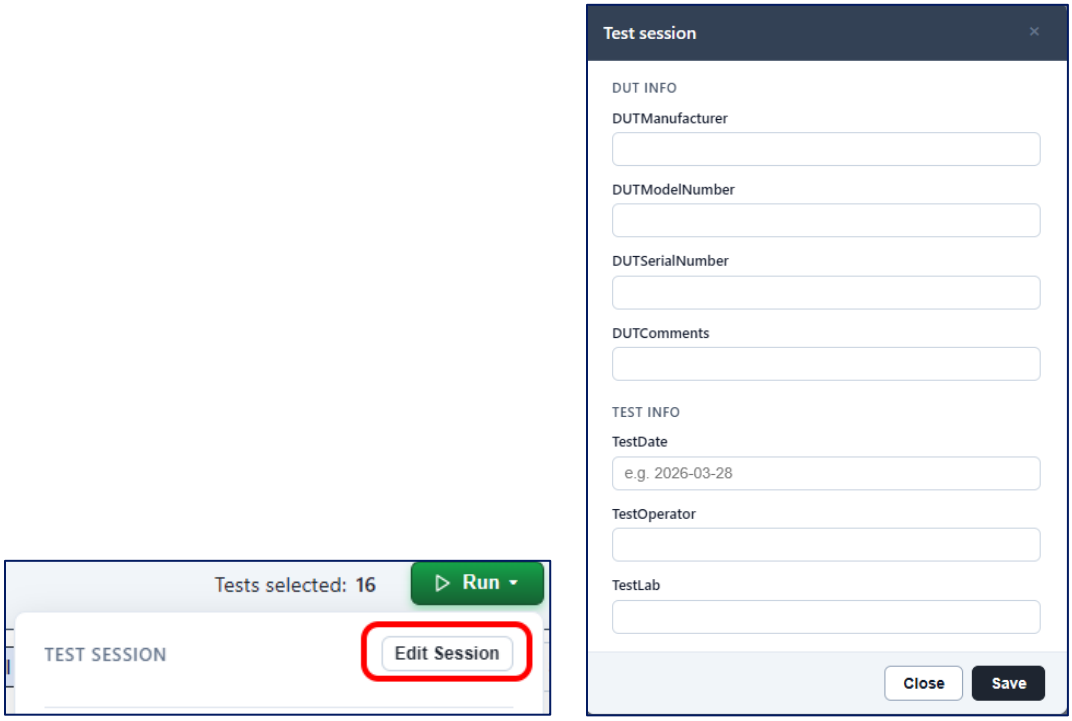


Figure 38. Test Session Info

The information provided will be included in the test report.

11.3 Start Test

After selecting the Run option and configuring the Test Session info, click on the **Start Test** button to initiate the calibration/test run. The Anritsu_GRLPS-PXE7-BASE-RXA software will walk you through step by step while tests are being run.

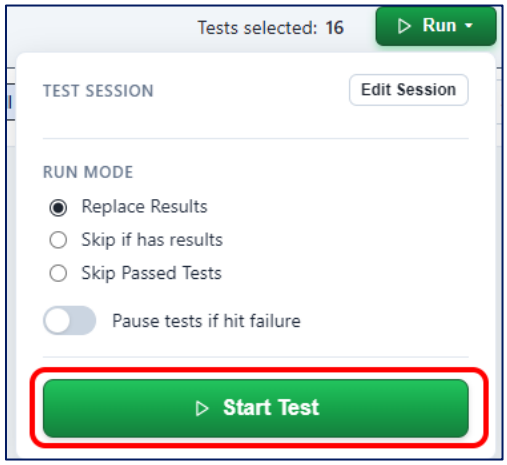


Figure 39. Start Test Button

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12 Test Results and Reports

After running a set of calibration/tests, the Anritsu_GRLPS-PXE7-BASE-RXA software allows full reports to be created in the Test Report screen as shown in the following example:

