Keysight M8091CKPA Pre-Compliance Rx Test Application for IEEE 802.3ck

User Guide

KEYSIGHT TECHNOLOGIES

Notices

Manual Part Number

M8070-91300

Edition

Edition 6.2, June 2022

Address

Keysight Technologies Deutschland GmbH
Herrenberger Strasse 130,
71034 Böblingen, Germany

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User Guide

1 Introduction

This chapter provides an overview of the IEEE 802.3ck Rx Test Application and the related documents that can be consulted.

KEYSIGHT TECHNOLOGIES

Overview

The IEEE P802.3ck 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interfaces Task Force is currently developing interoperability test procedures for chip-to-chip (C2C) and chip-to-module (C2M) Attachment Unit Interface based on 53.125 Gbaud PAM4 signaling.

The Keysight M8091CKPA Rx Test Application for IEEE 802.3ck standard provides a framework for using Keysight M8000 BERT Test Solutions along with Keysight DCA Oscilloscopes to perform Receiver testing based on the calibration and test procedures defined in *Annex 120F* and *Annex 120G* of the *IEEE P802.3ck™/D3.2, Draft Standard for Ethernet Amendment: Physical Layer Specifications and Management Parameters for 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interfaces Based on 100 Gb/s Signaling*.

Chip-to-Module

The Chip-to-Module (C2M) test procedures are based on the stressed eye method. Characteristics of a test signal are adjusted towards specific values following a precise calibration procedure. The stress input test signal is defined for devices on both module and host sides.

Chip-to-Chip

The Chip-to-Chip (C2C) test procedure is based on the Channel Operating Margin (COM) method, which was first introduced in *IEEE Annex 93C, IEEE Std 802.3bj-2014, Amendment to IEEE Std 802.3-2012: Ethernet*. For the receiver interference tolerance test, a broadband noise is injected into the test signal after the channel, so that the targeted COM, which the receiver is supposed to accommodate for, is achieved. The amplitude of the broadband noise depends on the transmitter and channel characteristics and must be adjusted very carefully. No broadband noise is injected for the receiver jitter tolerance test.

Related Documents

- *IEEE P802.3ck™/D3.2, Draft Standard for Ethernet Amendment: Physical Layer Specifications and Management Parameters for 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interfaces Based on 100 Gb/s Signaling*.
- 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 IEEE 802.3ck Rx Test App

As a prerequisite to installing the IEEE 802.3ck Rx Test Application, you require the necessary hardware, along with installing certain software and licenses.

System requirements

PC Hardware requirements

The following hardware configurations are required to run compliance tests on a device under test (DUT) using the IEEE 802.3ck 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. 8.0 or higher
    Note that if you are using version 8.5, then use the latest version 8.5.380.14.
- M8070ADVB Advanced Measurement Package for M8000 Series
  - Ver. 1.6.180.2
- M8194A Firmware and Soft Front Panel version 2.0.31.0 or M8196A Soft Front Panel version 2.1.1.0
- 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
- FlexDCA version A.06.90

Table 1 shows the required equipment for each IEEE 802.3ck standard option supported by the Test Application.

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

Equipment Type	C2M	C2C
Victim Pattern Generator	▪ M8045A	▪ M8045A
Crosstalk Generator	▪ 2nd Channel of M8045A ▪ 3rd party Crosstalk Generator	▪ NA
Interference Source	▪ NA	▪ M8194A / M8196A / M8054A ▪ 3rd party Noise Generator
Victim Error Detector	▪ M8046A ▪ DCI (DUT Control Interface)	▪ M8046A ▪ DCI (DUT Control Interface)
Clock Recovery	▪ M8046A - 0A5 (internal CDR) ▪ N1076B / N1078A	▪ M8046A - 0A5 (internal CDR) ▪ N1076B / N1078A
DCA-X	▪ N1000A + N1060A	▪ N1000A + N1060A

NOTE

You can retrieve the BER from the DUT internal error counters (if available) by making use of the "DUT Control Interface (DCI)". For information about DCI, refer to the *DUT Control Interface* topic in the *M8070ADVB Advanced Measurement Package User Guide*.

Required Configuration & licenses

The IEEE 802.3ck Rx Test Application is a licensed feature. To use the application with the recommended hardware and software arrangements, the following licenses are required:

Table 2 M8040A 64GBaud BERT (1st BERT Module minimum required configuration)

Product	Description
M8040A-BU2	Bundle consisting of one M9505A 5-slot AXIe Chassis plus control module with USB option
M8045A	Pattern generator and clock module 64 Gbaud, 3 slot AXIe
M8045A-G64	Pattern generator one channel NRZ, data rate up to 64 Gbaud (requires Remote Head, such as M8057A)
M8045A-0G3	Advanced jitter sources for receiver characterization, license
M8045A-0G4	De-emphasis, module-wide license
M8045A-0P3	PAM4 encoding up to 32 Gbaud, module-wide license
M8045A-0P6	PAM4 extension up to 64 Gbaud, module-wide license
M8057B-FG	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 Error Detector minimum required configuration*

Product	Description
M8046A	Analyzer module, 32/64 Gbaud, 1-slot AXIe
M8046A-A64	Analyzer, one channel, data rate up to 64 Gbaud, NRZ
M8046A-0A4	Clock recovery for 32 Gbaud, license
M8046A-0A5	Clock Recovery Extension up to 64 Gbaud, license
M8046A-0P3	PAM4 decoding up to 32 Gbaud, license
M8046A-0P6	PAM4 extension up to 58 Gbaud, license

Product	Description
M8046A-0A3	Equalizer 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) - two matched cable pairs are required
M8046A-801	Cable 2.92 mm (m) to 2.92 mm (m), 0.5 m for clock input (Qty 1)

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

NOTE

To establish a successful connection between the IEEE 802.3ck 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)
- For C2C: M8054A or M819xA in slot 5 (M3)

In configuration that does not involve M8046A (M2), the following sequence can be used:

- M8045A in slots 1-3 (M1)
- For C2C: M8054A or M819xA in slot 4 or 5 (M2)

Table 4 Electrical Clock Recovery*

Product	Description
N1076B/N1078A	Electrical/Optical Clock Recovery
N107xx-264	Supported input rates: 125 MBd to 64 GBd
N1076B-CR1	Clock Recovery Phase Matching Kit for N1076B Electrical

Product	Description
N1076B-2P8	Microwave Pick-Off Tee 1.85 mm connectors, matched pair
11900B	Adapter, 2.4 mm (f) to 2.4 mm (f), DC to 50 GHz
83059A	Coaxial Adapter, 3.5 mm (m) to 3.5 mm (m), DC to 26.5 GHz

*Select if external clock recovery is required for BER measurement using ED. No electrical CDR is required if M8046A-0A4/0A5 options have 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 For C2C tests: Interference source minimum required configuration*

Product	Description
M8194A	120 GSa/s arbitrary waveform generator
M8194A-001	Arbitrary Waveform Generator, 1 Channel, 120 GSa/s
M8196A	92 GSa/s Arbitrary Waveform Generator
M8196A-001	Arbitrary Waveform Generator, 1 Channel, 92 GSa/s
M8054A	Interference Source, 32 GHz

*Choose only one model of Interference Source.

Table 7 Select DCA configuration (N1000A DCA-X + N1060A)

Product	Description
DCA-X mainframe minimum configuration	
N1000A	DCA-X Wide-Bandwidth Oscilloscope Mainframe
N1000A-PLK	Pattern Lock Trigger Hardware Model
Either choose legacy DCA option	
N1010AT-200	Enhanced Jitter Analysis SW
N1010AT-201	Advanced Waveform analysis
N1010AT-9FP	PAM-N analysis software
N1010AT-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 N1060A Precision Waveform Analyzer minimum configuration

Product	Description
N1060A-050	Two 50 GHz channels
N1060A-EVA	Equalizer Integrated, Variable
N1060A-264	Supported input rates: 125 MBd to 64 GBd
N1060A-PTB	Precision Timebase, Ultra-Low Random Jitter
N1060A-JSA	Jitter Spectrum Analysis and Clock Recovery Emulation

Table 9 Fixtures*

Product	Description
M8049A	ISI Channel Board
M8049A-002	ISI Channel Board, Nine Traces from 0.8 to 8.0 inches (for C2M and C2C low loss)
M8049A-003	ISI Channel Board, Seven Traces from 9.1 to 22.3 inches (for C2C high loss)
SP0602A	Wilder OSFP 112G/800G MCB 1.85mm Receptacle Test Adapter
SP0603A	Wilder OSFP 112G/800G HCB Plug 1.85mm Test Adapter
SP0606A	Wilder QSFP-DD 112G/800G MCB 1.85mm Receptacle Test Adapter
SP0607A	Wilder QSFP-DD 112G/800G HCB Plug 1.85mm Test Adapter

*The characteristics of the test channel consisting of Keysight M8049A ISI boards and mated test fixtures may not be sufficient to ensure successful calibration for chip-to-module (C2M) long channel. The M8049A ISI channel boards exhibit a dip at 40GHz which make the performance marginal for 100G C2M and C2C applications.

Table 10 M8091CKPA software configuration

Product	Description
M8091CKPA-1xx	Pre-Compliance RX Test Application license for IEEE 802.3ck (node-locked, transportable floating or USB license)

Installing the Software

The installer for the IEEE 802.3ck Rx Test Application can be downloaded from the Keysight website.

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

To install the IEEE 802.3ck Rx Test Application,

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

The Installation Wizard for the Keysight IEEE 802.3ck Rx Test Application appears.

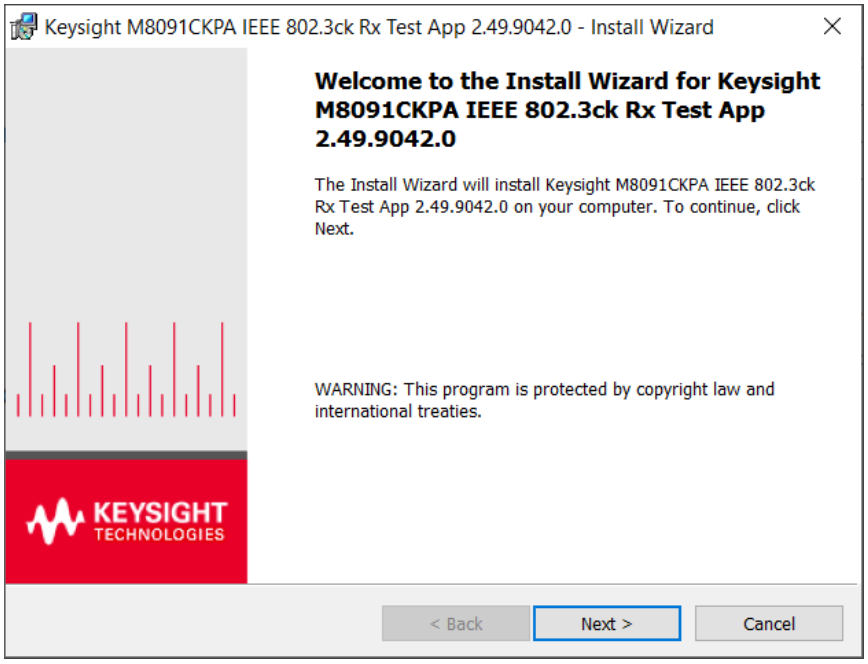


Figure 1 Installation wizard for the IEEE 802.3ck Rx Test Application

NOTE The application version in your installer screens might look different from what is displayed in the images in this section.

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.

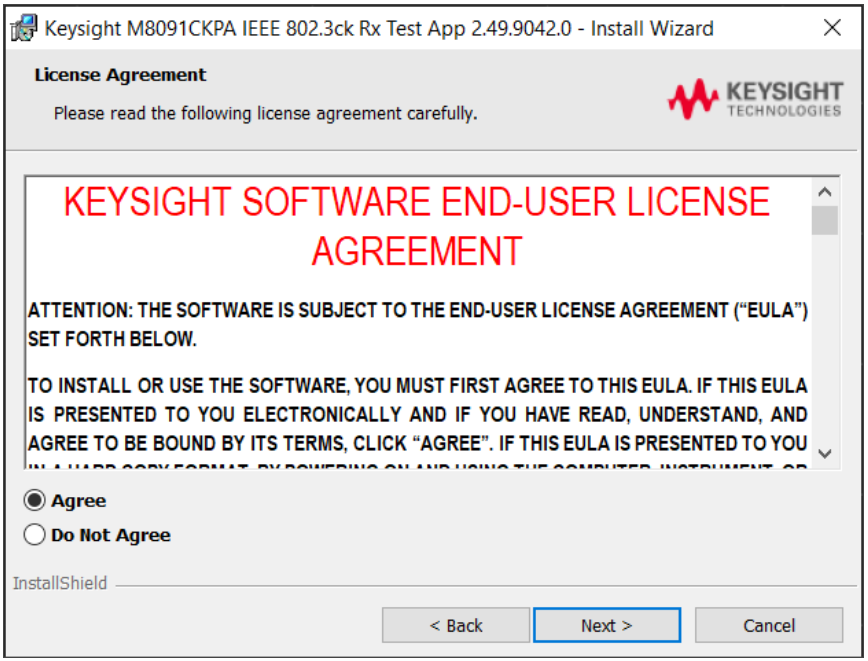


Figure 2 License Agreement window

4 Click **Next**.

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

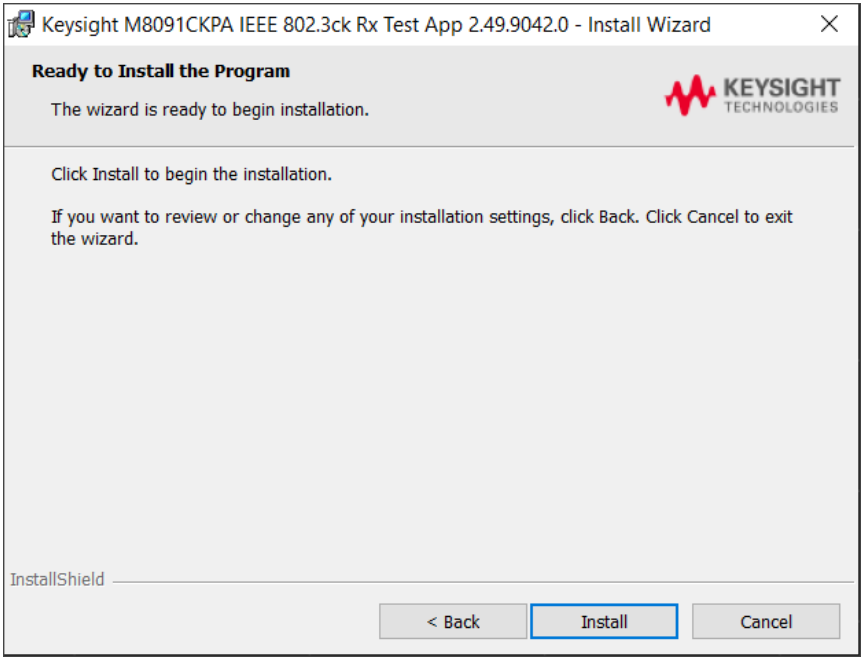


Figure 3 Window to begin Application installation

6 Once the installation of the IEEE 802.3ck Rx Test Application begins, its status is displayed.

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

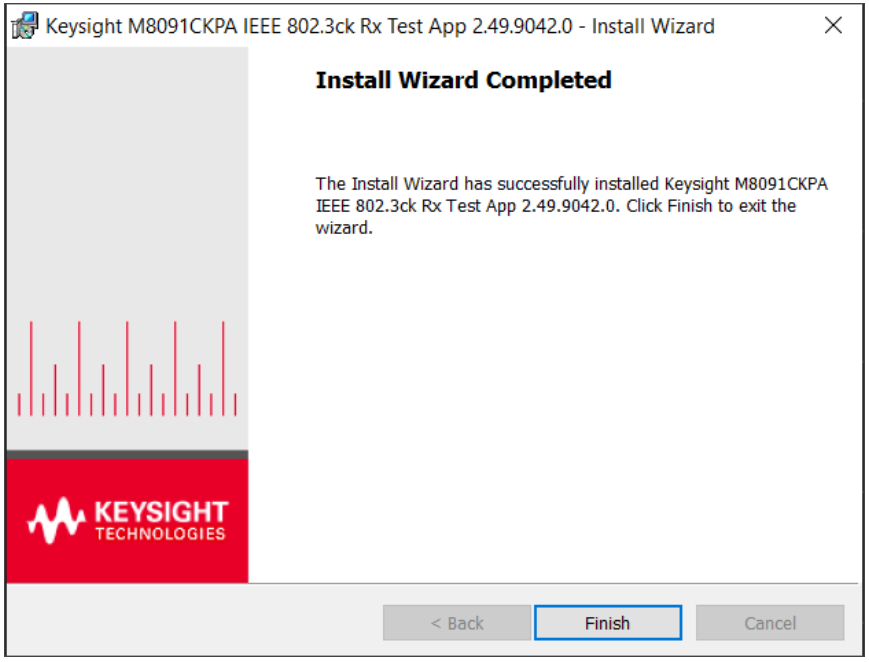


Figure 4 Window indicating end of installation

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.

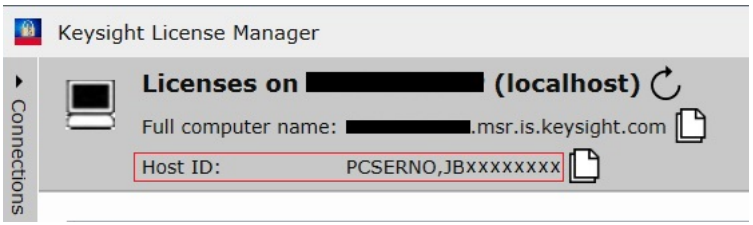


Figure 5 Viewing the Host ID information in KLM 5

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.

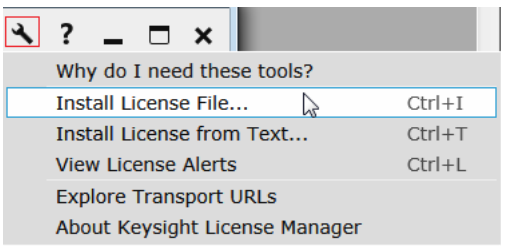


Figure 6 Configuration menu options to install licenses on KLM 5

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 7) that appears in the Environment tab of the application. Note that x indicates numeric values.

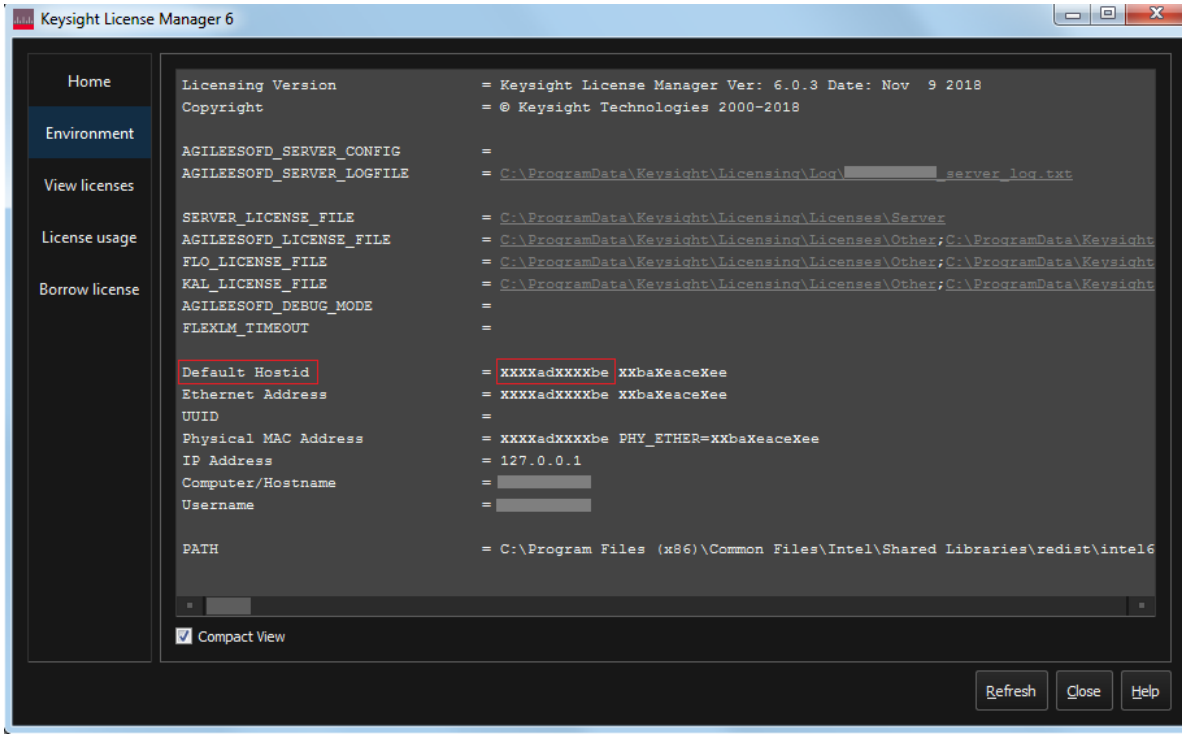


Figure 7 Viewing the Host ID information in KLM 6

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.

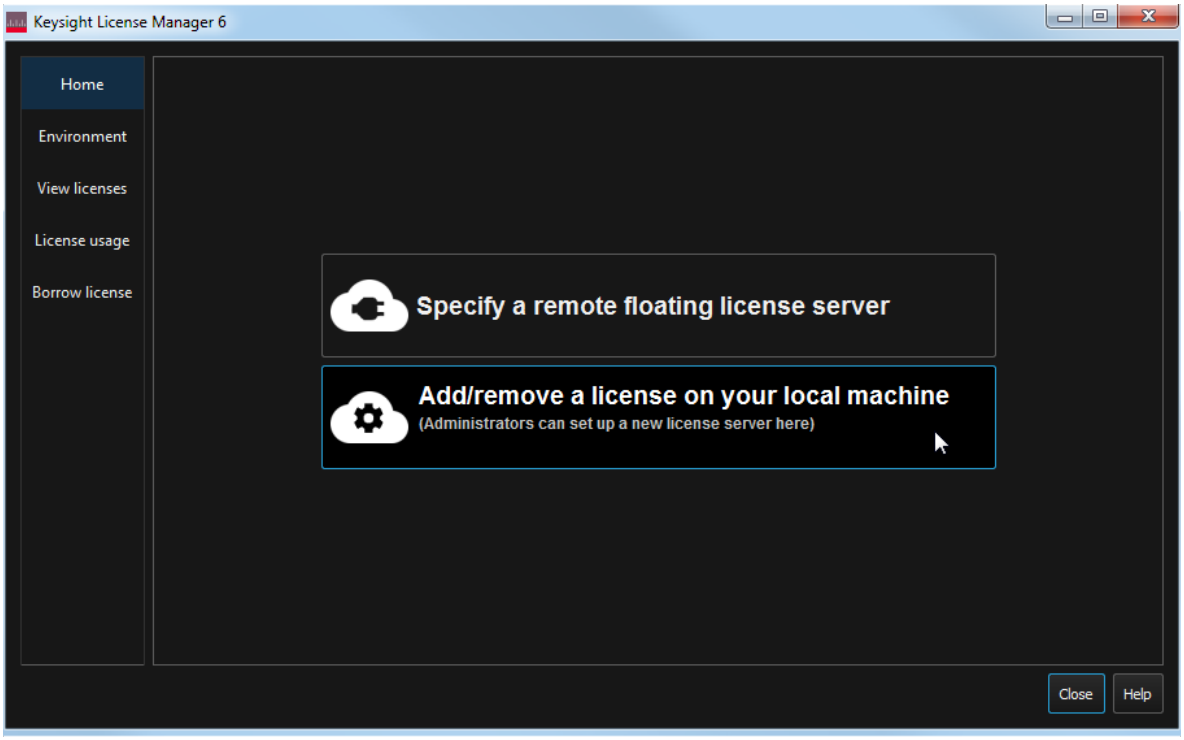


Figure 8 Home menu options to install licenses on KLM 6

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 IEEE 802.3ck Rx Test Application is installed.

Calibrating the Instruments

If you haven't already calibrated the DCA oscilloscope, Keysight recommends calibrating the oscilloscope before performing calibrations or tests using the IEEE 802.3ck Rx Test Application.

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

2 From the main menu of the FlexDCA N1000-Series System Software, select **Tools** > **Calibrations...**The Calibrations dialog box will appear.

3 Follow the on-screen instructions to perform all calibrations, including the DCA module Skew calibration.

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* documentation for more details.

Skew Calibration

Before performing the IEEE 802.3ck C2C/C2M calibrations and tests, Keysight recommends the use of external Phase Trimmers to measure and remove the skew contributed by the pattern generator, fixture, and cables.

NOTE First, ensure that the oscilloscope calibrations and internal skew calibration are valid.

System Calibrations

For any calibrations where the M8040A BERT remote head is directly connected to the DCA Oscilloscope, then **if the recommended M8045AA-801 short matched cables are used, there should be no need to de-skew the data normal and data complement signals**.

If other cables are used, then the skew should be checked and if needed, be adjusted to be less than 3 ps. Insert a phase trimmer, Keysight part number N1027A-PT2, in both the data normal and data complement signal path and adjust them until the desired skew is obtained. It should be possible to essentially zero-out the skew to just few hundred femtoseconds. When the de-skew is complete, lock the phase trimmer adjustment, and keep the phase trimmers in the normal and complement path throughout the entire calibration and DUT test procedures.

Figure 9 shows the example of a M8040A remote head connected directly to DCA Oscilloscope with M8045A-801 cables, as used in C2M Amplitude, SJ, UUGJ, BUJ and Transmitter Characterization and in C2C Amplitude, SJ, UUGJ, Transmitter Measurements for COM Model-Rx ITol/JTol calibration steps.

Figure 9 System Calibrations

Stressed Eye Calibrations

For C2M Stressed Eye calibrations, the skew should be checked at the output of the MCB/HCB pair **for each calibration configuration**, and if needed, adjusted to be less than 1 ps. Insert a phase trimmer, Keysight part number N1027A-PT2, in both the data normal and data complement signal path and adjust them until the desired skew is obtained. It should be possible to essentially zero-out the skew to just a few hundred femtoseconds. When the de-skew is complete, lock the phase trimmer adjustment, and keep the phase trimmers in the normal and complement path throughout the entire calibration and DUT test procedures.

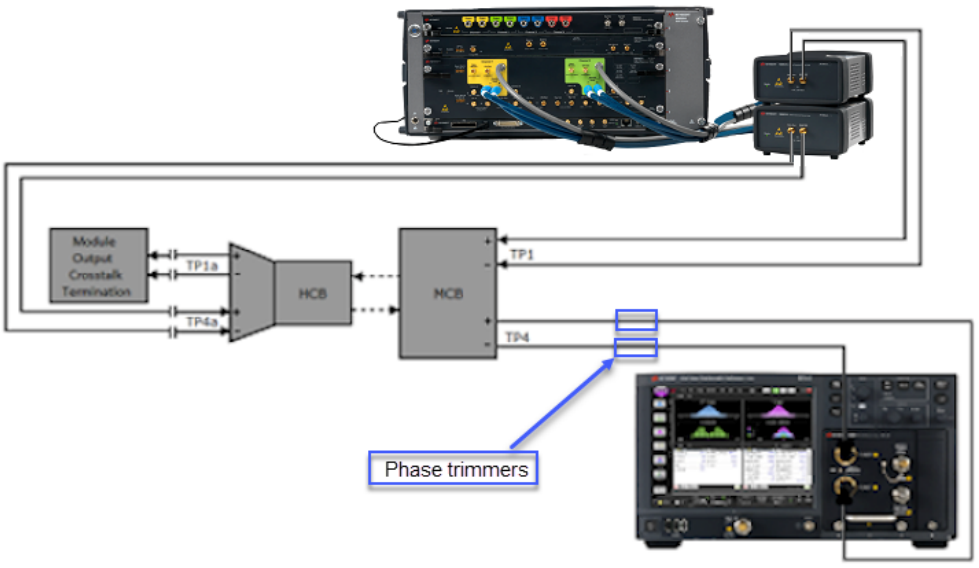


Figure 10 Stressed Eye Calibration connections for C2M Host with phase trimmers for de-skew

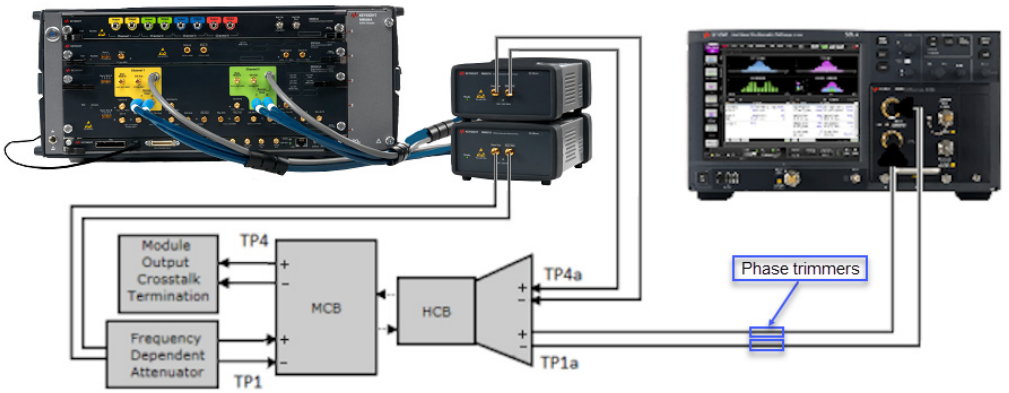


Figure 11 Stressed Eye Calibration connections for C2M Module with phase trimmers for de-skew

COM-related Calibrations

No de-skew is required for C2C COM-related calibrations since they are calculated from the channel S-parameter files. However, the skew of the DUT test setup should be checked at the output of the couplers **for each calibration configuration**, and if needed, adjusted to be less than 1 ps.

Insert a phase trimmer, Keysight part number N1027A-PT2, in both the data normal and data complement signal path and adjust them until the desired skew is obtained. It should be possible to essentially zero-out the skew to just few hundred femtoseconds. When the de-skew is complete, lock the phase trimmer adjustment, and keep the phase trimmers in the normal and complement path throughout the DUT test procedures.

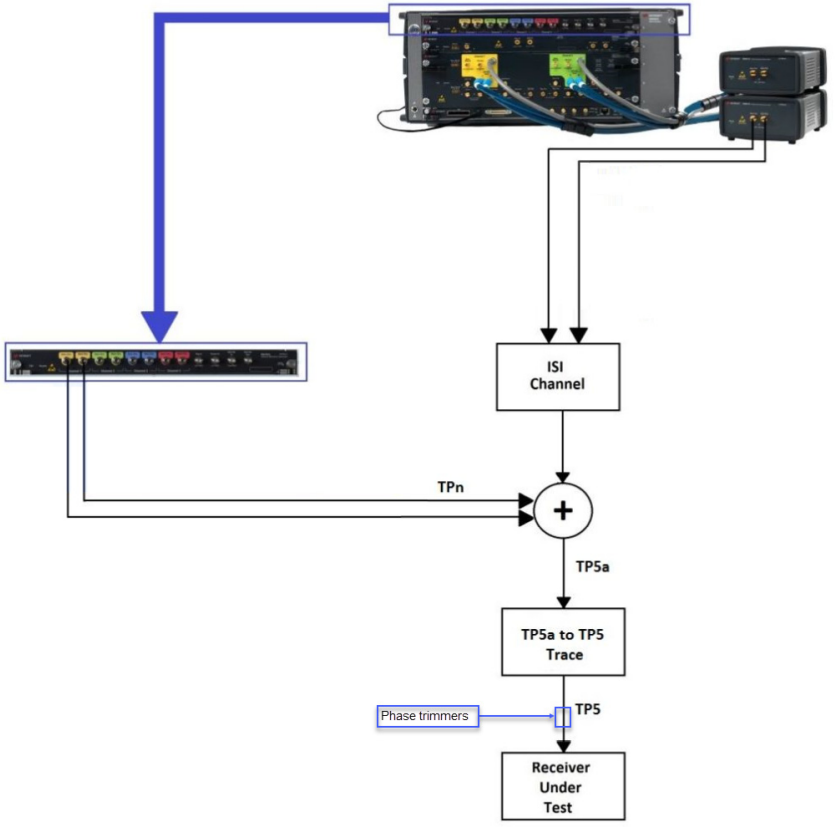


Figure 12 C2C Receiver Test setup with position of phase trimmers

Starting the Test Application

The IEEE 802.3ck Rx Test Application is available to be run as a standalone application on a PC, either locally or remotely.

