Keysight M809256PB OIF CEI-56G Pre-Compliance Rx Test Automation Application

User Guide

KEYSIGHT TECHNOLOGIES

Notices

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Keysight M809256PB OIF CEI-56G Rx Test Automation Application

User Guide

1 Introduction

To install the OIF CEI-56G Rx Test Application, you require the installer file and the licenses necessary for the installation and for running various tests.

KEYSIGHT TECHNOLOGIES

Overview

The Optical Internetworking Forum (OIF) has developed Interoperability Agreements (IAs) focused on the development and deployment of new common electrical interfaces (CEI) applicable to higher speed optical systems. The common Electrical I/O implementation has a number of agreements but Keysight OIF CEI-56G Rx Test Automation Application provides support for CEI-56G-VSR-PAM4, CEI-56G-MR-PAM4 and CEI-56G-LR-PAM4 calibrations and tests. The OIF CEI-56G specifies a 56Gb/s electrical interface for use in the range 18.0 to 29.0 Gsym/s with up to 10.0 dB loss at the Nyquist frequency, including one connector.

For more details, refer to *Optical Internetworking Forum - Clauses 16, 17 and 21 of the OIF-CEI-4.0 Common Electrical I/O (CEI) - Electrical and Jitter Interoperability Agreements, December 29, 2017*.

The Keysight M809256PB OIF CEI-56G Rx Test Automation Application provides a framework for using Keysight M8000 BERT Test Solutions along with the Keysight FlexDCA Oscilloscopes to perform testing on the OIF CEI-56G Rx Device Under Test (DUT).

Related Documents

- *Optical Internetworking Forum - Clauses 16, 17 and 21 of the OIF-CEI-4.0 Common Electrical I/O (CEI) - Electrical and Jitter Interoperability Agreements, December 29, 2017*
- *IEEE Standard for Ethernet Amendment 2: Physical Layer Specifications and Management Parameters for 100 Gb/s Operation Over Backplanes and Copper Cables*
- M8070B documentation
  - For more information about M8070B software, refer to the M8070B documentation. To locate the M8070B documents, click **Start Keysight M8070B** > **Keysight M8070B Documentation**. Alternatively, you may also visit www.keysight.com/find/M8070B to find the latest versions of the M8070B manuals.

Contacting Keysight Technologies

For more information on products, applications or services associated with Keysight Technologies, contact your local Keysight office.

The complete list is available at: www.keysight.com/find/contactus.

2 Installing the OIF CEI-56G Rx Test App

As a prerequisite to installing the OIF CEI-56G Rx Test Application, you require the necessary hardware, along with installing certain softwares along with various licenses.

System requirements

PC Hardware requirements

The following hardware instruments are required to run compliance tests on a device under test (DUT) using the OIF CEI-56G Rx Test Application:

- Memory: 8 GB RAM minimum
- Monitor Resolution: WXGA+ (1440 x 900) minimum

PC installed software requirements

- Keysight IO Library Suite Rev. 18.1 or later
- M8070B system software for M8000 series
  - Ver. 6.5.0.0 or later
- M8070ADVB Advanced Measurement Package for M8000 Series
  - Ver. 1.1.550.2 or later
- M8195A soft front panel version 3.6 or M8196A soft front panel version 2.1
- Microsoft Office 2010 or higher
- MATLAB Compiler Runtime R2017a (9.2)
  - Installer Link: http://ssd.mathworks.com/supportfiles/downloads/R2017a/deployment_files/R2017a/installers/win64/MCR_R2017a_win64_installer.exe
  - Updater Link: http://ssd.mathworks.com/supportfiles/downloads/R2017a/deployment_files/R2017a/installers/win64/MCR_R2017a_Update_3.exe

PC Interfaces

- USB, LAN

Instrument Firmware Requirements

- M8040A BERT: M8070B system software as above
- 81600D/N1000A DCA-X: FlexDCA version A.06.03 or later

Table 1 shows the required equipment for each OIF CEI-56G standard option supported by the Test Application.

Table 1 Equipment required for each standard option supported by the Test App

Equipment Type	VSR	MR	LR
Victim Pattern Generator	▪ M8045A	▪ M8045A	▪ M8045A
Crosstalk Generator	▪ 2nd CH of M8045A ▪ 3rd party Crosstalk Generator	▪ NA	▪ NA
Interference Source	▪ NA	▪ M8054A / M8195A / M8196A ▪ 3rd party Noise Generator	▪ M8054A / M8195A / M8196A ▪ 3rd party Noise Generator
Victim Error Detector	▪ M8046A ▪ DCI (DUT Control Interface)	▪ M8046A ▪ DCI (DUT Control Interface)	▪ M8046A ▪ DCI (DUT Control Interface)
Clock Recovery	▪ M8046A - 0A4 (internal CDR) ▪ N1076A / N1076B / N1077A / N1078A	▪ M8046A - 0A4 (internal CDR) ▪ N1076A / N1076B / N1077A / N1078A	▪ M8046A - 0A4 (internal CDR) ▪ N1076A / N1076B / N1077A / N1078A
DCA-X	▪ N1000A + N1060A ▪ 86100D + 86108B	▪ N1000A + N1060A ▪ 86100D + 86108B	▪ N1000A + N1060A ▪ 86100D + 86108B

NOTE If you are using a DCI as Victim Analyzer during test runs along with the VirtualDUT DCI script, you must replace “127.0.0.1” with the actual IP address of the DUT.

Required Configuration & licenses

The OIF CEI-56G Rx Test Automation Application is a licensed feature. To use the plug-in with the recommended hardware and software arrangements, the following licenses are required:

Table 2 1st BERT Module minimum required configuration

Product	Description
M8045A	Pattern generator and clock module 32/64 Gbaud, 3 slot AXIe
M8045A-G32/G64	Pattern generator one channel NRZ, data rate up to 32/64 Gbaud
M8045A-0G3	Advanced jitter sources for receiver characterization, license
M8045A-0G4	De-emphasis, module-wide license
M8045A-0P3	PAM-4 encoding up to 32 Gbaud, module-wide license
M8057A/B	Remote head for M8045A pattern generator, 1 channel
M8045A-801	Short cable, 1.85 mm (m) to 1.85 mm (m), 0.15 m, 699 ps delay ± 1 ps (two are recommended for each differential data output of M8057A/B)
M8045A-802	Matched directional coupler pair, 50 GHz, 13 dB, 2.4 mm (recommended for RI and higher BW)

Table 3 2nd BERT Module minimum required configuration*

Product	Description
M8046A	Analyzer module, 32/64 Gbaud, 1-slot AXIe
M8046A-A32	Analyzer, one channel, data rate up to 32 Gbaud, NRZ
M8046A-0A4	Clock recovery for 32 Gbaud, license
M8046A-0P3	PAM-4 decoding up to 32 Gbaud, license
M8046A-802	Matched cable pair 2.4 mm (m) to 2.4 mm (m), 2 ps, length 0.85 m (recommended for data input of M8046A analyzer)

*This configuration is required if primary BER not provided by DUT internal error counter.

NOTE

To establish a successful connection between the OIF CEI-56G Rx Test Application and the BERT as well as the Interference Source, you must configure the modules in the following sequence on a 5-slot AXIe chassis:

- M8045A in slots 1-3 (M1)
- M8046A in slot 4 (M2)
- M8054A in slot 5 (M3)

Table 4 Electrical Clock Recovery*

Product	Description
N1076A	Electrical Clock Recovery (discontinued)
N1076A-232	Supported input rates: 50 MBd to 32 GBd (discontinued)
N1076B	Electrical Clock Recovery
N1076B-232	Supported input rates: 125 MBd to 32 GBd
N1077A	Optical/Electrical Clock Recovery
N1077A-232	Supported input rates: 50 MBd to 32 GBd
N1078A	Optical/Electrical Clock Recovery
N1078A-232	Supported input rates: 125 MBd to 32 GBd

*Select if external clock recovery is required for BER measurement using ED. No electrical CDR is required if M8046A-A04 has been chosen.

Table 5 M8000 system software configuration

Product	Description
M8070B	System software for M8000 Series of BER test solutions
M8070ADVB-1xx	Advanced Measurement Package for M8000 Series of BERT Test Solutions (node-locked, transportable, floating or USB license)

Table 6 Interference source minimum required configuration*

Product	Description
M8195A	65 GSa/s arbitrary waveform generator
M8195A-001	Arbitrary Waveform Generator, 1 Channel, 65 GSa/s
M8196A	92 GSa/s arbitrary waveform generator
M8196A-001	Arbitrary Waveform Generator, 1 Channel, 92 GSa/s
M8054A**	Interference Source 32 GHz

*select one of the listed signal generators for Gaussian noise interference.

**on a 5-slot AXIe chassis, insert M8054A in slot 5 (M3).

Table 7 Select DCA configuration (N1000 DCA-X + N1060A or 86100D DCA-X + 86108B)

Product	Description
DCA-X mainframe minimum configuration	
N1000A	DCA-X Wide-Bandwidth Oscilloscope Mainframe
N1000A-PLK	Pattern Lock Trigger Hardware Model
Model	
86100D	Infiniium DCA-X Oscilloscope mainframe
86100D-ETR	Enhanced Trigger, 13 GHz BW, pattern and module trigger
Either choose legacy DCA option	
N1010AT/86100D-200	Enhanced Jitter Analysis SW
N1010AT/86100D-201	Advanced Waveform analysis
N1010AT/86100D-9FP	PAM-N analysis software
N1010AT/86100D-SIM	InfiniiSim-DCA (embedding/de-embedding of cables or fixtures)
OR choose FlexDCA R&D package	
N1010100A	Research and Development Package for FlexDCA DCA-X mainframe minimum configuration

Table 8 Precision Waveform Analyzer minimum configuration

Product	Description
N1060A-050	Two 50 GHz channels
N1060A-232	Supported input rates: 125 MBd to 32 GBd
N1060A-PTB	Precision Timebase, Ultra-Low Random Jitter
N1060A-JSA	Jitter Spectrum Analysis and Clock Recovery Emulation
86108B-HBW	50 GHz Bandwidth, 2 Channel Electrical
86108B-232	Supported input rates: 50 Mb/s to 32 Gb/s
86108B-300	Adjustable Loop Bandwidth for Clock Recovery
86108B-PTB	Precision Timebase, Ultra-Low Random Jitter
86108B-JSA	Jitter Spectrum Analysis and SW Clock Recovery Emulation

Table 9 Fixtures

Product	Description
M8049A-002 (for VSR Host/Module)	ISI Channel Board, Nine Traces from 0.8 to 8.0 inches
M8049A-003 (for MR / LR)	ISI Channel Board, Seven Traces from 9.1 to 22.3 inches

Table 10 M809256PB software configuration

Product	Description
M809256PB-1xx	RX Test Automation license for OIF CEI-56G VSR/MR/LR (node-locked, transportable floating or USB license)

Installing the Software

The installer for the OIF CEI-56G Rx Test Application can be downloaded from the Keysight website.

Download the installer file from: www.keysight.com/find/m8000.

To install the OIF CEI-56G Rx Test Automation Application,

1 Double-click the downloaded installer file on your PC.

The Installation Wizard for the Keysight OIF CEI-56G Rx Test Automation Application appears.

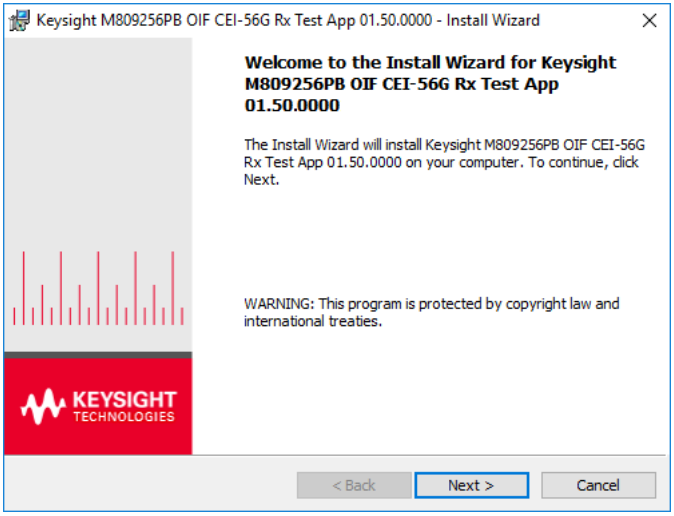


Figure 1 Installation wizard for the OIF CEI-56G Rx Test Application

2 Click **Next**. The **Keysight Software End-User License Agreement** window appears.

3 Select **Agree** to agree to the license agreement and to enable the **Next** button.

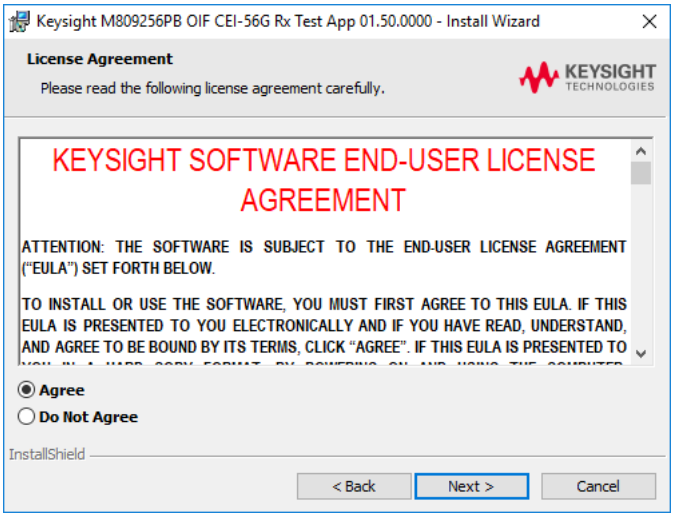


Figure 2 License Agreement window

4 Click **Next**.

5 On the window that appears, click **Install**.

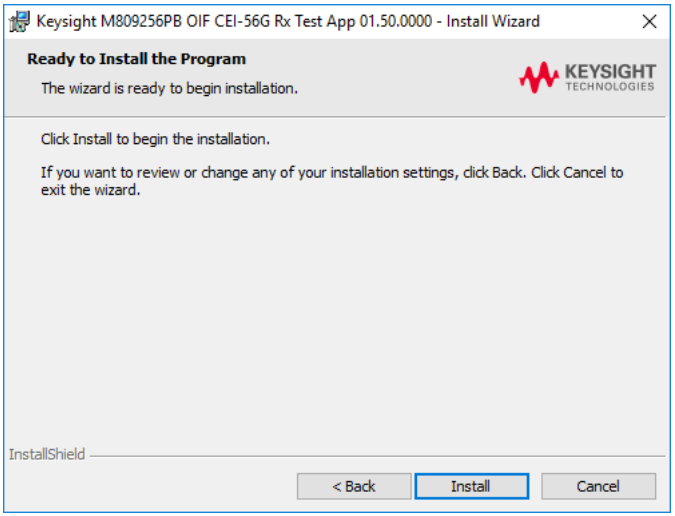


Figure 3 Window to begin Application installation

6 Once the installation of the OIF CEI-56G Rx Test Automation Application begins, its status is displayed.

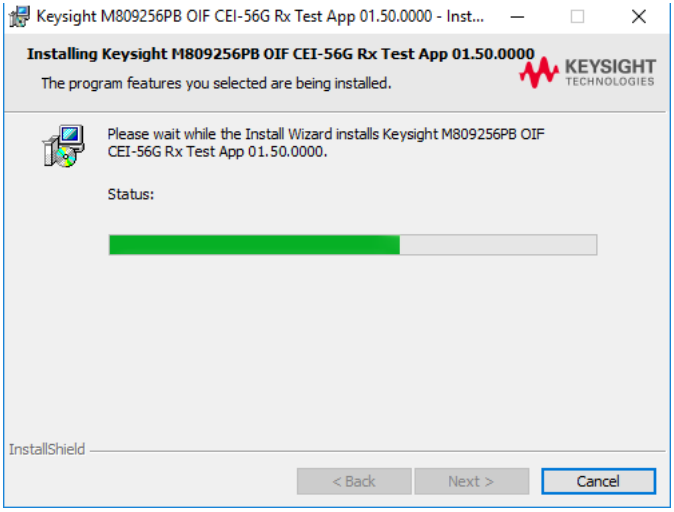


Figure 4 Window displaying installation status

7 Once the installation is complete, the following window appears. Click **Finish** to complete the installation and exit the wizard.

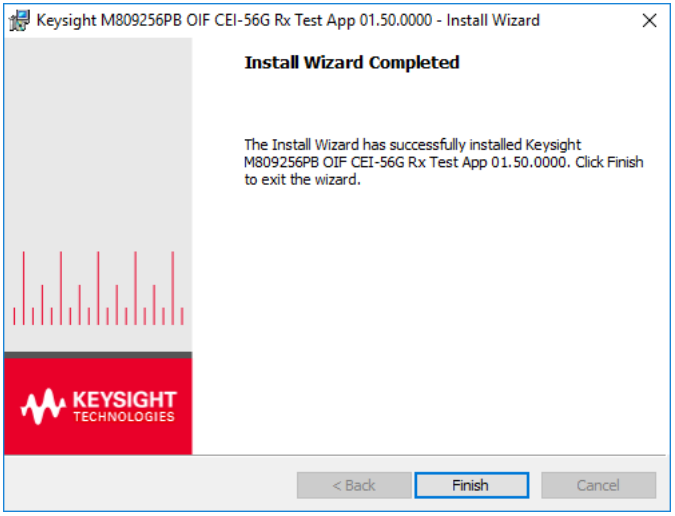


Figure 5 Window indicating end of installation

Installing the License Key

To procure a license, you require the Host ID information that is displayed in the Keysight License Manager application installed on the same machine where you wish to install the license.

Using Keysight License Manager 5

To view and copy the Host ID from Keysight License Manager 5:

1 Launch Keysight License Manager on your machine, where you wish to run the Test Application and its features.

2 Copy the Host ID that appears on the top pane of the application. Note that x indicates numeric values.

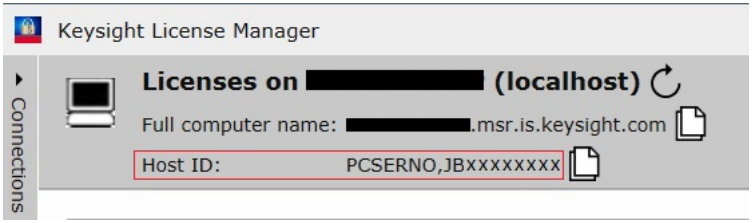


Figure 6 Viewing the Host ID information in KLM 5

To install one of the procured licenses using Keysight License Manager 5 application,

1 Save the license files on the machine, where you wish to run the Test Application and its features.

2 Launch Keysight License Manager.

3 From the configuration menu, use one of the options to install each license file.

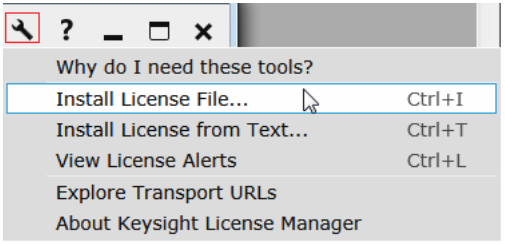


Figure 7 Configuration menu options to install licenses on KLM 5

For more information regarding installation of procured licenses on Keysight License Manager 5, refer to Keysight License Manager 5 Supporting Documentation.

Using Keysight License Manager 6

To view and copy the Host ID from Keysight License Manager 6:

1 Launch Keysight License Manager 6 on your machine, where you wish to run the Test Application and its features.

2 Copy the Host ID, which is the first set of alphanumeric value (as highlighted in Figure 8) that appears in the Environment tab of the application. Note that x indicates numeric values.

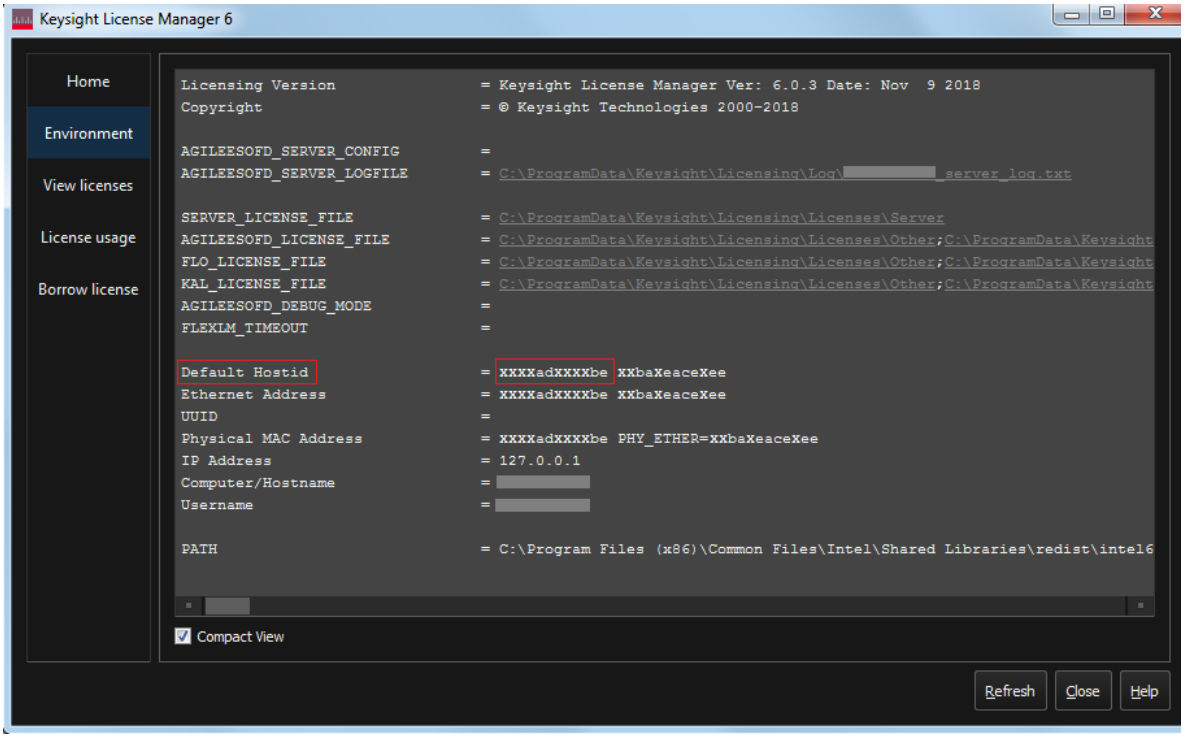


Figure 8 Viewing the Host ID information in KLM 6

To install one of the procured licenses using Keysight License Manager 6 application,

1 Save the license files on the machine, where you wish to run the Test Application and its features.

2 Launch Keysight License Manager 6.

3 From the Home tab, use one of the options to install each license file.

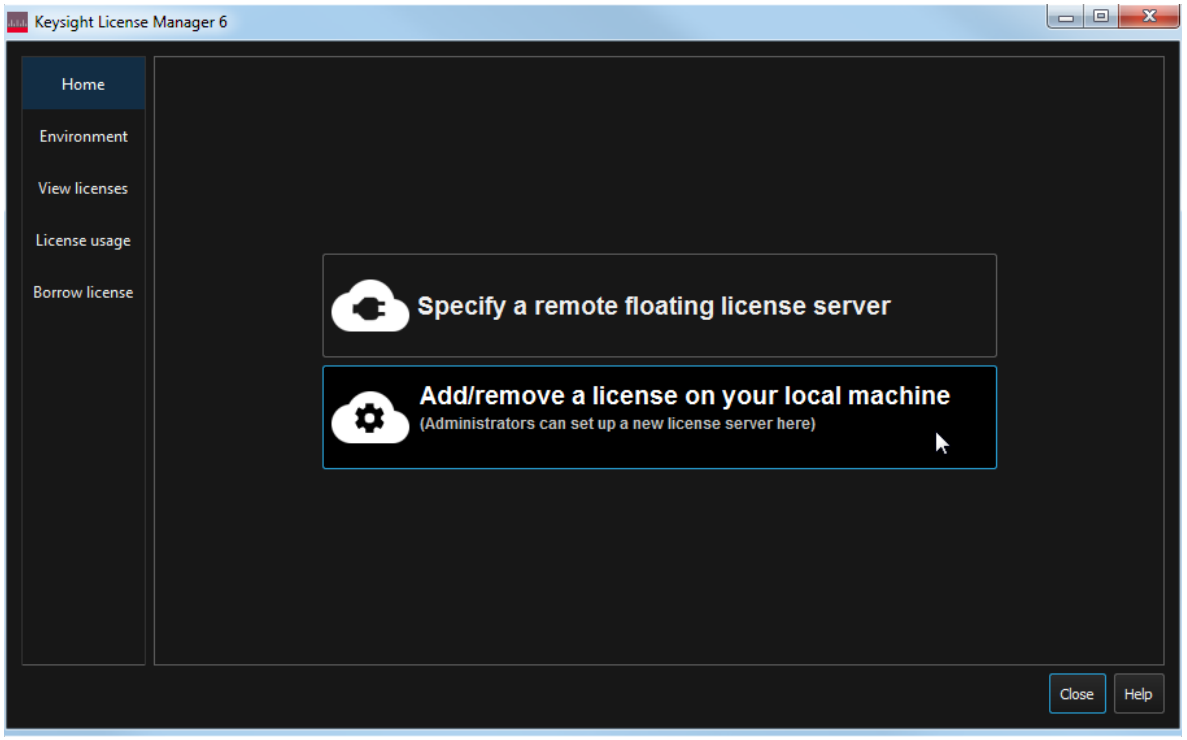


Figure 9 Home menu options to install licenses on KLM 6

For more information regarding installation of procured licenses on Keysight License Manager 6, refer to Keysight License Manager 6 Supporting Documentation.

3 Preparing to take Measurements

NOTE Ensure that all instruments specified in "Required Configuration & licenses" on page 14 are defined in the *Keysight Connection Expert* on the PC, where the OIF CEI-56G Rx Test Automation Application is installed.

Calibrating the Instruments

If you haven't already calibrated the FlexDCA oscilloscope, Keysight recommends calibrating the oscilloscope before performing calibrations or tests using the OIF CEI-56G Rx Test Automation Application.

1 Disconnect all the cables that may be connected to the FlexDCA oscilloscope.

2 From the main menu of the FlexDCA N1000-Series System Software, select **Tools** > **Calibrations...**.

3 Follow the on-screen instructions to perform calibrations.

If the calibrations are not performed, warning messages are logged for each calibration performed from the M8070B software.

To know how to perform calibrations on the oscilloscope, refer to the *DCA-X, DCA-M and FlexDCA Help v6.40 User's Guide* for more details.

Starting the Test Application

The OIF CEI-56G Rx Test Automation Application is available to be run as a stand-alone application on a PC, either locally or remotely.

Before you launch the OIF CEI-56G Rx Test Automation Application, make sure that Keysight M8070B software and FlexDCA N1000-Series System Software are online and active on the respective instruments.

For calibrations and tests, the VSR standard options require mated compliance boards and ISI channel boards, whereas the MR & LR standard options require ISI channel boards only. Ensure that proper connections with the testing instruments are established and that the measurement instruments are connected on the same LAN as the remote PC, where the OIF CEI-56G Rx Test Automation Application is installed.

To access the OIF CEI-56G Rx Test Automation Application,

1 From the **Start** menu of the Win10 OS, click **Keysight M8070B Applications > Launch Keysight M809256PB**.

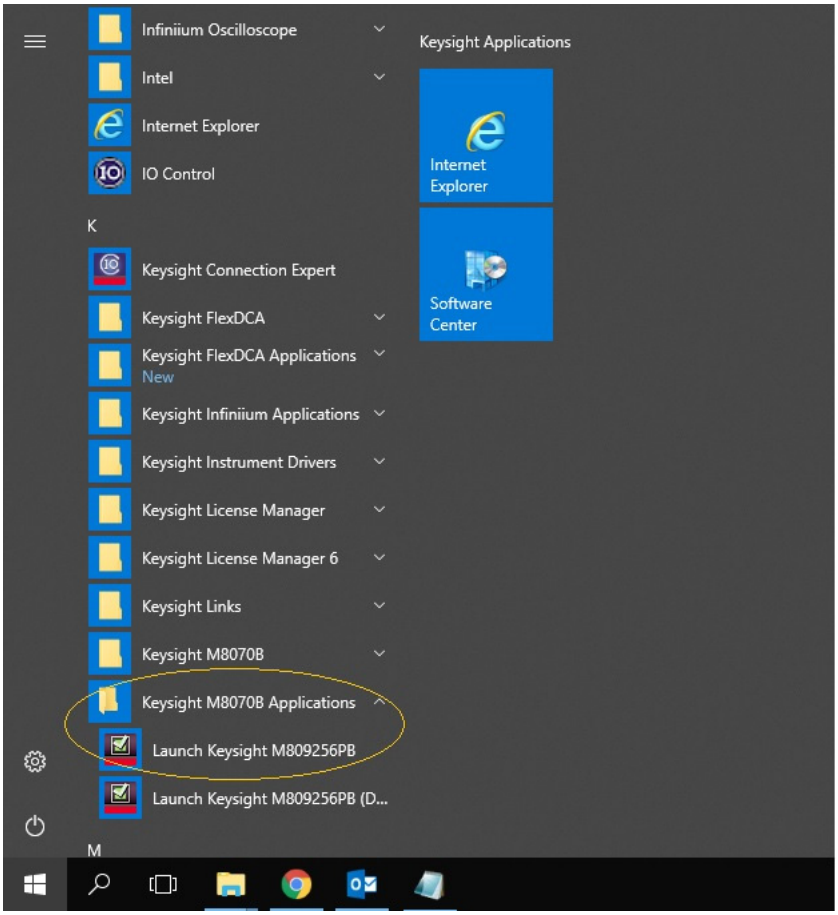


Figure 10 Launching the OIF CEI-56G Rx Test Application

NOTE

If you do not see Keysight M809256PB listed on the Start menu, the OIF CEI-56G Rx Test Automation Application has not yet been installed on the PC.

Refer to "Installing the Software" on page 18 for installation instructions.

- The **M809256PB OIF CEI-56G RX Test BERT Pre-Compliance App** banner appears.
- If a single instance of the M8070B software only is running online, the OIF CEI-56G Rx Test Automation Application launches after automatically getting connected to the M8070B software.
- If the OIF CEI-56G Rx Test Automation Application detects more than one instance of the M8070B software running, the **Connect to M8070B System Software for M8000 Series of BER Test Solutions (M8070)** window appears.

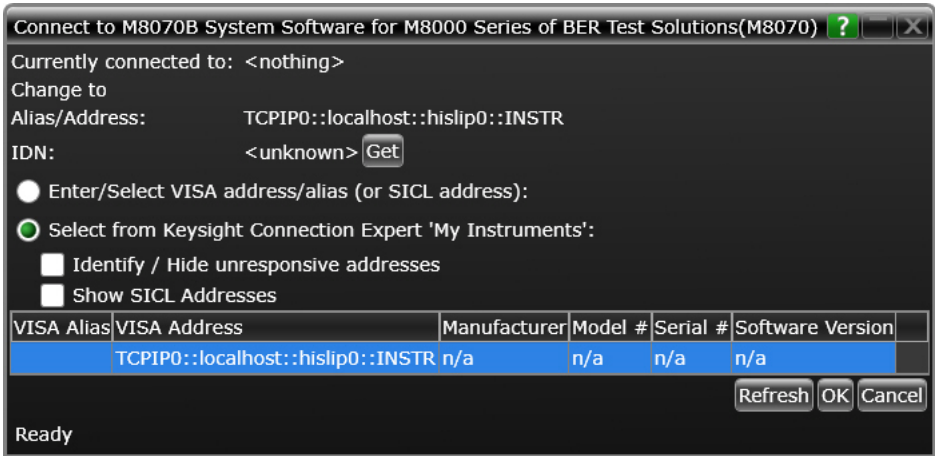


Figure 11 Connecting to M8070B if multiple instances are active

2 Perform one of the following actions:

- In the **Enter/Select VISA address/alias (or SICL address):** text field, you can either type or copy the VISA/SICL address directly from the Keysight M8070B Software and paste it here. To verify the correct VISA address to connect to M8070B, access the **SCPI Server Information** window by clicking **Utilities > SCPI Server Information...** from the main menu of the Keysight M8070B software.

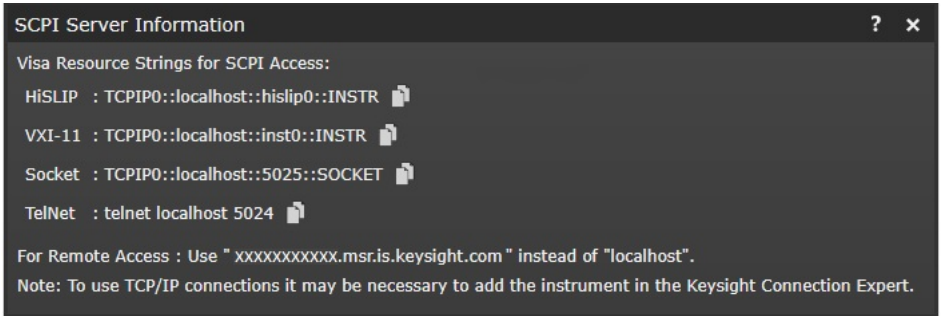


Figure 12 SCPI Server Information window on the M8070B Software

- If the BERT device is online and defined in the *Keysight Connection Expert*, click **Select from Keysight Connection Expert favorites:**. The VISA address list defined in the Keysight Connection Expert software for each online instrument is displayed. After you verify the VISA/SICL address, select the correct VISA Address from the list.

3 Click **Get** on the **Connect to M8070B System Software for M8000 Series of BER Test Solutions(M8070)** window. The **IDN:** field displays the instrument name.

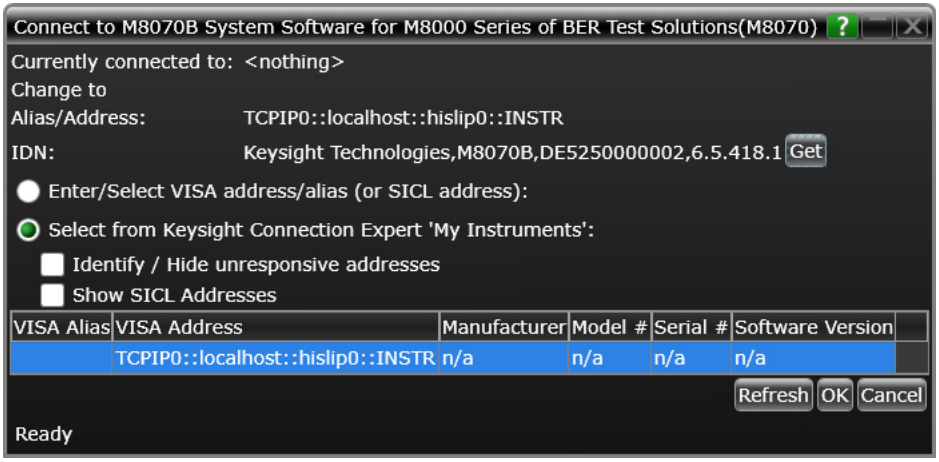


Figure 13 IDN field displaying successful connection to M8070B

4 Click **OK** to establish connection with M8070B and to launch the OIF CEI-56G Rx Test Automation Application. If a connection is not established, the application fails to launch.

- The OIF CEI-56G Rx Test Automation Application appears with the **Set Up** tab, as default.

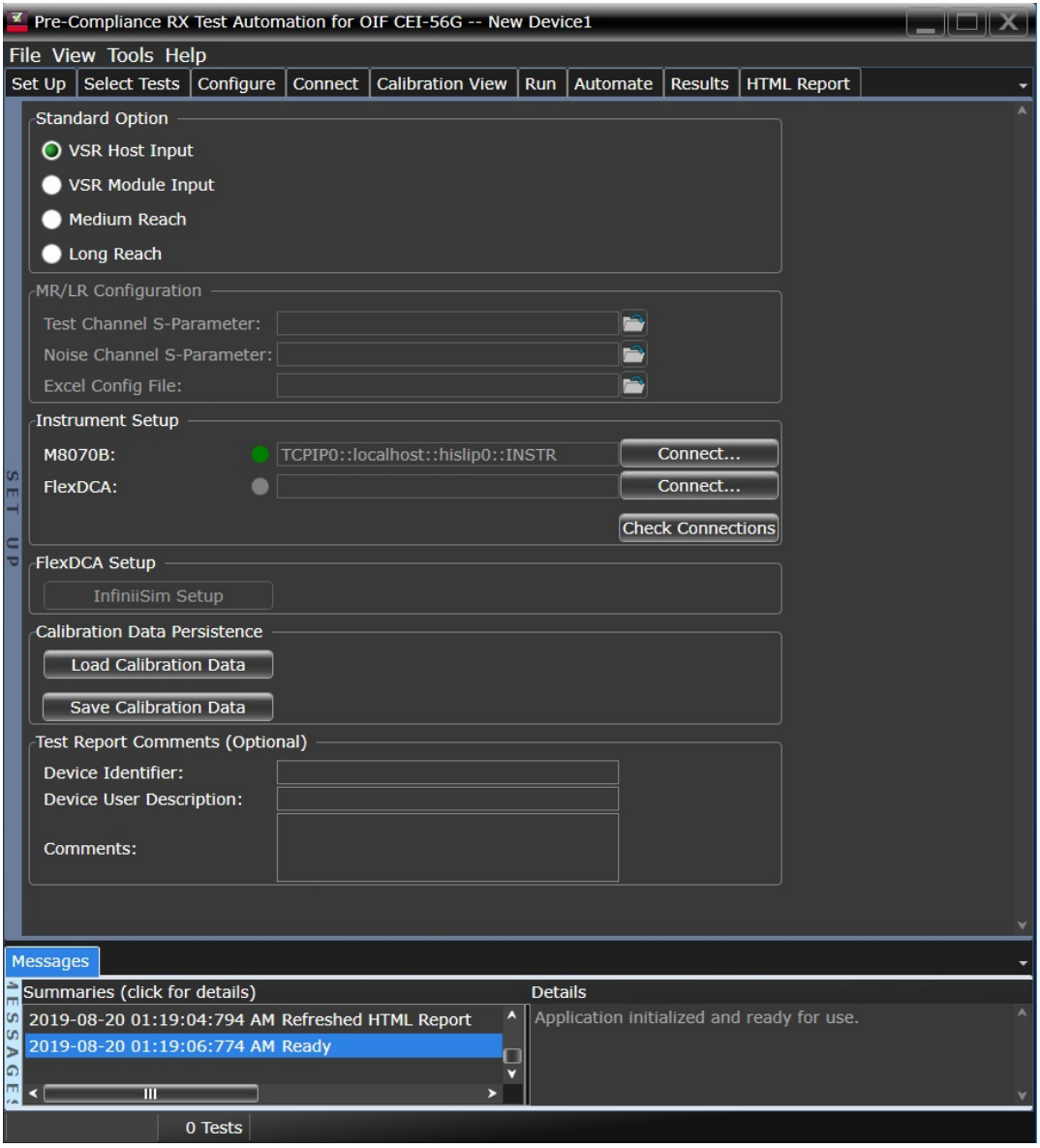


Figure 14 Default view of the OIF CEI-56G Rx Test App

For more information on how to use the various features in the OIF CEI-56G Rx Test Automation Application, refer to the *Keysight M809256PB OIF CEI-56G Pre-Compliance Rx Test Automation Application Online Help*.

Setting up the OIF CEI-56G Rx Test Application

Calibrations are performed using mated Compliance Boards, whereas the Device Under Test (DUT) is required to run the tests. However, even before you begin performing the OIF CEI-56G calibrations, you must set up the Test Application first.