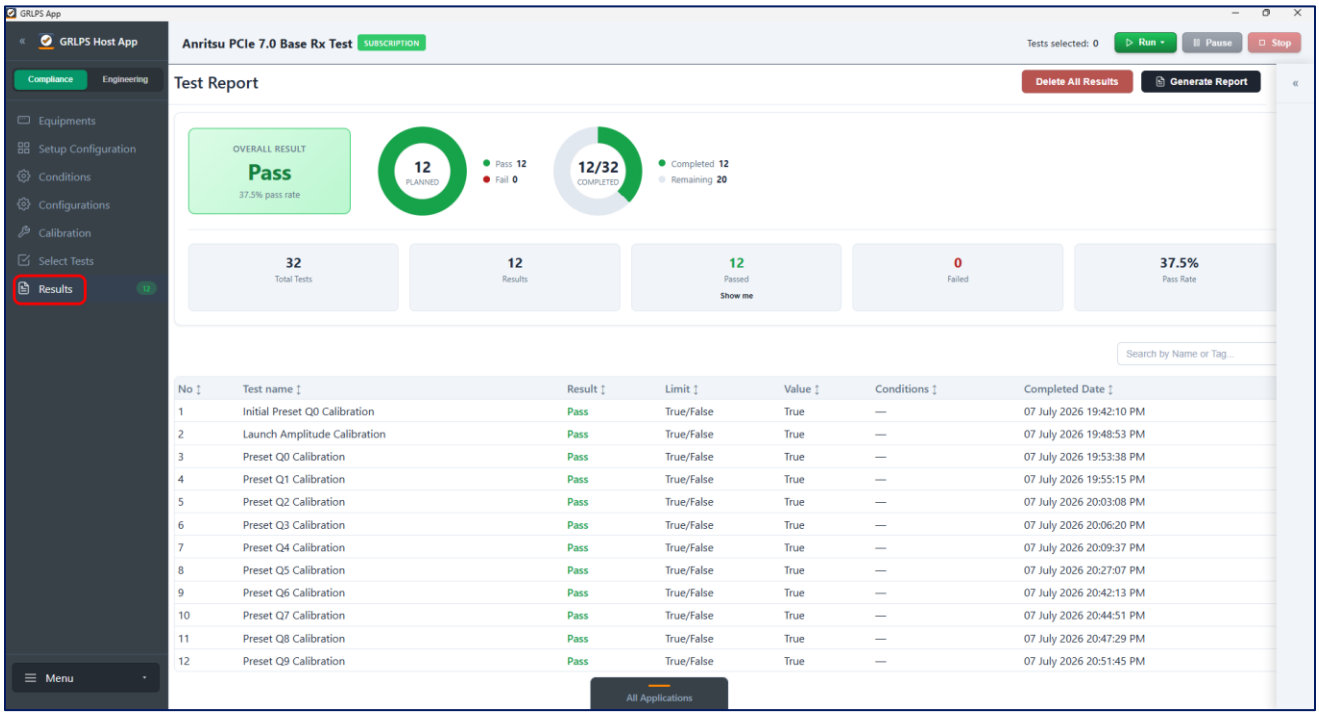


Figure 40. Test Report Screen

Select the **Results** tab on the left side panel bar to access the Test Report screen.

For a PDF or HTML report, click on the **Generate Report** button.

To entirely remove all existing calibration/test results, select the **Delete All Results** button.

12.1 PDF/HTML Test Report Overview

12.1.1 General Information

This portion is populated from the information in the Test Session Info form from the **Run** button → **Edit Session** button.