Before you launch the IEEE 802.3ck Rx Test 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 C2M standard options require mated compliance boards and ISI channel boards, whereas the C2C standard options require ISI channel boards and couplers. 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 IEEE 802.3ck Rx Test Application is installed.

To access the IEEE 802.3ck Rx Test Application,

1 From the **Start** menu of the Win10 OS, click **Keysight M8070B Applications > Launch Keysight M8091CKPA**.

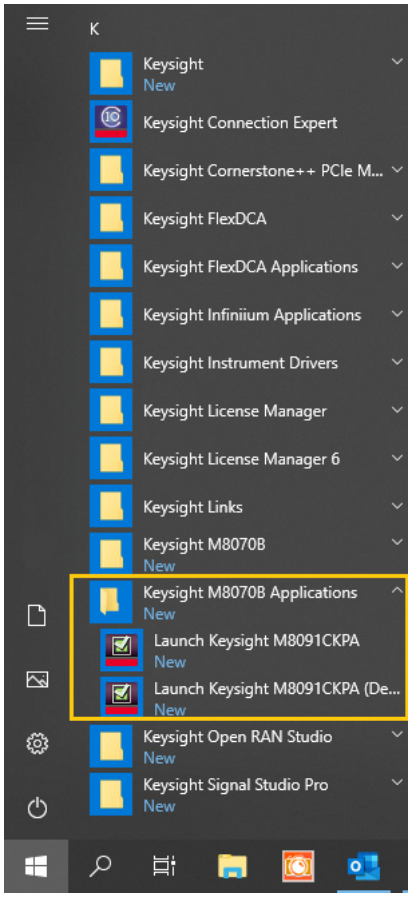


Figure 13 Launching the IEEE 802.3ck Rx Test Application

NOTE

If you do not see Keysight M8091CKPA listed on the **Start** menu, the IEEE 802.3ck Rx Test Application has not yet been installed on the PC.

Refer to "Installing the Software" on page 19 for installation instructions.

- The **M8091CKPA IEEE 802.3ck RX Test BERT Pre-Compliance App** banner appears.
- If a single instance of the M8070B software only is running online, the IEEE 802.3ck Rx Test Application launches after automatically getting connected to the M8070B software.
- If the IEEE 802.3ck Rx Test Application detects more than one instance of the M8070B software running, the **Connect to M8070 System Software for M8000 Series of BER Test Solutions (M8070)** window appears.

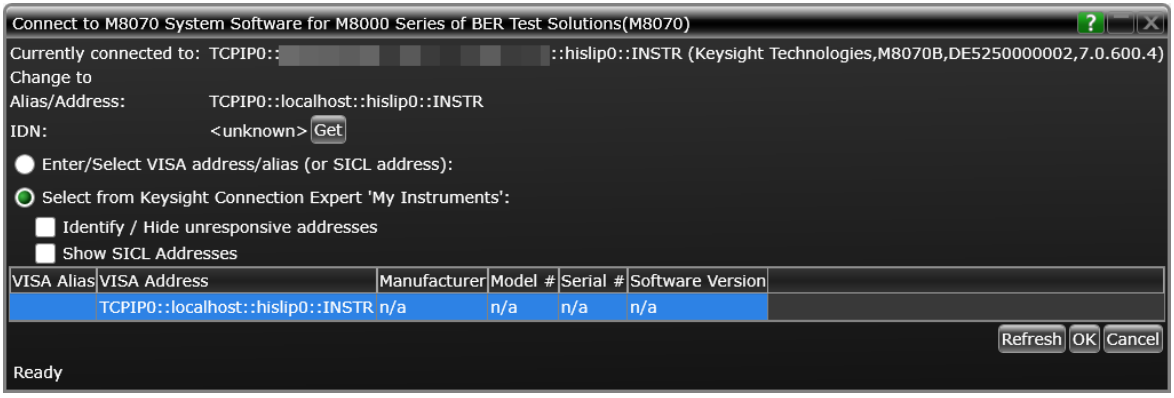


Figure 14 Connecting to M8070B if multiple instances are active

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.

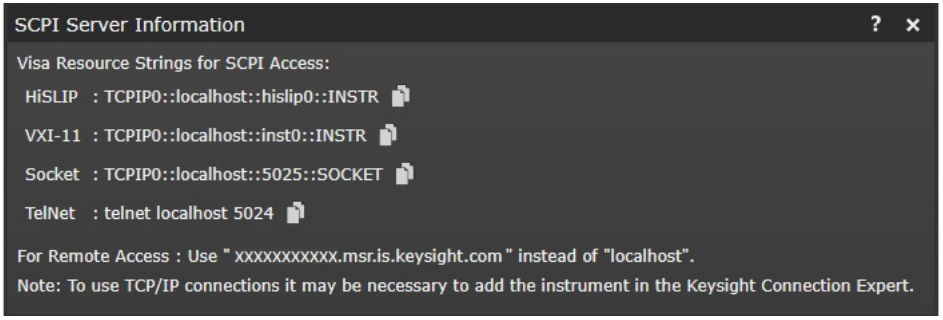


Figure 15 SCPI Server Information window on the M8070B Software

- 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.

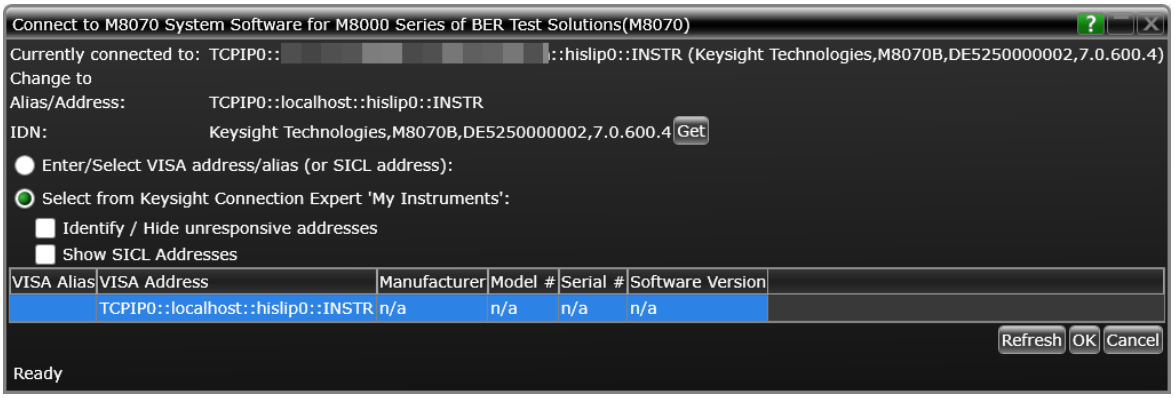


Figure 16 IDN field displaying successful connection to M8070B

4 Click **OK** to establish connection with M8070B and to launch the IEEE 802.3ck Rx Test Application. If a connection is not established, the application fails to launch.

- The IEEE 802.3ck Rx Test Application appears with the **Set Up** tab, as default.

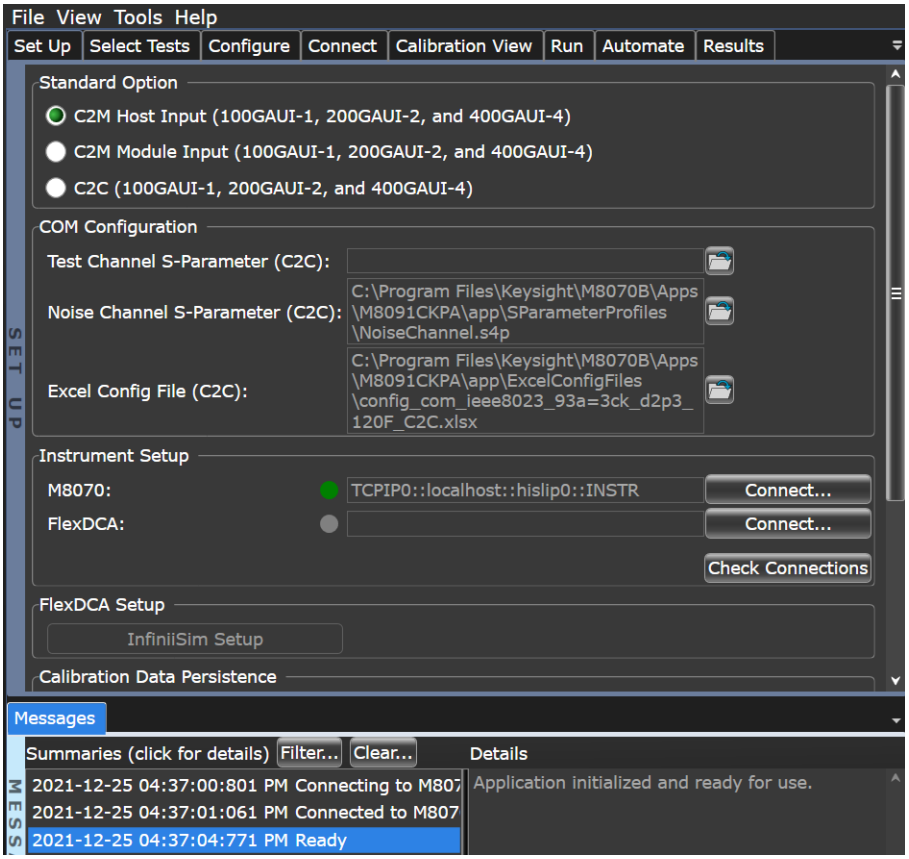


Figure 17 Default view of the IEEE 802.3ck Rx Test App

For more information on how to use the various features in the IEEE 802.3ck Rx Test Application, refer to the *Keysight M8091CKPA Rx Test Application for IEEE 802.3ck Online Help*.

Setting up the IEEE 802.3ck Rx Test Application

Calibrations are performed using mated Compliance Boards, ISI channels and couplers etc, whereas the Device Under Test (DUT) is required to run the tests. However, even before you begin performing the IEEE 802.3ck calibrations, you must set up the Test Application first.

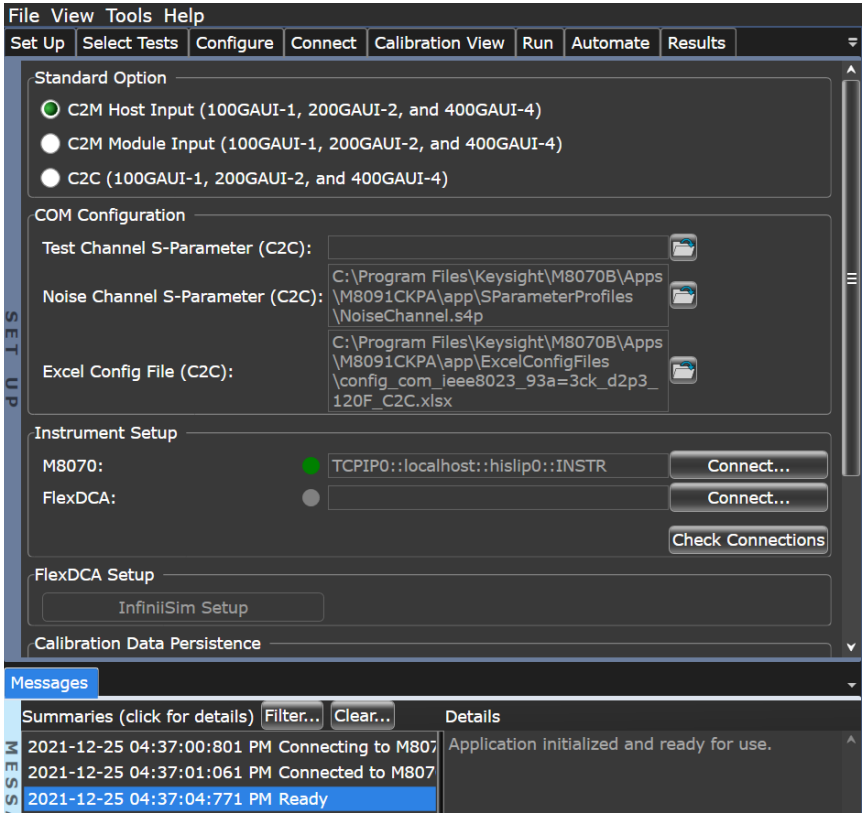


Figure 18 Setting up the IEEE 802.3ck Rx Test Appk

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 available options include:

- C2M Host Input (100GAUI-1, 200GAUI-2, and 400GAUI-4)

- C2M Module Input (100GAUI-1, 200GAUI-2, and 400GAUI-4)
- C2C (100GAUI-1, 200GAUI-2, and 400GAUI-4)

The **Select Tests** tab displays the respective calibrations and tests.

- For the selected standard option, you must perform the respective configuration using the predefined configuration. To know more about configuring the standard option, refer to *Configuring C2C and C2M Standard Options* section in the *Keysight M8091CKPA Rx Test Application for IEEE 802.3ck 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 IEEE 802.3ck 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 IEEE 802.3ck Rx Test Application.

NOTE

To establish a successful connection between the IEEE 802.3ck 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)
- For C2C: M8054A or M819xA in slot 5 (M3)

In configuration that does not involve M8046A (M2), the following sequence can be used:

- M8045A in slots 1-3 (M1)
- For C2C: M8054A or M819xA in slot 4 or 5 (M2)

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. A common use is to de-embed any additional RF cables that are used to connect to the oscilloscope for calibration that will not be used when running the DUT test.

Once the InfiniiSim is connected and calibration is selected, the **Apply InfiniiSim (except for exempted tests)** check box will appear in the **Connect** tab. By default, this check box is selected, indicating that the InfiniiSim settings will be used in the selected calibration run. If you do not want to apply InfiniiSim (de-embedding) settings to the calibration, you can uncheck this check box.

Note that the application will not display the **Apply InfiniiSim (except for exempted tests)** check box for calibrations that do not require InfiniiSim settings. For example, the results of SJ, BUJ, UUGJ, RJ, and Broadband Noise Calibrations do not change with the embedding/de-embedding. Therefore, application automatically exempts these calibrations from the InfiniiSim settings.

If you run a group of calibrations (including exempted calibrations) with the **Apply InfiniiSim (except for exempted tests)** check box selected, then the application will ignore this check box selection for the exempted calibrations and set **InfiniiSim OFF** for them.

To know more about configuring InfiniiSim for DCA within the Test Application, refer to *Configuring InfiniiSim for DCA* section in the *Keysight M8091CKPA Rx Test Application for IEEE 802.3ck 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 42.

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 selected standard option.

3 Under the **Configure** tab, modify the configuration parameters based on the values defined in the *IEEE P802.3ck™/D3.2, Draft Standard for Ethernet Amendment: Physical Layer Specifications and Management Parameters for 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interfaces Based on 100 Gb/s Signaling*.

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 IEEE 802.3ck Rx Test 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 IEEE 802.3ck RX tests. The IEEE 802.3ck Rx Test Application manages the Calibration data in the **.zip* file format.

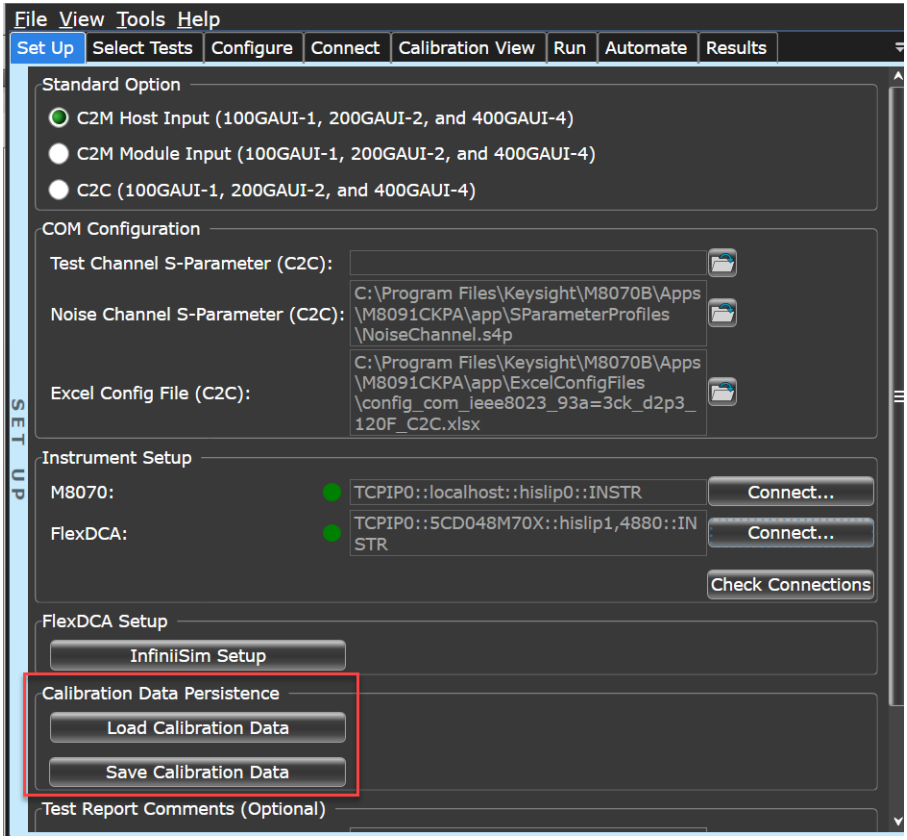


Figure 19 Calibration Data Persistence area

- To understand how to load calibration data before running IEEE 802.3ck Tests, see "Loading Calibration Data" on page 43.
- To understand how to save calibration data after running IEEE 802.3ck Calibrations, see "Saving Calibration Data" on page 44.

Loading Calibration Data

The IEEE 802.3ck 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.

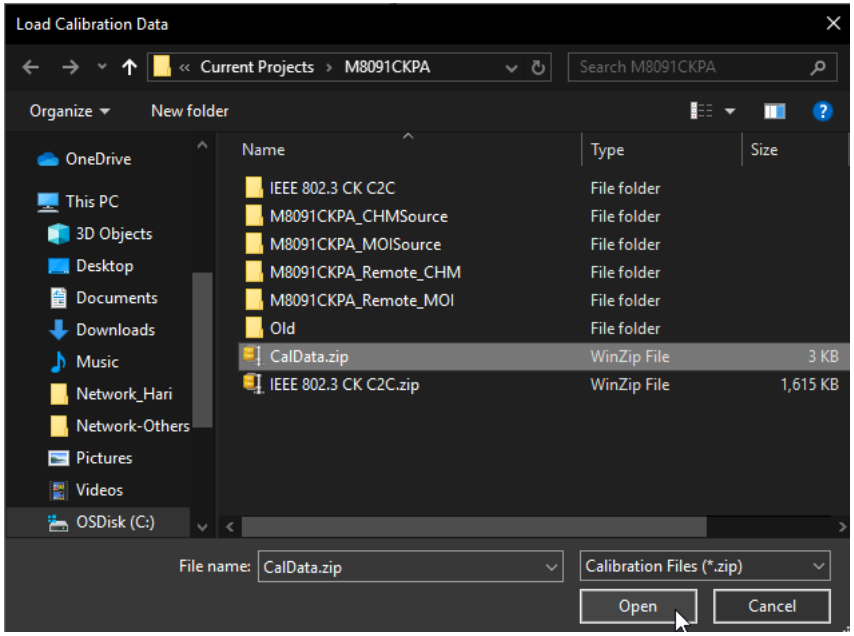


Figure 20 Selecting the Calibration Data Zip file from the target directory

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

4 The **Messages** area of the IEEE 802.3ck Rx Test Application indicates whether or not the calibration data has loaded successfully.

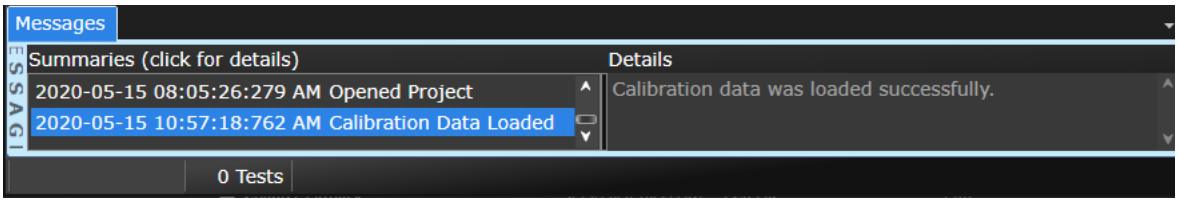


Figure 21 Set Up tab view after successfully loading Calibration Data

After you load the Calibration Data, the Test Application automatically identifies the data corresponding to IEEE 802.3ck standard option and uses the respective data during test runs in that instance of the Test Application.

Saving Calibration Data

The IEEE 802.3ck 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 IEEE 802.3ck 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.

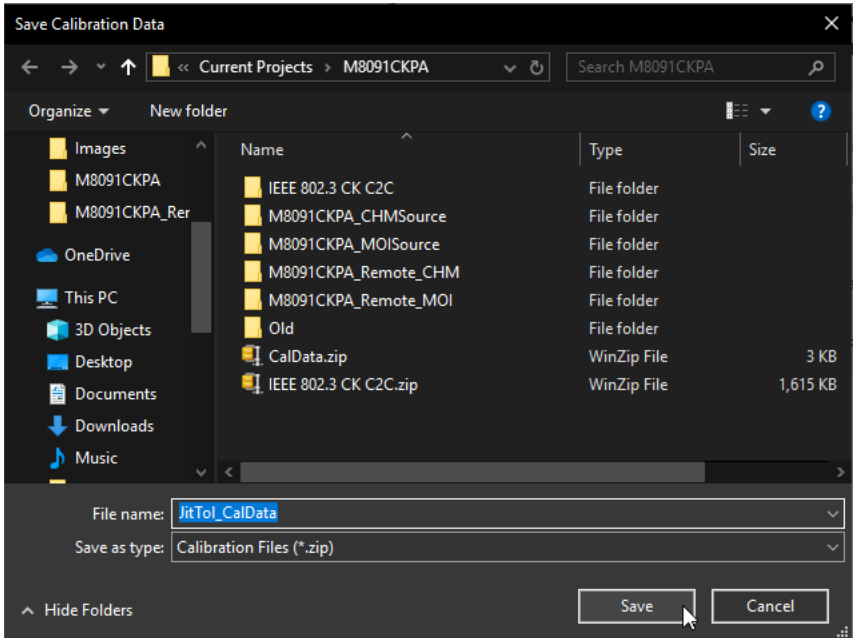


Figure 22 Saving the Calibration Data Zip file in the target directory

3 Click **Save**.

4 The **Messages** area in the IEEE 802.3ck Rx Test Application indicates whether or not the calibration data have been saved successfully.

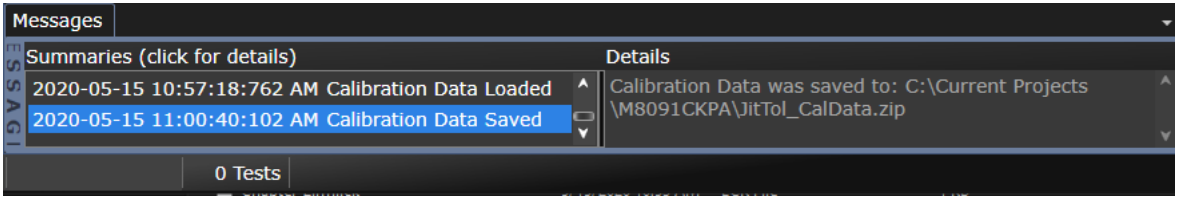


Figure 23 Set Up tab view after successfully saving Calibration Data

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...**.

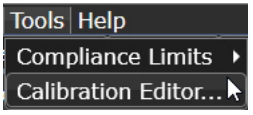


Figure 24 Launching Calibration Editor from Tools menu

2 On the **Calibration Editor** window that is displayed, click a standard option from the left pane.

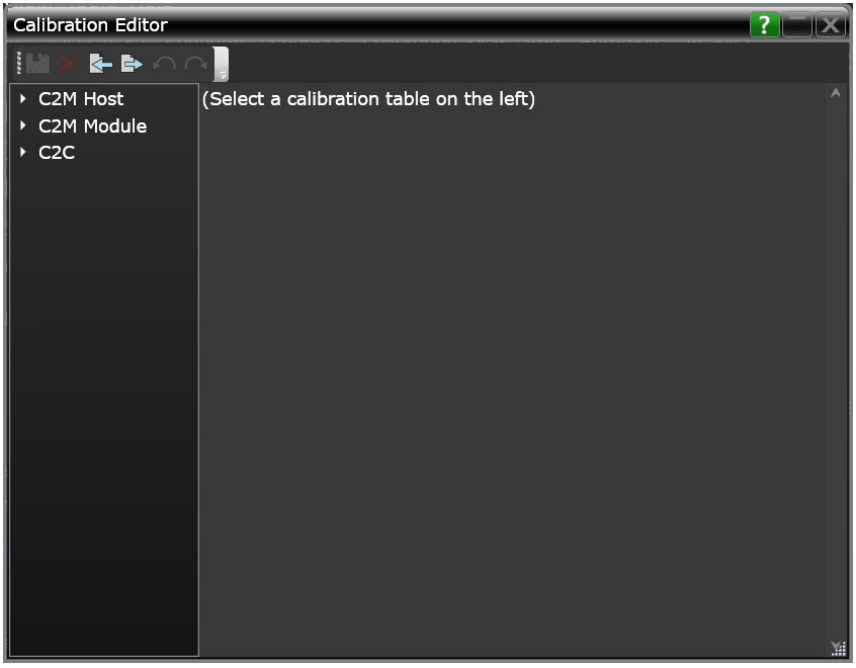


Figure 25 Calibration Editor window

3 Select a calibration type corresponding to the selected standard 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 **SJ** calibration under **C2C**.

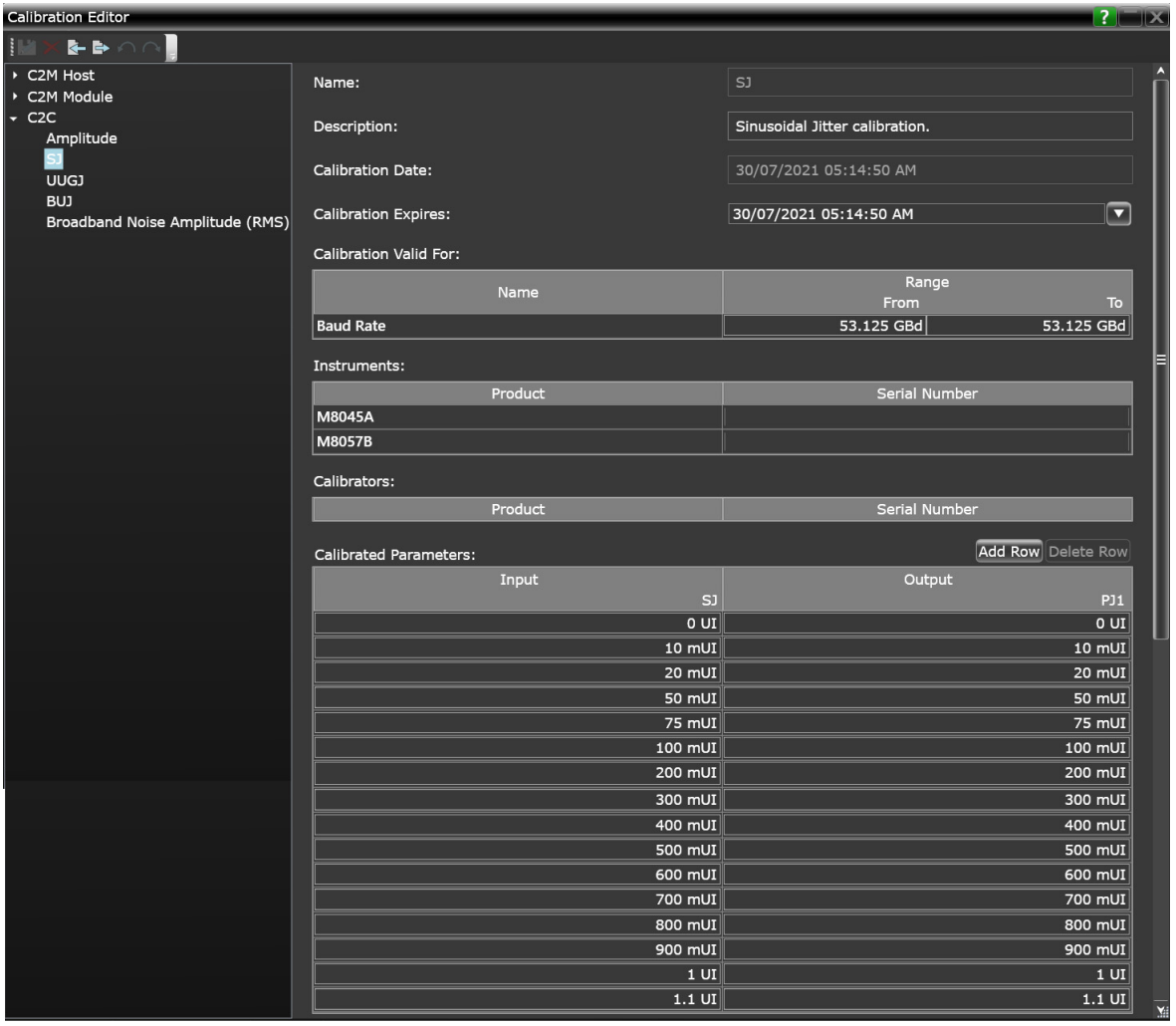


Figure 26 Default information for the selected calibration type

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

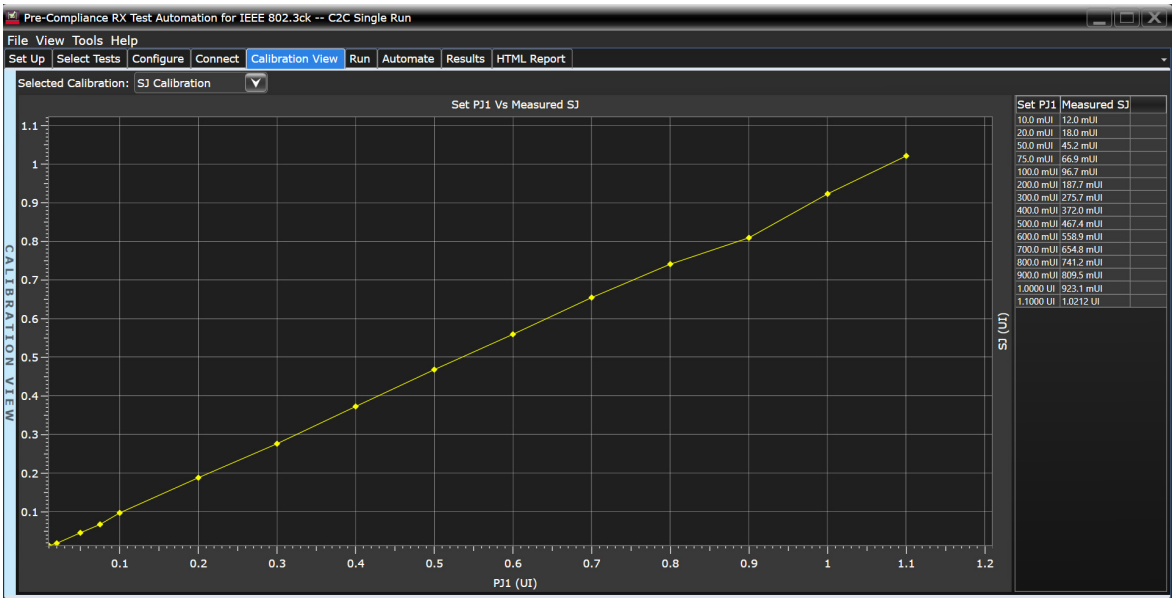


Figure 27 Plotted data in the Calibration Viewer for SJ Calibration

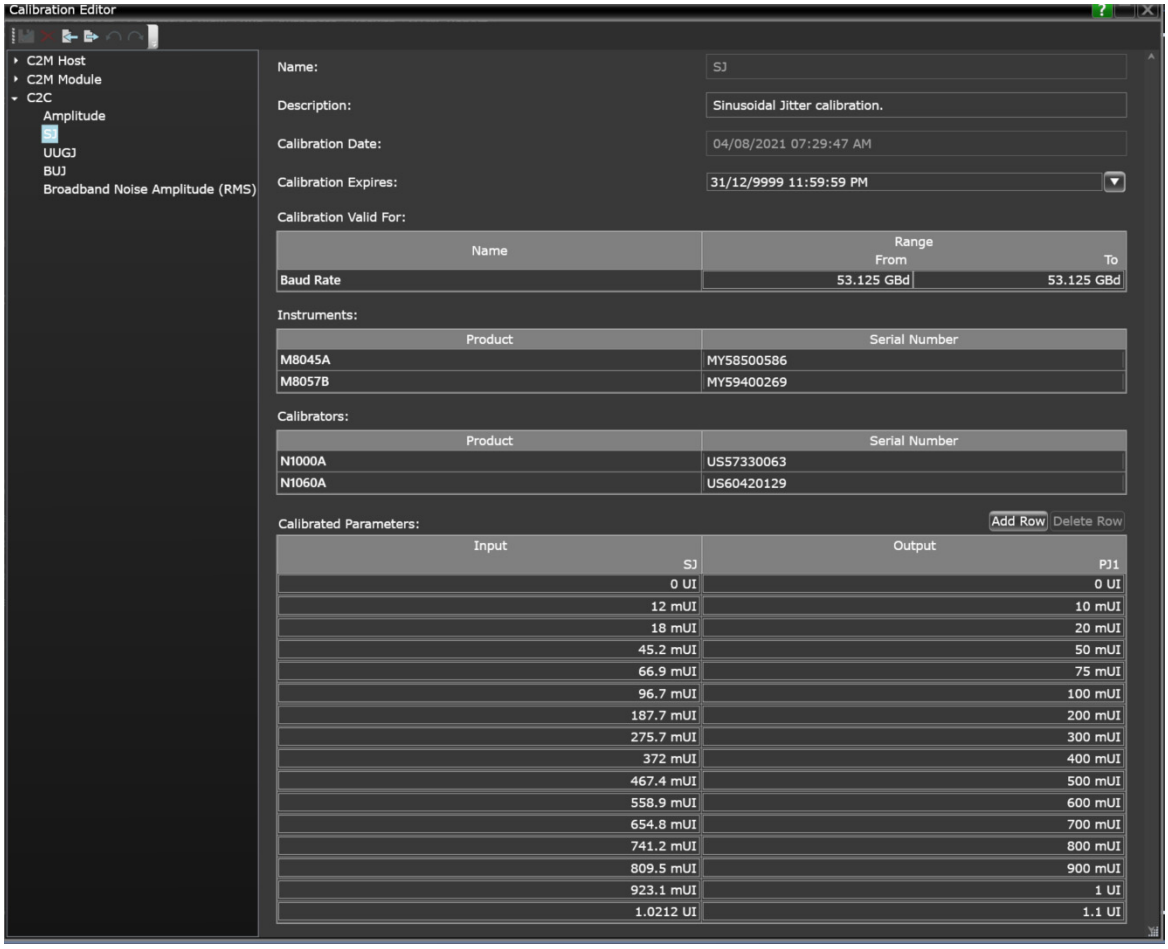


Figure 28 SJ Calibration data displayed in Calibration Editor

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 M8091CKPA Rx Test Application for IEEE 802.3ck Online Help*.

