GRL
GRANITE RIVER LABS

GRL SAS-3 12Gbps Receiver Physical Layer Test Application

(GRL-SAS-12G-RX)

Quick Start Guide

V1.10

Contact the GRL office to obtain the latest revision of this document

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1.1 Equipment Requirements

TABLE 1. EQUIPMENT REQUIREMENTS – SYSTEMS

Equipment	Qty.	Description	Key Specification Requirement
BERTScope	1	Tektronix BSA125C or higher (12.5Gb/s), or BSX Series	Option STR for stress generation
Real-time Oscilloscope	1	Tektronix DPO/MSO70000DX Series	≥ 25GHz bandwidth with Option 5XL or higher memory depth and Option SAS3
Digital Pre-Emphasis Processor	1	Tektronix DPP125C	Provides external clock doubler function to operate at 12G
Clock Recovery Unit	1	Tektronix CR125A or higher (12.5Gb/s)	
ISI Generator	1	Tektronix BSA12500ISI or BSAITS	BSAITS offers programmable ISI Generator

Note: The ARTEK CLE1000-A2 can also be used as an option for variable ISI generation. Refer to Appendix of this document for the driver installation procedure.

TABLE 2. EQUIPMENT REQUIREMENTS – ACCESSORIES

	Qty.	Description	Key Specification Requirement
SAS Receptacle Test Adapter	1	TF-SAS-TPA-R[*]	>15dB return loss from 50MHz to 6GHz, and insertion loss that meets the Zero-Length Test Load requirements per the Standard
miniSASHD 12G SAS Receptacle	1	TF-SASHD-TPA-R[*]	>15dB return loss from 50MHz to 6GHz, and insertion loss that meets the Zero-Length Test Load requirements per the Standard
Phase-matched Cable Set	1	PMCABLE1M or equivalent	
DC Blocks	1	Picosecond Pulse Labs 5501A or equivalent	Optional (if required by setup)
Pick-off Tees	2	Picosecond Pulse Lab Model 5370-104-14dB	

[*] Device configuration-dependent

2 Setting Up GRL-SAS-12G-RX Software

2.1 Setup

This section provides procedures for installing, configuring and verifying the operation of the GRL SAS 12G Rx Automation Test solution. It also helps you familiarize yourself with the basic operation of the application.

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

To open the application, follow the procedure in the following section.

2.1.1 Download Software

Install, launch and set up the GRL SAS 12G Rx Automation Test Application software:

1. Download **SASRxTestVX.XX.XX.zip** package from the Granite River Labs support site.
2. The zip file contains:
   a) **SASRxPatternFilesInstallation00xxxxxxxSetup.exe** – Run this on the Tektronix BERTScope to install the setup files. This will place the SAS Configuration and Pattern files on the BERTScope in the *'D:\'* directory hierarchy.
   b) **SASRxTestApplication00xxxxxxxSetup.exe** – Run this on the PC, or on the Oscilloscope. This application will create the *'C:\GRL\Rx Test Solution\Applications\SASRxTest'* directory hierarchy.
   c) **SASRxTestScopeSetupFilesInstallation00xxxxxxxx.exe** – Run this on the Tektronix Oscilloscope. This will place the SAS Setup and SAS Filter folders in the *'C:\TekApplications\DPOJET'* directory hierarchy.

2.1.2 Launch and Set Up Software

2.1.2.1 On the BERTScope

1. Select **View** > **System** > **Tools Tab**.
2. Under **Utilities** Column, press the Remote button.
3. In Remote Client window, select **TCP/IP**.
4. Change **Terminator** to "**LF**". Select the **Connect** Button.

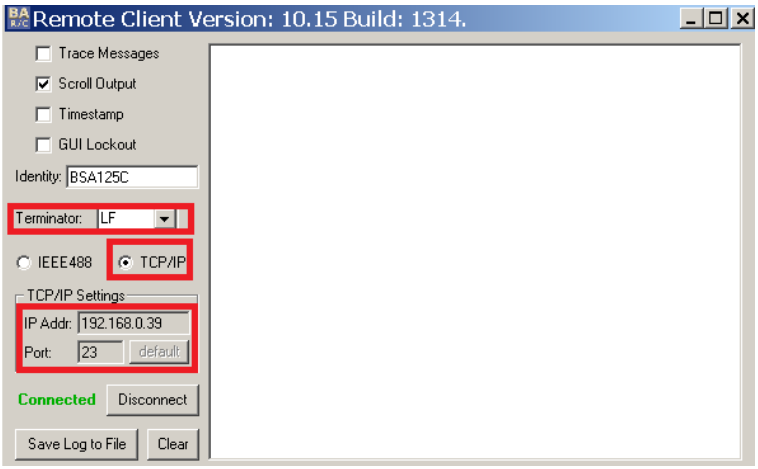

FIGURE 1. REMOTE CLIENT WINDOW

Note: If you see an error pop-up when selecting the Connect button, try a different Port. For example, change Port 23 to 21.

5. Note the IP Address and Port # on Remote Client. They will be needed to connect the BERTScope to the GRL automation software.
6. Minimize, but do not close, the *Remote Client* window.

2.1.2.2 On the PC Used for GRL Framework Installation

1. Navigate to Start Menu > All Programs > GRL > GRL Automated Test Solutions.

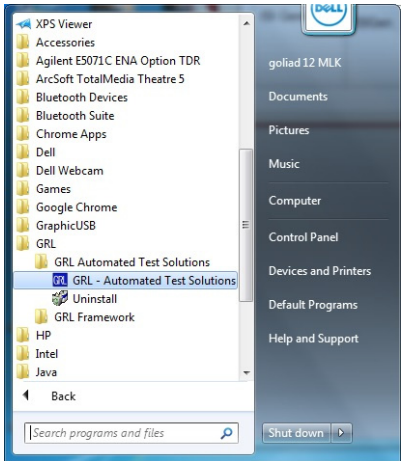

FIGURE 2. GRL AUTOMATED TEST SOLUTIONS IN START MENU

2. Click Application > Rx Test Solution > SAS 12G Rx Test to open the application.

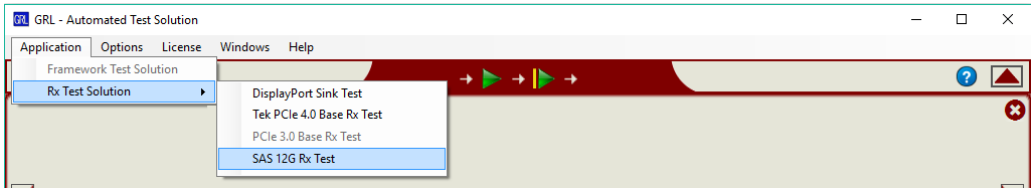

FIGURE 3. RX TEST SOLUTIONS IN GRL AUTOMATED TEST SOLUTIONS WINDOW

3. To enable license, go to License > License Details. The following dialog will pop up.

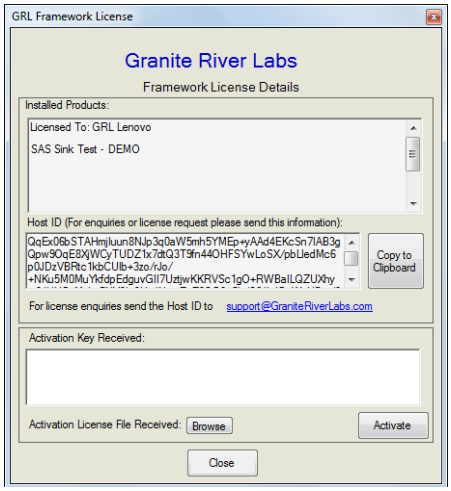

FIGURE 4. LICENSE DETAILS WINDOW

4. Activate License:

   a) If you have an Activation Key, please enter in the box provided and press **Activate**.
   b) If you do not have an Activation Key, press **Close** to use the SW for 10 Days free of charge.

   Note: Once the 10-day trial times out, you will need to request an activation key for future usage on the same computer or oscilloscope. The demo SW 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 a License key by contacting support@graniteriverlabs.com.

5. Click on Equipment Setup icon  on the GRL Framework.
6. Enter the BERTScope IP address and Port number to match what is in the BERTScope *Remote Client* window shown in Section 2.1.2.1.
7. Enter the Scope IP Address. *(Note: The scope IP address can be obtained, if not known, by typing CMD → IPCONFIG on the scope and observe the IP address listed.)*
8. Enter the COM Address of the ISI Generator to be used (*applicable only if using an external ISI Generator*).

   If the Tektronix BSAITS is used as the ISI Generator, it is not necessary to enter the COM address. The BSAITS is connected along with the BERTScope. Drivers for the BSAITS will be installed when connected with the BERTScope for the first time.

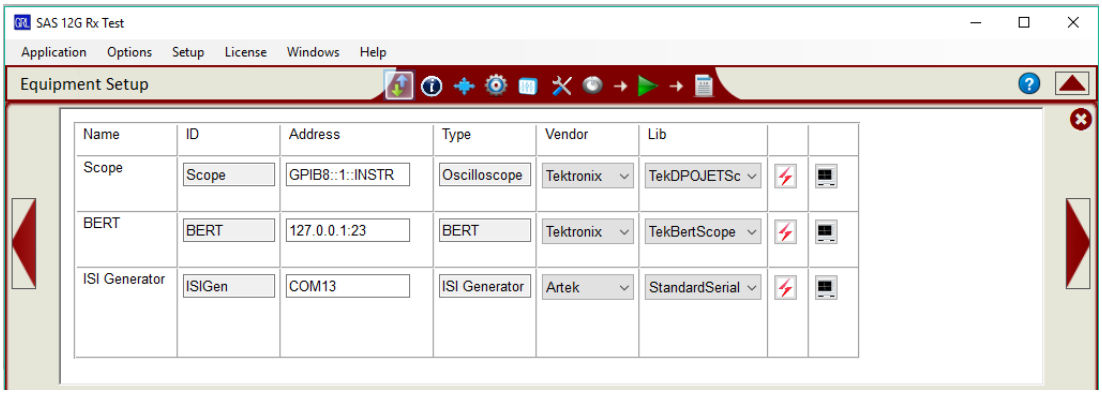

FIGURE 5. EQUIPMENT SETUP WINDOW – VIEW #1

9. Check the connection for each instrument by clicking the "lightning"  button. The "lightning" button should turn green if the connection has been verified.

