



GRL Platform Solutions

**Serial ATA International Organization: Serial ATA Revision
2.0 (SATA 3Gb/s) & Revision 3.0 (SATA 6Gb/s)
PHY Receiver Calibration and Test Automation Software**

User Guide/Method of Implementation (MOI)

**Using
Anritsu High Performance BERT,
High Performance Real-Time Oscilloscope
with
GRL-SATA-RXA Automation Software**

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TABLE OF CONTENTS

1	INTRODUCTION	7
2	REFERENCE DOCUMENTS	7
3	RESOURCE REQUIREMENTS	7
3.1	EQUIPMENT REQUIREMENTS	7
4	SETTING UP GRL-SATA-RXA AUTOMATION SOFTWARE	10
4.1	DOWNLOAD GRL-SATA-RXA SOFTWARE	10
4.2	LAUNCH AND SET UP GRL-SATA-RXA SOFTWARE.....	10
4.3	PRE-CONFIGURE GRL-SATA-RXA SOFTWARE BEFORE CALIBRATION/TESTING	13
4.3.1	Enter Test Session Information.....	13
4.3.2	Set Measurement Conditions.....	14
5	CALIBRATING USING GRL-SATA-RXA SOFTWARE	15
5.1	CONNECTION SETUP FOR MP1900A BERT GENERATOR SET.....	15
5.2	SET UP SATA RX CALIBRATION WITH AUTOMATION	16
5.2.1	Connect Equipment for Random Jitter (RJ) and Sinusoidal Jitter (SJ) Calibration	16
5.2.2	Connect Equipment for Total Jitter (TJ) and Eye Height Calibration	17
6	COMPLIANCE TESTING USING GRL-SATA-RXA SOFTWARE	18
6.1	SET UP SATA RX DUT TEST WITH AUTOMATION.....	18
6.1.1	Connect Equipment for Rx Jitter Tolerance Compliance Test.....	18
7	CONFIGURING AND SELECTING COMPLIANCE TESTS USING GRL-SATA-RXA SOFTWARE	19
7.1	SET UP COMPLIANCE TEST REQUIREMENTS	19
7.1.1	BER Automation Tab.....	19
7.1.2	Compliance Test Tab.....	19
7.1.3	Margin Test Tab	20
7.2	SELECT CALIBRATION AND COMPLIANCE TESTS	20
7.2.1	Select Calibration.....	20
7.2.2	Select DUT Compliance RSG Tests.....	20
7.2.3	Select Margin Search Tests.....	21
7.3	CALIBRATION/COMPLIANCE TEST PARAMETERS CONFIGURATION PAGE	21
7.4	CONFIGURE CALIBRATION TARGET VALUES.....	22
8	RUNNING AUTOMATION CALIBRATION AND TESTS USING GRL-SATA-RXA SOFTWARE	23
9	INTERPRETING GRL-SATA-RXA TEST REPORT	24
9.1	UNDERSTAND TEST REPORT INFORMATION.....	24
9.1.1	Test Session Information.....	24

9.1.2	Test Summary Table.....	25
9.1.3	Test Results	25
9.2	DELETE TEST RESULTS.....	27
10	SAVING AND LOADING GRL-SATA-RXA TEST SESSIONS	28
11	APPENDIX A: METHOD OF IMPLEMENTATION (MOI) FOR MANUAL SATA 6GB/S RECEIVER MEASUREMENTS	29
11.1	SATA 6Gb/s Rx CALIBRATION SETUP OVERVIEW	29
11.2	TP1 CALIBRATION PROCEDURE	29
11.2.1	RJ Calibration Steps	29
11.2.2	SJ Calibration Steps	29
11.3	TP2 CALIBRATION PROCEDURE.....	30
11.3.1	TJ Calibration Steps	30
11.3.2	Eye Height Calibration Steps	30
11.4	SATA 6G Rx COMPLIANCE TEST SETUP OVERVIEW	30
11.5	Rx COMPLIANCE TEST PROCEDURE	31
11.5.1	RSG-03 6Gb/s Rx Jitter Tolerance Test Steps	31
11.5.2	Rx Margin Search Test Steps	31
12	APPENDIX B: CONNECTING KEYSIGHT OSCILLOSCOPE TO PC	32
13	APPENDIX C: CONNECTING TEKTRONIX OSCILLOSCOPE TO PC	34
14	APPENDIX D: ARTEK CLE1000 SERIES INSTALLATION	36
14.1	ISI GENERATOR DRIVER INSTALLATION	36
14.2	CLE1000 USER INTERFACE (UI) INSTALLATION	39

List of Figures

Figure 1. Select and Launch GRL Platform Solutions Framework	10
Figure 2. Start GRL Platform Solutions Anritsu SATA Rx Test Application	11
Figure 3. See License Details.....	11
Figure 4. Check License for Installed Applications	11
Figure 5. Connect Instruments with GRL Platform Solutions Software.....	13
Figure 6. Session Info Page	13
Figure 7. Select SATA Data Rate(s).....	14
Figure 8. Select SJ Frequencies.....	14
Figure 9. Connection Setup for MP1900A BERT Generator Set Modules	15
Figure 10. RJ and SJ Calibration Setup.....	16
Figure 11. TJ and Eye Height Calibration Setup	17
Figure 12. Compliance Test Setup for Receiver DUT Jitter Tolerance	18
Figure 13. Configure BER Automation Test.....	19
Figure 14. Configure BER Compliance	19
Figure 15. Configure Margin Test Parameters	20
Figure 16. Rx Calibration Selection	20
Figure 17. Rx Compliance Test Selection.....	20
Figure 18. Rx Margin Search Test Selection	21
Figure 19. Calibration/Compliance Test Parameters Configuration.....	21
Figure 20. Calibration Target Overwrite.....	22
Figure 21. Run Tests Page.....	23
Figure 22. Connection Diagram Pop-Up Window Example	23
Figure 23. Test Report Page	24
Figure 24. Test Session Information Example	24
Figure 25. Test Summary Table Example	25
Figure 26. Test Results Example.....	27
Figure 27. Test Report Deleted	27
Figure 28. Save/Load/Create Test Sessions	28
Figure 29. SATA Calibration Block Diagram (From SATA UTD).....	29
Figure 30. Keysight Connection Expert.....	32
Figure 31. Oscilloscope's VISA Address.....	33
Figure 32. OpenChoice Instrument Manager In Start Menu.....	34
Figure 33. OpenChoice Instrument Manager Menu.....	35
Figure 34. Device Manager Window.....	36
Figure 35. Update Driver Window	37
Figure 36. Windows Security Window And Confirmation Window	38
Figure 37. Device Manager Window After Installation	38
Figure 38. CLE1000 UI	39

List of Tables

Table 1. Equipment Requirements – Systems.....	7
Table 2. Equipment Requirements – Accessories.....	9
Table 3. Calibration/Compliance Test Parameters Description	21

1 Introduction

This MOI & User Guide describes how to set up and test a PHY electrical receiver (Rx) device using the GRL-SATA-RXA automation software for SATA-IO Interoperability Program standard compliance certification for the 3 Gb/s and 6 Gb/s data rates.

The GRL-SATA-RXA software when run from a control computer or oscilloscope automates calibration and tests for RSG receiver jitter tolerance compliance of the SATA 3 Gb/s & 6 Gb/s based DUT. The GRL-SATA-RXA software works together with the Anritsu BERT Signal Quality Analyzer and a high-performance real-time oscilloscope to calibrate the stressed signal and test receiver conformance. The BERT along with a compliant ISI generator are used to generate the necessary test patterns with jitter and ISI components. A high-performance real-time oscilloscope is required for signal calibration while the BERT analyzer/error detector is used for error checking via loopback mode. To enable loopback mode for Bit Error Ratio (BER) compliance testing, the DUT will go into a forced loopback state, where the loopback test pattern of the DUT will be measured and should achieve a specified BER with a 95% confidence level.

Note: For manual test methodology, refer to the Appendix of this documentation or approved vendor-specific MOI's as technical reference.

2 Reference Documents

- Serial ATA Interoperability Program Revision 1.6 Unified Test Document (UTD) Version 1.0

3 Resource Requirements

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

3.1 Equipment Requirements

TABLE 1. EQUIPMENT REQUIREMENTS – SYSTEMS

System	Qty.	Description/Key Specification Requirement
GRL-SATA-RXA	1	GRL Platform Solutions SATA 3Gb/s & 6Gb/s Receiver Compliance Calibration & Test Automation Software – www.grlps.com – with Node Locked License to single Oscilloscope/PC OS Note: Users are required to purchase an additional license to use the GRL Platform Solutions SATA 3Gb/s software version. Please contact support@grlps.com for more information.
High Performance Real-Time Oscilloscope ^[a]	1	≥ 12 GHz bandwidth with Windows 7+ OS ^[b] With SATA measurement functionality

System	Qty.	Description/Key Specification Requirement
Anritsu BERT ^[c]	1	MP1900A Signal Quality Analyzer, with following modules: - MU181000A/B 12.5 GHz Synthesizer - MU181500B Jitter Modulation Source - MU195020A 32G bit/s SI Pulse Pattern Generator, or MU196020A 64.2G bit/s or 64.2G baud PAM4 Pulse Pattern Generator ^[d] - MU195040A 32G bit/s SI Error Detector - MU195050A Noise Generator
ISI Generator	1	SATA 3Gb/s or 6Gb/s Base Spec compliant Fixed or Variable ISI channel <i>(The Anritsu J1758A ISI Board is recommended if using the internal variable ISI function of the MP1900A BERT)</i>
VISA (Virtual Instrument Software Architecture) API Software	1	The VISA software is required to be installed on the host PC running the GRL-SATA-RXA software. GRL Platform Solutions' software framework has been tested to work with all three versions of VISA available on the Market: - NI-VISA: http://www.ni.com/download/ni-visa-17.0/6646/en/ - Keysight IO Libraries: www.keysight.com (Search on IO Libraries) - Tektronix TekVISA: www.tek.com (Downloads > Software > TekVisa)
Computer	1	Laptop or desktop PC running Windows 7+ OS for automation control

^[a] Oscilloscope with scope software requirements as specified in vendor specific MOI's. For example, when using the Keysight Scope, scope software such as Keysight InfiniiSim / EZ-JIT / Serial Data Analysis / Serial Data Equalization that are required for testing and signal processing must be pre-installed on the Scope. Similarly, the Tektronix Scope shall be used with the DPOJET (Jitter and Eye Analysis Tools) software for making measurements.

^[b] Oscilloscope with scope bandwidth as specified in vendor specific MOI's.

^[c] BERT SATA 3Gb/s & 6Gb/s patterns are distributed with the GRL-SATA-RXA software and are installed during installation.

^[d] The GRL-SATA-RXA software supports PAM4 PPG in NRZ mode.

TABLE 2. EQUIPMENT REQUIREMENTS – ACCESSORIES

Accessory	Qty.	Description/Key Specification Requirement
SATA Receptacle Test Adapter	1	– <i>DUT connector type dependent</i> • For SATA Device DUT: SATA receptacle to SMA female adapter • For SATA Host DUT: SATA plug to SMA female adapter
Connection Cables	3 pairs	– <i>DUT connector type and test configuration dependent</i> • Low loss, matched pair length SMA male to SMA male cables (of approximately 36” length) • HUBER+SUHNER SUCOFLEX® 107 cable model or equivalent
<i>V(m) - K(f) Adapter</i>	2	<i>34VKF50A Coaxial Adapter, only required if using a PAM4 Pulse Pattern Generator</i>
1-meter SMA coaxial cables	1 pair	– <i>DUT connector type and test configuration dependent</i>
Phase-matched K-K coaxial cables	1 pair	– <i>DUT connector type and test configuration dependent</i>
SMA-to-SMA cables	2	– <i>DUT connector type and test configuration dependent</i>
LAN cable	1	

4 Setting Up GRL-SATA-RXA Automation Software

This section provides the procedures to start up and pre-configure the GRL-SATA-RXA automation software before running tests. It also helps users familiarize themselves with the basic operation of the software.

Note: The GRL-SATA-RXA software installer will automatically create shortcuts in the Desktop and Start Menu when installing the software.

To start using the GRL-SATA-RXA software, follow the procedures in the following sections.

