Keysight N8841A CAUI-4 Compliance Test Application

KEYSIGHT TECHNOLOGIES

Methods of Implementation

Notices

Revision

Version 01.00.0000 or greater

Edition

May 4, 2016

Available in electronic format only

Published by:
Keysight Technologies, Inc.
1900 Garden of the Gods Road
Colorado Springs, CO 80907 USA

Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Keysight disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Keysight shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Keysight and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology License

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

U.S. Government Rights

The Software is "commercial computer software," as defined by Federal Acquisition Regulation ("FAR") 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement ("DFARS") 227.7202, the U.S. government acquires commercial computer software under the same terms by which the software is customarily provided to the public. Accordingly, Keysight provides the Software to U.S. government customers under its standard commercial license, which is embodied in its End User License Agreement (EULA), a copy of which can be found at www.keysight.com/find/sweula. The license set forth in the EULA represents the exclusive authority by which the U.S. government may use, modify, distribute, or disclose the Software. The EULA and the license set forth therein, does not require or permit, among other things, that Keysight: (1) Furnish technical information related to commercial computer software or commercial computer software documentation that is not customarily provided to the public; or (2) Relinquish to, or otherwise provide, the government rights in excess of these rights customarily provided to the public to use, modify, reproduce, release, perform, display, or disclose commercial computer software or commercial computer software documentation. No additional government requirements beyond those set forth in the EULA shall apply, except to the extent that those terms, rights, or licenses are explicitly required from all providers of commercial computer software pursuant to the FAR and the DFARS and are set forth specifically in writing elsewhere in the EULA. Keysight shall be under no obligation to update, revise or otherwise modify the Software. With respect to any technical data as defined by FAR 2.101, pursuant to FAR 12.211 and 27.404.2 and DFARS 227.7102, the U.S. government acquires no greater than Limited Rights as defined in FAR 27.401 or DFAR 227.7103-5 (c), as applicable in any technical data.

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

CAUI-4 Compliance Test Application—At a Glance

The Keysight N8841A CAUI-4 Compliance Test Application is an Ethernet test solution that covers the electrical timing parameters for CAUI-4 specification (IEEE 802.3bm Sections 83D and 83E).

The CAUI-4 Compliance Test Application:

- Lets you select individual or multiple tests to run.
- Lets you identify the device being tested and its configuration.
- Shows you how to make oscilloscope connections to the device under test.
- Automatically checks for proper oscilloscope configuration.
- Automatically sets up the oscilloscope for each test.
- Allows you to determine the number of trials for each test.
- Provides detailed information of each test that has been run. The result of maximum 64 worst trials can be displayed at any one time.
- Creates a printable HTML report of the tests that have been run. This report includes pass/fail limits, margin analysis, and screen shots.

Required Equipment and Software

In order to run the CAUI-4 automated tests, you need the following equipment and software:

Product	Description	Notes
DSO/DSAZ634A	Infiniium Oscilloscope: 63 GHz	63 GHz and above
N8841A-1FP, or	CAUI-4 Compliance Test Software, fixed perpetual license	Required
N5435A-102	CAUI-4 Compliance Test Software, server based license	
N8841A-7FP, or	Switch matrix option, fixed perpetual license	Optional
N5435A-716	Switch matrix option, server based license	
E2688A-1FP	Serial data analysis software	Required
N5400A-1FP	EZJIT Plus Software	Required
N5465A-1FP	InfiniiSim Software – Advanced license	Recommended for probe correction
N5234A	Network analyzer, 43.5 GHz	Required for up to 30 Gb/s return loss testing

Contents

1 Installing the N8841A CAUI-4 Compliance Test Application

If you purchased the N8841A Compliance Test Application separate from your Infiniium oscilloscope, you need to install the software and license key.

Installing the Software

1. Make sure you have the minimum version of Infiniium oscilloscope software (see the N8841A release notes) by choosing **Help > About Infiniium...** from the main menu.
2. To obtain the N8841A Compliance Test Application, go to Keysight website: http://www.keysight.com/support/N8841A
3. The link for N8841A CAUI-4 Compliance Test Application will appear. Double-click on it and follow the instructions to download and install the application software.

Installing the License Key

1. Request a license code from Keysight by following the instructions on the Entitlement Certificate.

   You will need the oscilloscope's "Option ID Number", which you can find in the **Help > About Infiniium...** dialog box.
2. After you receive your license code from Keysight, choose **Utilities > Install Option License...**.
3. In the Install Option License dialog box, enter your license code and click **Install License**.
4. Click **OK** in the dialog box that tells you to restart the Infiniium oscilloscope application software to complete the license installation.
5. Click **Close** to close the Install Option License dialog box.
6. Choose **File > Exit**.
7. Restart the Infiniium oscilloscope application software to complete the license installation.

2 Preparing to Take Measurements

Before running the automated tests, you should calibrate the oscilloscope and probe. No test fixture is required for this application. After the oscilloscope and probe have been calibrated, you are ready to start the N8841A CAUI-4 Compliance Test Application and perform the measurements.

Calibrating the Oscilloscope

If you haven't already calibrated the oscilloscope, see Appendix A, “Calibrating the Infiniium Oscilloscope and Probe,” starting on page 63.

NOTE If the ambient temperature changes more than 5 degrees Celsius from the calibration temperature, internal calibration should be performed again. The delta between the calibration temperature and the present operating temperature is shown in the **Utilities > Calibration** menu.

NOTE If you switch cables between channels or other oscilloscopes, it is necessary to perform cable and probe calibration again. Keysight recommends that, once calibration is performed, you label the cables with the channel on which they were calibrated.

Starting the Compliance Test Application

1 Ensure that the Device Under Test (DUT) is operating and set to desired test modes.

2 To start the Compliance Test Application: From the Infiniium oscilloscope's main menu, choose **Analyze > Automated Test Apps > N8841A CAUI-4 Test App**.