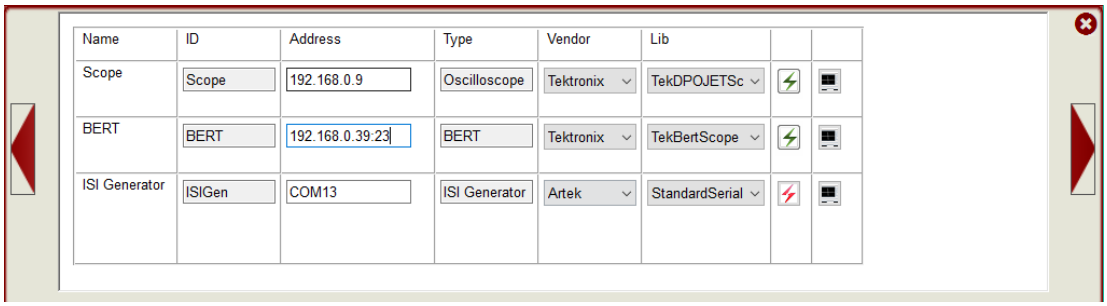

FIGURE 6. EQUIPMENT SETUP WINDOW – VIEW #2

Additional note:

The USB driver software for the ISI Generator being used must be installed on the PC being used for testing, and the ISI Generator must be connected to the PC via USB. The driver for the ISI Generator is available from the ISI Generator manufacturer. Refer to Appendix for driver installation information for supported ISI generators.

2.2 Configuring Software Before Calibration and Testing

2.2.1 Session Info

The information provided will be included in the report.

The **DUT Info** and **Test Info** are input by the user.

The **Software Info** is automatically populated.

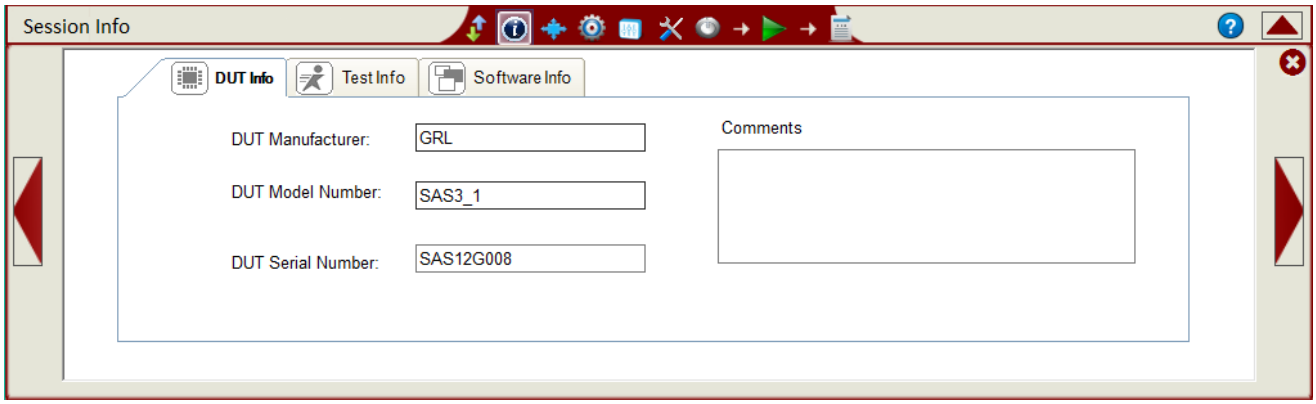

FIGURE 7. SESSION INFO

2.2.2 Conditions for Testing and Calibration

In this section, conditions for Testing and Calibration will need to be set. User selects Conditions  for testing and for calibration.

When calibrating, the application will calibrate the selected SSC Capabilities and SJ Test Frequencies. The Reference Presets will only be used during testing. The application will perform testing using the selected Reference Presets, SSC Capabilities and SJ Test Frequencies.

Recommended procedure:

- *Step 1*: When calibrating, select all conditions that may be used for future testing, and perform the desired calibration tests.
- *Step 2*: When ready for testing, re-select the desired test conditions. For example, if required to test only one SSC Capability at two frequencies for Reference Preset 1, then select the appropriate conditions for testing.

a) **Preset tab**: Select the desired Reference Presets for testing. For calibration, the application will produce a calibration curve based on a set of predefined Preset values.

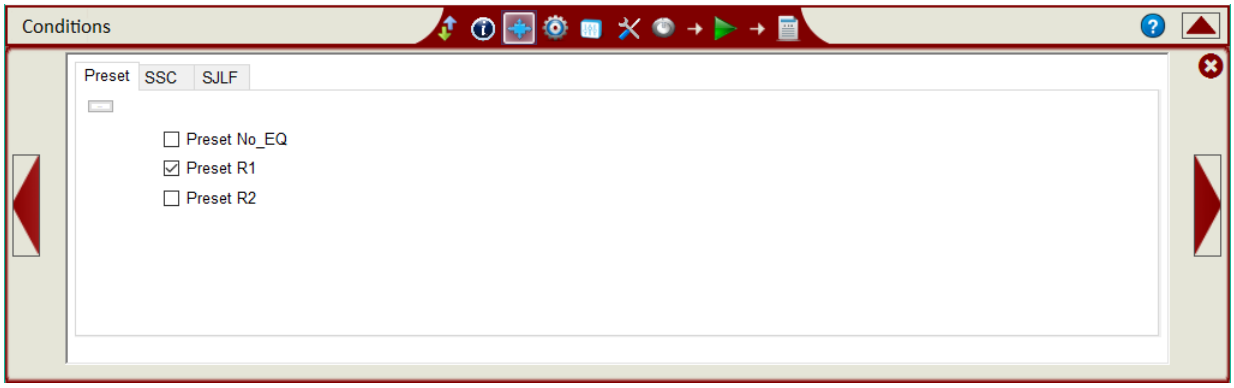

FIGURE 8. SELECT REFERENCE PRESETS

b) **SSC tab**: Select to enable or disable SSC Capability supported by the DUT for calibration or testing.

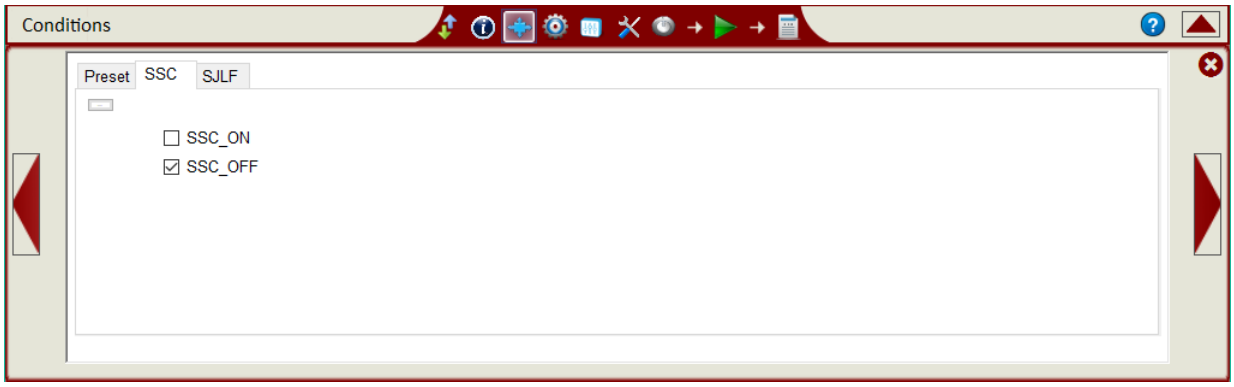

FIGURE 9. SELECT SSC CONDITIONS

c) **SJLF tab**: Select the SJ frequencies for testing or calibration. Select the Custom_SJ frequencies to use additional SJ frequencies not defined by the Specification. These frequency values can be entered in the Setup Configuration page under the *Custom SJ Frequencies* tab.

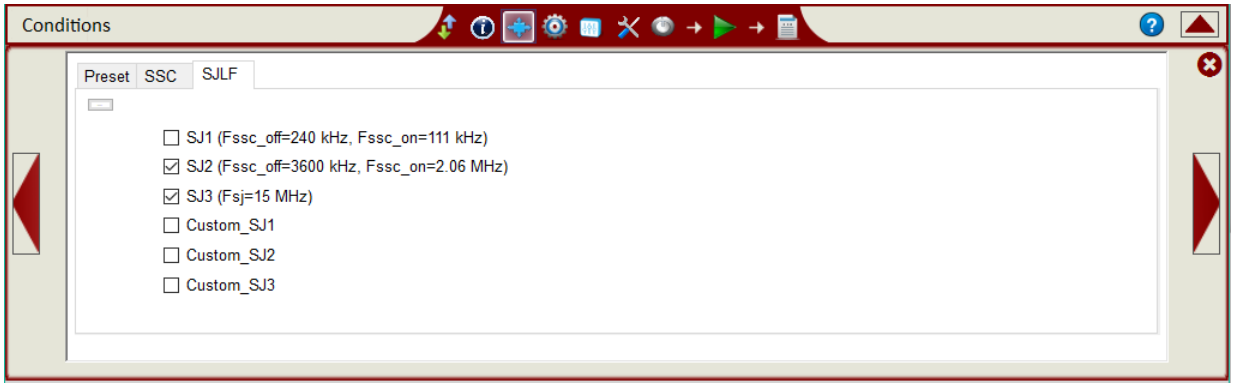

FIGURE 10. SELECT SJ FREQUENCIES

2.2.3 Setup Configuration for Testing

Use the Setup Configuration page to configure the necessary test-related settings prior to running tests.

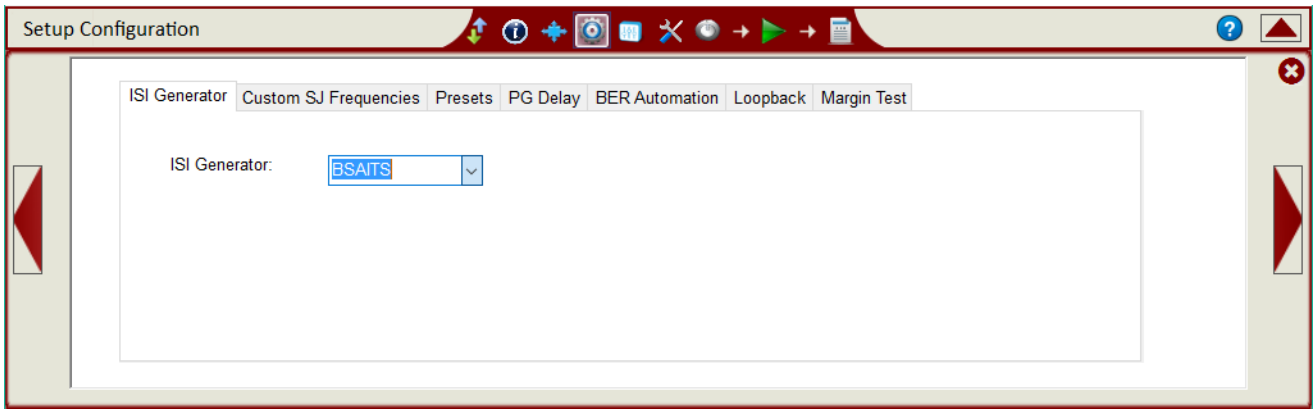

FIGURE 11. TEST SETUP CONFIGURATION

TABLE 3. TEST SETUP PARAMETERS

Setup	Description
ISI Generator	Select the ISI Generator that is being used. Select 'None' if using a fixed ISI Channel. *The ISI Generator will be used for both calibration and testing.*
Custom SJ Frequencies	Enter the value for any Custom_SJ frequency selected from the Conditions page. *This configuration will be used for SJ calibration and for testing.*
Presets	Set up the Reference Presets for the selected Mode. • **Nominal Presets** mode: The settings in this mode are defined by the Specification, which disables any user configuration and displays the specified nominal values. • **Custom Presets** mode: This mode allows user configuration for the presets. • **Optimized Search** mode: This mode ignores any existing user configuration, and requires an additional *Rx Link Optimized Preset Search* test to be performed for the preset values to be determined.
PG Delay	Select the 'Overwrite PG Delay' option to configure the PG Delay value. If unsure on the value to set, un-select the option and perform the PG Delay calibration. Also select the pattern to use for the PG Delay calibration.