4.1 Download GRL-SATA-RXA Software

Download and install the GRL-SATA-RXA software on a PC or an oscilloscope (where GRL-SATA-RXA is referred to as 'Controller PC' or 'Scope' respectively in this User Guide & MOI):

1. Install VISA (Virtual Instrument Software Architecture) on to the PC/Scope where GRL-SATA-RXA is to be used (see Section 3.1).
2. Download the software ZIP file package from the GRL Platform Solutions support site.
3. The ZIP file contains:
 - **SATA_AN_RxPatternFilesInstallation0000000xxSetup.exe** – Run this on the Anritsu MP1900A BERT Signal Quality Analyzer to install the SATA test pattern setup files.
 - **SATA_AN_RxTestApplication0000000xxSetup.exe** – Run this on the Controller PC or Scope to install the GRL-SATA-RXA application.
 - **SATA_AN_RxTestScopeSetupFilesInstallation0000000xxSetup.exe** – Run this on the Scope to install the scope setup files.

4.2 Launch and Set Up GRL-SATA-RXA Software

1. Once the GRL-SATA-RXA software is installed, open the **GRL** folder from the Windows Start menu. Click on **GRL – Automated Test Solutions** within the GRL folder to launch the GRL Platform Solutions software framework.

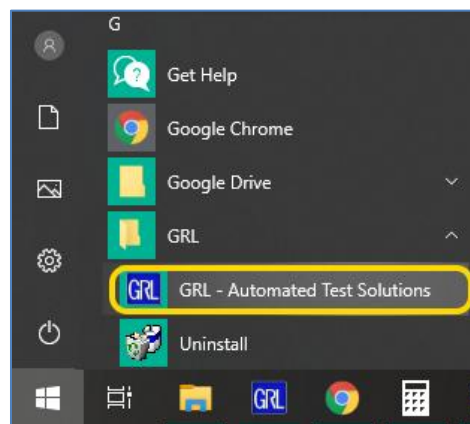


FIGURE 1. SELECT AND LAUNCH GRL PLATFORM SOLUTIONS FRAMEWORK

2. From the **Application → Rx Test Solution** drop-down menu, select **Anritsu SATA Rx Test** to start the GRL Platform Solutions Anritsu SATA Rx Test Application. If the selection is grayed out, it means that your license has expired.

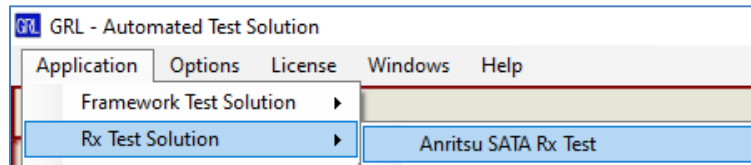


FIGURE 2. START GRL PLATFORM SOLUTIONS ANRITSU SATA RX TEST APPLICATION

3. To enable license, go to License→License Details.

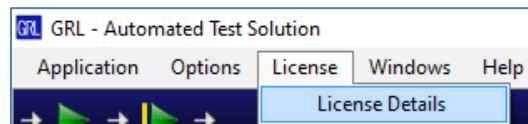


FIGURE 3. SEE LICENSE DETAILS

- a) Check the license status for the installed application.

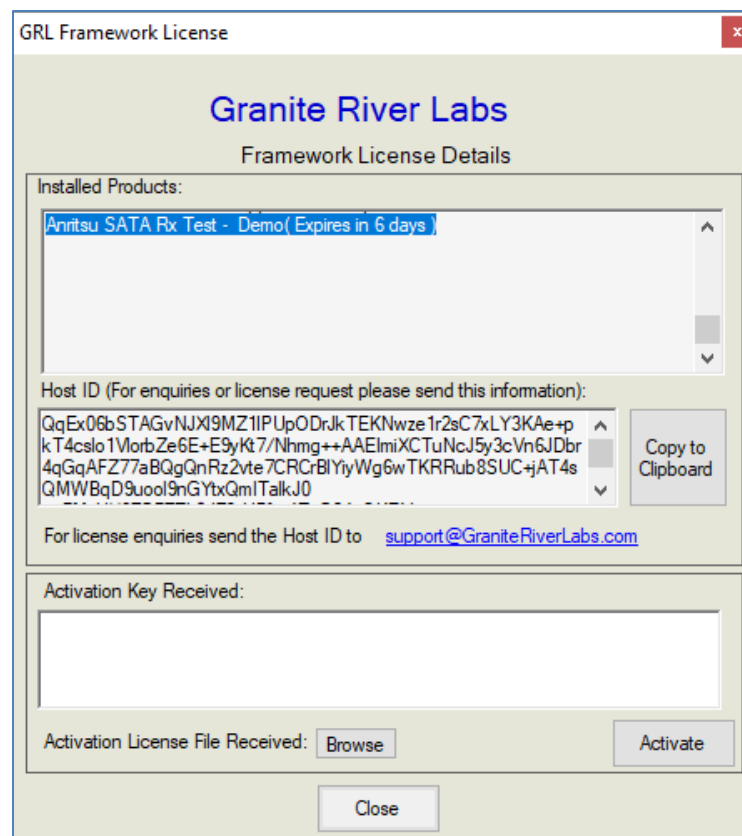


FIGURE 4. CHECK LICENSE FOR INSTALLED APPLICATIONS

- b) Activate a License:
 - If you have an Activation Key, enter it in the field provided and select “Activate”.
 - If you do not have an Activation Key, select “Close” to use a demo version of the software over a free 10-day trial period.

Note: Once the 10-day trial period ends, you will need to request an Activation Key to continue using the software on the same computer or oscilloscope. The demo software is also limited in its capability, in that it will only calibrate the maximum frequency for each data rate. Thus, the demo version cannot be used to fully calibrate and test a device. For Demo and Beta Customer License Keys, please request an Activation Key by contacting support@grlps.com.

Note: The GRL-SATA-RXA 3Gb/s software version requires additional licensing upon purchase. Please contact support@grlps.com for more information.

4. Select the Equipment Setup icon  on the GRL Platform Solutions Anritsu SATA Rx Test application menu.
5. Connect the Anritsu MP1900A BERT via LAN to the GRL Platform Solutions automation control enabled Scope or PC. The BERT and MX183000A software can be connected using connection string formats similar to the following examples:
 - BERT: "TCPIP0::192.168.0.14::5001::SOCKET" or "192.168.0.14:5001"
 - MX183000A: "TCPIP0::192.168.0.14::5000::SOCKET" or "192.168.0.14:5000"

Note the IP addresses listed above are only examples and should be changed according to the actual network connection being used.

6. If using an external ISI source (e.g., Artek CLE Series), connect the ISI source via USB to the GRL Platform Solutions automation control enabled Scope or PC. (Note: The USB driver software for the Artek ISI Generator must be installed on the Scope or PC. The driver is available from the ISI Generator manufacturer. Refer to Appendix of this MOI & User Guide for driver installation information.)
7. On the Scope or controller PC, obtain the network addresses for all the connected instruments from the device settings. Note these addresses as they will be used to connect the instruments to the GRL Platform Solutions automation software.
8. On the Equipment Setup page of the GRL Platform Solutions Anritsu SATA Rx Test application, type in the address of each connected instrument into the 'Address' field.

(Note: If the GRL Platform Solutions software is installed on the **Keysight Scope**, type in the Scope IP address, for example "TCPIP0::127.0.0.1::inst0::INSTR".)

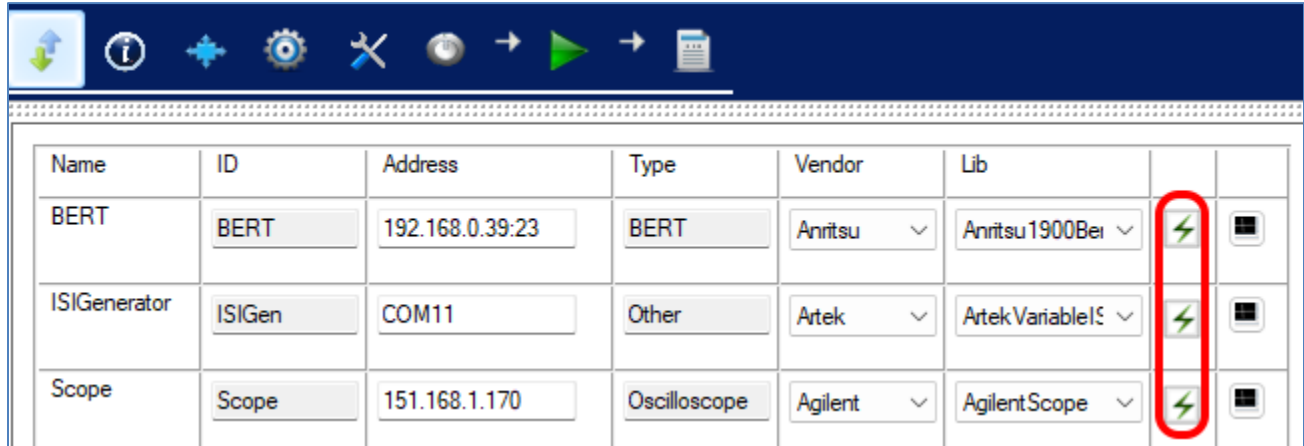
(Note: If the GRL Platform Solutions software is installed on the **Tektronix Scope**, ensure the Scope is connected via GPIB and type in the GPIB network address, for example "GPIB8::1::INSTR".)

If the GRL Platform Solutions software is installed on the PC to control the Scope, type in the Scope IP address, for example "TCPIP0::192.168.0.35::inst0::INSTR". Note to **omit** the Port number from the address.

(Note: If the GRL Platform Solutions software is installed on the **Keysight Scope**, and if there is error in connection, type in the Scope IP address as "TCPIP0::192.168.0.35::5025::SOCKET".)

9. Select the "lightning" button () for each connected instrument.

The "lightning" button should turn green () once the GRL Platform Solutions software has successfully established connection with each instrument.



Name	ID	Address	Type	Vendor	Lib	Status
BERT	BERT	192.168.0.39:23	BERT	Anritsu	Anritsu1900Bei	⚡
ISIGenerator	ISIGen	COM11	Other	Artek	ArtekVariableI	⚡
Scope	Scope	151.168.1.170	Oscilloscope	Agilent	AgilentScope	⚡

FIGURE 5. CONNECT INSTRUMENTS WITH GRL PLATFORM SOLUTIONS SOFTWARE

Note: Additional information for connecting supported vendor oscilloscopes (Keysight and Tektronix) to the controller PC is provided in the Appendix of this document.

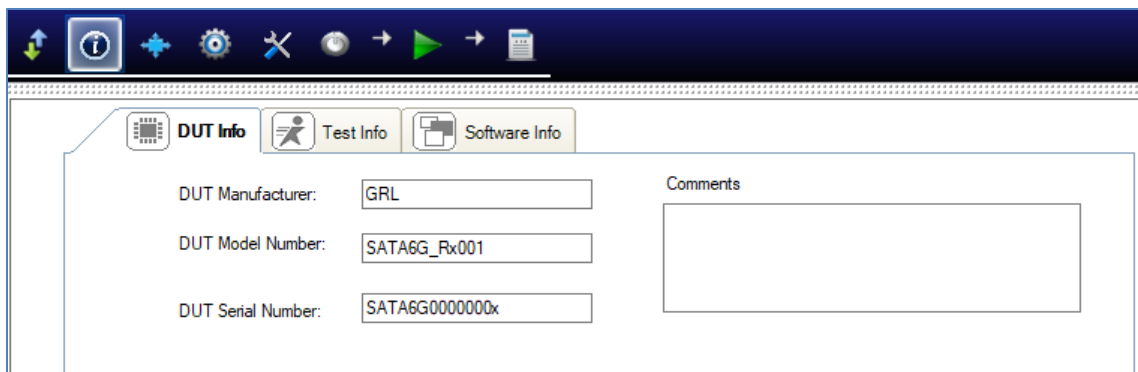
4.3 Pre-Configure GRL-SATA-RXA Software Before Calibration/Testing

Once all equipment is successfully connected from the previous section, proceed to set up the preliminary settings before going to the advanced measurement setup.

4.3.1 Enter Test Session Information

Select  from the menu to access the **Session Info** page. Enter the information as required for the test session that is currently being run. The information provided will be included in the test report generated by the GRL Platform Solutions software once tests are completed.

- The fields under **DUT Info** and **Test Info** are defined by the user.
- The **Software Info** field is automatically populated by the software.




DUT Info

Test Info

Software Info

DUT Manufacturer:

DUT Model Number:

DUT Serial Number:

Comments:

FIGURE 6. SESSION INFO PAGE

4.3.2 Set Measurement Conditions

Select  from the menu to access the **Conditions** page to set the conditions for calibration and compliance testing. The GRL-SATA-RXA software will perform calibration and testing using selected SJ Test Frequencies for the SATA 3Gb/s or 6Gb/s data rate.