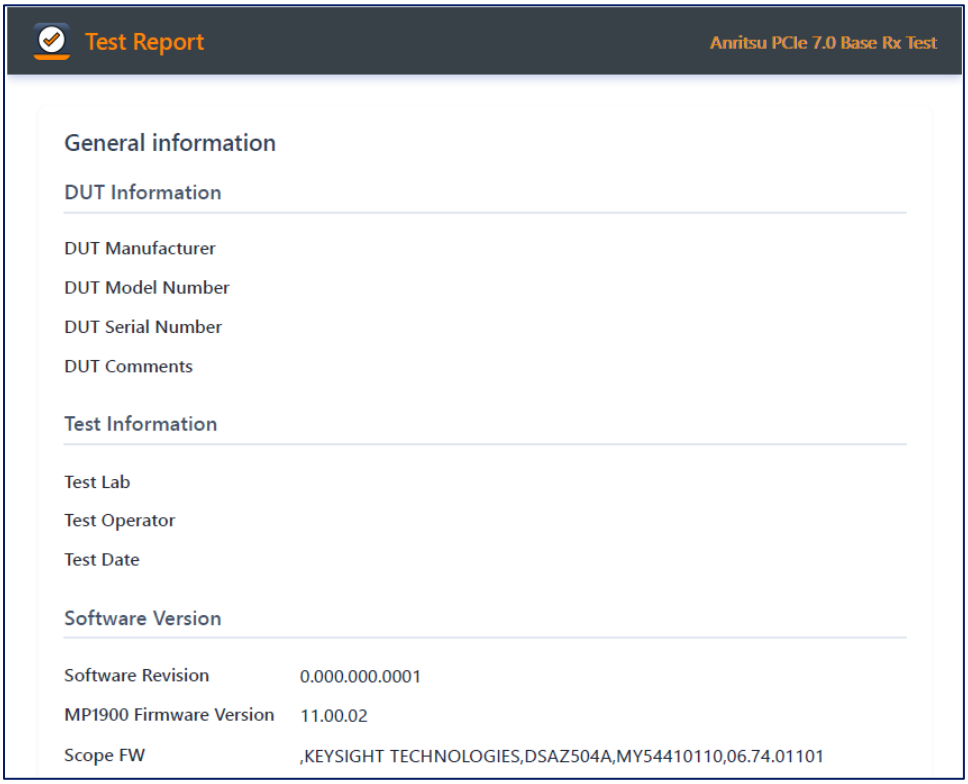


Figure 41. General Information

12.1.2 Results Summary Table

This portion is populated from the calibration and tests performed with their respective results. This gives an overall view of all the results and test conditions.

Summary

No	Test Name	Test Result	Value	Limit	Condition
1	Initial Preset Q0 Calibration	Pass	True	N/A	—
2	Launch Amplitude Calibration	Pass	True	N/A	—
3	Preset Q0 Calibration	Pass	True	N/A	—
4	Preset Q1 Calibration	Pass	True	N/A	—
5	Preset Q2 Calibration	Pass	True	N/A	—
6	Preset Q3 Calibration	Pass	True	N/A	—

Figure 42. Results Summary Table Example

12.1.3 Calibration & Test Result Details

This portion is populated with results from each of the calibration and test runs. Here the results are explained in depth with supporting data points, screenshots and calibration data plots.



Figure 43. Calibration Result Details Example

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13 Saving and Loading Test Sessions

Test results are created and maintained as a 'Live Session' in the Anritsu_GRLPS-PXE7-BASE-RXA software. This allows you to quit the software and return later to continue where you left off.

Save and Load Sessions are used to Save a Test Session that you may want to recall later. You can 'switch' between different sessions by Saving and Loading them when needed.

Select the **Menu** tab on the left side panel bar and select the following:

- To **Save** a test session, with all of the parameter information, test results and any waveforms, select **Save Session**.
- To **Load** a test session back into the software, including the saved parameter settings, select **Load Session**.
- To create a **New** test session and return the software to the default configuration, select **New Session**.

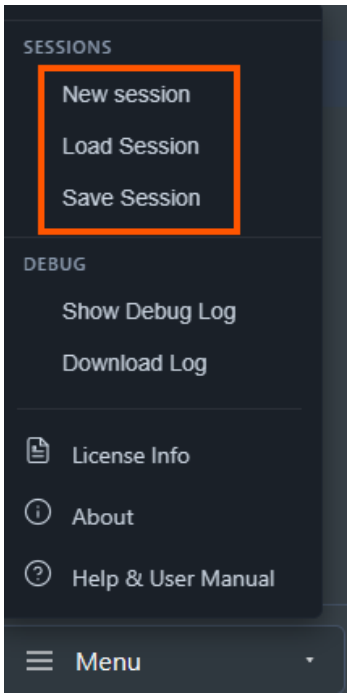


Figure 44. Saving and Loading Test Sessions

The configuration and session results are saved in a file with the extension '.ses', which is a compressed zip-style file, containing a variety of information.

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14 Appendix A: Method of Implementation (MOI) Using Automation

This section provides a sample methodology to automate PCIe 7.0 Base Rx calibration using the Anritsu_GRLPS-PXE7-BASE-RXA software at 128.0 GT/s. This procedure will ensure Receiver Impairment adjustments on the MP1900A BERT are accurate before running DUT compliance tests.