Setup	Description
BER Automation	Select the method to enable BER Automation. • **Forced Loopback** method: Select this method if using a proprietary software tool to control the DUT. For this, an appropriate loopback method must be selected under the Loopback tab. The BERTScope will then apply the required stress and run BER tests using its built-in Error Detector. This method requires very little user input. • **Manual** method: Select this method if the DUT does not support any loopback mode but has a built-in error detector to measure BER. The application will prompt the user to run BER tests manually and report the errors detected which will be saved in the results. • **Local Script** method: Select this method if using an external *.exe script to force the DUT in the loopback mode and perform BER testing. This requires the user to specify the path for the script file which the application will call when it is ready to test the loopback BER. • **Remote Script** method: This method is similar to Local Script where it also uses an external *.exe script to control the DUT loopback and BER measurement. Unlike the Local script, this Remote script resides on a remote (separate) PC, and thus requires the user to specify the IP address and port number for the script to be called by the application.
Loopback	Select the method to enable DUT loopback if the Forced Loopback method is selected under the BER Automation tab. • **None** method: Select this method to place the DUT in the continuous loopback mode. The application will assume that the DUT is in loopback, and will continue to test BER without any prompts. • **Prompt User** method: Select this method to manually enable DUT loopback at every single time. This is recommended if the loopback method for the DUT is not known or there is a physical method that cannot be automated. • **Local Script** method: This method is similar to Local Script for the BER Automation, but here the script will be called to force the DUT into loopback instead of testing BER. • **Remote Script** method: Similar to Local Script, this method will also use an external script to force the DUT into loopback, just that the script is located on a remote terminal.
Margin Test	Define the target BER and Confidence level to achieve when testing for compliance. If running the optional 'Compliance + Margin' and 'Margin Search' tests, specify the Step Size and Maximum Steps for stepping through margins.

2.3 Calibration/Test Selection Page

Select the  button in the main software menu to choose the calibration or tests to be performed on the **Select Tests** page. 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 show an error message.

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. The application supports automated control of the Tektronix BSAITS or the ARTEK CLE1000-A2 variable ISI generator.

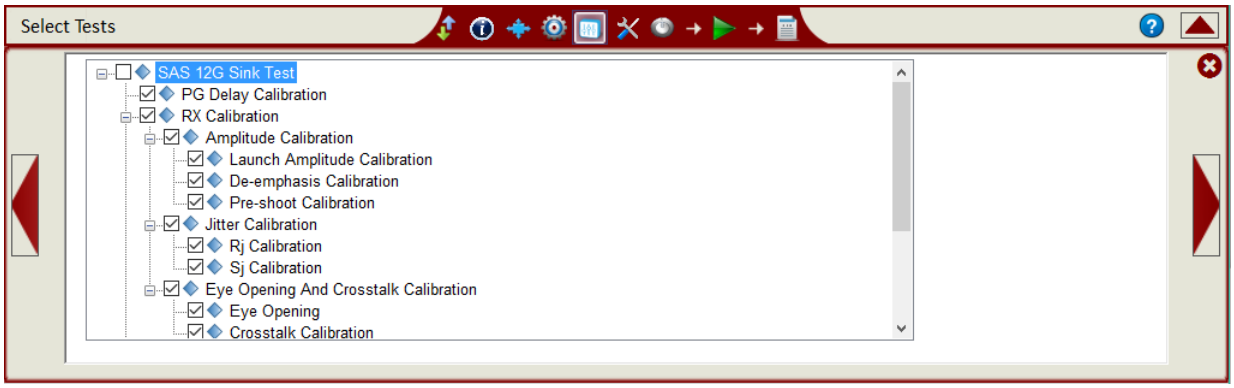

FIGURE 12. CALIBRATION SELECTION

Select the calibration groups to perform calibration for all SAS-3 Rx parameters. Note that while user can select individual calibration parameters, it is possible that a particular calibration may require the previous calibration to be completed before it can proceed. Thus it is advisable to complete all previous calibration before going on to the next calibration.

TABLE 4. CALIBRATION DESCRIPTION

Calibration Name	Description
PG Delay	Calibrate the delay between the Clock and Data outputs of the BERTScope Pattern Generator connected to the inputs of the DPP-C, *every time when changing the cables*. If the PG Delay value is known, this calibration can be skipped, and the value should be entered in the Setup Configuration page as described earlier. *(Note: PG Delay calibration will not be available for selection if using the Tektronix BSX BERTScope, which does not require an external DPP-C.)*
Launch Amplitude	Calibrate the launch amplitudes using the 64ones_64zeros pattern. This pattern includes high-frequency components (1010) and low-frequency components (11111 or 000) to determine if the initial signal generated by the DPP-C has equalized amplitudes for both high-frequency and low-frequency components.
De-emphasis	Calibrate de-emphasis using the 64ones_64zeros_64ones_zeros pattern to ensure the value is accurately measured.

Pre-shoot	Calibrate pre-shoot using the same pattern as de-emphasis calibration.
RJ/SJ	Calibrate RJ or SJ using the 1100 clock pattern.
Eye Opening	Calibrate eye opening using any frequency-rich pattern. For this calibration, the PRBS15 pattern will be used.
Crosstalk	Calibrate crosstalk using an All Zeros pattern that measures only the crosstalk being injected.

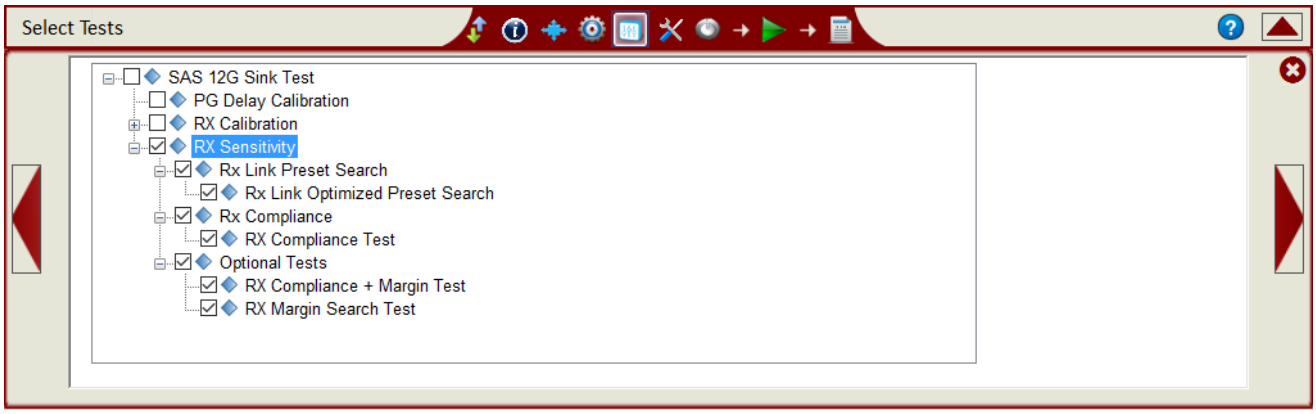

FIGURE 13. TESTS SELECTION

Select the test groups to perform compliance tests for all SAS-3 Rx parameters. Note that user may be prompted for connection changes during testing.

TABLE 5. TEST DESCRIPTION

Test Name	Description
Rx Link Optimized Preset Search	This test permutates through different pre-shoot and de-emphasis settings within specification tolerances to find the optimized preset setting to be used for Rx Compliance and Margin Tests. This test will only be performed if the Preset Mode *(from the Setup Configuration page)* is set to 'Optimized Search'.
Rx Compliance	This is a compliance test for receiver jitter tolerance which measures jitter response at the calibrated levels mentioned in the specification.
Rx Compliance + Margin	This test is similar to the Rx Compliance test, but measures the jitter tolerance of the DUT at one step above the calibrated levels mentioned in the specification. The step value comes from the step size specified in the Setup Configuration page. The margin is the percentage value of the calibrated value.
Rx Margin Search	This is a jitter search test which measures the maximum SJ value that the DUT can handle at the chosen BER. The step size is the percentage value of the currently applied SJ.

2.4 Calibration/Receiver Test Parameters Configuration Page

Click the Configuration button  in the main software menu to access the Parameters Configuration page. Set all parameters for SAS-3 RX calibration and testing as described in Table 6 below.

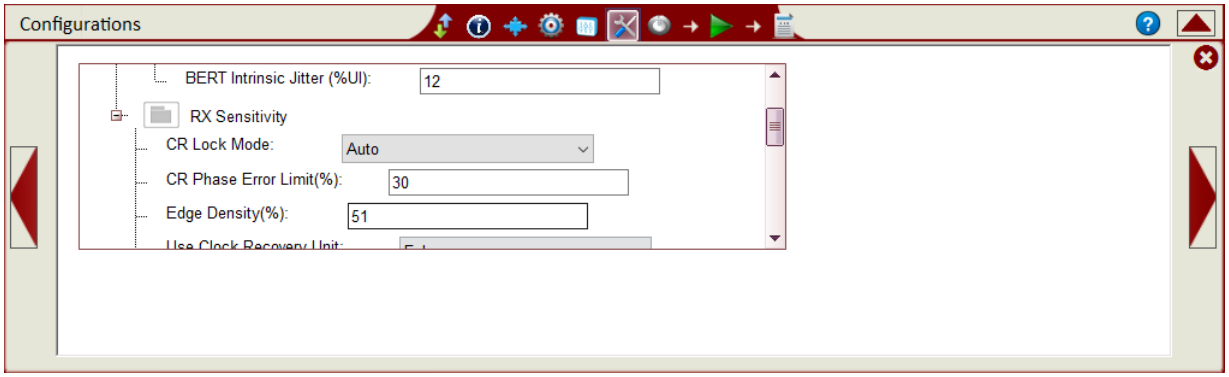

FIGURE 14. PARAMETERS CONFIGURATION PAGE

TABLE 6. CALIBRATION/TEST PARAMETERS DESCRIPTION

Parameter Name	Description
BERT Intrinsic Jitter	Set the intrinsic jitter value in %UI to be used for jitter calibration.
CR Lock Mode	Select the Auto or Manual lock mode for the clock recovery unit in loopback testing.
CR Phase Error Limit	Set the limit for phase error on the clock recovery unit.
Edge Density	Set the edge density value.
Use Clock Recovery Unit	Select to enable or disable clock recovery for loopback mode.
Preset Search Steps	Set the number of steps to find the optimized preset setting to be used for Rx Compliance and Margin Tests. This setting is applicable when the Preset Mode (*from the Setup Configuration page*) is set to 'Optimized Search'.
Preset Search SJ/Frequency	Set the SJ amplitude (%UI) and frequency for the optimized preset search to be used for testing.
Always Default BERT	Select to always enable or disable default configuration on the BERTScope during testing.
Skip Calibrate Detector Delay	Select whether or not to skip the calibration for delay between the clock and data inputs of the error detector during cable change.
Prompt Before CJTPAT Pattern	Select whether or not to receive a software prompt prior to transmitting CJTPAT signaling for BER loopback testing.
Overwrite Detector Delay	Select whether or not to overwrite the delay between the clock and data inputs of the error detector during cable change.
Detector Delay (ps)	Set the delay value in ps for the error detector.