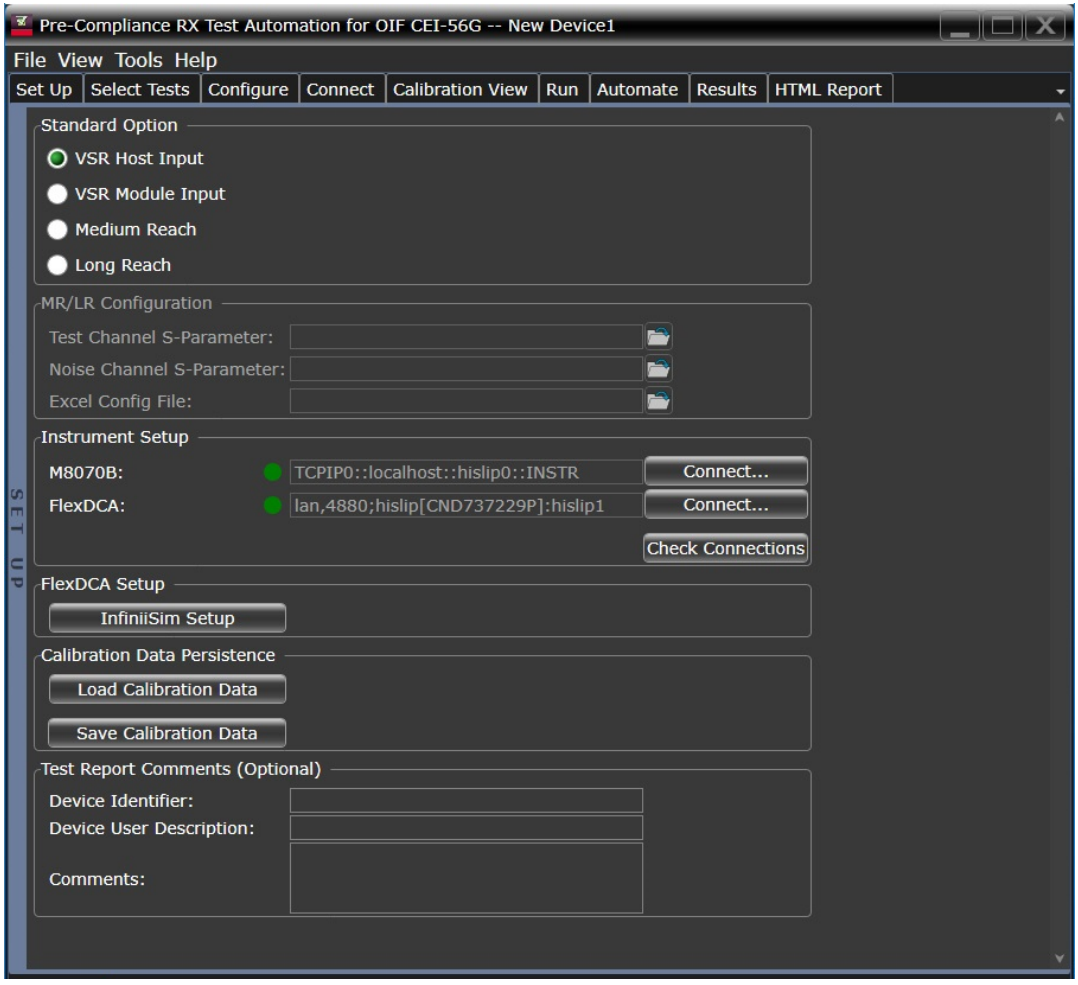


Figure 15 Setting up the OIF CEI-56G Rx Test App

1 Under the **Set Up** tab,

a Select an option in the **Standard Option** area, to indicate the standard on which the calibrations/tests are to be performed. The **Select Tests** tab displays the respective calibrations and tests. By default, **VSR Host** is selected.

- If **Medium Reach** or **Long Reach** is selected as the **Standard Option**, you must perform the **MR/LR Configuration**. To know more about configuring these standard options, refer to *Configuring MR/LR Standard Options* section in the *Keysight M809256PB OIF CEI-56G Rx Test Automation Application Online Help*.

b In the **Instrument Setup** area,

i Click **Connect...** corresponding to M8070B and FlexDCA to connect to the respective instrument using the SICL/VISA address, if not connected already. By default, when you start the OIF CEI-56G Rx Test Application, a connection dialog is displayed to connect at least to the BERT device, else the application fails to launch. A green dot indicates that the instrument is already connected.

ii Click **Check Connections** to verify that M8070B and FlexDCA are properly connected to the OIF CEI-56G Rx Test Application.

NOTE

To establish a successful connection between the OIF CEI-56G Rx Test Application and the BERT as well as the Interference Source, you must configure the modules in the following sequence on a 5-slot AXIe chassis:

- M8045A in slots 1-3 (M1)
- M8046A in slot 4 (M2)
- M8054A in slot 5 (M3)

c Click **InfiniiSim Setup** in the **FlexDCA Setup** area to configure the Oscilloscope's FlexDCA De-embedding. The **InfiniiSim Setup** button is enabled only after a connection with the FlexDCA instrument is established. To know more about configuring InfiniiSim for DCA within the Test Application, refer to *Configuring InfiniiSim for DCA* section in the *Keysight M809256PB OIF CEI-56G Rx Test Automation Application Online Help*.

d In the **Calibration Data Persistence** area, you can save the calibration data in zip format for future use and load existing calibration data in zip format. To understand the functionality of the

Calibration Data Persistence, refer to "Understanding Calibration Data Persistence" on page 39.

e In the **Test Report Comments (Optional)** area, enter appropriate values in the **Device Identifier:**, **Device User Description:** and **Comments:** text fields, respectively, such that they appear in the HTML Report that is generated after test runs. Performing this step is optional. However, Keysight recommends entering these values to identify the test results for the corresponding DUT when there are large number of DUTs to be tested.

2 Under the **Select Tests** tab, select one or more Calibrations or Tests or both options for the standard selected earlier.

3 Under the **Configure** tab, modify the configuration parameters based on the values defined in the *Optical Internetworking Forum - Clauses 16, 17 and 21 of the OIF-CEI-4.0 Common Electrical I/O (CEI) - Electrical and Jitter Interoperability Agreements, December 29, 2017*.

4 In the **Connect** tab, the instructions and the connection diagram to perform connections between the test boards and the instruments is displayed. Follow the instructions to perform the appropriate connections for each calibration/test.

5 Once the connections are verified and application set up is complete, click **Run Tests** to start running Calibrations/Tests.

Understanding Calibration Data Persistence

The **Calibration Data Persistence** feature of the OIF CEI-56G Rx Test Automation Application provides you a way to save and load the Calibration data. The advantage of using this feature is to save time from running calibrations again, which are a prerequisite to running the OIF CEI-56G RX tests. The OIF CEI-56G Rx Test Automation Application manages the Calibration data in the **.zip* file format.

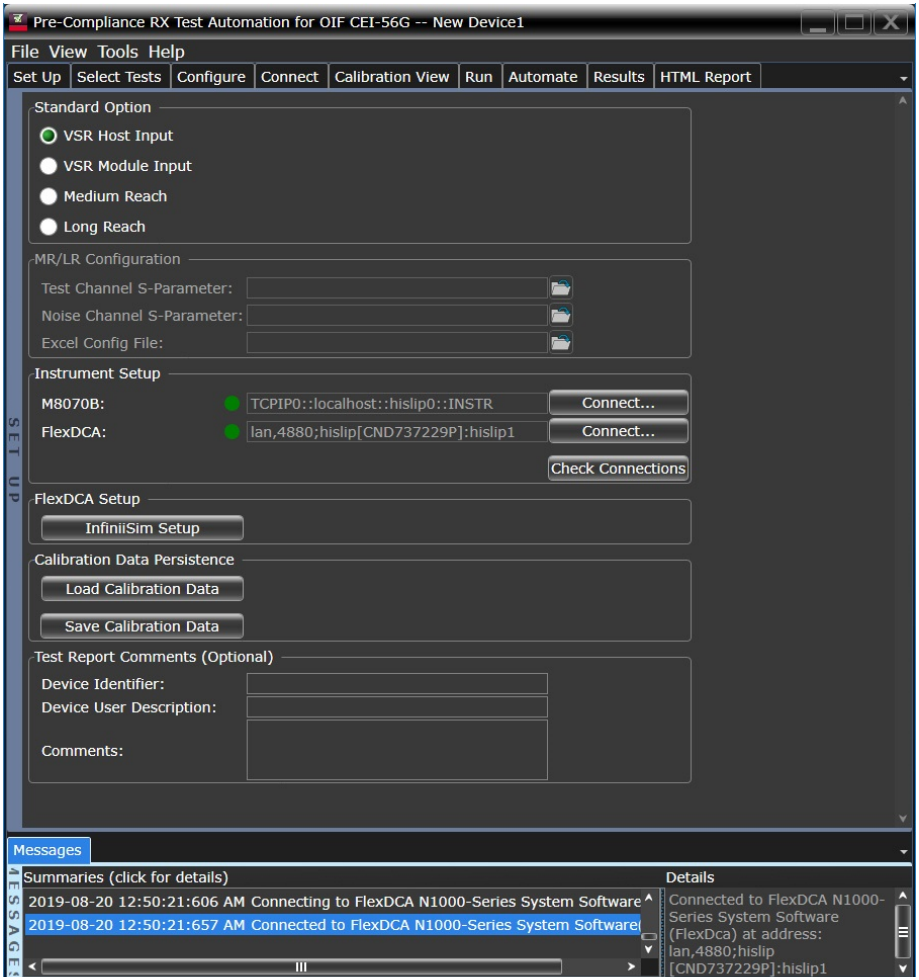


Figure 16 Performing Calibration Data Persistence

- To understand how to load calibration data before running OIF CEI-56G Tests, see "Loading Calibration Data" on page 41.
- To understand how to save calibration data after running OIF CEI-56G Calibrations, see "Saving Calibration Data" on page 43.

Loading Calibration Data

The OIF CEI-56G tests are dependent on the calibration data, which can be obtained after performing one or more Calibrations with respect to a standard option. Pre-saved calibration data can be used to run tests in the current instance of the Test Application.

To load such Calibration data into the Test Application,

1 In the **Calibration Data Persistence** area, click **Load Calibration Data**.

2 In the **Open** window that appears, navigate to the folder where the Calibration data file is located in *zip* format.

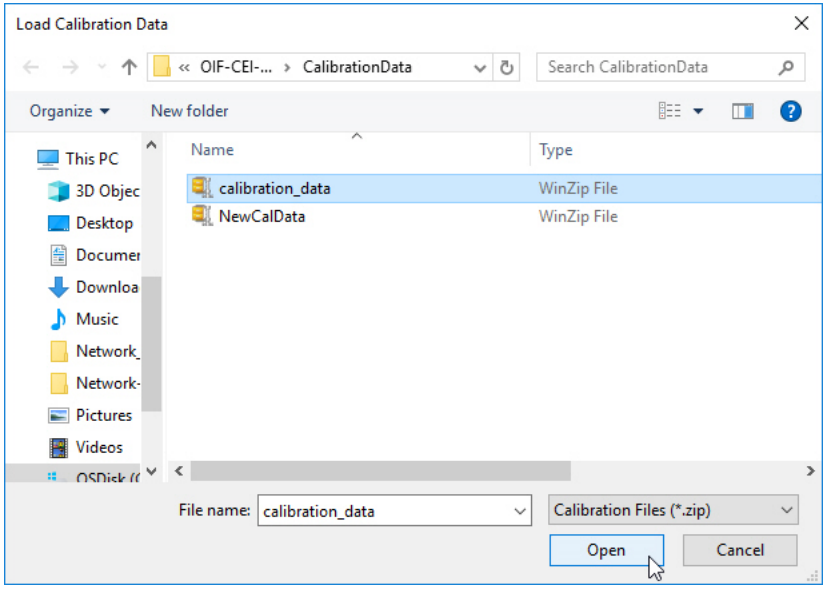


Figure 17 Selecting the Calibration Data Zip file from the target directory

3 Select the required data file and click **Open**.

4 The **Messages** area of the OIF CEI-56G Rx Test Automation Application indicates whether or not the calibration data has loaded successfully.

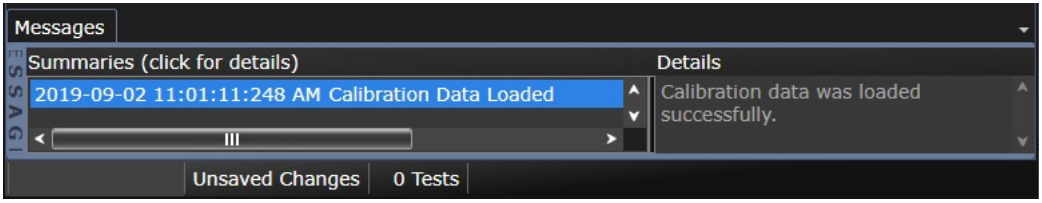


Figure 18 Set Up tab view after successfully loading Calibration Data

After you load the Calibration Data, the Test Application automatically identifies the data corresponding to OIF CEI-56G standard option and uses the respective data during test runs in that instance of the Test Application.

Saving Calibration Data

The OIF CEI-56G tests are dependent on the calibration data, which can be obtained after performing one or more Calibrations with respect to a standard option. Running Calibrations is time-consuming and may take up some time before you finish running each calibration (along with modifying the hardware setup for each calibration) and obtaining the required data.

The **Save Calibration Data** feature helps you to save the Calibration data for future use. After you have performed all calibrations successfully, Keysight recommends that the Calibration data be saved, such that you can use the calibrated values for OIF CEI-56G tests later, if required.

To save the Calibration data,

1 In the **Calibration Data Persistence** area, click **Save Calibration Data**.

2 In the **Save As** window that appears, navigate to the folder where you wish to save the Calibration data in *zip* file format.

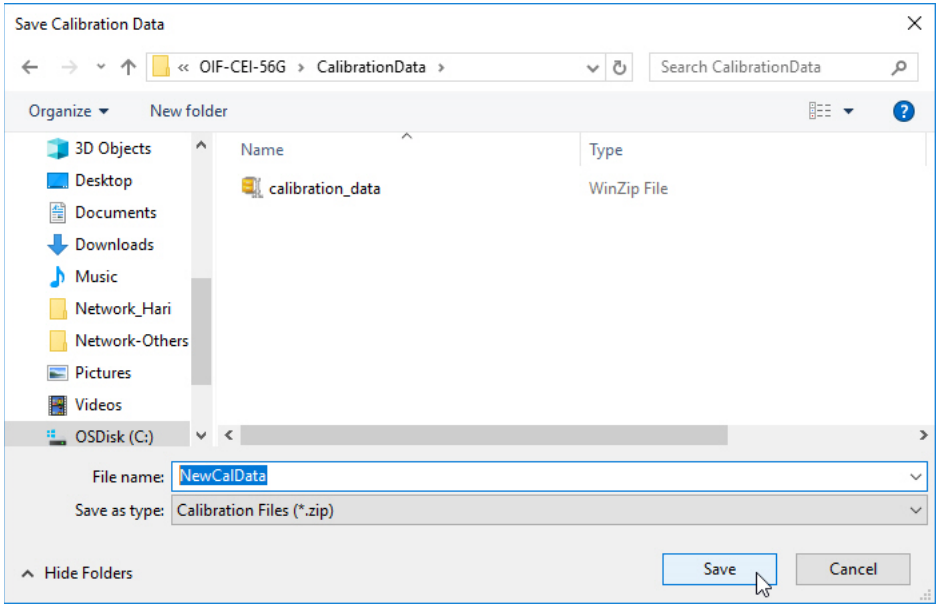


Figure 19 Saving the Calibration Data Zip file in the target directory

3 Click **Save**.

4 The **Messages** area in the OIF CEI-56G Rx Test Automation Application indicates whether or not the calibration data have been saved successfully.

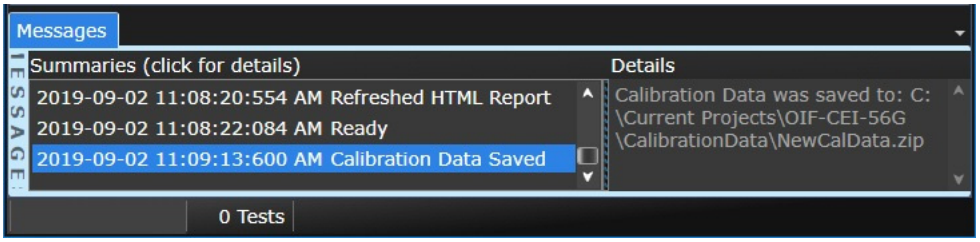


Figure 20 Set Up tab view after successfully saving Calibration Data

NOTE

The **Calibration Data Persistence** feature only lets you save any calibration data after calibrations are performed in the Test Application or load any pre-saved calibration data into the Test Application prior to running tests. However, if you wish to modify the calibrated data, you may use the **Calibration Editor** feature within the Test Application.

Modifying calibration data using Calibration Editor

The Calibration Editor feature in the Test Application offers you capabilities to view and to modify calibrated values, which may have been saved using the Calibration Data Persistence feature or appear in the current instance of the Test Application after performing one or more calibrations.

1 From the main menu of the Test Application, click **Tools > Calibration Editor...**.

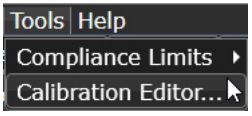


Figure 21 Launching Calibration Editor from Tools menu

2 On the Calibration Editor window that is displayed, click a calibration type to view the corresponding default calibration data or the data from a recent calibration run in the current instance of the Test Application.

- Following image displays the default calibration data for Amplitude calibration under VSR Host.

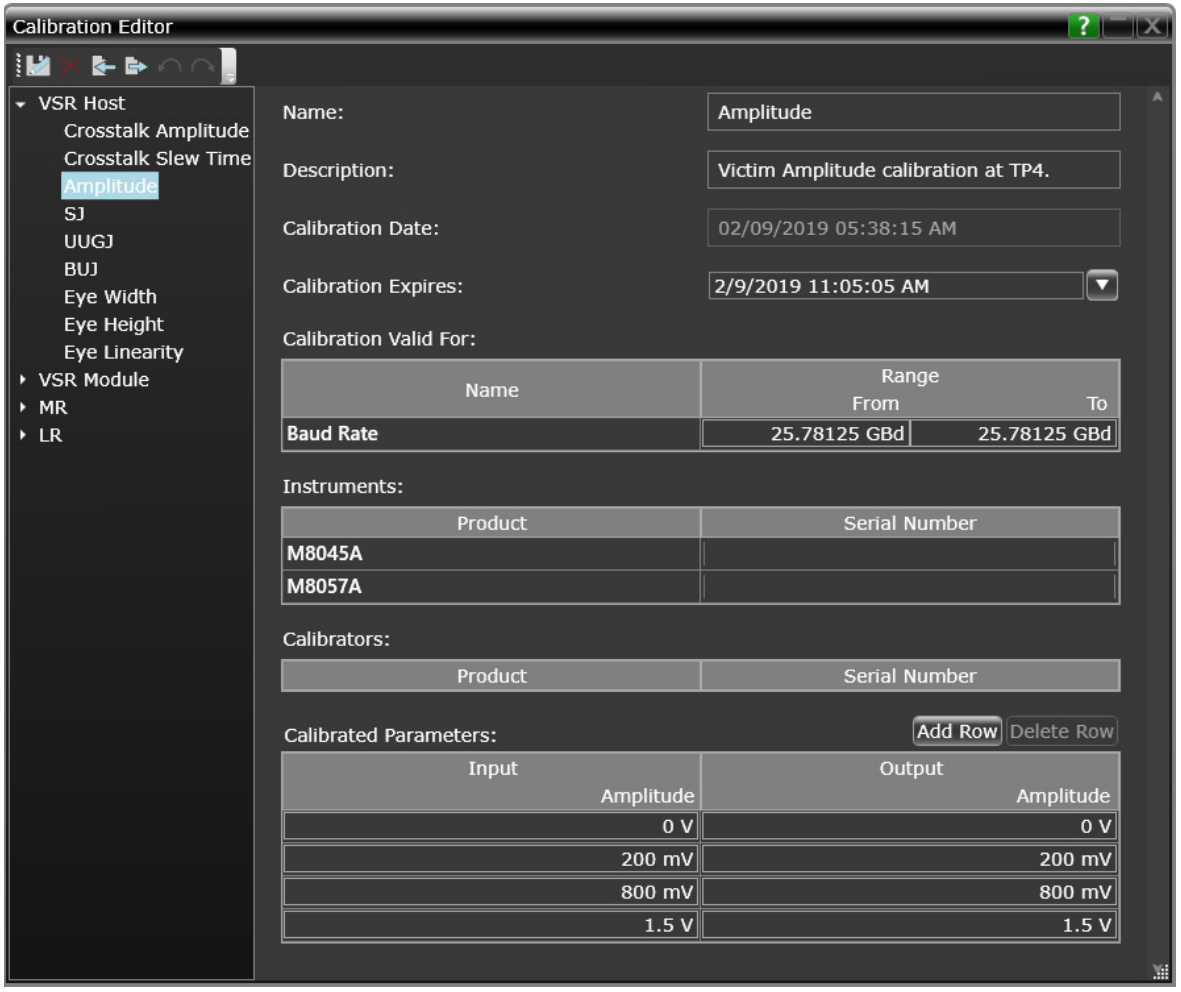


Figure 22 Default information for the selected calibration type

- Following images display the calibration data either after the Test Application performs the Amplitude Calibration in the current instance or a pre-saved calibration data corresponding to Amplitude Calibration was loaded.

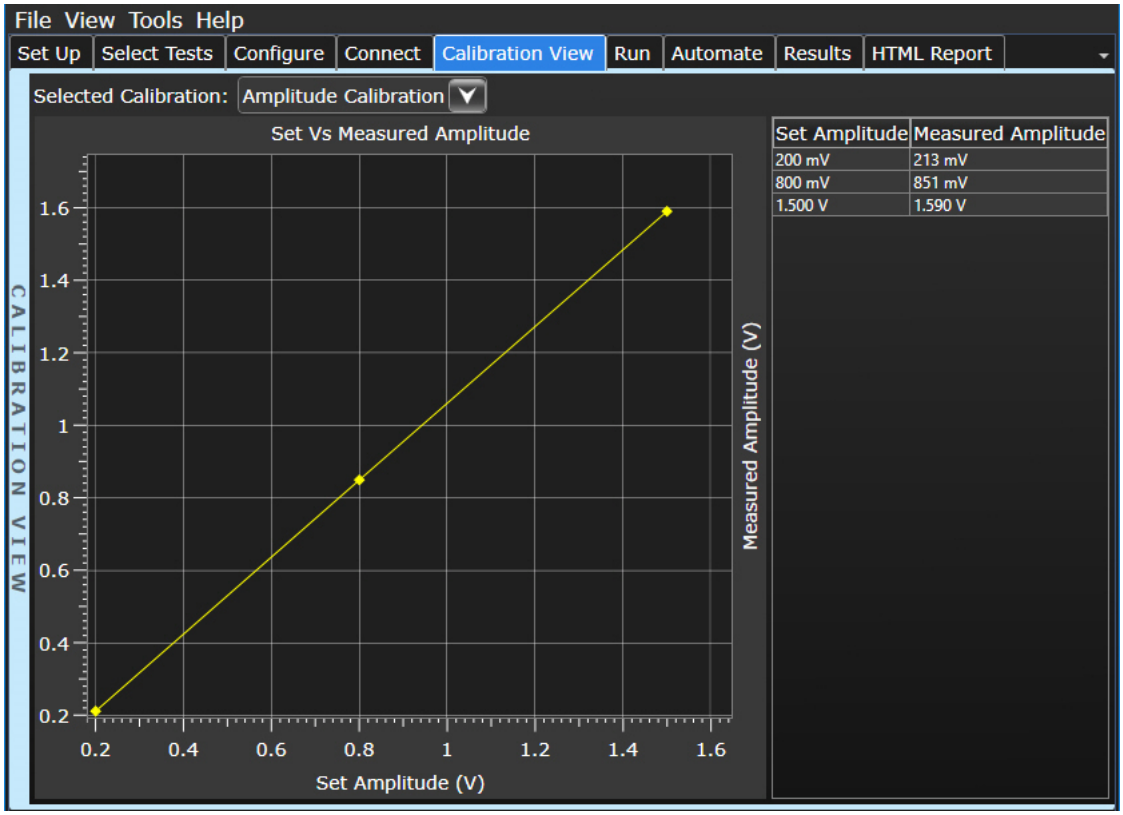


Figure 23 Plotted data in the Calibration Viewer for Amplitude Calibration

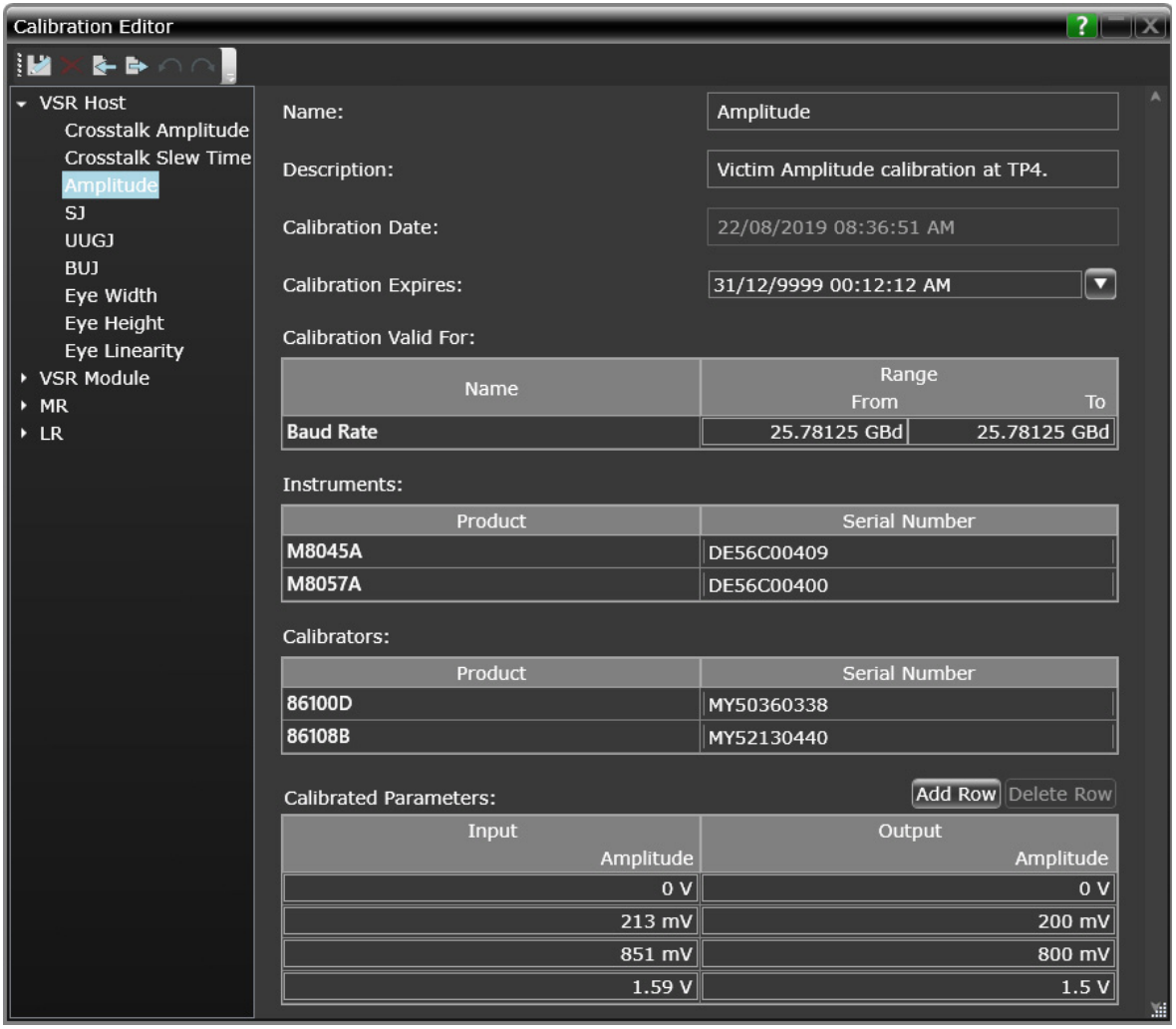


Figure 24 Amplitude Calibration data displayed in Calibration Editor

Table 11 describes the attributes in the calibrated data for each type.

Table 11 Attributes in the Calibration Editor

Attribute name	Description
Name	Name of the selected calibration type.
Description	Description of the selected calibration type along with the test point where the calibration is to be performed.
Calibration Date	The date and time stamp when the selected calibration type was performed.
Calibration Expires	The date and time stamp to indicate the validity of the calibrated values for the selected calibrated type.
Calibration Valid For	The list of parameters and their range of values, which decide the validity of the calibrated values.
Instruments	The list of instruments that were used to perform the calibration and the serial number of each instrument.
Calibrators	The Oscilloscope and its modules used for the calibration.
Calibrated Parameters	The parameter values that were measured by the Oscilloscope are displayed under the Input column whereas the calibrated parameters and their values are displayed under the Output column. These correlate with the Measured Amplitude and Set Amplitude values in the Calibration Viewer window of the Test Application. Some calibration types may have more than one output parameters.

You can use the functional features that appear on the top menu in the Calibration Editor to:

- Save any changes
- Discard all changes
- Import calibration data for editing
- Export edited calibration data into a zipped file
- Undo or redo any changes in the current instance
- Modify
  - Text in the **Name** and **Description** fields
  - Date and Time stamp in the **Calibration Expires** field
  - **Range** values in **Calibration Valid For** table
  - **Serial Number** values in the **Instruments** and **Calibrators** tables
  - Both **Input** and **Output** cells in the **Calibrated Parameters** table
- Add one or more rows in the **Calibrated Parameters** table only; each new row shall display interpolated values.
- Delete one or more rows in the **Calibrated Parameters** table only.

After you export the modified data, you may use the **Calibration Data Persistence** feature to use the calibrated values for a specific calibration to run associated tests.

For more information on each feature that appears in the Calibration Editor, refer to *Using the Calibration Editor* section in the *Keysight M809256PB OIF CEI-56G Pre-Compliance Rx Test Automation Application Online Help*.

Overview on Channel Operating Margin (COM)

COM is a figure of merit (FOM) determined from a minimum reference PHY architecture and channel's S-parameters. It allows designers to explore physical design budget (choices) between loss, reflection ISI, crosstalk, and device specifications.

COM is the Signal to Noise Ratio (SNR) of available signal amplitude (As) to statistical noise amplitude (An) in dB. It can be calculated using the equation:

$$COM = 20 * \log_{10}(As/N)$$

where, N = Peak BER Noise and As = Peak signal

Both N and As are calculated based on the transmitter and channel characteristics assuming a reference receiver with optimized equalization.

A channel set contains a victim channel response called THRU, some number of far-end crosstalk aggressor responses (FEXT), which do not have the same transmitter as the victim lane and some number of near-end aggressor responses (NEXT), which do have the same transmitter as the victim lane.

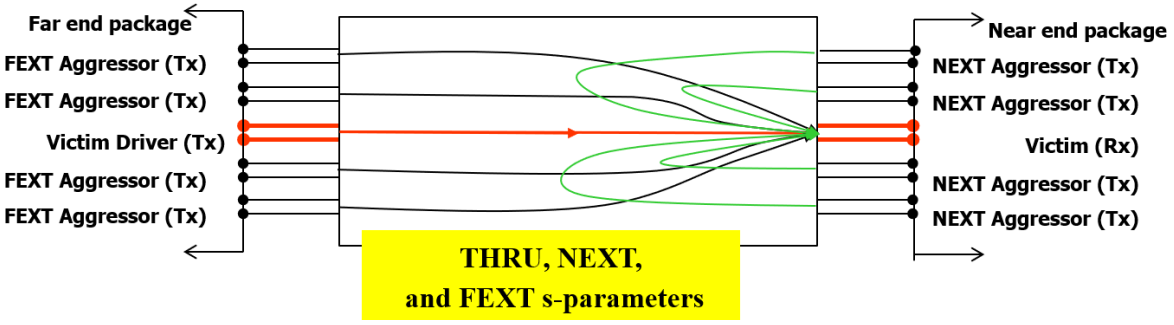


Figure 25 Channel Model for COM

For OIF CEI-56G Medium Reach and Long Reach Interfaces, COM shall be greater than or equal to 3.0 dB for each test. This minimum value allocates margin for practical limitations on the receiver implementation, the largest step size allowed for transmitter equalizer coefficients.

4 OIF CEI-56G VSR PAM4 Calibrations

This section provides the test procedures for the OIF CEI-56G Rx Calibrations, which are applicable for both VSR Host and VSR Module standards.

Before performing the OIF CEI-56G VSR tests, you must calibrate all the related parameters. Perform calibrations in the order displayed in the OIF CEI-56G Rx Test Application.

As mentioned earlier, ensure that the FlexDCA Oscilloscope has been calibrated and the mated Compliance Board is properly connected to the testing instruments to perform OIF CEI-56G Calibrations.

Calibration Parameters in Debug Mode

The Debug Mode in the Configure tab of the Test Application consists of some parameters in addition to those that can be configured in the Compliance Mode. Besides, for some of the configuration options, you may enter custom values, which provides a greater flexibility in performing calibrations and tests.

For each VSR Host Input and VSR Module Input standard options, the following parameters are available for configuration. Note that other than the “Test Method” parameter, rest of the parameters appear for both standard options.

Parameters common for all calibrations

- Baud Rate
- Victim Generator PAM4 Symbol Mapping
- Victim Generator PAM4 Custom Symbol Mapping
- Loop Bandwidth
- SIRC Response
- SIRC Bandwidth
- Eye Height/Width Probability

Common Parameter for all VSR Host Input calibrations only

- Test Method—If ‘Far-end’ is selected, configure the “Far-end Channel” parameter for “Stressed Eye Calibration”.

Parameters for Crosstalk Calibration

- Crosstalk Amplitude
- Crosstalk Slew Time

Parameters for BUJ Calibration

- BUJ

Parameters for Stressed Eye Calibration

- Transmitter Equalization—set to Auto for optimized values of both De-Emphasis and CTLE; set to Manual for custom optimization of De-Emphasis by configuring the following Pre-Cursor and Post-Cursor values.
- Pre-Cursor2
- Pre-Cursor
- Post-Cursor1
- Post-Cursor2
- Crosstalk Amplitude—value duplicated from / to Crosstalk Calibration.
- Crosstalk Slew Time—value duplicated from / to Crosstalk Calibration.
- SJ
- UUGJ
- BUJ—value duplicated from / to BUJ Calibration.
- Eye Width
- Eye Height
- Eye Linearity
- Far-end Channel—available for VSR Host Input standard option only, appears only when “Test Method” parameter is selected as ‘Far-end’.
- Start value for CTLE
- Stop value for CTLE

Crosstalk Calibration

Overview The Crosstalk Calibration is performed to calibrate the cross-talk amplitude and transition time.

Connection Diagram Connect the instruments as shown in Figure 26 and Figure 27.

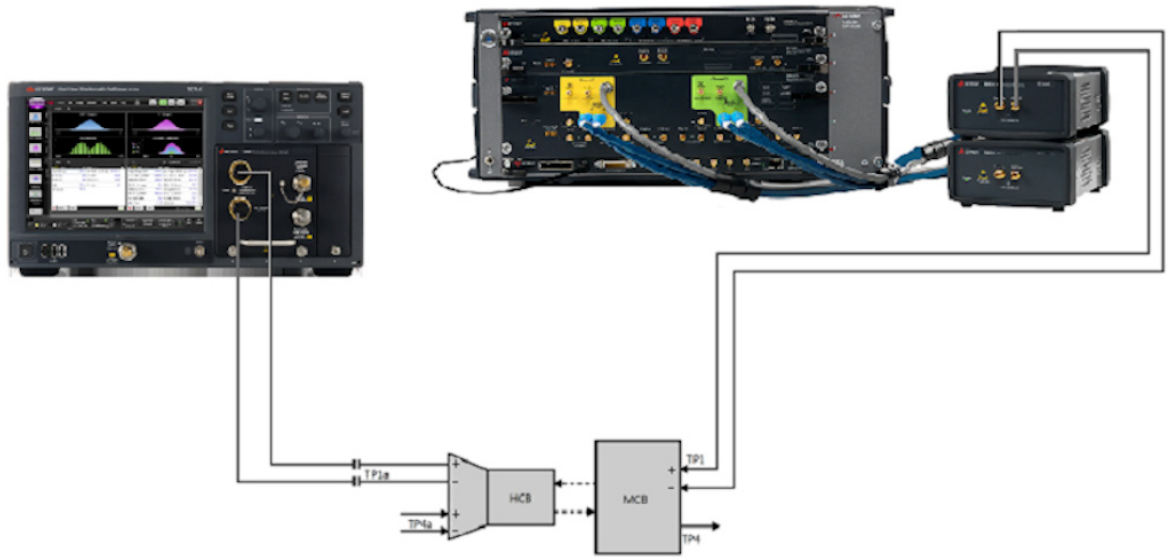


Figure 26 Crosstalk Calibration connections for VSR Host

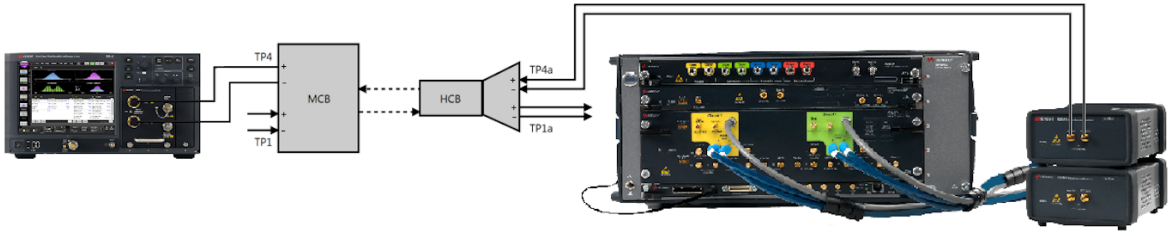


Figure 27 Crosstalk Calibration connections for VSR Module

ID

Standard Name	Test ID
VSR Host	71100
VSR Module	271100

Dependencies This calibration depends on the values configured for the following settings:

- InfiniiSim-DCA 2-Port DeEmbed S-parameters for Scope Ch 1A / 2A
- InfiniiSim-DCA 4-Port DeEmbed S-parameters for Scope Ch 1A / 2A

Parameters Refer to "Calibration Parameters in Debug Mode" on page 52.

Procedure This calibration uses the QPRBS13-CEI pattern.

Results This calibration returns the following results, in tabular format:

- Standard Parameter
  - Crosstalk Amplitude
  - Crosstalk Slew Time
- Instrument Parameter
  - Amplitude
  - De-Emphasis parameters
    - Pre-Cursor1
    - Pre-Cursor2
    - Post-Cursor1
    - Post-Cursor2

Troubleshooting steps Perform the following steps if this calibration fails:

- Ensure that the cable to the oscilloscope is de-embedded.

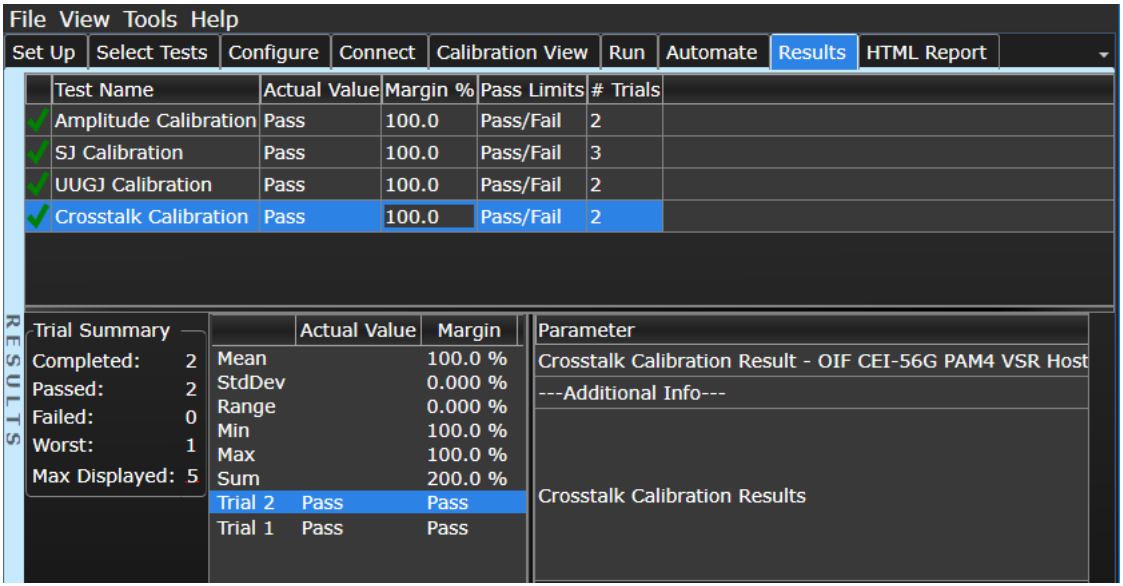


Figure 28 Crosstalk Calibration resulting information in the Results tab

Parameter	Value						
Crosstalk Calibration Result - OIF CEI-56G PAM4 VSR Host TP1a	Pass						
---Additional Info---							
Crosstalk Calibration Results	Standard Parameter	Status	Target	Measured	Instrument Parameter	Nominal	Actual
	Crosstalk Amplitude	Pass	900 mV	900 mV	Amplitude	900 mV	1.404 V
	Crosstalk Slew Time	Pass	19.0 ps	19.0 ps	Pre-Cursor2	0	0.01
	Crosstalk Slew Time	Pass	19.0 ps	19.0 ps	Pre-Cursor1	0	-0.07
	Crosstalk Slew Time	Pass	19.0 ps	19.0 ps	Post-Cursor1	0	-0.09
	Crosstalk Slew Time	Pass	19.0 ps	19.0 ps	Post-Cursor2	0	0

Figure 29 Crosstalk Calibration results for VSR Host Input

Parameter	Value						
Crosstalk Calibration Result - OIF CEI-56G PAM4 VSR Module TP4	Pass						
---Additional Info---							
Crosstalk Calibration Results	Standard Parameter	Status	Target	Measured	Instrument Parameter	Nominal	Actual
	Crosstalk Amplitude	Pass	900 mV	898 mV	Amplitude	900 mV	1.493 V
	Crosstalk Slew Time	Pass	19.0 ps	19.0 ps	Pre-Cursor2	0	0.02
	Crosstalk Slew Time	Pass	19.0 ps	19.0 ps	Pre-Cursor1	0	-0.11
	Crosstalk Slew Time	Pass	19.0 ps	19.0 ps	Post-Cursor1	0	-0.07
	Crosstalk Slew Time	Pass	19.0 ps	19.0 ps	Post-Cursor2	0	-0.02

Figure 30 Crosstalk Calibration results for VSR Module Input

Amplitude Calibration

Overview The Amplitude Calibration is performed to calibrate the Victim Generator's Amplitude for the Voltage Tolerance test.