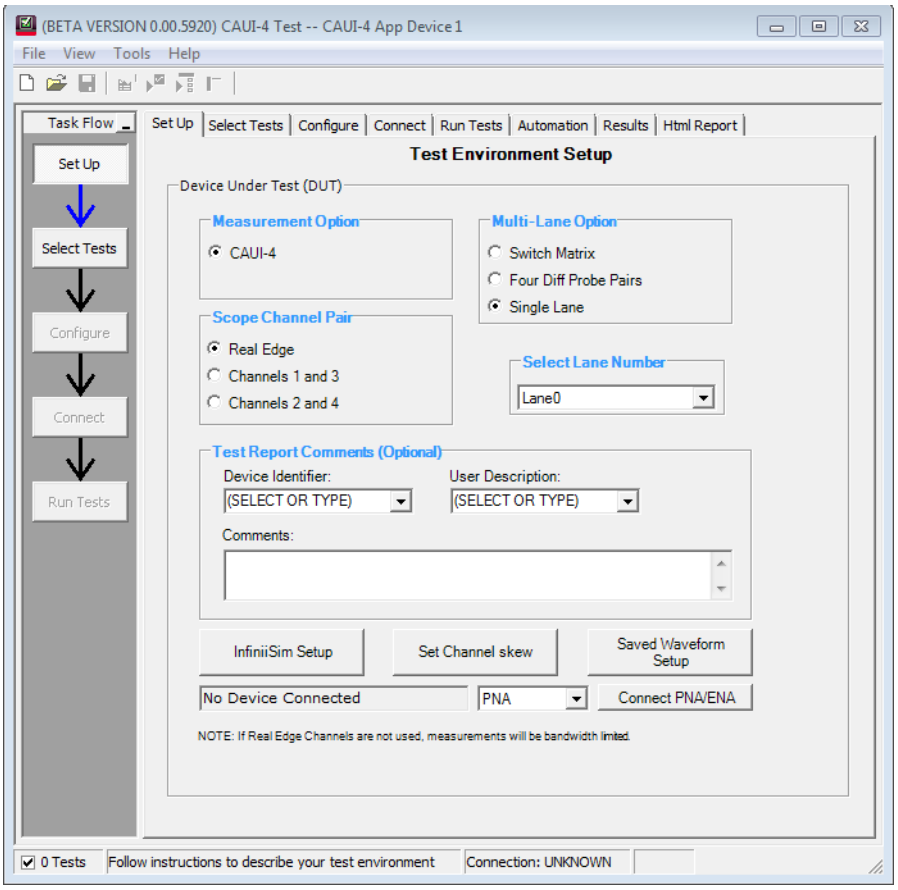

Figure 1 N8841A CAUI-4 Compliance Test Application Main Window

The task flow pane, and the tabs in the main pane, show the steps you take in running the automated tests:

Set Up	Lets you identify and set up the test environment, including information about the device under test. Select the oscilloscope channel pair that will be used. The **Multi-Lane Option** enables you to choose to test a single lane or with the switch matrix. The **Device Identifier**, **User Description**, and **Comments** are all printed in the final HTML report. Set up InfiniiSim with the **InfiniiSim Setup** button. With the **Set Channel skew** button, the channels can be visually adjusted and skewed. The **Saved Waveform Setup** button enables easy setup of saved waveforms. When waveforms are set up, the application will make all measurements on the saved waveforms. Select PNA or ENA; then click **Connect PNA/ENA** to make the instrument connection.
Select Tests	Lets you select the tests you want to run. The tests are organized hierarchically so you can select all tests in a group. After tests are run, status indicators show which tests have passed, failed, or not been run, and there are indicators for the test groups.
Configure	Lets you configure test parameters (for example, channels used in test, Number of UI to test, oscilloscope bandwidth, etc.).
Connect	Shows you how to connect the oscilloscope to the device under test for the tests that are to be run.
Run Tests	Starts the automated tests. If the connections to the device under test need to be changed while multiple tests are running, the tests pause, show you how to change the connection, and wait for you to confirm that the connections have been changed before continuing.
Automation	Lets you construct scripts of commands that drive execution of the application.
Results	Contains more detailed information about the tests that have been run. You can change the thresholds at which marginal or critical warnings appear.
HTML Report	Shows a compliance test report that can be printed.

3 CAUI-4 Transmitter Characteristics at TP0a

This section provices the Methods of Implemenation for the CAUI-4 Transmitter Characteristics at TP0a as specified in IEEE802.3bm Table 83D-1. Measurements are made at TP0a.

Main Voltage Measurements

This section provides the Methods of Implementation (MOIs) for the CAUI-4 Main Voltage Measurements using a Keysight Infiniium oscilloscope and the N8841A Compliance Test Application.

Probing and Connection

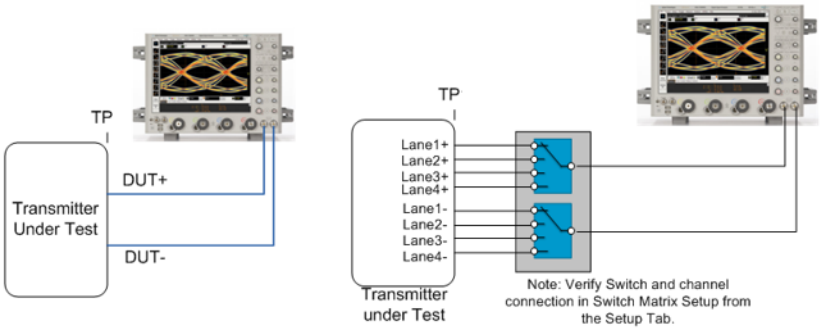

Figure 2 Probing for Main Voltage Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