2.5 Calibration Target Configuration Page

If necessary, select  from the main menu to change the calibration target value for any of the calibration items. By default, the target values are those defined in the specification. Change the values only when debugging.

To change the values, un-select the Use Default Value checkbox. Also at any point in time if the default values are required, just select the checkbox and the default values will replace all the current values.

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.

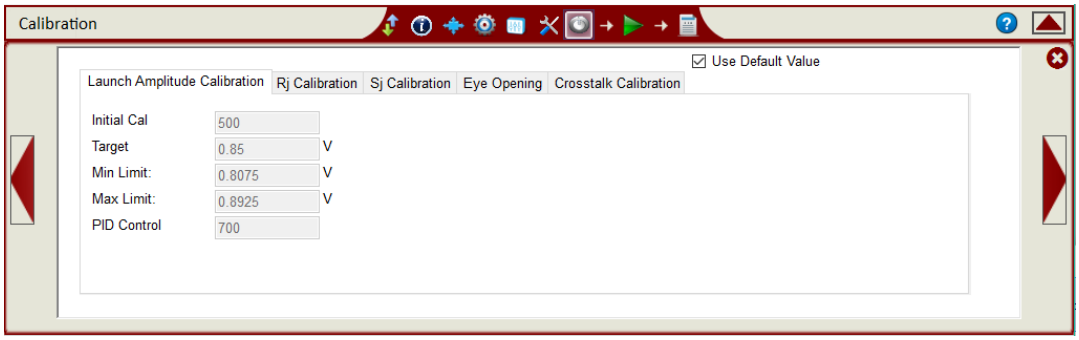

FIGURE 15. CALIBRATION OVERWRITE

2.6 Running the Calibration/Tests

From the pop-up menu, select the Run  icon to access the Run Tests page. Select the Run Option before clicking the Run Tests button to start calibration or testing.

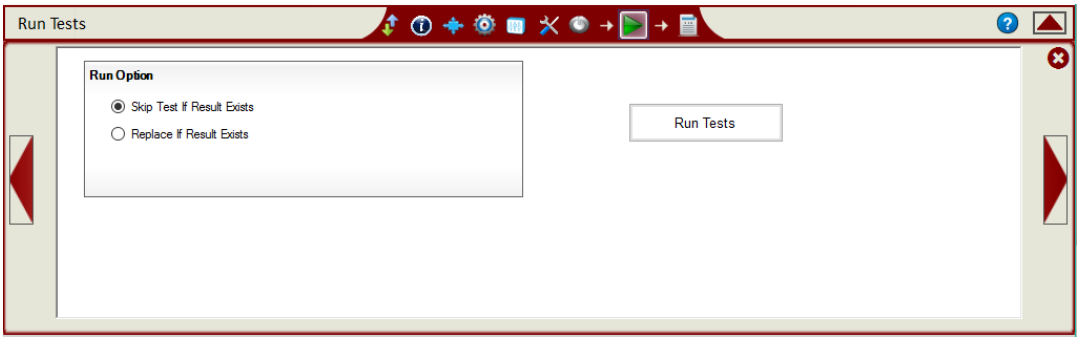

FIGURE 16. RUN TESTS PAGE

TABLE 7. RUN OPTIONS

Parameter Name	Description
Skip Test if Result Exists	If previous test or calibration results exists, then the software will *skip* the tests/calibration steps that have existing reports.
Replace if Result Exists	If previous test/calibration results exist, then the software will replace each step in the test/calibration with new results.

If you need to re-run only certain test on certain conditions, please delete the tests from the Report tab and Run with **Skip Test if Result Exists.** GRL software will keep track of the missing tests in the report and perform those tests only. See figure below.

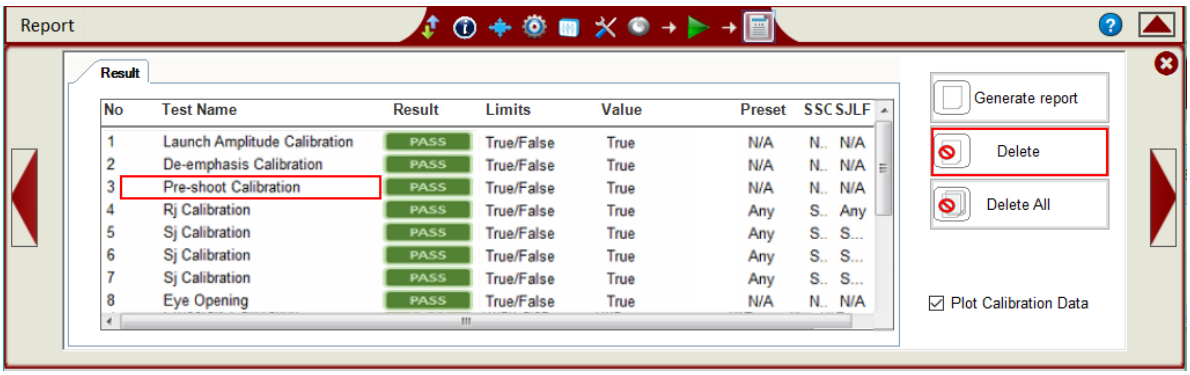

FIGURE 17. DELETE RESULTS

3 Calibrating Using GRL-SAS-12G-RX Software

The receiver will be calibrated for SAS-3 Signal Amplitude and Jitter as well as Eye Opening and Crosstalk. Calibration will basically be performed at Test Point A and Test Point IR/CR. Test Point A (TP-A) is a physical test point for calibration while Test Point IR/CR is an electrical test point calculated by the *SAS3_Eye Opening* software tool (which may be installed on the scope test instrument). This is explained in more details in the manual methodology of the GRL-SAS-12G-RX User Manual and MOI.

The typical receiver calibration will require the BERTScope and appropriate equipment to provide the necessary jitter, ISI and crosstalk components. A Digital Pre-Emphasis Processor (DPP-C) will be used to perform transmitter equalization, which is required in the link training when calibrating the test pattern. The BSAITS will be used as the ISI Generator, and the signal will be measured with a real-time Oscilloscope.

Note: The ISI source can be either a Variable ISI Generator (BSAITS) or a Fixed Channel. Using a Variable ISI Generator enables calibration to be performed with minimum reconfiguration of the test setup, which allows testing to be more fully automated.

Note: Each time a cable change is required for the BERTScope Pattern Generator outputs, it is advisable to perform the PG Delay calibration (if the value is not known), to calibrate the delay between the Clock and Data outputs of the BERTScope Pattern Generator connected to the inputs of the DPP-C.

3.1 Calibration Connection Setups

3.1.1 Signal Amplitude and Jitter Calibration Setup

Figure 18 below shows the setup diagram to calibrate for signal amplitude and jitter at TP-A. *(Note: An external DPP-C is not required if using the Tektronix BSX BERTScope. The BSX BERTScope can be directly connected to the pick-off tees or directional couplers.)*

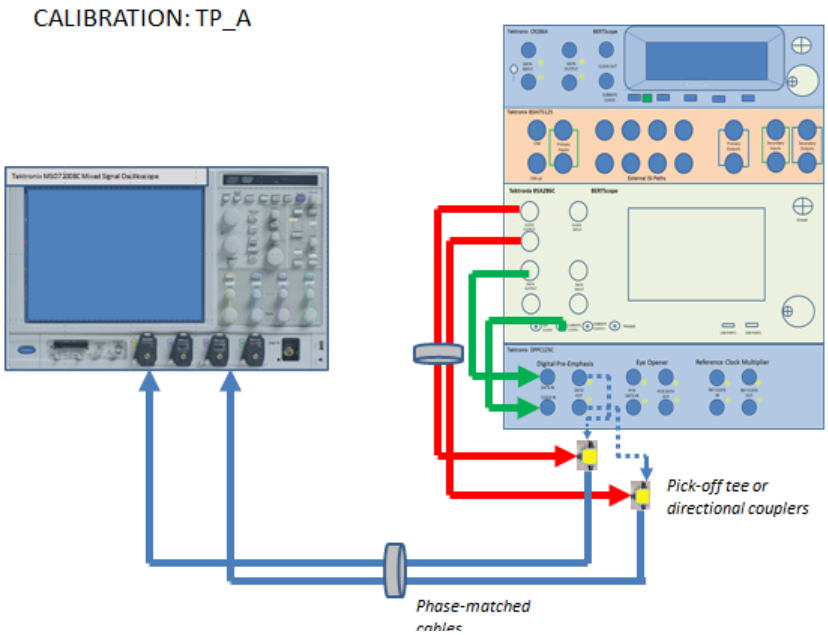

FIGURE 18. SIGNAL AMPLITUDE AND JITTER CALIBRATION SETUP

Connection Steps:

1. Connect DATA OUTPUT(+) of the BERTScope to DATA IN of the DPP-C.
2. Connect Sub-rate Clock Output of the BERTScope to Clock Input of the DPP-C.
3. Connect Clock Outputs of the BERTScope to the pick-off tees tapped input ports (labeled as 14dB).
4. Connect the pick-off tees inputs to DATA OUT+ and DATA OUT- of the DPP-C respectively.
5. Connect the outputs of pick-off tee 1 and pick-off tee 2 to Channel 1 and Channel 3 of the oscilloscope.