Connection Diagram Connect the instruments as shown in Figure 31.

Figure 31 Amplitude Calibration connections for VSR Host & VSR Module

ID

Standard Name	Test ID
VSR Host	71101
VSR Module	271101

Parameters Refer to "Calibration Parameters in Debug Mode" on page 52.

Procedure This calibration uses the QPRBS13-CEI pattern.

The Victim Generator Amplitude is set and measured for multiple Amplitudes.

Results This calibration contains the results for the Set Amplitude versus Measured Amplitude, in graphical and tabular format.

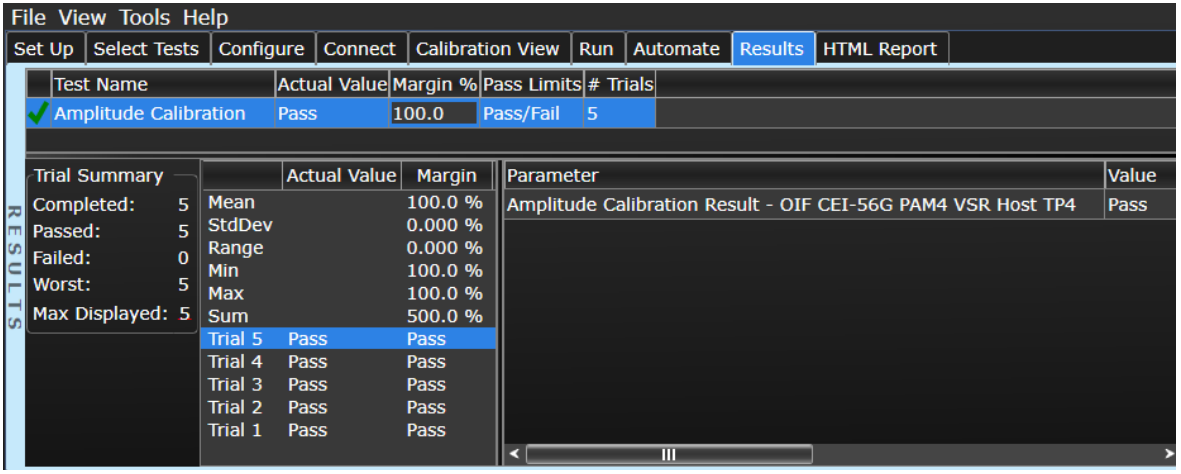


Figure 32 Amplitude Calibration resulting information in the Results tab

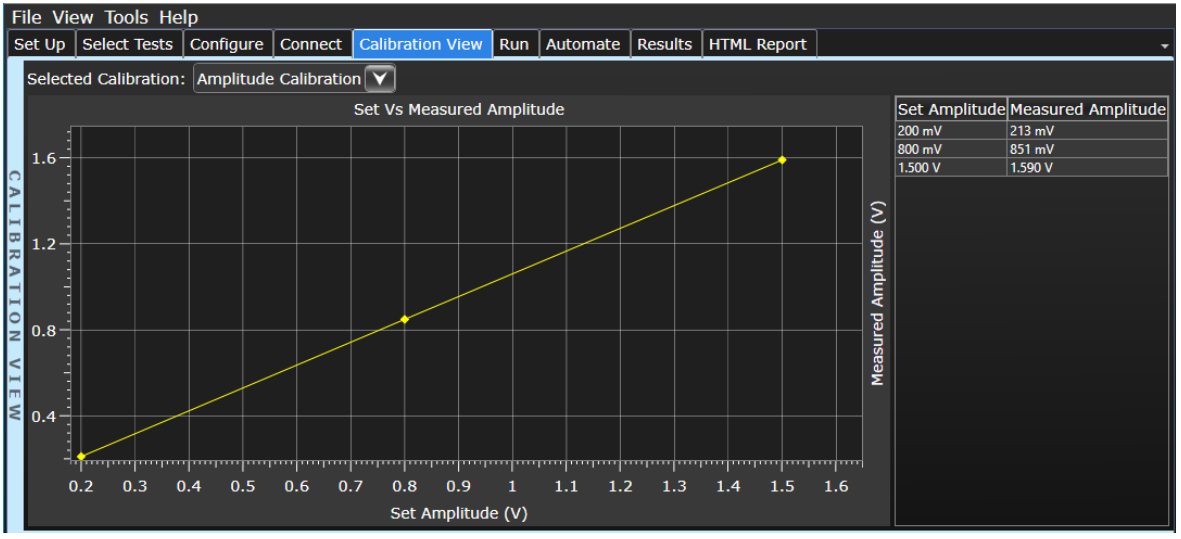


Figure 33 Amplitude Calibration calibrated data in Calibration View tab

SJ Calibration

Overview The SJ Calibration is performed to calibrate the Sinusoidal Jitter.

Connection Diagram Connect the instruments as shown in Figure 40 for both VSR standards.

Figure 34 SJ Calibration connections for VSR Host & VSR Module

ID

Standard Name	Test ID
VSR Host	71104
VSR Module	271104

Parameters Refer to “Calibration Parameters in Debug Mode” on page 52.

Procedure This calibration uses the Clock/8 pattern.

The Victim Generator PJ1 is set until the desired SJ value is measured.

Results This calibration returns the results for the set PJ1 versus measured SJ, in graphical and tabular format.

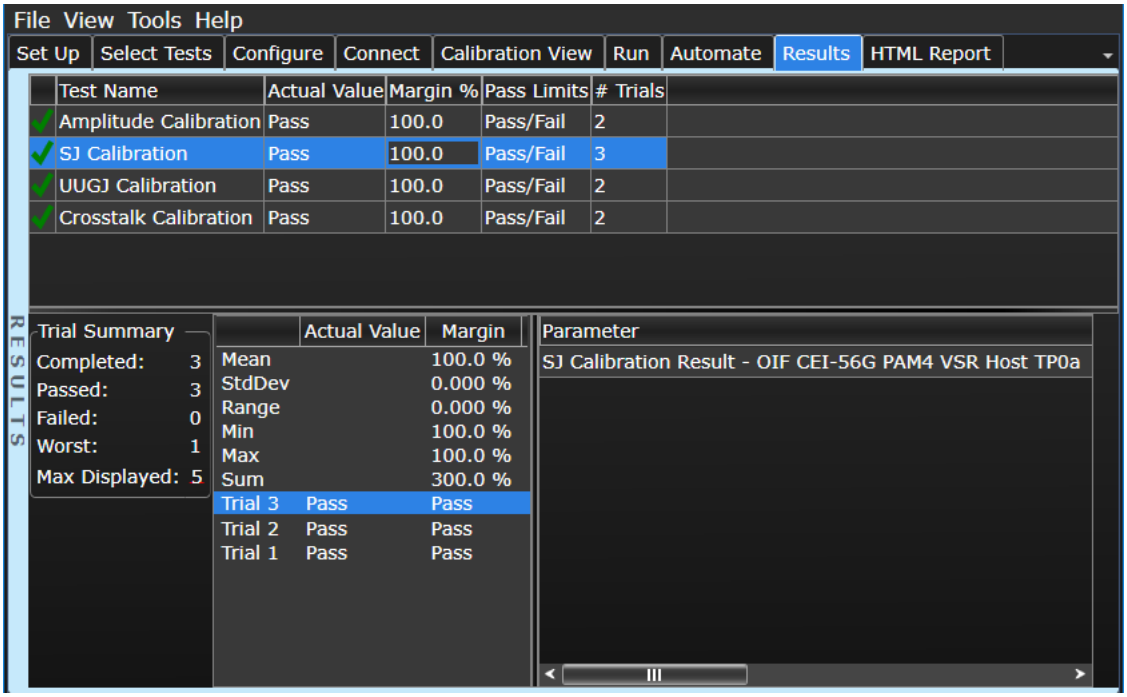


Figure 35 SJ Calibration resulting information in the Results tab

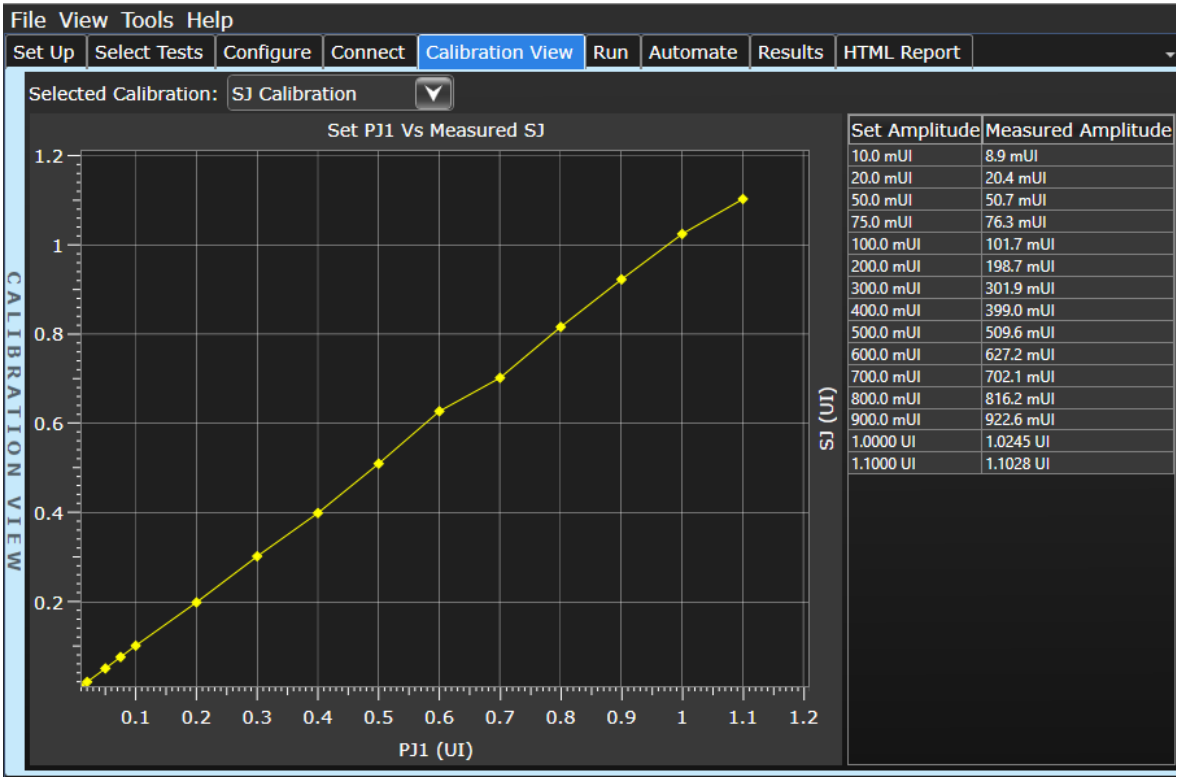


Figure 36 SJ Calibration calibrated data in Calibration View tab

UUGJ Calibration

Overview The UUGJ Calibration is performed to calibrate the Uncorrelated Unbounded Gaussian Jitter (UUGJ) at TP0a.

Connection Diagram Connect the instruments as shown in Figure 37 for both VSR standards.

Figure 37 UUGJ Calibration connections for VSR Host & VSR Module

ID

Standard Name	Test ID
VSR Host	71102
VSR Module	271102

Parameters Refer to “Calibration Parameters in Debug Mode” on page 52.

Procedure This calibration uses the 1010... toggle (Clock) pattern.

The Victim Generator Random Jitter (RJ) is set until the desired UUGJ value is measured.

Results This calibration displays the results for the set RJ versus the measured UUGJ, in graphical and tabular format.

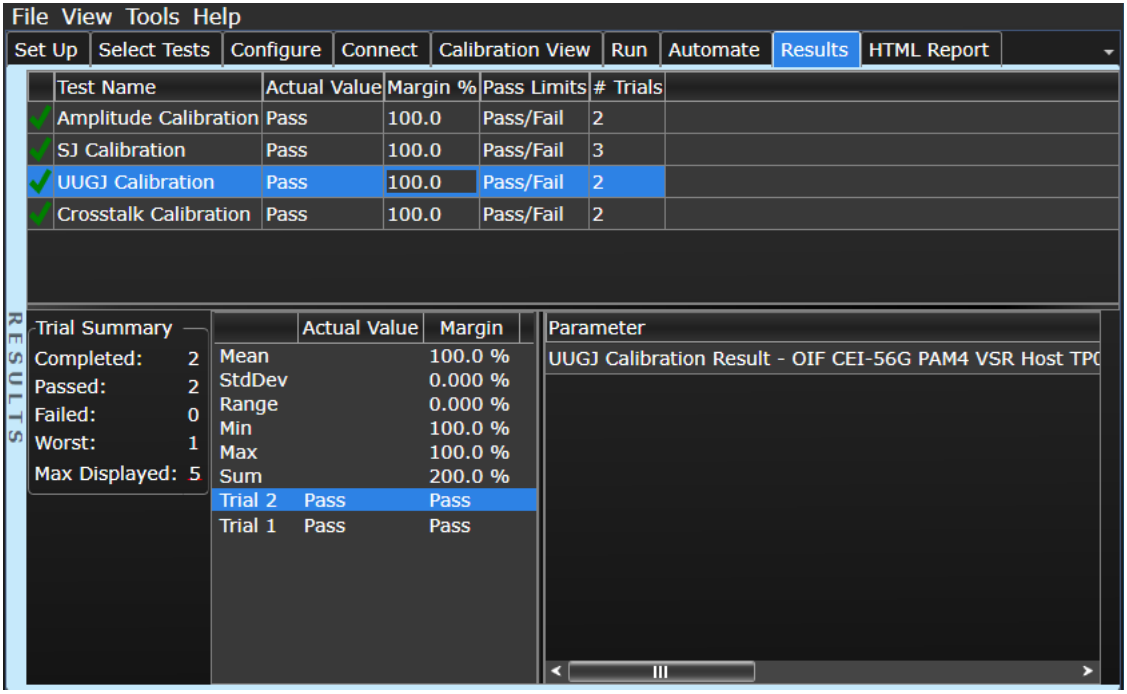


Figure 38 UUGJ Calibration resulting information in the Results tab

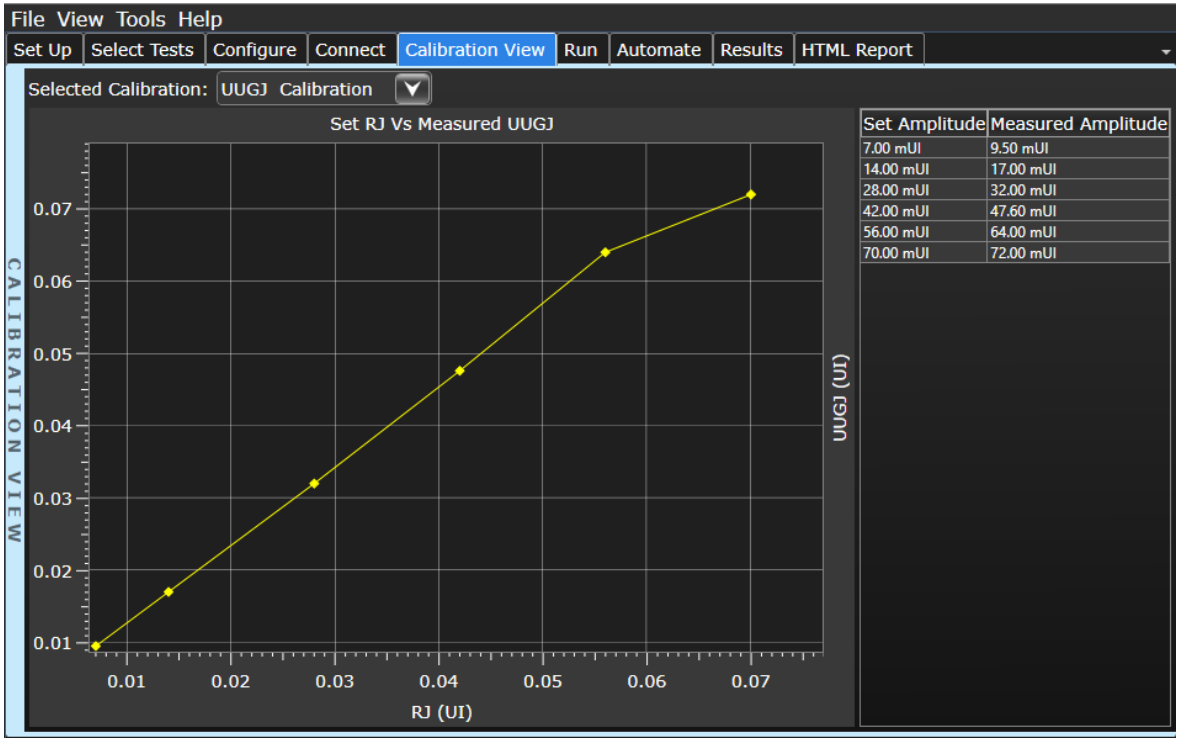


Figure 39 UUGJ Calibration calibrated data in Calibration View tab

BUJ Calibration

Overview The BUJ Calibration is performed to calibrate the Bounded Uncorrelated Jitter.

Connection Diagram Connect the instruments as shown in Figure 40 for both VSR standards.

Figure 40 BUJ Calibration connections for VSR Host & VSR Module

ID

Standard Name	Test ID
VSR Host	71104
VSR Module	271104

Parameters Refer to “Calibration Parameters in Debug Mode” on page 52.

Procedure This calibration uses the 1010... toggle (Clock) pattern.

The Victim Generator BUJ is set until the desired BUJ value is measured.

Results This calibration returns the results for the set BUJ versus measured BUJ, in tabular format.

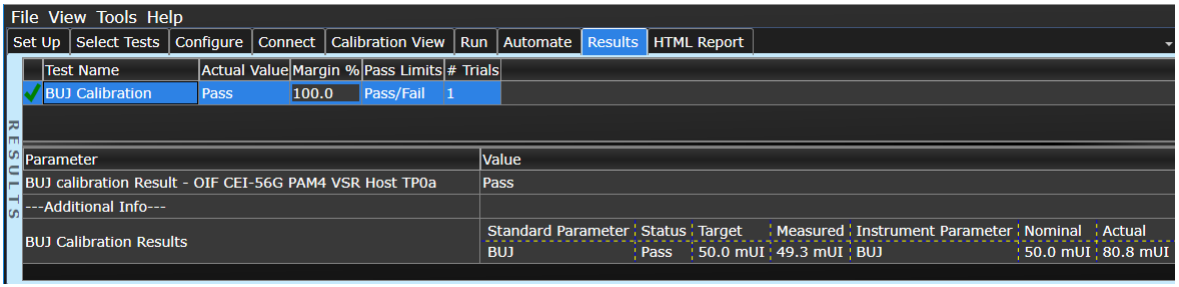


Figure 41 BUJ Calibration resulting information in the Results tab

Stressed Eye Calibration

Overview The Stressed Eye Calibration is performed to calibrate the stressed eye signal for the Host or Module Stressed Input Test.

Connection Diagram Connect the instruments as shown in Figure 42 and Figure 43.

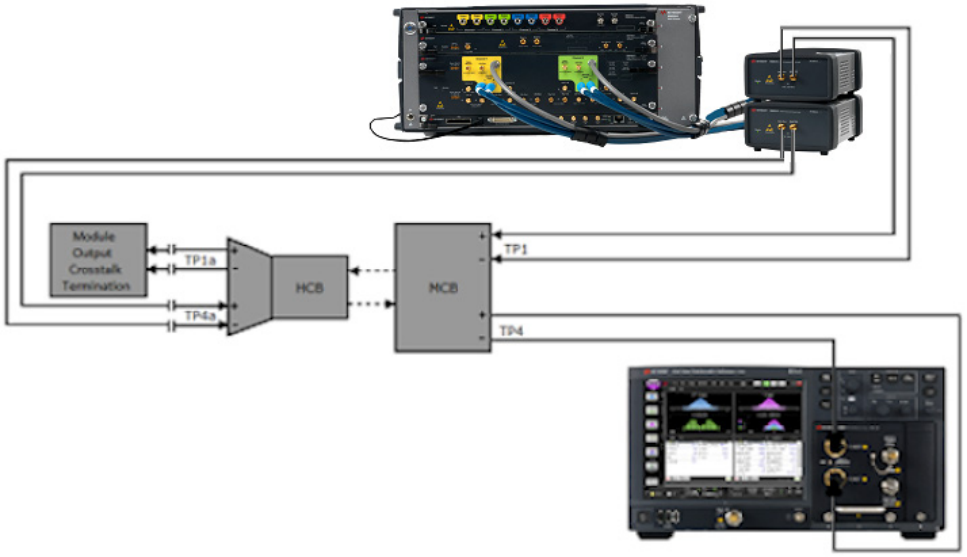


Figure 42 Stressed Eye Calibration connections for VSR Host

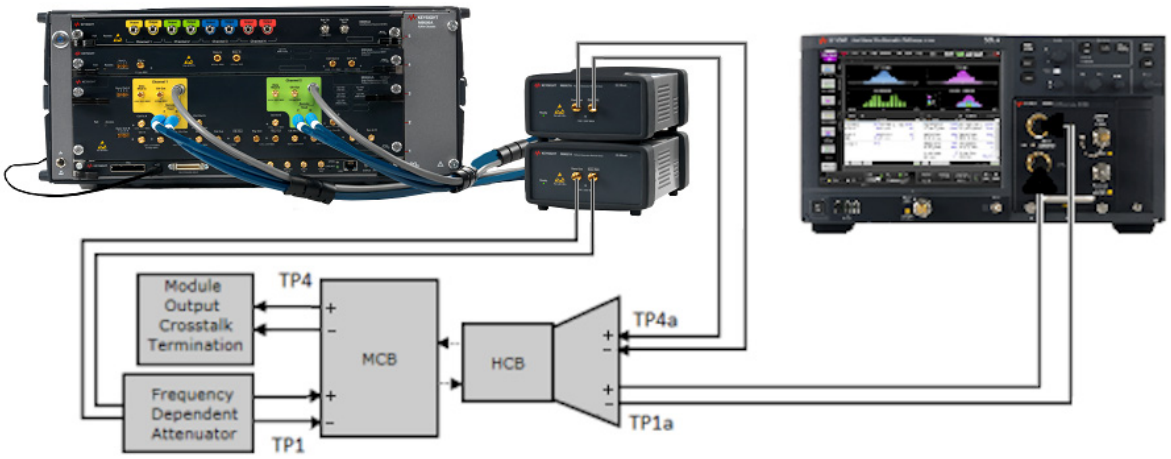


Figure 43 Stressed Eye Calibration connections for VSR Module

ID

Standard Name	Test ID
VSR Host	71105
VSR Module	271105

Dependencies

This calibration depends on the values configured for the following settings:

- InfiniiSim-DCA 2-Port DeEmbed S-parameters for Scope Ch 1A / 2A
- InfiniiSim-DCA 4-Port DeEmbed S-parameters for Scope Ch 1A / 2A
- All calibrations performed previously:
  - Crosstalk Calibration
  - UUGJ Calibration
  - SJ Calibration
  - BUJ Calibration

Parameters Refer to "Calibration Parameters in Debug Mode" on page 52.

NOTE

The UBHPJ comprises of the BUJ and SJ components. However, since the SJ component compensates for the UBHPJ component, the BUJ component is not required for calibrations. However, if you require the BUJ component to be included for Calibration, you can set the BUJ parameter and reduce the corresponding SJ component, so that the overall UBHPJ component remains the same.

Procedure This calibration uses the QPRBS13-CEI pattern.

Results This calibration returns the following results, in tabular format:

- Standard Parameter
  - EW6
  - EH6
  - Eye Linearity
- Instrument Parameter
  - RJ
  - De-Emphasis parameters
    - Pre-Cursor1
    - Pre-Cursor2
    - Post-Cursor1
    - Post-Cursor2
  - Amplitude
  - Lower PAM4 Eye Level
  - Upper PAM4 Eye Level

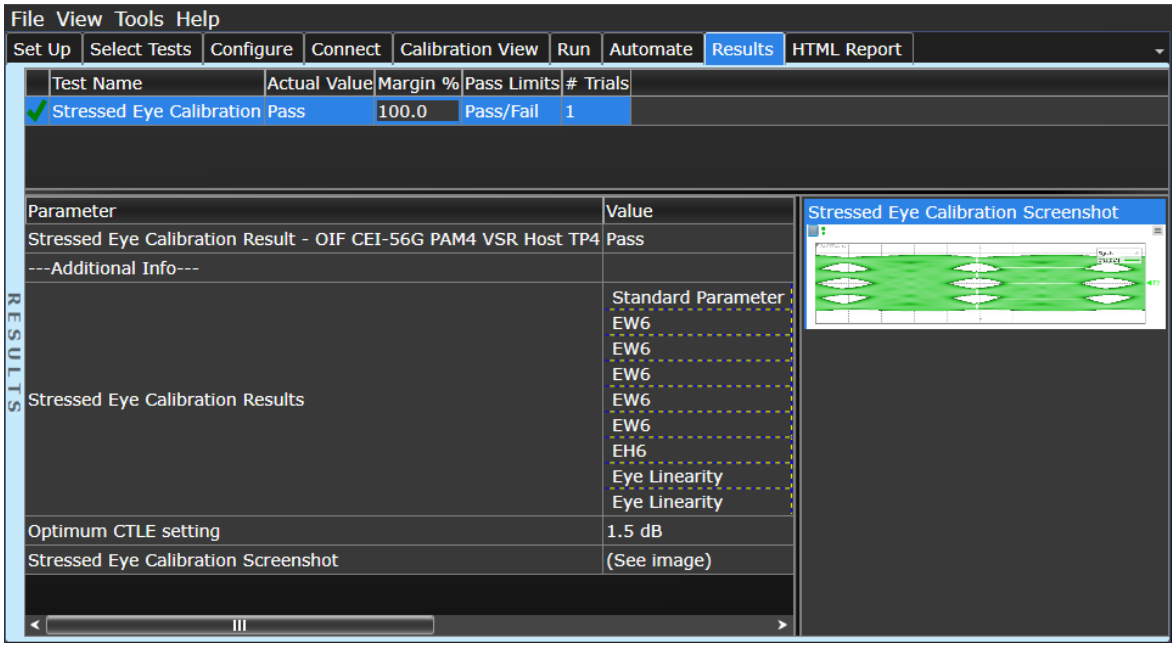


Figure 44 Stressed Eye Calibration resulting information in the Results tab

Value						
Pass						
Standard Parameter	Status	Target	Measured	Instrument Parameter	Nominal	Actual
EW6	Pass	265 mUI	267 mUI	RJ	10.00 mUI	7.59 mUI
EW6	Pass	265 mUI	267 mUI	Pre-Cursor2	0	0.01
EW6	Pass	265 mUI	267 mUI	Pre-Cursor1	0	-0.09
EW6	Pass	265 mUI	267 mUI	Post-Cursor1	0	-0.1
EW6	Pass	265 mUI	267 mUI	Post-Cursor2	0	-0.01
EH6	Pass	70 mV	70 mV	Amplitude	800 mV	804 mV
Eye Linearity	Pass	0.85	0.84	Lower PAM4 Eye Level	33%	31%
Eye Linearity	Pass	0.85	0.84	Upper PAM4 Eye Level	67%	69%
1.5 dB						
(See image)						

Figure 45 Stressed Eye Calibration results table for VSR Host Input

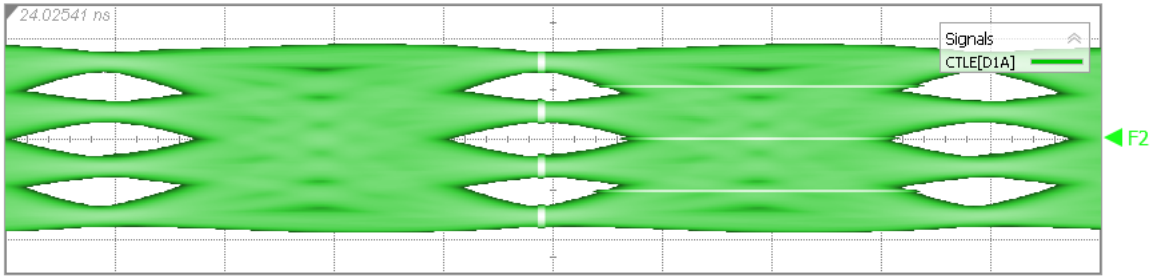


Figure 46 Stressed Eye Calibration image for VSR Host Input

Parameter	Value						
Stressed Eye Calibration Result - OIF CEI-56G PAM4 VSR Module TP1a	Pass						
---Additional Info---							
Stressed Eye Calibration Results	Standard Parameter	Status	Target	Measured	Instrument Parameter	Nominal	Actual
	EW6	Pass	200 mUI	198 mUI	RJ	10.00 mUI	8.04 mUI
	EW6	Pass	200 mUI	198 mUI	Pre-Cursor2	0	0.03
	EW6	Pass	200 mUI	198 mUI	Pre-Cursor1	0	-0.15
	EW6	Pass	200 mUI	198 mUI	Post-Cursor1	0	-0.05
	EW6	Pass	200 mUI	198 mUI	Post-Cursor2	0	0
	EH6	Pass	32 mV	31 mV	Amplitude	800 mV	820 mV
	Eye Linearity	Pass	0.85	0.84	Lower PAM4 Eye Level	33%	31%
	Eye Linearity	Pass	0.85	0.84	Upper PAM4 Eye Level	67%	69%
Optimum CTLE setting	7.0 dB						
Stressed Eye Calibration Screenshot	(See image)						

Figure 47 Stressed Eye Calibration results table for VSR Module Input

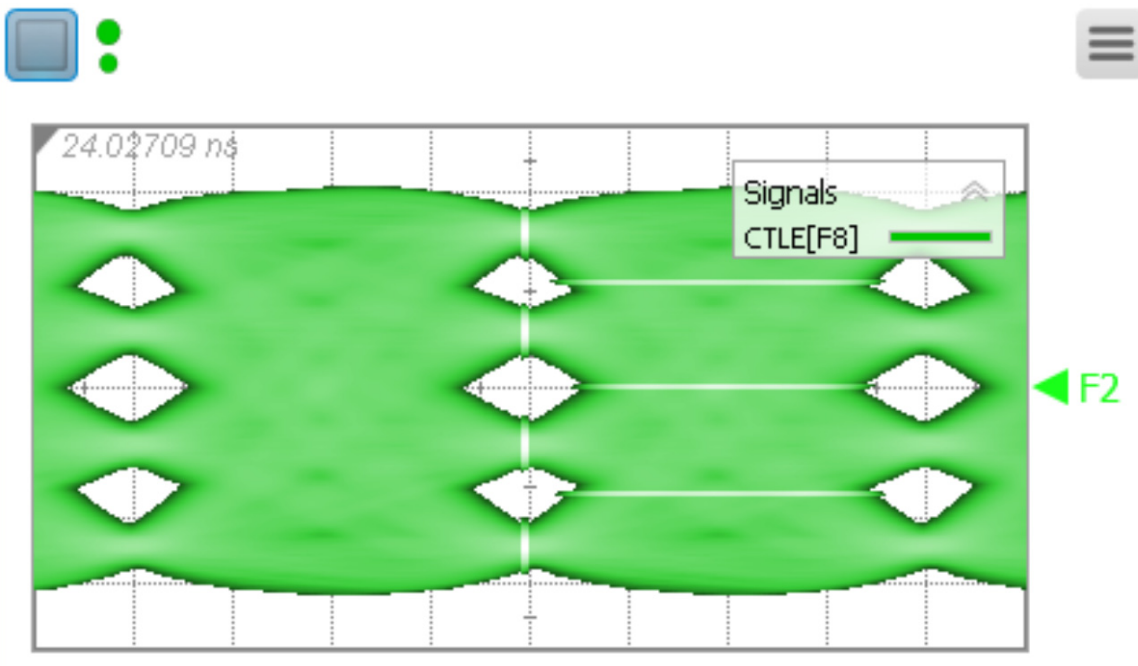


Figure 48 Stressed Eye Calibration image for VSR Module Input

5 OIF CEI-56G VSR PAM4 Tests

This section provides the test procedures for the OIF CEI-56G Rx Tests, which are applicable for both VSR Host and VSR Module standards.

As a prerequisite, run all OIF CEI-56G VSR Host and Module calibrations before running tests. Ensure that the DUT is properly connected to the BERT modules and the FlexDCA Oscilloscope.

Test Parameters in Debug Mode

The Debug Mode in the Configure tab of the Test Application consists of some parameters in addition to those that can be configured in the Compliance Mode. Besides, for some of the configuration options, you may enter custom values, which provides a greater flexibility in performing calibrations and tests.

For each VSR Host Input and VSR Module Input standard options, the following parameters are available for configuration. Note that other than the “Test Method” parameter, rest of the parameters appear for both standard options.

Parameters common for all tests

- Baud Rate
- Victim Generator PAM4 Symbol Mapping
- Victim Generator PAM4 Custom Symbol Mapping
- Victim Analyzer Module—If ‘BERT Analyzer’ is selected, manually configure the “Victim Analyzer Clock Source” parameter. If ‘DCI’ is selected, manually configure the “DUT Control Interface script file” and “DUT Control Interface Location” parameters.
- Victim Analyzer Clock Source
- Victim Analyzer PAM4 Symbol Mapping
- Victim Analyzer PAM4 Custom Symbol Mapping
- Target Error Ratio
- Target Confidence Level
- DUT Control Interface script file
- DUT Control Interface Location

Common Parameter for VSR Host Input tests only

- Test Method

Parameters for Stressed Input Test

- Test Mode
- Jitter Profile Frequency1
- Jitter Profile Amplitude1
- Jitter Profile Frequency2

- Jitter Profile Amplitude2
- Jitter Profile Frequency3
- Jitter Profile Amplitude3
- Frequency Mode
- Start Frequency
- Stop Frequency
- Number of Steps
- Manual Frequency List

Parameters for Voltage Tolerance Test

- Minimum Voltage
- Maximum Voltage

Single-lane Stressed Input Test

Overview The Single-lane Stressed Input Test validates the ability of the host input to tolerate the sinusoidal jitter with the specified limit. The test signal is applied at TP4a using a Host Compliance Board (HCB).

Connection Diagram For Single-lane tests, connect the instruments as shown in Figure 49 and Figure 50.

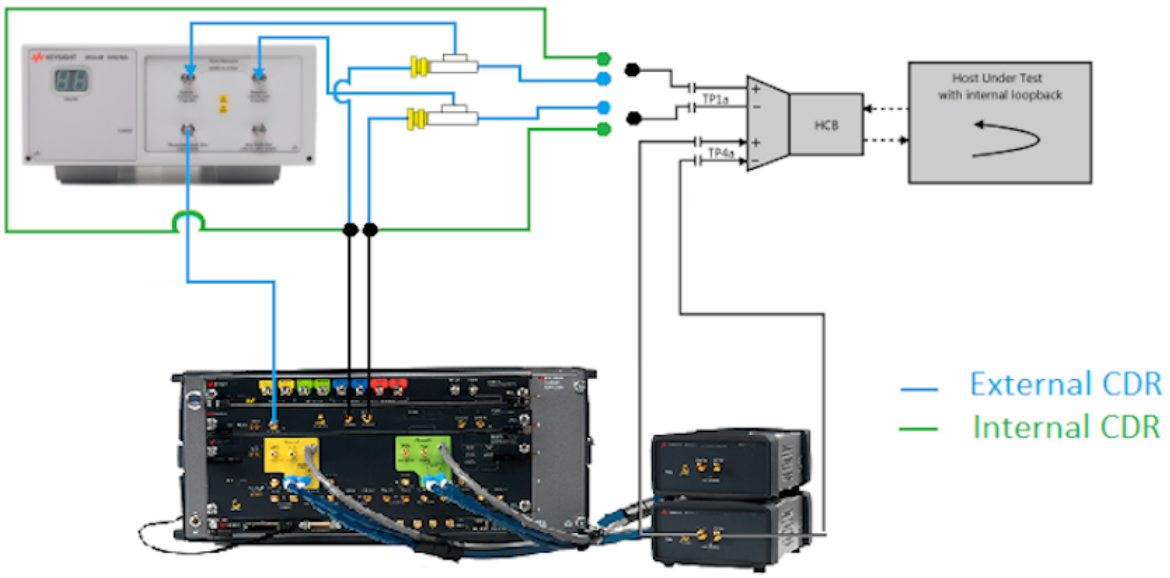


Figure 49 Single Lane Stressed Input Test connections for VSR Host

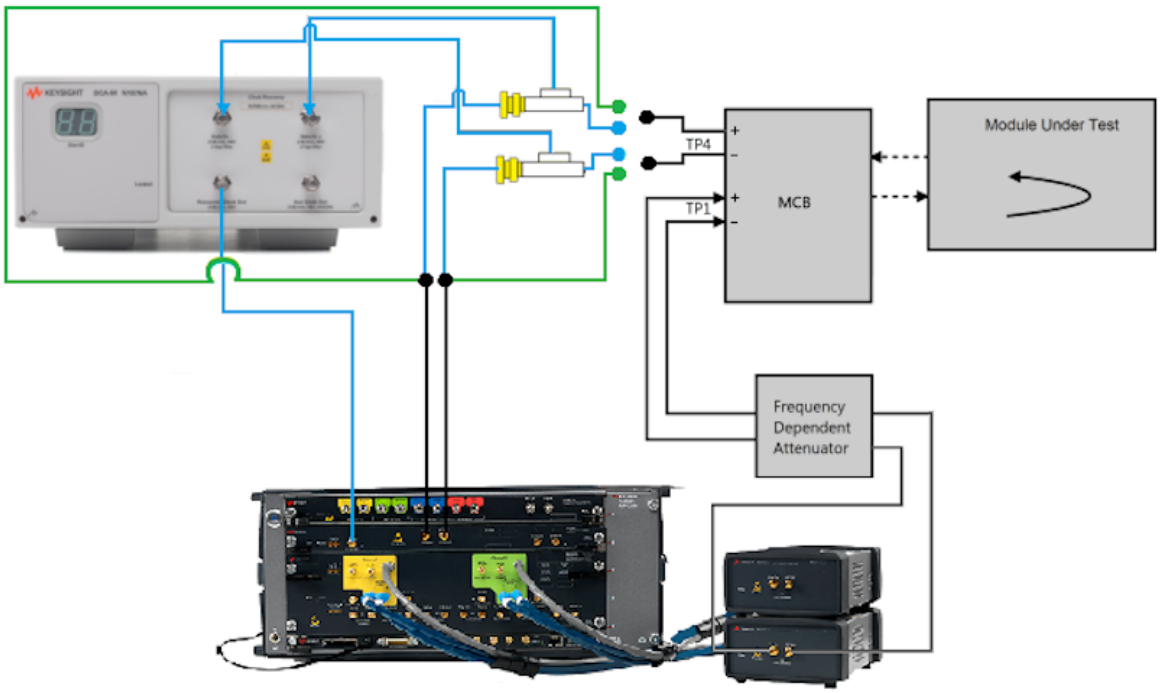


Figure 50 Single Lane Stressed Input Test connections for VSR Module

ID

Standard Name	Test ID
VSR Host Single-Lane	75100
VSR Module Single-Lane	275100

Dependencies

This test depends on the values configured for the following settings:

- All calibrations performed previously:
  - Crosstalk Calibration
  - UUGJ Calibration
  - SJ Calibration

NOTE As mentioned earlier, UBHPJ Calibration is not required, since the SJ Calibration sufficiently compensates for the UBHPJ Calibration.

Parameters Refer to "Test Parameters in Debug Mode" on page 74.

Procedure This test uses the QPRBS31-CEI pattern.