Viewing Application Log

To view the application log files, navigate to the log folder:

C:\ProgramData\Keysight\M8070B\Apps\M8091CKPA\log

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 trade-offs 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 and associated near-end crosstalk aggressor files (NEXT) and far-end aggressor crosstalk files (FEXT).

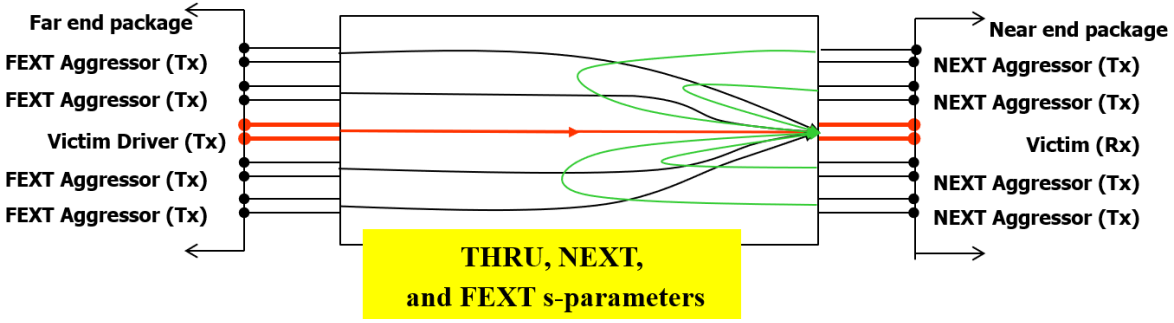


Figure 29 Channel Model for COM

The chip-to-chip C2C test procedures defined in *IEEE 802.3ck draft 3.2 Annex 120F* rely on the Channel Operating Margin (COM) method defined by the procedure in *Annex 93C, IEEE Std 802.3bj-2014, Amendment to IEEE Std 802.3-2012: Ethernet*. COM has been first introduced to measure the performance margin of a channel and then extended to digital systems. Interoperability of digital receiver can be expressed in terms of COM requirements. COM is calculated out of channel 4-ports S-parameters (for victim and aggressor lanes) as well as the noise and equalization functionality of the considered transmitter and receiver.

For IEEE 802.3ck C2C interface, 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.

The COM-based receiver test workflow consists of the following steps. The figures mentioned below can be found in *Annexure 93C*, *IEEE Std 802.3bj-2014, Amendment to IEEE Std 802.3-2012: Ethernet*.

Table 12 Calibration procedure step summary

#	Procedure	Summary of steps
1	Channel Characterization	Measure S4P for Test channel and Noise additional channel (see setup from Figure 32 and Figure 33).
2	Tx Equalization	Obtain a working link by adjusting Tx de-emphasis towards best Rx performance (see setup from Figure 30).
3	Equipment Calibration	Calibrate Tx jitter and amplitude (see setup from Figure 31). Note that amplitude is calibrated using optimized de-emphasis (see step 2).
4	Tx Characterization	Measure Tx characteristics (see setup from Figure 31).
5	Rx testing	Perform interference and jitter tolerance test.

These procedures are broadly described in the following section.

Detailed steps for Calibration Procedures

Step#1. Start with S4P Channel Characterization

1 Measure the scattering parameters, $S^{(tc)}$ on the Test channel (TPt to TP5 replica) using the test setup shown in Figure 32.

2 Measure the scattering parameters, $S^{(nc)}$ on the Noise Channel with additional network (TPn to TP5 replica) using the test setup shown in Figure 33.

See "Receiver Interference Tolerance" on page 84.

Step#2. Obtain a working link

3 Using the test setup shown in Figure 30, (that is, with Test Channel but without the noise source) initiate the Tx Equalization sequence.

- optimize Tx de-emphasis taps towards minimum BER
- retain the resulting transmitter [opti Tx Eq taps] coefficients

See "Rx Calibration using COM model" on page 87.

NOTE

For the C2C standard option, the **Channel Characterization using COM model** calibration will determine the channel de-emphasis taps settings (Channel EQ Pre-cursor3/2/1 and Channel EQ Post-Cursor1) under the **Configure** tab and automatically updates the channel equalization coefficients in the de-emphasis taps. For more information on Channel Characterization using COM model calibration, refer to “Channel Characterization using COM model” on page 82.

Step#3. Calibrate the equipment

4 Calibrate Tx amplitude using the test setup shown in Figure 31.

- Use optimized Tx de-emphasis [opti Tx Eq taps] shown in Figure 32.

5 Calibrate Tx SJ injection using the test setup shown in Figure 31.

- Do not use de-emphasis

6 Calibrate broadband noise source using the test setup shown in Figure 34.

See "Transmitter Measurements for COM Model-Rx JTol" on page 90.

Step#4. Perform TX Characterization

7 Measure Tx jitter parameters (j4u or j3u, Jrms) using the test setup shown in Figure 31.
   - Do not use Tx de-emphasis
   - Embed transmitter replica trace S parameter
   - Jitter injection (for example, 20mUI SJ @40MHz) maybe required to be achieved to ensure realistic jitter profile

8 Measure the noise parameters SNR_{TX} (or SNDR) using the test setup in Figure 32.

9 Measure the Tx transition time Trm following using the test setup shown in Figure 31.
   - Do not use Tx de-emphasis

See "COM Verification" on page 93.

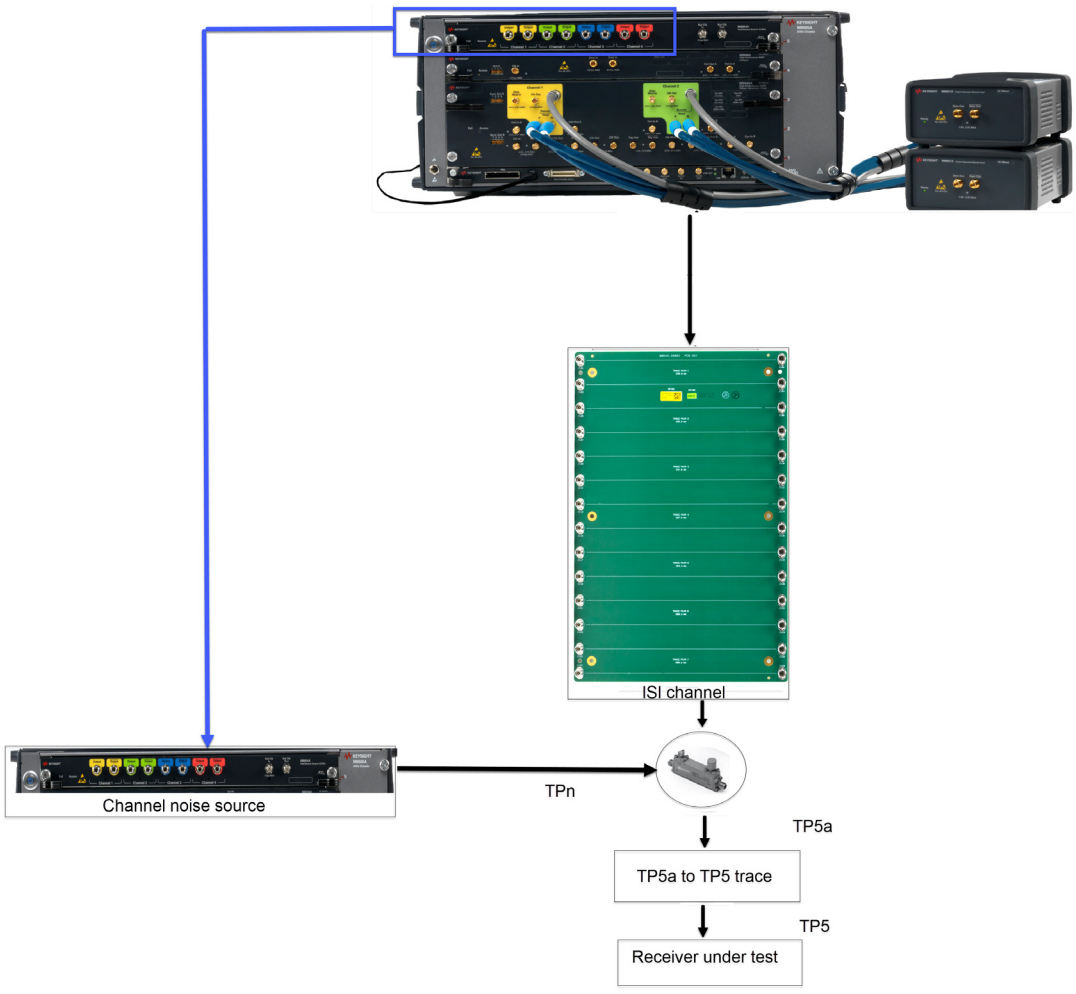


Figure 30 Interference tolerance test setup

Figure 31 Interference tolerance transmitter test setup

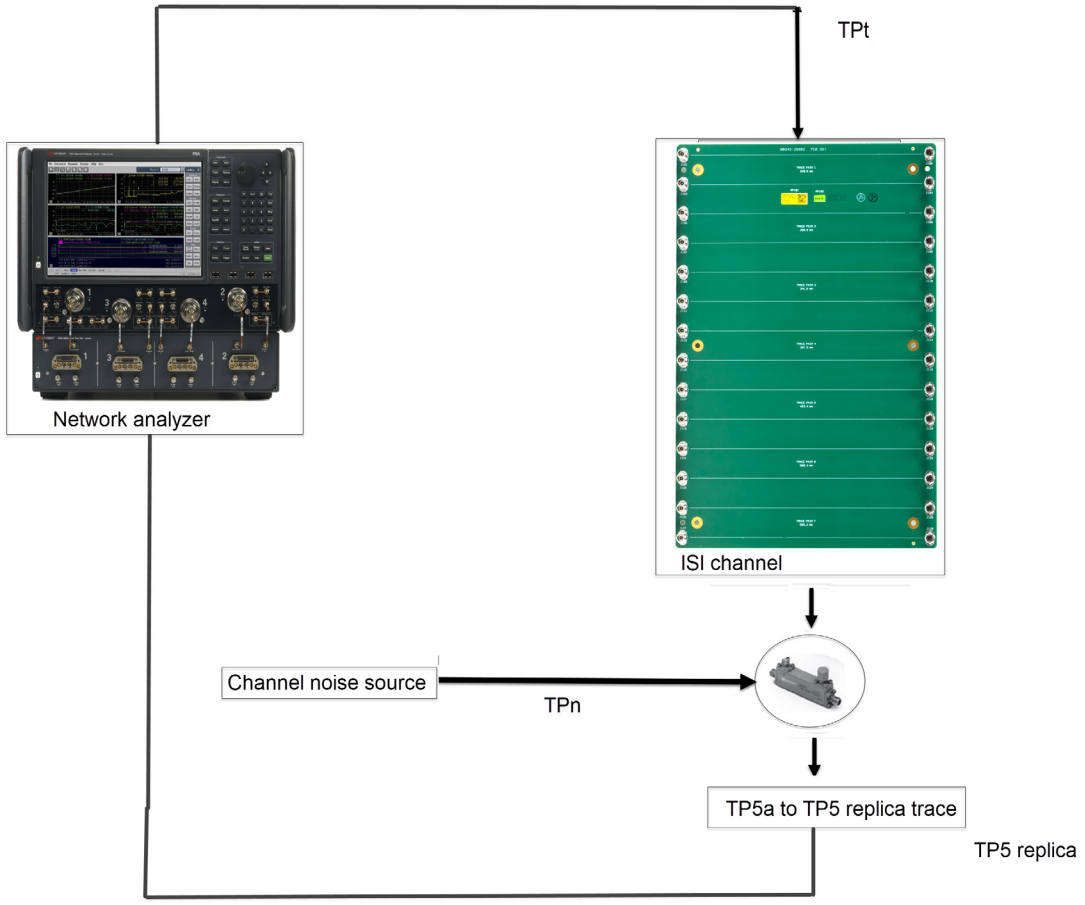


Figure 32 Interference tolerance channel s-parameter test setup

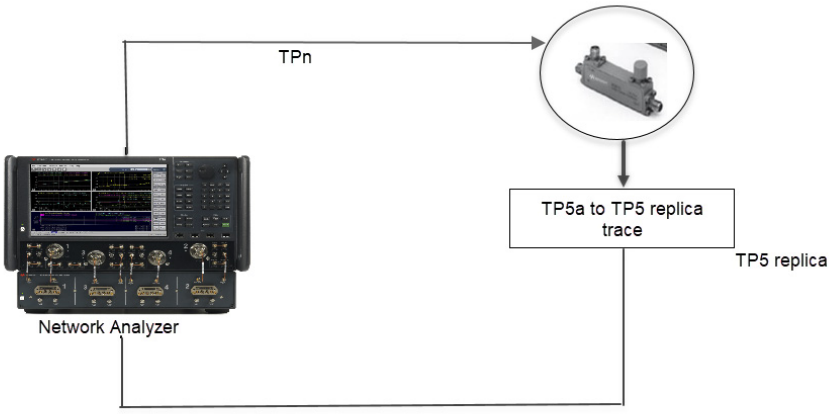


Figure 33 Interference tolerance channel noise path test setup

Figure 34 Interference tolerance channel noise level test setup

4 IEEE 802.3ck C2C Calibrations

This section provides the test procedures for the IEEE 802.3ck Rx Calibrations, which are applicable for the C2C standard option.

As mentioned earlier, ensure that the oscilloscope has been calibrated and the test channel is properly connected to the test instruments to perform IEEE 802.3ck Calibrations.

Before performing the IEEE 802.3ck C2C tests, you must calibrate all the related parameters. Perform calibrations in the order displayed in the IEEE 802.3ck Rx Test Application.

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 **C2C (100GAUI-1, 200GAUI-2, and 400GAUI-4)** standard option, the following parameters are available for configuration.

Parameters common for all calibrations (in Debug mode)

- Baud Rate
- Victim Generator PAM4 Symbol Mapping
- Victim Generator PAM4 Custom Symbol Mapping
- Target Error Ratio
- Target COM
- Test Channel Configuration (Low Loss) corresponds to Test1, whereas Test Channel Configuration (High Loss) corresponds to Test2; both configured to meet the COM value (3 dB max)
- PAM4 Symbol 1 Level
- PAM4 Symbol 2 Level
- Transmitter Pre-Cursor3
- Transmitter Pre-Cursor2
- Transmitter Pre-Cursor1
- Transmitter Post-Cursor1
- Channel EQ Pre-Cursor3
- Channel EQ Pre-Cursor2
- Channel EQ Pre-Cursor1
- Channel EQ Post-Cursor1
- Noise Generator Channel Selection
- Loop Bandwidth
- SIRC Response For Tx Measurements
- SIRC Bandwidth For Tx Measurements
- Number of averages for waveform acquisition
- CTLE Zero Frequency
- CTLE Pole 1 Frequency

- CTLE Pole 2 Frequency
- CTLE Low-frequency Pole/Zero
- Common> Amplitude Calibration > Amplitude
- Common> Amplitude Calibration > Transmitter Pre-Cursor3
- Common> Amplitude Calibration > Transmitter Pre-Cursor2
- Common> Amplitude Calibration > Transmitter Pre-Cursor1
- Common> Amplitude Calibration > Transmitter Post-Cursor1
- Common> BUJ Calibration > BUJ

Parameters for Receiver Interference Tolerance Calibrations

- Transmitter Measurements for COM Model:
  - Amplitude
  - SJ
  - UUGJ
  - BUJ
  - PAM4 Symbol 1 Level
  - PAM4 Symbol 2 Level
  - Transmitter Pre-Cursor3
  - Transmitter Pre-Cursor2
  - Transmitter Pre-Cursor1
  - Transmitter Post-Cursor1
  - Np for TP0v
  - Dp for TP0v
  - Np for Rx Test
  - Dp for Rx Test
  - Jnu Type

Parameters for Receiver Jitter Tolerance Calibrations

- Transmitter Measurements for COM Model:
  - Amplitude
  - SJ
  - UUGJ
  - BUJ
  - PAM4 Symbol 1 Level
  - PAM4 Symbol 2 Level

- Transmitter Pre-Cursor3
- Transmitter Pre-Cursor2
- Transmitter Pre-Cursor1
- Transmitter Post-Cursor1
- Np for TP0v
- Dp for TP0v
- Np for Rx Test
- Dp for Rx Test
- Jnu Type

C2C 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 for the **C2C (100GAUI-1, 200GAUI-2, and 400GAUI-4)** standard option,

- In the current version of the IEEE 802.3ck Test Application, the S-Parameter files (low loss channel) and Excel file corresponding to the C2C standard option are displayed by default.

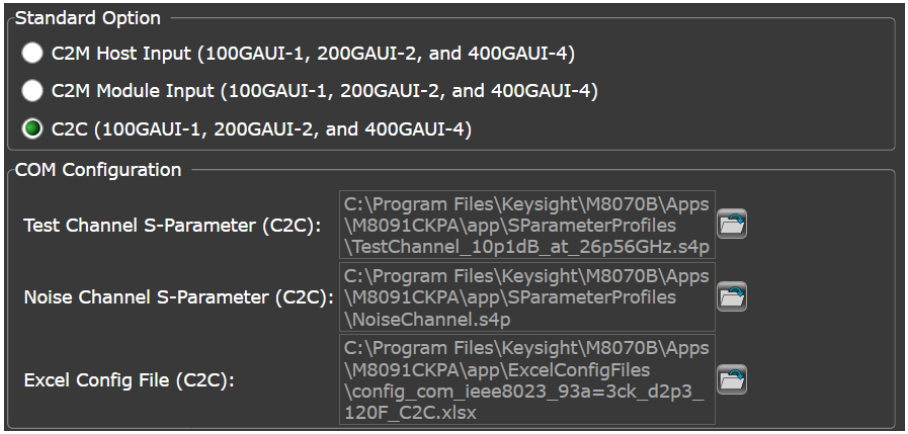


Figure 35 Configuration files for Medium Reach standard

- 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\M8091CKPA\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 as shown in Table 13. Note that Table 13 shows an example of S-Parameter files, which may differ based on your test setup.

Table 13 Selecting Test Channel S-Parameter

Test Channel Configuration setting	Corresponding Rx Interference Tolerance parameter	Standard Option	S-Parameter file that can be selected
Low Loss	Test 1	C2C	TestChannel_10p1dB_at_26p56GHz.s4p
High Loss	Test 2		TestChannel_19p8dB_at_26p56GHz.s4p

10 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\M8091CKPA\app\ExcelConfigFiles* for the **Excel Config File** configuration field.

11 From the **Open** window that appears, select the alternative S-parameter file (factory installed) for C2C and click **Open**.

NOTE

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. Also, the s4p file used for the Test & Noise Channels and for replica trace must have the same attributes:

Input Ports: 1&3

Output Ports: 2&4

Start Frequency: 10MHz

Stop Frequency: 60GHz

Step Size: 10 MHz

No. of points: 6000

Desired formats: (DB) for dB-angle, (MA) for magnitude angle, or (RI) for real-imaginary

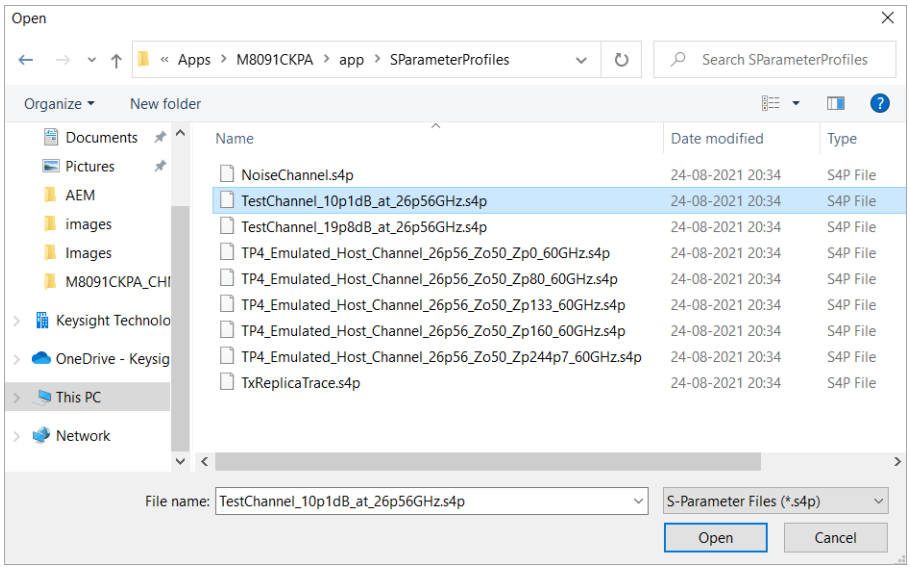


Figure 36 Selecting an S-Parameter file from the default location

The new file location appears in the **C2C Configuration** area for the corresponding (Test / Noise) Channel or Excel Configuration File.

NOTE

The S-parameter file for the Test Channel includes the response of the cable or PCB trace and also the transmitter and Receiver test fixtures. It is usually not possible to measure this. An S-parameter file combining all can be generated using the individual responses using PLTS.

Calibration Procedure

The IEEE 802.3ck C2C receiver test calibration procedures comprise of three steps:

1 System calibration: Calibrate the equipment used to generate the victim transmitter and the broadband noise (once per setup configuration).

2 Channel characterization: S-parameter measurements using a Network Analyzer for both the low loss and high loss channels. The optimal amount of channel equalization at the transmitter is defined during this stage.

3 COM-related calibration: Following steps are performed to complete the COM model:

   a Verify channel compliance based on S-parameters analysis

   b Measure transmitter characteristics (jitter & electrical characteristics)

Finally, the COM-model computes the amount of broadband noise to be injected in the noise path to test the receiver (BER measurement for different level of noise or jitter) under a specific channel operating margin (usually 3dB).

Two COM-related calibrations are required, one for the low loss channel and one for the high loss channel. As well as choosing the appropriate test channel s-parameter file, the user should also set the Test Channel Configuration parameter in the **Configure tab** to match the chosen channel loss. The Calibration Persistence function can be used to save/recall common calibration data between the two tests.

Overview on Calibration procedures

Table 12 shows a summary of steps for each procedure that must be performed for calibration. Reference to each figure mentioned in the steps in this section is from *Annexure 93C*, *IEEE Std 802.3bj-2014, Amendment to IEEE Std 802.3-2012: Ethernet*.

NOTE

For the C2C standard option, if you run the **Channel Characterization using COM model** calibration, it will determine the channel de-emphasis taps settings (Channel EQ Pre-cursor3/2/1 and Channel EQ Post-Cursor1) under the **Configure** tab and automatically updates the channel equalization coefficients in the de-emphasis taps. For more information on Channel Characterization using COM model calibration, refer to "Channel Characterization using COM model" on page 82.

Common Calibrations

Amplitude Calibration

Overview The Amplitude Calibration is performed to calibrate the Victim Generator's Amplitude for the Transmitter Measurements for COM model. Note that the de-emphasis configuration resulting from the Transmitter Equalization sequence must be applied during calibration.

Connection Diagram Connect the instruments as shown in Figure 37.

Connect:

- Victim Generator Data Out 1 P/N to Oscilloscope CH1/CH2.
- Unused ports with 50 ohms.
- Note: TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

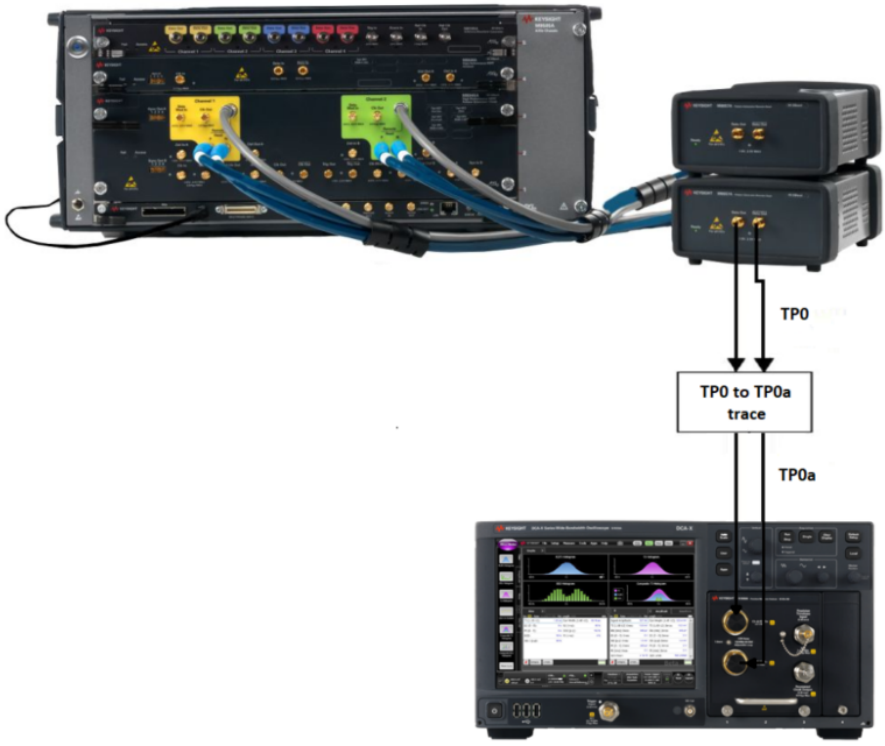


Figure 37 Amplitude Calibration connections for C2C

NOTE TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

ID

Standard Name	Test ID
C2C	471100

Parameters Refer to “Calibration Parameters in Debug Mode” on page 64.

Procedure This calibration uses the PRBS13Q 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.

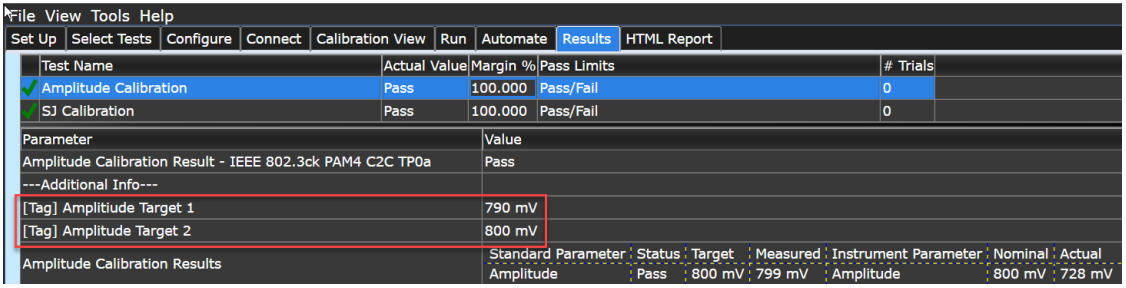


Figure 38 Amplitude Calibration resulting information in the Results tab

NOTE If there are any tags applied to the test results, then the tags will be displayed under the Additional Info section (as highlighted in the above image). To know more about tags, refer to the *Configuring Result Tags* section in the *Keysight M8091CKPA Rx Test Application for IEEE 802.3ck Online Help*.

SJ Calibration

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

Connection Diagram Connect the instruments as shown in Figure 39.

Connect:

- Victim Generator Data Out 1 P/N to Oscilloscope CH1/CH2.
- Unused ports with 50 ohms.

Figure 39 SJ Calibration connections for C2C

ID

Standard Name	Test ID
C2C	471101

Parameters Refer to “Calibration Parameters in Debug Mode” on page 64.

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.