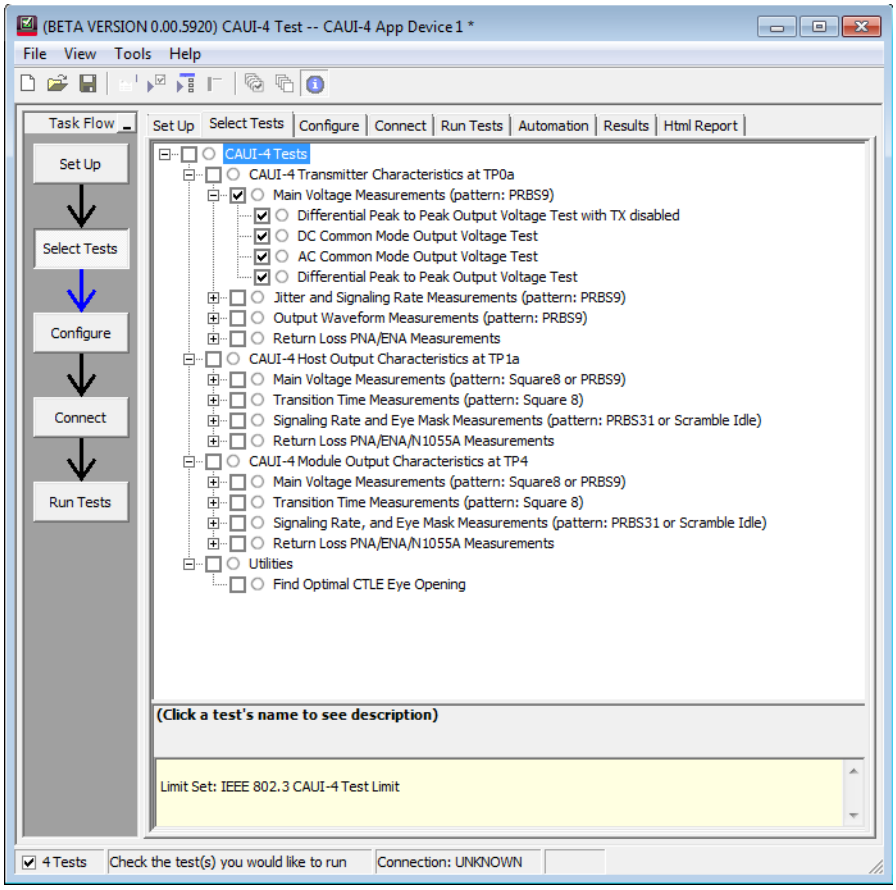

Figure 3 Selecting Main Voltage Measurement Tests

Specifications

The CAUI-4 specifications can be found in IEEE 802.3bm section 83D.

- Differential Peak-to-Peak Output Voltage with TX disabled (max 30 mV).
- DC Common Mode Output Voltage (0 to 1.9 V).
- AC Common Mode Output Voltage (max 12 mV).
- Differential Peak-to-Peak Output Voltage (max 1200 mV).

Differential Peak-to-Peak Output Voltage Test with TX disabled

The purpose of this test is to verify that when TX is disabled the peak-to-peak voltage is less than 30 mV.

PASS Condition

The max peak-to-peak voltage is less than 30 mV.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Check that signal is truly with TX disabled (no valid data transitions).
3. Measure peak-to-peak voltage of the signal.

4 Compare the max peak-to-peak voltage to 30 mV.

DC Common Mode Output Voltage Test

The purpose of this test is to verify that the common mode signal of the differential pair is between 0 to 1.9 V.

NOTE **This measurement can be done with a dual-single ended connection only; it cannot be done with a differential probing connection.**

PASS Condition The signal is between 0 to 1.9 V.

Measurement Algorithm

1 Obtain sample or acquire signal data.
2 Verify that there is a signal and that the connection is dual-single ended.
3 Measure the peak-to-peak voltage of the addition of the channel 1 and 3 or channel 2 and 4.
4 Compare the voltage measurement to 0 to 1.9 V.

AC Common Mode Output Voltage Test

The purpose of this test is to verify that the common mode signal of the differential pair rms voltage does not exceed 12 mV.

NOTE **This measurement can be done with a dual-single ended connection only; it cannot be done with a differential probing connection.**

PASS Condition The signal is less than 12 mV.

Measurement Algorithm

1 Obtain sample or acquire signal data.
2 Verify that there is a signal and that the connection is dual-single ended.
3 Measure the peak-to-peak voltage of the addition of the channel 1 and 3 or channel 2 and 4.
4 Compare the voltage measurement to 12 mV.

Differential Peak-to-Peak Output Voltage Test

The purpose of this test is to verify that the peak-to-peak voltage of the differential signal on a PRBS9 pattern is less than 1200 mV.

PASS Condition The differential signal max peak-to-peak voltage on a PRBS9 pattern is less than 1200 mV.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Verify that there is a signal is connected and has a PRBS9 pattern.
3. Measure the peak-to-peak voltage of the differential signal of DUT+ and DUT-.
4. Compare the max peak-to-peak voltage to 1200 mV.

Jitter and Data Rate Measurements

This section provides the Methods of Implementation (MOIs) for the Jitter and Data Rate Measurements using a Keysight Infiniium oscilloscope and the N8841A CAUI-4 Compliance Test Application.

Probing and Connection

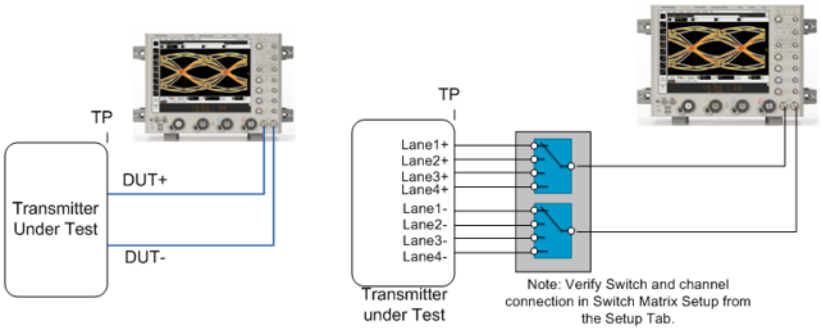

Figure 4 Probing for Jitter and Data Rate Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

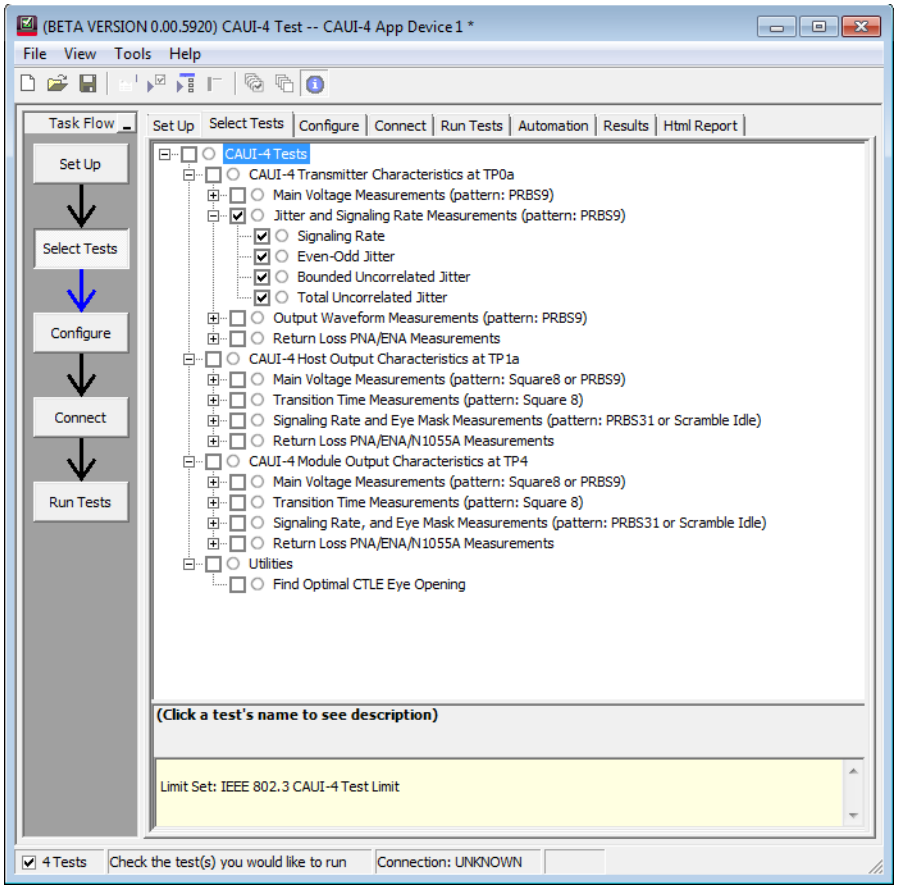

Figure 5 Selecting Jitter and Data Rate Tests

Specifications The CAUI-4 specifications can be found in IEEE 802.3bm section 83D.