14.1 Perform Calibration at TP1

14.1.1 Initial Preset Q0 Calibration

Adjust the Pre Cursor1, Pre Cursor2 and Post Cursor1 of Preset Q0 to 0 ± 0.3 dB using the LFPR method:

1. Set BERT amplitude to 550mV and Equalization settings to Preset Q0.
2. Capture waveform and run LFPR processing using SigTest or Scope to obtain the impulse response.
3. The peak of the impulse response is treated as the Main Cursor.
    a. Pre Cursor1 is obtained by sampling the impulse response at 1UI before the main cursor.
    b. Pre Cursor2 is obtained by sampling the impulse response at 2UI before the main cursor.
    c. Post Cursor1 is obtained by sampling the impulse response at 1UI after the main cursor.
4. Convert the cursor value to Pre-shoot 1 or 2 and De-emphasis values.
5. Calculate the error between the BERT setting and Measured values and adjust Pre-shoot 1 or 2 and De-emphasis values on the BERT accordingly.
6. Repeat steps 2 to 5 until the error is less than 0.3dB.

14.1.2 Launch Amplitude Calibration

The Caltable method is used to calibrate Launch Amplitude:

1. Initialize BERT.
2. Set BERT to 0dB Pre-shoot and De-emphasis obtained from Caltable as measured above.
3. Set 200mV Amplitude at BERT, then measure the amplitude in scope, record it.
4. Increase 100mV on each iteration, measure the amplitude in scope, until measured amplitude meets or exceeds 820mV.
5. Plot a Caltable graph.
6. Passing criteria is to obtain target value of Launch Amplitude measurement at 800mV (500-820mV is acceptable).

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14.1.3 Preset (Q1-Q9) Calibration

Adjust the Pre Cursor1, Pre Cursor2 and Post Cursor1 of Preset Q1 to Q9 to 0 ± 0.3 dB using the LFPR method:

1. Capture waveform of Preset Q0.
2. Set BERT amplitude to 550mV and Equalization settings to Preset Q1.
3. Capture waveform of Preset Q1.
4. Using the SigTest LFPR Preset Test (Preset_TestLFPR template), apply the Preset Q0 and Preset Q1 waveforms to calculate the Pre-shoot 1 or 2 and De-emphasis values.
5. Calculate the error between the BERT setting and Measured values and adjust Pre-shoot 1 or 2 and De-emphasis values on the BERT accordingly.
6. Repeat steps 3 to 5 until the error is less than 0.3dB.
7. Repeat steps 1 to 5 for Preset Q2 to Q9.

14.1.4 RJ Calibration

The binary-linear search method is used to calibrate RJ:

1. Initialize BERT.
2. Set 800mV (p-p) amplitude (based on calibrated value).
3. Set BERT to 0dB Pre-shoot and De-emphasis obtained from Caltable as measured above.
4. Set All Stress to 0mV.
5. Set 1100 Pattern on BERT.
6. Set Initial RJ value to 0.1UI (p-p) on BERT.
7. Capture signal on the oscilloscope.
8. Measure RJ (in ps (RMS)) of the captured waveform using SigTest, record the measured value.
9. Table sweep 0.15UI to 0.4UI in two steps, measure RJ from scope, until measured RJ meets or exceeds 0.125ps (RMS).
10. Passing criteria is to obtain measured RJ at 0.125ps (RMS) (0.125-0.15ps is acceptable).

14.1.5 SJ Calibration

The Caltable method is used to calibrate SJ:

1. Initialize BERT.
2. Set 800mV (p-p) amplitude (based on calibrated value).
3. Set BERT to 0dB Pre-shoot and De-emphasis obtained from Caltable as measured above.
4. Set All Stress to 0mV.
5. Set 1100 Pattern on BERT.

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6. Set the SJ Frequency of the first Permutation (33KHz, 1MHz, 10MHz, 100MHz).
7. Set 0 (%UI (p-p)) as base value in SJ, measure SJ (in ps (p-p)) from scope using EJZIT, record.
8. Increase 0.1UI (p-p) on each iteration for SJ Frequency 1MHz, 10MHz, 100MHz; Increase 0.2UI (p-p) on each iteration for SJ Frequency 33KHz.
9. Capture signal on the oscilloscope.
10. Measure SJ from scope using SigTest until measured SJ meets or exceeds 7500ps for 33KHz SJ Frequency (500ps in common-clock) or 3.125ps for SJ Frequency 1MHz or 0.78125ps for 10MHz and 100MHz.
11. Plot a Caltable graph.
12. Passing criteria is to obtain measured SJ at Min 6ps (p-p) and Max 10ps (p-p) for 33KHz, 3.75ps (p-p) for 1MHz, 0.9375ps (p-p) for 10MHz and 100MHz.
13. Proceed to next permutation.