Recommended procedure:

- *Step 1:* When calibrating, select all conditions that may be used for testing, and perform the calibration.
 - *Step 2:* Once calibration is completed and ready for testing, re-select the necessary test conditions. For example, if required to test only at specific SJ frequencies, then select the appropriate conditions for testing.
- a) **Data Rate** tab: Select to enable the SATA 3Gb/s or 6Gb/s signaling speed as supported by the DUT for calibration or testing.

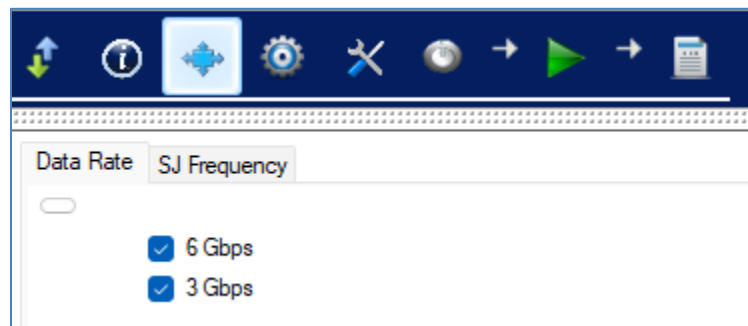


FIGURE 7. SELECT SATA DATA RATE(S)

- b) **SJ Frequency** tab: Select SJ Frequencies as required for calibration or testing.

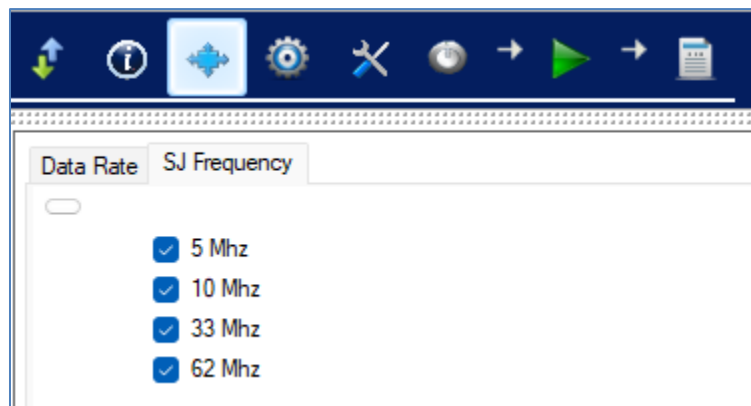


FIGURE 8. SELECT SJ FREQUENCIES

5 Calibrating Using GRL-SATA-RXA Software

The GRL-SATA-RXA test solution supports automated Rx calibration for SATA 3Gb/s & 6Gb/s Jitter and Eye Height requirements. To perform calibration, the GRL-SATA-RXA software is run from the oscilloscope or an external controller PC to enable automation control for each step of calibration.

The Anritsu BERT and appropriate equipment are used in the setup to provide the necessary test patterns with jitter and ISI components during calibration. A high-performance real-time oscilloscope is required for signal calibration while a compliant ISI source is used to generate insertion loss.

Note: A Variable ISI Generator is recommended to be used as the ISI source in the calibration/test setup. Variable ISI enables calibration/testing to be performed with minimum reconfiguration of the setup, which allows measurements to be more fully automated.

The GRL-SATA-RXA software provides a series of calibration that can be selected and run as described in Section 7.2.1.

When calibration is completed, the GRL-SATA-RXA software will generate a test report detailing all results obtained from the calibration.

5.1 Connection Setup for MP1900A BERT Generator Set

Figure 9 shows the connection setup between each module of the Anritsu MP1900A BERT Generator Set. *Note that the cable models used in this setup are examples and can be replaced with their equivalent.*

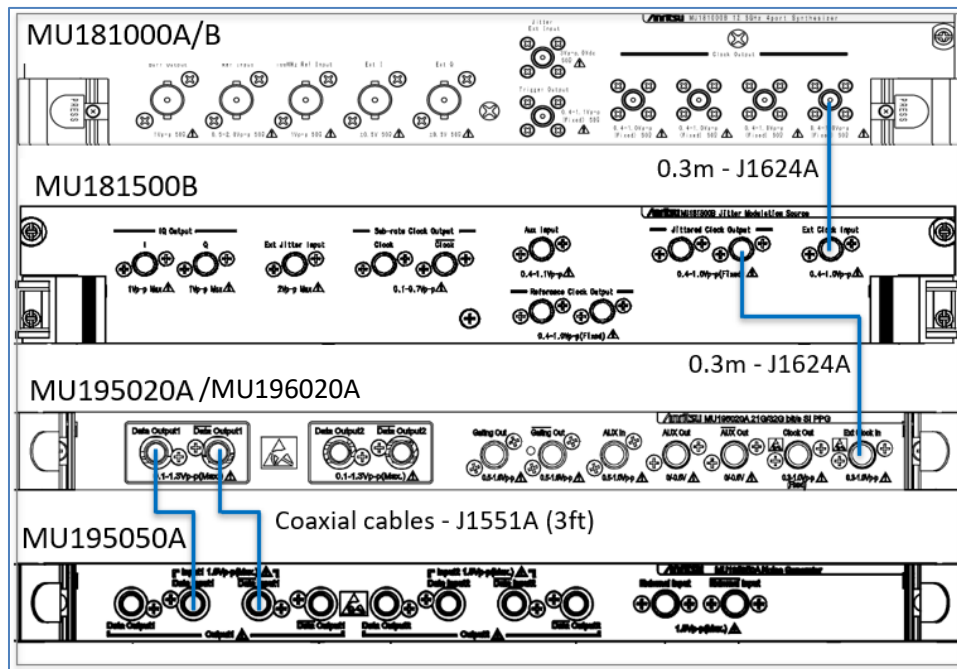


FIGURE 9. CONNECTION SETUP FOR MP1900A BERT GENERATOR SET MODULES

Connection Steps:

1. Using the J1624A SMA-SMA (0.3m) cable, connect the Clock Output of the MU181000A/B Synthesizer to the Ext Clock Input of the MU181500B Jitter Modulator.
2. Using the J1624A SMA-SMA (0.3m) cable, connect the Jittered Clock Output of the MU181500B Jitter Modulator to the Ext Clock Input of the MU195020A/MU196020A Pulse Pattern Generator.
3. Using the J1551A coaxial cables (3ft), connect the MU195020A/MU196020A Data Outputs to the MU195050A Data Inputs.

5.2 Set Up SATA Rx Calibration with Automation

After the GRL-SATA-RXA software has been pre-configured from Section 4.3, continue with the calibration setup. The following procedures show how to set up the physical connections to perform automated Rx calibration for stressed signals.

5.2.1 Connect Equipment for Random Jitter (RJ) and Sinusoidal Jitter (SJ) Calibration

The connection diagram below shows the recommended equipment setup to calibrate for RJ and SJ.

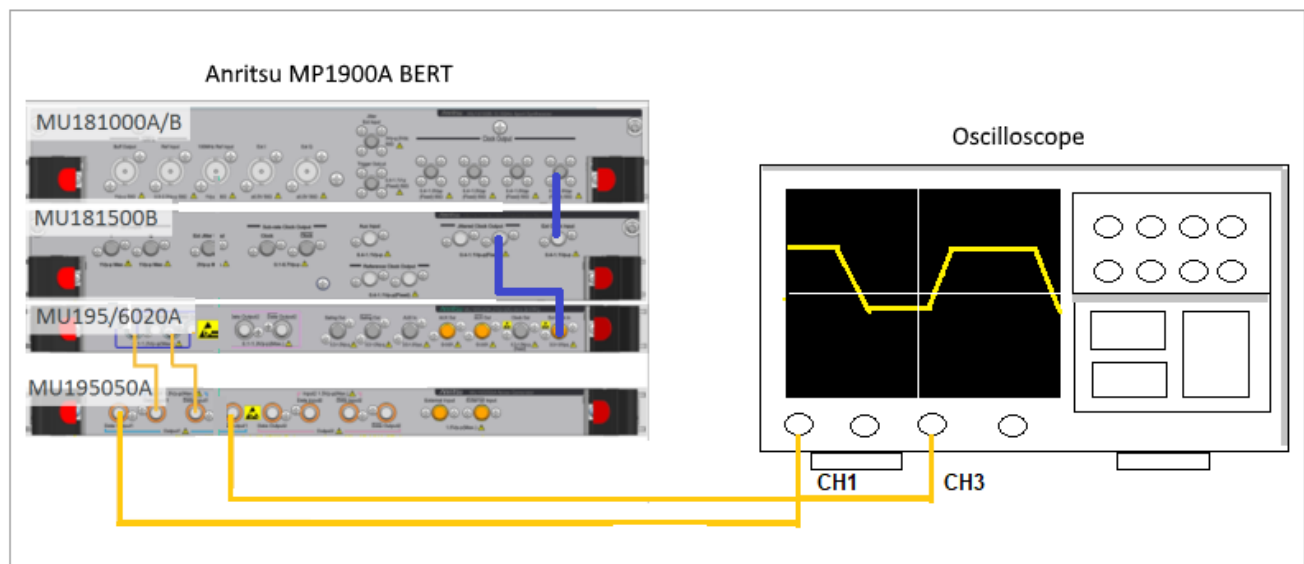


FIGURE 10. RJ AND SJ CALIBRATION SETUP

Connection Steps:

1. Set up the MP1900A BERT connections as described in Section 5.1 above.
2. Connect the MU195050A data outputs to Channels 1 and 3 on the oscilloscope using phase-matched K-K coaxial cables.

5.2.2 Connect Equipment for Total Jitter (TJ) and Eye Height Calibration

The connection diagram below shows the recommended equipment setup to calibrate for TJ and Eye Height.

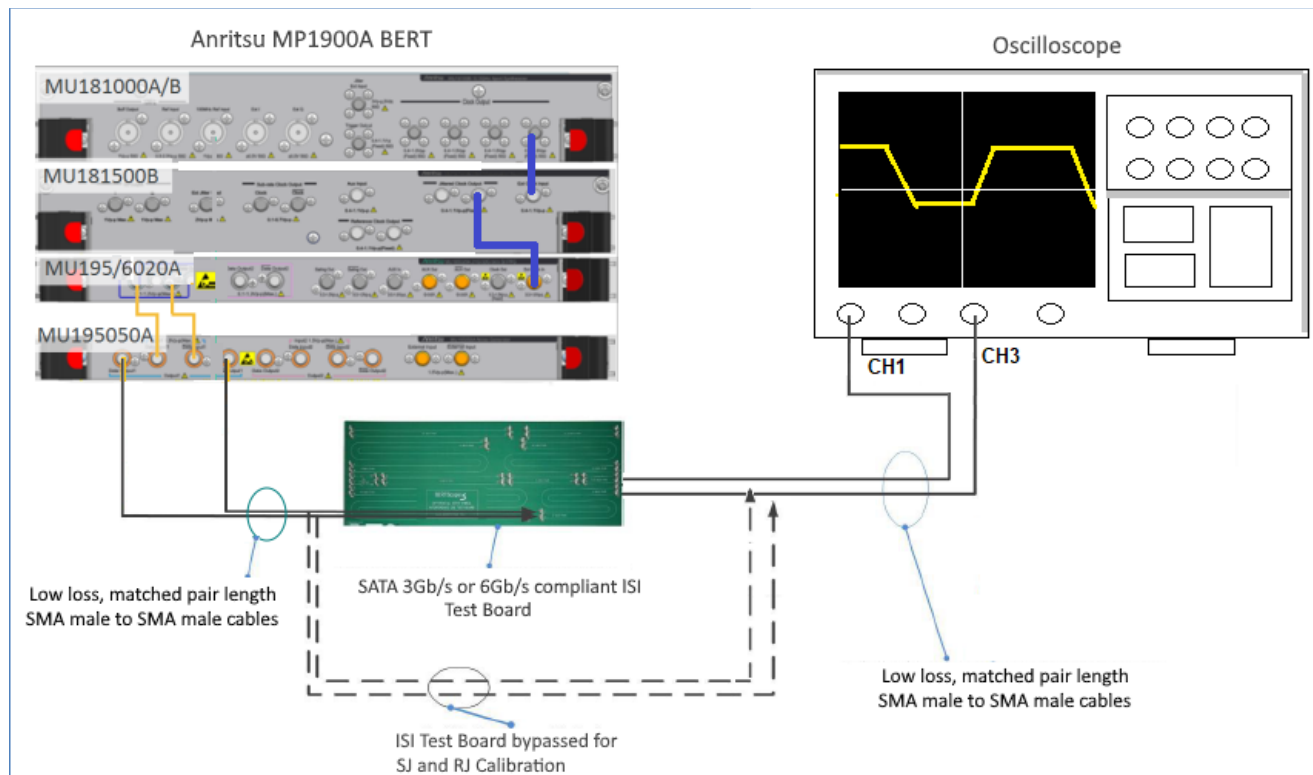


FIGURE 11. TJ AND EYE HEIGHT CALIBRATION SETUP

Connection Steps:

1. Using back the same BERT connections from the RJ/SJ calibration, disconnect the MU195050A data outputs from the oscilloscope channels.
2. Connect the MU195050A data outputs to a SATA 3Gb/s or 6Gb/s compliant ISI board using low loss, matched pair length SMA male to SMA male cables.
3. Connect another pair of low loss, matched pair length SMA male to SMA male cables from the ISI board to channels 1 and 3 on the oscilloscope.