- Signaling Rate (25.78125 ±100 ppm GBd).
- Max output jitter.
  - Even-Odd Jitter (max 35 mUI)
  - Bounded Uncorrelated Jitter (max 100 mUI)
  - Total Uncorrelated Jitter (max 260 mUI)

Signaling Rate

The purpose of this test is to verify that the data rate mean is between 25.78125 ±100 ppm GBd.

PASS Condition The mean signaling rate is between 25.78125 ±100 ppm GBd.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Check that signal is connected and data pattern exists (PRBS9 must be used for this test).
3. Set memory depth to capture the number or UI set in the Configure tab.
4. Set data rate measurement to semi-automatic 25.78125 Gb/s.
5. Measure min, max, mean data rate.
6. Report min and max values.
7. Compare and report the mean data rate value to 25.78125 ±100 ppm GBd.

Jitter (Even-Odd Jitter, Bounded Uncorrelated Jitter, Total Uncorrelated Jitter)

The purpose of this test is to verify that differential signal's Even-Odd Jitter is less that 35 mUI, Bounded Uncorrelated Jitter is less than 100 mUI, and Random Jitter is less than 10 mUI. If all tests are selected, all tests are run on a single measurement. Each test can be run individually by selecting any or some of the tests.

PASS Conditions

Even-Odd Jitter is less than 35 mUI, BUJ is less than 100 mUI, and Total Uncorrelated Jitter is less than 260 mUI.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Check that signal is connected and data pattern exists (PRBS9 must be used for this test).
3. Set memory depth to capture the number or UI set in the Configure tab.
4. Set clock recovery to OJTF First Order PLL with Nominal Data Rate 25.78125 Gb/s and Loop Bandwidth to 10 MHz.
5. Using EZJIT, measure Even-Odd Jitter, BUJ, and calculate Total Uncorrelated Jitter = 7.9*ERJ + EBUJ.
6. Compare and report the values to their respective maximum specification.

Transmitter Output Waveform Measurements

This section provides the Methods of Implementation (MOIs) for the Transmitter Output Waveform Measurements for Transition Time using a Keysight Infiniium oscilloscope and the N8841A CAUI-4 Compliance Test Application.

Probing and Connection

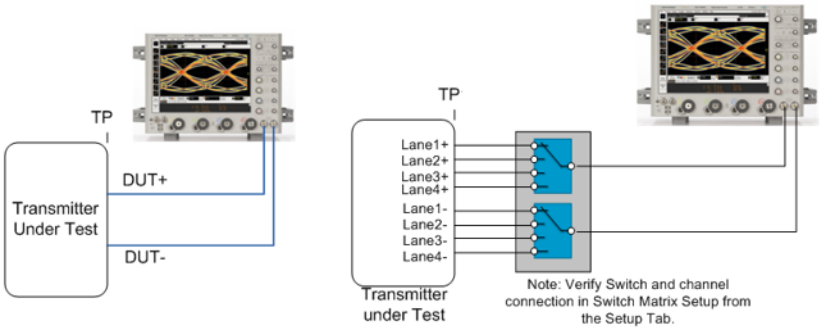

Figure 6 Probing for Transmitter output Waveform Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

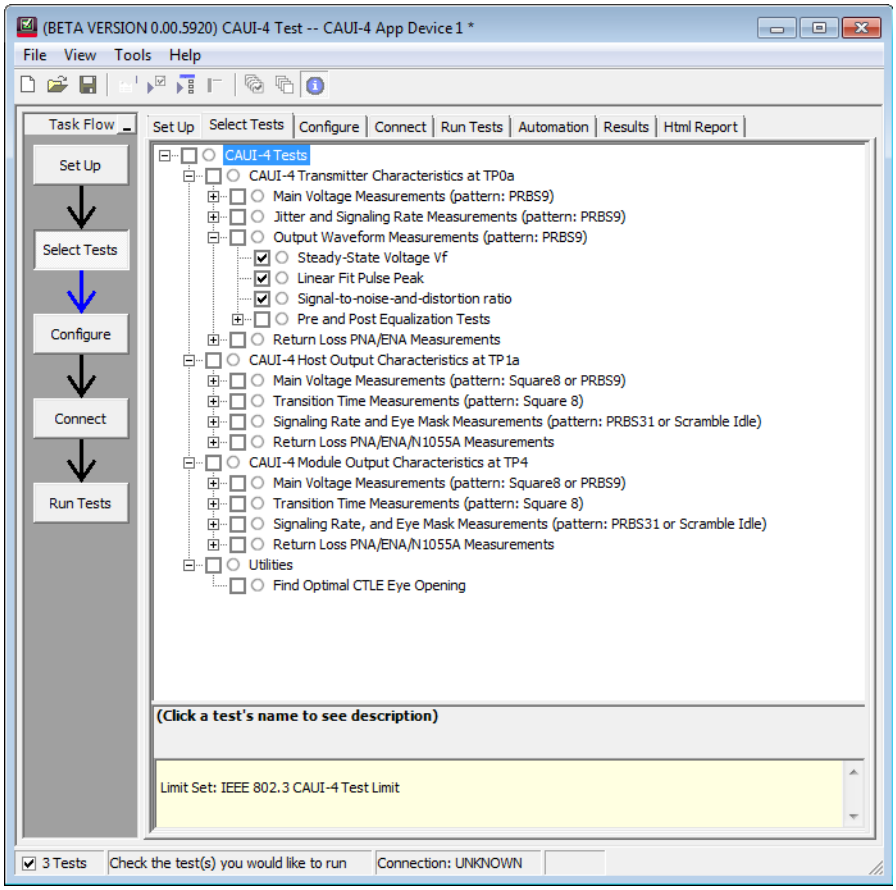

Figure 7 Selecting Transmitter Output Waveform Test

Specifications

The CAUI-4 specifications can be found in IEEE 802.3bm section 83D.