Results This test returns the following results:

- Pass/Fail for each SJ Amplitude & Frequency pair point

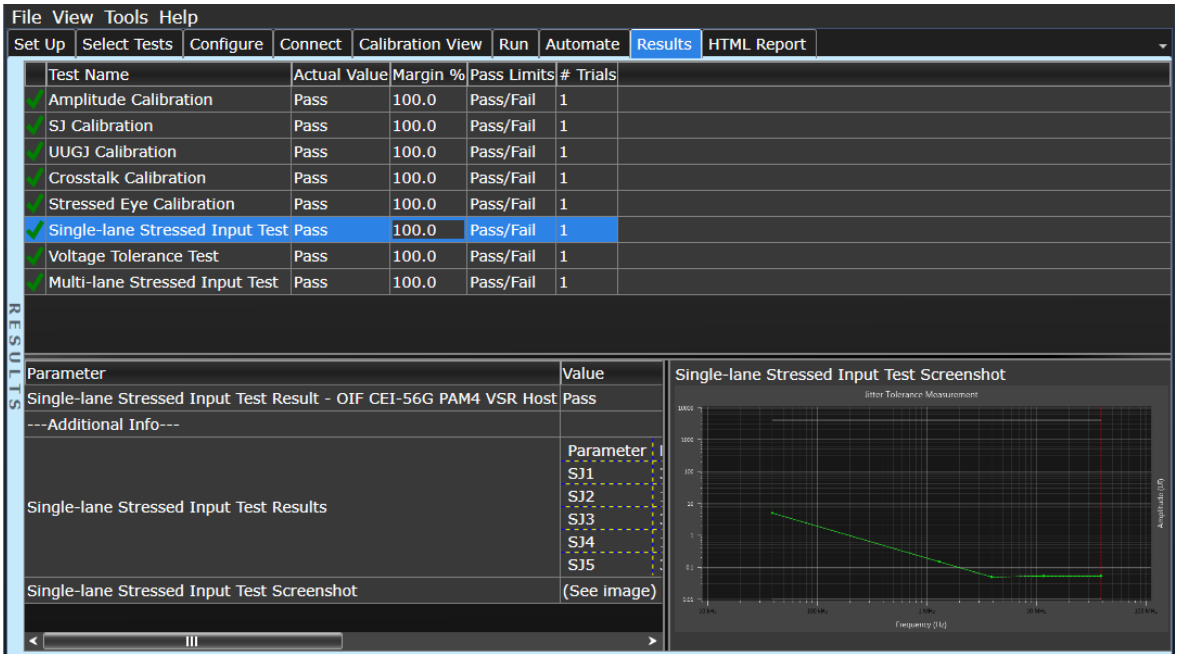


Figure 51 VSR Host Single-lane Stressed Input Test Result

Parameter	Value			
Single-lane Stressed Input Test Result - OIF CEI-56G PAM4 VSR Host	Pass			
---Additional Info---				
Single-lane Stressed Input Test Results	Parameter	Frequency	Amplitude	Status
	SJ1	38.827 kHz	5.0000 UI	Pass
	SJ2	1.294239 MHz	150.0 mUI	Pass
	SJ3	3.882718 MHz	50.0 mUI	Pass
	SJ4	11.648155 MHz	50.0 mUI	Pass
	SJ5	38.827184 MHz	50.0 mUI	Pass
Single-lane Stressed Input Test Screenshot	(See image)			

Figure 52 VSR Host Single-lane Stressed Input Test Result (tabular)

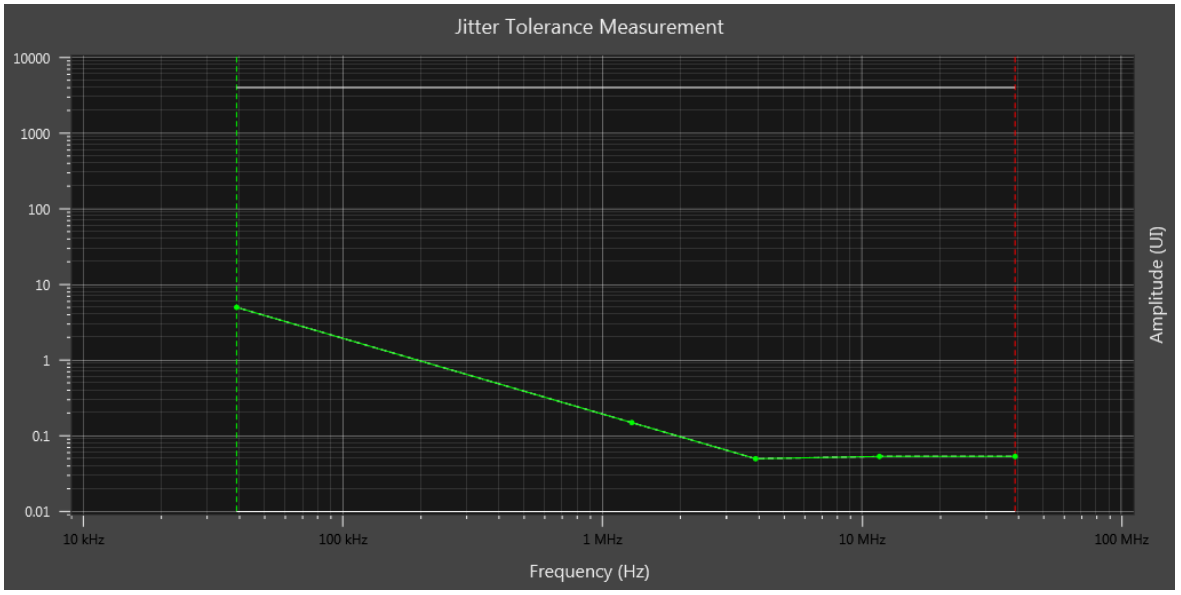


Figure 53 VSR Host Single-lane Stressed Input Test Result (graphical)

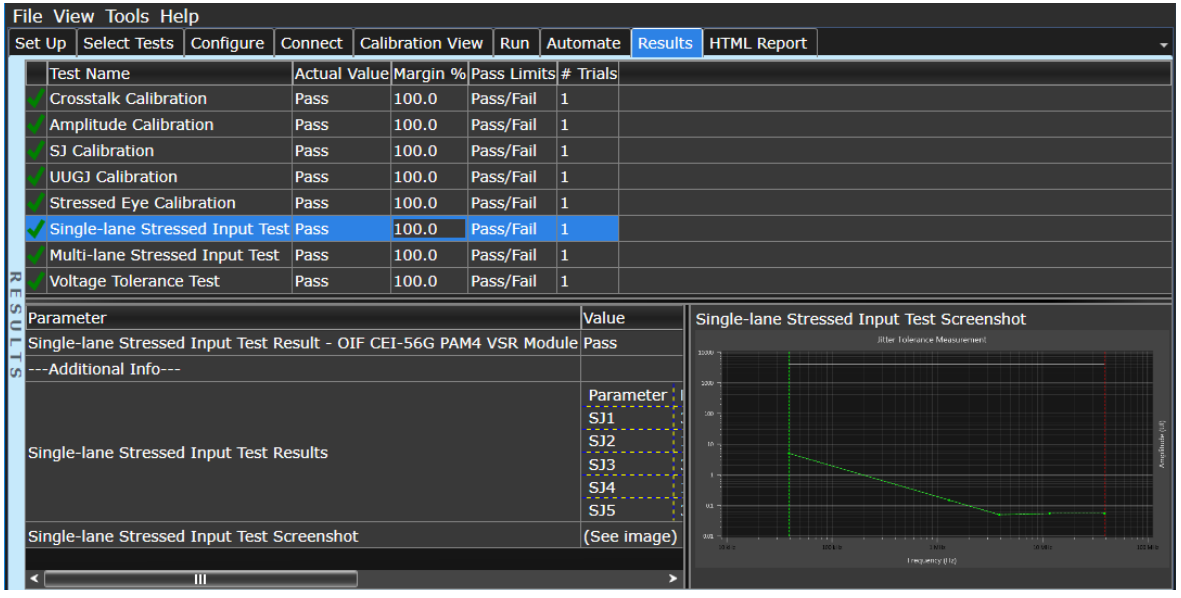


Figure 54 VSR Module Single-lane Stressed Input Test Result

Parameter	Value			
Single-lane Stressed Input Test Result - OIF CEI-56G PAM4 VSR Module	Pass			
---Additional Info---				
Single-lane Stressed Input Test Results	Parameter	Frequency	Amplitude	Status
	SJ1	38.827 kHz	5.0000 UI	Pass
	SJ2	1.294239 MHz	150.0 mUI	Pass
	SJ3	3.882718 MHz	50.0 mUI	Pass
	SJ4	11.648155 MHz	50.0 mUI	Pass
	SJ5	38.827184 MHz	50.0 mUI	Pass
Single-lane Stressed Input Test Screenshot	(See image)			

Figure 55 VSR Module Single-lane Stressed Input Test Result (tabular)

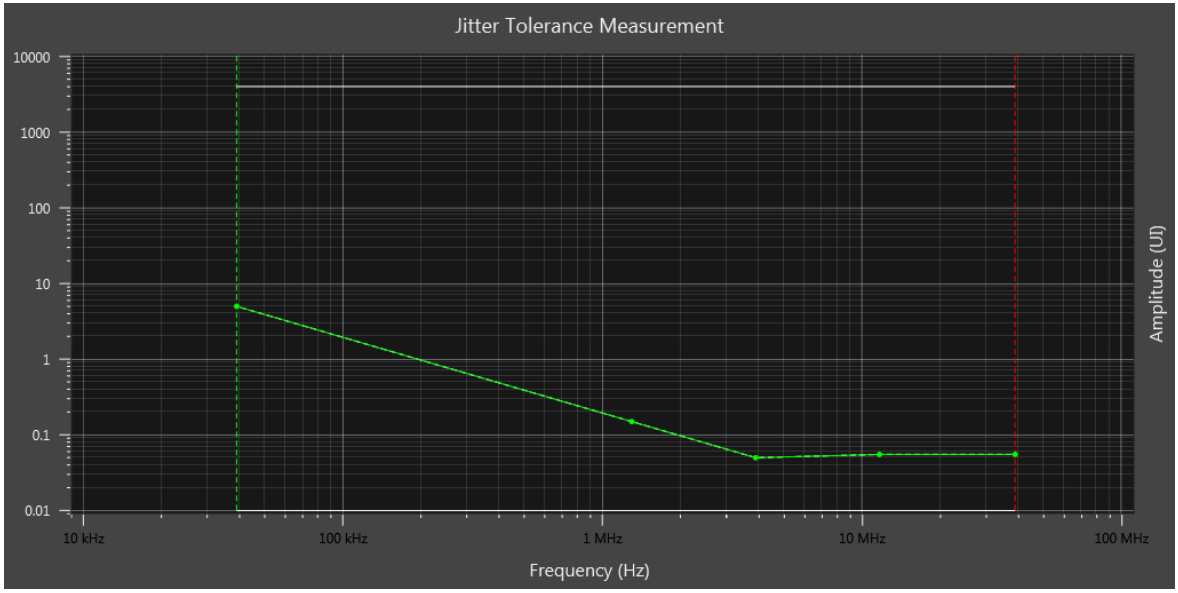


Figure 56 VSR Module Single-lane Stressed Input Test Result (graphical)

Multi-lane Stressed Input Test

Overview The Multi-lane Stressed Input Test validates the ability of the host input to tolerate the sinusoidal jitter with the specified limit. The test signal is applied at TP4a using a Host Compliance Board (HCB).

Connection Diagram For Multi-lane tests, connect the instruments as shown in Figure 57 and Figure 58.

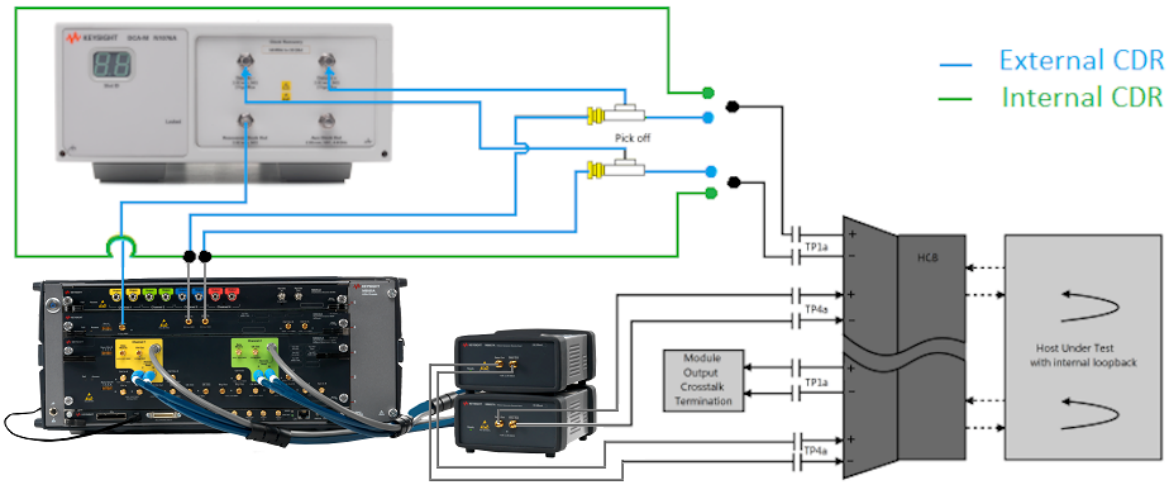


Figure 57 Multi Lane Stressed Input Test connections for VSR Host

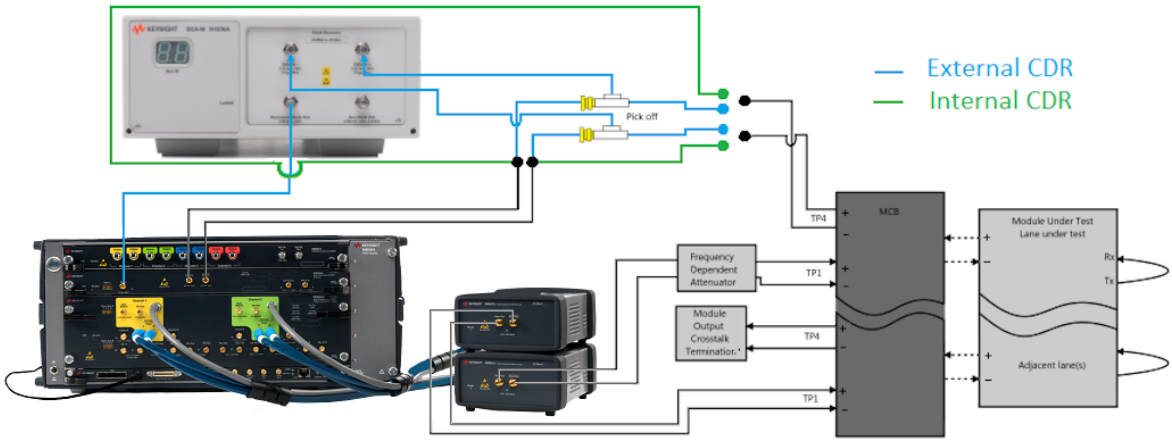


Figure 58 Multi Lane Stressed Input Test connections for VSR Module

ID

Standard Name	Test ID
VSR Host Multi-Lane	75101
VSR Module Multi-Lane	275101

Dependencies

This test depends on the values configured for the following settings:

- All calibrations performed previously:
  - Crosstalk Calibration
  - UUGJ Calibration
  - SJ Calibration

NOTE

As mentioned earlier, UBHPJ Calibration is not required, since the SJ Calibration sufficiently compensates for the UBHPJ Calibration.

Parameters

You may modify the following parameters for this test:

- Baud Rate
- Victim Analyzer Module
- Victim Analyzer Clock Source (select the source being used when Victim Analyzer Module is a BERT Analyzer)
- Target Error Ratio

- Target Confidence Level
- If Victim Analyzer Module is selected as DCI, configure:
  - DUT Control Interface script file—select DCI script file location
  - DUT Control Interface Location—select the Lane where the script file will be run
- Manual Frequency List

Procedure This test uses the QPRBS31-CEI pattern.

Results This test returns the following results:

- Pass/Fail for each SJ Amplitude & Frequency pair point

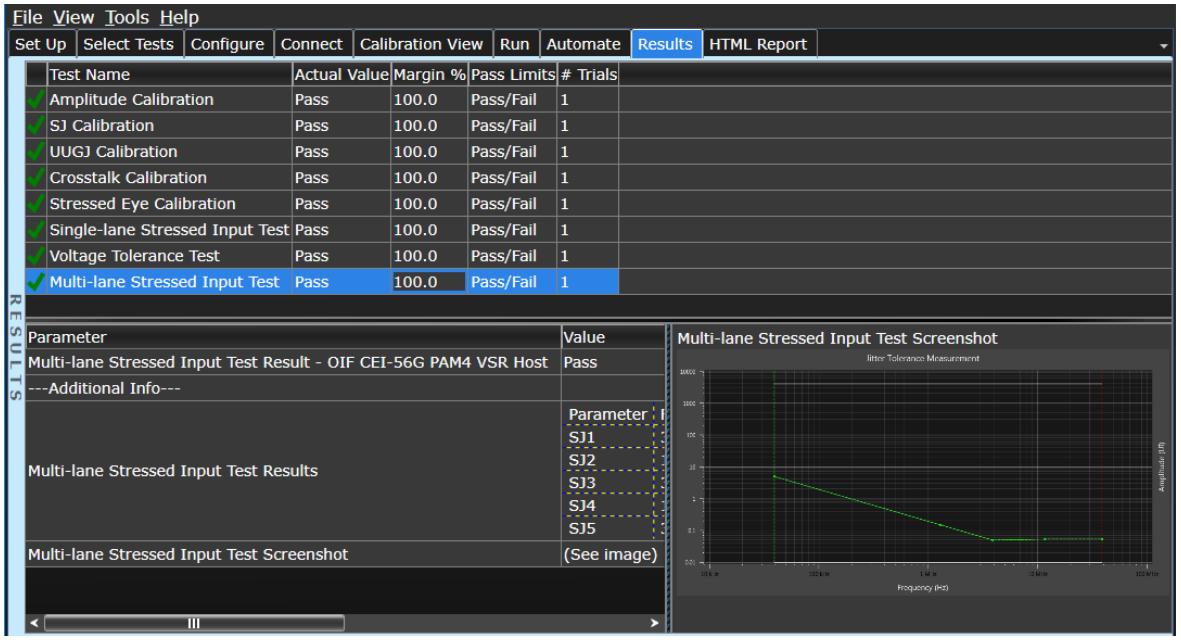


Figure 59 VSR Host Multi-lane Stressed Input Test Result

Parameter	Value			
Multi-lane Stressed Input Test Result - OIF CEI-56G PAM4 VSR Host	Pass			
---Additional Info---				
Multi-lane Stressed Input Test Results	Parameter	Frequency	Amplitude	Status
	SJ1	38.827 kHz	5.0000 UI	Pass
	SJ2	1.294239 MHz	150.0 mUI	Pass
	SJ3	3.882718 MHz	50.0 mUI	Pass
	SJ4	11.648155 MHz	50.0 mUI	Pass
	SJ5	38.827184 MHz	50.0 mUI	Pass
Multi-lane Stressed Input Test Screenshot	(See image)			

Figure 60 VSR Host Multi-lane Stressed Input Test Result (tabular)

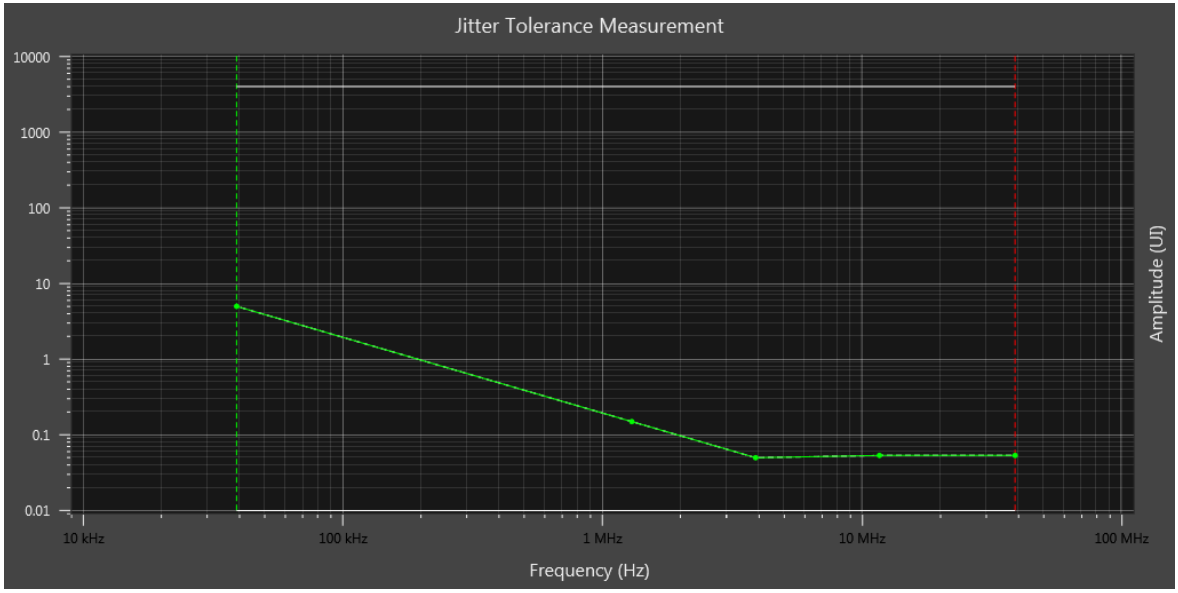


Figure 61 VSR Host Multi-lane Stressed Input Test Result (graphical)

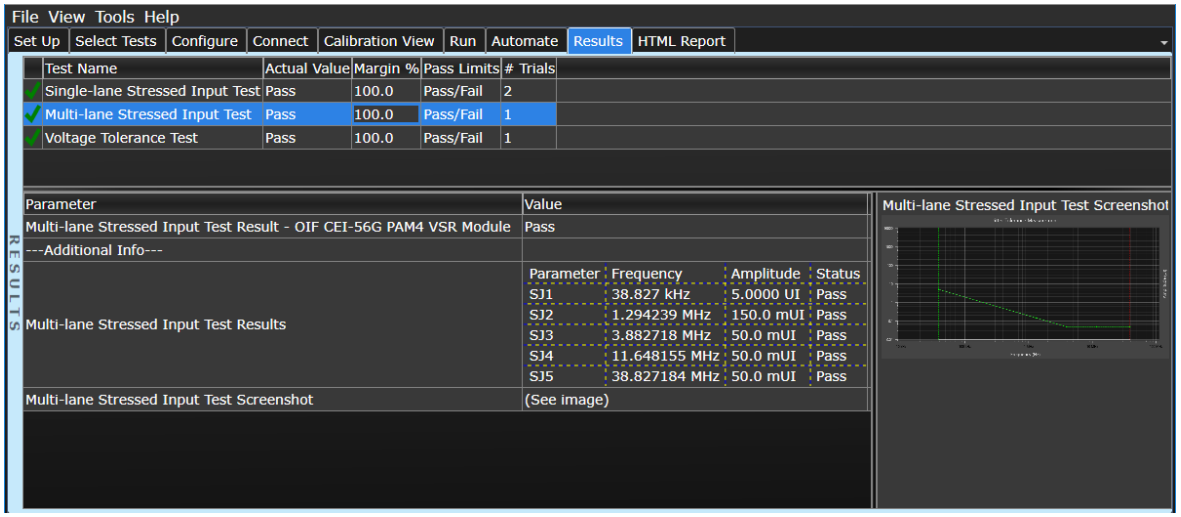


Figure 62 VSR Module Multi-lane Stressed Input Test Result

Parameter	Value			
Multi-lane Stressed Input Test Result - OIF CEI-56G PAM4 VSR Module	Pass			
---Additional Info---				
Multi-lane Stressed Input Test Results	Parameter	Frequency	Amplitude	Status
	SJ1	38.827 kHz	5.0000 UI	Pass
	SJ2	1.294239 MHz	150.0 mUI	Pass
	SJ3	3.882718 MHz	50.0 mUI	Pass
	SJ4	11.648155 MHz	50.0 mUI	Pass
	SJ5	38.827184 MHz	50.0 mUI	Pass
Multi-lane Stressed Input Test Screenshot	(See image)			

Figure 63 VSR Module Multi-lane Stressed Input Test Result (tabular)

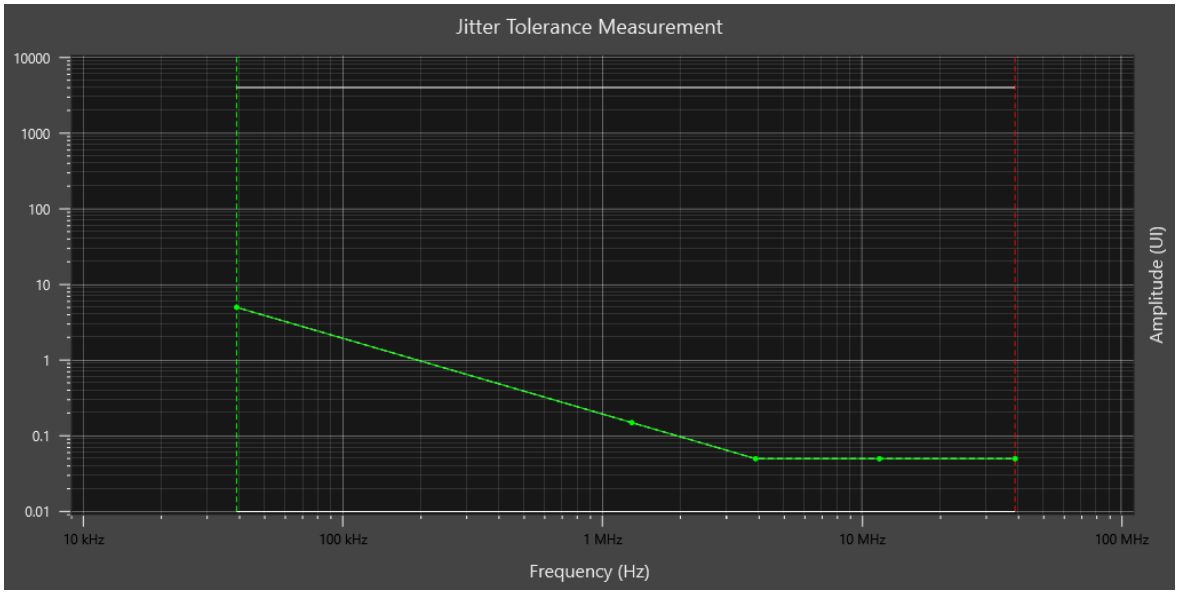


Figure 64 VSR Module Multi-lane Stressed Input Test Result (graphical)

Voltage Tolerance Test

Overview The input Voltage Tolerance Test validates the acceptance of the differential input peak to peak amplitudes produced by the extreme operating conditions from the transmitter.

Connection Diagram Connect the instruments as shown in Figure 65 and Figure 66.

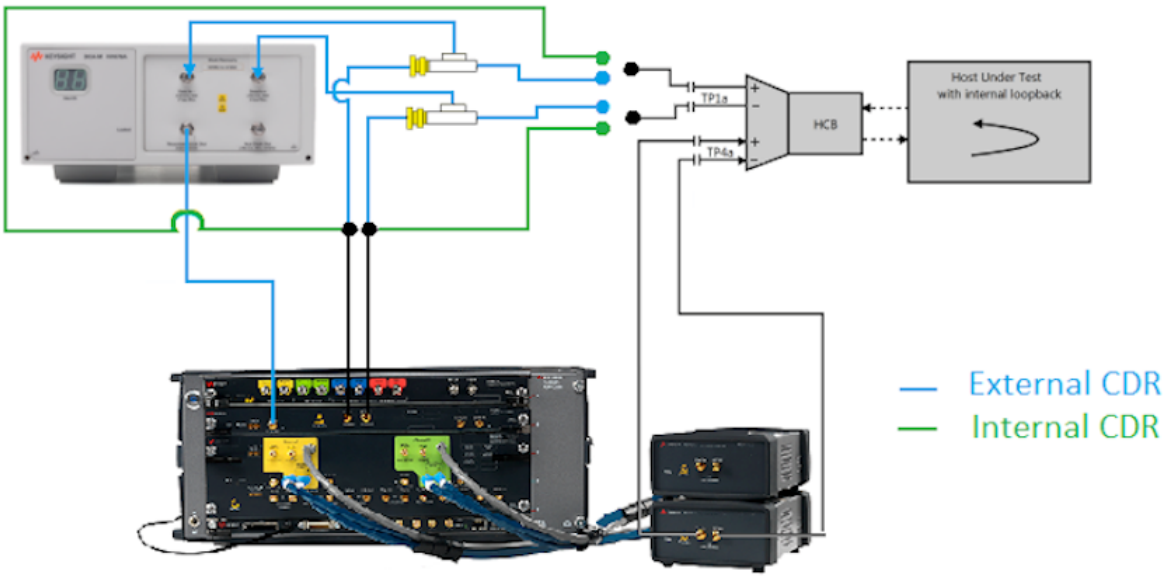


Figure 65 Voltage Tolerance Test connections for VSR Host

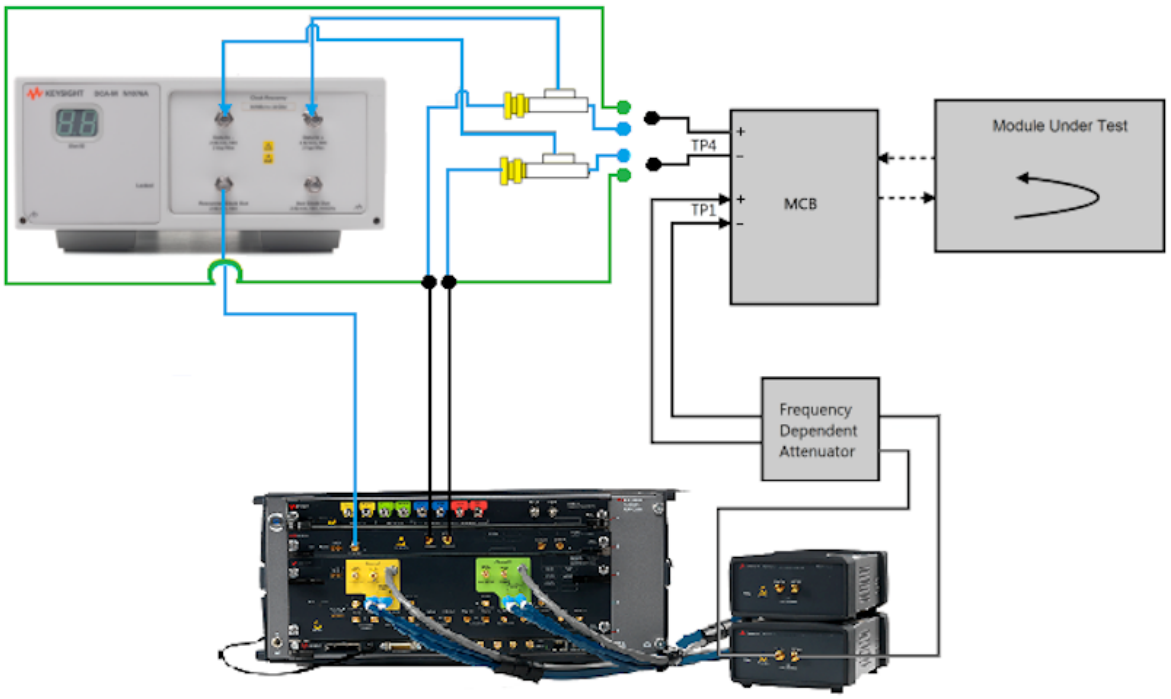


Figure 66 Voltage Tolerance Test connections for VSR Module

ID

Standard Name	Test ID
VSR Host	75102
VSR Module	275102

Dependencies This test depends on the values configured for the following settings:

- Amplitude Calibration

Parameters Refer to “Test Parameters in Debug Mode” on page 74.

Procedure This test uses the QPRBS31-CEI pattern.

Results This test returns the following results:

- Pass/Fail for each Amplitude point

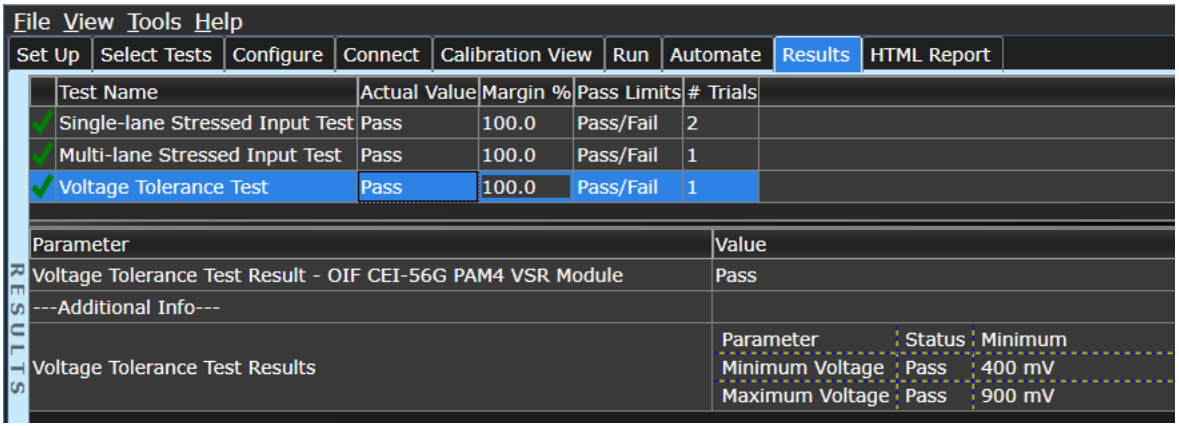


Figure 67 VSR Host Voltage Tolerance Test Result

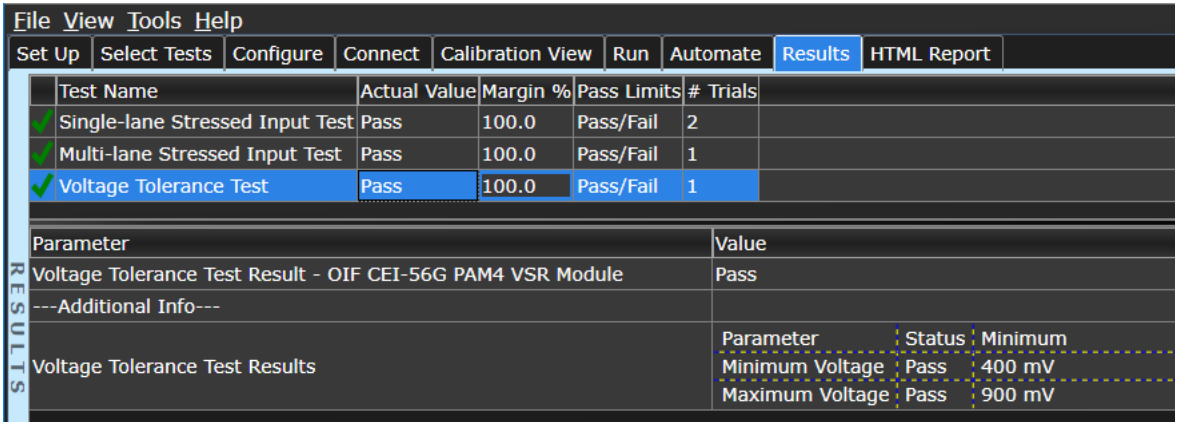


Figure 68 VSR Module Voltage Tolerance Test Result

6 OIF CEI-56G MR PAM4 Calibrations

This section provides the test procedures for the OIF CEI-56G Rx Calibrations, which are applicable for Medium Reach (MR) standards.

Before performing the OIF CEI-56G MR tests, you must calibrate all the related parameters. Perform calibrations in the order displayed in the OIF CEI-56G Rx Test Application.

As mentioned earlier, ensure that the FlexDCA Oscilloscope has been calibrated and the mated Compliance Board is properly connected to the testing instruments to perform OIF CEI-56G Calibrations.

Calibration Parameters in Debug Mode

The Debug Mode in the Configure tab of the Test Application consists of some parameters in addition to those that can be configured in the Compliance Mode. Besides, for some of the configuration options, you may enter custom values, which provides a greater flexibility in performing calibrations and tests.

For the Medium Reach (MR) standard option, the following parameters are available for configuration.

Parameters common for all calibrations

- Baud Rate
- Victim Generator PAM4 Symbol Mapping
- Victim Generator PAM4 Custom Symbol Mapping
- Test Channel Configuration—'Low Loss' corresponds to Test1 whereas 'High Loss' corresponds to Test2; configured to meet the COM value
- Pre-Cursor2
- Pre-Cursor
- Main Cursor
- Post-Cursor1
- Post-Cursor2
- Noise Generator Channel Selection
- Loop Bandwidth
- SIRC Response
- SIRC Bandwidth
- Np
- Dp

Parameters for Receiver Interference Tolerance Calibrations

- SJ
- UUGJ

Parameters for Receiver Jitter Tolerance Calibrations

- SJ
- UUGJ

MR configuration in the Test App

In order to obtain valid calibration data and test measurements, ensure that the Test Application is using the correct configuration parameters and corresponding values. The S-Parameter files are used for compensation losses whereas the Excel configuration file consists of Channel Operating Margin (COM) parameters.

To configure the correct S-Parameter and Excel Config File in the **Set Up** tab,

1 Select **Medium Reach** as the **Standard Option**.

- By default, the Test Application displays certain S-Parameter files and Excel file corresponding to the MR standard.

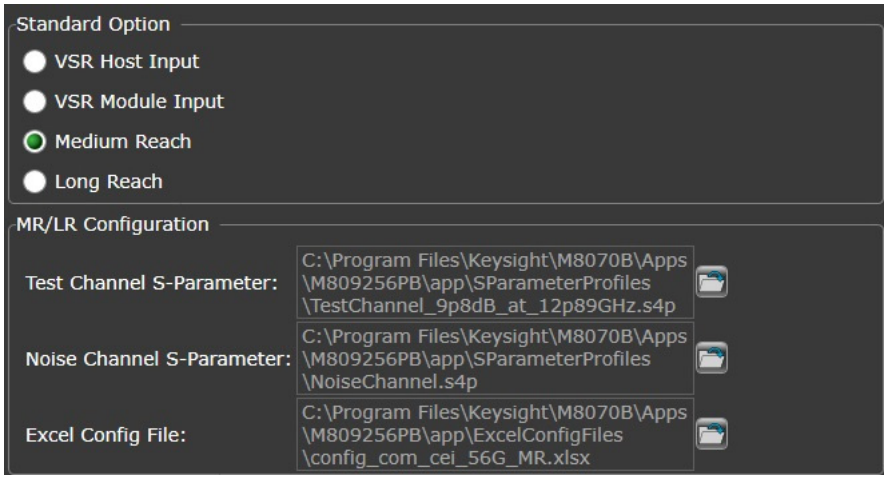


Figure 69 Configuration files for Medium Reach standard

2 To define another Test Channel S-Parameter, Noise Channel S-Parameter or both files, click the respective  (folder icon).

By default, the Application installer places all S-Parameter files in the folder: *C:\Program Files\Keysight\M8070B\Apps\M809256PB\app\SParameterProfiles* for **Test Channel S-Parameter** and **Noise Channel S-Parameter** configuration fields.

From the default files available in the Test Application, you must choose the correct Test Channel S-Parameter file that correlates with the configuration parameter “Test Channel Configuration” setting. Table 12 helps you determine the correct S-Parameter file you must select for each standard option.

Table 12 Selecting Test Channel S-Parameter

Test Channel Configuration setting	Corresponding Rx Interference Tolerance parameter	Standard Option	S-Parameter file that must be selected
Low Loss	Test 1	Medium Reach	TestChannel_9p8dB_at_12p89GHz.s4p
		Long Reach	TestChannel_14p1dB_at_12p89GHz.s4p
High Loss	Test 2	Medium Reach	TestChannel_18p1dB_at_12p89GHz.s4p
		Long Reach	TestChannel_29p2dB_at_12p89GHz.s4p

3 Similarly, to define another Excel Config file, click the folder icon.

By default, the Application installer places all Configuration files in the folder: *C:\Program Files\Keysight\M8070B\Apps\M809256PB\app\ExcelConfigFiles* for the **Excel Config File** configuration field.

4 From the **Open** window that appears, select the alternative S-parameter file (factory installed) for MR and click **Open**.

NOTE

Currently, the Test Application installs a single Noise Channel S-Parameter file for both standards and an Excel Configuration file each for MR and LR standard. While you may also load custom S-Parameter files in the Test Application for Test Channel and Noise Channel, you must ensure that these files contain measurements from the exact test setup.

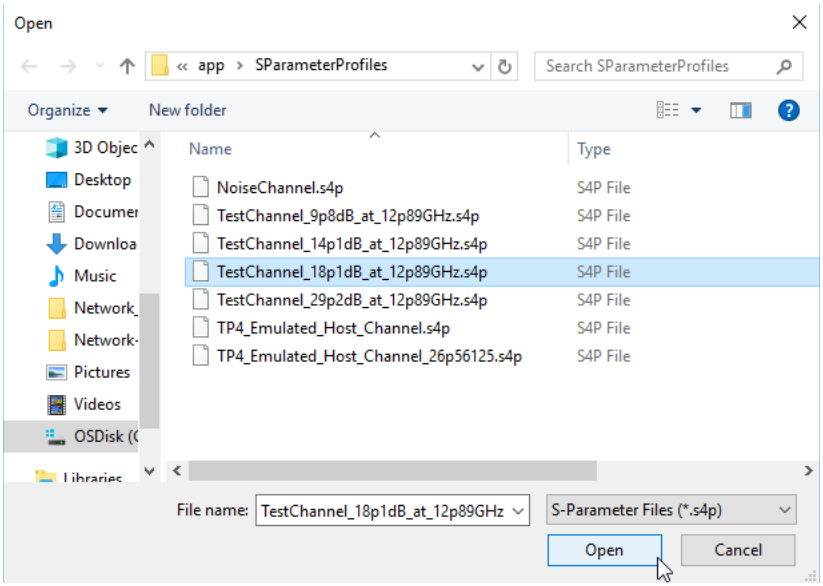


Figure 70 Selecting an S-Parameter file from the default location

The new file location appears in the **MR/LR Configuration** area for the corresponding (Test / Noise) Channel or Excel Configuration File.