6 Compliance Testing Using GRL-SATA-RXA Software

The GRL-SATA-RXA software supports automated Rx compliance testing with forced loopback mode for the SATA 3Gb/s or 6Gb/s based receiver DUT.

To enable loopback mode for Bit Error Ratio (BER) compliance testing, the DUT will go into a forced loopback state, where the loopback test pattern of the DUT will be measured. The test is run using FCOMP signaling with 2 Aligns and new LBP section, and the loopback pattern should report no more than zero frame errors for all four SJ frequencies– 10 MHz, 33 MHz, 62 MHz and 5 MHz.

6.1 Set Up SATA Rx DUT Test with Automation

6.1.1 Connect Equipment for Rx Jitter Tolerance Compliance Test

The connection diagram below shows the recommended equipment setup to test the DUT for SATA RSG-03 3Gb/s & 6Gb/s Rx jitter tolerance.

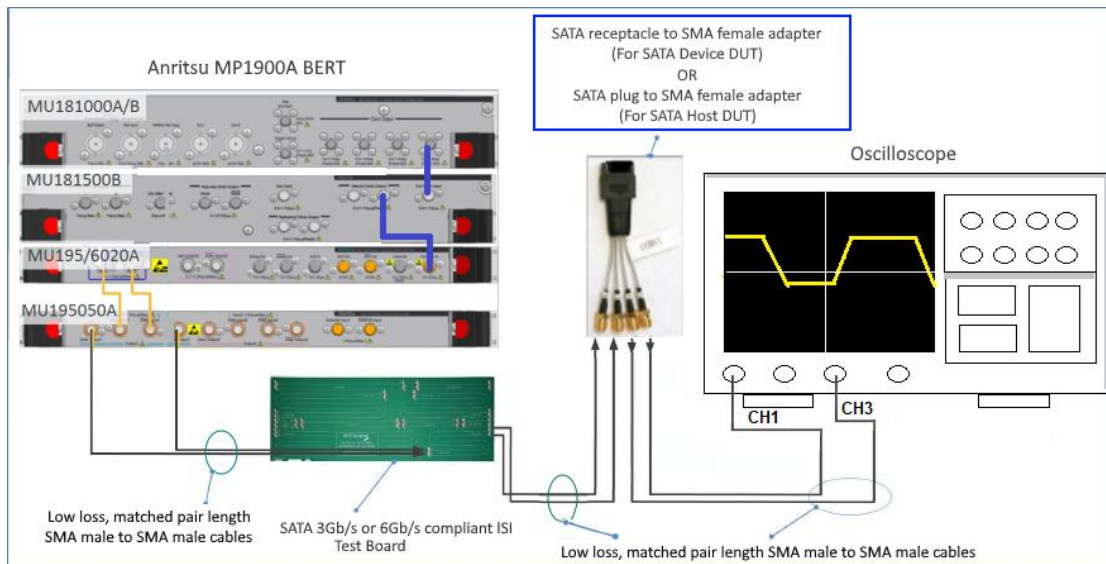


FIGURE 12. COMPLIANCE TEST SETUP FOR RECEIVER DUT JITTER TOLERANCE

Connection Steps:

1. Using back the same setup connections from the TJ/Eye Height calibration, disconnect the ISI board from the oscilloscope channels.
2. Connect the ISI board to the DUT through the Rx +/- inputs of an appropriate SATA receptacle/plug test adapter using low loss, matched pair length SMA male to SMA male cables. *[Note: For the SATA Device DUT, connect a SATA receptacle to SMA female adapter. For the SATA Host DUT, connect a SATA plug to SMA female adapter.]*
3. Connect another pair of low loss, matched pair length SMA male to SMA male cables from the Tx +/- outputs of the SATA receptacle/plug test adapter to Channels 1 and 3 on the oscilloscope for loopback error detection.

7 Configuring and Selecting Compliance Tests Using GRL-SATA-RXA Software

7.1 Set Up Compliance Test Requirements

After setting up the physical equipment, select  from the GRL Platform Solutions Anritsu SATA Rx Test Application menu to access the Setup Configuration page.

Use this page to configure the necessary measurement-related settings prior to running tests.

7.1.1 BER Automation Tab

Select the test method to run the BER Rx automation tests for the DUT.

- **Forced Loopback** mode: This mode allows running BER Rx automation tests using software loopback method (if the DUT can be configured to loopback mode).
- **Manual** mode: This mode allows running BER Rx automation tests manually.

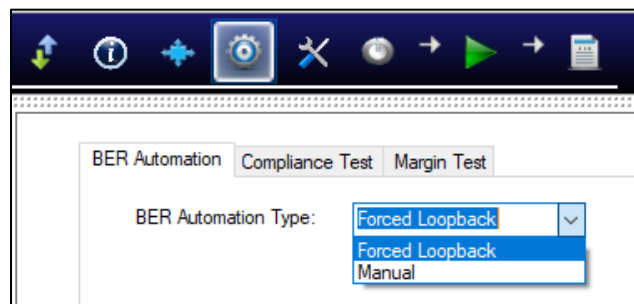


FIGURE 13. CONFIGURE BER AUTOMATION TEST

7.1.2 Compliance Test Tab

Specify the duration for the BER test run in the **Compliance Test Time** field for the 3 Gb/s and/or 6 Gb/s data rate and the maximum error limits in the **Max Error Count** field to be tested for compliance.

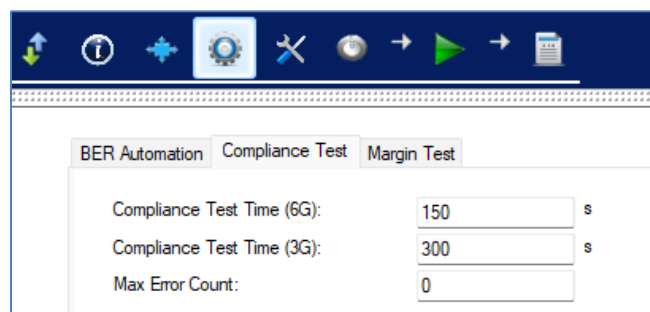


FIGURE 14. CONFIGURE BER COMPLIANCE

7.1.3 Margin Test Tab

Specify the test duration in the **Margin Test Time** field, maximum error limits in the **Max Error Count** field, **Step Size** and **Maximum Steps** to be applied during marginal testing.

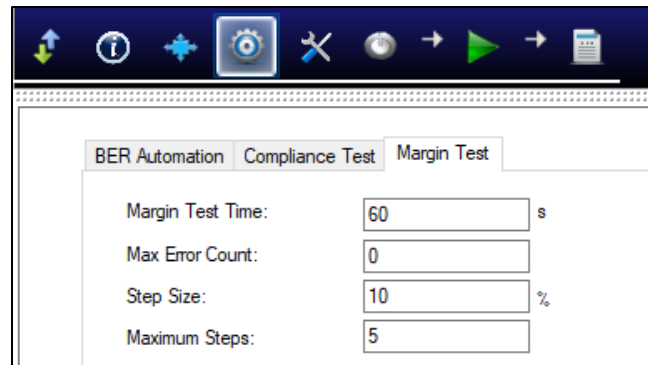


FIGURE 15. CONFIGURE MARGIN TEST PARAMETERS

7.2 Select Calibration and Compliance Tests

After setting up test requirements, go to the test selection page which allows all available Rx calibration and DUT compliance tests to be selected. Select the check boxes of the respective calibration and tests to be performed.

Note: When running tests for the first time or changing anything in the setup, it is suggested to perform calibration first. If calibration is not completed, attempting to run the Rx tests will throw errors.

Note: For calibration/testing, it is recommended to use a variable ISI channel as it allows the channel to be more easily adjusted to meet the required specification.

7.2.1 Select Calibration

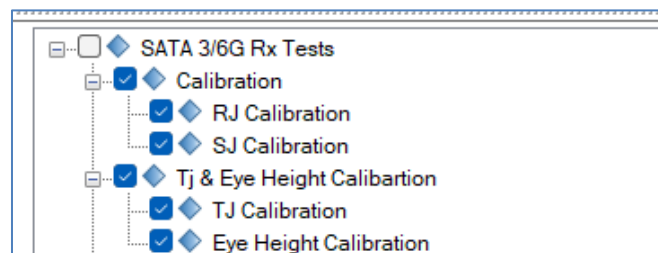


FIGURE 16. RX CALIBRATION SELECTION

7.2.2 Select DUT Compliance RSG Tests

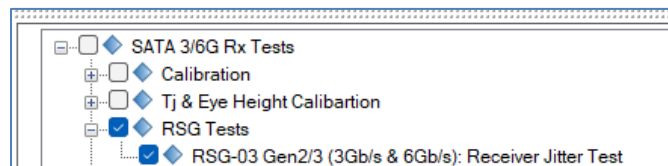


FIGURE 17. RX COMPLIANCE TEST SELECTION

7.2.3 Select Margin Search Tests

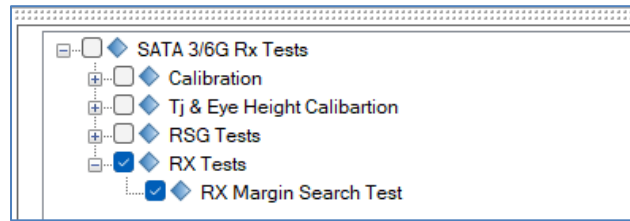


FIGURE 18. RX MARGIN SEARCH TEST SELECTION

7.3 Calibration/Compliance Test Parameters Configuration Page

Select  from the menu to access the Configurations page.

Set any of the available parameters required for measurement as described below. To return all parameters to their default values, select the 'Set Default' button.

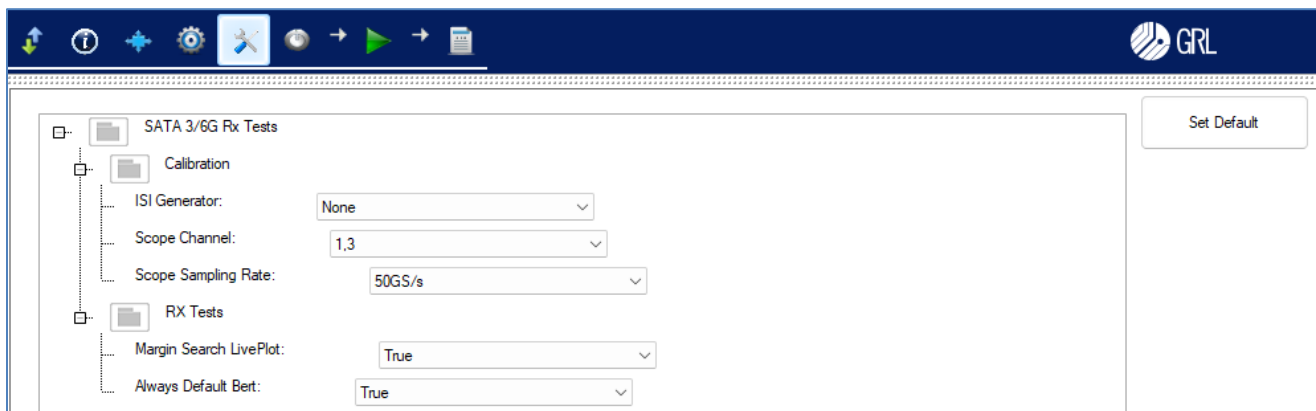


FIGURE 19. CALIBRATION/COMPLIANCE TEST PARAMETERS CONFIGURATION

TABLE 3. CALIBRATION/COMPLIANCE TEST PARAMETERS DESCRIPTION

Parameter	Description
ISI Generator	Select the type of supported ISI generators to be used: “None”: This is the recommended method which is used to provide the required physical channel Insertion Loss for calibration and testing. “Artek”: This is provided as an Option. A compliant Artek CLE Model Series ISI channel can be used in the setup for ISI automation. (<i>Also see Appendix for more information on installing the Artek CLE Series.</i>) “MP1900 ISI”: This is provided as an Option. The Anritsu BERT can be used in the setup for ISI automation if an external ISI channel is not available. The ISI source will be used for both calibration and compliance testing.
Scope Channel	Select the scope channel pair to be connected for calibration and

	compliance testing.
Scope Sampling Rate	Select the scope sampling rate to be used in calibration and compliance testing.
Margin Search Live Plot	Select 'True' to enable a graphical margin plot that updates as the margin test is performed to indicate progress of the test results. To disable select 'False'.
Always Default BERT	Select 'True' to always enable or 'False' to always disable default configuration on the BERT during testing.