3.1.2 Eye Opening and Crosstalk Calibration Setup

Figure 19 below shows the setup diagram to calibrate for eye opening and crosstalk. *(Note: An external DPP-C is not required if using the Tektronix BSX BERTScope. The BSX BERTScope can be directly connected to the pick-off tees or directional couplers.)*

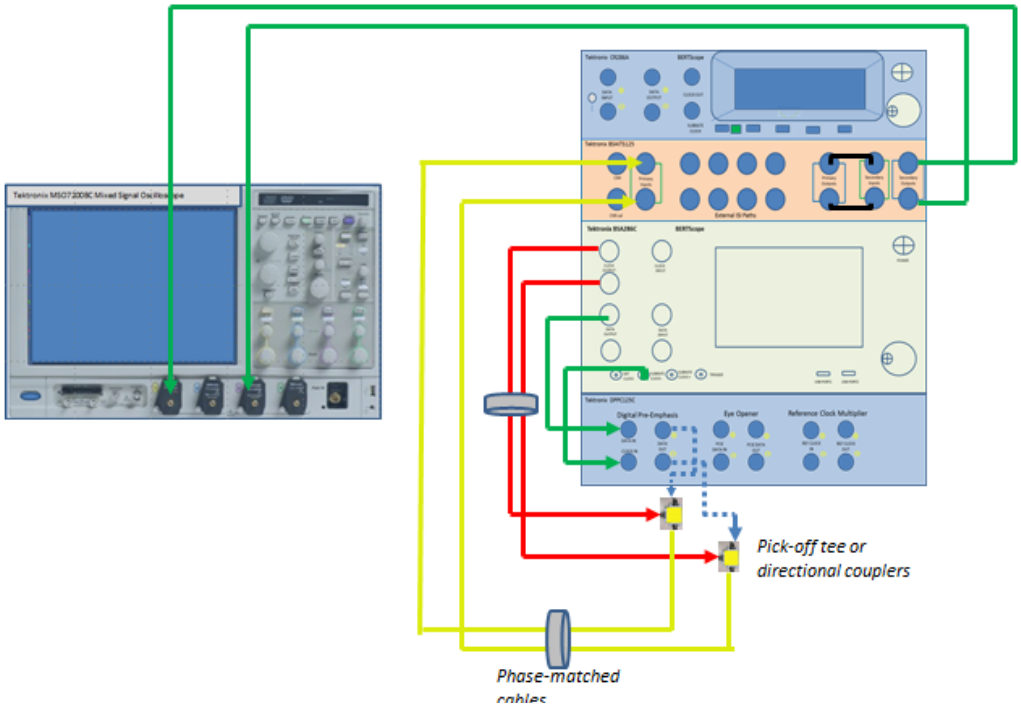

FIGURE 19. EYE OPENING AND CROSSTALK CALIBRATION SETUP

Connection Steps:

1. Connect DATA OUTPUT(+) of the BERTScope to DATA IN of the DPP-C.
2. Connect Sub-rate Clock Output of the BERTScope to Clock Input of the DPP-C.
3. Connect Clock Outputs of the BERTScope to the pick-off tees tapped input ports (labeled as 14dB).
4. Connect the pick-off tees inputs to DATA OUT+ and DATA OUT- of the DPP-C respectively.
5. Connect the pick-off tees outputs to DATA IN of the ISI Generator.
6. Connect the outputs of the ISI Generator to Channels 1 and 3 of the oscilloscope.

Note: To set up the equipment network connection, connect both the BERTScope and Scope with a LAN cable and then to a Network Switch, on the same network.

4 Testing Using GRL-SAS-12G-RX Software

After calibration has completed, then testing the Receiver DUT for compliance can be performed.

The typical receiver DUT jitter tolerance test setup will include a clock recovery unit and the BERT analyzer/error detector for loopback testing. The DUT shall receive CJTPAT signaling with maximum allowable jitter, noise and signal loss. The loopback pattern will be verified by the BERT error detector and shall report a BER of less than 1E-12 with a 95% confidence level for the DUT to be considered as compliant.

4.1 Test Connection Setups

4.1.1 Jitter Tolerance Compliance Test Setup

The following figure shows the physical setup for the SAS-3 Rx jitter tolerance test. *(Note: An external DPP-C is not required if using the Tektronix BSX BERTScope. The BSX BERTScope can be directly connected to the pick-off tees or directional couplers.)*

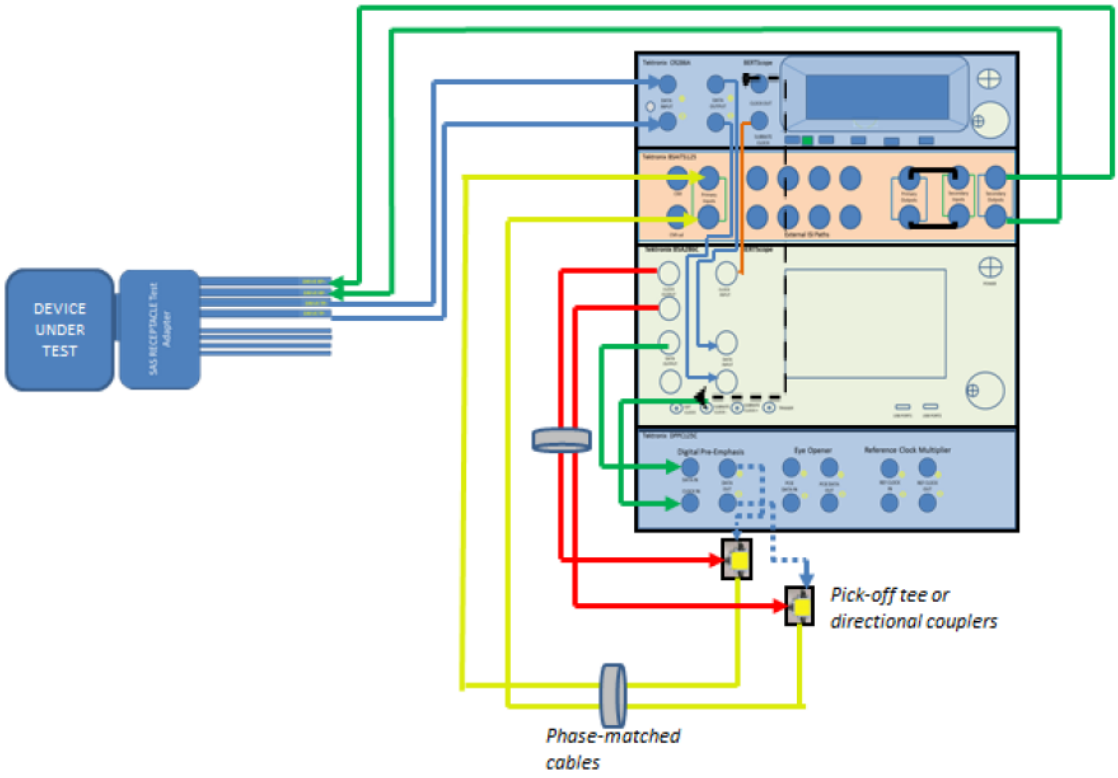

FIGURE 20. COMPLIANCE TEST SETUP FOR RECEIVER DUT JITTER TOLERANCE

Connection Steps:

1. Connect DATA OUTPUT(+) of the BERTScope to DATA IN of the DPP-C.
2. Connect Sub-rate Clock Output of the BERTScope to Clock Input of the DPP-C.
3. Connect Clock Outputs of the BERTScope to the pick-off tees tapped input ports (labeled as 14dB).
4. Connect the pick-off tees inputs to DATA OUT+ and DATA OUT- of the DPP-C respectively.
5. Connect the pick-off tees outputs to DATA IN of the ISI Generator.

6. Connect the outputs of the ISI Generator to RX+/- of the DUT.
7. Connect TX+/- of the DUT to Data Input+/- of the clock recovery unit.
8. Connect Data Output+/- of the clock recovery unit to Data Input+/- of the BERT Error Detector.
9. Connect the Sub-rate Clock Output of the clock recovery unit to Clock Input of the BERT Error Detector.

Note: If using a derived clock, connect the Clock Output of the clock recovery unit to the External Clock Input of the BERTScope.

5 Test Results and Reports Using GRL-SAS-12G-RX

The **Report** page displays the results from all calibration and test runs. If some of the results are not desired, they can be individually deleted by using the **Delete** button. Also for a PDF report, click the **Generate report** button. To have the calibration data plotted in the report, make sure the **Plot Calibration Data** box is checked.

5.1 Test Report Generation

Click the **Generate report** button for the detailed calibration and tests report.

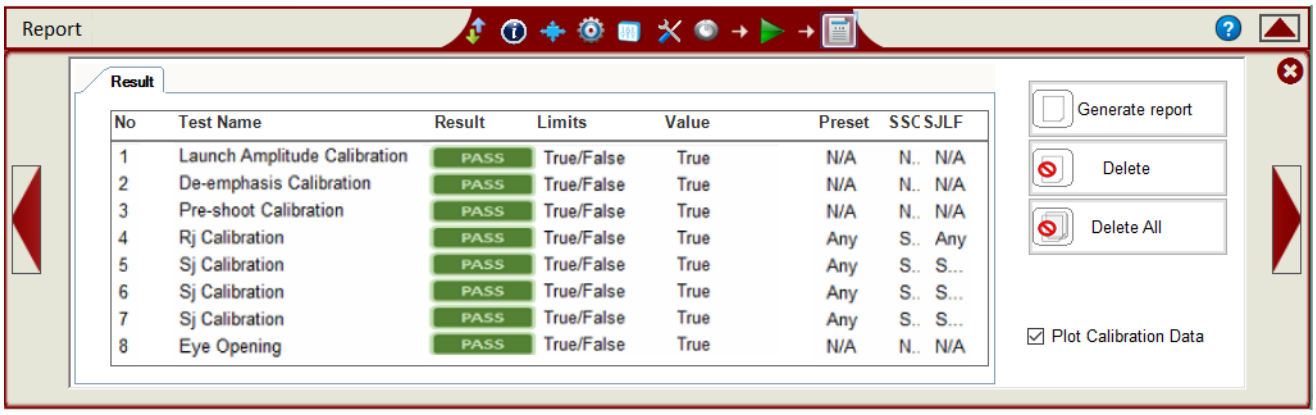

FIGURE 21. GENERATE REPORT PAGE

5.1.1 DUT Information

This portion is populated from the information in the DUT tab on the **Session Info** page.