Common Calibrations

Amplitude Calibration

Overview The Amplitude Calibration is performed to calibrate the Victim Generator's Amplitude for the Transmitter Measurements for COM model.

Connection Diagram Connect the instruments as shown in Figure 71.

Figure 71 Amplitude Calibration connections for MR

ID

Standard Name	Test ID
Medium Reach	471100

Parameters Refer to "Calibration Parameters in Debug Mode" on page 92.

Procedure This calibration uses the QPRBS13-CEI pattern.

The Victim Generator Amplitude is set and measured for multiple Amplitudes.

Results This calibration contains the results for the Set Amplitude versus Measured Amplitude, in graphical and tabular formats.

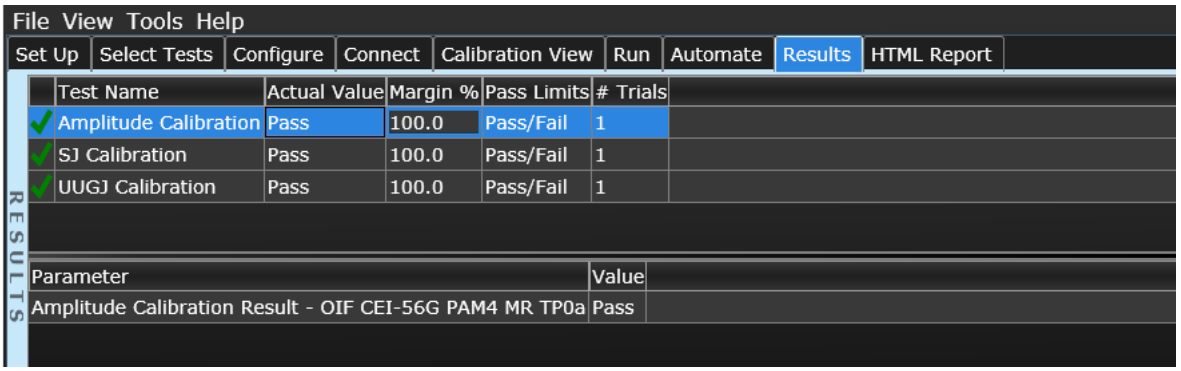


Figure 72 Amplitude Calibration resulting information in the Results tab

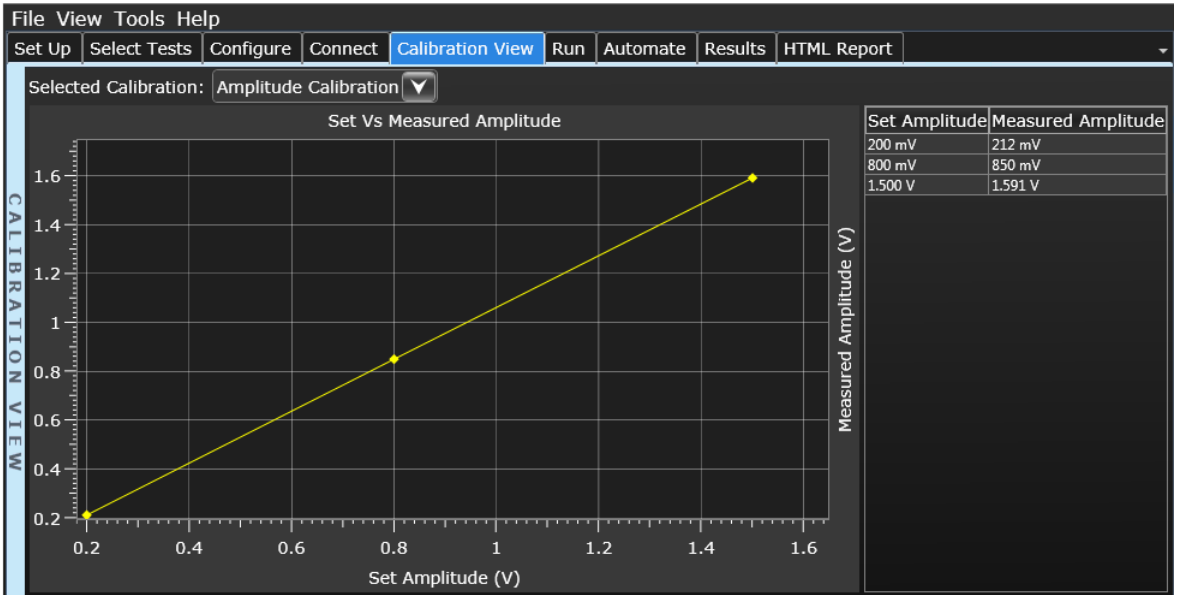


Figure 73 Amplitude Calibration calibrated data in Calibration View tab

SJ Calibration

Overview The SJ Calibration is performed to calibrate the Sinusoidal Jitter.

Connection Diagram Connect the instruments as shown in Figure 74.

Figure 74 SJ Calibration connections for MR

ID

Standard Name	Test ID
Medium Reach	471101

Parameters Refer to “Calibration Parameters in Debug Mode” on page 92.

Procedure This calibration uses the Clock/8 pattern.

The Victim Generator PJ1 is set until the desired SJ value is measured.

Results This calibration returns the results for the set PJ1 versus measured SJ, in graphical and tabular formats.

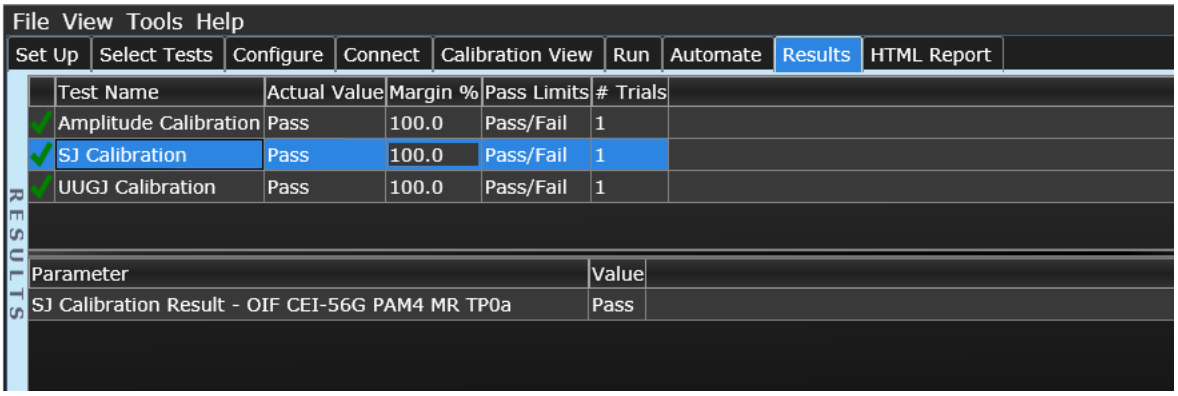


Figure 75 SJ Calibration resulting information in the Results tab

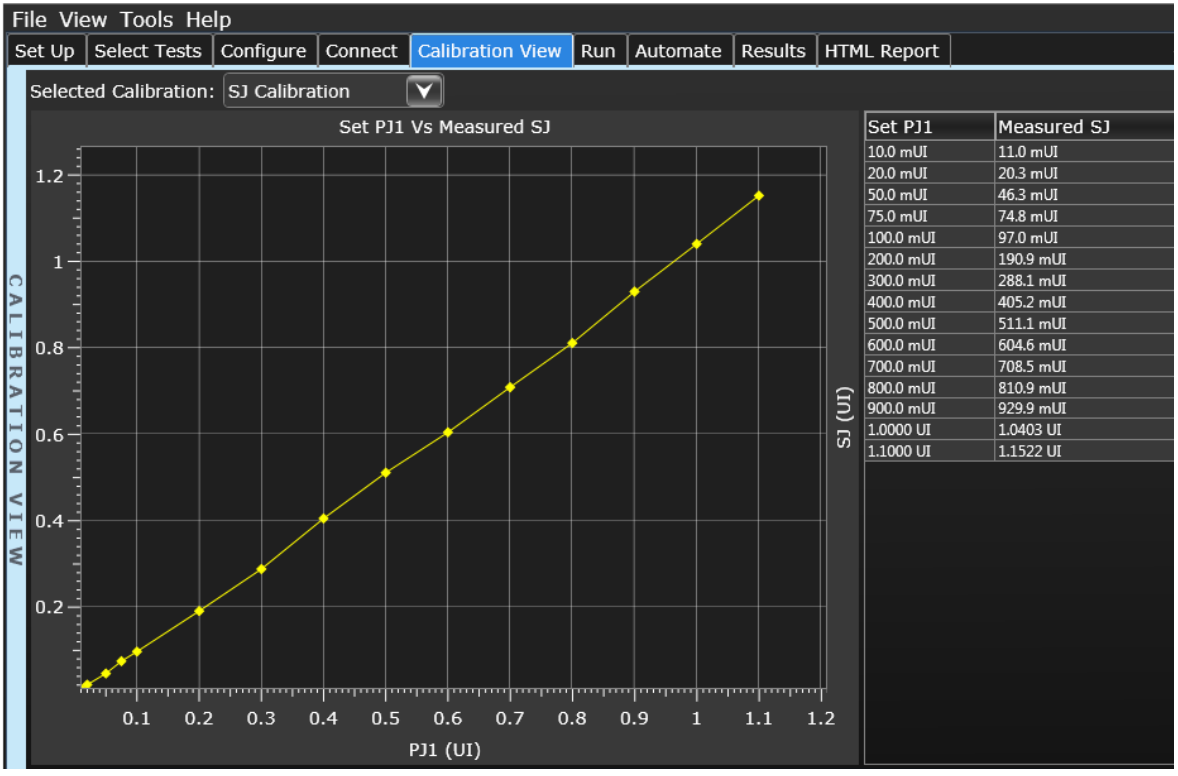


Figure 76 SJ Calibration calibrated data in Calibration View tab

UUGJ Calibration

Overview The UUGJ Calibration is performed to calibrate the Uncorrelated Unbounded Gaussian Jitter (UUGJ).

Connection Diagram Connect the instruments as shown in Figure 77.

Figure 77 UUGJ Calibration connections for MR

ID

Standard Name	Test ID
Medium Reach	471102

Parameters Refer to “Calibration Parameters in Debug Mode” on page 92.

Procedure This calibration uses the 1010... toggle (Clock) pattern.

The Victim Generator Random Jitter (RJ) is set until the desired UUGJ value is measured.

Results This calibration displays the results for the set RJ versus the measured UUGJ, in graphical and tabular formats.

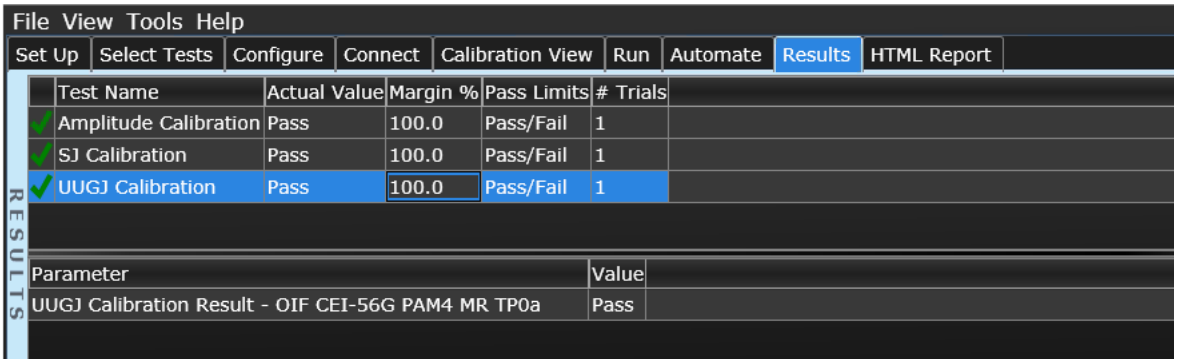


Figure 78 UUGJ Calibration resulting information in the Results tab

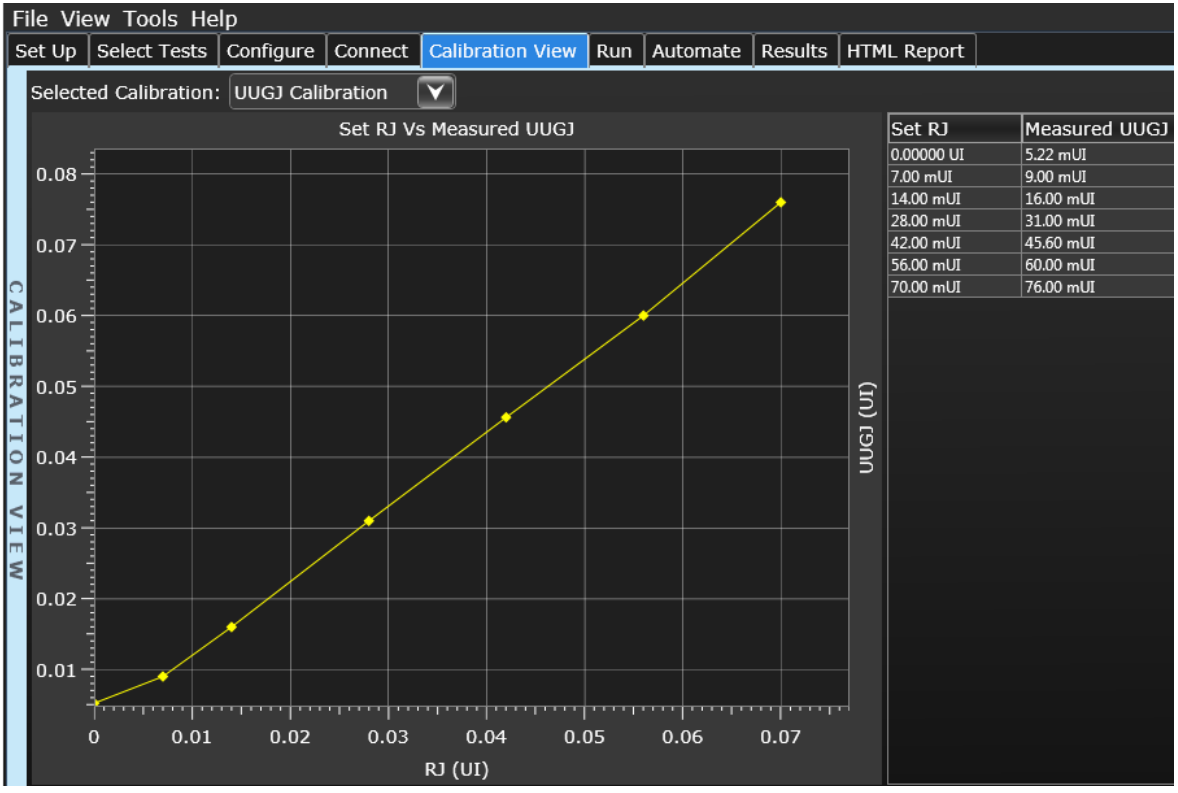


Figure 79 UUGJ Calibration calibrated data in Calibration View tab

Broadband Noise Calibration

Overview The Broadband Noise Calibration is performed to calibrate the broadband noise in the Channel.

Connection Diagram Connect the instruments as shown in Figure 80.

Figure 80 Broadband Noise Calibration connections for MR

ID

Standard Name	Test ID
Medium Reach	471103

Parameters Refer to “Calibration Parameters in Debug Mode” on page 92.

Procedure The discrete number of points from the minimum to maximum amplitude of the random interference from the Noise Generator, are calibrated.

Results This calibration returns the results for the measured Broadband Noise amplitude, in graphical and tabular formats.

Receiver Interference Tolerance

Channel Characterization using COM model

Overview The Channel Characterization using COM Model validates the pre-FEC BER requirements for each receiver lane along with channels matching the COM and loss parameters for Test1 and Test2 as per Table 17-7 of *Clause 17 of the OIF-CEI-4.0* specification.

Connection Diagram Connect the instruments as shown in Figure 81.

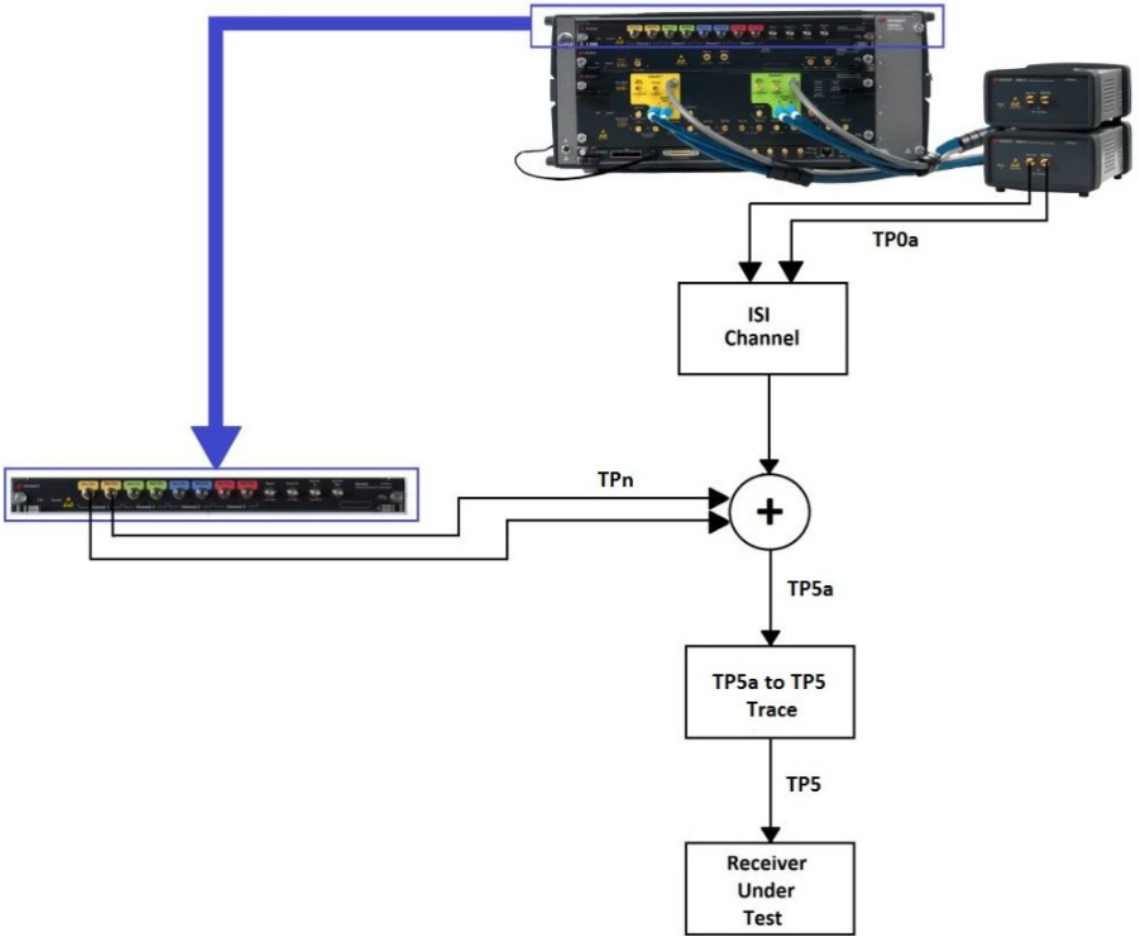


Figure 81 Channel Characterization using COM model connections for MR

ID

Standard Name	Test ID
Medium Reach	471104

Dependencies This test depends on the values configured for the following settings:

- Test Channel S-Parameter
- Excel Config File—to configure COM parameters

For more information on configuring Test Channel S-Parameter and Excel Config File, refer to "MR configuration in the Test App" on page 93.

Parameters Refer to "Calibration Parameters in Debug Mode" on page 92.

Procedure This test uses the QPRBS31-CEI pattern.

Results This calibration contains the results for the all Receiver Interference Tolerance parameters for the selected Test Channel Configuration, in tabular format.

- COM, including effects of Broadband Noise
- Insertion Loss at Nyquist

Transmitter Measurements for COM Model

Overview The Transmitter Measurements for COM Model performs the transmitter electrical and jitter measurements as per Tables 17-2 and 17-3 of *Clause 17 of the OIF-CEI-4.0* specification.

Connection Diagram Connect the instruments as shown in Figure 82.

Figure 82 Transmitter Measurements for COM Model connections for MR

ID

Standard Name	Test ID
Medium Reach	471105

Dependencies This test depends on the values configured for the following settings:

- All MR calibrations performed previously:
  - Amplitude Calibration
  - SJ Calibration
  - UUGJ Calibration

Parameters Refer to "Calibration Parameters in Debug Mode" on page 92.

Procedure This test uses the QPRBS31-CEI pattern.

Results This calibration contains the results for all Transmitter Electrical Output and Jitter Output parameters for the selected Test Channel Configuration, in tabular format.

Transmitter Electrical Output Specification

- Transition Time
- Level Separation Mismatch Ratio
- Signal-to-Noise-and-Distortion-Ratio

Transmitter Output Jitter Specification

- Uncorrelated Jitter (J4u) (time interval from 0.005% to 99.995% of the probability distribution)
- Uncorrelated jitter RMS (Jrms) (standard deviation of the probability distribution)

Rx Calibration using COM model

Overview The Rx Calibration using COM Model prepares the calibration data as a prerequisite to performing the Receiver Interference Tolerance Test.

Connection Diagram Connect the instruments as shown in Figure 83.

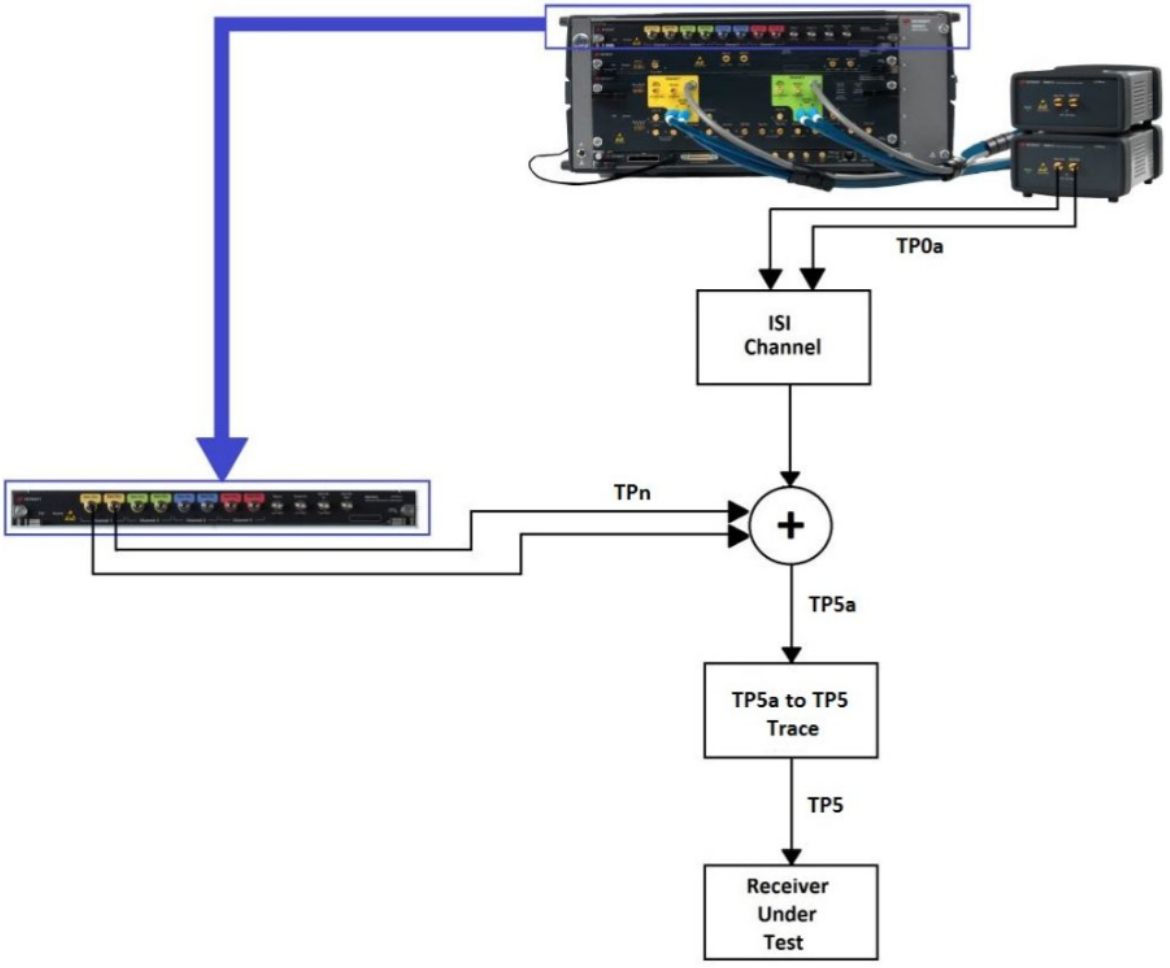


Figure 83 Rx Calibration using COM model connections for MR

ID

Standard Name	Test ID
Medium Reach	471106

Dependencies

This test depends on the values measured in "Transmitter Measurements for COM Model" on page 105.

- Test Channel S-Parameter
- Noise Channel S-Parameter
- Excel Config File—containing COM parameter values after "Transmitter Measurements for COM Model is performed"

For more information on configuring Test Channel S-Parameter, Noise Channel S-Parameter and Excel Config File, refer to "MR configuration in the Test App" on page 93.

Parameters

Refer to "Calibration Parameters in Debug Mode" on page 92.

Procedure

This calibration determines the Broadband Noise (RMS) value using COM calibration until the COM value begins decreasing below 3dB.

The following parameters are modified automatically in the Excel Config File by the software, without any manual intervention:

- Tr
- Sigma RJ
- Add
- SNDR
- R_LM
- All parameters that are dependent on Baud Rate, such as CTLE and zeros
- RX_CALIBRATION = 1
- IDEAL_TX_TERM = 1
- FORCE_TR = 1

Results

This calibrated values are displayed in a tabular format in the Results tab.

Receiver Jitter Tolerance

Transmitter Measurements for COM Model

Overview The Transmitter Measurements for COM Model performs the transmitter electrical and jitter measurements as per Tables 17-2 and 17-3 of *Clause 17 of the OIF-CEI-4.0* specification.

Connection Diagram Connect the instruments as shown in Figure 84.

Figure 84 Transmitter Measurements for COM Model connections for MR

ID

Standard Name	Test ID
Medium Reach	471107

Dependencies This test depends on the values configured for the following settings:

- Excel Config File—to configure COM parameters

For more information on configuring Test Channel S-Parameter and Excel Config File, refer to “MR configuration in the Test App” on page 93.

- Calibrated values from the following Calibrations:
  - Amplitude Calibration
  - SJ Calibration
  - UUGJ Calibration

Parameters Refer to "Calibration Parameters in Debug Mode" on page 92.

Procedure This test uses the QPRBS31-CEI pattern.

Results This calibration contains the results for all Transmitter Electrical Output and Jitter Output parameters for the selected Test Channel Configuration, in tabular format.

Transmitter Electrical Output Specification

- Transition Time
- Level Separation Mismatch Ratio
- Signal-to-Noise-and-Distortion-Ratio

Transmitter Output Jitter Specification

- Uncorrelated Jitter (J4u) (time interval from 0.005% to 99.995% of the probability distribution)
- Uncorrelated jitter RMS (Jrms) (standard deviation of the probability distribution)

Rx Verification using COM model

Overview The Rx Verification using COM Model verifies the calibration data as a prerequisite to performing the Receiver Jitter Tolerance Test.

Connection Diagram Connect the instruments as shown in Figure 83.

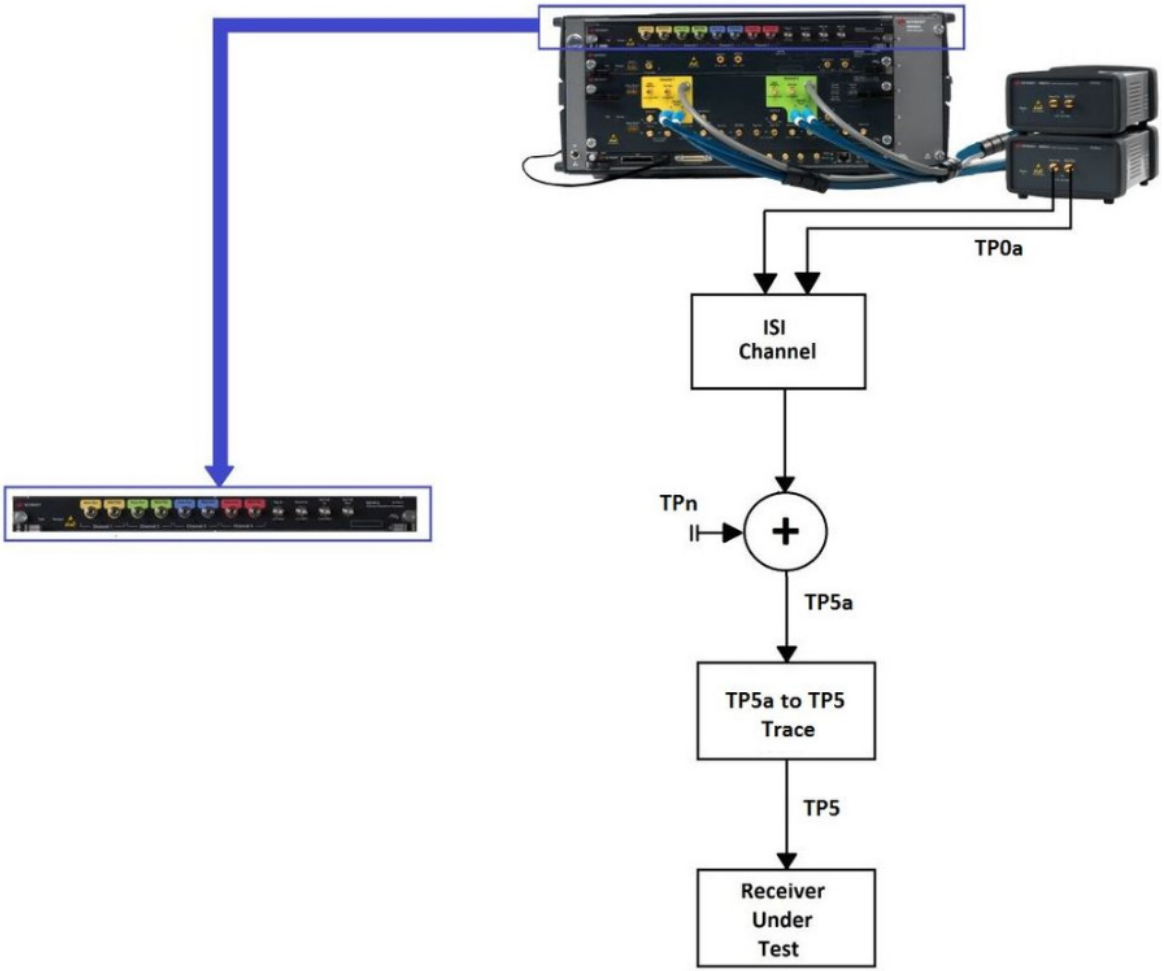


Figure 85 Rx Verification using COM model connections for MR

ID

Standard Name	Test ID
Medium Reach	471108

Dependencies This test depends on the values measured in "Transmitter Measurements for COM Model" on page 109.

- Test Channel S-Parameter
- Noise Channel S-Parameter
- Excel Config File—containing COM parameter values after "Transmitter Measurements for COM Model is performed"

For more information on configuring Test Channel S-Parameter, Noise Channel S-Parameter and Excel Config File, refer to "MR configuration in the Test App" on page 93.

Parameters Refer to "Calibration Parameters in Debug Mode" on page 92.

Procedure This calibration validates the Broadband Noise (RMS) value using COM calibration until the COM value begins decreasing below 3dB.

Results This calibrated values are displayed in a tabular format in the Results tab.

7 OIF CEI-56G MR PAM4 Tests

This section provides the test procedures for the OIF CEI-56G Rx Tests, which are applicable for the Medium Reach (MR) standard.

As a prerequisite, run all OIF CEI-56G MR calibrations before running tests. Ensure that the DUT is properly connected to the BERT modules and the FlexDCA Oscilloscope.

Test Parameters in Debug Mode

The Debug Mode in the Configure tab of the Test Application consists of some parameters in addition to those that can be configured in the Compliance Mode. Besides, for some of the configuration options, you may enter custom values, which provides a greater flexibility in performing calibrations and tests.

For the Medium Reach (MR) standard option, the following parameters are available for configuration.

Parameters common for all tests

- Baud Rate
- Victim Generator PAM4 Symbol Mapping
- Victim Generator PAM4 Custom Symbol Mapping
- Test Channel Configuration—'Low Loss' corresponds to Test1 whereas 'High Loss' corresponds to Test2; configured to meet the COM value
- Pre-Cursor2
- Pre-Cursor
- Main Cursor
- Post-Cursor1
- Post-Cursor2
- Noise Generator Channel Selection
- Victim Analyzer Module—If 'BERT Analyzer' is selected, manually configure the "Victim Analyzer Clock Source" parameter. If 'DCI' is selected, manually configure the "DUT Control Interface script file" and "DUT Control Interface Location" parameters.
- Victim Analyzer Clock Source
- Victim Analyzer PAM4 Symbol Mapping
- Victim Analyzer PAM4 Custom Symbol Mapping
- Target Error Ratio
- Target Confidence Level
- DUT Control Interface script file
- DUT Control Interface Location

Parameters for Receiver Interference Tolerance Test

- Broadband Noise Amplitude
- Broadband Noise Selector

Parameters for Receiver Jitter Tolerance Test

- Test Mode
- Jitter Profile Frequency1
- Jitter Profile Amplitude1
- Jitter Profile Frequency2
- Jitter Profile Amplitude2
- Jitter Profile Frequency3
- Jitter Profile Amplitude3
- Frequency Mode
- Start Frequency
- Stop Frequency
- Number of Steps
- Manual Frequency List

Receiver Interference Tolerance Test

Overview The Receiver Interference Tolerance Test validates that the receiver on each lane shall meet the pre-FEC BER requirement with channels matching the Channel Operating Margin (COM) and loss parameters for Test 1 and Test 2.

Connection Diagram Connect the instruments as shown in Figure 86.

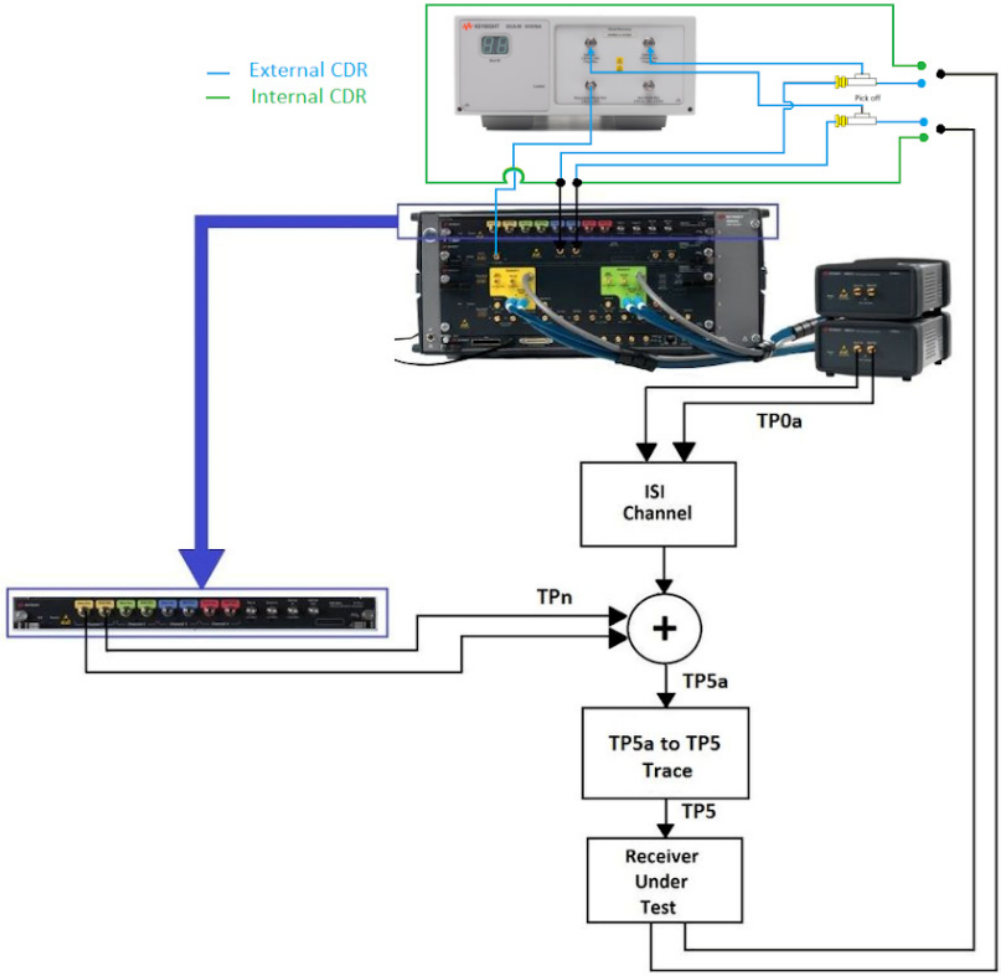


Figure 86 Rx Interference Tolerance Test connections for MR

ID

Standard Name	Test ID
Medium Reach	475100

Dependencies This test depends on the values configured for the following calibrations:

- Broadband Noise Calibration
- Transmitter Measurements for COM Model
- Rx Calibration using COM model

Parameters Refer to "Test Parameters in Debug Mode" on page 114.

Procedure This test uses the QPRBS31-CEI pattern.

Results This test attains 'Pass' value if the Rx BER is less than 1e-4, as per the *OIF-CEI-4.0* specification.

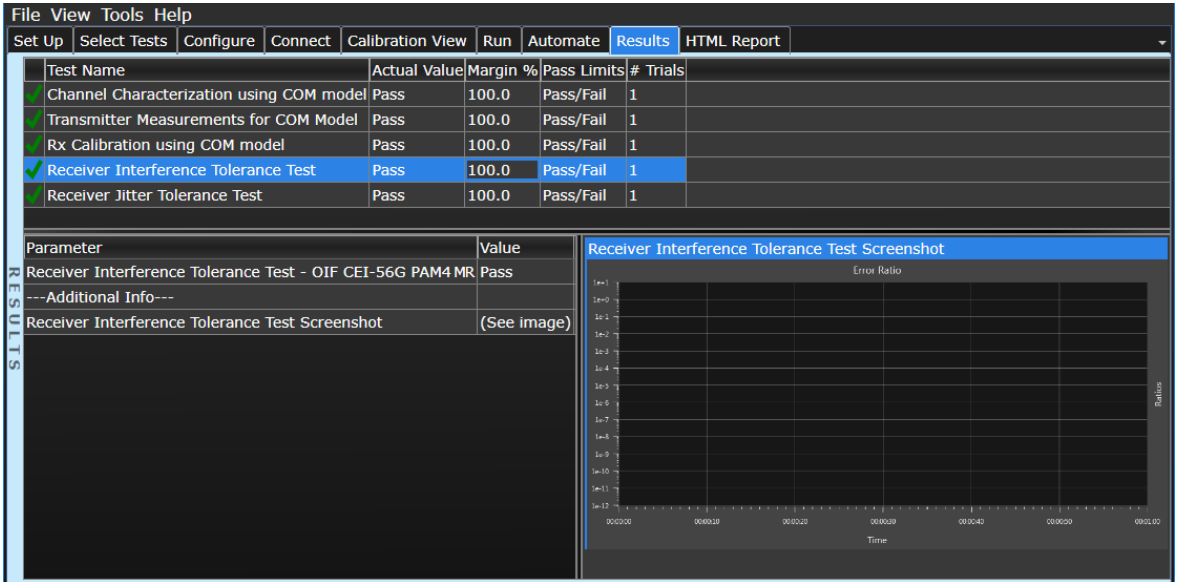


Figure 87 Rx Interference Tolerance Test results in tabular format

Receiver Jitter Tolerance Test

Overview The Receiver Jitter Tolerance Test validates that the receiver bit error ratio (BER) shall meet the requirements for each pair of jitter frequency and peak-to-peak amplitude values as per the *OIF-CEI-4.0* specification.

Connection Diagram Connect the instruments as shown in Figure 88.