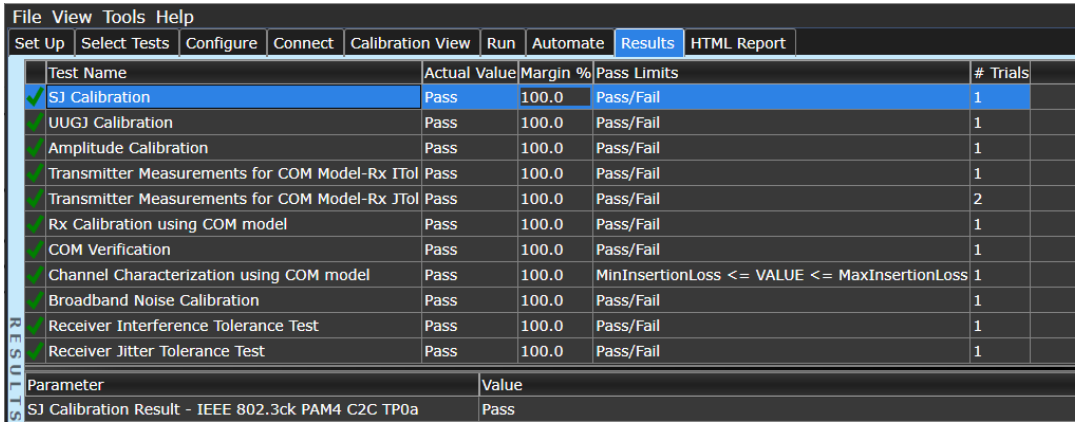


Figure 40 SJ Calibration resulting information in the Results tab

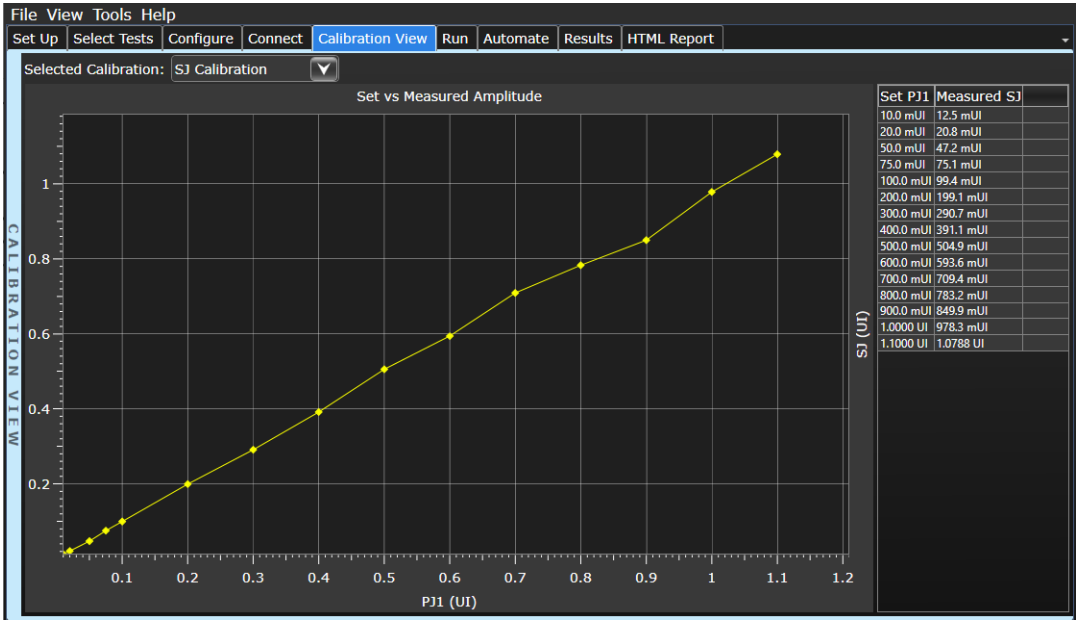


Figure 41 SJ Calibration calibrated data in Calibration View tab

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 42.

Connect:

- Victim Generator Data Out 1 P/N to Oscilloscope CH1/CH2.
- Unused ports with 50 ohms.

Figure 42 UUGJ Calibration connections for C2C

ID

Standard Name	Test ID
C2C	471102

Parameters Refer to “Calibration Parameters in Debug Mode” on page 64.

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.

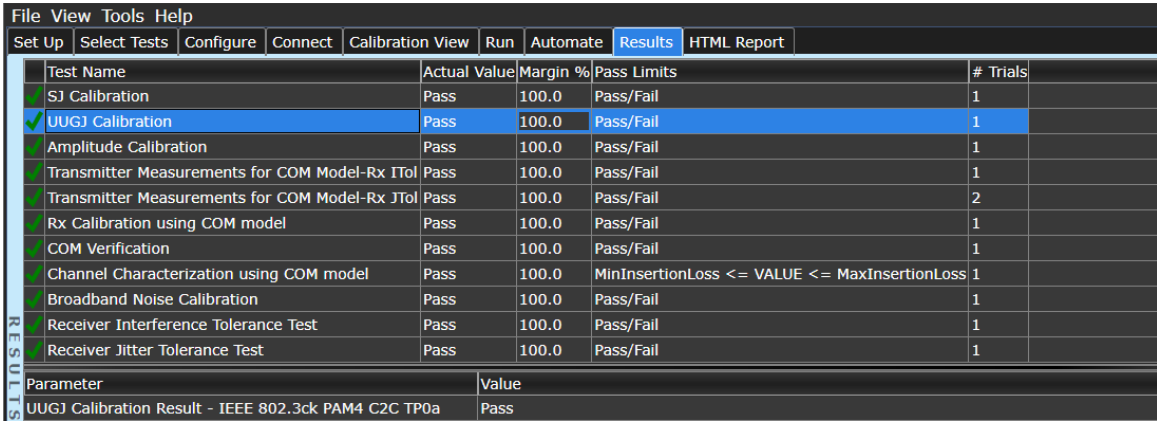


Figure 43 UUGJ Calibration resulting information in the Results tab

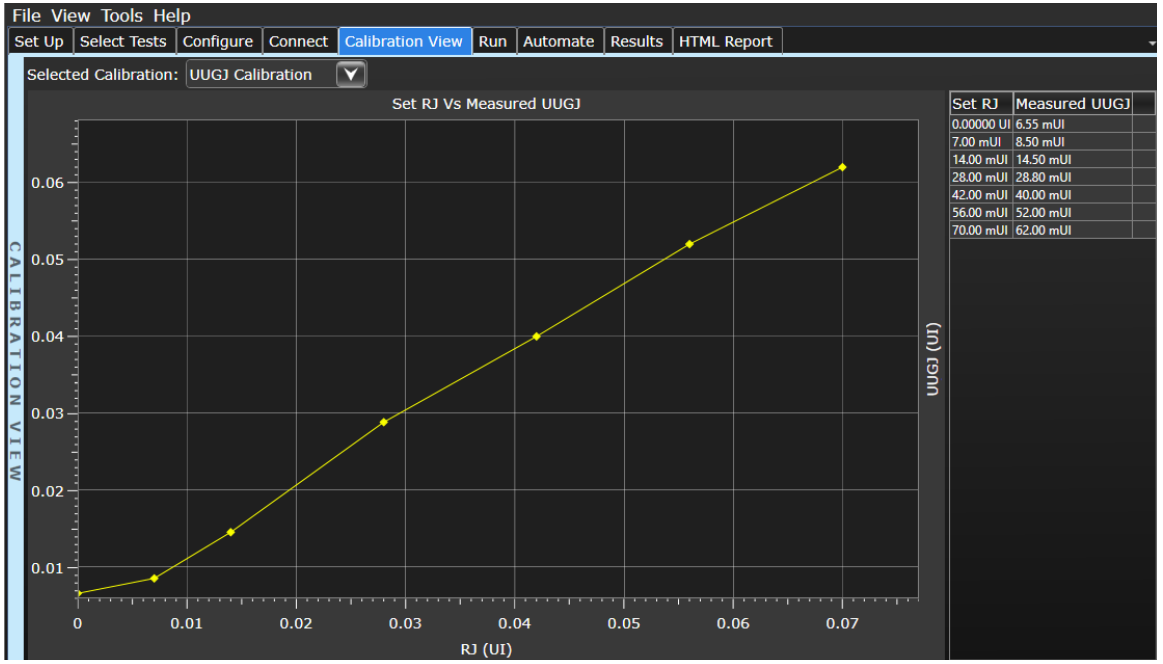


Figure 44 UUGJ Calibration calibrated data in Calibration View tab

BUJ Calibration

NOTE

The UBHPJ stress component comprises of 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 wish a 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.

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

Connection Diagram Connect the instruments as shown in Figure 45.

Connect:

- Victim Generator Data Out 1 P/N to Oscilloscope CH1/CH2.
- Unused ports with 50 ohms.

Figure 45 BUJ Calibration connections for C2C

ID

Standard Name	Test ID
C2C	471103

Parameters Refer to "Calibration Parameters in Debug Mode" on page 64.

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.

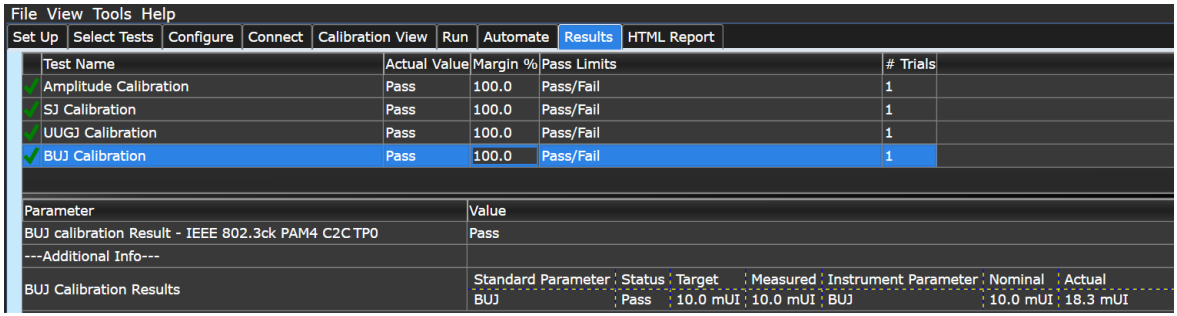


Figure 46 BUJ Calibration resulting information in the Results tab

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 47.

Figure 47 Broadband Noise Calibration connections for C2C

ID

Standard Name	Test ID
C2C	471104

Parameters Refer to “Calibration Parameters in Debug Mode” on page 64.

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.

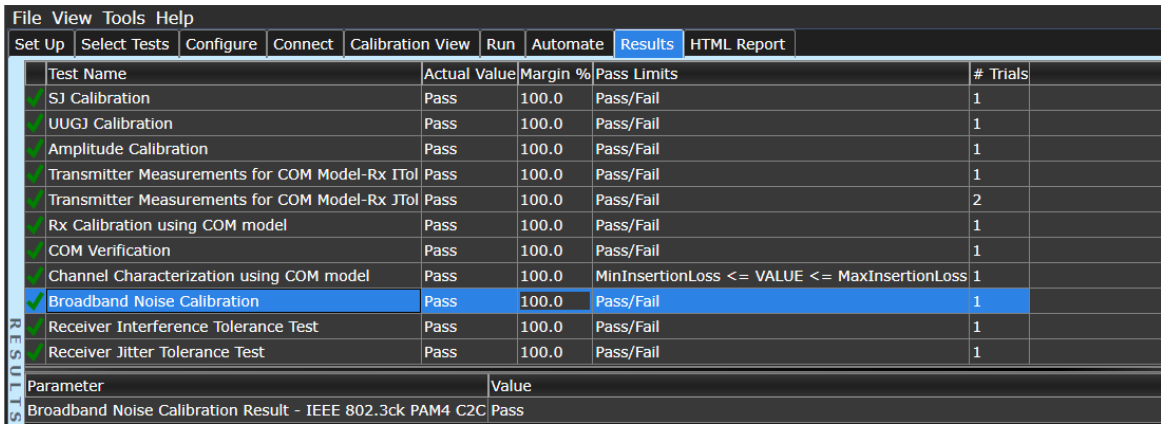


Figure 48 Broadband Noise Calibration resulting information in the Results tab

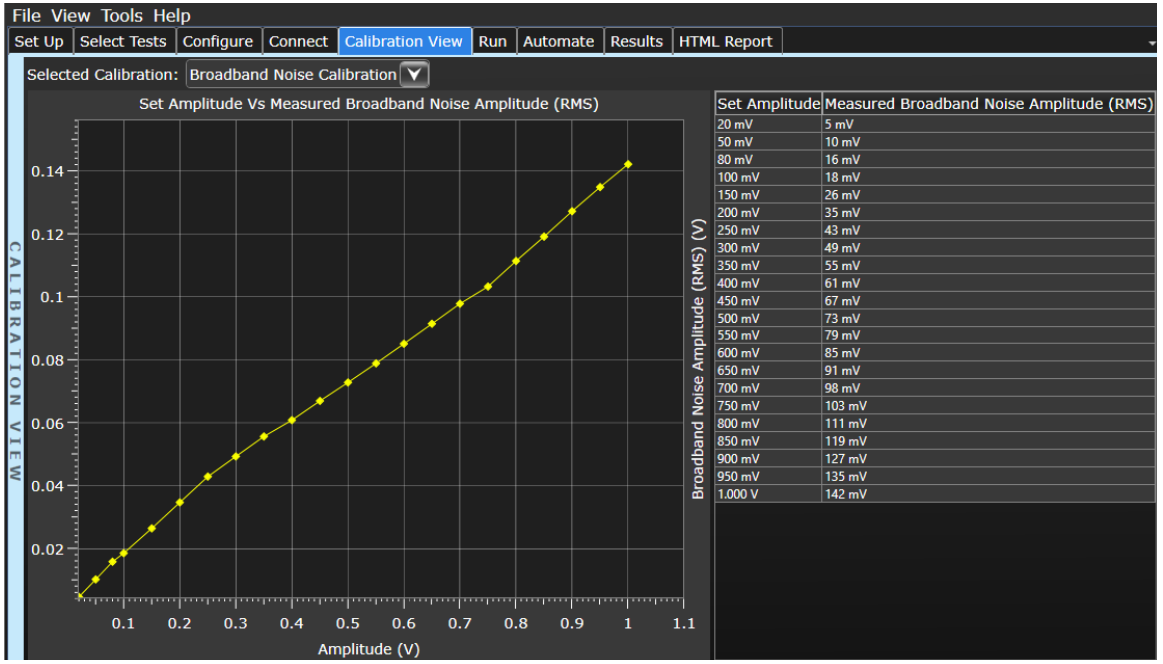


Figure 49 Broadband Noise Calibration calibrated data in Calibration View tab

Channel Characterization using COM model

Overview The Channel Characterization using COM Model validates the channel characteristics using COM model as per *Table 120F-5* mentioned in the section *120F* of the *IEEE P802.3ck™/D3.2* specification. This calibration should be performed for both the low and high loss channel test cases.

Connection Diagram Connect the instruments as shown in Figure 50.

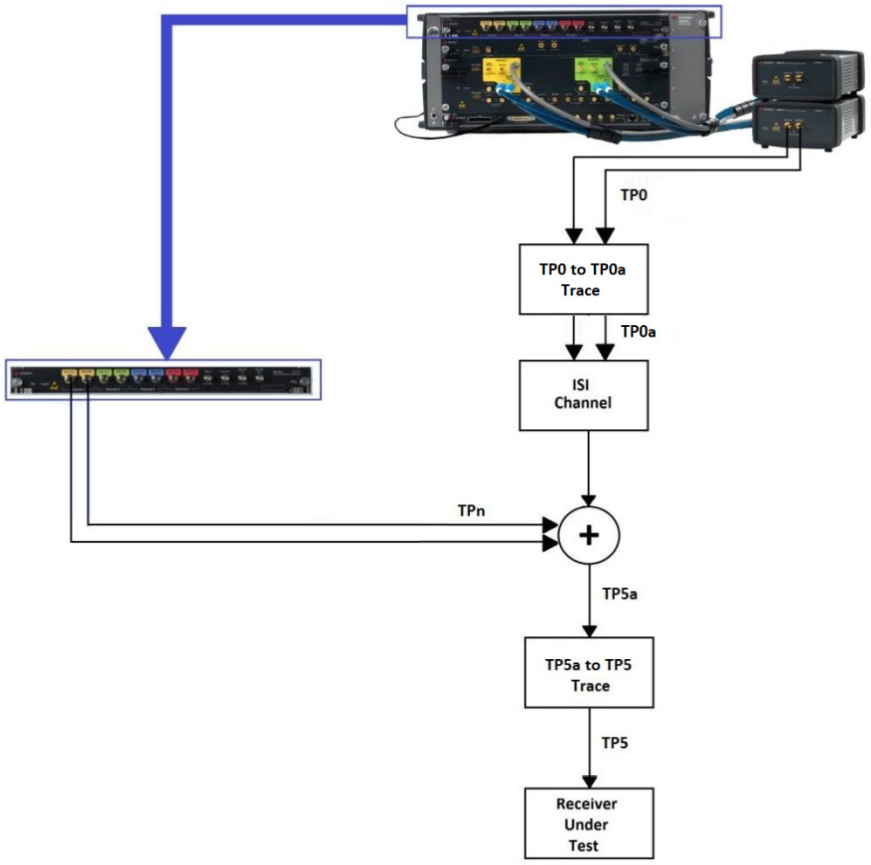


Figure 50 Channel Characterization using COM model connections for C2C

NOTE TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

ID

Standard Name	Test ID
C2C	472100

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 "C2C configuration in the Test App" on page 67.

Parameters Refer to "Calibration Parameters in Debug Mode" on page 64.

Procedure This calibration uses the PRBS13Q pattern.

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

- COM, including effects of Broadband Noise
- Insertion Loss at Nyquist
- This calibration will determine the channel de-emphasis taps settings (Channel EQ Pre-cursor3/2/1 and Channel EQ Post-Cursor1) under the Configure tab and automatically updates the channel equalization coefficients in the de-emphasis taps.

File View Tools Help

Set Up | Select Tests | Configure | Connect | Calibration View | Run | Automate | Results | HTML Report

Test Name	Actual Value	Margin %	Pass Limits	# Trials
Channel Characterization using COM model	Pass	100.000	Pass/Fail	1
Transmitter Measurements for COM Model-Rx ITol	Pass	100.000	Pass/Fail	1
Rx Calibration using COM model	Pass	100.000	Pass/Fail	1
Transmitter Measurements for COM Model-Rx JTol	Pass	100.000	Pass/Fail	1

Parameter	Value
Channel Characterization Result- IEEE 802.3ck PAM4 C2C	Pass
---Additional Info---	
PassLimit Min (MinInsertionLoss)	9.500 dB
PassLimit Max (MaxInsertionLoss)	10.500 dB
Channel Characterization using COM model Results	

Measurement Name	Status	Measured Value	Margin %	Pass Limits
COM	Pass	7.187 dB	139.6 %	>= 3.000 dB
Insertion Loss	Pass	10.241 dB	25.9 %	[MinInsertionLoss dB to MaxInsertionLoss dB]

Figure 51 Channel Characterization using COM model Calibration results

Receiver Interference Tolerance

Transmitter Measurements for COM Model-Rx ITol

Overview The Transmitter Measurements for COM Model-Rx ITol measures transmitter parameters for the calculation of test channel COM as per *Table 120F-1* mentioned in the *section 120F* of the *IEEE P802.3ck™/D3.2* specification.

Connection Diagram Connect the instruments as shown in Figure 52.

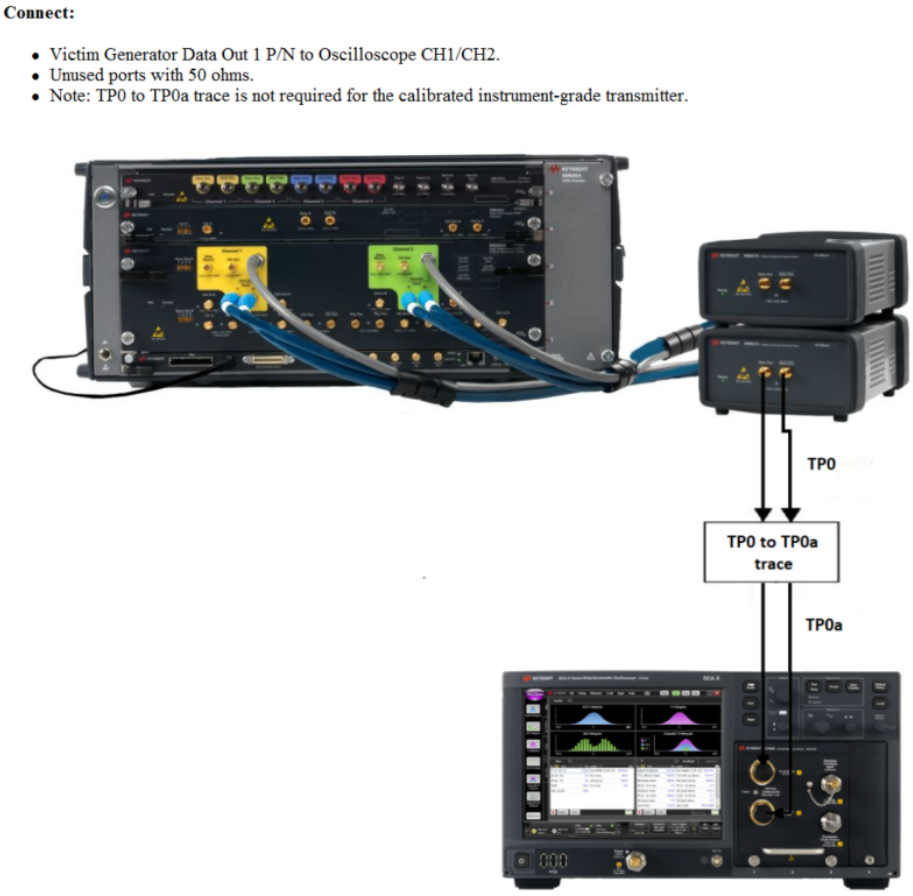


Figure 52 Transmitter Measurements for COM Model-Rx ITol connections for C2C

NOTE TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

ID

Standard Name	Test ID
C2C	472101

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

- All C2C calibrations performed previously:
  - Amplitude Calibration
  - SJ Calibration
  - UUGJ Calibration

Parameters Refer to "Calibration Parameters in Debug Mode" on page 64.

Procedure This calibration uses the PRBS13Q 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(Np = 200)
- SNDR for Rx Test(Np = 11)

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)

Set Up | Select Tests | Configure | Connect | Calibration View | Run | Automate | Results | HTML Report

	Test Name	Actual Value	Margin %	Pass Limits	# Trials
✓	Transmitter Measurements for COM Model-Rx ITol	Pass	100.000	Pass/Fail	1
✓	Rx Calibration using COM model	Pass	100.000	Pass/Fail	1

RESU

Parameter	Value
Transmitter Measurements - IEEE 802.3ck PAM4 C2C TP0a	Pass
---Additional Info---	
Transition Time	10 ps
SNDR for Rx Test(Np=11)	31.27 dB
Output Jitter Measurement	(See image)
Linear Fit Pulse Response(Np=11)	(See image)

Transmitter Measurements

Measurement Name	Status	Measured Value	Margin %	Pass Limits
Jrms	Pass	14.0 mUI	39.1 %	<= 23.0 mUI
J4u	Pass	98.0 mUI	16.9 %	<= 118.0 mUI
Level mismatch ratio RLM	Pass	0.97	2.1 %	>= 0.95
Signal-to-noise-and-distortion ratio(Np=200)	Pass	33.11 dB	1.9 %	>= 32.50 dB

Figure 53 Tx Meas. for COM model - Rx ITol Calibration results - Tabulated

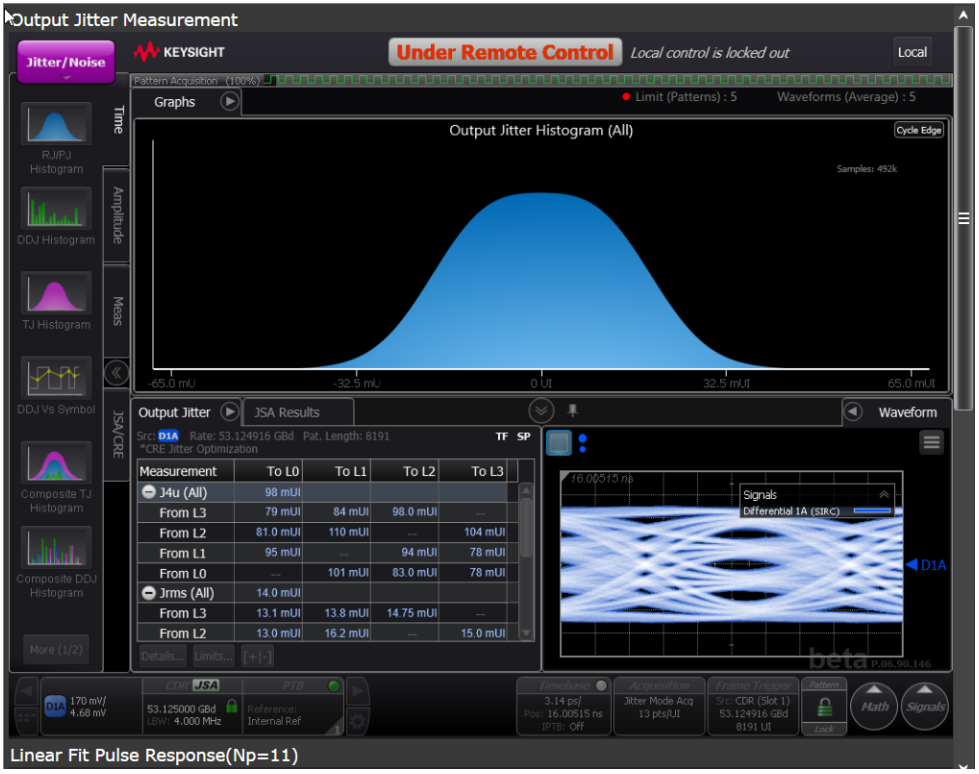


Figure 54 Tx Meas. for COM model - Rx ITol Calibration results - Graphical

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. This calibration should be performed for both the low and high loss channel test cases.

Connection Diagram Connect the instruments as shown in Figure 55.

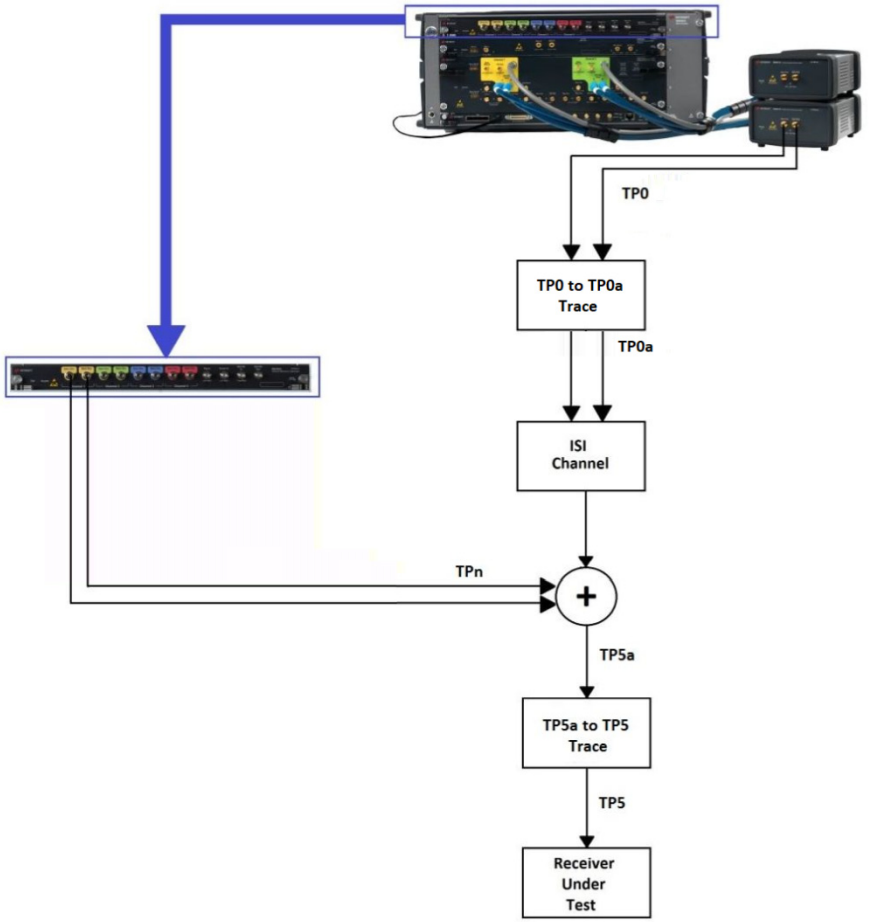


Figure 55 Rx Calibration using COM model connections for C2C

NOTE TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

ID

Standard Name	Test ID
C2C	472102

Dependencies This test depends on the values measured in "Transmitter Measurements for COM Model-Rx ITol" on page 84.

- 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 "C2C configuration in the Test App" on page 67.

Parameters Refer to "Calibration Parameters in Debug Mode" on page 64.

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
- FORCE_TR = 1

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

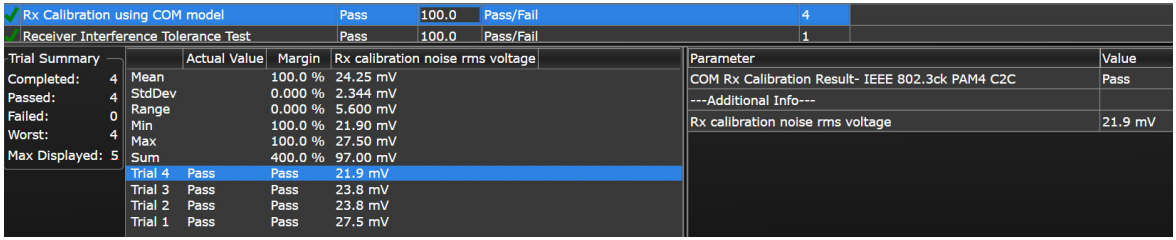


Figure 56 Rx Calibration using COM model Calibration results

Receiver Jitter Tolerance

Transmitter Measurements for COM Model-Rx JTol

Overview The Transmitter Measurements for COM Model-Rx JTol 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 *Table 120F-1* mentioned in the *section 120F* of the *IEEE P802.3ck™/D3.2* specification.

Connection Diagram Connect the instruments as shown in Figure 57.

Connect:

- Victim Generator Data Out 1 P/N to Oscilloscope CH1/CH2.
- Unused ports with 50 ohms.
- Note: TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

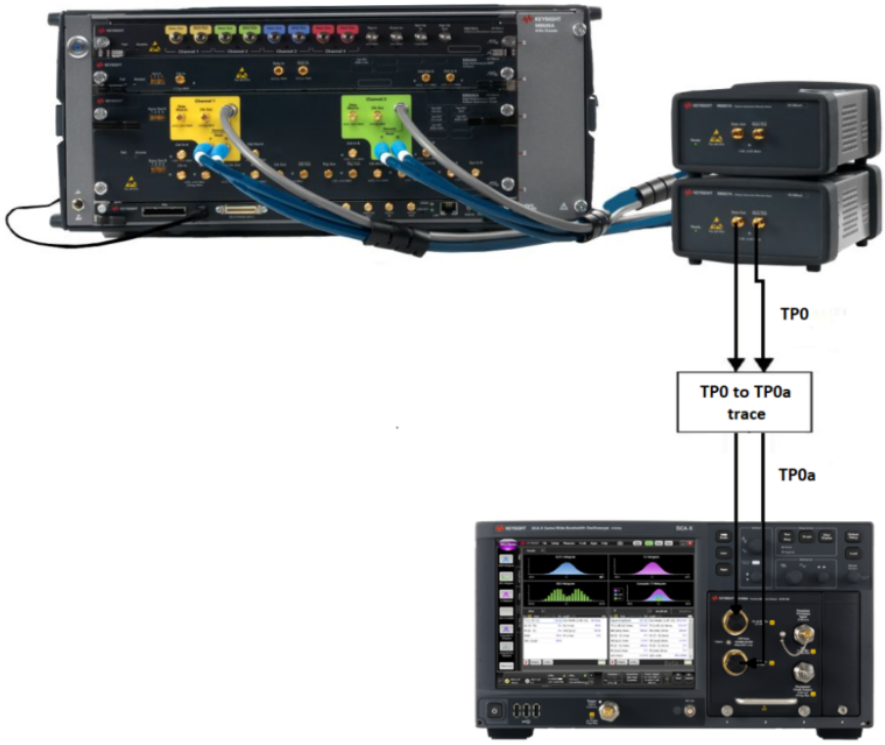


Figure 57 Transmitter Measurements for COM Model-Rx JTol connections for C2C

NOTE TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

ID

Standard Name	Test ID
C2C	473100

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 "C2C configuration in the Test App" on page 67.