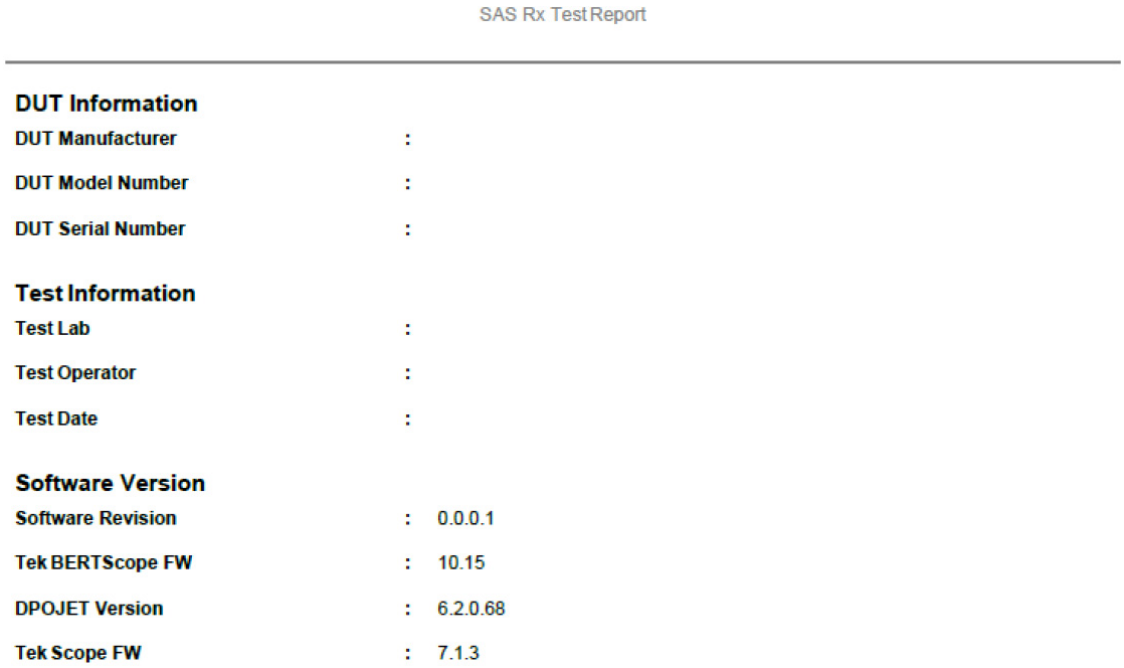

FIGURE 22. DUT INFORMATION

5.1.2 Summary Table

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

No	TestName	Limits	Value	Results	Preset	SSC	SJLF
1	Launch Amplitude Calibration	True/False	True	Pass			
2	De-emphasis Calibration	True/False	True	Pass			
3	Pre-shoot Calibration	True/False	True	Pass			
4	Rj Calibration	True/False	True	Pass	N/A	SSC_ON	N/A
5	Sj Calibration	True/False	True	Pass	N/A	SSC_ON	SJ1
6	Sj Calibration	True/False	True	Pass	N/A	SSC_ON	SJ2
7	Sj Calibration	True/False	True	Pass	N/A	SSC_ON	SJ3
8	Eye Opening	True/False	True	Pass			
9	Crosstalk Calibration	True/False	True	Pass			
10	PG Delay Calibration	True/False	True	Pass			
11	RX Compliance Test	True/False	True	Pass	Preset_R1	SSC_ON	SJ1
12	RX Compliance Test	True/False	False	Fail	Preset_No_EQ	SSC_ON	SJ1
13	RX Compliance Test	True/False	True	Pass	Preset_R2	SSC_ON	SJ1
14	RX Compliance + Margin Test	True/False	True	Pass	Preset_No_EQ	SSC_ON	SJ1
15	RX Margin Search Test	True/False	True	Pass	Preset_No_EQ	SSC_ON	SJ1

FIGURE 23. SUMMARY TABLE

5.1.3 Test Results

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

5.1.3.1 Compliance Test

This portion is populated from the results of all compliance tests performed.

Compliance Test(Preset_No_EQ)

Sj Frequency	SJ1	SJ2	SJ3
SSC_ON	FAIL(203534)	X	X

Compliance Margin Test(Preset_No_EQ)

Sj Frequency	SJ1	SJ2	SJ3
SSC_ON	PASS(0)	X	X

FIGURE 24. COMPLIANCE TEST RESULTS PAGE

5.1.4 Margin Test Plots

This portion is populated from the Margin Search Tests.

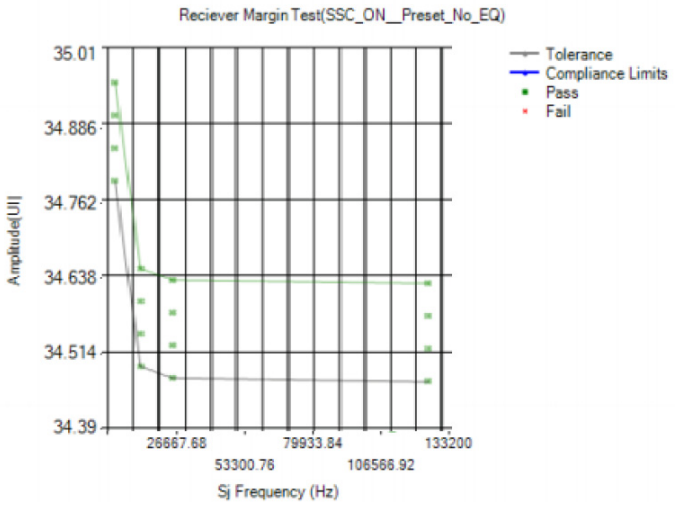

FIGURE 25. MARGIN TEST RESULTS PAGE

5.2 Deleting Test Reports

Click the **Delete** button to delete individual test results or **Delete All** to delete the entire test report.

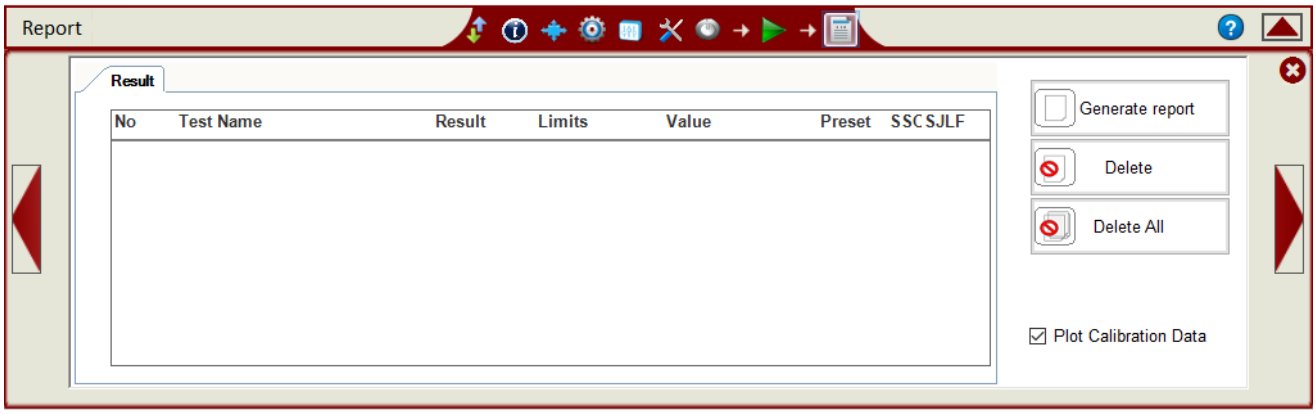

FIGURE 26. TEST REPORT DELETED

6 Saving and Loading Test Sessions

The usage model for the GRL-SAS3-12G-RX automation software is that Calibration and Test Results are created and maintained as a 'Live Session' in the 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.

To Save a session, with all of the parameter information, test results, and any waveforms, select **Options** on the menu bar and select **Save Session**.

To Load a session back into the software, including the saved parameter settings, select **Options** on the menu bar and select **Load Session**.

To create a New session and return the software to the default configuration, select **Options** on the menu bar and select **New Session**.

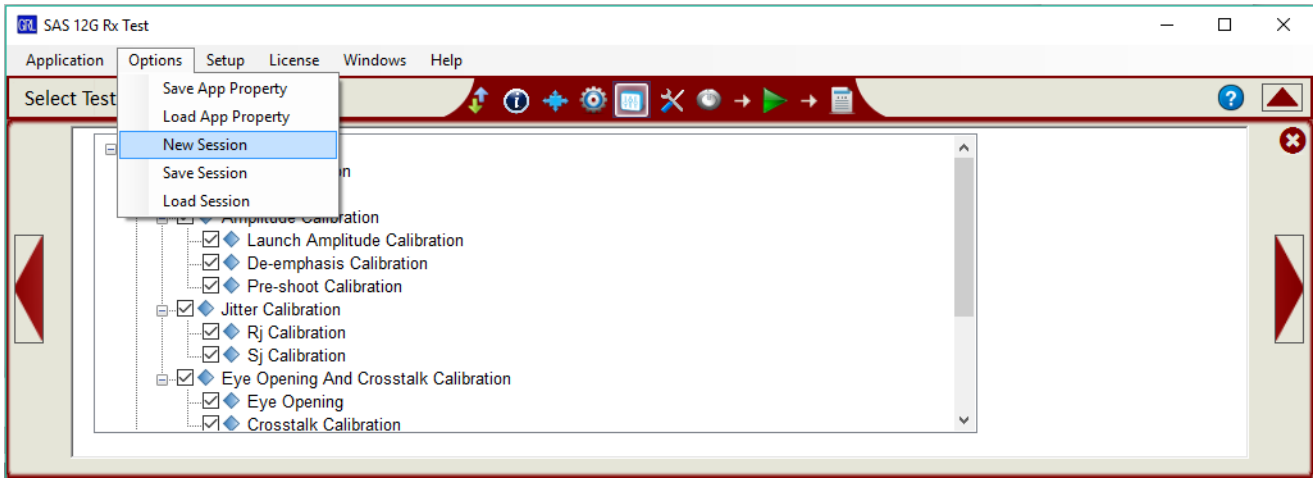

FIGURE 27. SAVING AND LOADING CALIBRATION AND TEST SESSIONS

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.

7 Appendix A: ARTEK CLE1000-A2 Installation

7.1 ISI Generator Driver Installation

If using the Artek CLE1000-A2 for Variable ISI Calibration, follow these steps to install the ISI generator driver before selecting it as an ISI channel in the GRL *DP Configuration Utility*.

1. Connect the CLE1000-A2 to the PC being used as the controller using a USB 2.0 cable.
2. Turn on the front panel power switch on the CLE1000-A2.
3. Right-click on **My Computer > Manage > Device Manager**. If no software for the CLE1000-A2 has been installed, you will see a 'bang' in the Device Manager.