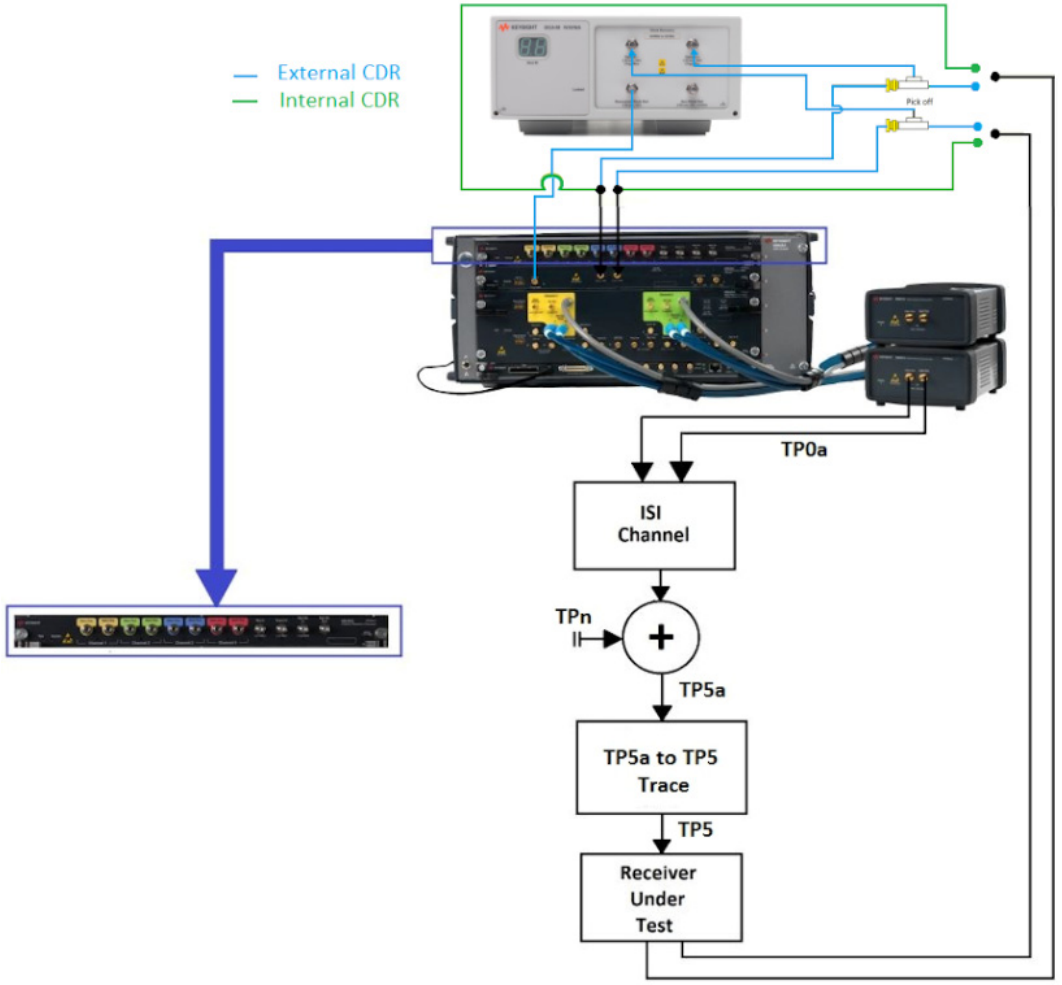


Figure 88 Rx Jitter Tolerance Test connections for MR

ID

Standard Name	Test ID
Medium Reach	475101

Dependencies This test depends on the values configured for the following calibrations:

- SJ Calibration

Parameters Refer to "Test Parameters in Debug Mode" on page 114.

Procedure This test uses the QPRBS31-CEI pattern.

Results This test returns Pass/Fail for each Sinusoidal Jitter Amplitude & Frequency pair point.

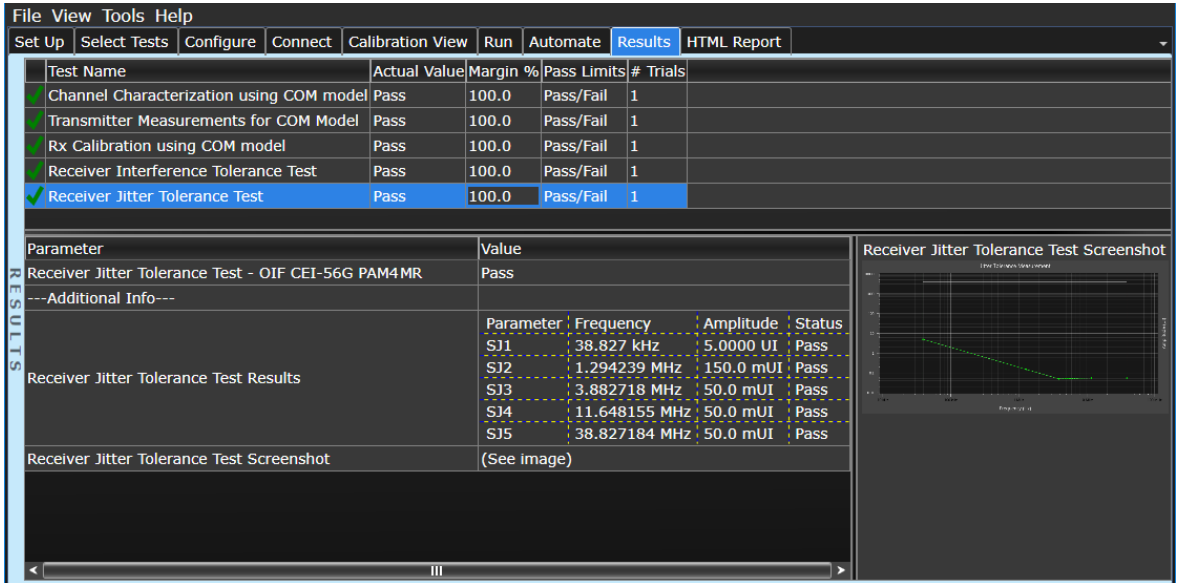


Figure 89 Rx Jitter Tolerance Test results

Parameter	Value			
Receiver Jitter Tolerance Test - OIF CEI-56G PAM4 MR	Pass			
---Additional Info---				
Receiver Jitter Tolerance Test Results	Parameter	Frequency	Amplitude	Status
	SJ1	38.827 kHz	5.0000 UI	Pass
	SJ2	1.294239 MHz	150.0 mUI	Pass
	SJ3	3.882718 MHz	50.0 mUI	Pass
	SJ4	11.648155 MHz	50.0 mUI	Pass
	SJ5	38.827184 MHz	50.0 mUI	Pass
Receiver Jitter Tolerance Test Screenshot	(See image)			

Figure 90 Rx Jitter Tolerance Test results in tabular format

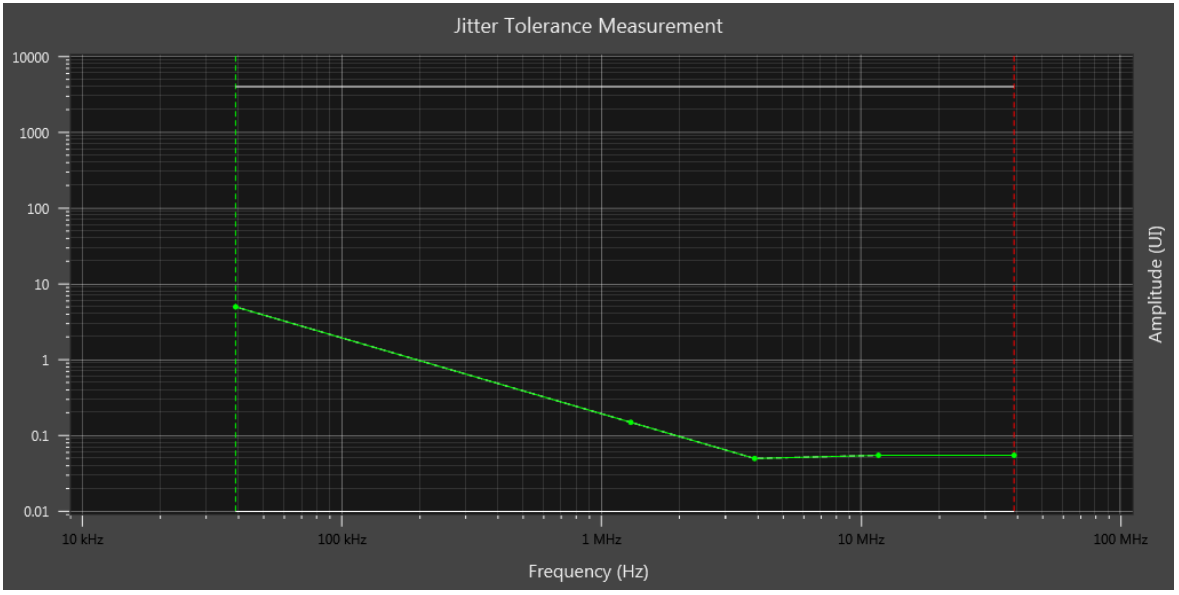


Figure 91 Rx Jitter Tolerance Test results in graphical format

8 OIF CEI-56G LR PAM4 Calibrations

This section provides the test procedures for the OIF CEI-56G Rx Calibrations, which are applicable for Long Reach (LR) standards.

Before performing the OIF CEI-56G LR tests, you must calibrate all the related parameters. Perform calibrations in the order displayed in the OIF CEI-56G Rx Test Application.

As mentioned earlier, ensure that the FlexDCA Oscilloscope has been calibrated and the mated Compliance Board is properly connected to the testing instruments to perform OIF CEI-56G Calibrations.

Calibration Parameters in Debug Mode

The Debug Mode in the Configure tab of the Test Application consists of some parameters in addition to those that can be configured in the Compliance Mode. Besides, for some of the configuration options, you may enter custom values, which provides a greater flexibility in performing calibrations and tests.

For the Long Reach (LR) standard option, the following parameters are available for configuration.

Parameters common for all calibrations

- Baud Rate
- Victim Generator PAM4 Symbol Mapping
- Victim Generator PAM4 Custom Symbol Mapping
- Test Channel Configuration—'Low Loss' corresponds to Test1 whereas 'High Loss' corresponds to Test2; configured to meet the COM value
- Pre-Cursor2
- Pre-Cursor
- Main Cursor
- Post-Cursor1
- Post-Cursor2
- Noise Generator Channel Selection
- Loop Bandwidth
- SIRC Response
- SIRC Bandwidth
- Np
- Dp

Parameters for Receiver Interference Tolerance Calibrations

- SJ
- UUGJ

Parameters for Receiver Jitter Tolerance Calibrations

- SJ
- UUGJ

LR configuration in the Test App

In order to obtain valid calibration data and test measurements, ensure that the Test Application is using the correct configuration parameters and corresponding values. The S-Parameter files are used for compensation losses whereas the Excel configuration file consists of Channel Operating Margin (COM) parameters.

To configure the correct S-Parameter and Excel Config File in the **Set Up** tab,

1 Select **Long Reach** as the **Standard Option**.

- By default, the Test Application displays certain S-Parameter files and Excel file corresponding to the LR standard.

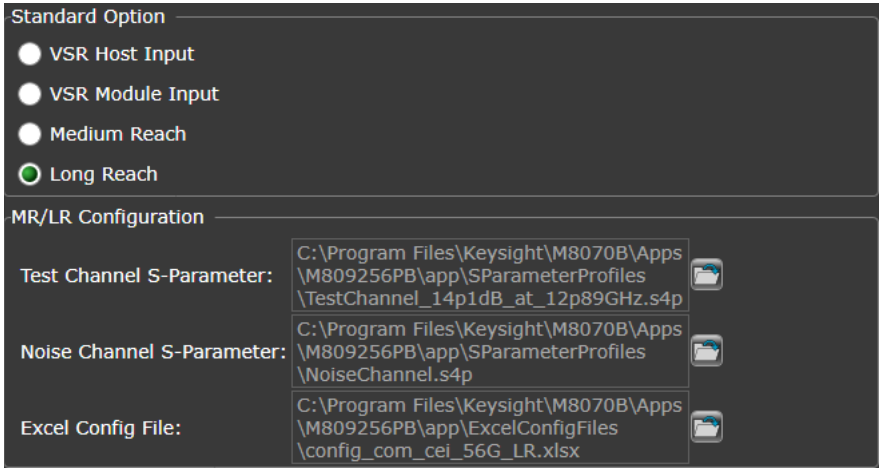


Figure 92 Configuration files for Medium Reach standard

2 To define another Test Channel S-Parameter, Noise Channel S-Parameter or both files, click the respective  (folder icon).

By default, the Application installer places all S-Parameter files in the folder: *C:\Program Files\Keysight\M8070B\Apps\M809256PB\app\SParameterProfiles* for **Test Channel S-Parameter** and **Noise Channel S-Parameter** configuration fields.

From the default files available in the Test Application, you must choose the correct Test Channel S-Parameter file that correlates with the configuration parameter “Test Channel Configuration” setting. Table 13 helps you determine the correct S-Parameter file you must select for each standard option.

Table 13 Selecting Test Channel S-Parameter

Test Channel Configuration setting	Corresponding Rx Interference Tolerance parameter	Standard Option	S-Parameter file that must be selected
Low Loss	Test 1	Medium Reach	TestChannel_9p8dB_at_12p89GHz.s4p
		Long Reach	TestChannel_14p1dB_at_12p89GHz.s4p
High Loss	Test 2	Medium Reach	TestChannel_18p1dB_at_12p89GHz.s4p
		Long Reach	TestChannel_29p2dB_at_12p89GHz.s4p

3 Similarly, to define another Excel Config file, click the folder icon.

By default, the Application installer places all Configuration files in the folder: *C:\Program Files\Keysight\M8070B\Apps\M809256PB\app\ExcelConfigFiles* for the **Excel Config File** configuration field.

4 From the **Open** window that appears, select the alternative S-parameter file (factory installed) for LR and click **Open**.

NOTE

Currently, the Test Application installs a single Noise Channel S-Parameter file for both standards and an Excel Configuration file each for MR and LR standard. While you may also load custom S-Parameter files in the Test Application for Test Channel and Noise Channel, you must ensure that these files contain measurements from the exact test setup.

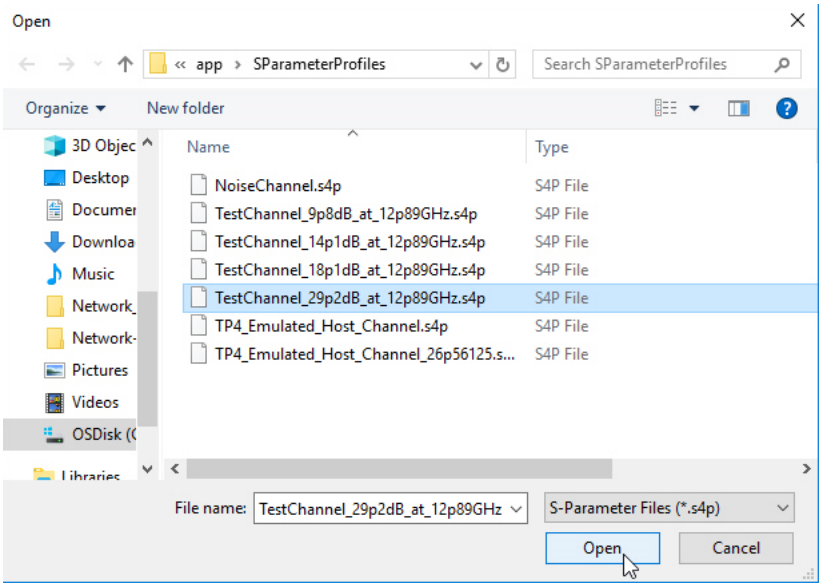


Figure 93 Selecting an S-Parameter file from the default location

The new file location appears in the **MR/LR Configuration** area for the corresponding (Test / Noise) Channel or Excel Configuration File.

Common Calibrations

Amplitude Calibration

Overview The Amplitude Calibration is performed to calibrate the Victim Generator's Amplitude for the Transmitter Measurements for COM model.

Connection Diagram Connect the instruments as shown in Figure 94.

Figure 94 Amplitude Calibration connections for LR

ID

Standard Name	Test ID
Long Reach	671100

Parameters Refer to "Calibration Parameters in Debug Mode" on page 122.

Procedure This calibration uses the QPRBS13-CEI pattern.

The Victim Generator Amplitude is set and measured for multiple Amplitudes.

Results This calibration contains the results for the Set Amplitude versus Measured Amplitude, in graphical and tabular formats.

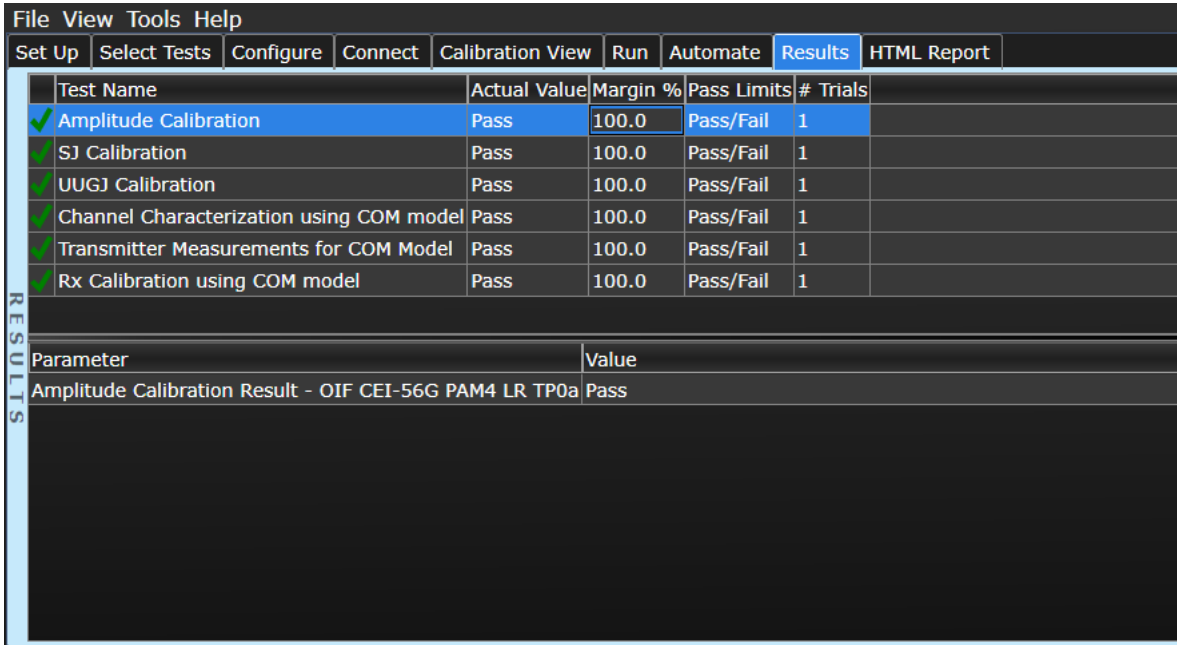


Figure 95 Amplitude Calibration resulting information in the Results tab

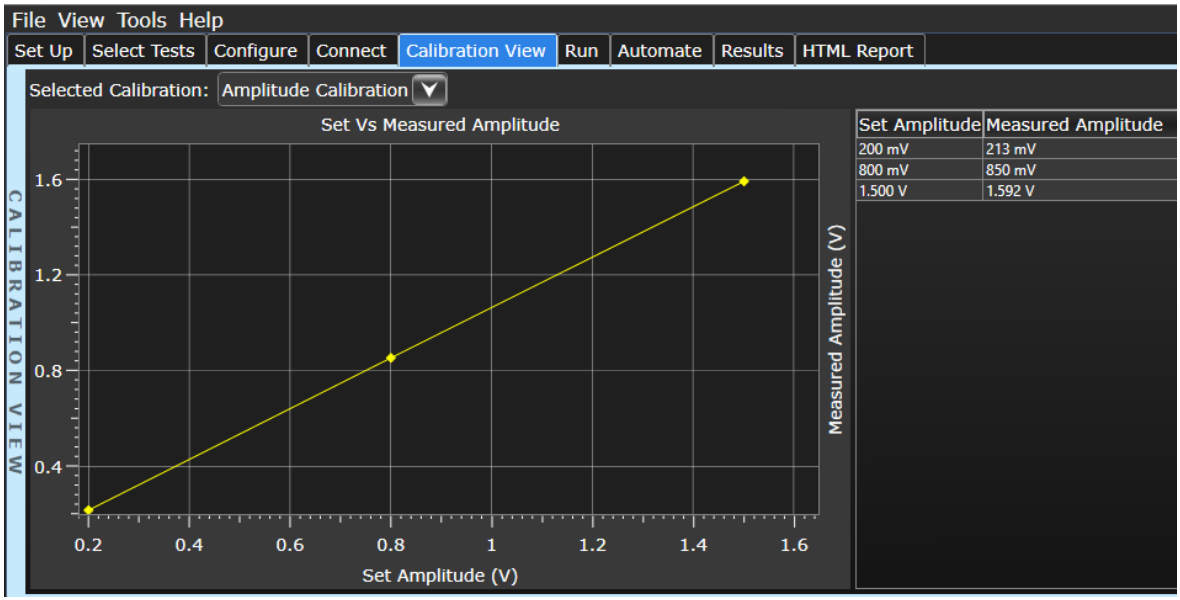


Figure 96 Amplitude Calibration calibrated data in Calibration View tab

SJ Calibration

Overview The SJ Calibration is performed to calibrate the Sinusoidal Jitter.

Connection Diagram Connect the instruments as shown in Figure 97.

Figure 97 SJ Calibration connections for LR

ID

Standard Name	Test ID
Long Reach	671101

Parameters Refer to “Calibration Parameters in Debug Mode” on page 122.

Procedure This calibration uses the Clock/8 pattern.

The Victim Generator PJ1 is set until the desired SJ value is measured.

Results This calibration returns the results for the set PJ1 versus measured SJ, in graphical and tabular formats.

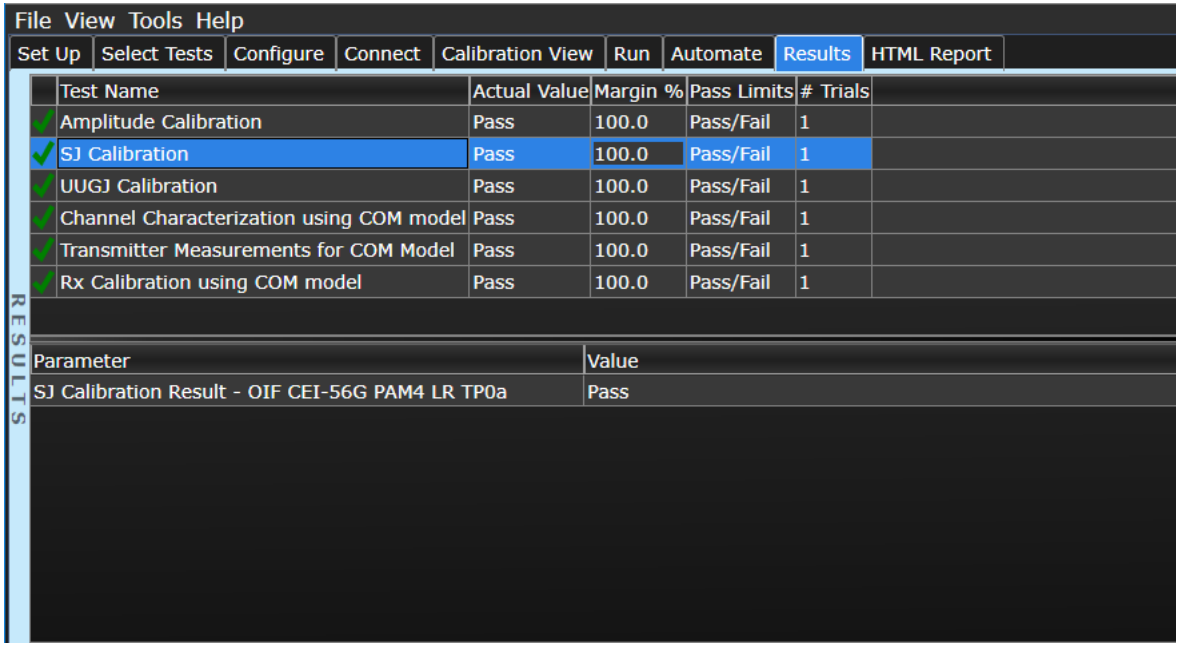


Figure 98 SJ Calibration resulting information in the Results tab

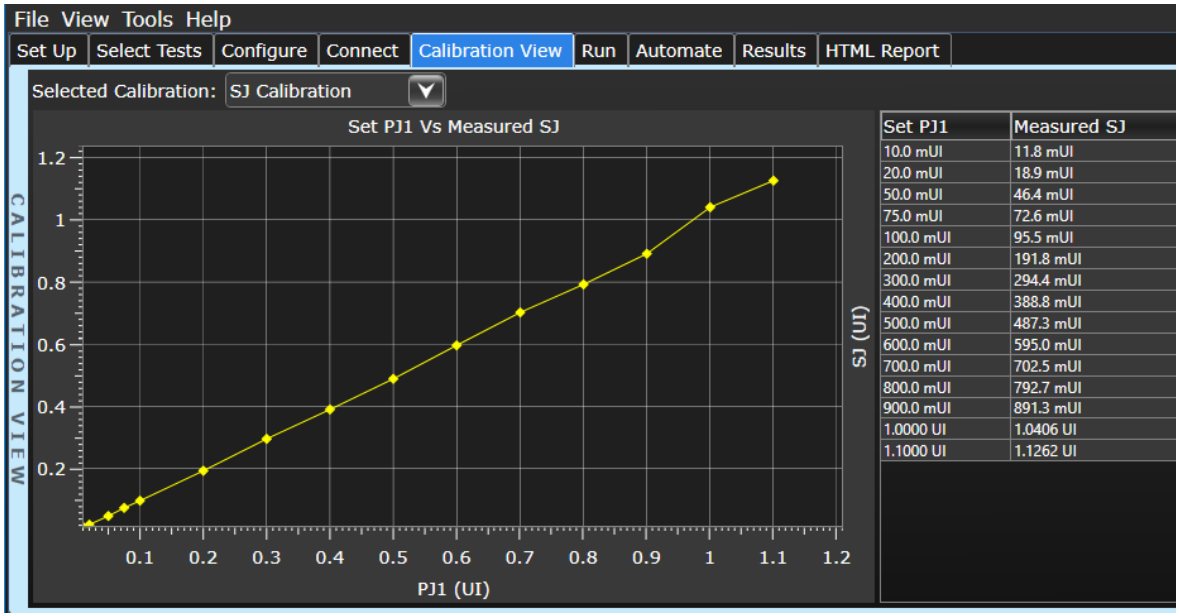


Figure 99 SJ Calibration calibrated data in Calibration View tab

UUGJ Calibration

Overview The UUGJ Calibration is performed to calibrate the Uncorrelated Unbounded Gaussian Jitter (UUGJ).

Connection Diagram Connect the instruments as shown in Figure 100.

Figure 100 UUGJ Calibration connections for LR

ID

Standard Name	Test ID
Long Reach	671102

Parameters Refer to “Calibration Parameters in Debug Mode” on page 122.

Procedure This calibration uses the 1010... toggle (Clock) pattern.

The Victim Generator Random Jitter (RJ) is set until the desired UUGJ value is measured.

Results This calibration displays the results for the set RJ versus the measured UUGJ, in graphical and tabular formats.

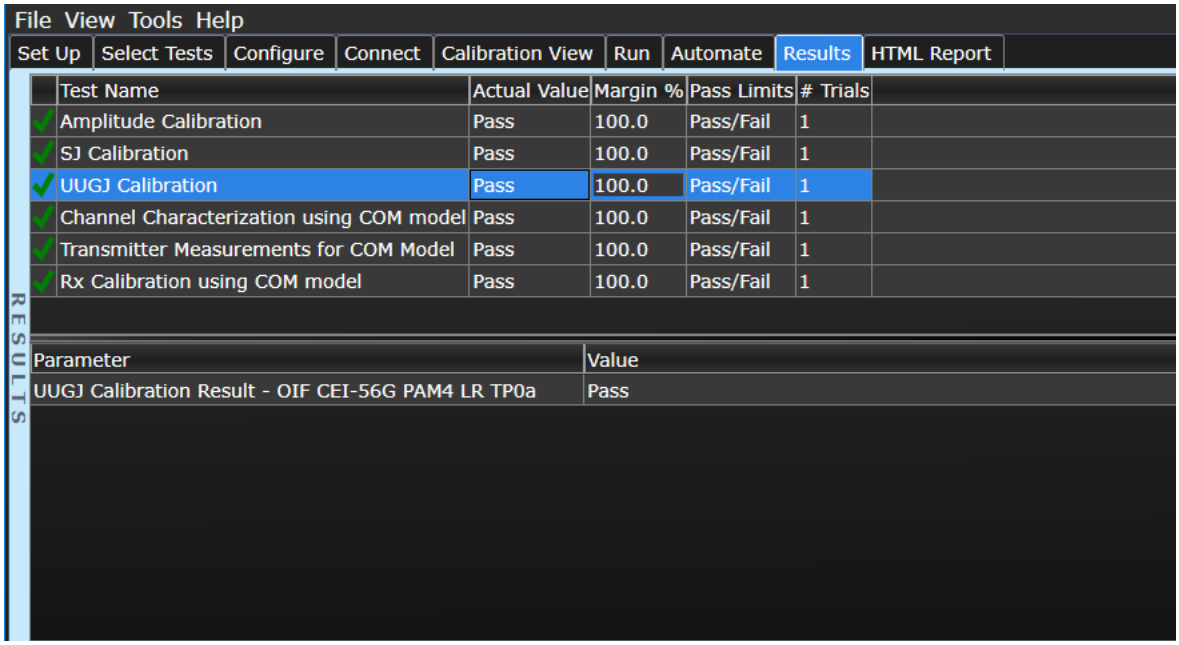


Figure 101 UUGJ Calibration resulting information in the Results tab

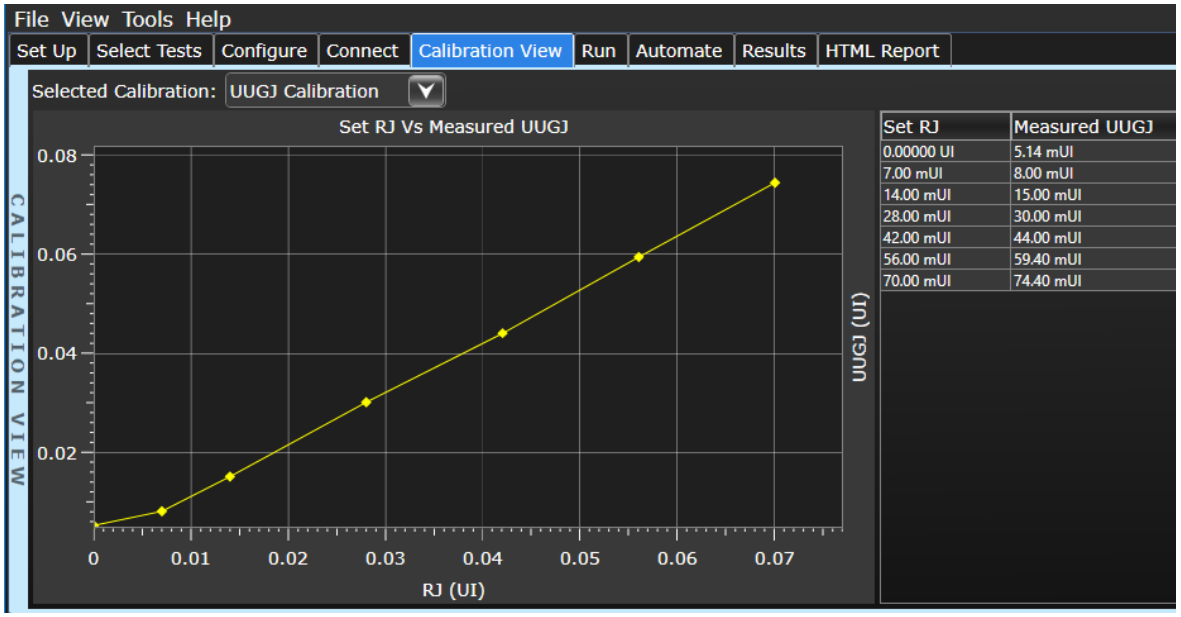


Figure 102 UUGJ Calibration calibrated data in Calibration View tab

Broadband Noise Calibration

Overview The Broadband Noise Calibration is performed to calibrate the broadband noise in the Channel.

Connection Diagram Connect the instruments as shown in Figure 103.

Figure 103 Broadband Noise Calibration connections for LR

ID

Standard Name	Test ID
Long Reach	671103

Parameters Refer to “Calibration Parameters in Debug Mode” on page 122.

Procedure The discrete number of points from the minimum to maximum amplitude of the random interference from the Noise Generator, are calibrated.

Results This calibration returns the results for the measured Broadband Noise amplitude, in graphical and tabular formats.

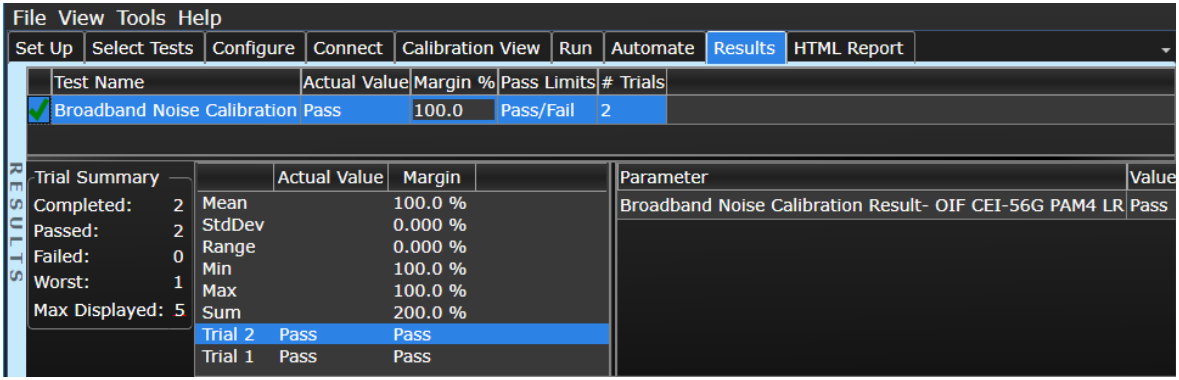


Figure 104 Broadband Noise Calibration resulting information in the Results tab

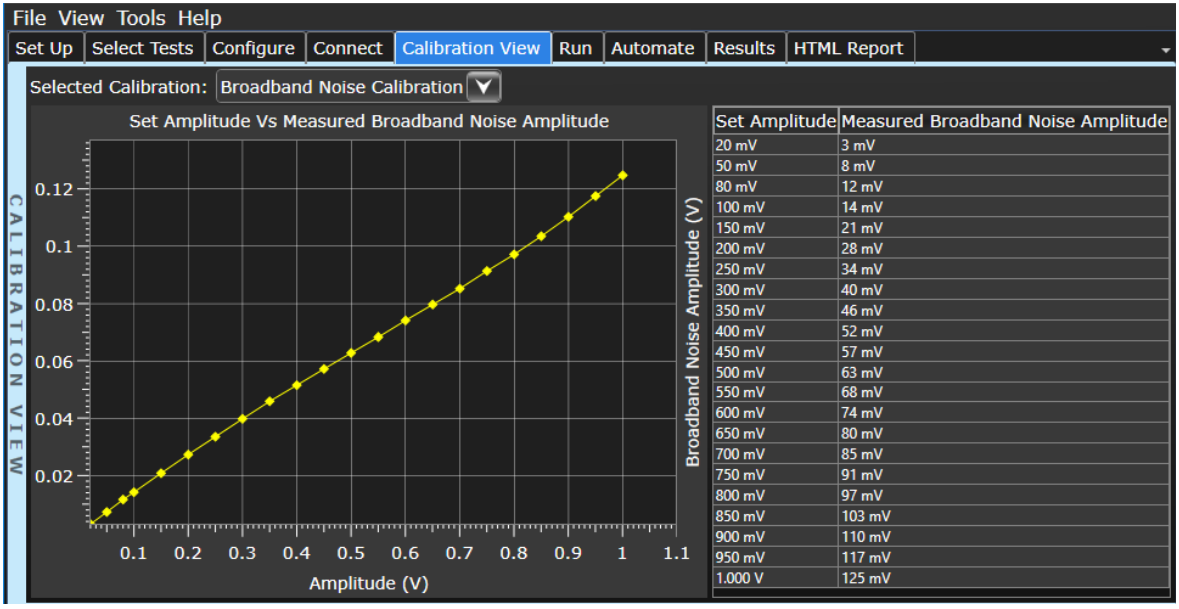


Figure 105 Broadband Noise Calibration calibrated data in Calibration View tab

Receiver Interference Tolerance

Channel Characterization using COM model

Overview The Channel Characterization using COM Model validates the pre-FEC BER requirements for each receiver lane along with channels matching the COM and loss parameters for Test1 and Test2 as per Table 21-7 of *Clause 21 of the OIF-CEI-4.0* specification.

Connection Diagram Connect the instruments as shown in Figure 106.

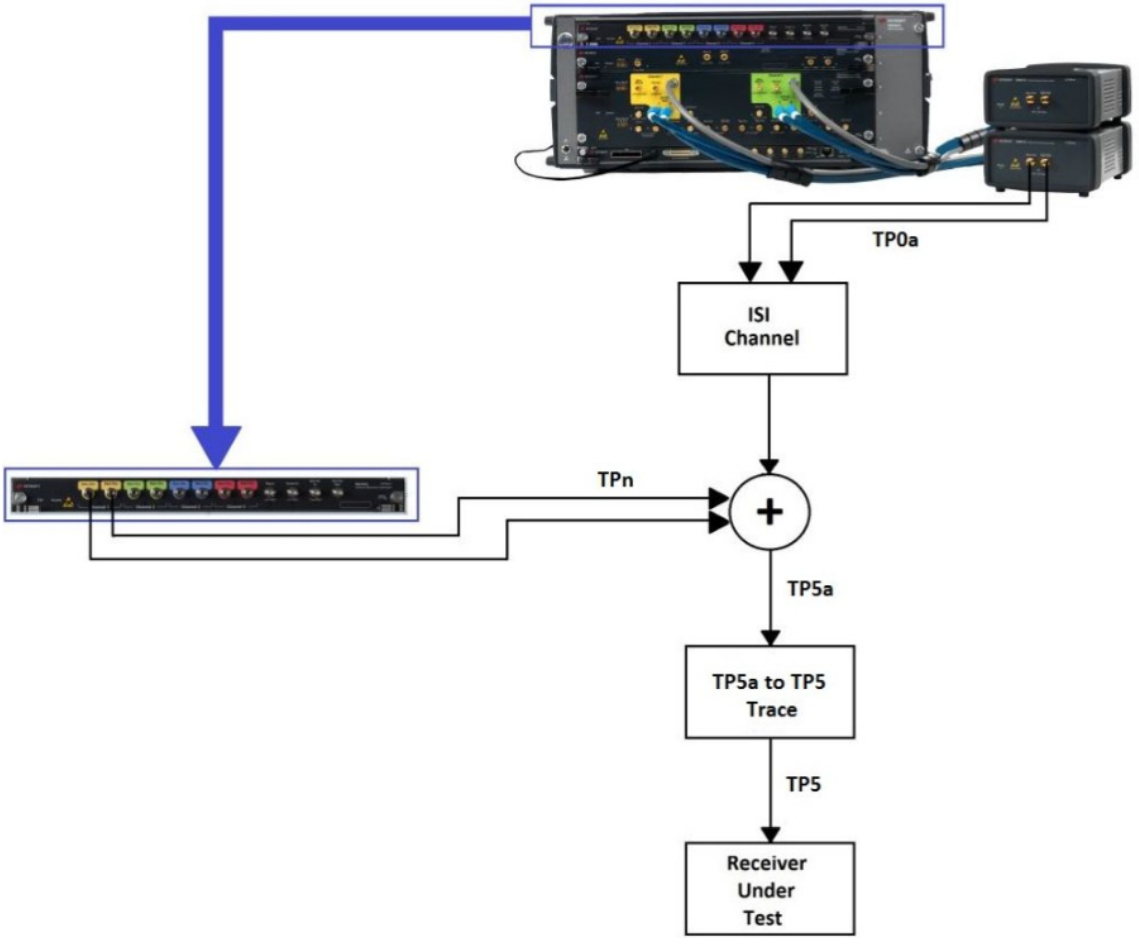


Figure 106 Channel Characterization using COM model connections for LR

ID

Standard Name	Test ID
Long Reach	671104

Dependencies This test depends on the values configured for the following settings:

- Test Channel S-Parameter
- Excel Config File—to configure COM parameters

For more information on configuring Test Channel S-Parameter and Excel Config File, refer to “LR configuration in the Test App” on page 123.