7.4 Configure Calibration Target Values

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

any of the calibration. To do this, select  from the menu to access the Calibration page.

By default, the calibration target values are those defined in the specification. To change the values, un-select the 'Use Default Value' checkbox. In case the default values are required again, just select the checkbox to allow all existing values to be reset to default.

Note: The PID Control setting is used to adjust the step width for steps calculation if the target measurement cannot be met with the current step. To adjust, use a lower PID Control value to reduce the subsequent step or increase the control value to make the subsequent step bigger.

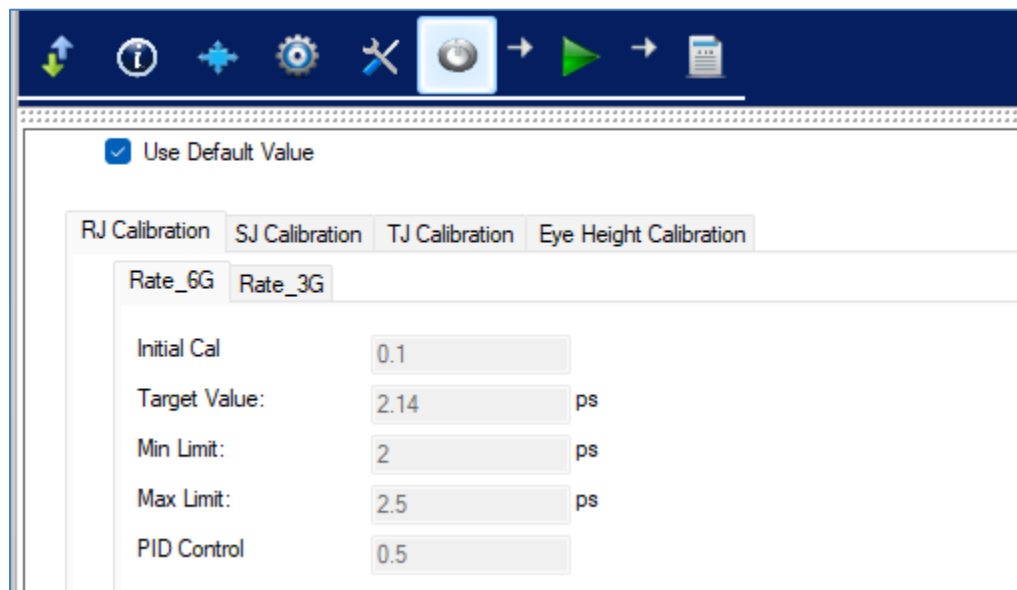


FIGURE 20. CALIBRATION TARGET OVERWRITE

8 Running Automation Calibration and Tests Using GRL-SATA-RXA Software

Once calibration and tests have been selected and set up from the previous sections, they are now ready to be run.

Select  from the menu to access the Run Tests page. The GRL-SATA-RXA software automatically runs the selected calibration and tests when initiated.

Before running the tests, select the option to:

- **Skip Test if Result Exists** – If results from previous calibration/tests exist, the software will *skip* those calibration/tests, or
- **Replace if Result Exists** – If results from previous calibration/tests exist, the software will *replace* those calibration/tests with new results.

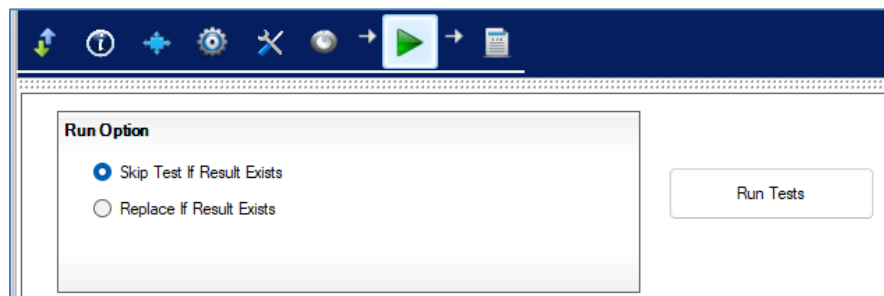


FIGURE 21. RUN TESTS PAGE

Select the **Run Tests** button to automatically start running the selected calibration and tests. At the start of a specific calibration/test, the corresponding connection diagram will initially appear to allow the user to verify with the recommended physical setup before continuing with the next step. Below shows an example of a connection diagram pop-up window.

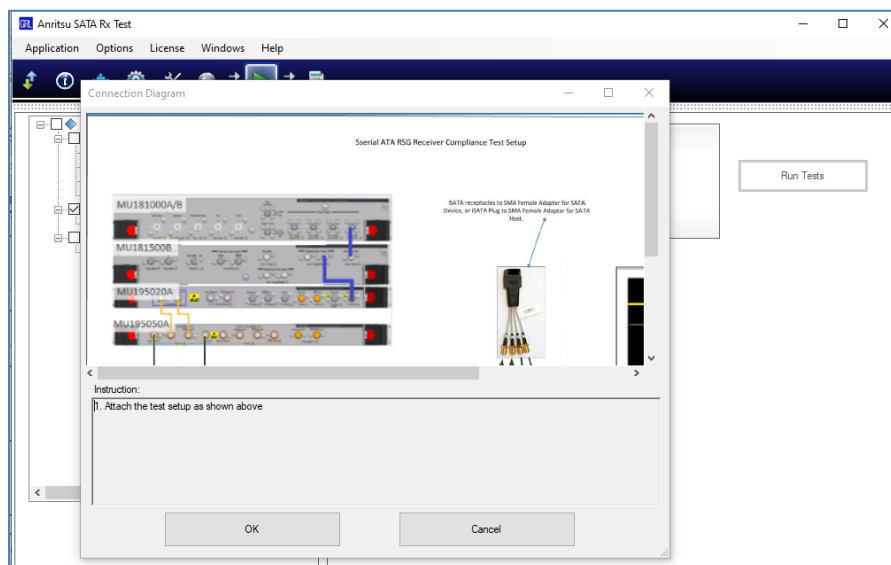


FIGURE 22. CONNECTION DIAGRAM POP-UP WINDOW EXAMPLE

9 Interpreting GRL-SATA-RXA Test Report

When all calibration and test runs have completed from the previous section, the GRL-SATA-RXA software will automatically display the results on the **Report** page.

Select  from the menu to access the Report page for a quick view of all results.

If some of the results are not desired, they can be individually deleted by selecting the **Delete** button.

For detailed test report, select the **Generate report** button to generate a PDF report. To have the calibration data plotted in the report, select the **Plot Calibration Data** checkbox.

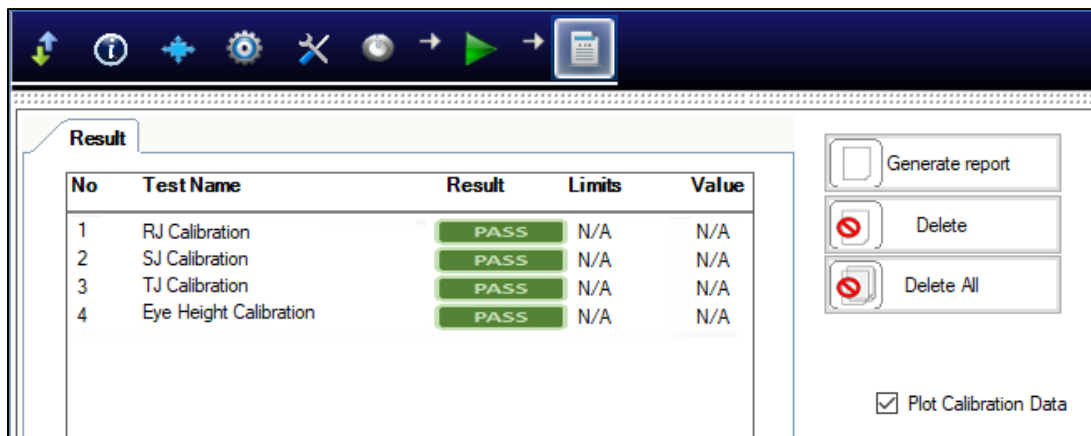


FIGURE 23. TEST REPORT PAGE

9.1 Understand Test Report Information

This section gives a general overview of the test report to help users familiarize themselves with the format. Select the **Generate report** button to generate the test report.

9.1.1 Test Session Information

This portion displays the information previously entered on the **Session Info** page.

Anritsu SATA Rx Test Report	
DUT Information	
DUT Manufacturer	: GRL
DUT Model Number	: SATA_Rx001
DUT Serial Number	: SATA_000000000000x1
DUT Comments	:
Test Information	
Test Lab	: Granite River Labs
Test Operator	: David
Test Date	: 20 December 2023
Software Version	
Software Revision	: 1.08.14

FIGURE 24. TEST SESSION INFORMATION EXAMPLE

9.1.2 Test Summary Table

This table provides an overall view of all the calibration and tests performed along with their conditions and results.

No	TestName	Limits	Value	Results	Data Rate	SJ Frequency
1	RJ Calibration	N/A	N/A	Pass		
2	SJ Calibration	N/A	N/A	Pass	Rate_6G	SJ1
3	SJ Calibration	N/A	N/A	Pass	Rate_6G	SJ2
4	SJ Calibration	N/A	N/A	Pass	Rate_6G	SJ3
5	SJ Calibration	N/A	N/A	Pass	Rate_6G	SJ4
6	IJ Calibration	N/A	N/A	Pass		
7	Eye Height Calibration	N/A	N/AmV	Pass		
8	RSG-03 Gen3 (6Gb/s): Receiver Jitter Test	N/A	N/A	Fail	Rate_6G	SJ3
9	RSG-03 Gen3 (6Gb/s): Receiver Jitter Test	N/A	N/A	Fail	Rate_6G	SJ4
10	RX Margin Search Test	N/A	N/A	Pass	Rate_6G	SJ1
11	RX Margin Search Test	N/A	N/A	Fail	Rate_6G	SJ3
12	RX Margin Search Test	N/A	N/A	Fail	Rate_6G	SJ4

Compliance Test

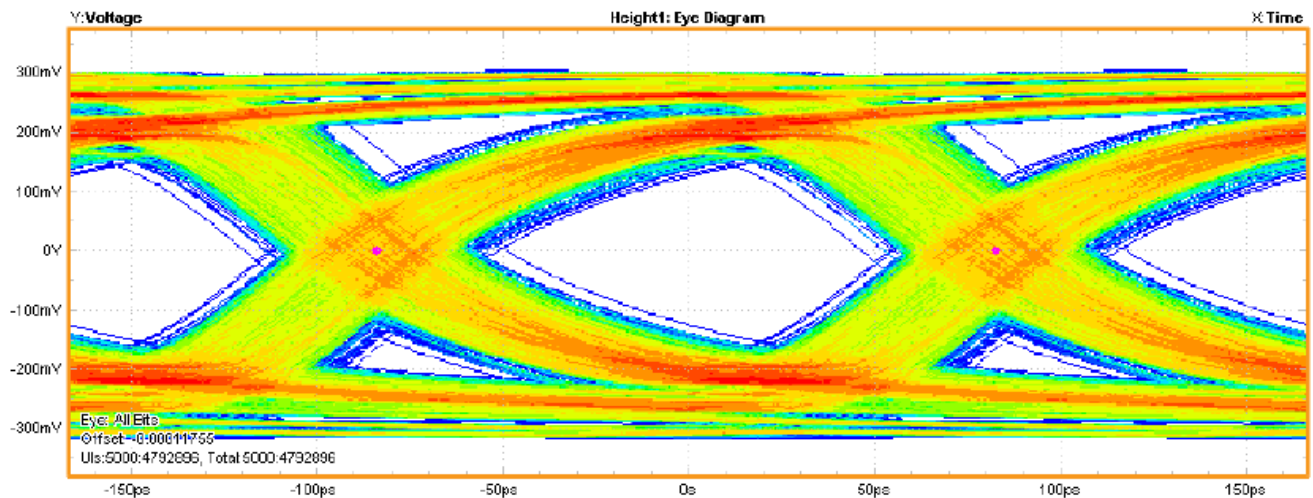
Data Rate	SJ1	SJ2	SJ3	SJ4
Rate_6G	-	-	FAIL(1)	FAIL(1)

FIGURE 25. TEST SUMMARY TABLE EXAMPLE

9.1.3 Test Results

This portion displays the results in detail along with supporting data points and screenshots for each calibration/test run.