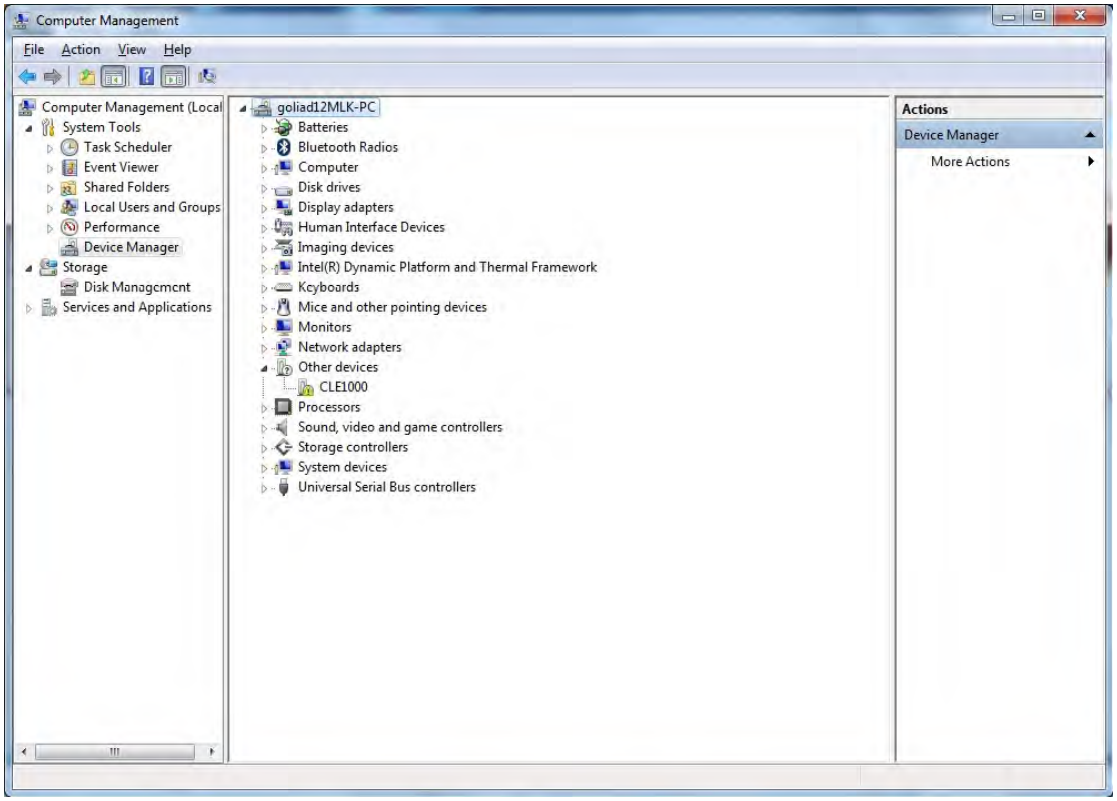

FIGURE 28. DEVICE MANAGER WINDOW

4. To install the CLE1000-A2, go to http://www.aceunitech.com/support.html and download the Control SW package for the CLE1000.
5. Unpack the CLE1000 SW .zip file.
6. Install the CLE1000 Driver:
   a) In Device Manager, right-click on **CLE1000** > **Update Driver**.
   b) Select **Browse My Computer for Driver** from Windows dialog. See Figure 29.
   c) Browse to the root directory of the unzipped CLE1000 SW folder.
   d) Click **Next**. You will be asked to confirm your request to install a driver. See Figure 30.
   e) Click **Install**. The driver software will complete the installation.
7. Once installation has completed, the Device Manager should look like Figure 31.

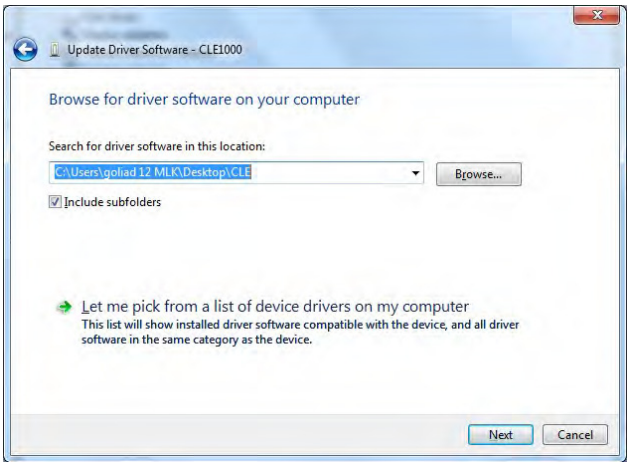

FIGURE 29. UPDATE DRIVER WINDOW

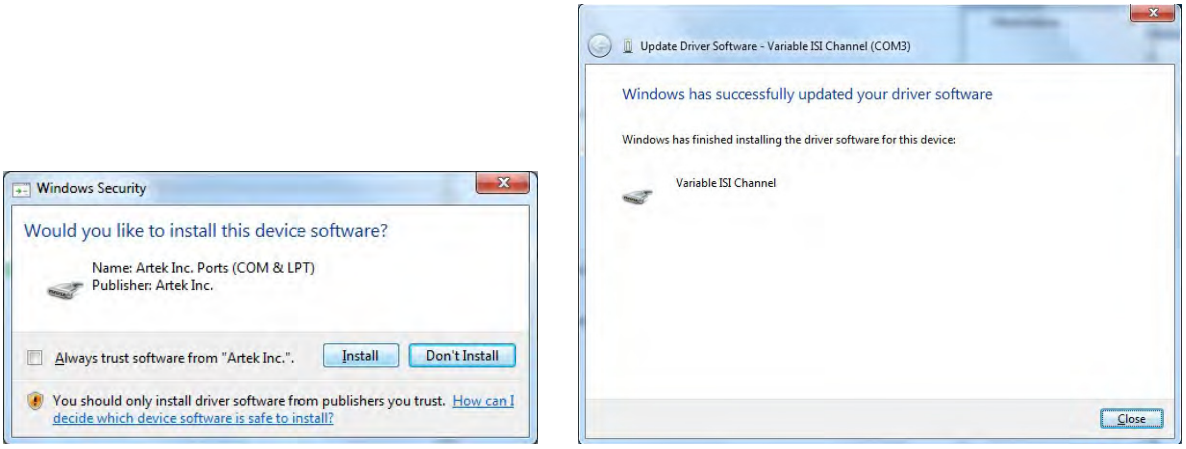

FIGURE 30. WINDOWS SECURITY WINDOW AND CONFIRMATION WINDOW

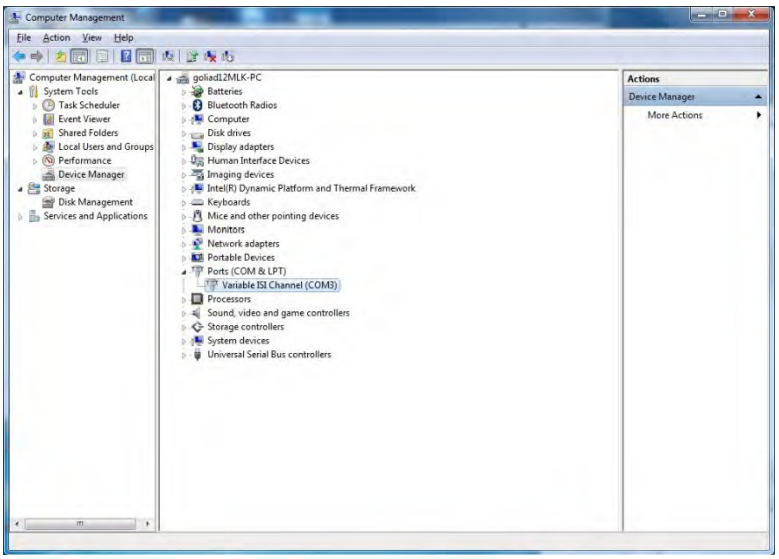

FIGURE 31. DEVICE MANAGER WINDOW AFTER INSTALLATION

The CLE1000 software driver is now installed and the CLE1000-A2 can now be selected for use remotely using the GRL *DP Configuration Utility*.

7.2 CLE1000 GUI Installation

It may also be useful to install the CLE1000 GUI, so that the ISI channel can also be controlled manually from the PC. To install the software, do the following:

1. In the CLE1000 SW folder, click on the Setup.exe file. Once installed successfully, the following GUI will appear on the desktop.
2. You can now close the GUI if you do not want to have manual control.

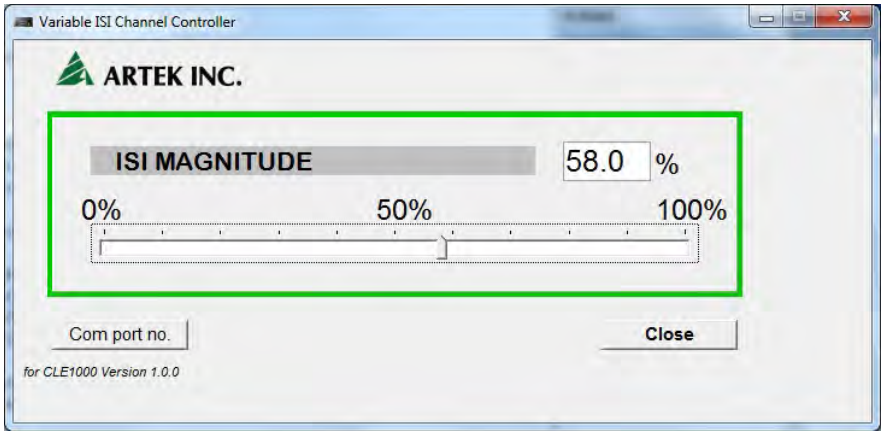

FIGURE 32. CLE1000 GUI

8 Appendix B: SPL-3 Test Pattern Requirements

Table 228 — TWO_DWORDS phy test pattern examples

PHY TEST PATTERN DWORDS CONTROL field	PHY TEST PATTERN DWORDS field	Description
00h	4A4A4A4A 4A4A4A4Ah	D10.2 characters (see table 49 in 5.3.6). This pattern contains 01b repeating and has the highest possible frequency. This pattern may be used for measuring intra-pair skew, rise time, fall time, and RJ (see SAS-3).
00h	B5B5B5B5 B5B5B5B5h	D21.5 characters (see table 49 in 5.3.6). This pattern contains 10b repeating and has the highest possible frequency. This pattern may be used for measuring intra-pair skew, rise time, fall time, and RJ (see SAS-3).
00h	78787878 78787878h	D24.3 characters (see table 49 in 5.3.6). This pattern contains 0011b or 1100b repeating (depending on starting disparity) and has half the highest possible frequency. This pattern may be used for calibrating the JTF, calibrating the reference transmitter test load, and measuring transmitter device S-parameters (see SAS-3).
00h	D926D926 D926D926h	Pairs of D25.6 and D6.1 characters (see table 49 in 5.3.6). This pattern contains 1001b repeating and has half the highest possible frequency.
00h	7E7E7E7E 7E7E7E7Eh	D30.3 characters (see table 49 in 5.3.6). This pattern contains four bits of one polarity, three bits of the other polarity, and three bits of the first polarity (e.g., 1111000111b), followed by the inverse (e.g., 0000111000b). This pattern may be used for measuring transmitter equalization and SSC-induced jitter (see SAS-3).
88h	BC4A4A7B BC4A4A7Bh	ALIGN (0) primitives (see table 98 in 6.2.3). This pattern appears during OOB bursts (SAS-3), the SATA speed negotiation sequence (see 5.10.2.2), and the SAS speed negotiation sequence (see 5.10.4.2).
88h	BC070707 BC070707h	ALIGN (1) primitives (see table 98 in 6.2.3). This pattern appears during the SAS speed negotiation sequences (see 5.10.4.2).
80h	BC4A4A7B 4A787E7Eh	Pairs of an ALIGN (0) (see table 98 in 6.2.3) and a dword containing D10.2, D24.3, D30.3, and D30.3 characters (see table 49 in 5.3.6).