14.1.6 SJ Tone Calibration

The Caltable method is used to calibrate SJ Tone:

1. Initialize BERT.
2. Set 800mV (p-p) amplitude (based on calibrated value).
3. Set BERT to 0dB Pre-shoot and De-emphasis obtained from Caltable as measured above.
4. Set All Stress to 0mV.
5. Set 1100 Pattern on BERT.
6. Set SJ2 Frequency (210MHz).
7. Set 0 (%UI (p-p)) as base value in SJ2, measure SJ (in ps (p-p)) from scope using EJZIT, record.
8. Increase 0.1UI (p-p) on each iteration.
9. Capture signal on the oscilloscope.
10. Measure SJ from scope using SigTest until measured SJ meets or exceeds 2.5ps (p-p).
11. Plot a Caltable graph.
12. Passing criteria is to obtain measured SJ at Min 1.5ps (p-p) and Max 2.5ps (p-p).

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14.2 Perform Calibration at TP2

Calibration at TP2 can be performed for Downstream (for Host) or Upstream (for Device).

14.2.1 Common Mode (CM) Sinusoidal Interference Calibration

The binary-linear method is used to calibrate CM-SI:

1. Insert ISI trace at 36dB loss from previous calibration step.
2. Initialize BERT.
3. Set 0mV (p-p) amplitude.
4. Set BERT to 0dB Pre-shoot and De-emphasis obtained from Caltable as measured above.
5. Set All Stress to 0mV.
6. Set Frequency on BERT for Common Mode to 120MHz.
7. Set Output on BERT for Common Mode to 60mV, turn On Output.
8. Turn Off Output on BERT for Differential Mode.
9. Initialize scope.
10. Set up Func1 on scope to (Chan1 + Chan3)/2.
11. Measure Vp-p on Func1.
12. Record measured Phase.
13. Set 800mV (p-p) amplitude (based on calibrated value).
14. Set All Zero Pattern on BERT.
15. Set ISI % value based on above calibrated data.
16. Set BERT (Common Mode) to Sine Wave.
17. Measure Amplitude (in mV) from scope, record.
18. Lookup table 50mV to 250mV in four steps, measure Amplitude from scope until measured value meets or exceeds 75mV (p-p).
19. Passing criteria is to obtain measured CM-SI at Min 73mV and Max 77mV.

14.2.2 Differential Mode (DM) Sinusoidal Interference Calibration

This calibration is to ensure that the waveform achieves the calibrated eye height.

The Caltable method is used to calibrate DM-SI:

1. Insert ISI trace at 36dB loss from previous calibration step.
2. Initialize BERT.
3. Set 0mV (p-p) amplitude.
4. Set BERT to 0dB Pre-shoot and De-emphasis obtained from Caltable as measured above.
5. Set All Stress to 0mV.

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6. Set Frequency on BERT for Differential Mode to 2.1GHz.
7. Set Output on BERT for Differential Mode to 15mV, turn On Output.
8. Turn Off Output on BERT for Common Mode.
9. Initialize scope.
10. Set up Func1 on scope to (Chan1 – Chan3).
11. Measure Vp-p on Func1.
12. Measure Amplitude (in mV) from scope, record.
13. Increase 0.174dBm/15mV on each iteration, measure Amplitude from scope until measured value meets or exceeds 35mV (p-p).
14. Plot a Caltable graph.
15. Passing criteria is to obtain measured DM-SI at Min 20mV and Max 40mV.

14.2.3 Stress Jitter Voltage Eye Calibration

This calibration is to ensure that the waveform achieves the calibrated eye width and eye height.