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

Parameters Refer to "Calibration Parameters in Debug Mode" on page 64.

Procedure This calibration uses the PRBS13Q 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(Np =200)
- SNDR for Rx test(Np = 11)

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)

Parameter	Value				
Transmitter Measurements - IEEE 802.3ck PAM4 C2C TP0a	Pass				
---Additional Info---					
Transition Time	10 ps				
Transmitter Measurements for COM Model Results	Measurement Name	Status	Measured Value	Margin %	Pass Limits
	Jrms	Pass	21.5 mUI	6.5 %	<= 23.0 mUI
	J4u	Pass	116.0 mUI	1.7 %	<= 118.0 mUI
	Level mismatch ratio RLM	Pass	0.96	1.1 %	>= 0.95
	Signal-to-noise-and-distortion ratio(Np=200)	Pass	32.65 dB	0.5 %	>= 32.50 dB
SNDR for Rx Test(Np=11)	31.02 dB				
Output Jitter Measurement	(See image)				
Linear Fit Pulse Response(Np=11)	(See image)				

Figure 58 Tx Meas. for COM model - Rx JTol Calibration results - Tabulated

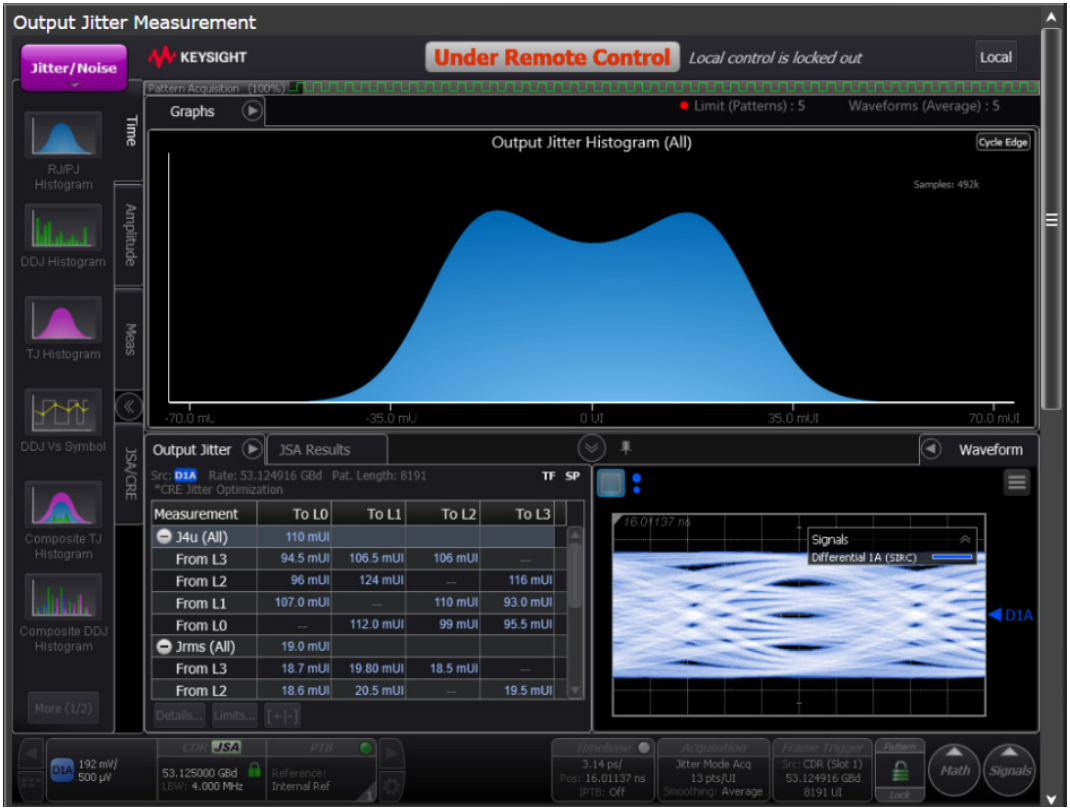


Figure 59 Tx Meas. for COM model - Rx JTol Calibration results - Graphical

COM Verification

Overview The COM Verification verifies the calibration data as a prerequisite to performing the Receiver Jitter Tolerance Test. This calibration is only required for the high loss channel test case.

Connection Diagram Connect the instruments as shown in Figure 60.

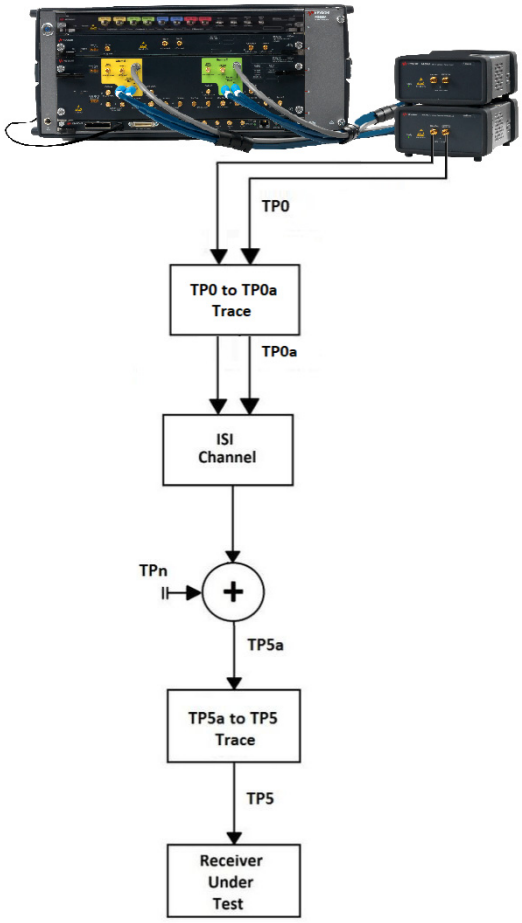


Figure 60 COM Verification connections for C2C

NOTE TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

ID

Standard Name	Test ID
C2C	473101

Dependencies This test depends on the values measured in "Transmitter Measurements for COM Model-Rx JTol" on page 90.

- 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 "C2C configuration in the Test App" on page 67.

Parameters Refer to "Calibration Parameters in Debug Mode" on page 64.

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.

COM Verification	Pass	100.0	Pass/Fail	1
Channel Characterization using COM model	Pass	100.0	MinInsertionLoss <= VALUE <= MaxInsertionLoss	1
Broadband Noise Calibration	Pass	100.0	Pass/Fail	1
Receiver Interference Tolerance Test	Pass	100.0	Pass/Fail	1
Receiver Jitter Tolerance Test	Pass	100.0	Pass/Fail	1

Parameter	Value				
COM Verification Result- IEEE 802.3ck PAM4 C2C	Pass				
---Additional Info---					
COM Verification Results	Measurement Name	Status	Measured Value	Margin %	Pass Limits
	Case 1 COM	Pass	4.612 dB	53.7 %	>= 3.000 dB
	Case 2 COM	Pass	4.322 dB	44.1 %	>= 3.000 dB

Figure 61 COM Verification Calibration results

5 IEEE 802.3ck C2C Tests

This section provides the test procedures for the IEEE 802.3ck Rx Tests, which are applicable for the C2C standard option.

As a prerequisite, before running C2C tests:

- Run all IEEE 802.3ck C2C calibrations.
- Ensure that the DUT is properly connected to the BERT modules and the test channel.

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 **C2C (100GAUI-1, 200GAUI-2, and 400GAUI-4)** 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
- Target Error Ratio
- Target COM
- Test Channel Configuration (Low Loss) corresponds to Test1, whereas (High Loss) corresponds to Test2; both configured to meet the COM value (3 dB max)
- PAM4 Symbol 1 Level
- PAM4 Symbol 2 Level
- Transmitter Pre-Cursor3
- Transmitter Pre-Cursor2
- Transmitter Pre-Cursor1
- Transmitter Post-Cursor1
- Channel EQ Pre-Cursor3
- Channel EQ Pre-Cursor2
- Channel EQ Pre-Cursor1
- Channel EQ Post-Cursor1
- 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 Confidence Level
- DUT Control Interface Script File
- DUT Control Interface Location
- Pause before starting Receiver tests

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

Rx Test Procedures

Overview on Receiver Tests

Table 14 shows a summary of steps for each procedure that must be performed for Rx tests. Reference to each figure mentioned in the steps in this section is from *Annexure 93C* of IEEE Std 802.3bj-2014, Amendment to IEEE Std 802.3-2012: Ethernet.

Table 14 Rx test procedure step summary

#	Procedure	Test Channel Configuration	Summary of steps to be performed
1	Rx Interference Tolerance Test	Perform Rx Interference Tolerance Test for both the low loss and high loss channel.	Perform Rx interference tolerance test (see setup from Figure 30).
2	Rx Jitter Tolerance Test	Perform Rx Jitter Tolerance Test for high loss channel.	Perform Rx jitter tolerance test (see setup from Figure 30).

These procedures are broadly described in the following section.

Detailed steps for Rx Test Procedures

Step#1. Rx Interference Tolerance Test

1. Using the test setup in Figure 30, the transmitter taps and the channel noise as determined in the calibration procedures, configure the transmitter to transmit the test pattern specified in the PMD clause that invokes this method.
2. Configure the transmitters of the PMD under test to transmit the same test pattern, with their transmitters in the preset condition.
3. Measure the BER using the PRBS31Q pattern on the receiver under test using the built-in error counter or by activating the DUT internal loopback mode and using a short loopback channel (IL < 7dB @ 26.5625GHz) to an M8046A error detector.

Step#2. Rx Jitter Tolerance Test

1. Using the test setup in Figure 30 and the transmitter taps (but without the channel noise) as determined in the calibration procedures, configure the transmitter to transmit the test pattern specified in the PMD clause that invokes this method.
2. Configure the transmitters of the PMD under test to transmit the same test pattern, with their transmitters in the preset condition.

3 Measure the BER using the PRBS31Q pattern on the receiver under test using the built-in error counter or by activating the DUT internal loopback mode and using a short loopback channel (IL < 7dB @ 26.5625GHz) to an M8046A error detector.

For each case listed in Table 15, the receiver under test shall meet the BER measurements as specified in Table 120F-5 of P802.3ck™/D3.2 specification.

Table 15 Receiver jitter tolerance parameters

Parameter	Case A	Case B	Case C	Case D	Case E	Case F	Units
Jitter frequency	0.04	0.4	1.333	4	12	40	MHz
Jitter amplitude (pk-pk)	5	0.5	0.15	0.05	0.05	0.05	UI

NOTE The BER reported in the standard assume that the error statistics are sufficiently random to result in the required frame loss ratio. Error statistics can be characterized using the M8046A error detector together with the M8070EDAB package.

Receiver Interference Tolerance Test

Overview

The Receiver Interference Tolerance Test validates that the receiver on each lane shall meet the BER requirement with channels matching the Channel Operating Margin (COM) and loss parameters for Test 1 and Test 2. This test should be performed for both the low and high loss channel test cases.

Connection Diagram

Connect the instruments as shown in Figure 62.

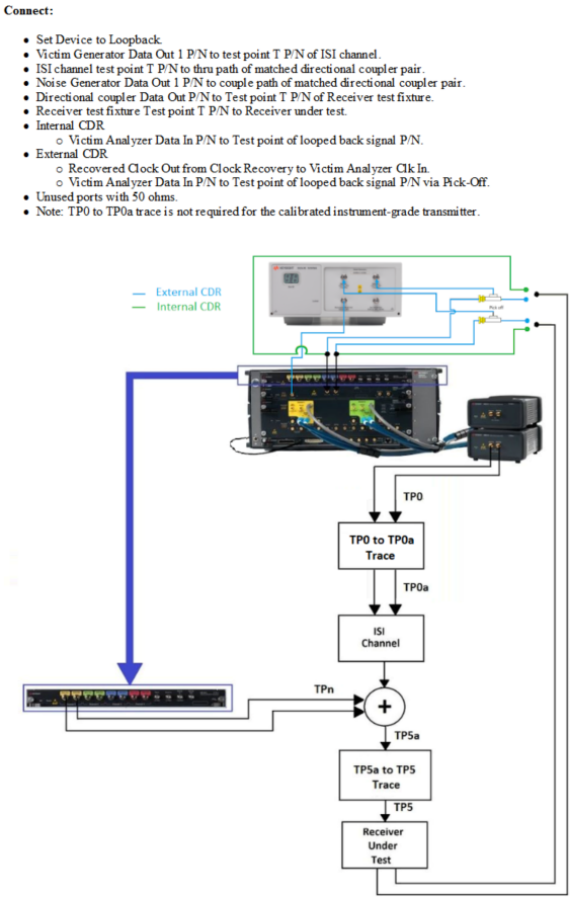


Figure 62 Rx Interference Tolerance Test connections for C2C

NOTE TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

ID

Standard Name	Test ID
C2C	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 96.

Procedure This test uses the PRBS31Q pattern.

Results This test attains ‘Pass’ value if the Rx BER is less than 1e-4, as per the *IEEE P802.3ck™/D3.2* specification.

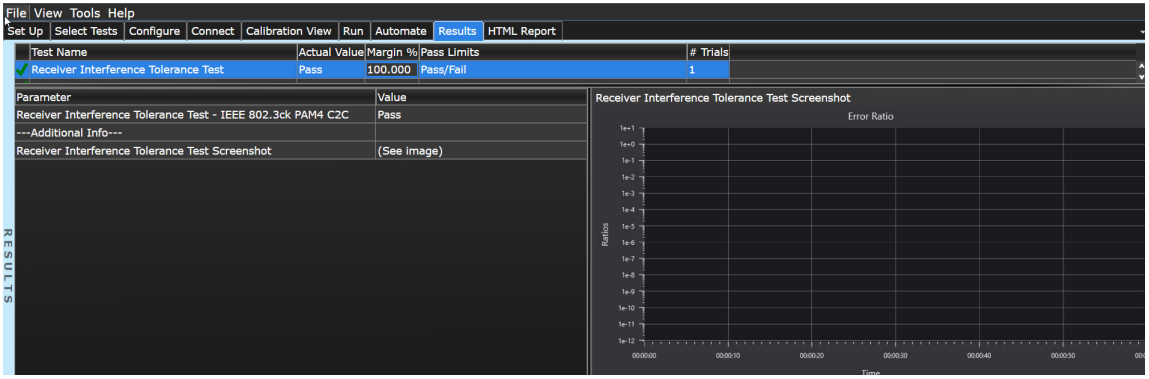


Figure 63 Rx Interference Tolerance Test results in tabular format

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 *IEEE P802.3ck™/D3.2* specification. This test is only required for the high loss channel test case.

Connection Diagram Connect the instruments as shown in Figure 64.

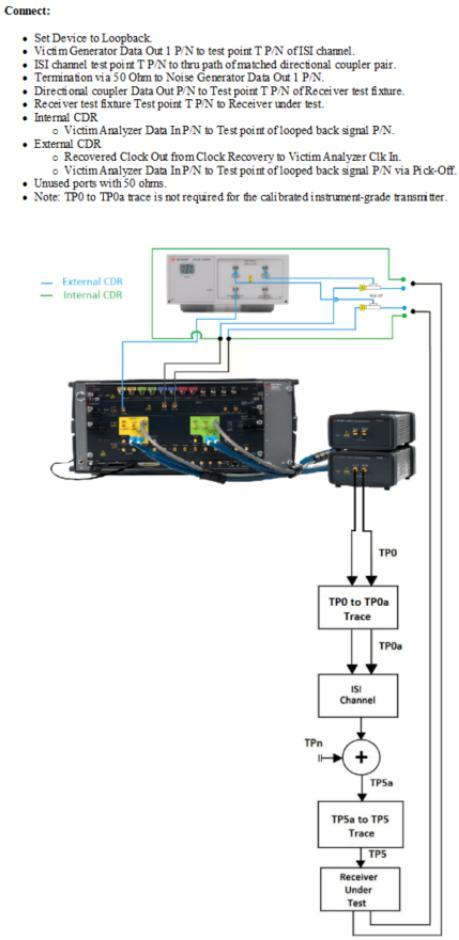


Figure 64 Rx Jitter Tolerance Test connections for C2C

NOTE TP0 to TP0a trace is not required for the calibrated instrument-grade transmitter.

ID

Standard Name	Test ID
C2C	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 96.

Procedure This test uses the PRBS31Q pattern.

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

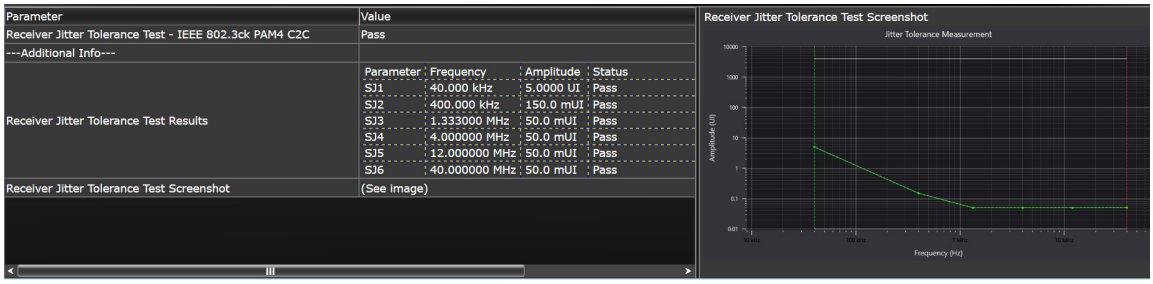


Figure 65 Rx Jitter Tolerance Test results

Parameter	Value			
Receiver Jitter Tolerance Test - IEEE 802.3ck PAM4 C2C	Pass			
---Additional Info---				
Receiver Jitter Tolerance Test Results	Parameter	Frequency	Amplitude	Status
	SJ1	40.000 kHz	5.0000 UI	Pass
	SJ2	400.000 kHz	150.0 mUI	Pass
	SJ3	1.333000 MHz	50.0 mUI	Pass
	SJ4	4.000000 MHz	50.0 mUI	Pass
	SJ5	12.000000 MHz	50.0 mUI	Pass
	SJ6	40.000000 MHz	50.0 mUI	Pass
Receiver Jitter Tolerance Test Screenshot	(See image)			

Figure 66 Rx Jitter Tolerance Test results in tabular format

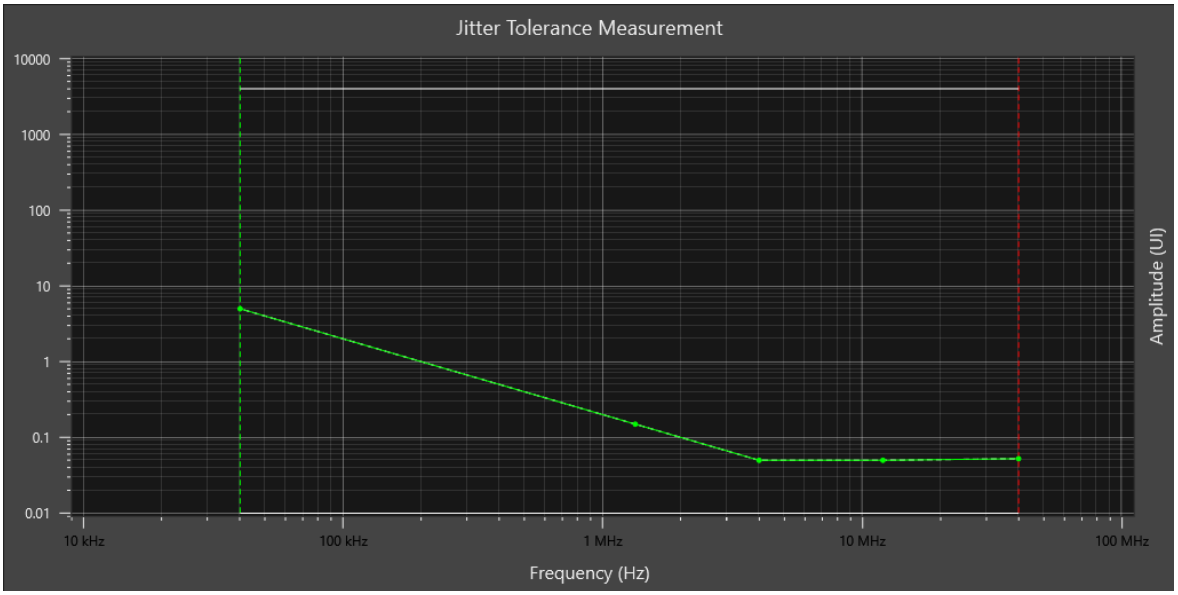


Figure 67 Rx Jitter Tolerance Test results in graphical format

6 IEEE 802.3ck C2M Calibrations

This section provides the procedures for the IEEE 802.3ck C2M Calibrations, which are applicable for both C2M Host and C2M Module standards.

As mentioned earlier, ensure that the FlexDCA Oscilloscope has been calibrated and the mated Compliance Board is properly connected to the test instruments to perform IEEE 802.3ck C2M Calibrations.

Before performing the IEEE 802.3ck C2M tests, you must calibrate all the related parameters. Perform calibrations in the order displayed in the Keysight M8091CKPA Rx Test Application for IEEE 802.3ck.

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 C2M Host Input and C2M Module Input standard option, the following parameters are available for configuration. Note that other than the “Module Output Mode” and “Minimum CTLE Gain” parameters, 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
- Target Error Ratio
- Host Channel: Select host channel settings.
  - For C2M Host Input, select between Near-end and Far-end host channel.
  - For C2M Module Input, select between Low-loss and High-loss channel. The frequency-dependent attenuation is used only for the long channel.
- Module Output Mode - Select either Short or Long module output mode, as requested by the host. The PCB length of the host channel is listed in *Table 120G-5 of section 120G of the IEEE P802.3ck™/D3.2* specification. (This parameter is available only for C2M Host standard.)
- PAM4 Symbol 1 Level
- PAM4 Symbol 2 Level
- Transmitter Pre-Cursor3
- Transmitter Pre-Cursor2
- Transmitter Pre-Cursor1
- Transmitter Post-Cursor1
- Channel EQ Pre-Cursor3
- Channel EQ Pre-Cursor2
- Channel EQ Pre-Cursor1
- Channel EQ Post-Cursor1
- Loop Bandwidth

- SIRC Response For TX Measurements
- SIRC Bandwidth For TX Measurements
- Number of averages for waveform acquisition

Parameters for Crosstalk Calibration

- Crosstalk Amplitude
- Crosstalk Transition Time

Parameters for Amplitude Calibration

- Amplitude
- Transmitter Pre-Cursor3
- Transmitter Pre-Cursor2
- Transmitter Pre-Cursor1
- Transmitter Post-Cursor1

Parameter for BUJ Calibration

- BUJ

Parameters for Transmitter Characterization

- Amplitude
- SJ
- UUGJ
- BUJ
- PAM4 Symbol 1 Level
- PAM4 Symbol 2 Level
- Transmitter Pre-Cursor3
- Transmitter Pre-Cursor2
- Transmitter Pre-Cursor1
- Transmitter Post-Cursor1
- Np for TP0v
- Dp for TP0v
- Jnu Type

Parameters for Stressed Eye Calibration

- SIRC Response for Stressed Eye
- SIRC Bandwidth for Stressed Eye
- Amplitude
- SJ
- UUGJ
- BUJ—value duplicated from / to BUJ Calibration.
- PAM4 Symbol 1 Level
- PAM4 Symbol 2 Level
- Transmitter Pre-Cursor3
- Transmitter Pre-Cursor2
- Transmitter Pre-Cursor1
- Transmitter Post-Cursor1
- FFE Mode—When set to 'Auto', the channel equalization coefficients are computed from measured pulse response; otherwise the Pre-Cursor1/2/3 and Post-Cursor parameters should be specified by the user.
- Channel EQ Pre-Cursor3
- Channel EQ Pre-Cursor2
- Channel EQ Pre-Cursor1
- Channel EQ Post-Cursor1
- Enable Tx Deemphasis Fine Tuning
- Crosstalk Amplitude—value duplicated from / to Crosstalk Calibration.
- Crosstalk Transition Time—value duplicated from / to Crosstalk Calibration.
- Eye Height
- Eye Height Accuracy
- Vertical Eye Closure
- Vertical Eye Closure Accuracy
- CTLE Mode- Selects CTLE control and behavior. The available choices include:
  - Optimized CTLE using COM Method: Use the optimized CTLE settings determined by the COM model.
  - Auto-tune: Run "Auto-tune" to find the optimal CTLE settings.
  - Manual: Manual entry of CTLE DC gain settings.
- CTLE Zero Frequency

- CTLE Pole 1 Frequency
- CTLE Pole 2 Frequency
- CTLE Low-frequency Pole/Zero
- Spectral Density Noise State
- Spectral Density Noise
- Histogram Window Shape
- Gaussian Standard Deviation
- Pulse Response Save File
- CTLE Auto-tune > Measure all CTLE options
- CTLE Auto-tune > Start value for gDC CTLE auto-tune
- CTLE Auto-tune > Stop value for gDC CTLE auto-tune
- CTLE Auto-tune > Start value for gDC2 CTLE auto-tune
- CTLE Auto-tune > Stop value for gDC2 CTLE auto-tune
- CTLE Auto-tune > Minimum CTLE Gain
  Note: Select minimum CTLE gain for module high-loss stressed input signal calibration. Condition is gdc + gdc2 <= Minimum CTLE Gain.
- CTLE Manual > Manual CTLE gDC
- CTLE Manual > Manual CTLE gDC2
- Differential Peak-Peak Voltage Tolerance Calibration > Differential Pk-Pk Voltage

C2M configuration in the Test Application

In order to obtain valid calibration data and test measurements for the C2M standard option, the pulse response is used.

During the Stressed Eye Calibration run, the test application measures the pulse response, which is then used to optimize equalizer settings (FFE, CTLE, and DFE).

When the FFE Mode configuration variable is set to ‘Auto’, the channel equalization coefficients are computed from the measured pulse response; otherwise the “Channel EQ” Pre-Cursor1/2/3 and Post-Cursor parameters should be specified by the user.

The measured pulse response data is saved by the test application as a csv file with time and voltage columns. The **Pulse Response Save File** configuration parameter shows the location of the saved pulse response csv file.

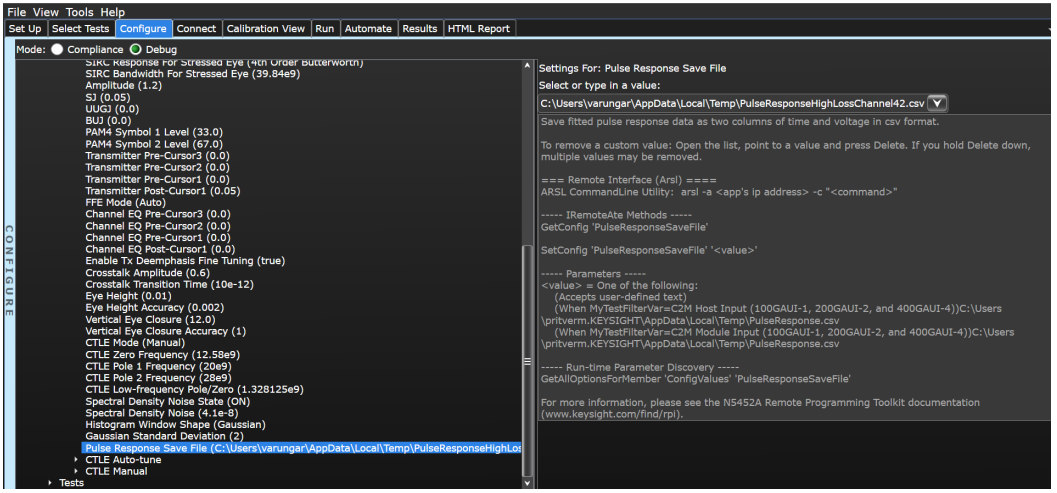


Figure 68 Pulse Response Save File Configuration Parameter

Calibration Procedure

The IEEE 802.3ck C2M receiver test calibration procedures comprise of two steps:

1 System calibration: Calibrate the equipment used to generate the victim transmitter, impairments and crosstalk source (once per setup configuration).

2 Stressed Eye calibration: Calibrate the stress signal after channel in front of the receiver under test (TP4 or TP1a) with appropriate amplitude and impairments to meet the required Eye Height and Vertical Eye Closure targets. The calibration procedure requires two steps:

- Transmitter Characterization at TP0v: Different transmitter profiles can be used as a starting point for the stress eye calibration. For instance, with different jitter profile (parameters **SJ**, **UUGJ**, **BUJ**) as well as rise time and SNDR (parameters **Transmitter Pre-Cursor1/2/3** and **Transmitter Post-Cursor1**). (See "Transmitter Characterization" section.) It is recommended to inject a fixed amount of BUJ (e.g. 5 or 10mUI) to obtain a jitter profile close to one listed in Table 120F of the IEEE P802.3ck™/D3.2. This comes in addition to the 50 mUI sinusoidal jitter that is required for jitter tolerance and added per default.
- Stress Signal Calibration: The calibration procedure requires the below steps:
  - Channel Equalization: For Stress Eye Calibration, it is expected that the transmitter (FIR filter) and receiver (CTLE-DFE) equalizers are optimized for the given channel and transmitter profile. The amount of transmitter de-emphasis used for channel equalization is specified by the parameters **Channel Eq Pre-Cursor1/2/3** and **Channel Eq Post-Cursor**. When the parameter **FFE Mode** is set to Auto, these parameters are computed from the system's pulse response. Otherwise, the user should specify them manually. Note that the resulting deemphasis taps of the BERT pattern generator are the convolution of **Transmitter** and **Channel Eq** taps.
    Similarly, the optimal CTLE gain can be set manually with a search or based on the pulse response measurement (parameter **CTLE mode**). The 4-tap DFE is always optimized for the actual combination of Tx deemphasis and CTLE using the Mueller-Mueller algorithm.
    Finally, an optional step can be carried out to optimize the "unstressed" VEC (parameter **Enable Deemphasis fine Tuning**).

- Stress eye calibration: Once the equalization is optimized, the system iteratively adjust the amount of random jitter and signal amplitude to meet the Eye Height and Vertical Eye Closure targets (parameters **Eye Height** and **Vertical Eye Closure**). (See "Stressed Eye Calibration" section.)

For the C2M Host Input standard a total of four calibrations is required to cover all Host Channel and Module Output Mode combinations (far-end/near-end/short/long). This is achieved by selecting the appropriate options for the Host Channel and Module Output Mode parameters in the **Configure** tab. A packaged host chip is usually tested either in a near-end or a far-end configuration, but both short and long modes of the module should be considered.

For the C2M Module Input standard, two calibrations are required for the low loss channel (mated MCB/HCB) and the high loss channel (mated MCB/HCB plus ISI board). It is also required to select the appropriate Channel choice in the **Configure** tab.

In each standard case, the Calibration Persistence function can be used to save/recall common calibration data.

BUJ calibration is only recommended if a fixed BUJ component is added to the transmitter.

The pulse response is used to optimize equalizer settings (FFE, CTLE, and DFE). Recommended setting for CTLE optimization is 'Auto-tune'.

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 69 and Figure 70.