- Steady State Voltage Vf (400 to 600 mV)
- Linear Fit Pulse Peak (0.71 * Vf)

Steady State Voltage Vf

The purpose of this test is to verify that the Steady State Voltage as described in section 85.8.3.3 is between 0.4 and 0.6 V.

PASS Condition

The Steady State Voltage is between 0.4 and 0.6 V.

Measurement Algorithm

1. Check that signal is connected and the proper data pattern exists. (PRBS9 is required for this test)
2. Set memory depth and sample rate to capture the 511 bits of the PRBS9 pattern for M= Np+1 points per bit.
3. Calculate Vf using the equations in section 85.8.3.3.5. The result value is the sum of the columns of p(k)/M.

4 Compare and report the result to 0.4 to 0.6 V.

Linear Fit Pulse Peak

The purpose of this test is to verify that the Linear Fit Pulse as described in section 85.8.3.3 is greater than the Vf * 0.71.

PASS Condition The Linear Fit Pulse is greater than Vf * 0.71.

Measurement Algorithm

1 Check that signal is connected and the proper data pattern exists. (PRBS9 is required for this test)

2 Set memory depth and sample rate to capture the 511 bits of the PRBS9 pattern for M= Np+1 points per bit.

3 Calculate Linear Fit Pulse using the equations in section 85.8.3.3.5. The result it the peak value of p(k).

4 Compare and report the result to 0.71* Vf.

Pre- and Post-Equalization Tests

This section provides the Methods of Implementation (MOIs) for the Pre- and Post-Equalization Tests using a Keysight Infiniium oscilloscope and the N8841A Compliance Test Application.

Probing and Connection

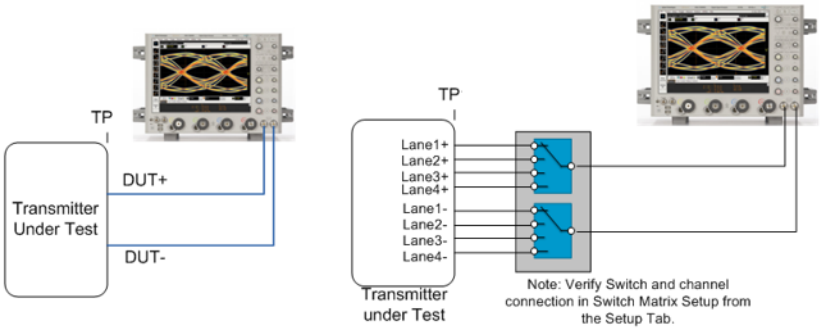

Figure 8 Probing for Pre- and Post-Equalization Tests

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

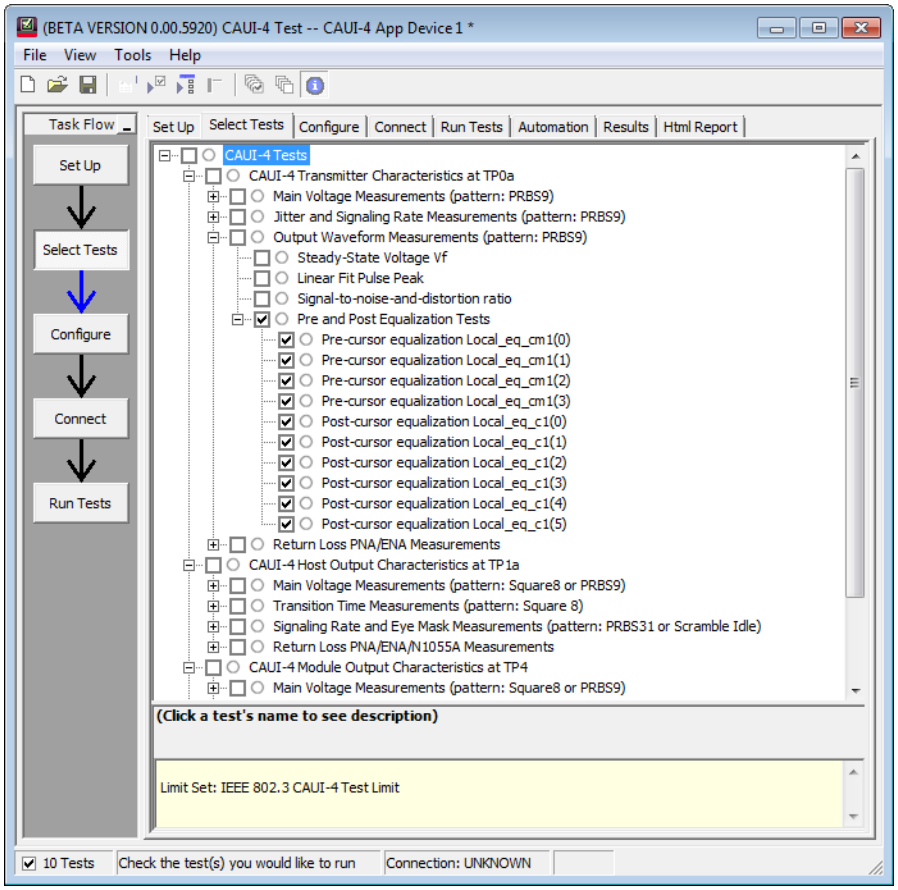

Figure 9 Selecting Pre- and Post-Equalization Tests

Pre-cursor equalization Local_eq_cm1(0)

The purpose of this test is to verify that the Pre-cursor equalization ratio is 0±0.04.

PASS Condition

When the Pre-cursor equalization with weight Local_eq_cm1 = 0, C(-1) / (|C(-1)| + |C(0)| + |C(1)|) must be within 0±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition.
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Pre-cursor equalization with weight local_eq_cm1 = 0.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(-1) / (|C(-1)| + |C(0)| + |C(1)|).

9 Report and compare the value calculated in step 8 with 0±0.04.

Pre-cursor equalization Local_eq_cm1(1)

The purpose of this test is to verify that the Pre-cursor equalization ratio is -0.05±0.04.

PASS Condition When the Pre-cursor equalization with weight Local_eq_cm1 = 1, C(-1) / (|C(-1)| + |C(0)| + |C(1)|) must be within -0.05±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Pre-cursor equalization with weight local_eq_cm1 = 1.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(-1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with -0.05±0.04.

Pre-cursor equalization Local_eq_cm1(2)

The purpose of this test is to verify that the Pre-cursor equalization ratio is -0.1±0.04.