Parameters Refer to “Calibration Parameters in Debug Mode” on page 122.

Procedure This test uses the QPRBS31-CEI pattern.

Results This calibration contains the results for the all Receiver Interference Tolerance parameters for the selected Test Channel Configuration, in tabular format.

- COM, including effects of Broadband Noise
- Insertion Loss at Nyquist

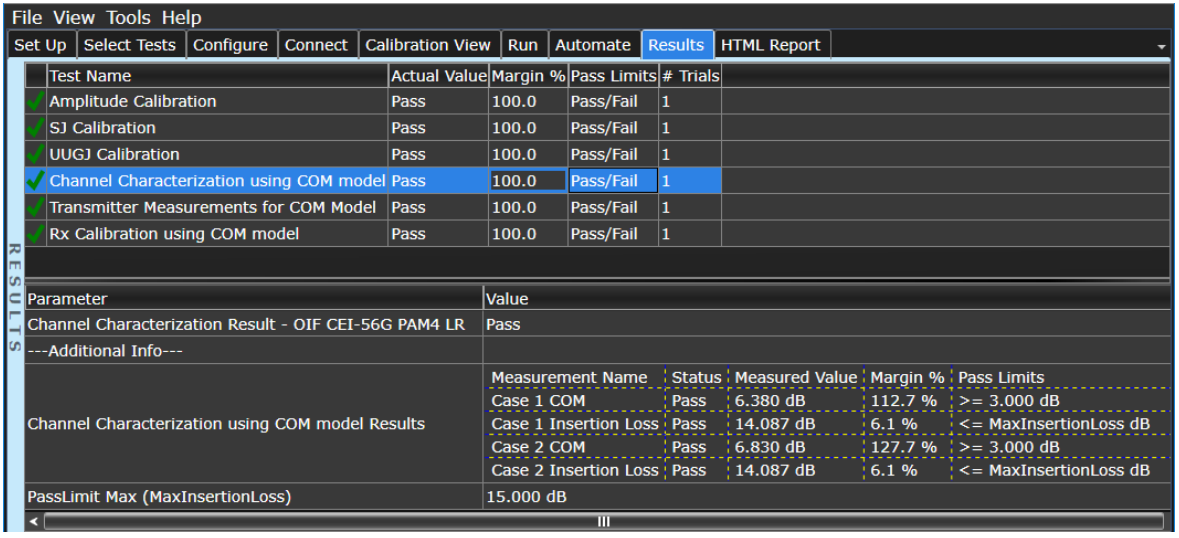


Figure 107 Channel Characterization using COM model information in the Results tab

Value				
Pass				
Measurement Name	Status	Measured Value	Margin %	Pass Limits
Case 1 COM	Pass	6.380 dB	112.7 %	>= 3.000 dB
Case 1 Insertion Loss	Pass	14.087 dB	6.1 %	<= MaxInsertionLoss dB
Case 2 COM	Pass	6.830 dB	127.7 %	>= 3.000 dB
Case 2 Insertion Loss	Pass	14.087 dB	6.1 %	<= MaxInsertionLoss dB
15.000 dB				

Figure 108 Channel Characterization using COM model results table

Transmitter Measurements for COM Model

Overview The Transmitter Measurements for COM Model performs the transmitter electrical and jitter measurements as per Tables 21-2 and 21-3 of *Clause 21 of the OIF-CEI-4.0* specification.

Connection Diagram Connect the instruments as shown in Figure 109.

Figure 109 Transmitter Measurements for COM Model connections for LR

ID

Standard Name	Test ID
Long Reach	671105

Dependencies This test depends on the values configured for the following settings:

- All LR calibrations performed previously:
  - Amplitude Calibration
  - SJ Calibration
  - UUGJ Calibration

Parameters Refer to "Calibration Parameters in Debug Mode" on page 122.

Procedure This test uses the QPRBS31-CEI pattern.

Results This calibration contains the results for all Transmitter Electrical Output and Jitter Output parameters for the selected Test Channel Configuration, in tabular format.

Transmitter Electrical Output Specification

- Transition Time
- Level Separation Mismatch Ratio
- Signal-to-Noise-and-Distortion-Ratio

Transmitter Output Jitter Specification

- Uncorrelated Jitter (J4u) (time interval from 0.005% to 99.995% of the probability distribution)
- Uncorrelated jitter RMS (Jrms) (standard deviation of the probability distribution)

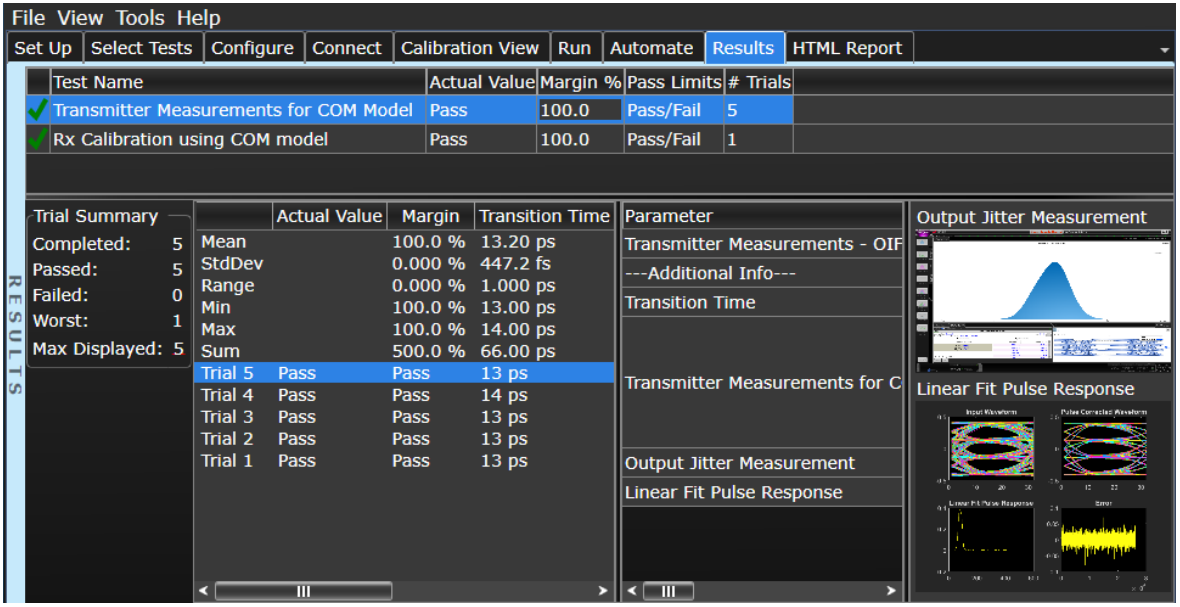


Figure 110 Tx Measurements for COM Model resulting information in the Results tab

Parameter	Value				
Transmitter Measurements - OIF CEI-56G PAM4 LR TP0a	Pass				
---Additional Info---					
Transition Time	13 ps				
Transmitter Measurements for COM Model Results	Measurement Name	Status	Measured Value	Margin %	Pass Limits
	JRMS	Pass	8.2 mUI	64.3 %	<= 23.0 mUI
	J4u	Pass	60.0 mUI	49.2 %	<= 118.0 mUI
	Level mismatch ratio RLM	Pass	0.97	2.1 %	>= 0.95
	Signal-to-noise-and-distortion ratio	Pass	34.04 dB	9.8 %	>= 31.00 dB
Output Jitter Measurement	(See image)				
Linear Fit Pulse Response	(See image)				

Figure 111 Tx Measurements for COM Model results in tabular format

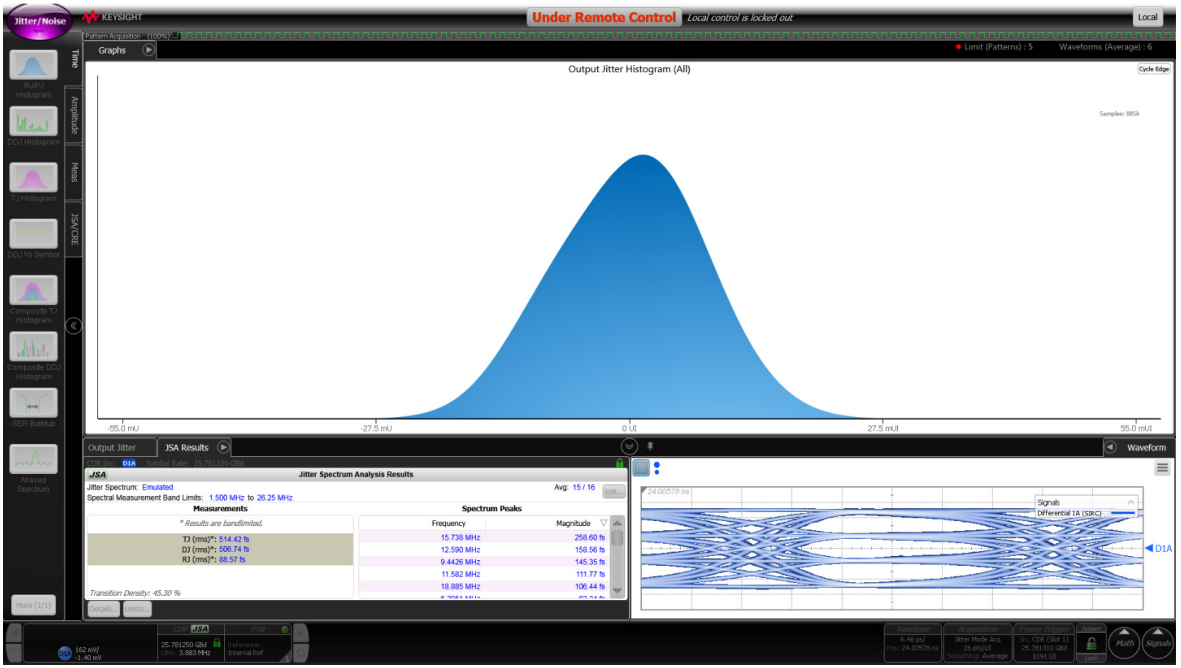


Figure 112 Output Jitter Measurement Histogram and JSA screenshot (maximized)

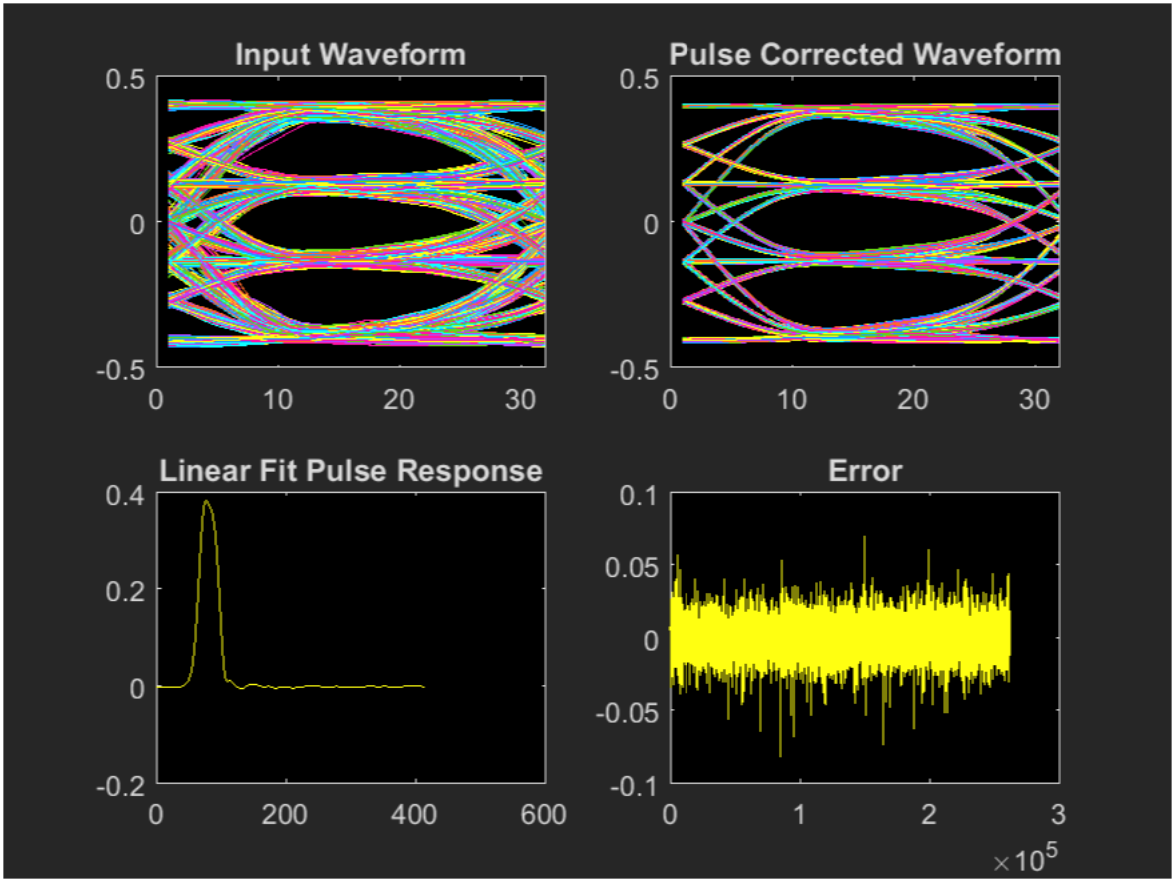


Figure 113 Linear Fit Pulse Response screenshot (maximized)

Rx Calibration using COM model

Overview The Rx Calibration using COM Model prepares the calibration data as a prerequisite to performing the Receiver Interference Tolerance Test.

Connection Diagram Connect the instruments as shown in Figure 114.

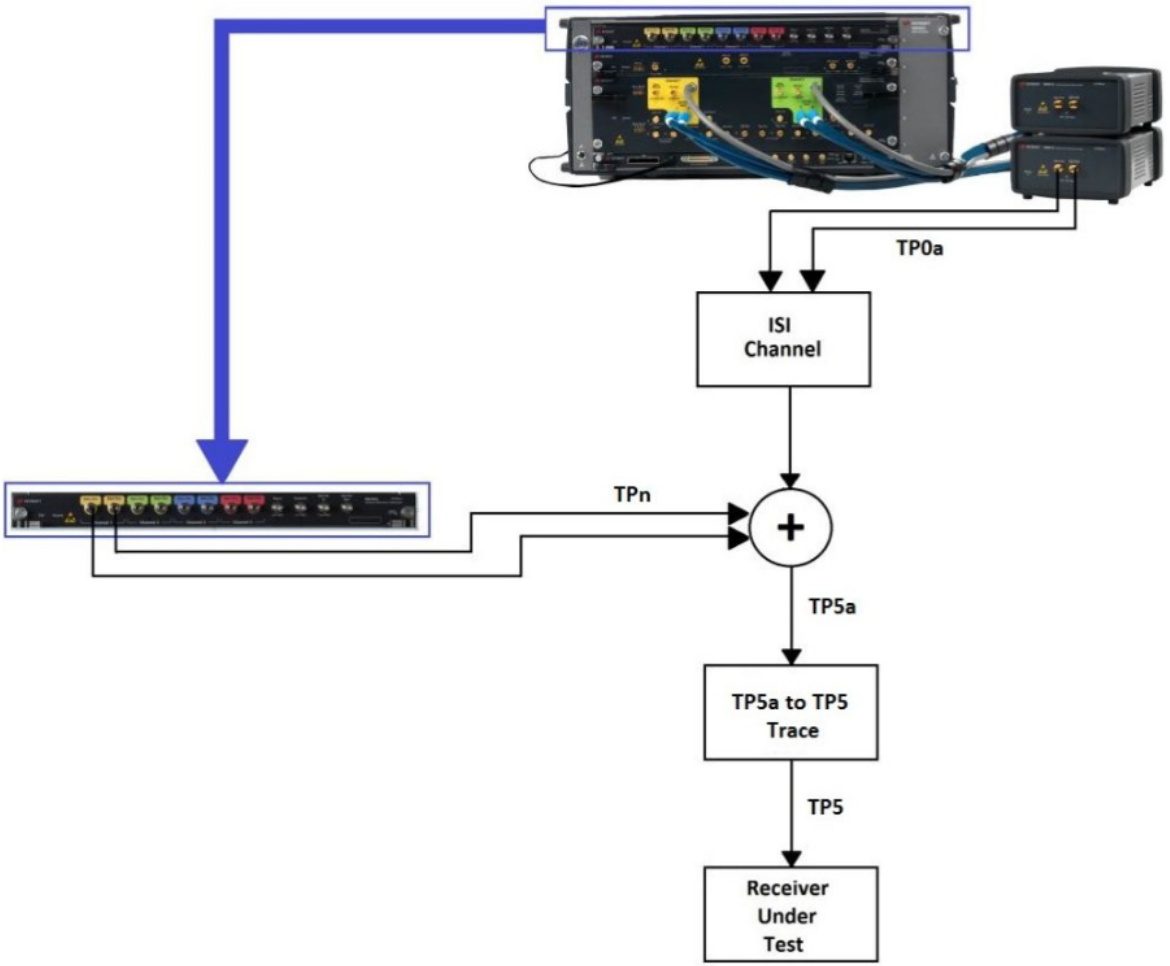


Figure 114 Rx Calibration using COM model connections for LR

ID

Standard Name	Test ID
Long Reach	671106

Dependencies This test depends on the values measured in "Transmitter Measurements for COM Model" on page 140.

- Test Channel S-Parameter
- Noise Channel S-Parameter
- Excel Config File—containing COM parameter values after "Transmitter Measurements for COM Model is performed"

For more information on configuring Test Channel S-Parameter, Noise Channel S-Parameter and Excel Config File, refer to "LR configuration in the Test App" on page 123.

Parameters Refer to "Calibration Parameters in Debug Mode" on page 122.

Procedure This calibration determines the Broadband Noise (RMS) value using COM calibration until the COM value begins decreasing below 3dB.

Results This calibrated values are displayed in a tabular format in the Results tab.

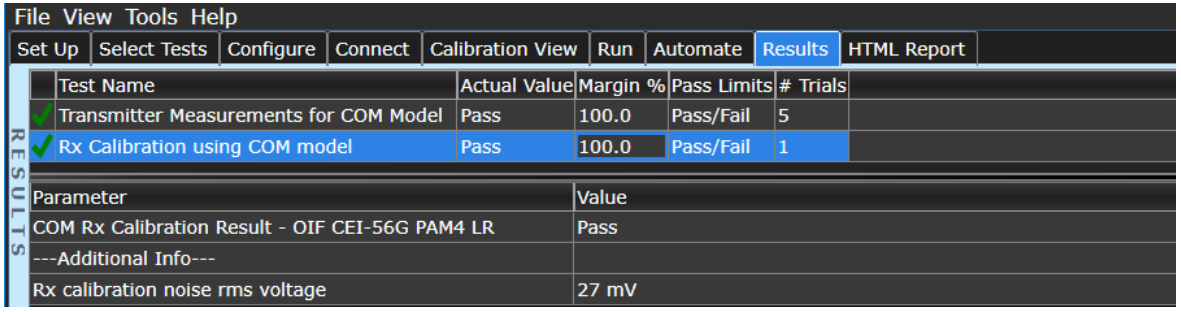


Figure 115 Rx Calibration using COM Model results in tabular format

Receiver Jitter Tolerance

Transmitter Measurements for COM Model

Overview The Transmitter Measurements for COM Model performs the transmitter electrical and jitter measurements as per Tables 21-2 and 21-3 of *Clause 21 of the OIF-CEI-4.0* specification.

Connection Diagram Connect the instruments as shown in Figure 116.

Figure 116 Transmitter Measurements for COM Model connections for LR

ID

Standard Name	Test ID
Long Reach	671107

Dependencies This test depends on the values configured for the following settings:

- Excel Config File—to configure COM parameters

For more information on configuring Test Channel S-Parameter and Excel Config File, refer to “LR configuration in the Test App” on page 123.

This test depends on the values configured for the following settings:

- All LR calibrations performed previously:
  - Amplitude Calibration
  - SJ Calibration
  - UUGJ Calibration

Parameters Refer to "Calibration Parameters in Debug Mode" on page 122.

Procedure This test uses the QPRBS31-CEI pattern.

Results This calibration contains the results for all Transmitter Electrical Output and Jitter Output parameters for the selected Test Channel Configuration, in tabular format.

Transmitter Electrical Output Specification

- Transition Time
- Level Separation Mismatch Ratio
- Signal-to-Noise-and-Distortion-Ratio

Transmitter Output Jitter Specification

- Uncorrelated Jitter (J4u) (time interval from 0.005% to 99.995% of the probability distribution)
- Uncorrelated jitter RMS (Jrms) (standard deviation of the probability distribution)

Rx Verification using COM model

Overview The Rx Verification using COM Model verifies the calibration data as a prerequisite to performing the Receiver Jitter Tolerance Test.

Connection Diagram Connect the instruments as shown in Figure 117.

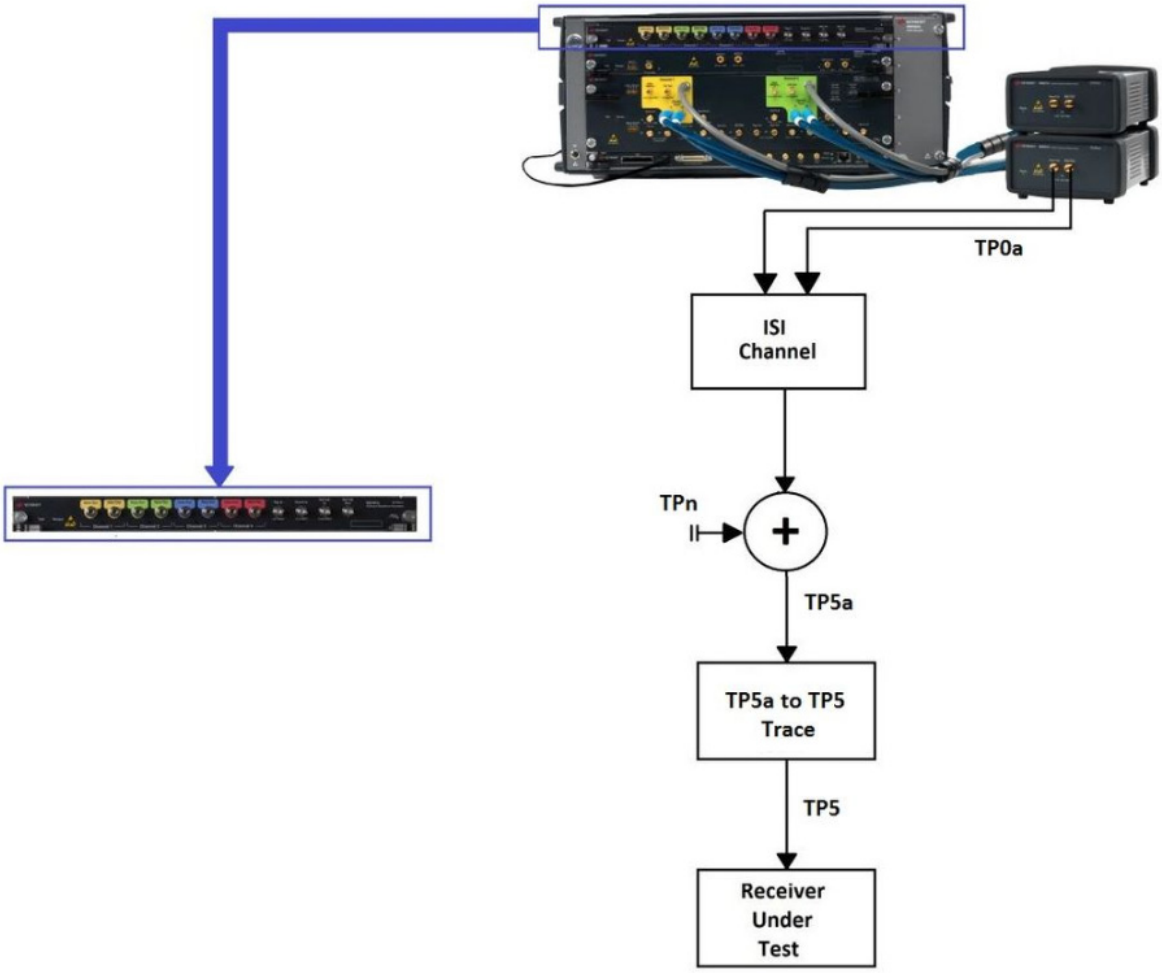


Figure 117 Rx Verification using COM model connections for LR

ID

Standard Name	Test ID
Long Reach	671108

Dependencies

This test depends on the values measured in "Transmitter Measurements for COM Model" on page 146.

- Test Channel S-Parameter
- Noise Channel S-Parameter
- Excel Config File—containing COM parameter values after "Transmitter Measurements for COM Model is performed"

For more information on configuring Test Channel S-Parameter, Noise Channel S-Parameter and Excel Config File, refer to "LR configuration in the Test App" on page 123.

Parameters

Refer to "Calibration Parameters in Debug Mode" on page 122.

Procedure

This calibration validates the Broadband Noise (RMS) value using COM calibration until the COM value begins decreasing below 3dB.

Results

This calibrated values are displayed in a tabular format in the Results tab.

9 OIF CEI-56G LR PAM4 Tests

This section provides the test procedures for the OIF CEI-56G Rx Tests, which are applicable for the Long Reach (LR) standard.

As a prerequisite, run all OIF CEI-56G LR calibrations before running tests. Ensure that the DUT is properly connected to the BERT modules and the FlexDCA Oscilloscope.

Test Parameters in Debug Mode

The Debug Mode in the Configure tab of the Test Application consists of some parameters in addition to those that can be configured in the Compliance Mode. Besides, for some of the configuration options, you may enter custom values, which provides a greater flexibility in performing calibrations and tests.

For the Long Reach (MR) standard option, the following parameters are available for configuration.

Parameters common for all tests

- Baud Rate
- Victim Generator PAM4 Symbol Mapping
- Victim Generator PAM4 Custom Symbol Mapping
- Test Channel Configuration—'Low Loss' corresponds to Test1 whereas 'High Loss' corresponds to Test2; configured to meet the COM value
- Pre-Cursor2
- Pre-Cursor
- Main Cursor
- Post-Cursor1
- Post-Cursor2
- Noise Generator Channel Selection
- Victim Analyzer Module—If 'BERT Analyzer' is selected, manually configure the "Victim Analyzer Clock Source" parameter. If 'DCI' is selected, manually configure the "DUT Control Interface script file" and "DUT Control Interface Location" parameters.
- Victim Analyzer Clock Source
- Victim Analyzer PAM4 Symbol Mapping
- Victim Analyzer PAM4 Custom Symbol Mapping
- Target Error Ratio
- Target Confidence Level
- DUT Control Interface script file
- DUT Control Interface Location

Parameters for Receiver Interference Tolerance Test

- Broadband Noise Amplitude
- Broadband Noise Selector

Parameters for Receiver Jitter Tolerance Test

- Test Mode
- Jitter Profile Frequency1
- Jitter Profile Amplitude1
- Jitter Profile Frequency2
- Jitter Profile Amplitude2
- Jitter Profile Frequency3
- Jitter Profile Amplitude3
- Frequency Mode
- Start Frequency
- Stop Frequency
- Number of Steps
- Manual Frequency List

Receiver Interference Tolerance Test

Overview The Receiver Interference Tolerance Test validates that the receiver on each lane shall meet the pre-FEC BER requirement with channels matching the Channel Operating Margin (COM) and loss parameters for Test 1 and Test 2.

Connection Diagram Connect the instruments as shown in Figure 118.

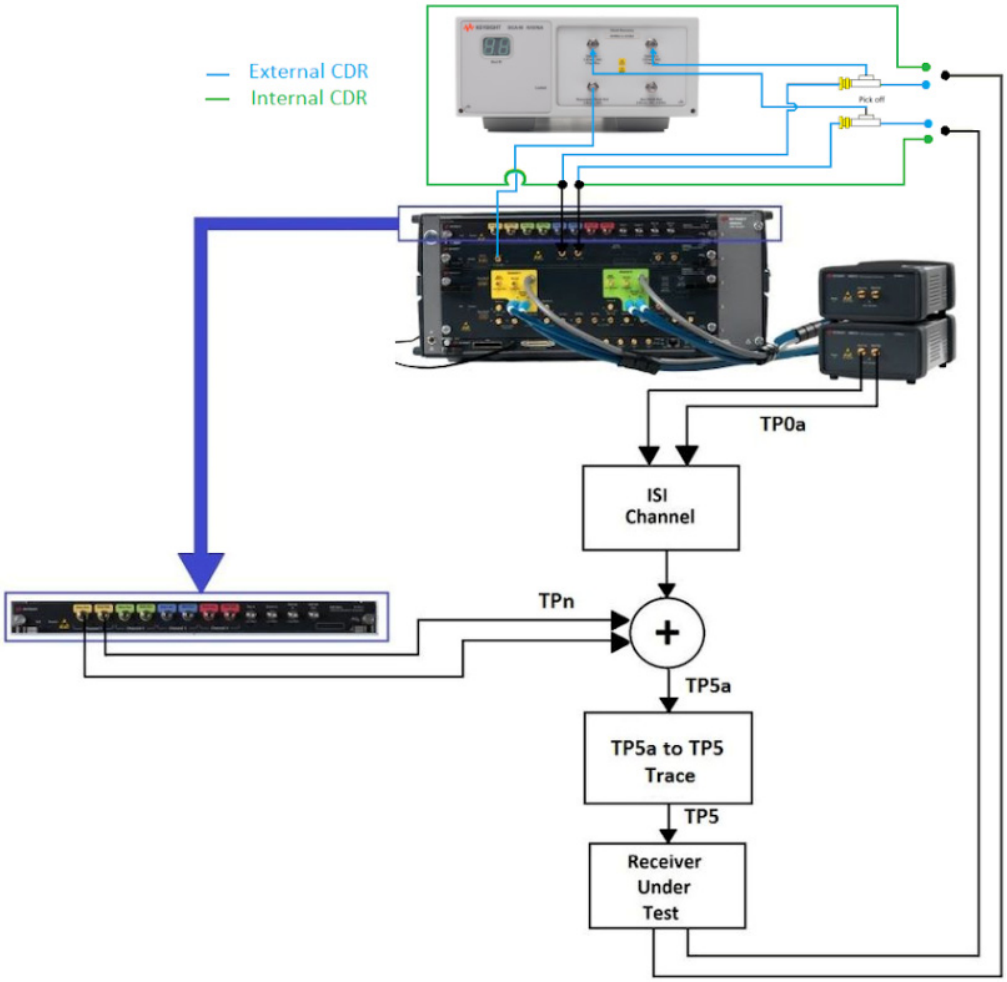


Figure 118 Rx Interference Tolerance Test connections for LR

ID

Standard Name	Test ID
Long Reach	675100

Dependencies This test depends on the values configured for the following calibrations:

- Broadband Noise Calibration
- Transmitter Measurements for COM Model
- Rx Calibration using COM model

Parameters Refer to "Test Parameters in Debug Mode" on page 152.

Procedure This test uses the QPRBS31-CEI pattern.

Results This test attains 'Pass' value if the Rx BER is less than 1e-4, as per the *OIF-CEI-4.0* specification.

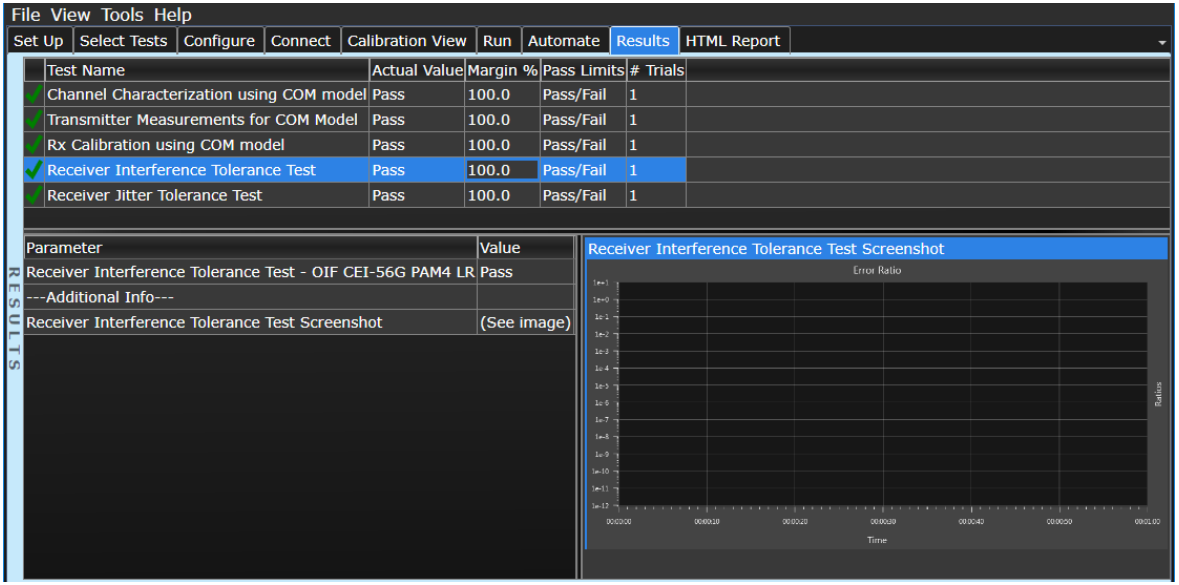


Figure 119 Rx Interference Tolerance Test results in tabular format

Receiver Jitter Tolerance Test

Overview The Receiver Jitter Tolerance Test validates that the receiver bit error ratio (BER) shall meet the requirements for each pair of jitter frequency and peak-to-peak amplitude values as per the *OIF-CEI-4.0* specification.

Connection Diagram Connect the instruments as shown in Figure 120.

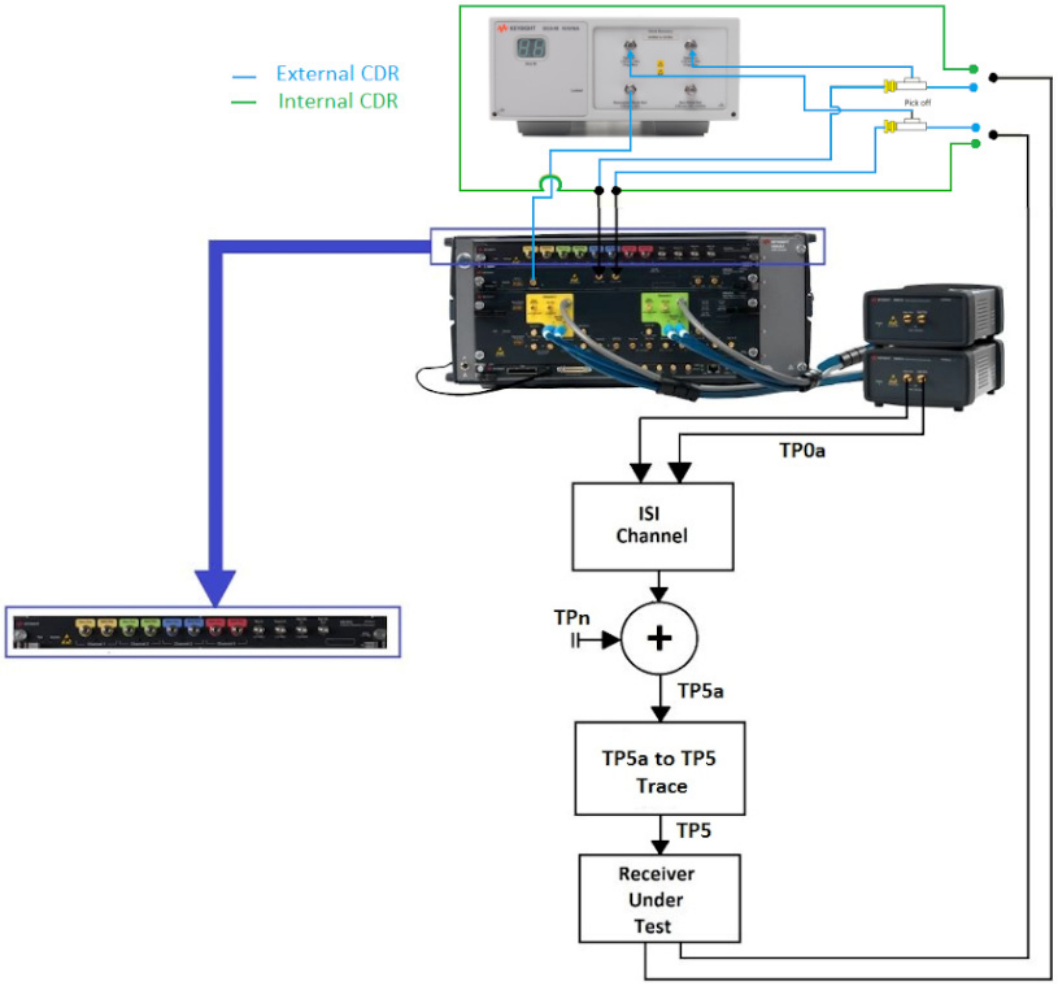


Figure 120 Rx Jitter Tolerance Test connections for LR

ID

Standard Name	Test ID
Long Reach	675101

Dependencies This test depends on the values configured for the following calibrations:

- SJ Calibration

Parameters Refer to "Test Parameters in Debug Mode" on page 152.

Procedure This test uses the QPRBS31-CEI pattern.

Results This test returns Pass/Fail for each Sinusoidal Jitter Amplitude & Frequency pair point.

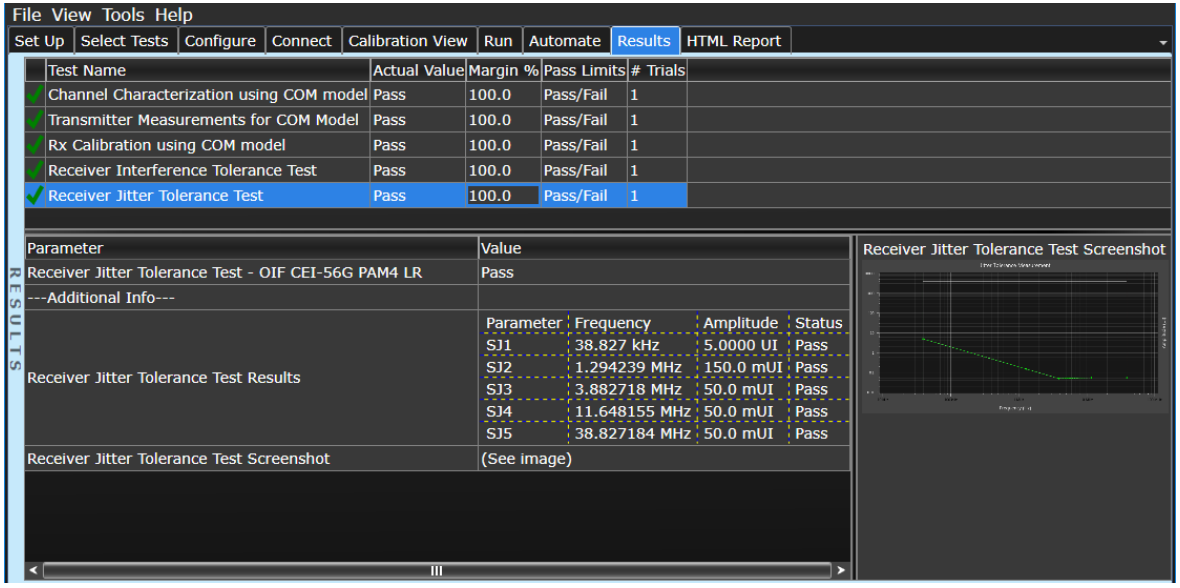


Figure 121 Rx Jitter Tolerance Test results

Parameter	Value			
Receiver Jitter Tolerance Test - OIF CEI-56G PAM4 LR	Pass			
---Additional Info---				
Receiver Jitter Tolerance Test Results	Parameter	Frequency	Amplitude	Status
	SJ1	38.827 kHz	5.0000 UI	Pass
	SJ2	1.294239 MHz	150.0 mUI	Pass
	SJ3	3.882718 MHz	50.0 mUI	Pass
	SJ4	11.648155 MHz	50.0 mUI	Pass
	SJ5	38.827184 MHz	50.0 mUI	Pass
Receiver Jitter Tolerance Test Screenshot	(See image)			

Figure 122 Rx Jitter Tolerance Test results in tabular format

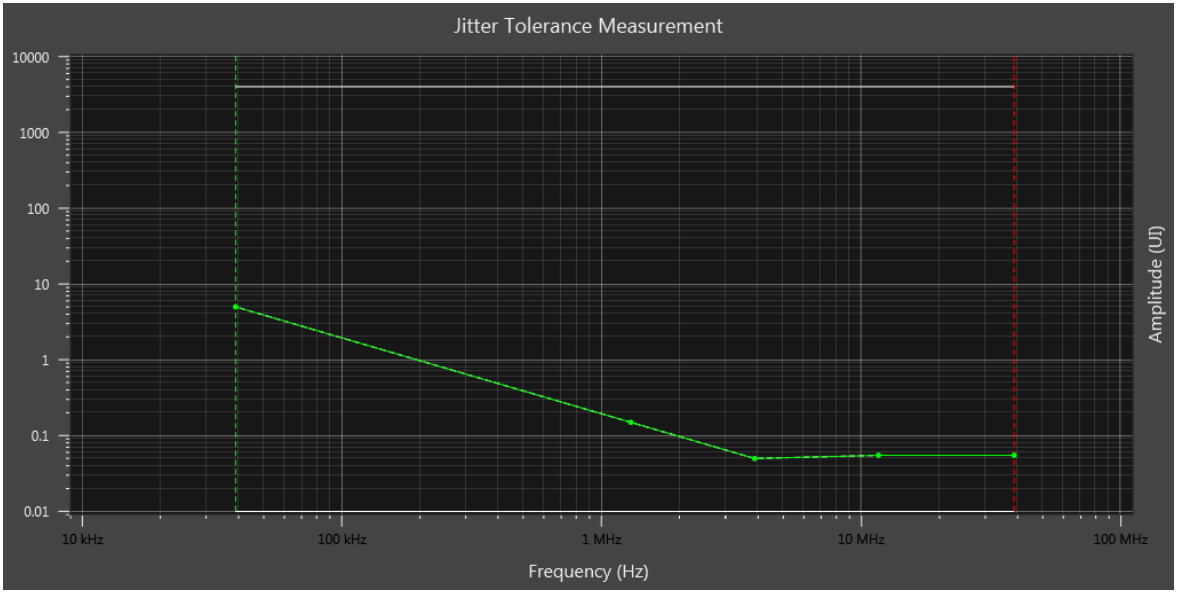


Figure 123 Rx Jitter Tolerance Test results in graphical format

10 Calibration & Test Results

KEYSIGHT TECHNOLOGIES

About Calibration View

The **Calibration View** tab displays the results from the calibrations run, in both graphical and tabular format.