7. Eye Height Calibration	
Pass/Fail Stats	: Pass
Cal Parameter	: Amplitude
Settings	: 474.0000
Measured Value	: 248.5048 mV
Test completed time	: 16 October 2020 8:45:56 AM



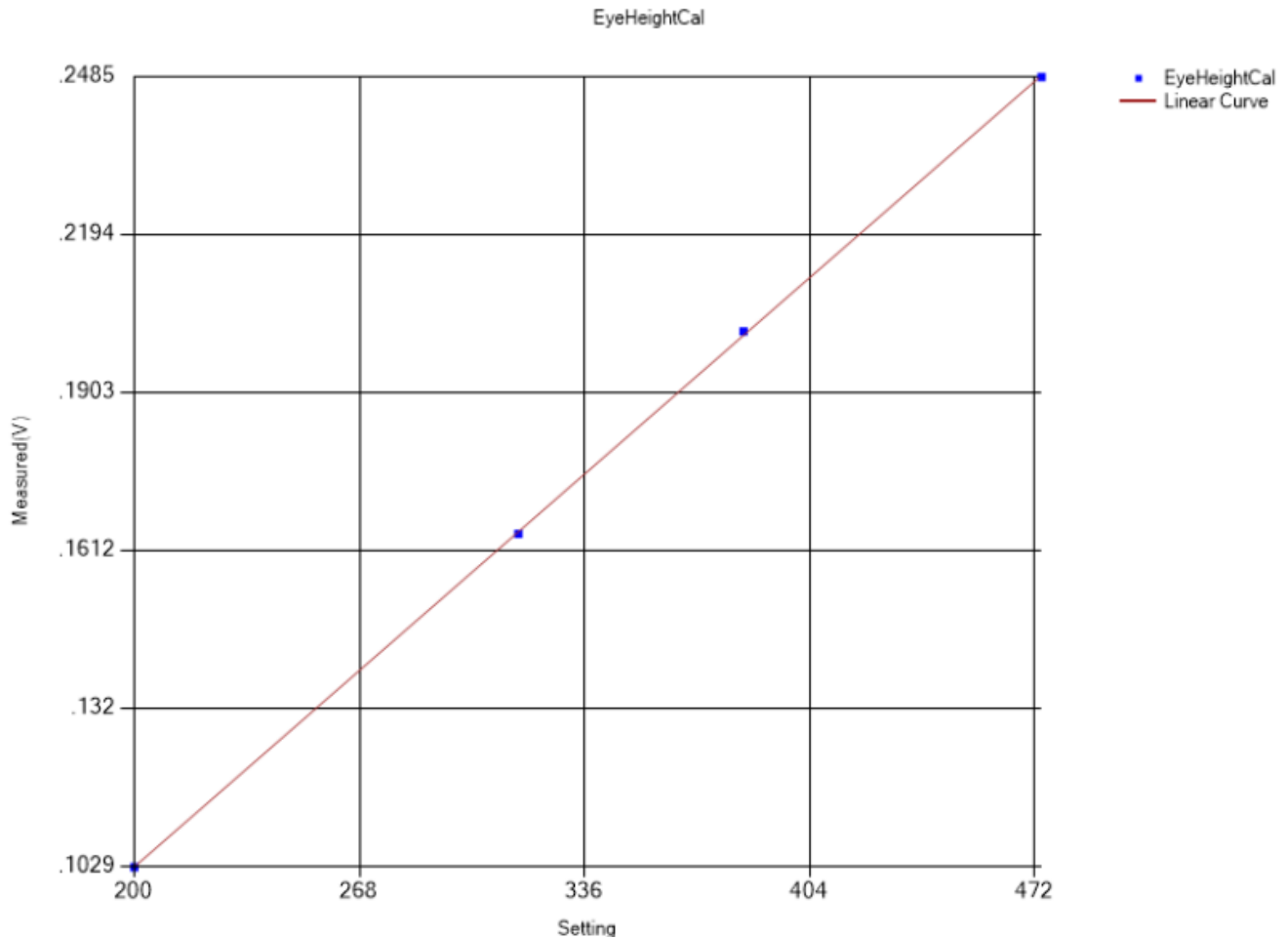


FIGURE 26. TEST RESULTS EXAMPLE

9.2 Delete Test Results

To individually delete any unwanted calibration/test results, select the corresponding result row and **Delete** button.

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

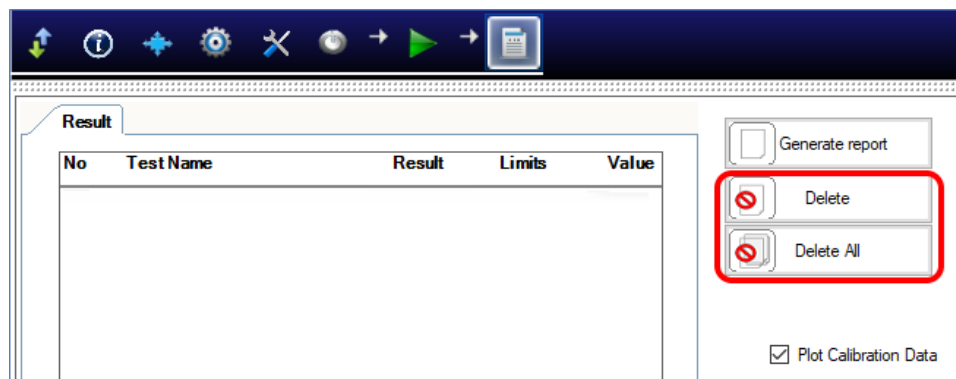


FIGURE 27. TEST REPORT DELETED

10 Saving and Loading GRL-SATA-RXA Test Sessions

The usage model for the GRL-SATA-RXA software is that the test results are created and maintained as a 'Live Session' in the application. This allows the user to quit the application and return later to continue where the user left off.

Save and Load Sessions are used to save a test session that the user may want to recall later. The user can 'switch' between different sessions by saving and loading them when needed.

- To **save a test session**, with all of the test parameter information, test results, and any waveforms, select the Options drop-down menu and then select 'Save Session'.
- To **load a test session** back into the application, including the saved test parameter settings, select Options → 'Load Session'.
- To **create a new test session** and return the application back to the default configuration, select Options → 'New Session'.

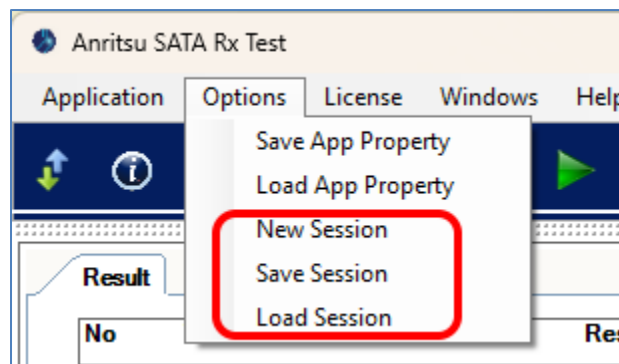


FIGURE 28. SAVE/LOAD/CREATE TEST SESSIONS

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

11 Appendix A: Method of Implementation (MOI) for Manual SATA 6Gb/s Receiver Measurements

This section provides the manual SATA 6Gb/s Rx calibration and compliance test methodology based on the SATA Unified Test Document (UTD) Standard. *Note the Tektronix Scope will be used in the following MOI.*

11.1 SATA 6Gb/s Rx Calibration Setup Overview

Calibration is performed at the TP1 & TP2 test points as shown in the following figure (extracted from the SATA UTD):

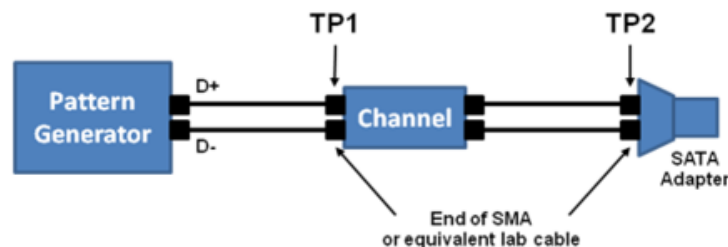


Figure 18 – Test points for RSG setup calibration.

FIGURE 29. SATA CALIBRATION BLOCK DIAGRAM (FROM SATA UTD)

TP1 is the test point without the effects of the channel. The Anritsu MP1900A BERT will be directly connected to the Oscilloscope using SMA cables for TP1 calibration.

TP2 calibration includes the effect of the channel into the calibration setup. A SATA 6G compliant ISI channel will be connected in between the Anritsu MP1900A BERT and Oscilloscope for TP2 calibration.

11.2 TP1 Calibration Procedure

Calibration at TP1 consists of Random Jitter (RJ) and Sinusoidal Jitter (SJ) calibration.

Set up the equipment connections as described in Section 5.2.1 before proceeding with the following steps.

11.2.1 RJ Calibration Steps

1. Initialize BERT.
2. Set 400 mV (p-p) amplitude.
3. Set All Stress to 0 mV.
4. Set Medium Frequency Test Pattern (MFTP) Pattern on BERT.
5. Set Initial RJ value to 0.1 UI(p-p) on BERT.
6. Measure RJ (in ps (RMS)) from Scope using DPOJET, record the measured value.
7. Use linear regression method to determine next estimated RJ setting, measure RJ, and repeat until RJ meets target of 2.14 ps (RMS).
8. Plot a linear graph.
9. Passing criteria is to obtain measured RJ at 2.14 ps (RMS).

11.2.2 SJ Calibration Steps

1. Initialize BERT.
2. Set 400 mV (p-p) amplitude.

3. Set All Stress to 0 mV.
4. Set Medium Frequency Test Pattern (MFTP) Pattern on BERT.
5. Set SJ Frequency of the first Permutation (5 MHz, 10 MHz, 33 MHz, 62 MHz).
6. Set 0.1 UI (p-p) as base value in SJ, measure SJ (in ps (p-p)) from Scope using DPOJET, record.
7. Use linear regression method to determine next estimated SJ setting, measure SJ, and repeat until SJ meets target of 0.192 UI.
8. Plot a linear graph.
9. Passing criteria is to obtain measured SJ at 0.192 UI.
10. Proceed to next permutation.

11.3 TP2 Calibration Procedure

Calibration at TP2 consists of Total Jitter (TJ) and Eye Height calibration.

Set up the equipment connections as described in Section 5.2.2 before proceeding with the following steps.

11.3.1 TJ Calibration Steps

1. Initialize BERT.
2. Set 400 mV (p-p) amplitude.
3. Set RJ and SJ to calibrated values.
4. Set Framed COMP Pattern on BERT.
5. Set Initial ISI value to 20 dB on ISI Generator.
6. Measure TJ (in UI (RMS)) from Scope using DPOJET, record the measured value.
7. Use linear regression method to determine next estimated ISI setting, measure TJ, and repeat until TJ meets target of 0.534 UI (RMS).
8. Plot a linear graph.
9. Passing criteria is to obtain measured TJ at 0.534 UI (RMS).

11.3.2 Eye Height Calibration Steps

1. Initialize BERT.
2. Set 200mV (p-p) amplitude.
3. Set RJ and SJ, ISI to calibrated values.
4. Set Framed COMP Pattern on BERT.
5. Measure amplitude (in mV) from Scope, record the measured value.
6. Use linear regression method to determine next estimated amplitude, measure amplitude, and repeat until amplitude meets target of 250 mV.
7. Plot a linear graph.
8. Passing criteria is to obtain measured amplitude at 250 mV.