PASS Condition When the Pre-cursor equalization with weight Local_eq_cm1 = 2, C(-1) / (|C(-1)| + |C(0)| + |C(1)|) must be within -0.1±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Pre-cursor equalization with weight local_eq_cm1 = 2.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(-1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with -0.1±0.04.

Pre-cursor equalization Local_eq_cm1(3)

The purpose of this test is to verify that the Pre-cursor equalization ratio is -0.15±0.04.

PASS Condition When the Pre-cursor equalization with weight Local_eq_cm1 = 3, C(-1) / (|C(-1)| + |C(0)| + |C(1)|) must be within -0.15±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Pre-cursor equalization with weight local_eq_cm1 = 3.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(-1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with -0.15±0.04.

Post-cursor equalization Local_eq_c1(0)

The purpose of this test is to verify that the Post-cursor equalization ratio is 0±0.04.

PASS Condition When the Post-cursor equalization with weight Local_eq_c1 = 0, C(1) / (|C(-1)| + |C(0)| + |C(1)|) must be within 0±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Post-cursor equalization with weight local_eq_c1 = 0.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with 0±0.04.

Post-cursor equalization Local_eq_c1(1)

The purpose of this test is to verify that the Post-cursor equalization ratio is -0.05±0.04.

PASS Condition When the Post-cursor equalization with weight Local_eq_c1 = 1, C(1) / (|C(-1)| + |C(0)| + |C(1)|) must be within -0.05±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Post-cursor equalization with weight local_eq_c1 = 1.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with -0.05±0.04.

Post-cursor equalization Local_eq_c1(2)

The purpose of this test is to verify that the Post-cursor equalization ratio is -0.1±0.04.

PASS Condition When the Post-cursor equalization with weight Local_eq_c1 = 2, C(1) / (|C(-1)| + |C(0)| + |C(1)|) must be within -0.1±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Post-cursor equalization with weight local_eq_c1 = 2.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with -0.1±0.04.

Post-cursor equalization Local_eq_c1(3)

The purpose of this test is to verify that the Post-cursor equalization ratio is -0.15±0.04.

PASS Condition When the Post-cursor equalization with weight Local_eq_c1 = 3, C(1) / (|C(-1)| + |C(0)| + |C(1)|) must be within -0.15±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Post-cursor equalization with weight local_eq_c1 = 3.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with -0.15±0.04.

Post-cursor equalization Local_eq_c1(4)

The purpose of this test is to verify that the Post-cursor equalization ratio is -0.2±0.04.

PASS Condition When the Post-cursor equalization with weight Local_eq_c1 = 4, C(1) / (|C(-1)| + |C(0)| + |C(1)|) must be within -0.2±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Post-cursor equalization with weight local_eq_c1 = 4.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with -0.2±0.04.

Post-cursor equalization Local_eq_c1(5)

The purpose of this test is to verify that the Post-cursor equalization ratio is -0.25±0.04.

PASS Condition

When the Post-cursor equalization with weight Local_eq_c1 = 5, C(1) / (|C(-1)| + |C(0)| + |C(1)|) must be within -0.25±0.04.

Measurement Algorithm

1. Request transmitter to be set to "PRESET" condition. (If not already measured/calculated in a previous equalization test of the same trial – else start at step 5).
2. Set memory depth to capture one full PRBS9 pattern and scale.
3. Calculate linear fit pulse response at "PRESET" condition.
4. Define matrix Rm using Equation (92-4) from IEEE 802.3.
5. Request to change the eq setting to Post-cursor equalization with weight local_eq_c1 = 5.
6. Calculate linear fit pulse response.
7. Calculate coefficients with equation (92-5).
8. Calculate precursor ratio C(1) / (|C(-1)| + |C(0)| + |C(1)|).
9. Report and compare the value calculated in step 8 with -0.25±0.04.

Return Loss ENA/PNA Measurements

This section provides the Methods of Implementation (MOIs) for the Return Loss Measurements using a Keysight Infiniium oscilloscope, PNA or ENA, and the N8841A Compliance Test Application. The Compliance test application controls the PNA/ENA to set the test limits and run the test. The calibration must be done on the PNA/ENA.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Calibrate the PNA or ENA.
3. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
4. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
5. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
6. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.
7. Click **Run**. The test limits are automatically calculated.

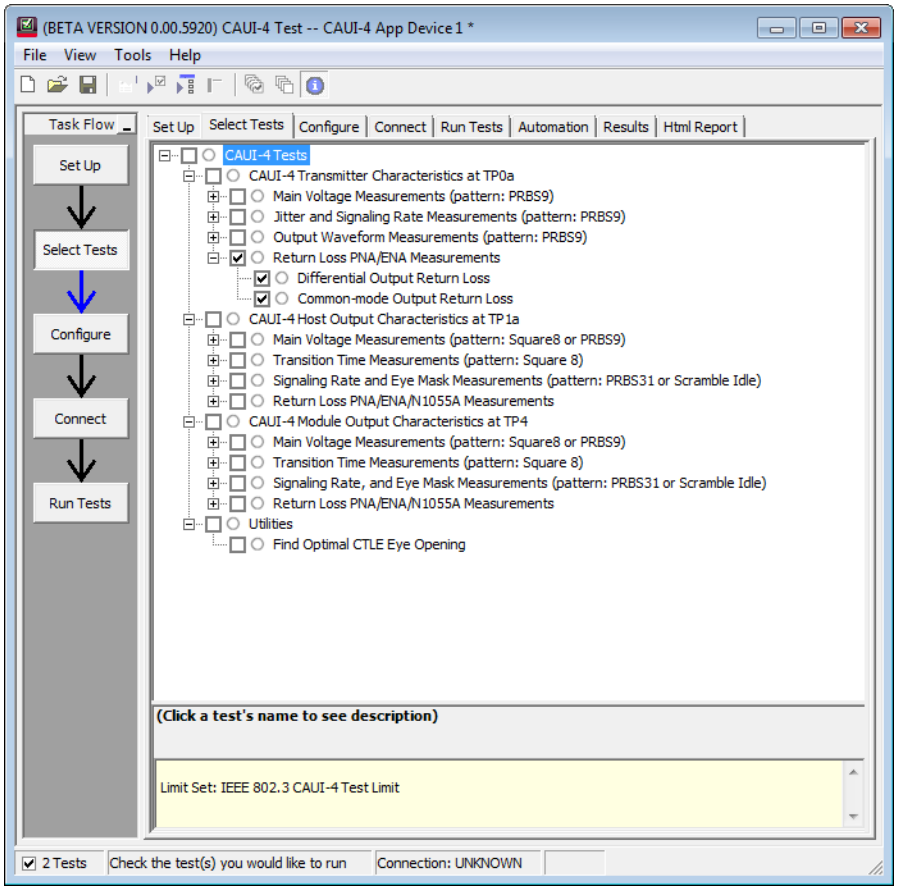

Figure 10 Selecting Return Loss Measurement

4 CAUI-4 Host Output Characteristics at TP1a

This section provides the Methods of Implemenation for the CAUI-4 Host Output Characteristics at TP1a as specified in IEEE802.3bm Table 83E-1. Measurements are made at TP1a.