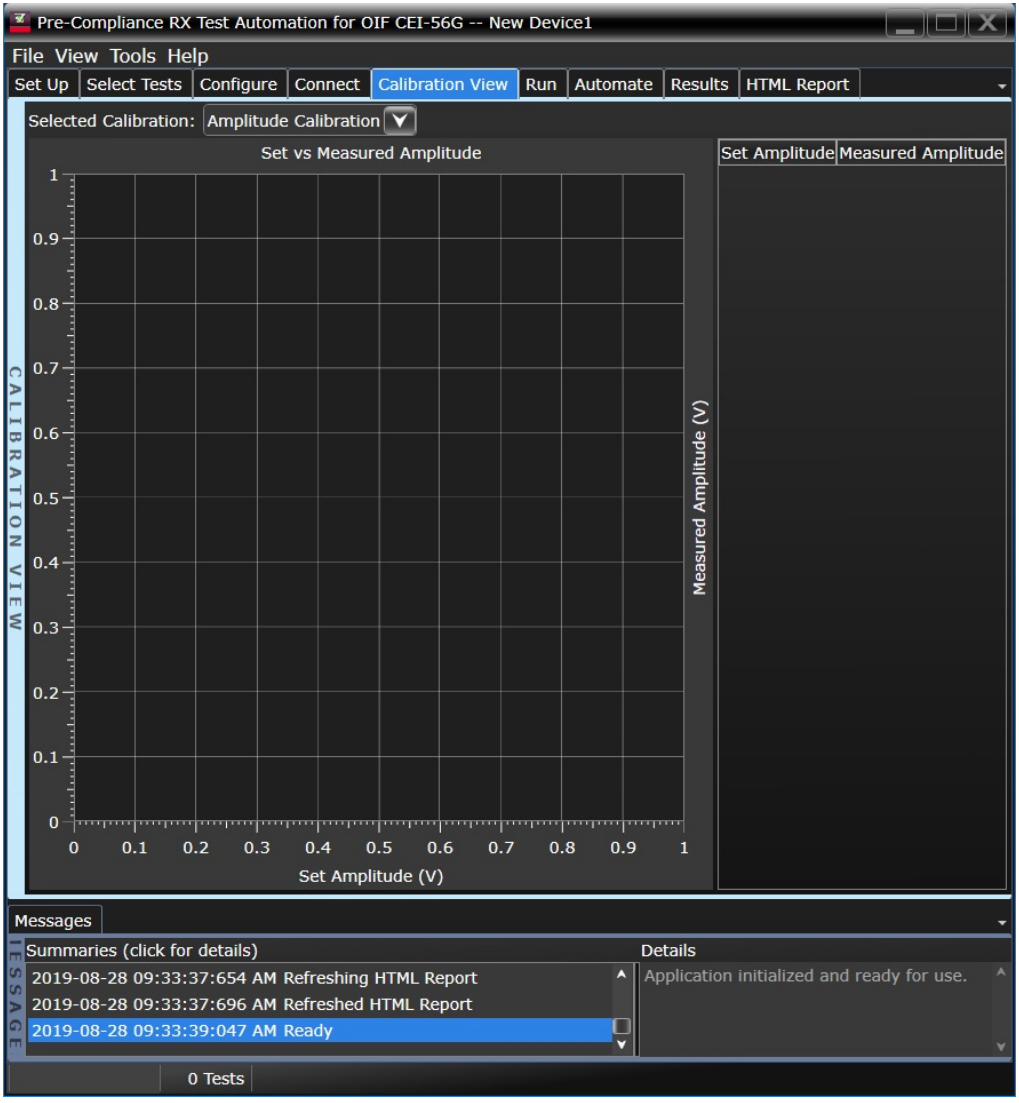


Figure 124 Default display of the Calibration View

After successful completion of the calibration run, the calibration results are reported in the **Calibration View** tab and **Results** tab.

The calibration results under the **Calibration View** tab include the following measurements:

- Set and measured values of the parameters being calibrated in a tabular format.
- Set and measured values of the parameters being calibrated in a graphical format.

NOTE

The Calibration View only plots graphs for continuous calibrations (such as Amplitude, SJ, UUGJ and Broadband Noise) and not single-point calibrations.

The Calibration View tab displays information related to calibrations only. All other results and associated information are displayed under the Results tab of the Test Application.

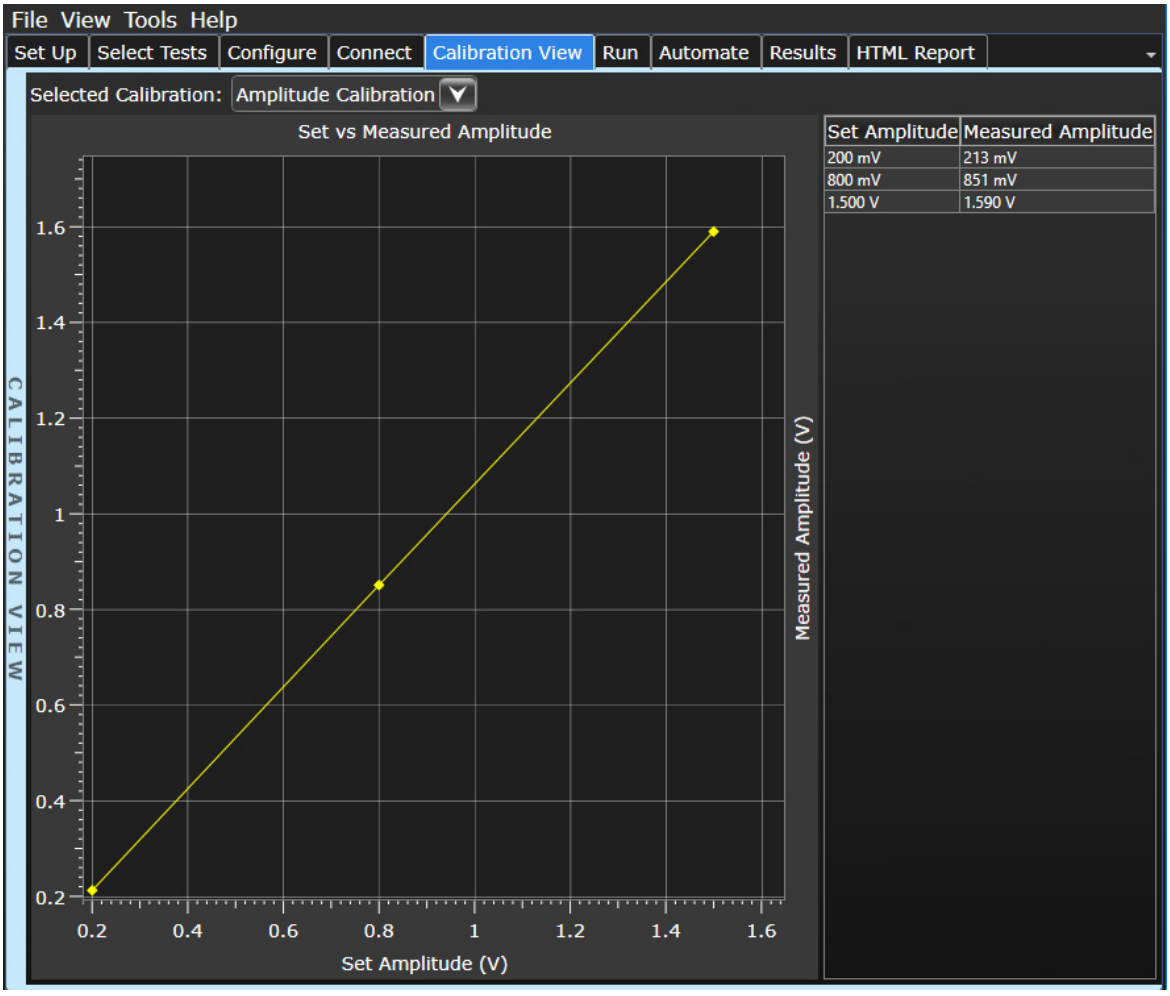


Figure 125 Display of the Calibration View after calibrations are performed

Exporting Measurement Results to Repository

The Upload Results To Repository feature is an add-on to the Keysight Test Application, where it expands the boundaries of storing and analyzing the measurement results to a wider audience, who may be based in multiple sites across various geographical locations. Along with the feature of exporting test results from the Test Application into your local disk in a CSV, HTML or PDF file formats, you have the option to upload the test results to a Dataset on a Web Repository. Based on your requirements, you may either upload only a single measurement trial or upload huge volumes of measurement results to any Dataset.

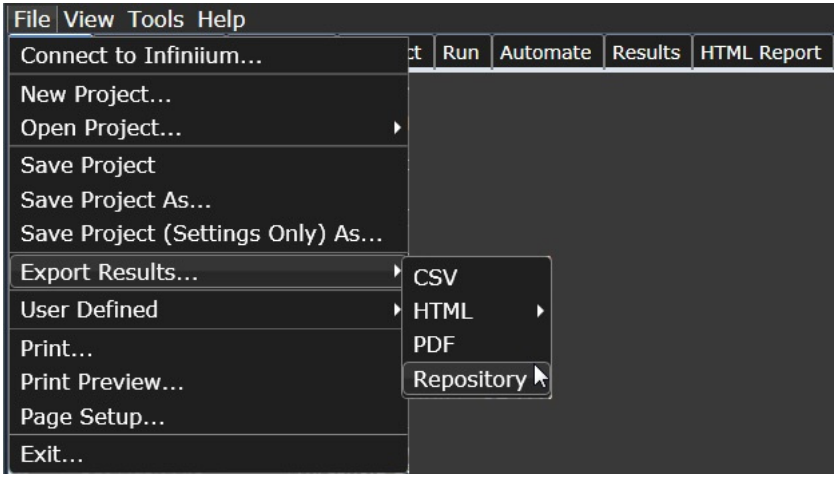
Not only can remote users with an active Internet connection access these Datasets and the corresponding test results on the Web Repository, but they have the option to add and delete Datasets on the Web Server. In the Upload Results To Repository feature, you can even modify the Dataset properties, which are helpful especially when performing a graphical analysis of the uploaded data.

In combination with the *Keysight KS6800A Series Analytics Software*, the Upload Results To Repository feature provides a comprehensive solution to export, view and perform analysis of the measurement results, thereby resulting in qualitative data to ensure that the Device Under Test (DUT) is compliant to the industry standards.

Refer to the *Keysight KS6800A Series Analytics Software Online Help* for more information about the functionality of various features in this software.

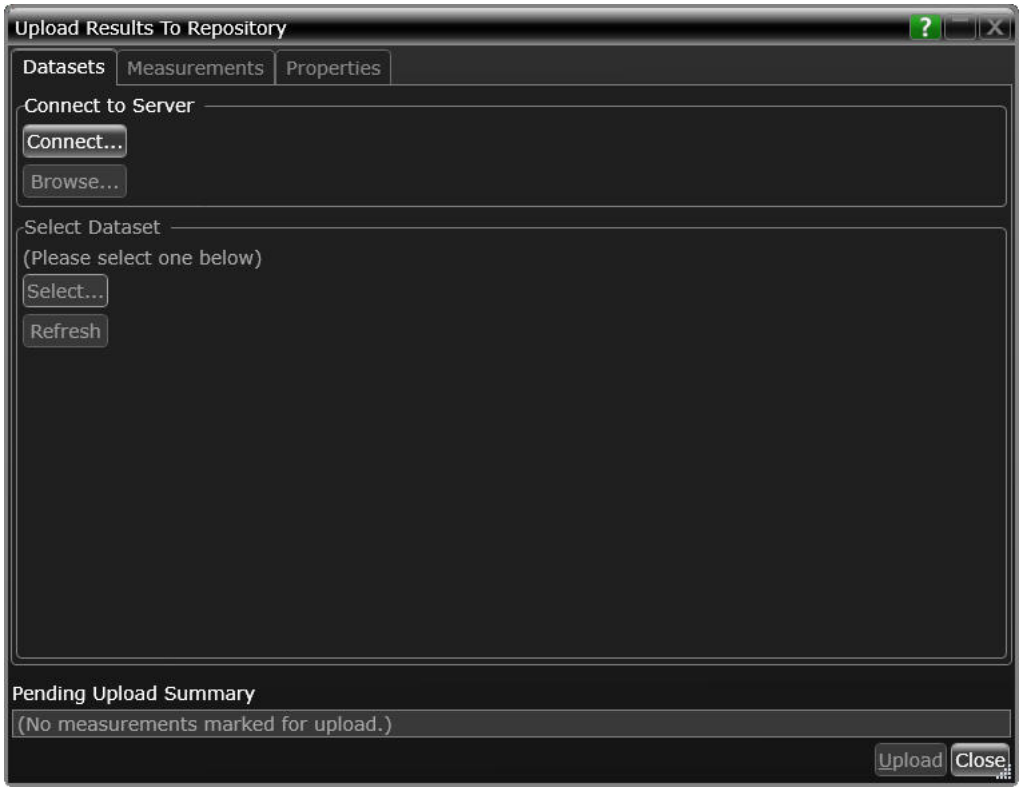
To export measurement results to the Repository after the completion of test runs,

1 From the Test Application's main menu, click **File > Export Results... > Repository**.



The **Upload Results to Repository** window appears.

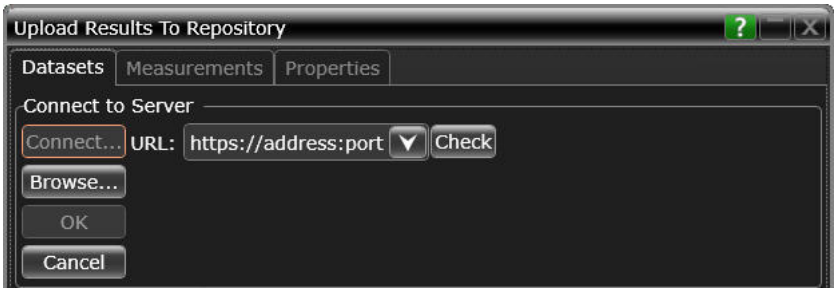
2 In the **Connect to Server** pane of the **Datasets** tab, click **Connect...** to login to the Dataset Repository server.



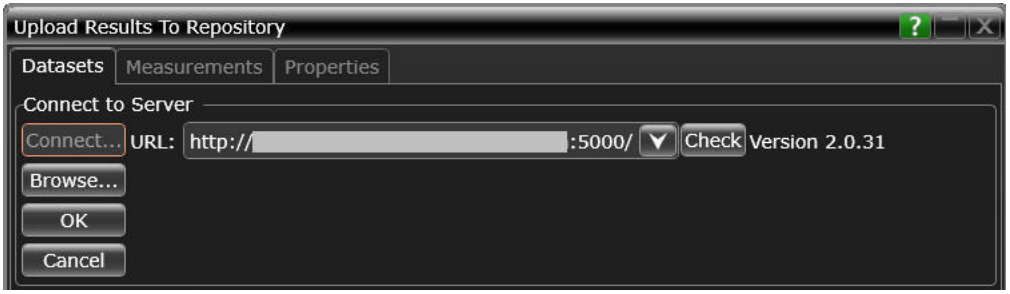
3 In the URL: drop-down text field that appears, replace the default text with the actual IP address or the URL along with the port number, if applicable.

You may enter the URL of the Web Repository server, which may be a self-hosted server on your machine (http://localhost:5000/), a remote server or an authentication server. Note that all such URLs accessed via this window appear as a drop-down list in the URL: field.

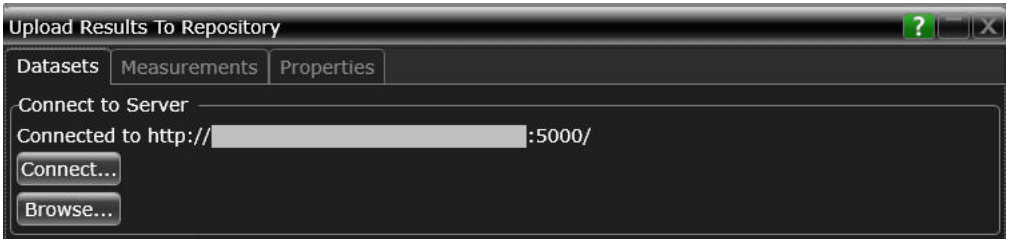
4 Click the Check button to verify that the KS6800A Series Analytics service is available on the specified web address. Repeat this step each time you edit the web address.



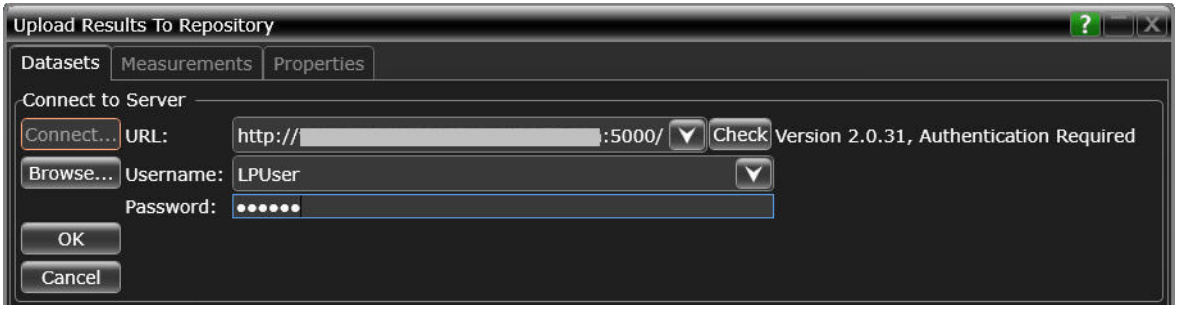
- For unrestricted access to the Repository
  - *a* If the server does not require authentication and the KS6800A Series Analytics service is found on the specified web address, the version information is displayed adjacent to the Check button.



  - *b* If you click OK, the Upload Results to Repository window displays the connectivity status to the Dataset Repository.
  - *c* Click Browse... to navigate directly to the URL.

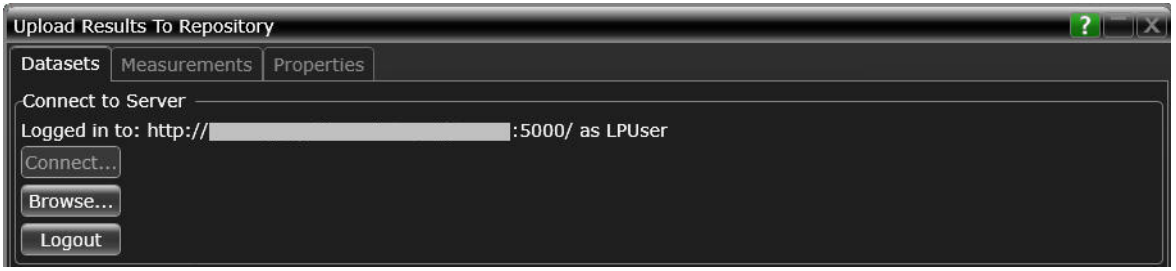


- For restricted access to the Repository
  - *a* If service is found on the specified URL but access to the web server is restricted based on authentication, the version information is displayed along with the text Authentication Required adjacent to the Check button. Also, the Username: and Password: fields appear. The OK button remains disabled until the authentication credentials are entered.
  - *b* Enter the user credentials in the respective fields, which are required for authentication to access those Datasets that have been created on the web server you are connecting to. For each URL that you access, the Username: drop-down box keeps a record and displays all user names used to access the respective URL.



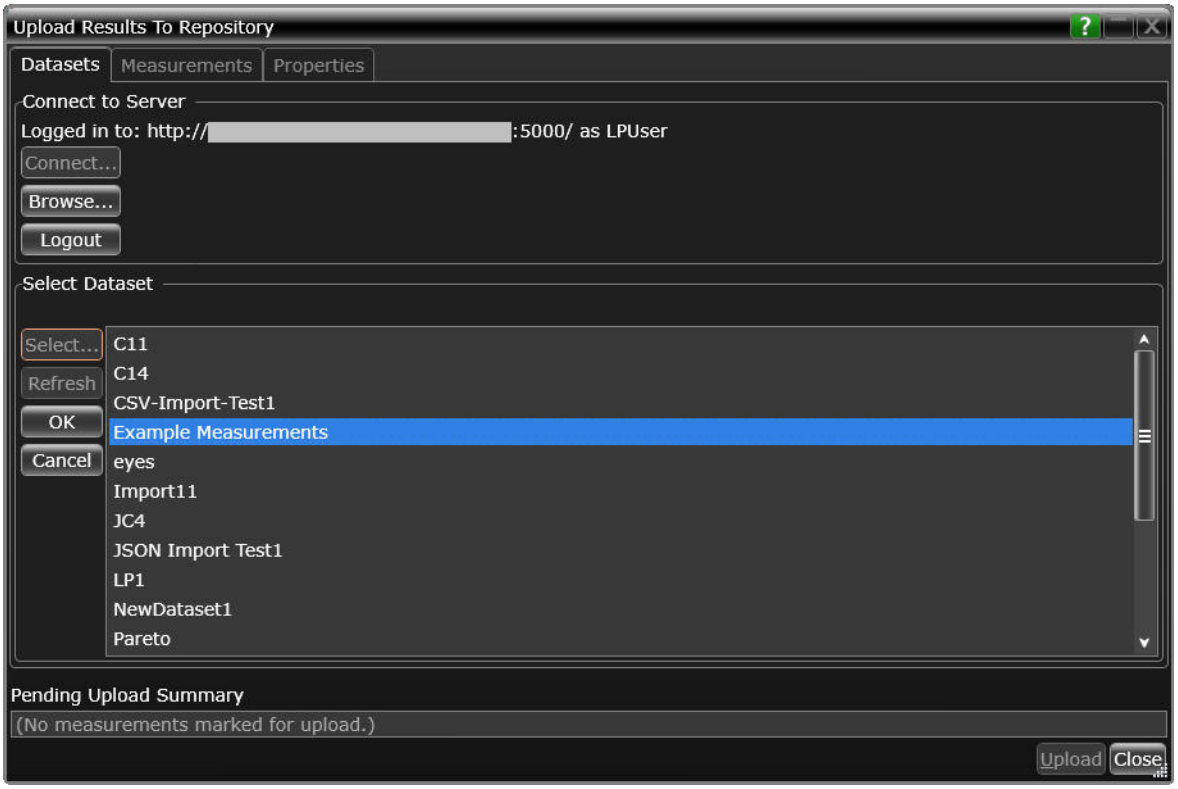
  - *c* Click OK to connect to the entered URL/IP address.

  The Connect to Server area displays the connection status along with the username.
  - *d* Click Browse... to navigate directly to the URL.

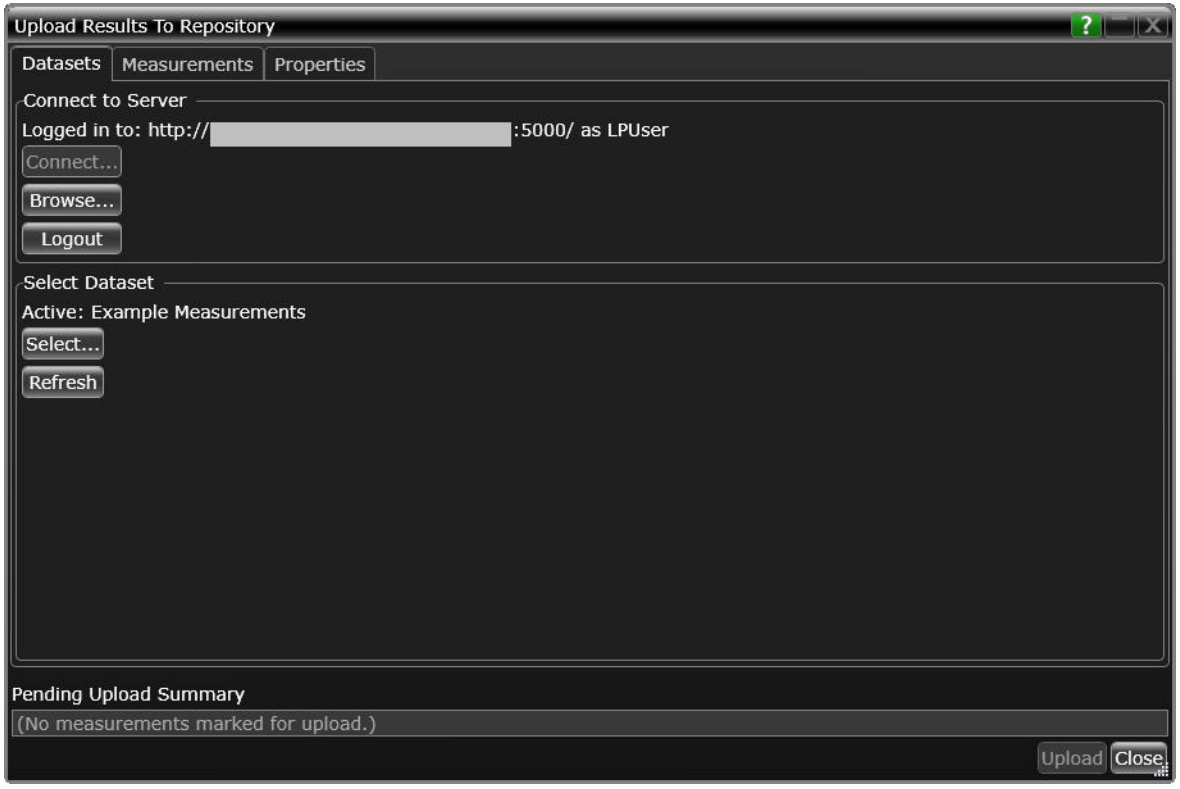


5 In the Select Dataset area, click Select... to view the list of Datasets created on the connected repository. Click Refresh to update the list of Datasets that appear in the Test Application's user interface.

6 Select the Dataset name where you wish to upload measurement results to. Click OK.

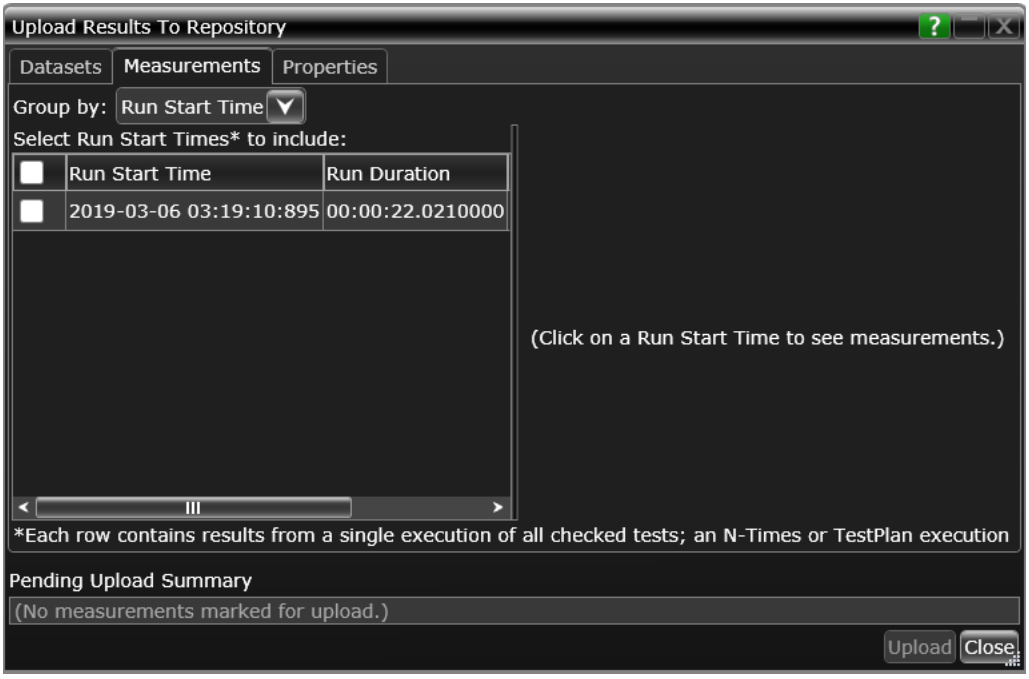


The Select Dataset area displays the selected Dataset as Active. The Measurements and Properties tabs are enabled after a Dataset is selected.



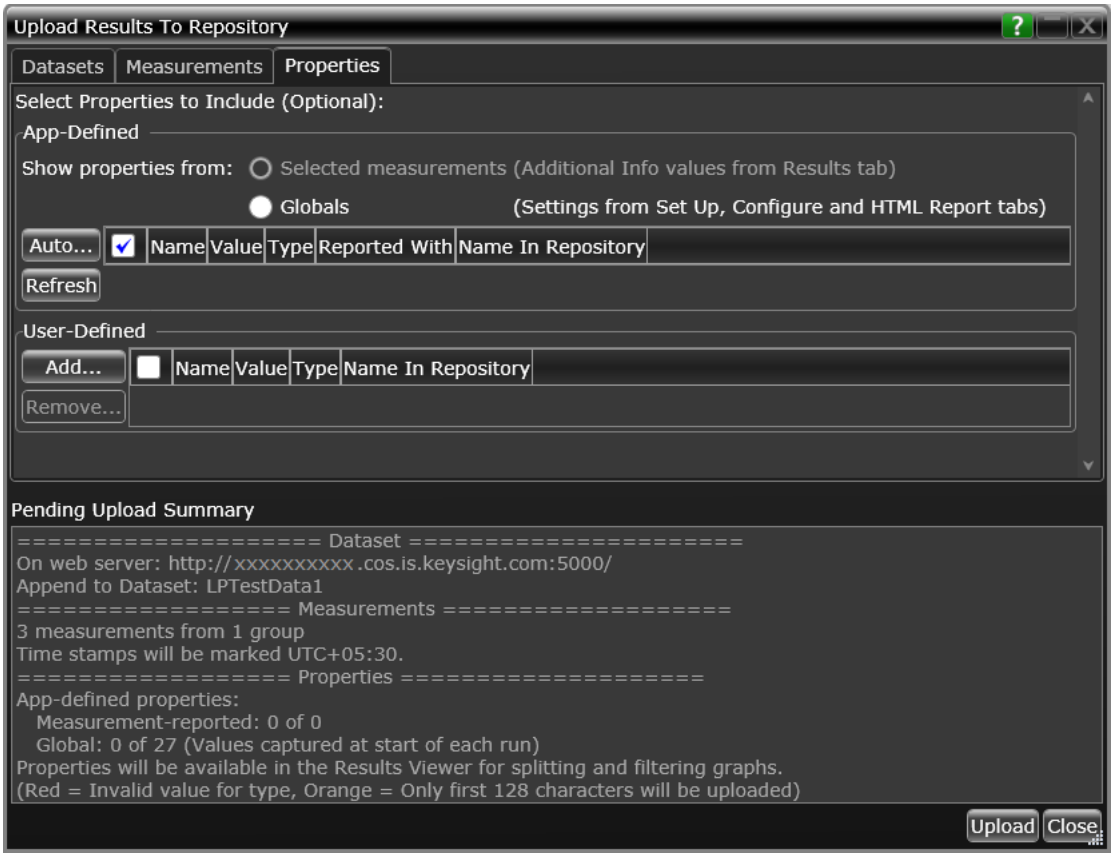
7 Click the **Measurements** tab where the test results from the last test run are displayed.

8 You may select and export multiple test results to the repository. You may change the format for the display of measurement data using the drop-down options in the **Group by:** field.

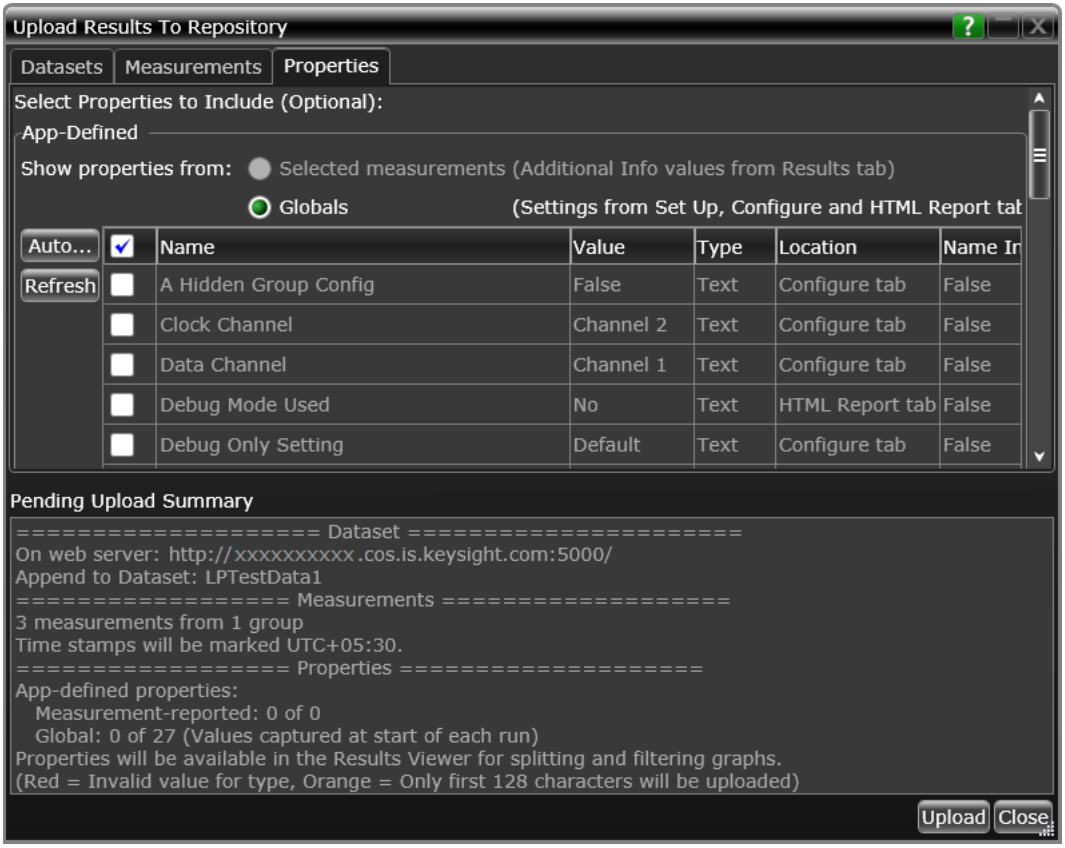


9 After selecting one or more measurements, either click **Upload** or switch to the **Properties** tab to associate one or more properties to the measurements that are being uploaded to the Web Server.

To perform an enhanced analysis on the measurement data using the *KS6800A Series Analytics Service Software*, Keysight recommends assigning properties to the measurements.



10 Click the **Properties** tab to assign properties for your measurement results that you select to upload. By default, the **App-Defined** properties are selected to be uploaded in association with the measurement data, wherein only certain aspects of the selected measurements are uploaded. However, you may switch to **Globals** to include as properties one or more options configured under the rest of the tabs of the Compliance Test Application or define one or more custom property values to be associated with the selected measurement data.



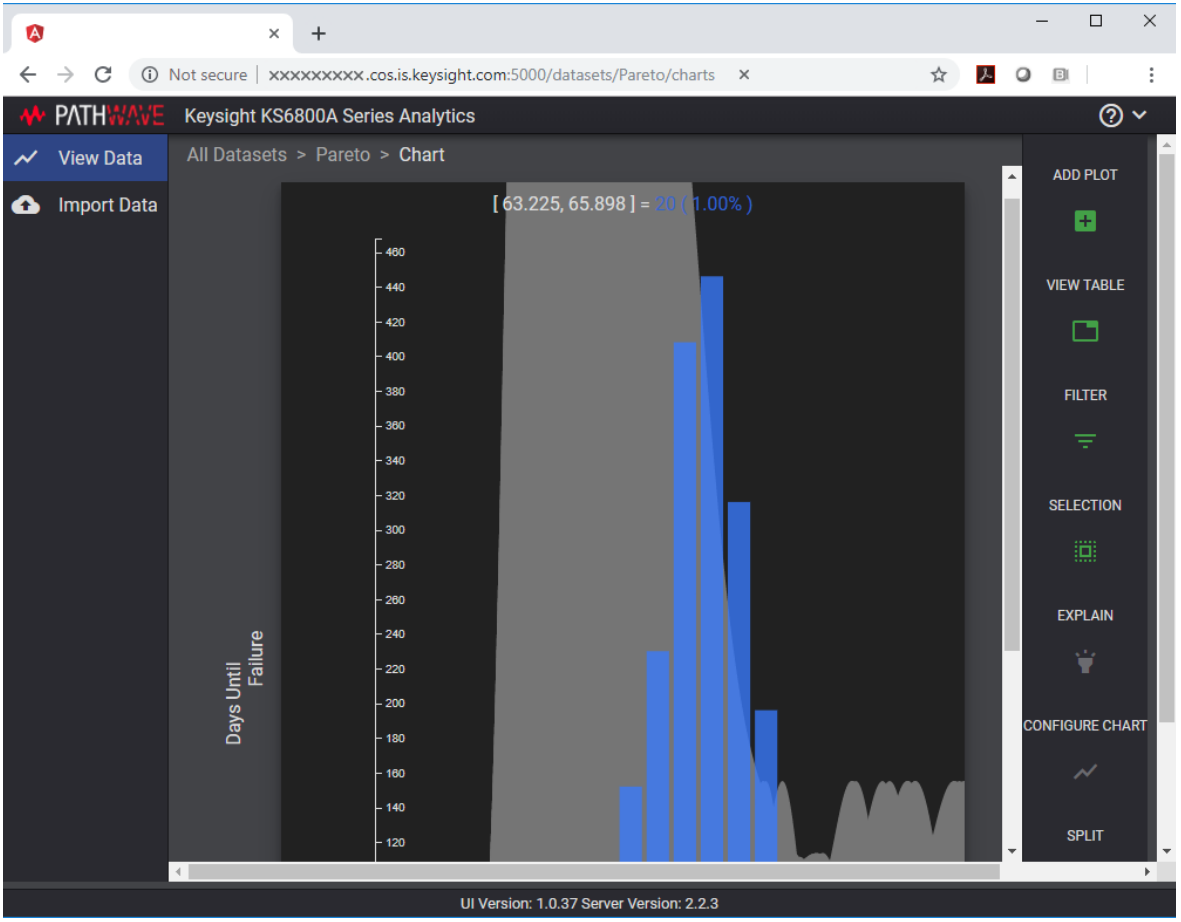
11 Click **Upload** to begin uploading measurement results.

12 Click **Close** to exit the **Upload Results to Repository** window and to return to the Compliance Test Application.

You may access the Dataset Repository using the Internet browser on your machine to view the measurement results graphically on the *KS6800A Series Analytics Service Software*.

KS6800A Series Analytics Service Software

The KS6800A Series Analytics Service software supports multiple data sources and also a wide range of data import clients. This web-based software provides various types of charts, such as Histogram, Box-and-Whisker, Line, Scatter, Eye Diagram and Constellation, each with split capability to enable data analysis. Once you upload the measurement results to a Dataset on the *KS6800A Series Analytics Service Software* via the **Upload Results to Repository** window of the Test Application, the measurement results can be viewed graphically as shown below:



For more information on the Data Analytics Web Service Software, visit KS6800A Series Analytics Service Software page on the Keysight website. You may refer to the Help manual provided within the software to understand the functionality of its features.

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