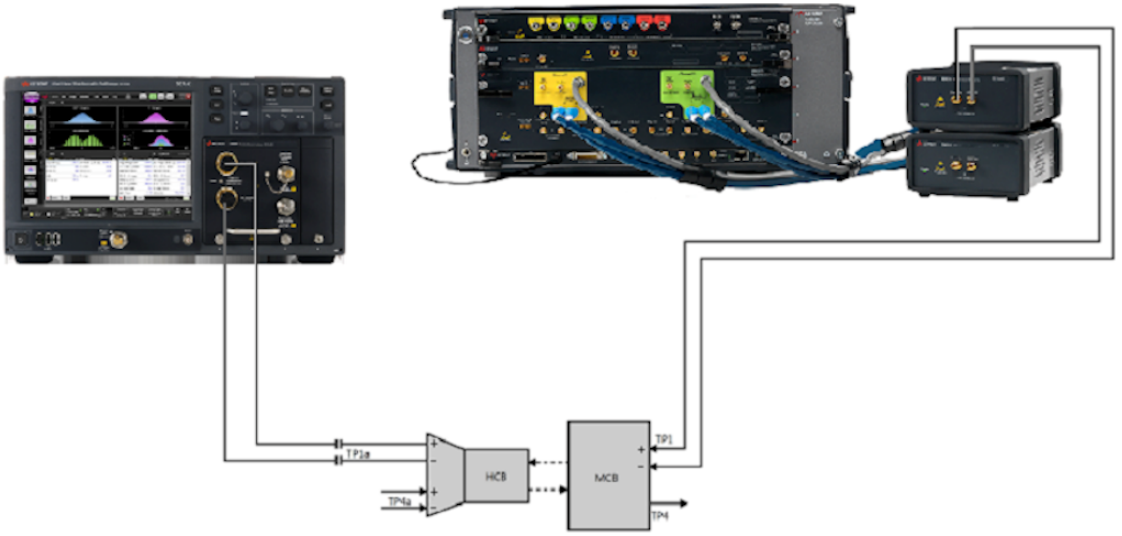


Figure 69 Crosstalk Calibration connections for C2M Host

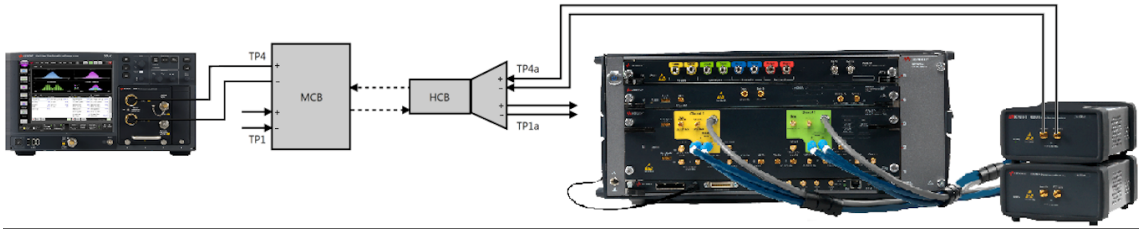


Figure 70 Crosstalk Calibration connections for C2M Module

ID

Standard Name	Test ID
C2M Host	71100
C2M 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 106.

Procedure This calibration uses the PRBS13Q pattern.

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

- Standard Parameter
  - Crosstalk Amplitude
  - Crosstalk Transition 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.

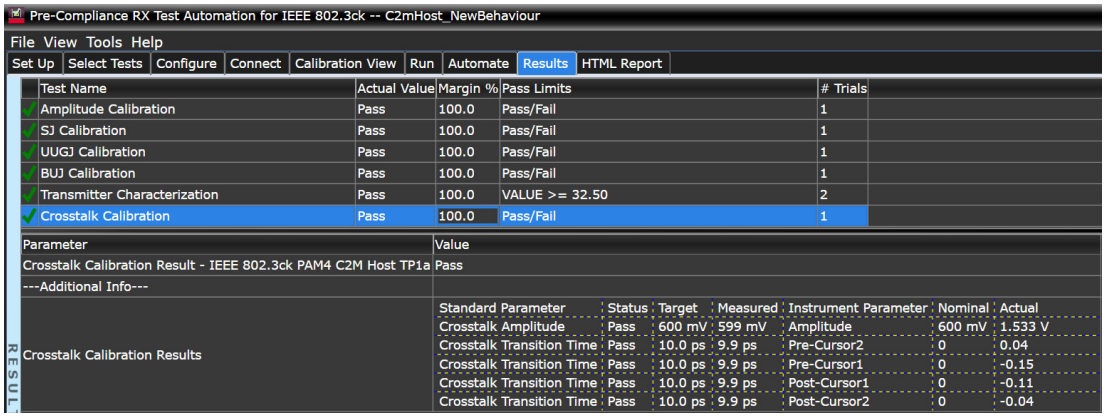


Figure 71 Crosstalk Calibration resulting information in the Results tab

Parameter	Value						
Crosstalk Calibration Result - IEEE 802.3ck PAM4 C2M Host TP1a	Pass						
---Additional Info---							
Crosstalk Calibration Results	Standard Parameter	Status	Target	Measured	Instrument Parameter	Nominal	Actual
	Crosstalk Amplitude	Pass	600 mV	599 mV	Amplitude	600 mV	1.533 V
	Crosstalk Transition Time	Pass	10.0 ps	9.9 ps	Pre-Cursor2	0	0.04
	Crosstalk Transition Time	Pass	10.0 ps	9.9 ps	Pre-Cursor1	0	-0.15
	Crosstalk Transition Time	Pass	10.0 ps	9.9 ps	Post-Cursor1	0	-0.11
	Crosstalk Transition Time	Pass	10.0 ps	9.9 ps	Post-Cursor2	0	-0.04

Figure 72 Crosstalk Calibration results for C2M Host Input

Amplitude Calibration

Overview The Amplitude Calibration is performed to calibrate the Victim Generator's Amplitude. Note that the de-emphasis configuration resulting from the Transmitter Equalization sequence must be applied during calibration.

Connection Diagram Connect the instruments as shown in Figure 73.

Figure 73 Amplitude Calibration connections for C2M Host & C2M Module

ID

Standard Name	Test ID
C2M Host	71101
C2M Module	271101

Parameters Refer to "Calibration Parameters in Debug Mode" on page 106.

Procedure This calibration uses the PRBS13Q 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.

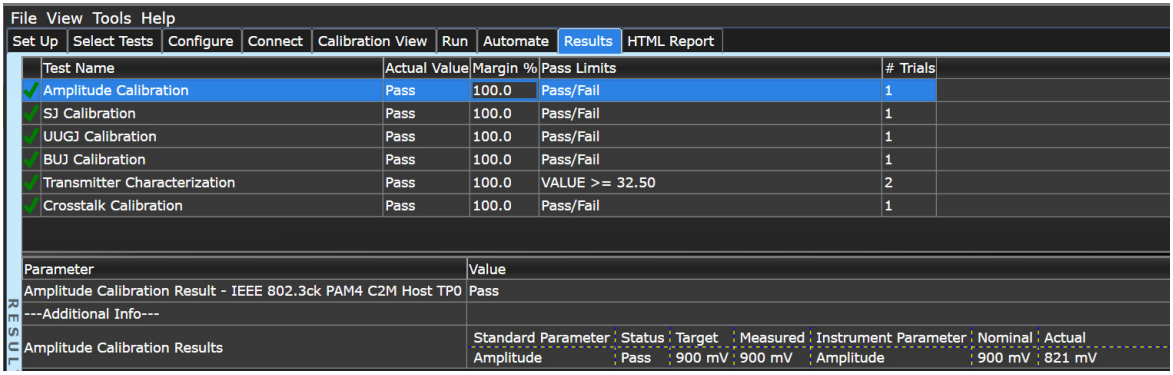


Figure 74 Amplitude Calibration resulting information in the Results tab

SJ Calibration

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

Connection Diagram Connect the instruments as shown in Figure 75 for both C2M standards.

Figure 75 SJ Calibration connections for C2M Host & C2M ModuleC2M

ID

Standard Name	Test ID
C2M Host	71102
C2M Module	271102

Parameters Refer to “Calibration Parameters in Debug Mode” on page 106.

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.

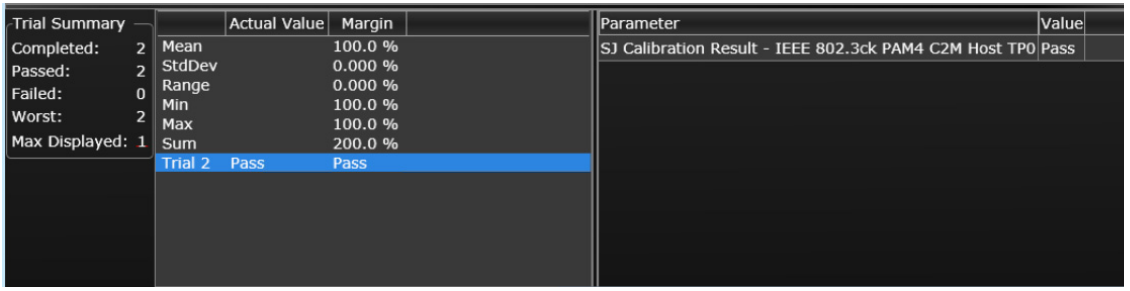


Figure 76 SJ Calibration resulting information in the Results tab

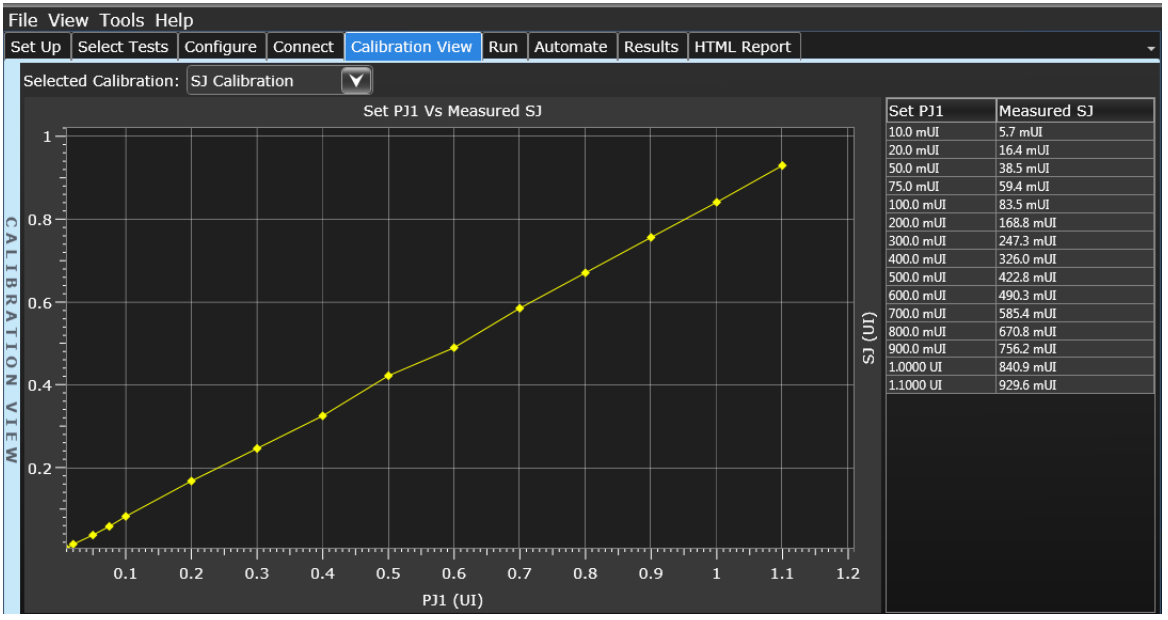


Figure 77 SJ Calibration calibrated data in Calibration View tab

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 78 for both C2M standards.

Figure 78 UUGJ Calibration connections for C2M Host & C2M Module

ID

Standard Name	Test ID
C2M Host	71103
C2M Module	271103

Parameters Refer to "Calibration Parameters in Debug Mode" on page 106.

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.

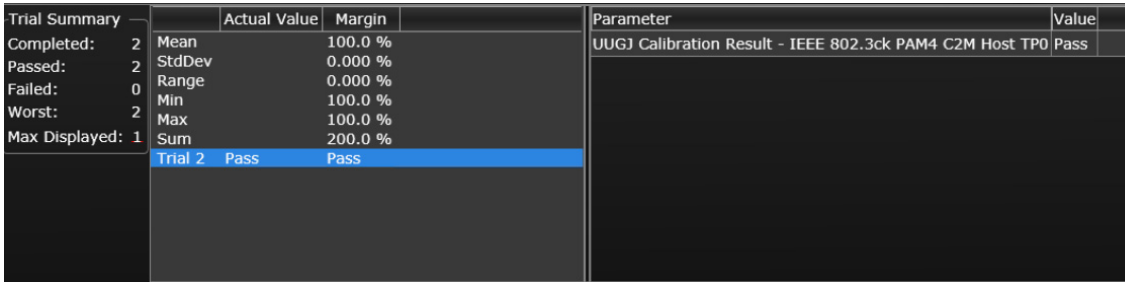


Figure 79 UUGJ Calibration resulting information in the Results tab

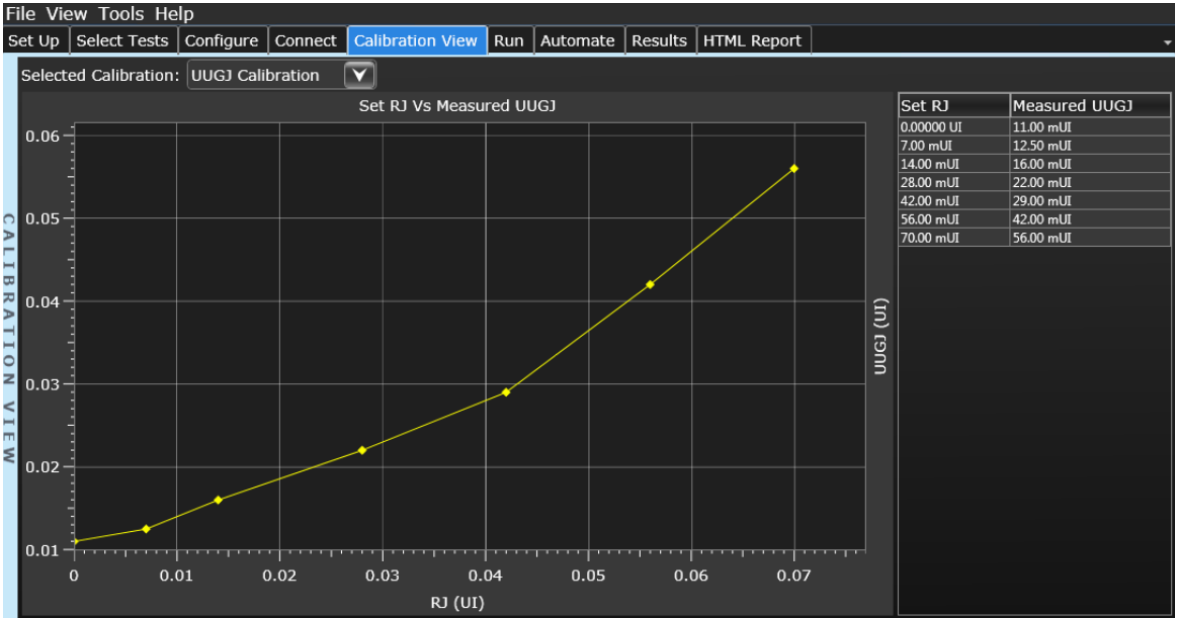


Figure 80 UUGJ Calibration calibrated data in Calibration View tab

BUJ Calibration

NOTE

The UBHPJ stress component comprises of 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 wish a 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.

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

Connection Diagram Connect the instruments as shown in Figure 81 for both C2M standards.

Figure 81 BUJ Calibration connections for C2M Host & C2M Module

ID

Standard Name	Test ID
C2M Host	71104
C2M Module	271104

Parameters Refer to “Calibration Parameters in Debug Mode” on page 106.

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.

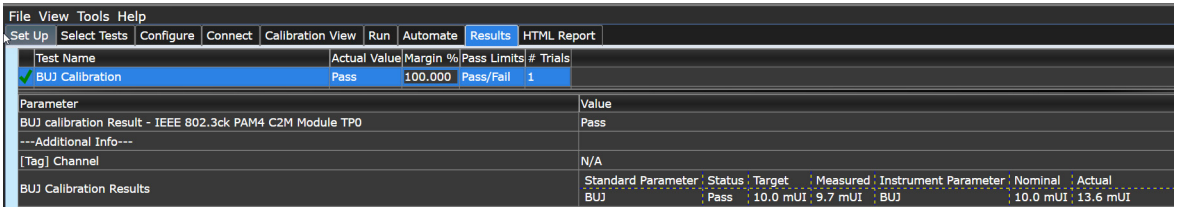


Figure 82 BUJ Calibration resulting information in the Results tab

Transmitter Characterization

Overview Transmitter Characterization is performed to explore different transmitters for the receiver tests. If the reference transmitter fails the transmitter characterization, the following parameters can be adjusted PAM4 Symbol 1/2 Level for linearity, Transmitter Post-Cursor1 for rise time and SNDR (value between 0 and 0.05) or reducing the BUJ component, if any. Note that matching the transmitter characteristics targets isn't required to proceed to the Stress Eye Calibration step.

Connection Diagram Connect the instruments as shown in Figure 83.

Figure 83 Transmitter characterization connections for C2M Host and C2M Module

ID

Standard Name	Test ID
C2M Host	71105
C2M Module	271105

Parameters Refer to “Calibration Parameters in Debug Mode” on page 106.

Procedure This calibration uses the PRBS13Q pattern.

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

- Transition Time
- Jrms
- J4u (Note that the J4u pass limit has been updated to 0.128 UI as specified in Table 120F-1 of P802.3ck™/D3.2 specification)
- Level mismatch ratio RLM
- Signal-to-noise-and-distortion ratio(Np=200)

Parameter	Value				
Transmitter Measurements - IEEE 802.3ck PAM4 C2M Host TP0a	Pass				
---Additional Info---					
Transition Time	10 ps				
Transmitter Measurements	Measurement Name	Status	Measured Value	Margin %	Pass Limits
	Jrms	Pass	19.0 mUI	17.4 %	<= 23.0 mUI
	J4u	Pass	110.0 mUI	6.8 %	<= 118.0 mUI
	Level mismatch ratio RLM	Pass	0.96	1.1 %	>= 0.95
	Signal-to-noise-and-distortion ratio(Np=200)	Pass	33.69 dB	3.7 %	>= 32.50 dB
Output Jitter Measurement	(See image)				
Linear Fit Pulse Response(Np=200)	(See image)				

Figure 84 Transmitter Characterization results

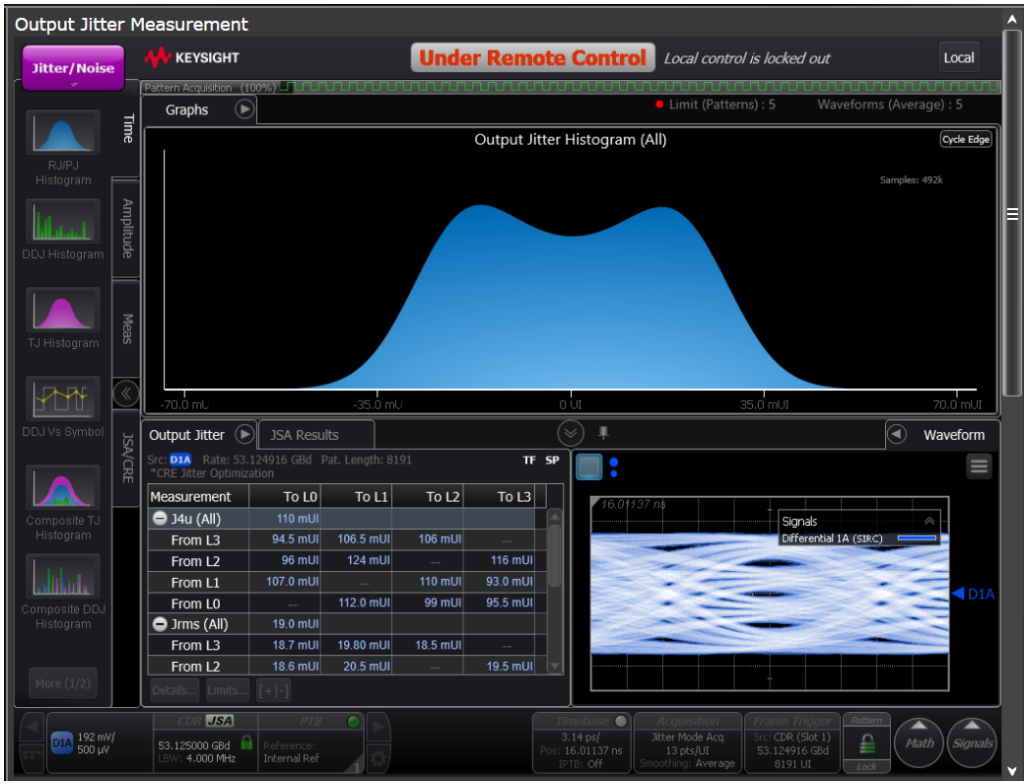


Figure 85 Output jitter measurement image for C2M Host Input

Stressed Eye Calibration

Overview The Stressed Eye Calibration is performed to calibrate the stressed eye signal for the Host or Module Stressed Input Test. This calibration should be performed four times for the C2M Host Input standard (as shown in Table 16) and two times for the C2M Module Input standard (as shown in Table 17).

Table 16 C2M Host Input Calibration Modes

Standard Option	Host Channel	Module Output Mode	Notes
C2M Host Input	Far-end	Short	Set Host Channel and Module Output Modes in the Configure tab
		Long	
	Near-end	Short	
		Long	

Table 17 C2M Module Input Calibration Modes

Standard Option	Channel	Notes
C2M Module Input	Low Loss	Mated MCB/HCB
	High Loss	Mated MCB/HCB + Frequency dependent attenuator

Connection Diagram Connect the instruments as shown in Figure 86 and Figure 87.

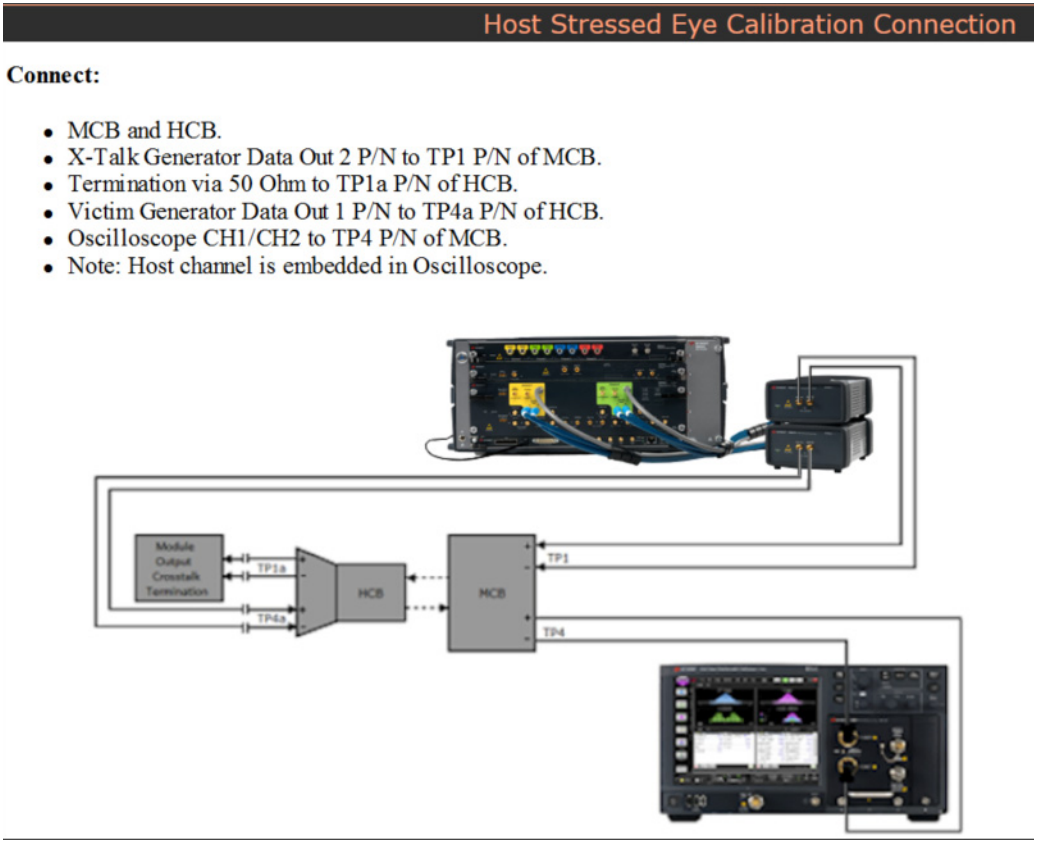


Figure 86 Stressed Eye Calibration connections for C2M Host

Module Stressed Eye Calibration Connection

Connect:

- MCB and HCB.
- X-Talk Generator Data Out 2 P/N to TP4a P/N of HCB.
- Termination via 50 Ohm to TP4 of MCB.
- Victim Generator Data Out 1 P/N to Frequency dependent attenuator.
- Frequency dependent attenuator to TP1 P/N of MCB.
- Oscilloscope CH1/CH2 to TP1a P/N of HCB.
- Note: The Frequency dependent attenuator is used only for the High Loss channel.

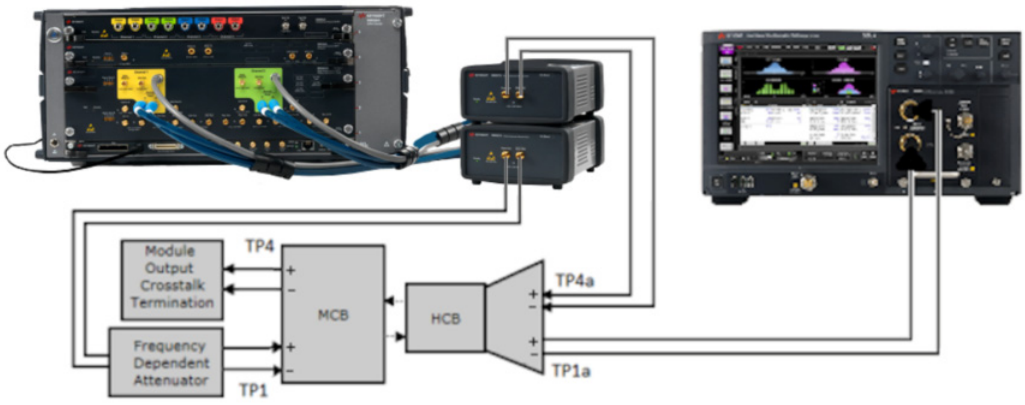


Figure 87 Stressed Eye Calibration connections for C2M Module

NOTE In the current version of the application, ISI board is required for high loss test case.

ID

Standard Name	Test ID
C2M Host	71106
C2M Module	271106

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
  - Transmitter Characterization when FFE Mode is set to 'Auto' or *CTLE Mode* is set to 'Optimized CTLE using COM Method'.

Parameters Refer to "Calibration Parameters in Debug Mode" on page 106.

Procedure This calibration uses the PRBS13Q pattern.

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

- Standard Parameter
  - EH5
  - VEC5
- Instrument Parameter
  - RJ
  - Amplitude

Parameter	Value						
Stressed Eye Calibration Result - IEEE 802.3ck PAM4 C2M Host TP4	Pass						
---Additional Info---							
Stressed Eye Calibration Results	Standard Parameter	Status	Target	Measured	Instrument Parameter	Nominal	Actual
	EH5	Pass	15 mV	15 mV	Amplitude	900 mV	398 mV
	VEC5	Pass	12dB	12.1dB	RJ	0.00000 UI	13.57 mUI
Optimum TX Cursor Values	(0,0.02,-0.13,0.84,-0.01)						
Optimum CTLE DC gain setting	-2.0 dB						
Optimum CTLE DC gain 2 setting	-1.5 dB						
Optimum DFE Taps	(0.107103,0.034644,-0.027867,0.003022)						
Stressed Eye Calibration Screenshot	(See image)						

Figure 88 Stressed Eye Calibration results for C2M Host Input

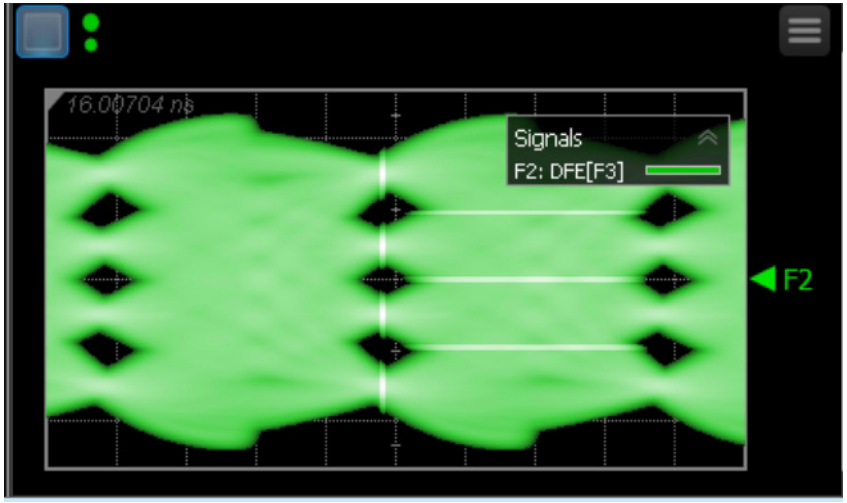


Figure 89 Stressed Eye Calibration image for C2M Host Input

Parameter	Value						
Stressed Eye Calibration Result - IEEE 802.3ck PAM4 C2M Module TP1a	Pass						
---Additional Info---							
Stressed Eye Calibration Results	Standard Parameter	Status	Target	Measured	Instrument Parameter	Nominal	Actual
	EH5	Pass	10 mV	10 mV	Amplitude	900 mV	693 mV
	VEC5	Pass	13.5dB	13.8dB	RJ	0.00000 UI	4.96 mUI
Optimum TX Cursor Values	(0,0.05,-0.21,0.72,-0.02)						
Optimum CTLE DC gain setting	-4.0 dB						
Optimum CTLE DC gain 2 setting	-2.0 dB						
Optimum DFE Taps	(0.4,0.042543,-0.026929,-0.001748)						
Stressed Eye Calibration Screenshot	(See image)						

Figure 90 Stressed Eye Calibration results for C2M Module Input

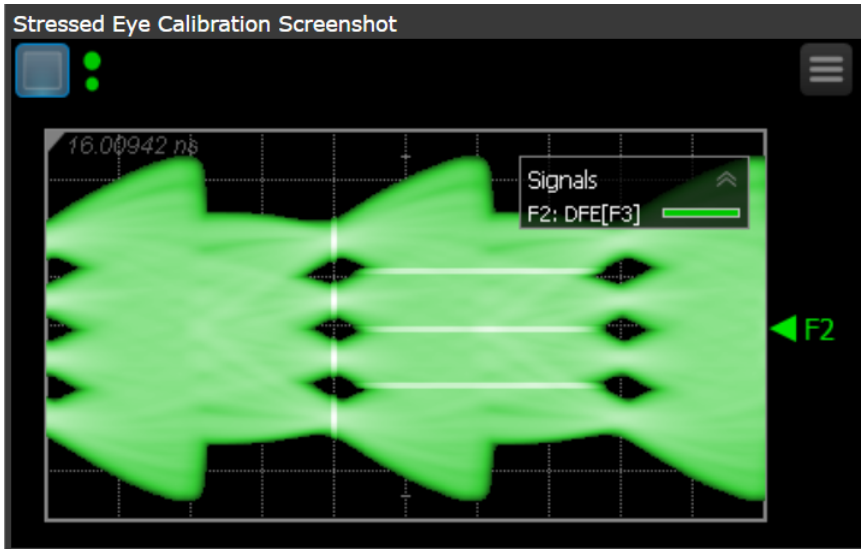


Figure 91 Stressed Eye Calibration image for C2M Module Input

If the CTLE Mode is set to **Auto-tune**, then the Auto-tune results will be displayed in the tabular format.