A.2 Compliant jitter tolerance pattern (CJTPAT)

The compliant jitter tolerance pattern (CJTPAT) is the JTPAT for RD+ and RD- (see table A.1) included as the payload in an SSP DATA frame or an SMP frame. The CJTPAT is:

1) SOF;
2) six data dwords containing either:
   A) an SSP DATA frame header; or
   B) an SMP frame header followed by 23 vendor specific bytes;
3) 112 data dwords containing JTPAT for RD+ and RD-;
4) one data dword containing a CRC value; and
5) EOF.

Deletable primitives may be included in the transmission of the CJTPAT, but the number of deletable primitives transmitted should be as small as possible so that the percentage of the transfer that is the JTPAT is as high as possible.

9 Appendix C: DPP-C to Data Skew Configuration

To correctly compensate for the delay in the Data Out vs. the Sub-rate Clock output from the BERTScope, the cable interconnecting the Sub-rate Out to the DPP-C should be approximately 1.6 meters (60 inches) longer than the cable connecting the BERTScope Data Out to the DPP-C Data In. With the additional cable length providing the rough delay match, use the calibration method shown in Figure 35 to fine tune the delay match to ensure optimum DPP timing.

9.1 Connection and Configuration

9.1.1 Step 1. Connect the DPP-C to the BERTScope Analyzer

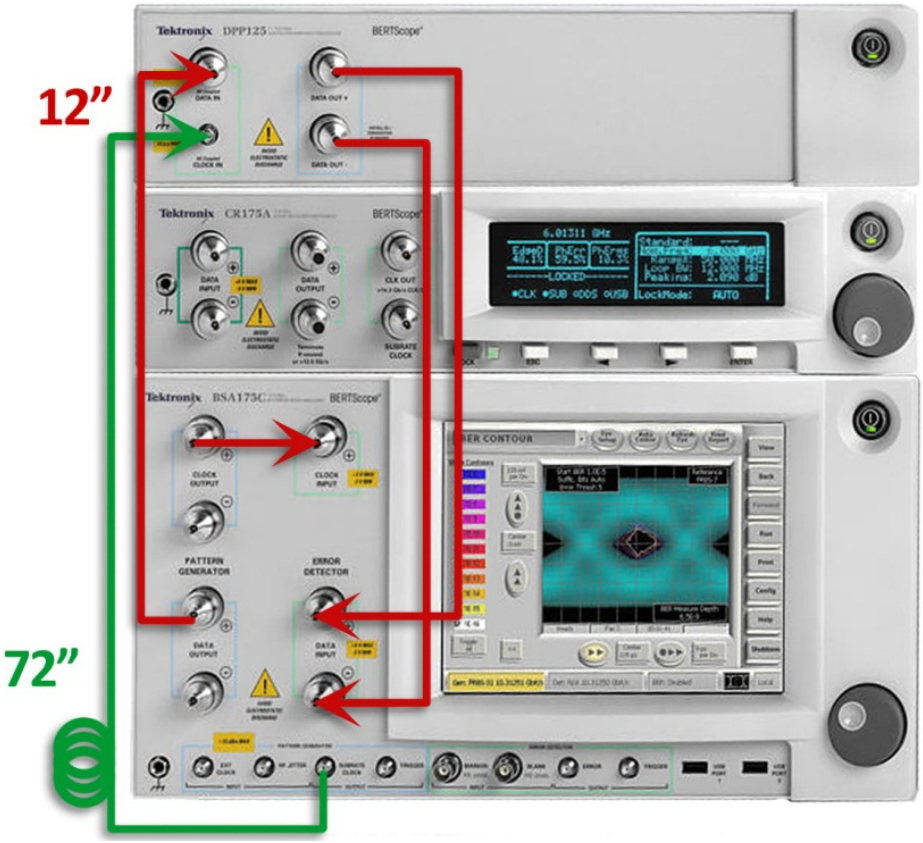

FIGURE 33. CONNECTIONS FOR DPP TIMING CALIBRATION

1. Using a cable of ~ 0.3 meters (12 inches), connect the Data Output+ of the BERTScope Generator to the Data Input of the DPP-C.
2. Using a cable of ~ 1.8 meters (72 inches) longer than the data cable, connect the Sub-rate Clock Out of the BERTScope Generator to the Clock In of the DPP-C.
3. Loop back the DPP-C Outputs to the Analyzer Error Detector Inputs. *This cable length is not critical.*
4. Turn on SJ. *(Go to View -> Stressed Eye -> Sine Jitter -> Enable)*
5. Set the SJ amplitude to 30%UI.
6. Set the SJ frequency to 50MHz.
7. Turn on RJ. *(Go to View -> Stressed Eye -> Random Jitter -> Enable)*
8. Set the RJ amplitude to zero. “Intrinsic Limit” will be indicated.

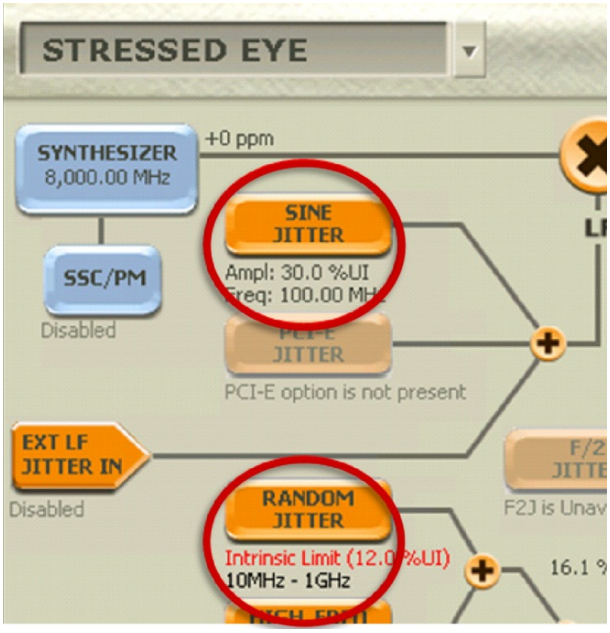

FIGURE 34. STRESS LEVEL CONFIGURATION

9.1.2 Step 2. Calibrate to Remove the Clock to Data Delay

1. Set the Generator Delay to 125 ps. *(Go to View -> Generator -> Delay)*

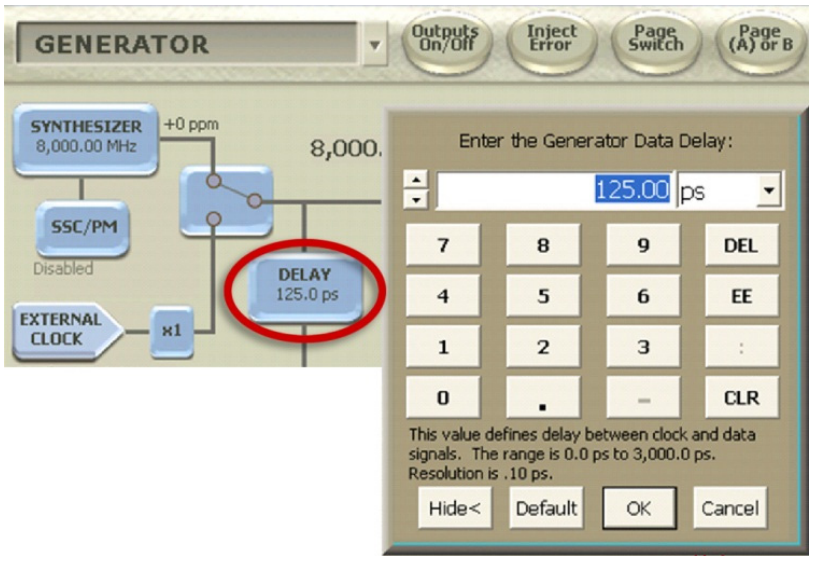

FIGURE 35. GENERATOR DELAY SETTING

2. On the BERTScope Detector view, check for error free operation (click 'Run' to start error counting). If not operating error free, advance the Generator delay to 183ps. Verify that the Detector is operating error free at this point. Record the Generator Delay.
3. Once error free operation is obtained, locate the boundary between error free and errored operation by decreasing the Generator Delay and using a binary search method as shown in Figure 36. Record the Generator Delay.
4. Return the Generator Delay to the error free point located in Step 2.

5. Locate the boundary between error free and errored operation by increasing the Generator Delay and using a binary search as shown in the figure below. Record the Generator Delay.
6. Set the Generator Delay to the average of the Delay values found in Steps 3 and 5. Record this Generator Delay value for later use in creating a Calibration Configuration file.

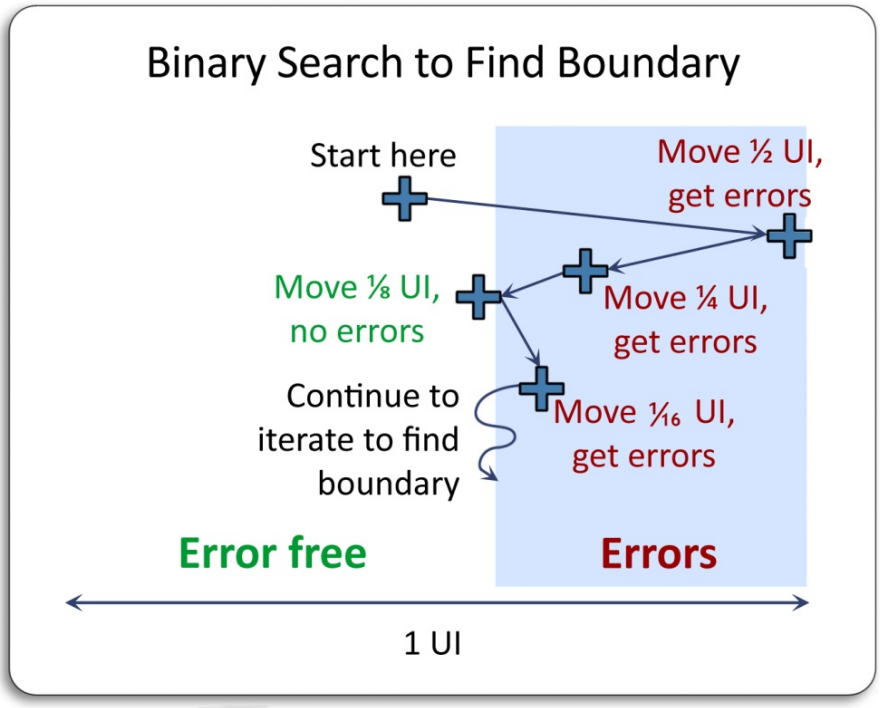

FIGURE 36. LOCATE OPTIMUM DELAY

9.1.3 Step 3. Record Generator Delay Value

After completing the Clock to Data skew calibration, record the BERTScope's Generator Delay setting for use in the Calibrated BERTScope Configuration file.

END_OF_DOCUMENT