Main Voltage Measurements

This section provides the Methods of Implementation (MOIs) for the CAUI-4 Main Voltage Measurements using a Keysight Infiniium oscilloscope and the N8841A Compliance Test Application.

Probing and Connection

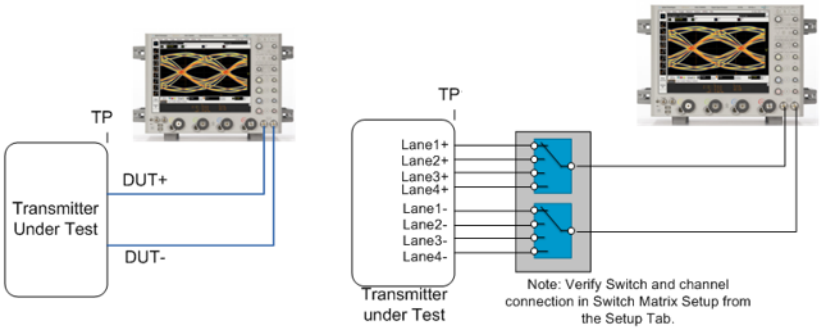

Figure 11 Probing for Main Voltage Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

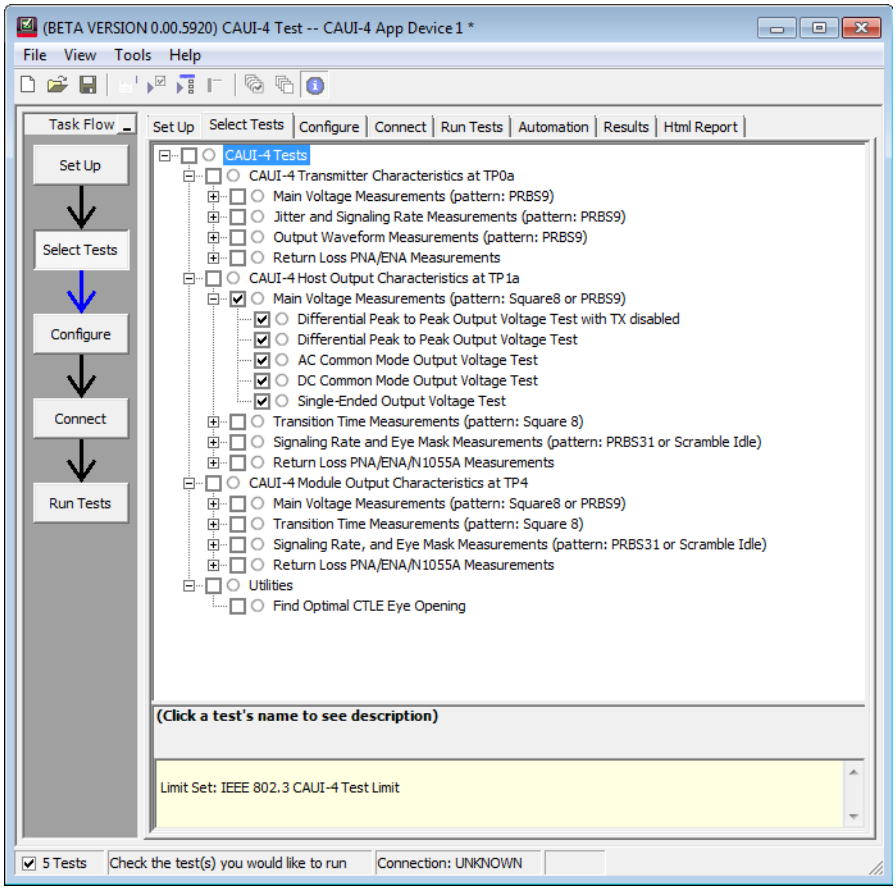

Figure 12 Selecting Main Voltage Measurement Tests

Specifications

The CAUI-4 specifications can be found in IEEE 802.3bm section 83E.

- Differential Peak-to-Peak Output Voltage with TX disabled (max 35 mV).
- Differential Peak-to-Peak Output Voltage (max 900 mV).
- AC Common Mode Output Voltage (max 17.5 mV).
- DC Common Mode Output Voltage (-300 mV – 2.8V).
- Single-Ended Output Voltage (-400 mV – 3.3V).

Differential Peak-to-Peak Output Voltage Test with TX disabled

The purpose of this test is to verify that when TX is disabled the peak-to-peak voltage is less than 30 mV.

PASS Condition

The max peak-to-peak voltage is less than 35 mV.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Check that signal is truly with TX disabled (no valid data transitions).

3 Measure peak-to-peak voltage of the signal.

4 Compare the max peak-to-peak voltage to 35 mV.

Differential Peak-to-Peak Output Voltage Test

The purpose of this test is to verify that the peak-to-peak voltage of the differential signal on a SQ8 or PRBS9 pattern is less than 900 mV.

PASS Condition The differential signal max peak-to-peak voltage on a SQ8 or PRBS9 pattern is less than 900 mV.

Measurement Algorithm

1 Obtain sample or acquire signal data.

2 Verify that there is a signal is connected and has a SQ8 or PRBS9 pattern.

3 Measure the peak-to-peak voltage of the differential signal of DUT+ and DUT-.

4 Compare the max peak-to-peak voltage to 900 mV.

AC Common Mode Output Voltage Test

The purpose of this test is to verify that the common mode signal of the differential pair rms voltage does not exceed 17.5 mV.

NOTE **This measurement can be done with a dual-single ended connection only; it cannot be done with a differential probing connection.**

PASS Condition The signal is less than 17.5 mV.

Measurement Algorithm

1 Obtain sample or acquire signal data.

2 Verify that there is a signal and that the connection is dual-single ended.

3 Measure the peak-to-peak voltage of the addition of the channel 1 and 3 or channel 2 and 4.

4 Compare the voltage measurement to 17.5 mV.

DC Common Mode Output Voltage Test

The purpose of this test is to verify that the common mode signal of the differential pair is between -300 mV to 2.8 V.