Stressed Eye Calibration Pass 100.000 Pass/Fail 10

RESULTS

Parameter	Value										
	gDC	gDC2	DFE taps	pulse main cursor	VEC Eye0	Eye Height Eye0	Eye Width Eye0	VEC Eye1	Eye Height Eye1	Eye Width Eye1
CTLE Auto-tune	-8	-2.5	3.09713E-01,-7.3204E-02,-4.3898E-02,-2.1393E-02	8.4459E-02	12.6dB	13mV	126mUI	10.1dB	18.1mV	178mUI
	-8	-3	3.05212E-01,-8.0435E-02,-5.0000E-02,-2.6304E-02	8.4120E-02	12.5dB	13.1mV	126mUI	9.78dB	18.7mV	182mUI
	-9	-1.5	2.84088E-01,-8.9860E-02,-4.6985E-02,-1.8194E-02	8.2684E-02	13.4dB	11.7mV	118mUI	10.5dB	16.8mV	168mUI
	-9	-2	2.76567E-01,-9.7158E-02,-5.0000E-02,-2.2959E-02	8.2410E-02	13dB	12.1mV	120mUI	10.2dB	17.4mV	168mUI
	-10	-0.5	2.60270E-01,-1.04063E-01,-4.9370E-02,-1.5400E-02	8.1293E-02	15.6dB	9mV	100mUI	12.1dB	13.8mV	148mUI
	-11	-0.5	2.25756E-01,-1.32688E-01,-5.0000E-02,-2.3112E-02	7.9467E-02	15.8dB	8.6mV	98mUI	12.6dB	12.8mV	146mUI

Standard Parameter | Status | Target | Measured | Instrument Parameter | Nominal | Actual

Figure 92 CTLE Mode Auto-tune results

Differential Peak-Peak Voltage Tolerance Calibration

Overview The Differential Peak-Peak Voltage Tolerance Calibration is performed to calibrate the peak-to-peak voltage of the differential signal on a PRBS13Q pattern. The minimum Differential Peak-Peak Voltage should be at least 750 mV at the TP1a test point (for Module Input Test) or should be at least 600 mV for short mode and 845 mV for long mode at the TP4 test point (for Host Input Test).

NOTE Calibrate the minimum Differential Peak-Peak Voltage at TP4 and TP1a test points without using CTLE and DFE.

As a prerequisite, this calibration will use the Transmitter Equalization values (such as Baud Rate, Pre-Cursor3, Pre-Cursor2, Pre-Cursor1, Main-Cursor, and Post-Cursor1) that are found in the Stressed Eye Calibration.

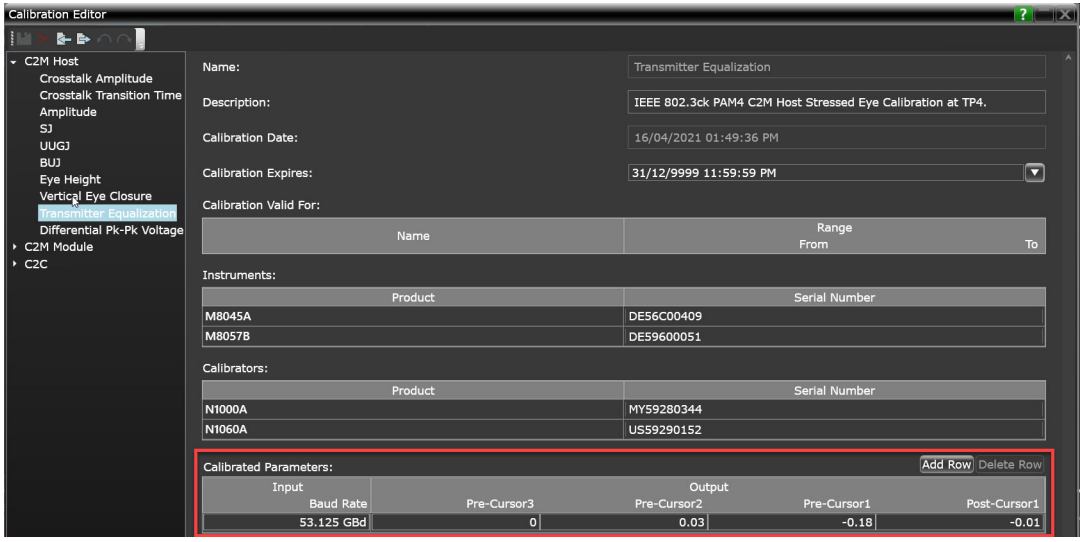


Figure 93 Example of Transmitter Equalization Values in Stressed Eye Calibration

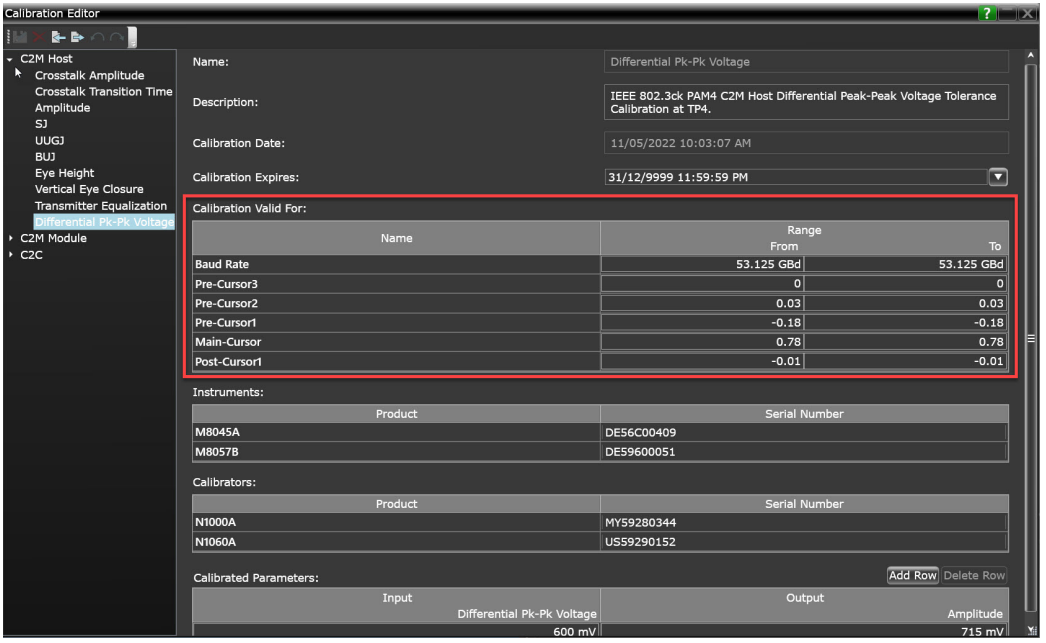


Figure 94 Differential PK-PK Voltage using Transmitter Equalization Values

Connection Diagram Connect the instruments as shown in Figure 95 and Figure 96.

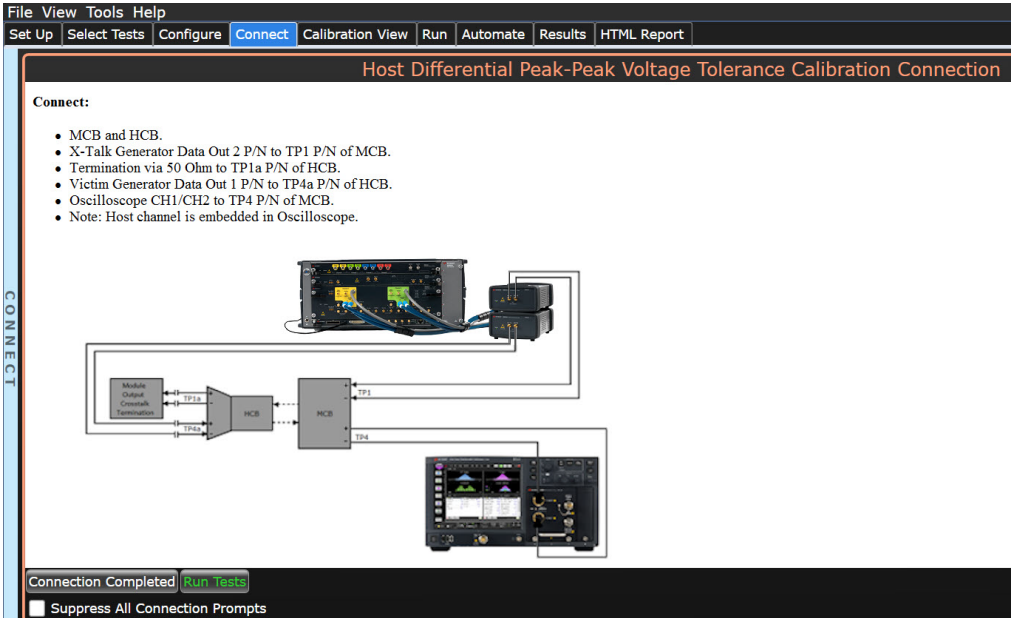


Figure 95 Differential Peak-Peak Voltage Tolerance Calibration for C2M Host

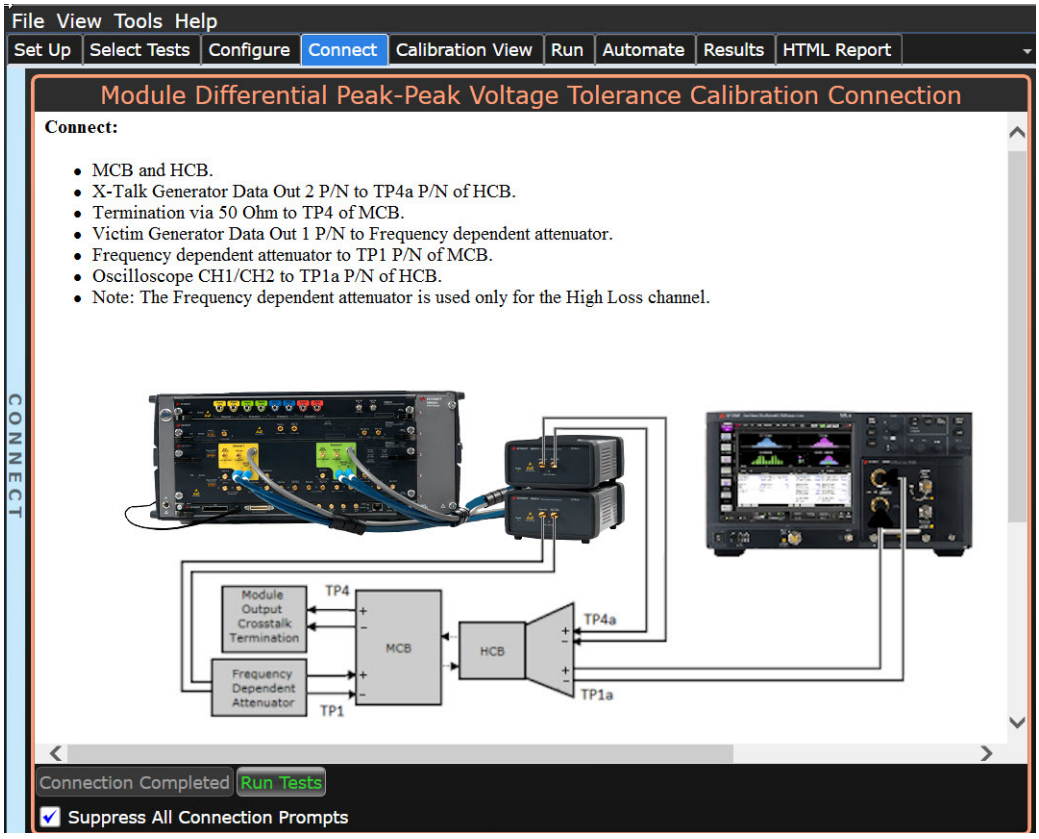


Figure 96 Differential Peak-Peak Voltage Tolerance Calibration for C2M Module

ID

Standard Name	Test ID
C2M Host	71107
C2M Module	271107

Dependencies This calibration depends on the Stressed Eye Calibration as it uses transmitter equalization values determined in the Stressed Eye Calibration and filled in the Transmitter Equalization calibration table (as shown in Figure 93).

Parameters Refer to “Calibration Parameters in Debug Mode” on page 106.

Procedure This calibration uses the PRBS13Q pattern.

Results This calibration returns the Differential Peak-Peak Voltage Tolerance Calibration results, in tabular format:

- Standard Parameter
  - Differential PK-PK Voltage
- Instrument Parameter
  - Amplitude

Parameter	Value
Differential Peak-Peak Voltage Tolerance Calibration Result - IEEE 802.3ck PAM4 C2M Host TP4	Pass
---Additional Info---	
[Tag] Host Channel	far-short
[Tag] Amplitude	1.2 mV
[Tag] Crosstalk Amp	0.4 V
[Tag] VEC	1
[Tag] eye Height	15mV
[Tag] patch	yes
Differential Peak-Peak Voltage Tolerance Calibration Results	Standard Parameter : Status : Target : Measured : Instrument Parameter : Nominal : Actual Differential Pk-Pk Voltage : Pass : 600 mV : 603 mV : Amplitude : 600 mV : 921 mV

Figure 97 Differential Peak-Peak Voltage Tolerance Calibration for C2M Host Input

File View Tools Help

Set Up | Select Tests | Configure | Connect | Calibration View | Run | Automate | Results | HTML Report

Test Name	Actual Value	Margin %	Pass Limits	# Trials
Differential Peak-Peak Voltage Tolerance Calibration	Pass	100.000	Pass/Fail	1

Parameter	Value
Differential Peak-Peak Voltage Tolerance Calibration Result - IEEE 802.3ck PAM4 C2M Module TP1a	Pass
---Additional Info---	
[Tag] Channel	Multilane FDA + Wilder OSFP
Differential Peak-Peak Voltage Tolerance Calibration Results	Standard Parameter : Status : Target : Measured : Instrument Parameter : Nominal : Actual Differential Pk-Pk Voltage : Pass : 1.600 V : 750 mV : Amplitude : 1.600 V : 1.261 V

Figure 98 Differential Peak-Peak Voltage Tolerance Calibration for C2M Module Input

7 IEEE 802.3ck C2M Tests

This section provides the test procedures for the IEEE 802.3ck C2M Tests, which are applicable for both C2M Host Input tests and C2M Module Input tests.

As a prerequisite, before running C2M Host and Module tests:

- Run all IEEE 802.3ck C2M Host and Module calibrations, respectively.
- Ensure that the DUT is properly connected to the BERT modules and the test channel.

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 C2M Host Input and C2M Module Input tests, the following parameters are available for configuration. Note that other than the "Module Output Mode" 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
- Target Error Ratio
- Host Channel: Select host channel settings.
  - For C2M Host Input, select between Near-end and Far-end host channel.
  - For C2M Module Input, select between Low-loss and High-loss channel. The frequency-dependent attenuation is used only for the long channel.
- Module Output Mode- Select either Short or Long module output mode, as requested by the host. The PCB length of the host channel is listed in *Table 120G-5 of section 120G of the IEEE P802.3ck™/D3.2* specification.
- PAM4 Symbol 1 Level
- PAM4 Symbol 2 Level
- Transmitter Pre-Cursor 3
- Transmitter Pre-Cursor 2
- Transmitter Pre-Cursor 1
- Transmitter Post-Cursor 1
- Channel EQ Pre-Cursor 3
- Channel EQ Pre-Cursor 2
- Channel EQ Pre-Cursor 1
- Channel EQ Post-Cursor 1

- 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 Confidence Level
- DUT Control Interface script file
- DUT Control Interface Location
- Pause before starting Receiver tests

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

- Differential Pk-Pk Voltage

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). This test should be performed four times for the C2M Host Input standard (as shown in Table 18) and two times for the C2M Module Input standard (as shown in Table 19).

Table 18 C2M Host Input Calibration Mode

Standard Option	Host Channel	Module Output Mode	Notes
C2M Host Input	Far-end	Short	Set Host Channel and Module Output Modes in the Configure tab
		Long	
	Near-end	Short	
		Long	

Table 19 C2M Module Input Calibration Modes

Standard Option	Channel	Notes
C2M Module Input	Low Loss	Mated MCB/HCB
	High Loss	Mated MCB/HCB + Frequency dependent attenuator

Connection Diagram For Multi-lane tests, connect the instruments as shown in Figure 99 and Figure 100.

Multi-lane Host Stressed Input Test Connection

Connect:

- Host Device and HCB.
- Set Device to Loopback.
- X-Talk Generator Data Out 2 P/N to TP4a P/N of Lane next to Victim.
- Termination via 50 Ohm to TP1a P/N of Lane next to Victim.
- Victim Generator Data Out 1 P/N to TP4a P/N.
- Internal CDR
  - Victim Analyzer Data In P/N to TP1a P/N.
- External CDR
  - Recovered Clock Out from Clock Recovery to Victim Analyzer Clk In.
  - Victim Analyzer Data In P/N to TP1a P/N via Pick-Off.

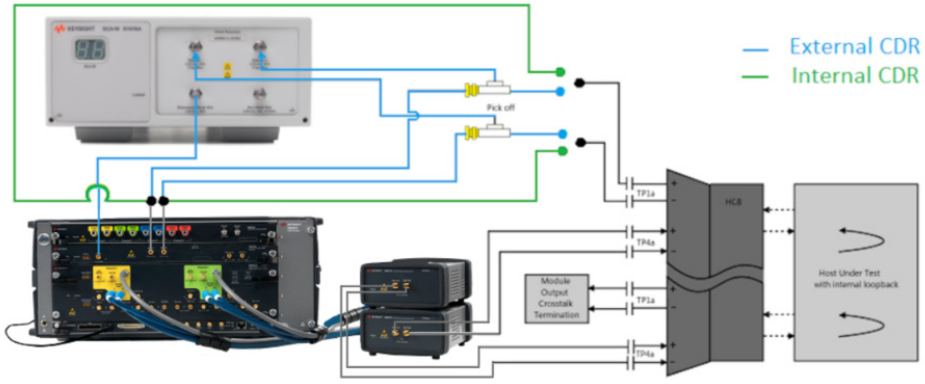


Figure 99 Multi Lane Stressed Input Test connections for C2M Host

Multi-lane Module Stressed Input Test Connection

Connect:

- Module Device and MCB.
- Set Device to Loopback.
- X-Talk Generator Data Out 2 P/N to TP1 P/N of Lane next to Victim.
- Termination via 50 Ohm to TP4 P/N of Lane next to Victim.
- Victim Generator Data Out 1 P/N to Frequency dependent attenuator.
- Frequency dependent attenuator to TP1 P/N.
- Internal CDR
  - Victim Analyzer Data In P/N to TP4 P/N.
- External CDR
  - Recovered Clock Out from Clock Recovery to Victim Analyzer Clk In.
  - Victim Analyzer Data In P/N to TP4 P/N via Pick-Off.
- Note: The Frequency dependent attenuator is used only for the High Loss channel.

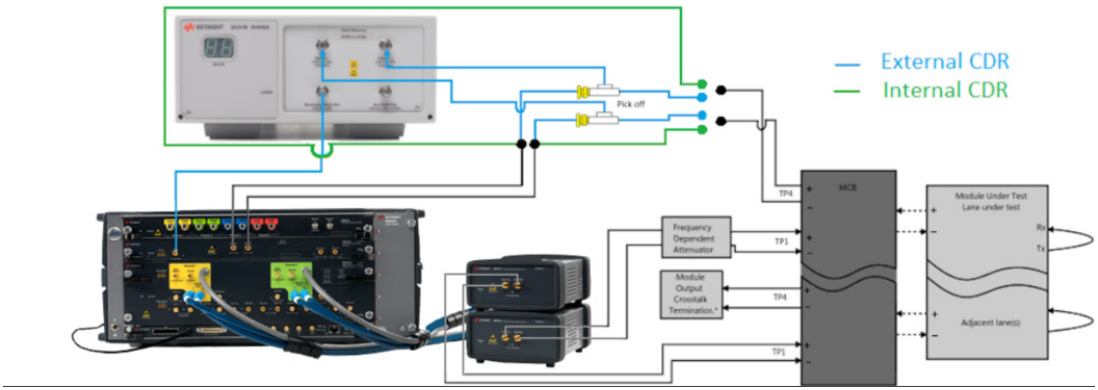


Figure 100 Multi Lane Stressed Input Test connections for C2M Module

ID

Standard Name	Test ID
C2M Host Multi-Lane	75100
C2M Module Multi-Lane	275100

Dependencies

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

- All calibrations performed previously:
  - Crosstalk Calibration
  - Amplitude Calibration
  - UUGJ Calibration
  - SJ Calibration
  - Stressed Eye 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 PRBS31Q pattern.

Results This test returns the following results:

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

Parameter	Value			
Multi-lane Stressed Input Test Result - IEEE 802.3ck PAM4 C2M Host	Pass			
---Additional Info---				
Multi-lane Stressed Input Test Results	Parameter	Frequency	Amplitude	Status
	SJ1	40.000 kHz	5.0000 UI	Pass
	SJ2	400.000 kHz	500.0 mUI	Pass
	SJ3	1.333000 MHz	150.0 mUI	Pass
	SJ4	4.000000 MHz	50.0 mUI	Pass
	SJ5	12.000000 MHz	50.0 mUI	Pass
	SJ6	40.000000 MHz	50.0 mUI	Pass
Multi-lane Stressed Input Test Screenshot	(See image)			

Figure 101 C2M Host Multi-lane Stressed Input Test Result

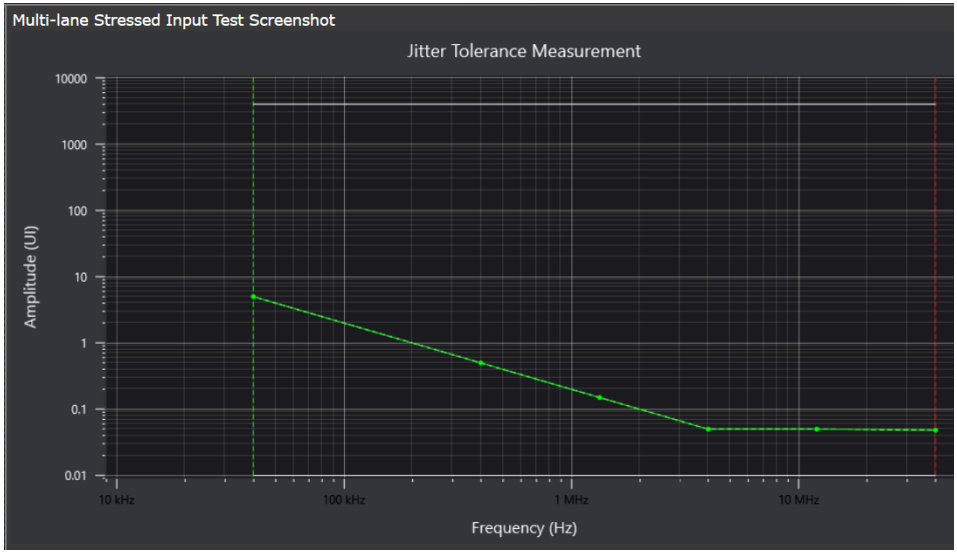


Figure 102 C2M Host Multi-lane Stressed Input Test Result (graphical)

Voltage Tolerance Tests

Overview

The Input Voltage Tolerance Test will use the Differential Peak-Peak Voltage Tolerance Calibration during the test. This test is carried out without stress but with an amplitude measured after the channel (TP4/TP1a) with proper de-emphasis (for example, the one found after C2M stress eye calibration).

This test should be performed four times for the C2M Host Input standard (as shown in Table 20)and two times for the C2M Module Input standard (as shown in Table 21).

Table 20 C2M Host Input Calibration Mode

Standard Option	Host Channel	Module Output Mode	Notes
C2M Host Input	Far-end	Short	Set Host Channel and Module Output Modes in the Configure tab
		Long	
	Near-end	Short	
		Long	

Table 21 C2M Module Input Calibration Mode

Standard Option	Channel	Notes
C2M Module Input	Low Loss	Mated MCB/HCB
	High Loss	Mated MCB/HCB + Frequency dependent attenuator

Connection Diagram For Input Voltage Tolerance Test, connect the instruments as shown in Figure 103 and Figure 104.

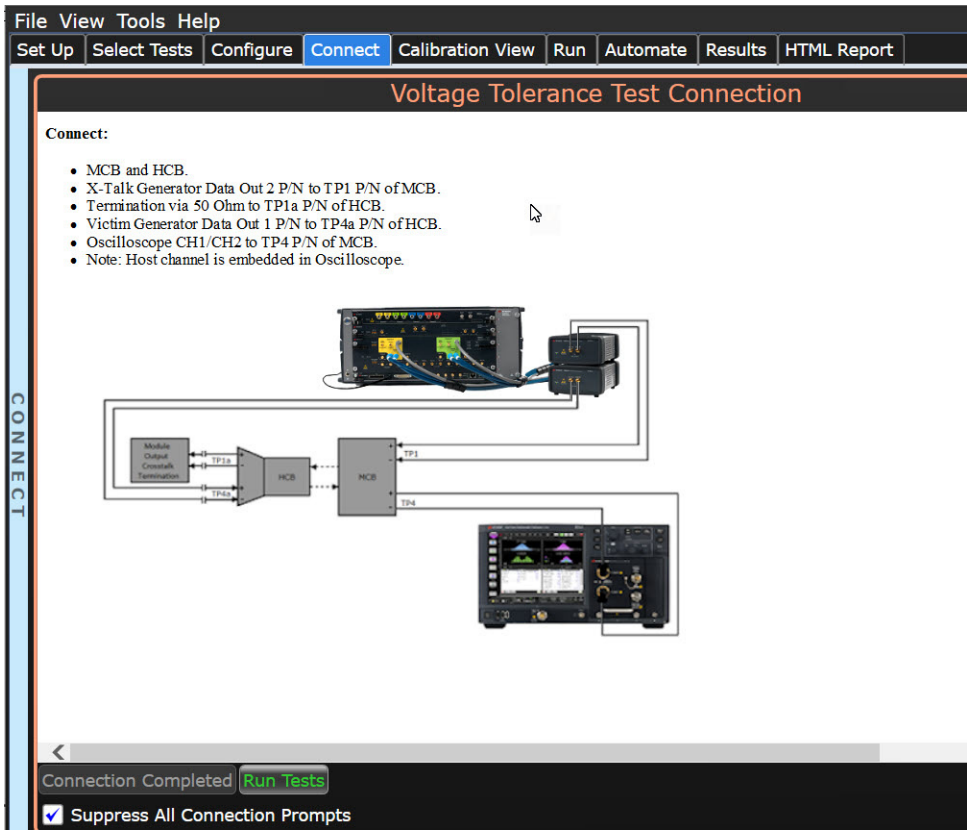


Figure 103 Voltage Tolerance Test connections for C2M Host

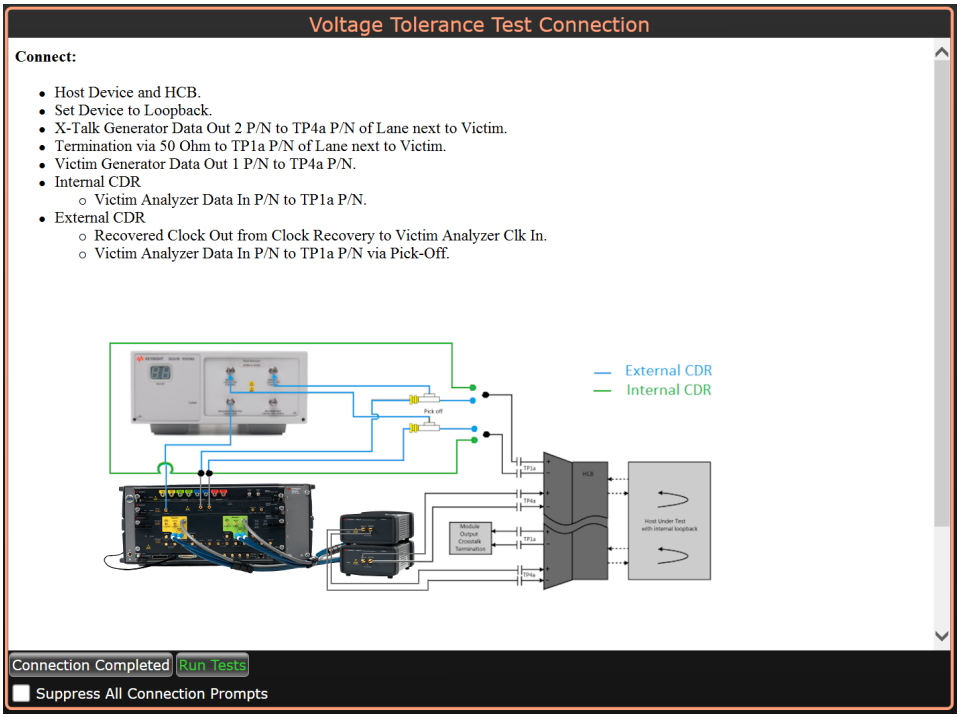


Figure 104 Voltage Tolerance Test connections for C2M Module

ID

Standard Name	Test ID
C2M Host Multi-Lane	75102
C2M Module Multi-Lane	275102

Dependencies This test depends on the Differential Peak-Peak Voltage Tolerance Calibration.

Parameters Refer to “Test Parameters in Debug Mode” on page 140.

Procedure This test uses the PRBS31Q pattern.