1. Initialize BERT.
2. Set 800mV (p-p) amplitude (based on calibrated value).
3. Set All Stress to 0mV.
4. Set Clk/256 Pattern on BERT.
5. Start with ISI traces of 36dB.
6. Trigger waveform on scope to display waveform.
7. Embed waveform with reference package s4p.
8. Save waveform to .dat file (Y only).
9. Convert saved waveform to Seasim-compatible waveform (step response) with X component (starting from 5). Save to xxx_vict.rfstep1. The _vict.rfstep1 format consists of time[SPACE]Voltage_level[New Line].
10. Create Seasim config file with predefined values for Eye Opening calculation, starting with 0mV DM-SI.
11. Run Seasim with config file and step response.
12. Obtain .log file from Seasim.
13. Read eye height (EH) and eye width (EW).
14. Record EH vs. DM, and EW vs. DM for 800mV.
15. Increase DM-SI (in Seasim config) to 10mV, run Seasim again, obtain EH and EW.
16. Once EH and EW at 10mV are obtained, plot Caltable graph and adjust DM setting needed to achieve 0.1UI and 10mV EH and EW.
17. If adjusted DM setting is out of range, increase/decrease SJ by 0.30-1.50ps in 0.15ps steps. Repeat method to obtain EH and EW by adjusting DM.

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18. If EH and EW do not fall within 10mV (top eye height: 10mV ± 0.5mV) and 0.1UI (top eye width: 1.5625ps ± 0.15ps) respectively after SJ variation, reduce ISI by 0.5dB up to 34dB and repeat steps 15 to 17.
19. If EH and EW still do not fall within specifications, return to starting ISI trace of 36dB while adjusting Amplitude and reducing ISI if necessary.
20. Repeat until EW and EW fall within specifications.
21. Record measured Amplitude, SJ and DM.

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15 Appendix B: Connecting Keysight Oscilloscope to PC (Manual Connection)

If using a Keysight oscilloscope, refer to the following procedure on how to connect the Scope to be used with a PC. The Keysight Scope can be connected to the PC through GPIB, USB, or LAN.

1. Download the latest version of the Keysight IO Libraries Suite software from the Keysight website and install it on your control PC.
2. When installed successfully, the IO icon ( ) will appear in the taskbar notification area of your control PC.
3. Select the IO icon to launch the **Keysight Connection Expert**.
4. Click Rescan.

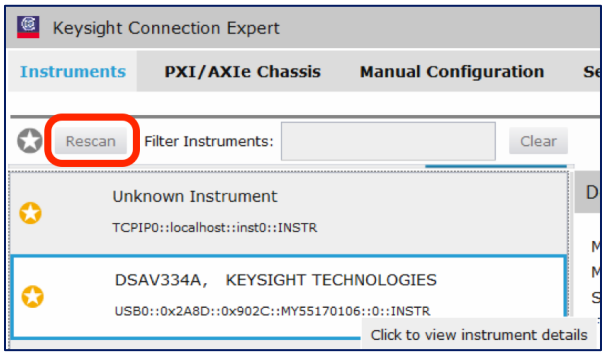


Figure 45. Keysight Connection Expert

5. Refresh the system. The Keysight oscilloscope is shown on the left pane and the VISA address is shown on the right pane.