11.4 SATA 6G Rx Compliance Test Setup Overview

Receiver tolerance testing is performed to ensure correct detection of data by the SATA 6Gb/s receiver DUT. After the calibration process has completed, receiver tolerance testing can be performed on the DUT.

The DUT will be subjected to the RSG-03 6Gb/s Receiver Jitter Tolerance Test, where a stressed signal with applied RJ, SJ and ISI is supplied to the DUT and the DUT will be tested to ensure that the receiver is able to correctly detect the signal.

An optional Receiver Margin Search Test can be performed to determine the SATA 6Gb/s DUT tolerance to applied jitter. During this test, the applied SJ will be progressively increased until the receiver is no longer capable of accurately receiving the signal.

11.5 Rx Compliance Test Procedure

Set up the equipment connections as described in Section 6.1.1 before proceeding with the following steps.

11.5.1 RSG-03 6Gb/s Rx Jitter Tolerance Test Steps

1. Configure the BERT to transition the DUT into loopback mode. Once the DUT is in loopback mode, configure the BERT so that the FCOMP pattern is looped back by the DUT.
2. Configure and start error counter functionality on the Scope.
3. Read the BER result.
4. Determine if the BER is within limits.

11.5.2 Rx Margin Search Test Steps

1. Configure the BERT to transition the DUT into loopback mode. Once the DUT is in loopback mode, configure the BERT so that the FCOMP pattern is looped back by the DUT.
2. Configure and start error counter functionality on the Scope.
3. Read the BER result.
4. If the BER result is within limits, increase applied SJ and repeat from step 3.

12 Appendix B: Connecting Keysight Oscilloscope to PC

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 the PC.
2. When installed successfully, the IO icon () will appear in the taskbar notification area of the PC.
3. Select the IO icon to launch the **Keysight Connection Expert**.
4. Click Rescan.

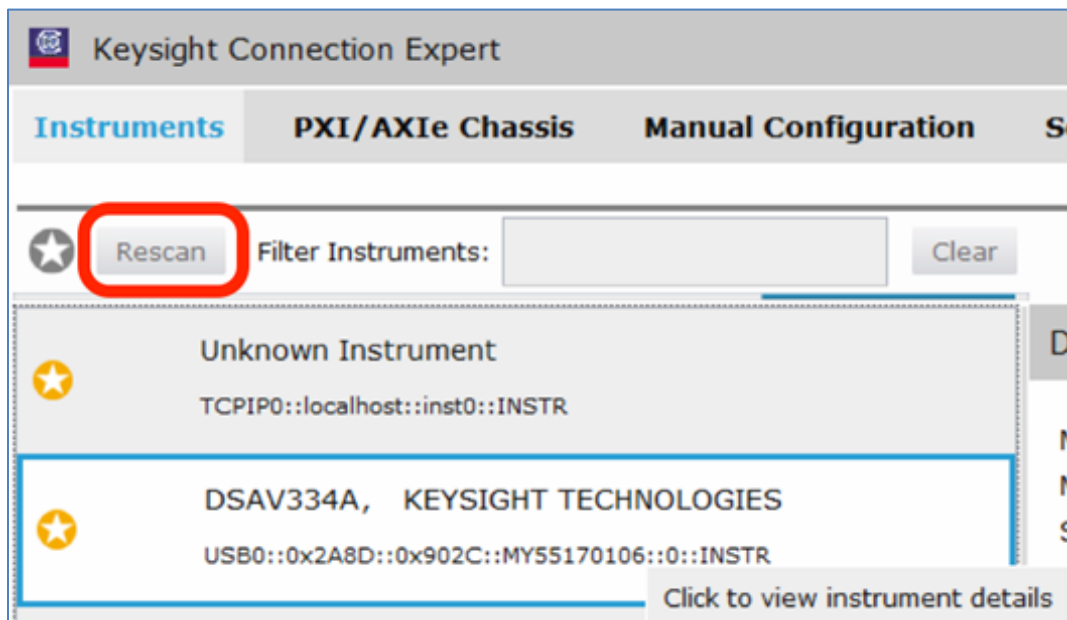


FIGURE 30. KEYSIGHT CONNECTION EXPERT

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

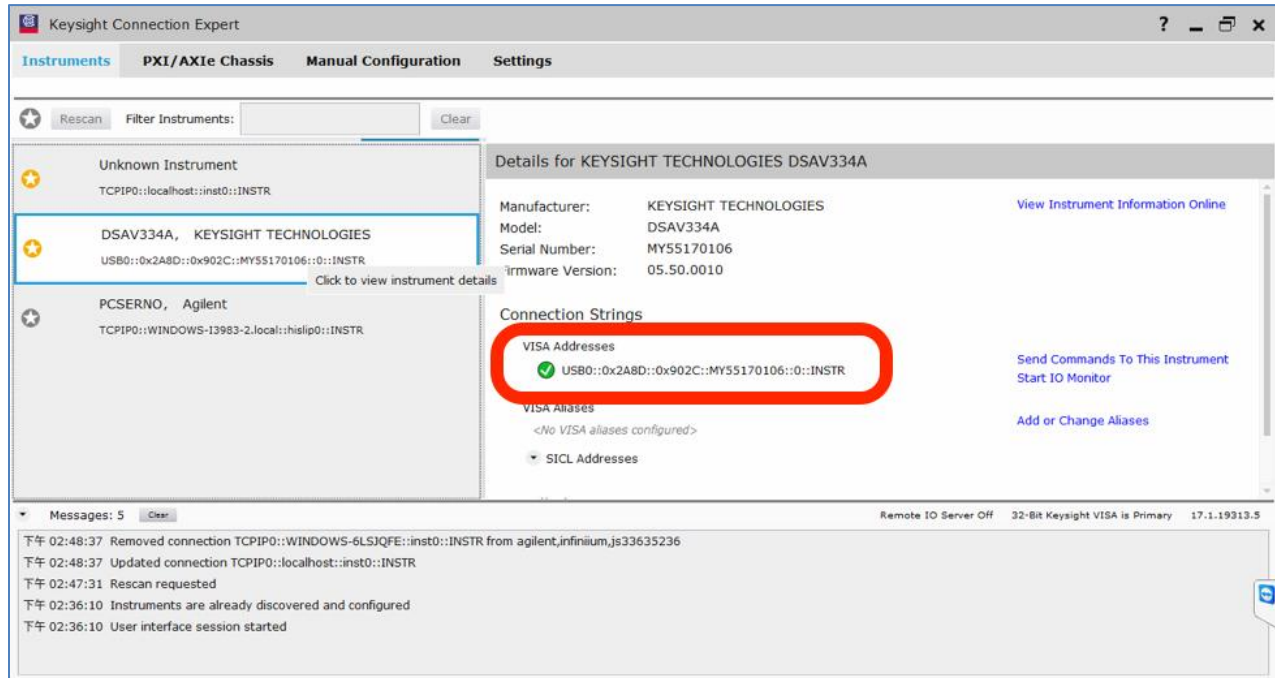


FIGURE 31. OSCILLOSCOPE'S VISA ADDRESS

6. When connecting the Keysight Scope to the PC through GPIB/USB, type in the VISA address into the 'Address' field on the Equipment Setup page of the GRL Platform Solutions SATA Rx Test Application. If connected 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.

If there is error in connection, type in the Scope IP address as "TCPIP0::192.168.0.4::5025::SOCKET".

13 Appendix C: Connecting Tektronix Oscilloscope to PC

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 on the PC.
2. When installed successfully, open the OpenChoice Instrument Manager application.

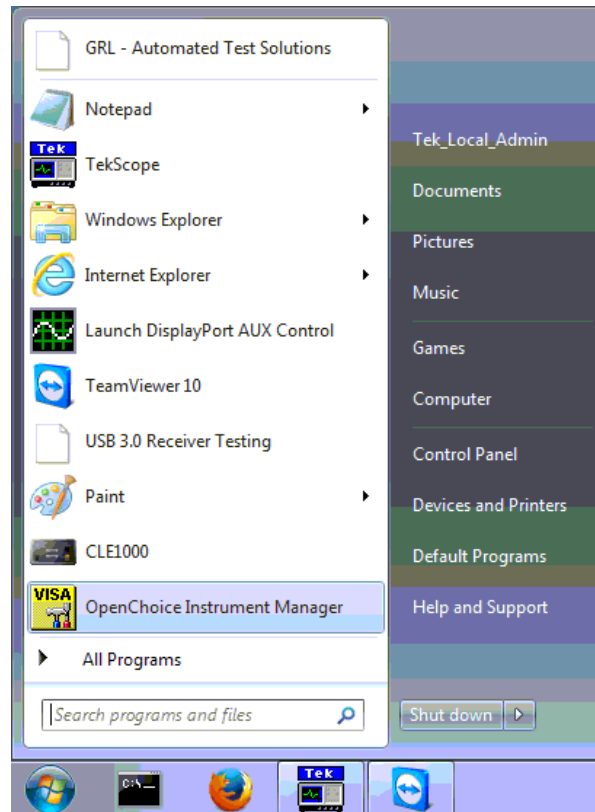


FIGURE 32. OPENCHOICE INSTRUMENT MANAGER IN START MENU

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

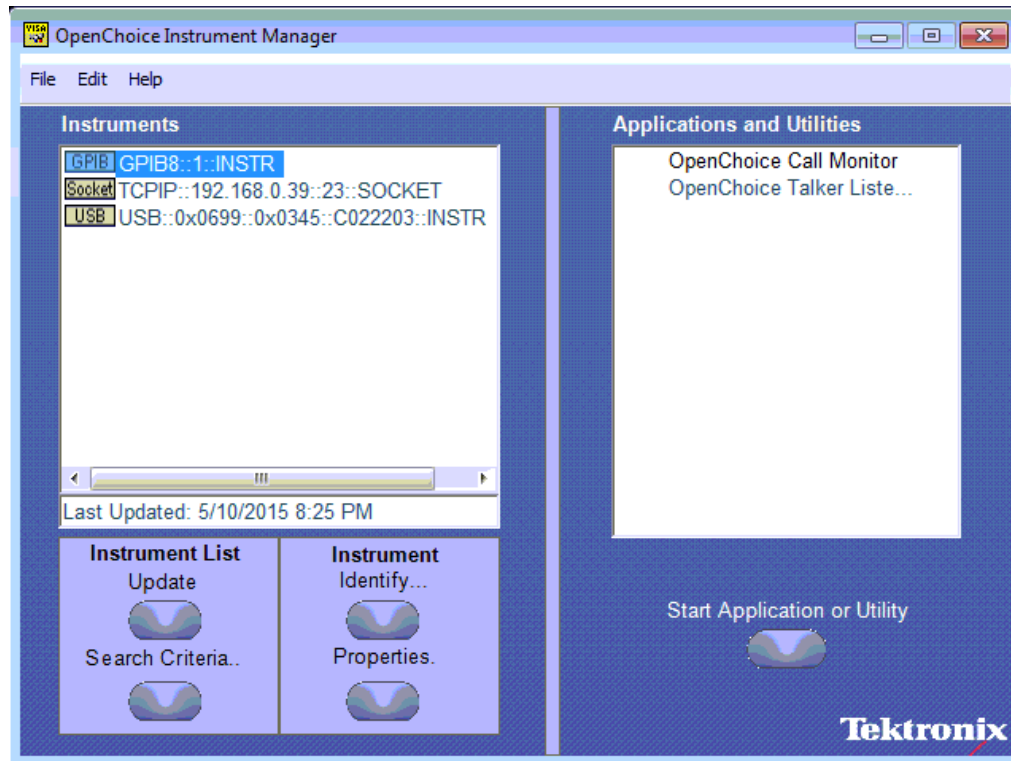


FIGURE 33. OPENCHOICE INSTRUMENT MANAGER MENU

4. If connecting the Tektronix Scope to the 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 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 Equipment Setup page of the GRL Platform Solutions Anritsu SATA Rx Test Application, type in the Scope address into the ‘Address’ field. If the GRL Platform Solutions Anritsu SATA Rx 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 GRL Platform Solutions software is installed on the 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.

14 Appendix D: Artek CLE1000 Series Installation

14.1 ISI Generator Driver Installation

If using a Artek CLE1000 Series model for variable ISI generation, follow these steps to install the ISI generator driver before selecting it as an ISI channel in the GRL Platform Solutions automation software.

1. Connect the CLE1000 to the computer being used as the controller using a USB 2.0 cable.
2. Turn on the front panel power switch on the CLE1000.
3. Right-click on **My Computer > Manage > Device Manager**. If no software for the CLE1000 has been installed, you will see a 'bang' in the Device Manager window.