Results This test returns the following results:

- Pass/Fail for each Amplitude point

Voltage Tolerance Test Result - IEEE 802.3ck PAM4 C2M Host	Pass
---Additional Info---	
[Tag] Host Channel	far-short
[Tag] Amplitude	1.2 mV
[Tag] Crosstalk Amp	0.4 V
[Tag] VEC	1
[Tag] eye Height	15mV
[Tag] patch	yes
Voltage Tolerance Test Results	Parameter / Status / Minimum Differential Pk-Pk Voltage / Pass / 600 mV

Figure 105 C2M Host Voltage Tolerance Test Result

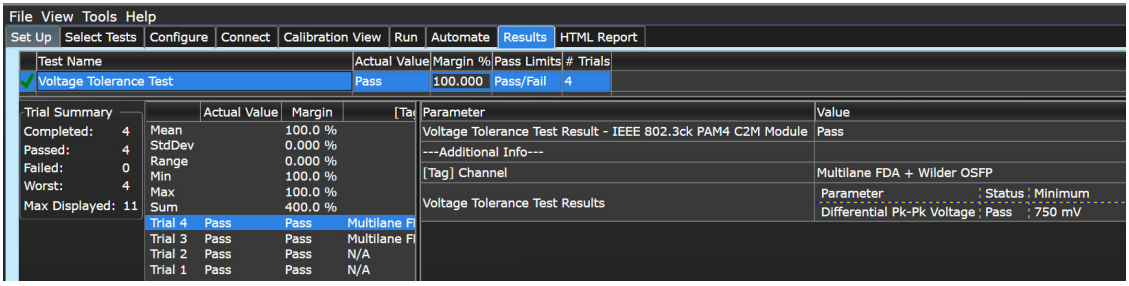


Figure 106 C2M Module Voltage Tolerance Test Result

8 Calibration & Test Results

About Calibration View

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

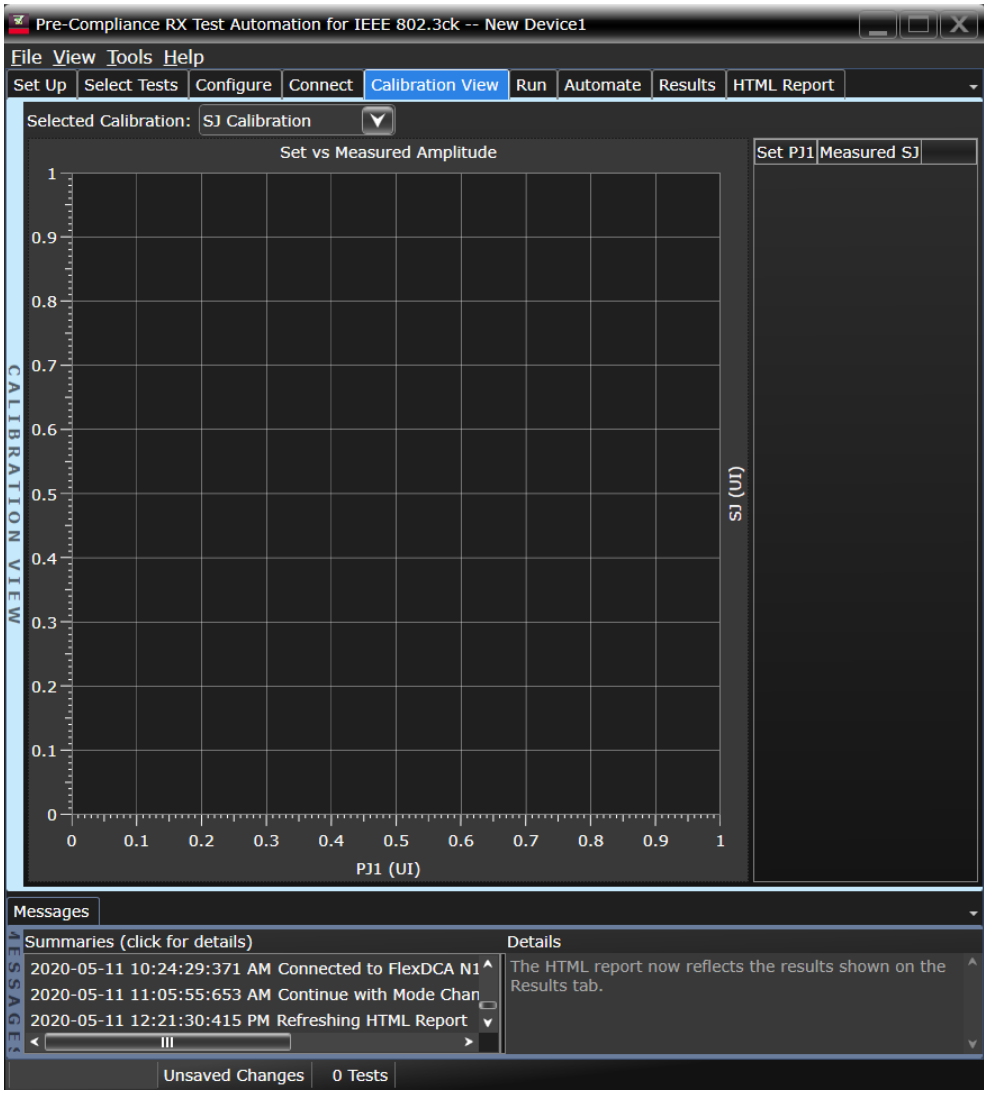


Figure 107 Default display of the Calibration View

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 SJ, UUGJ and Broadband Noise) and not single-point calibrations such as Amplitude Calibration.

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.

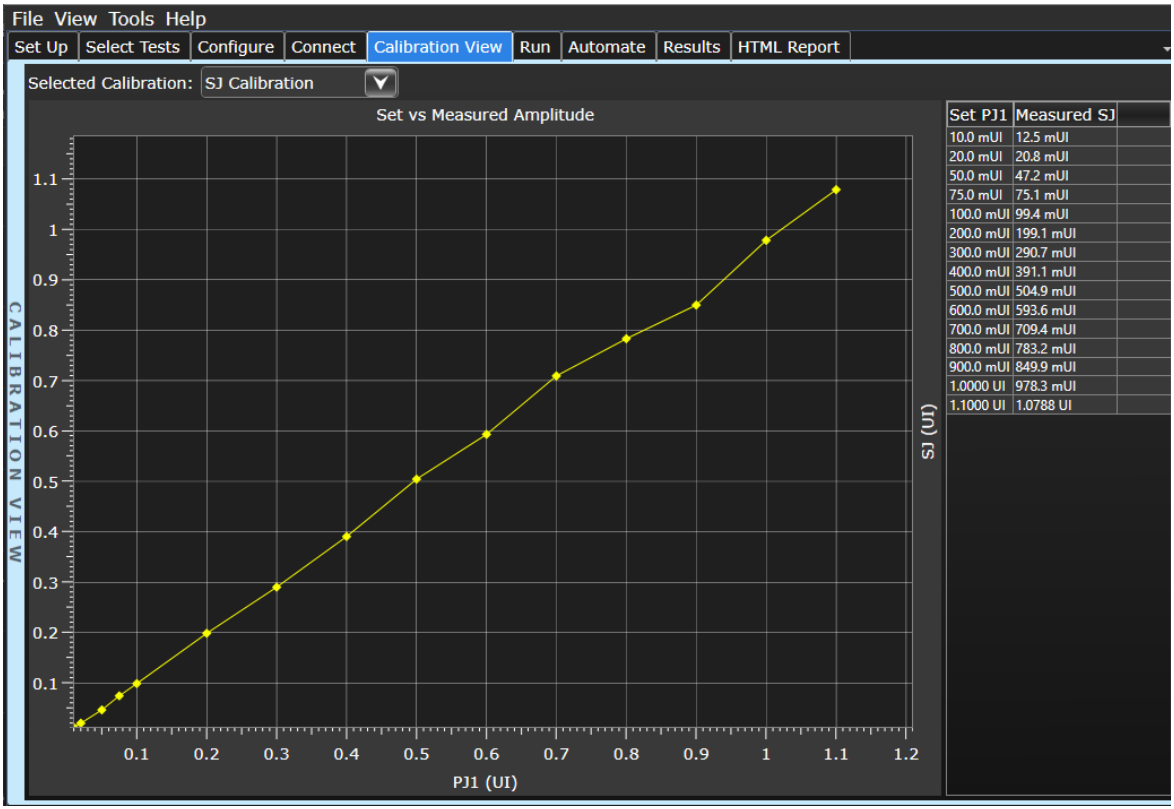


Figure 108 Display of the Calibration View after calibrations are performed

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.

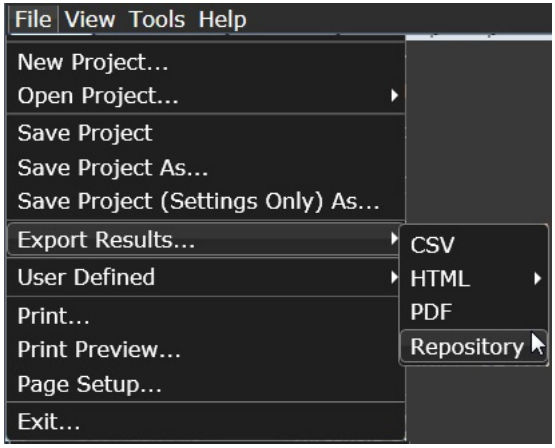
Not only can remote users with an active Internet connection access these Datasets and the corresponding test results on the Web Repository, but they have the option to add and delete Datasets on the Web Server. In the Upload Results To Repository feature, you can even modify the Dataset properties, 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.

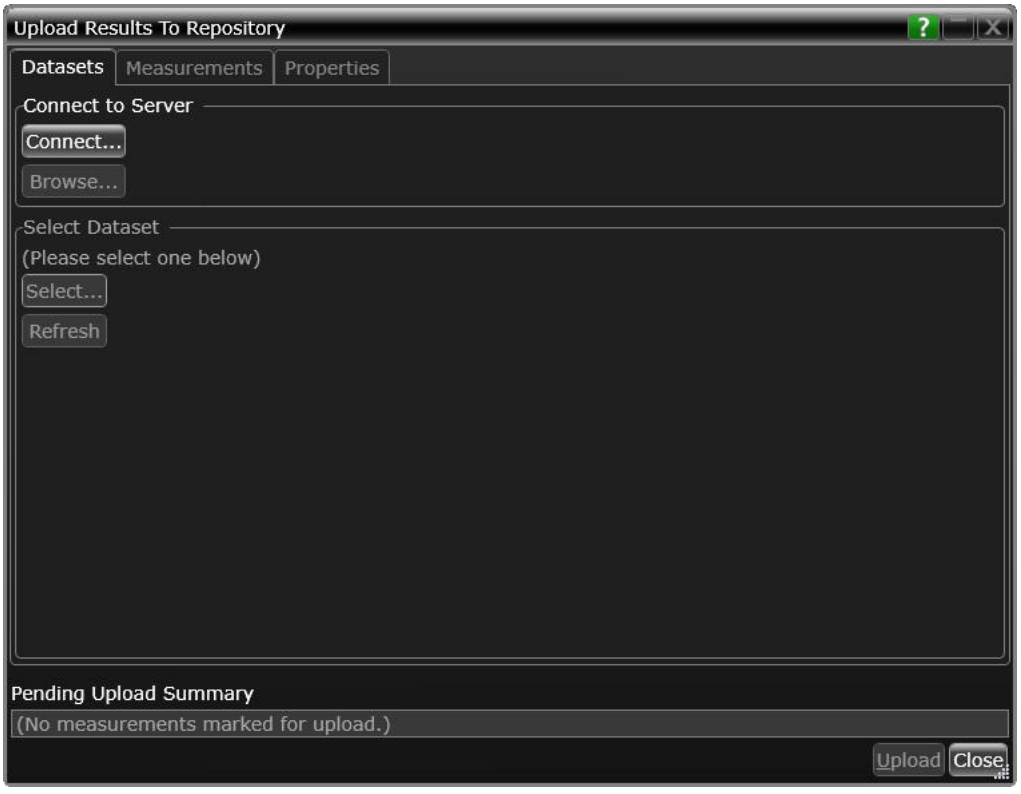
To export measurement results to the Repository after the completion of test runs,

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



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

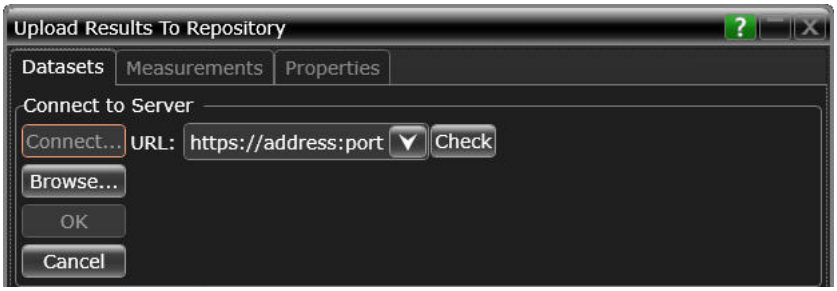
2 In the **Connect to Server** pane of the **Datasets** tab, click **Connect...** to login to the Dataset Repository server.



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.

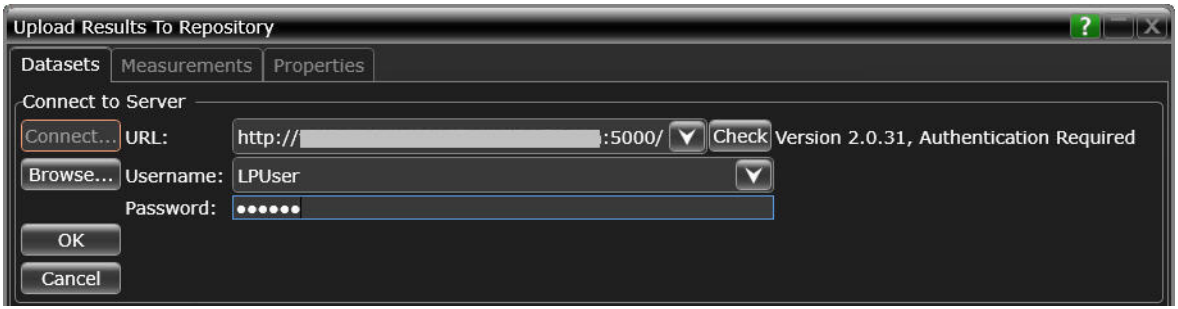
4 Click the **Check** button to verify that the KS6800A Series Analytics service is available on the specified web address. Repeat this step each time you edit the web address.



- 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.

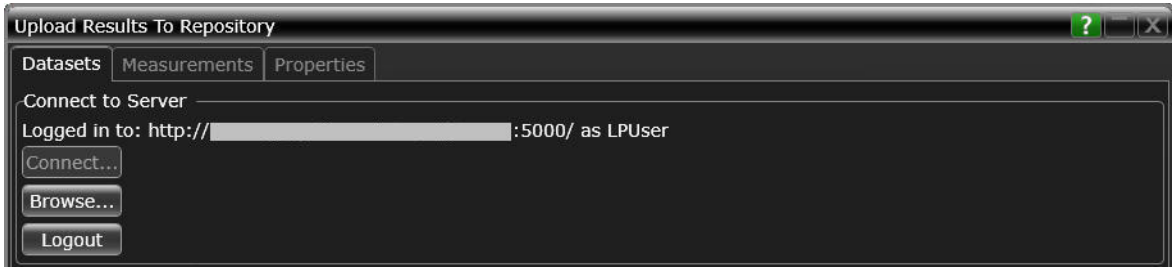
  - *b* If you click **OK**, the **Upload Results to Repository** window displays the connectivity status to the Dataset Repository.
  - *c* Click **Browse**... to navigate directly to the URL.

- 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.



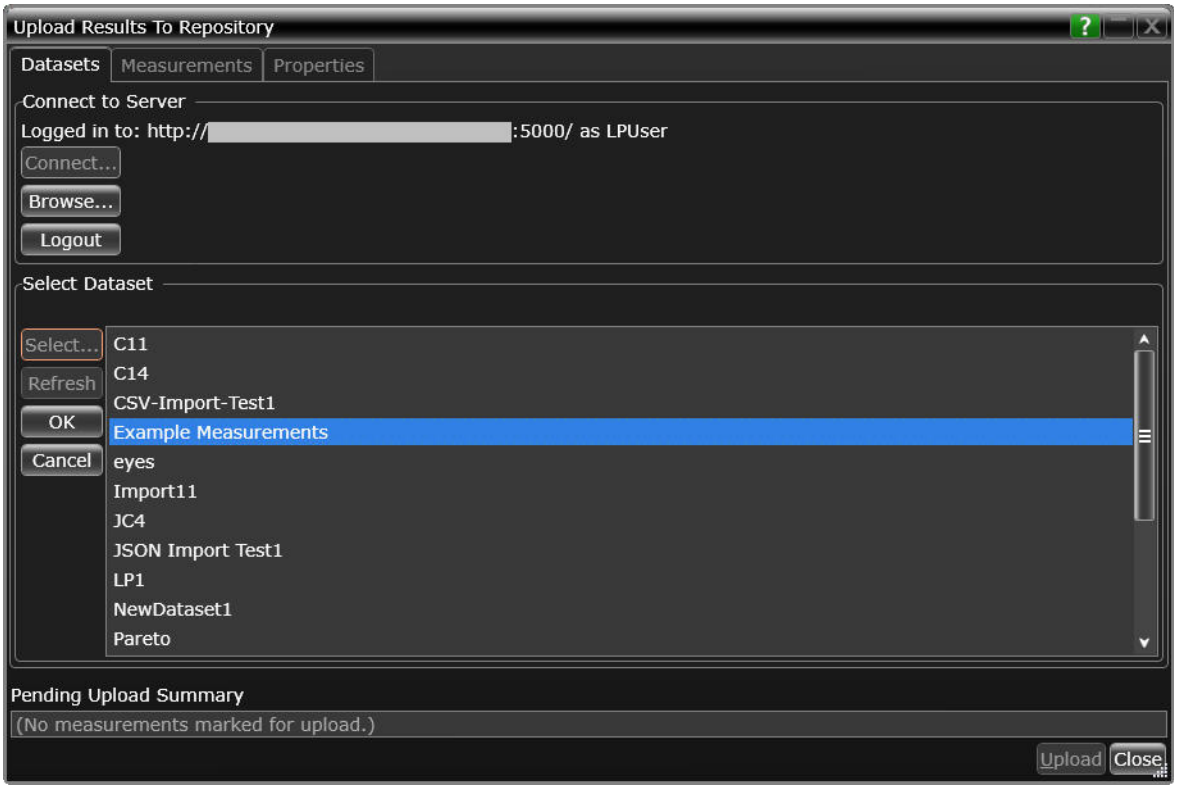
  - *c* Click **OK** to connect to the entered URL/IP address.

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

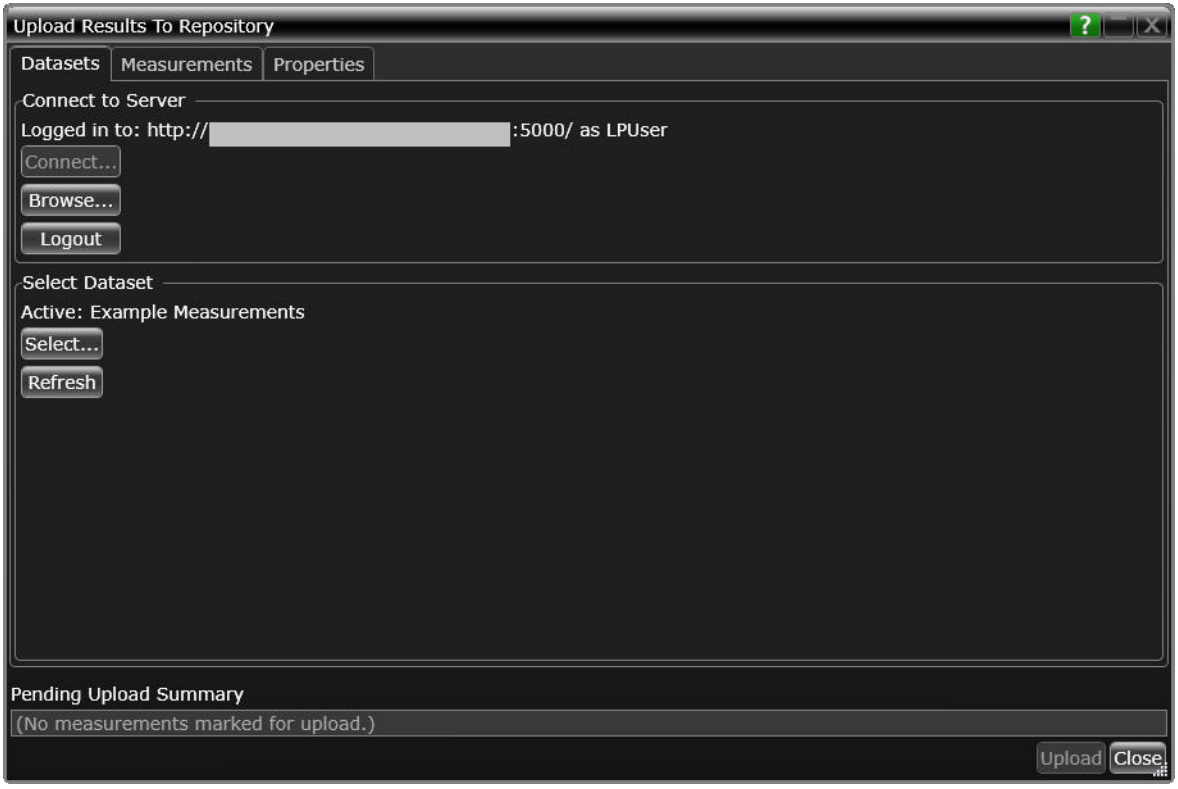


5 In the **Select Dataset** area, click **Select...** to view the list of Datasets created on the connected repository. Click **Refresh** to update the list of Datasets that appear in the Test Application's user interface.

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

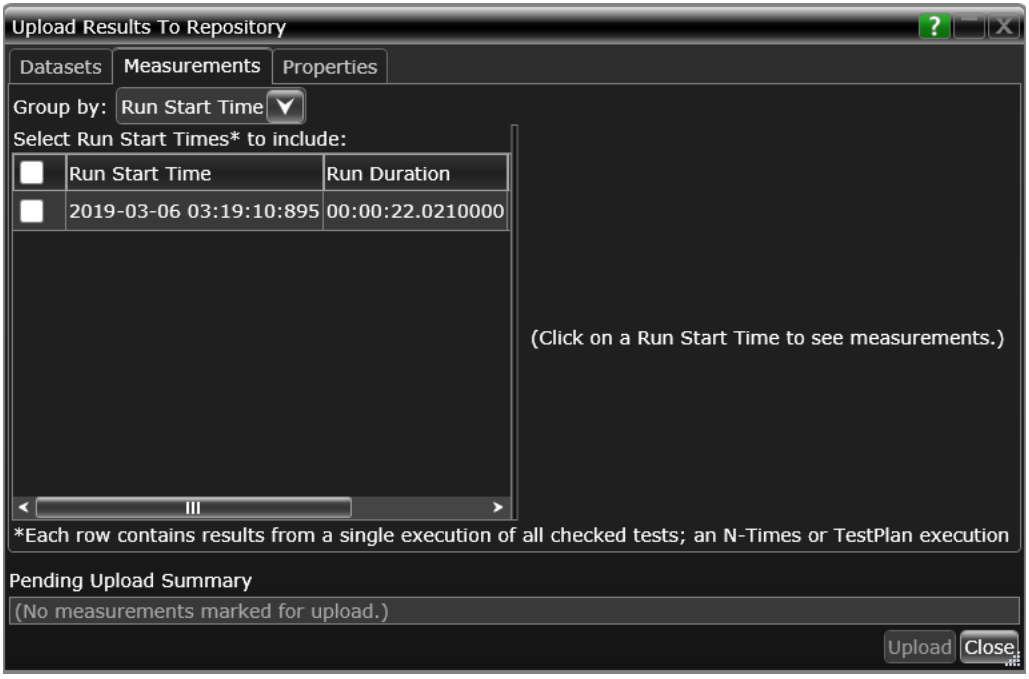


The Select Dataset area displays the selected Dataset as Active. The Measurements and Properties tabs are enabled after a Dataset is selected.



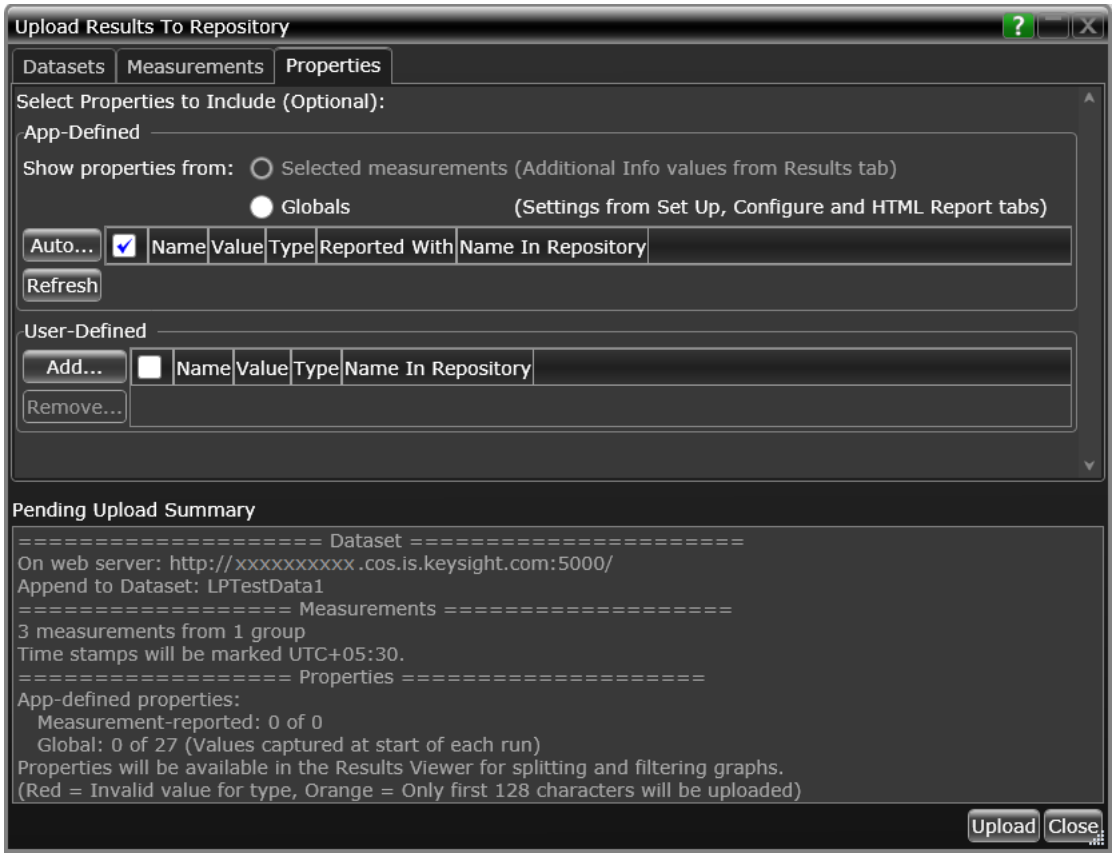
7 Click the **Measurements** tab where the test results from the last test run are displayed.

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.

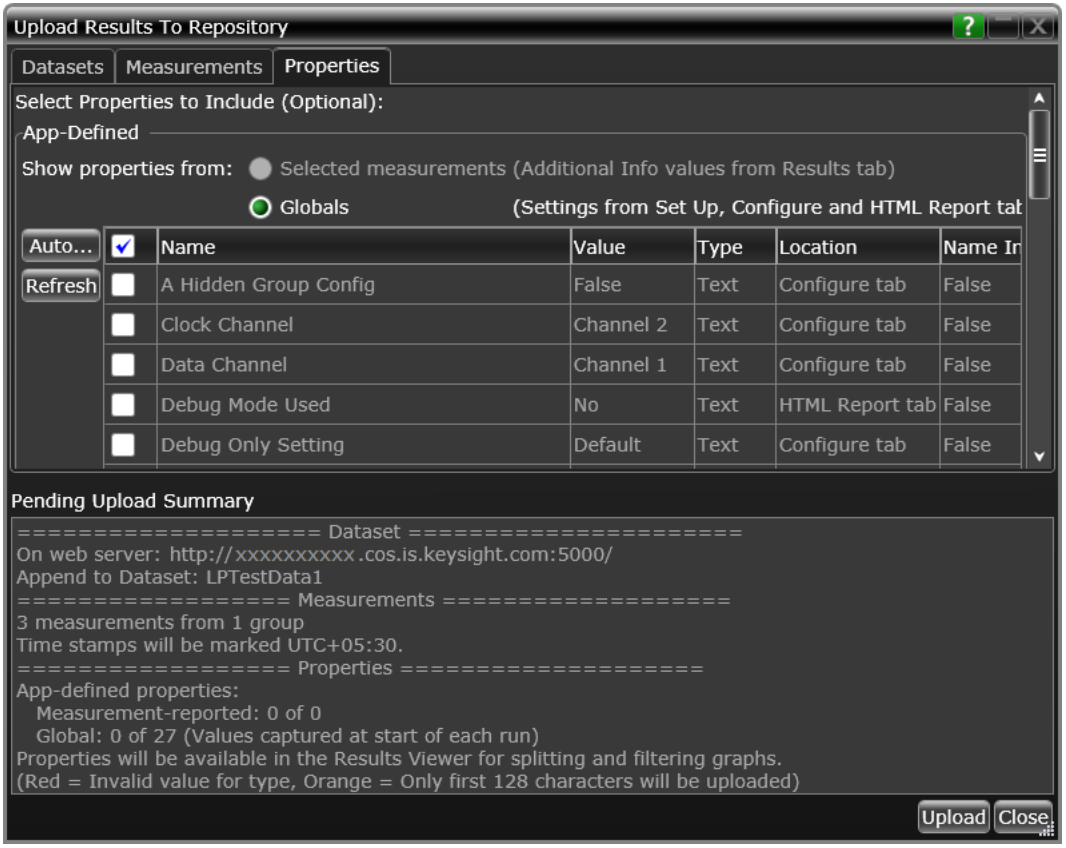


9 After selecting one or more measurements, either click **Upload** or switch to the **Properties** tab to associate one or more properties to the measurements that are being uploaded to the Web Server.

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.



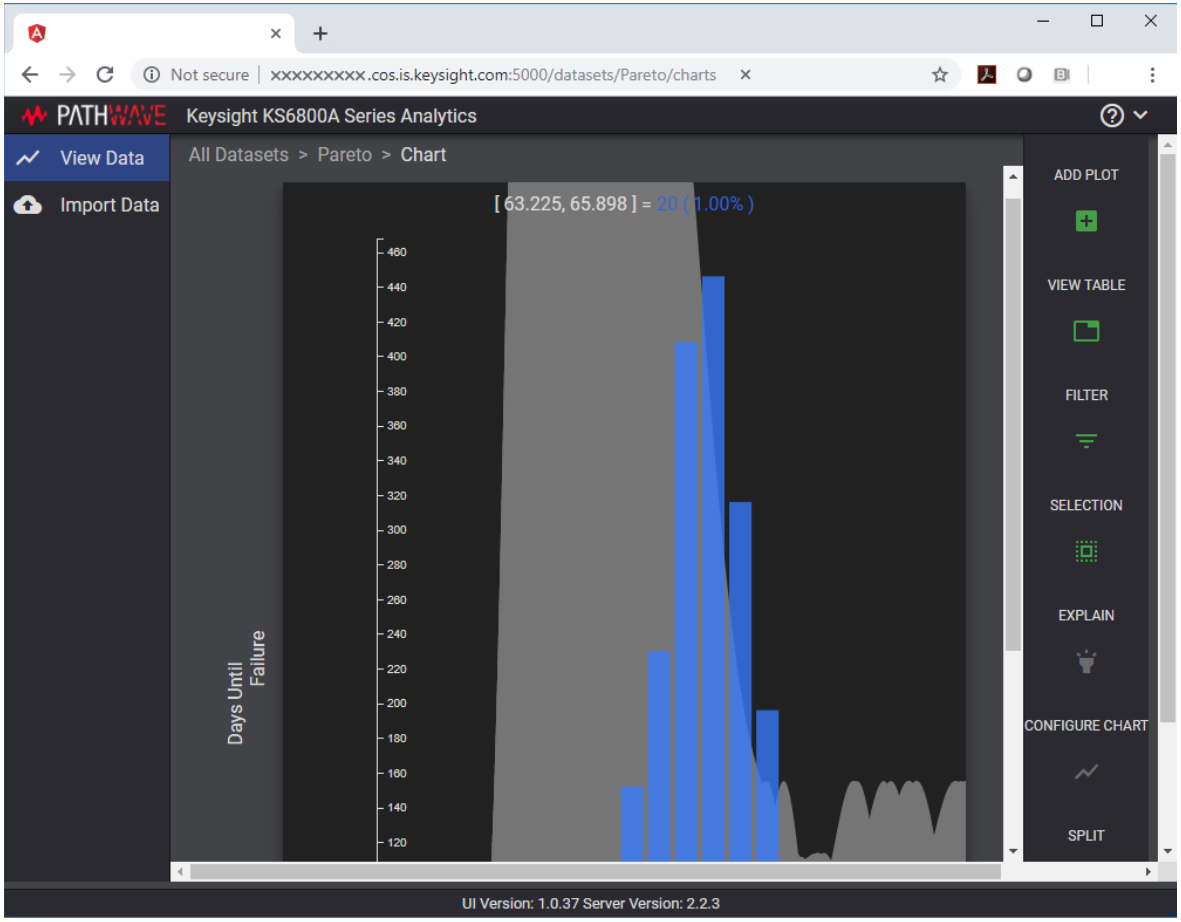
11 Click **Upload** to begin uploading measurement results.

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.

Edition 6.2, June 2022

M8070-91300
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