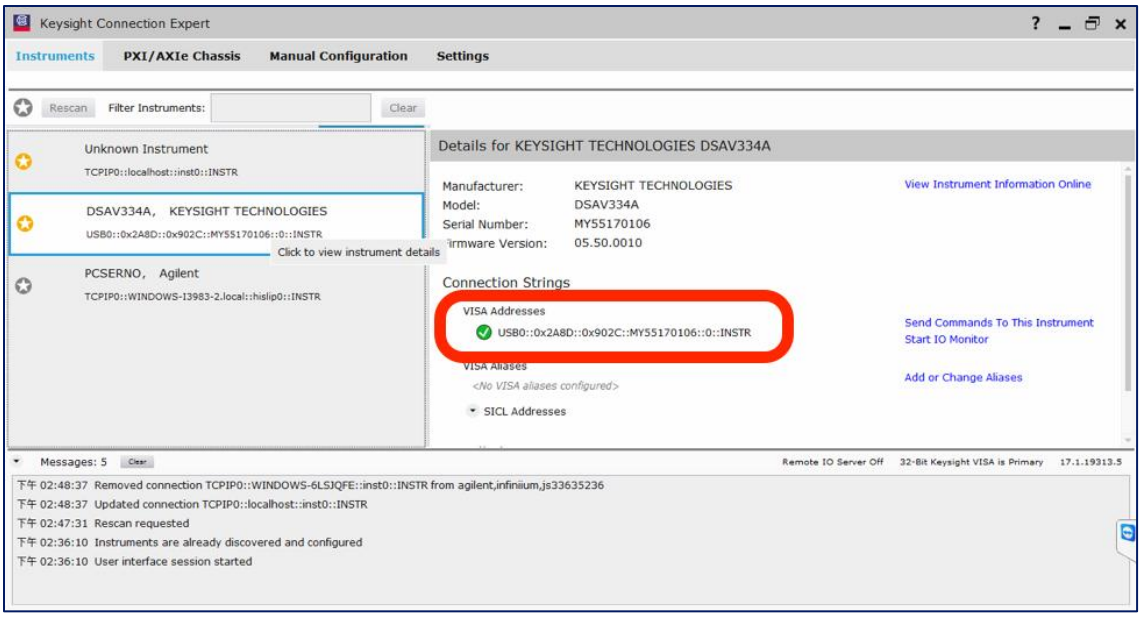


Figure 46. Oscilloscope's VISA Address

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6. When connecting the Keysight Scope to the control PC through GPIB/USB, type in the VISA address into the ‘Address’ field on the ‘Equipments’ screen of the Anritsu_GRLPS-PXE7-BASE-RXA Test Application.
    - If the Anritsu_GRLPS-PXE7-BASE-RXA software is installed on the Keysight Scope, type in the Scope IP address, for example “TCPIP0::127.0.0.1::inst0::INSTR”. If there is error in connection, type in the Scope IP address as “TCPIP0::192.168.0.4::5025::SOCKET”.
    - If the Anritsu_GRLPS-PXE7-BASE-RXA software is installed on the control PC to control the Scope via LAN, type in the Scope IP address, for example “TCPIP0::192.168.0.110::inst0::INSTR”. Note to ***omit*** the Port number from the address.

16 Appendix C: Connecting Tektronix Oscilloscope to PC (Manual Connection)

If using a Tektronix DPOJET Series oscilloscope, refer to the following procedure on how to connect the Scope to be used with a PC. The Tektronix Scope can be connected to the PC through GPIB, USB or LAN.

1. Download the latest version of the Tektronix TekVISA software from the Tektronix website and install it on the control PC.
2. When installed successfully, open the OpenChoice Instrument Manager application.

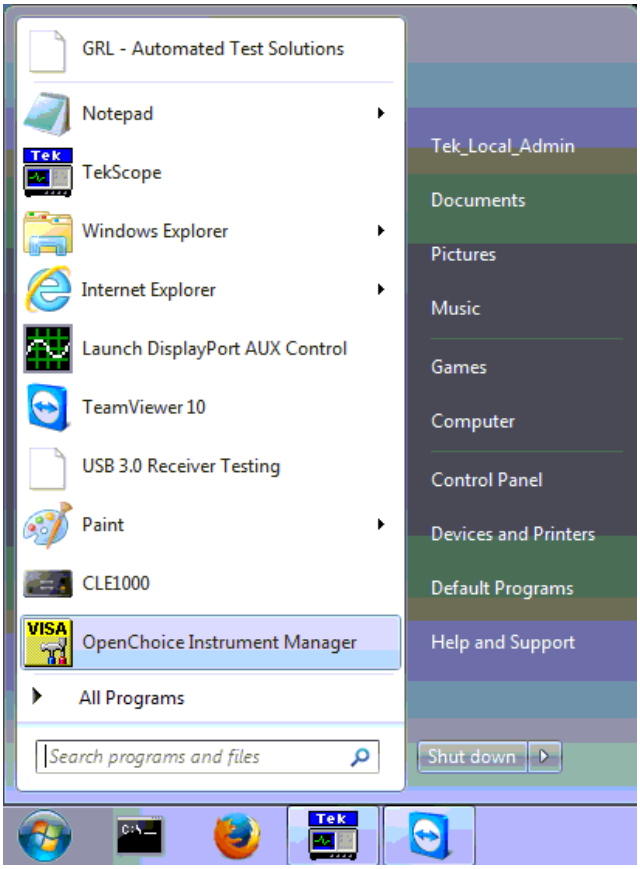


Figure 47. OpenChoice Instrument Manager In Start Menu

3. The left “Instruments” panel on the OpenChoice Instrument Manager will display all connected instruments. The functional buttons below the “Instruments” panel – “Instrument List Update”, “Search Criteria”, “Instrument Identify” and “Properties” can be used to detect the Scope in case it does not initially appear under “Instruments”.
    a) “Instrument List Update”: Select to refresh the instrument list and locate new instruments connected to the control PC.
    b) “Search Criteria”: Select to configure the instrument search function.
    c) “Instrument Identify”: Select to use a supported programming language to send a query to identify the selected instrument.