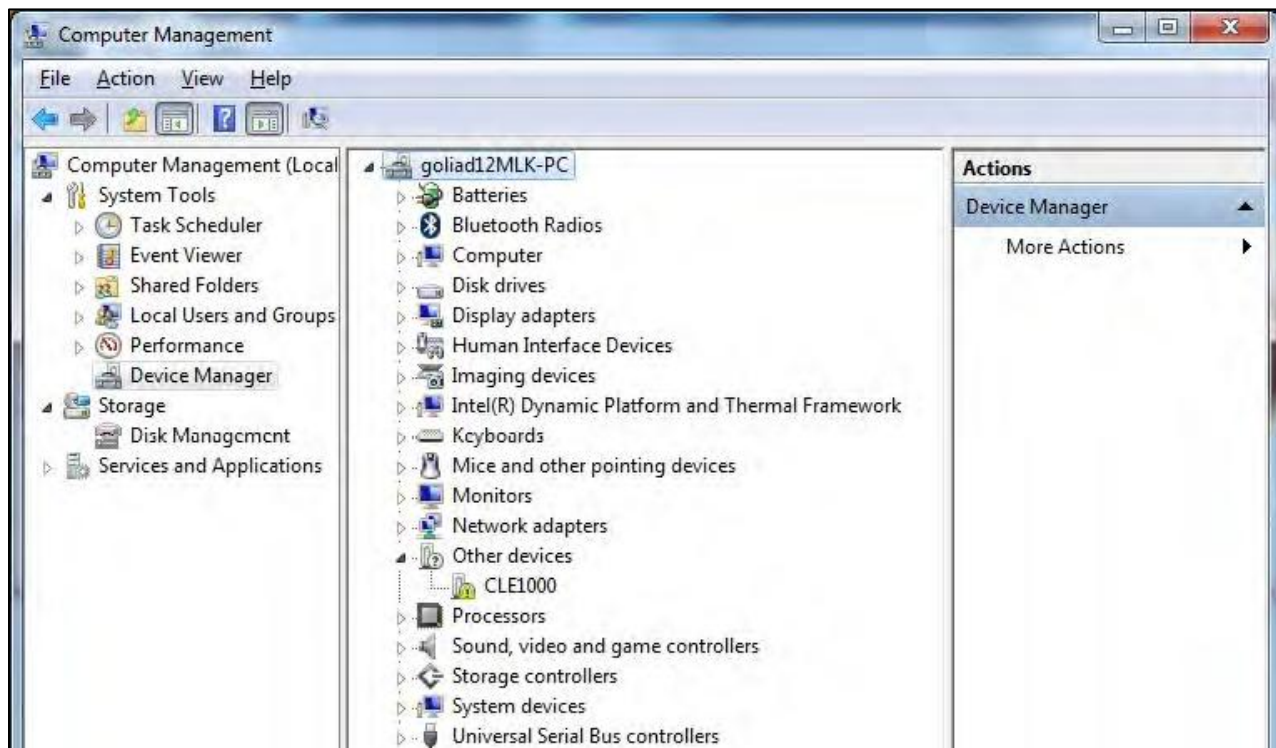


FIGURE 34. DEVICE MANAGER WINDOW

4. To install the CLE1000 driver, go to <http://www.aceunitech.com/support.html> and download the Control Software package for the CLE1000.
5. Unzip the CLE1000 Software folder and install the driver as follows:
 - a) In Device Manager, right-click on **CLE1000 > Update Driver**.
 - b) Select **Browse My Computer for Driver** from Windows dialog (see Figure 35).
 - c) Browse to the root directory of the unzipped CLE1000 Software folder.
 - d) Click **Next** and then click **Install** to complete installation for the driver software (see Figure 36).
6. Once installation has completed, the Device Manager window should look like the example in Figure 37.



FIGURE 35. UPDATE DRIVER WINDOW



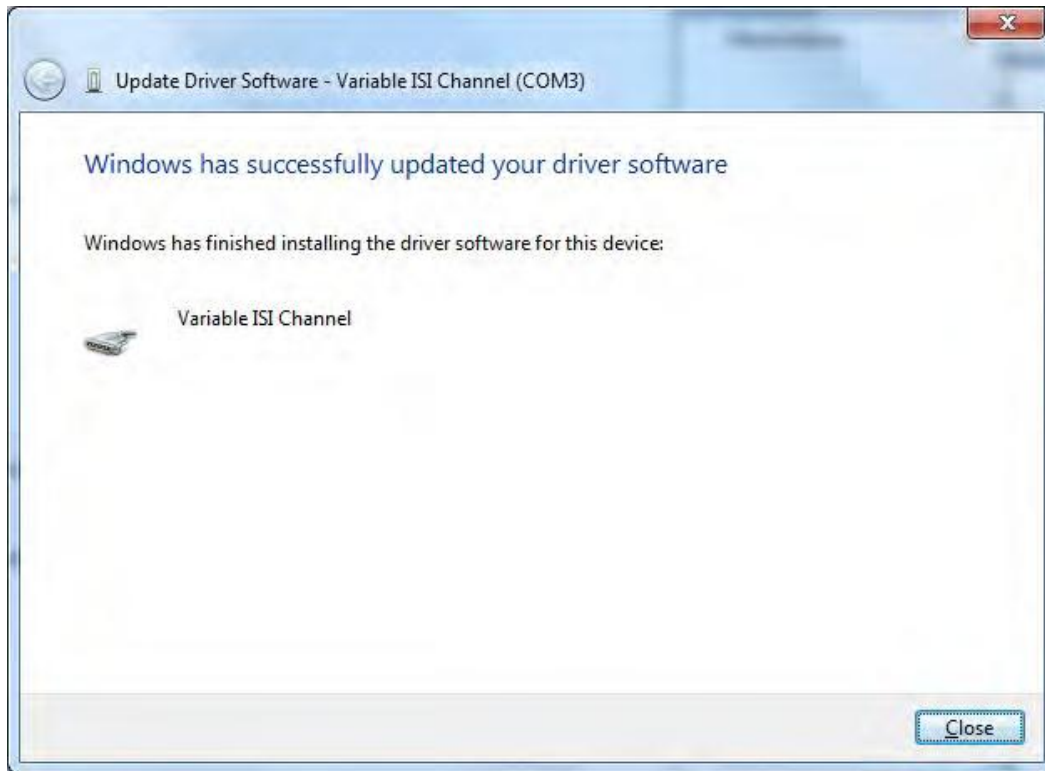


FIGURE 36. WINDOWS SECURITY WINDOW AND CONFIRMATION WINDOW

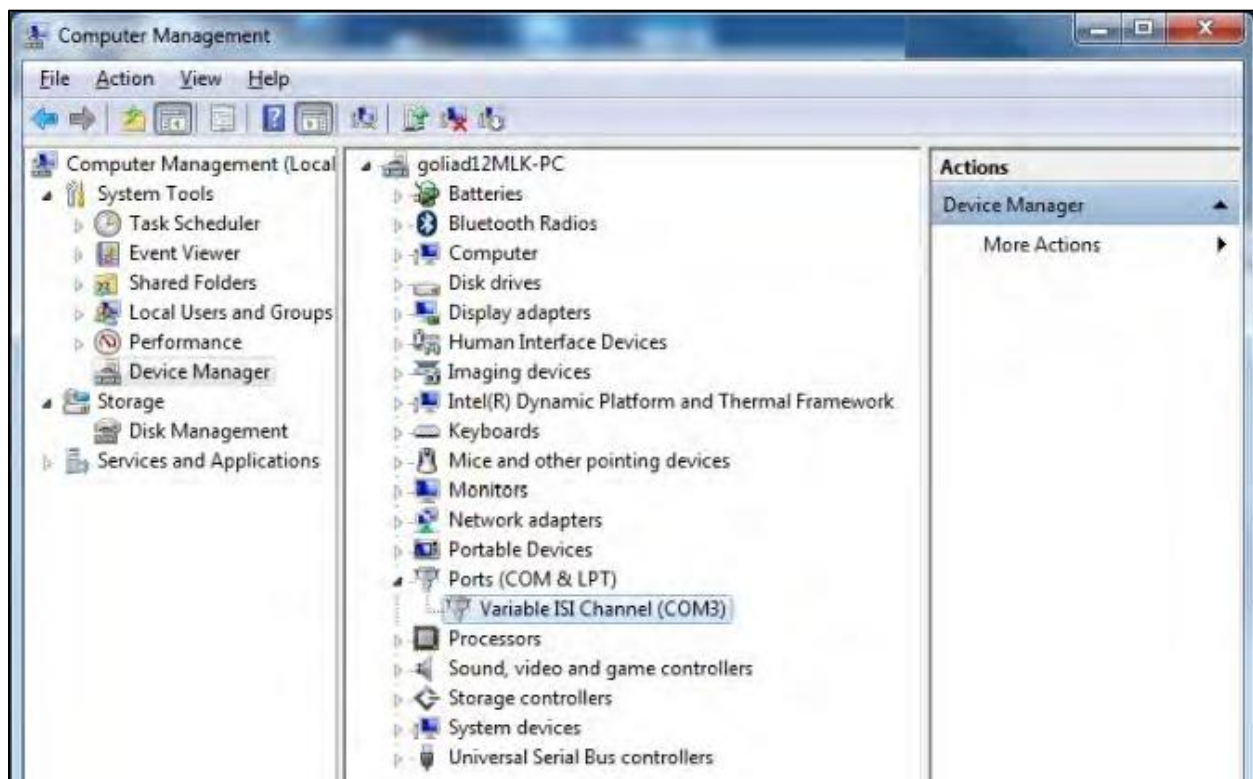


FIGURE 37. DEVICE MANAGER WINDOW AFTER INSTALLATION

The CLE1000 is now ready to be used remotely with the GRL Platform Solutions automation software.

14.2 CLE1000 User Interface (UI) Installation

It may also be useful to install the CLE1000 UI, so that the ISI channel can also be controlled manually from the computer. To install the UI, follow these steps:

1. In the CLE1000 Software folder, select and install the Setup.exe file. Upon successful installation, the following UI window will appear.
2. Close this window if manual control is not required.

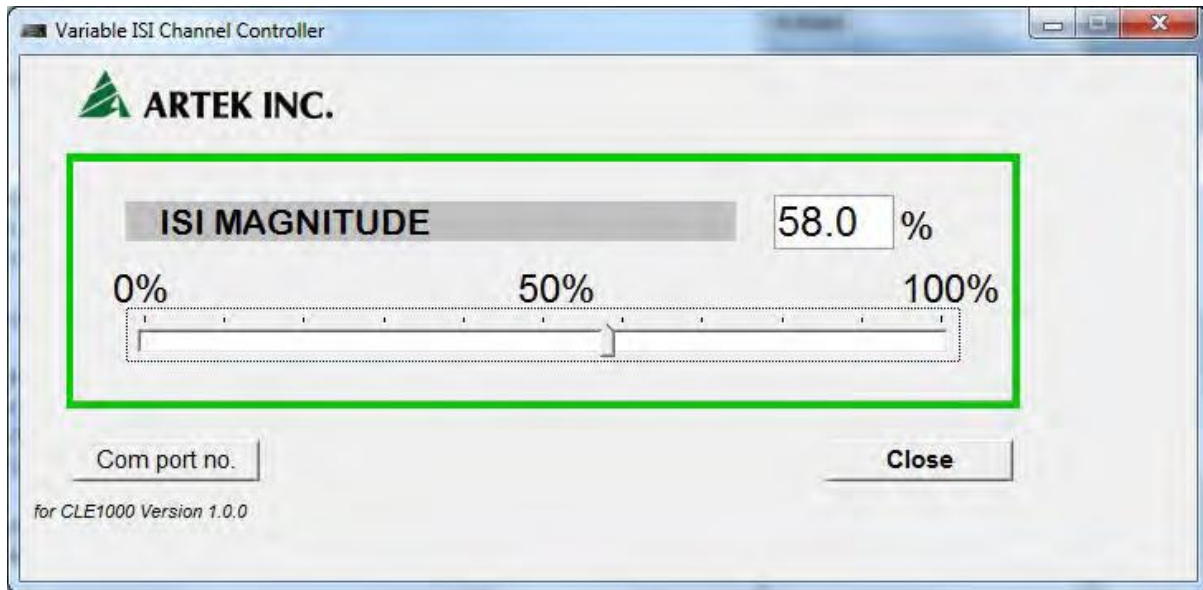


FIGURE 38. CLE1000 UI

END_OF_DOCUMENT