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d) “Properties”: Select to display and view the selected instrument properties.

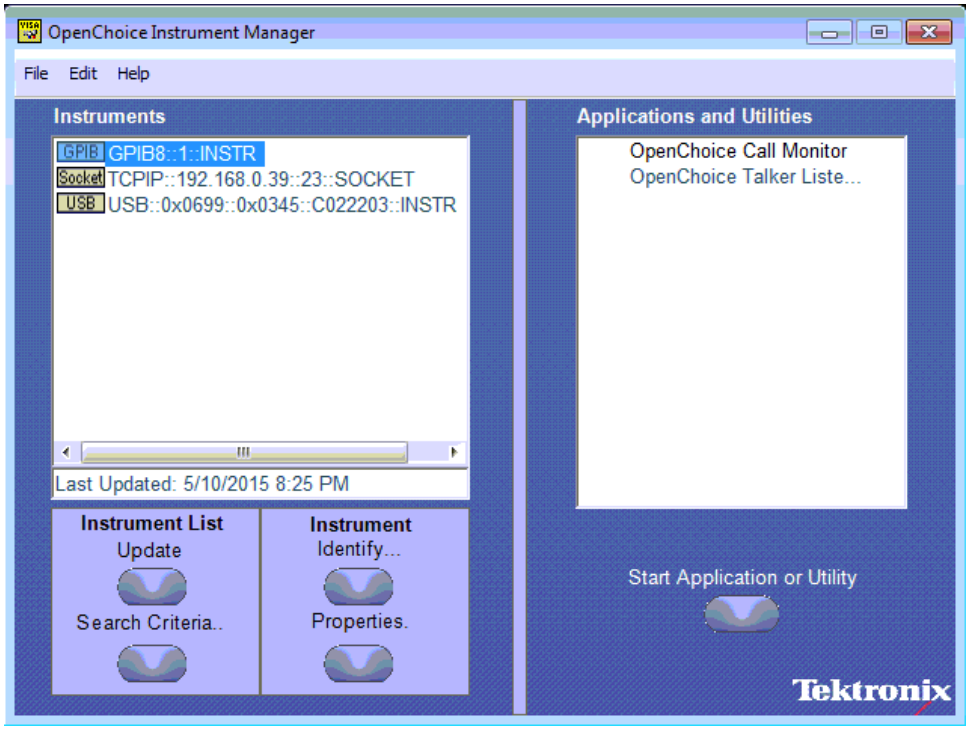


Figure 48. OpenChoice Instrument Manager Menu

4. If connecting the Tektronix Scope to the control PC via USB, select the “Search Criteria” function to ensure that USB connection is enabled, and then select the “Instrument List Update” function. When the Scope appears on the “Instruments” panel, select it and then go to the “Instrument Identify” function. This will display the model and serial number of the Scope once detected. Select the “Properties” function to view the Scope address.
5. If connecting the Tektronix Scope to the control PC via LAN, the Scope IP address must be pre-determined beforehand. Then select the “Search Criteria” function to ensure that LAN connection is enabled and type in the Scope IP address. When the Scope shows up in the list, select it followed by “Search”. The Scope should then appear on the “Instruments” panel. Select it and access the “Instrument Identify” function to view the Scope model and serial number as well as the “Properties” function to view the Scope address.
6. On the ‘Equipments’ screen of the Anritsu_GRLPS-PXE7-BASE-RXA Test Application, type in the Scope address into the ‘Address’ field.
   - If the Anritsu_GRLPS-PXE7-BASE-RXA Test Application is installed on the Tektronix Scope, ensure the Scope is connected via GPIB and type in the GPIB network address, for example “GPIB8::1::INSTR”.
   - If the application is installed on the control PC to control the Scope, type in the Scope IP address, for example “TCPIP0::192.168.0.110::inst0::INSTR”. Note to ***omit*** the Port number from the address.

END_OF_DOCUMENT

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