NOTE **This measurement can be done with a dual-single ended connection only; it cannot be done with a differential probing connection.**

PASS Condition The signal is between -300 mV to 2.8 V.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Verify that there is a signal and that the connection is dual-single ended.
3. Measure the peak-to-peak voltage of the addition of the channel 1 and 3 or channel 2 and 4.
4. Compare the voltage measurement to -300 mV to 2.8V.

Single-Ended Output Voltage Test

The purpose of this test is to verify that the minimum voltage of a single-ended signal is >-400 mV and the maximum voltage is <3.3 V.

NOTE **This measurement can be done with a dual-single ended connection only; it cannot be done with a differential probing connection.**

PASS Condition The minimum single-ended voltage is >-400 mV and the maximum single-ended voltage is <3.3 V.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Verify that there is a signal and that the connection is dual-single ended.
3. Measure the min and max voltage of each single-ended signal.
4. Compare the voltage measurements to -400 mV to 3.3 V.

Transition Time Measurements

This section provides the Methods of Implementation (MOIs) for the CAUI-4 Transition Time Measurements using a Keysight Infiniium oscilloscope and the N8841A Compliance Test Application.

Probing and Connection

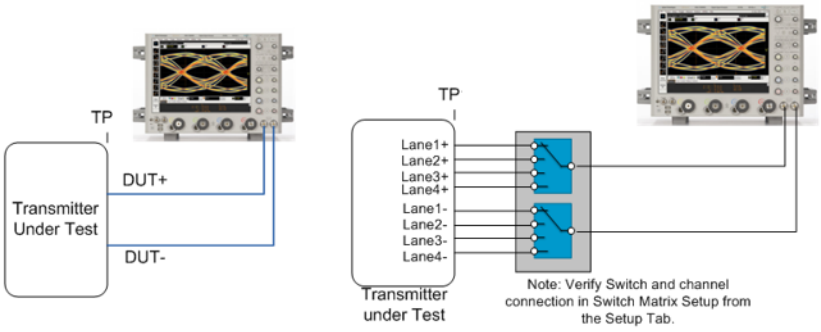

Figure 13 Probing for Transition Time Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

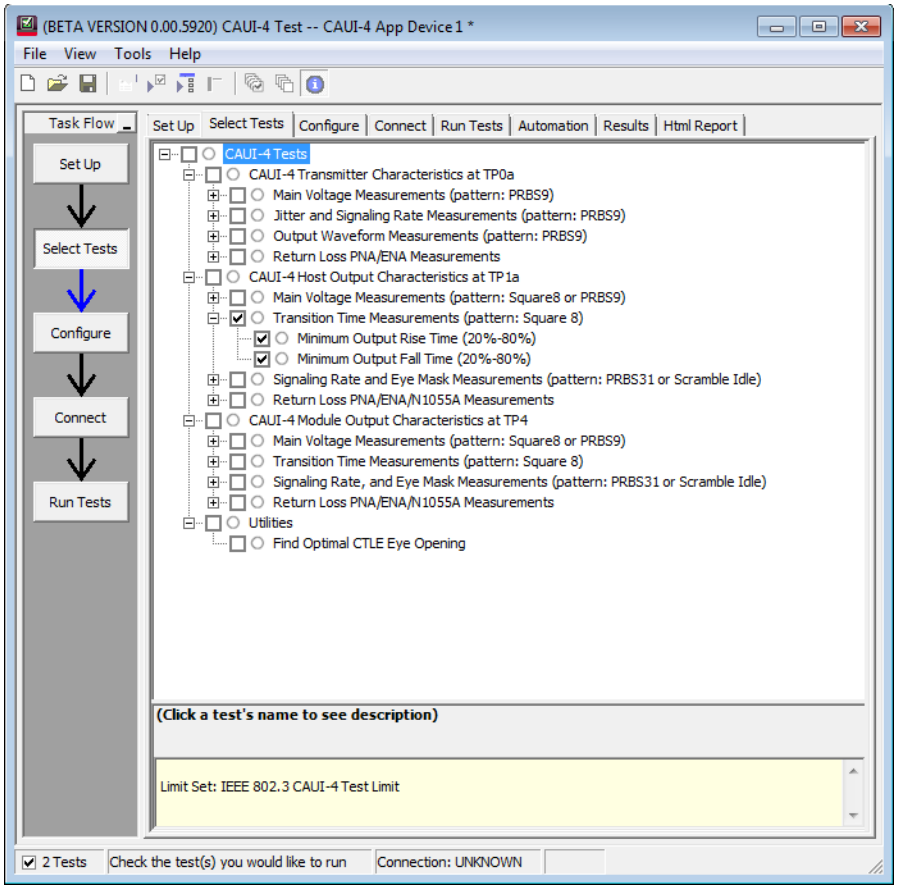

Figure 14 Selecting Transition Time Tests

Specifications

The CAUI-4 specifications can be found in IEEE 802.3bm section 83E.

- Minimum Output Rise Time (20%-80%) (min 10 ps).
- Minimum Output Fall Time (20%-80%) (min 10 ps).

Minimum Output Rise and Fall Time

The purpose of this test is to verify that the minimum rise and fall times are 10 ps.

PASS Condition

The min rise and fall times are greater than 10 ps.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Verify signal is SQ8.
3. Measure rise and fall times from 20% to 80% of signal amplitude.
4. Compare the min rise and fall times to 10 ps.

Signaling Rate and Eye Mask Measurements

This section provides the Methods of Implementation (MOIs) for the Signaling Rate and Eye Mask Measurements using a Keysight Infiniium oscilloscope and the N8841A CAUI-4 Compliance Test Application.

Probing and Connection

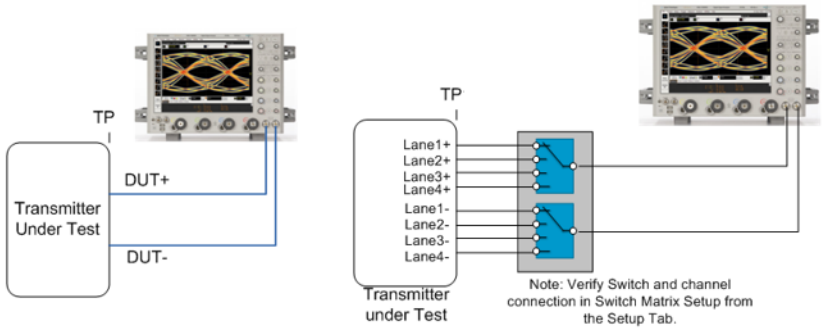

Figure 15 Probing for Signaling Rate and Eye Mask Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

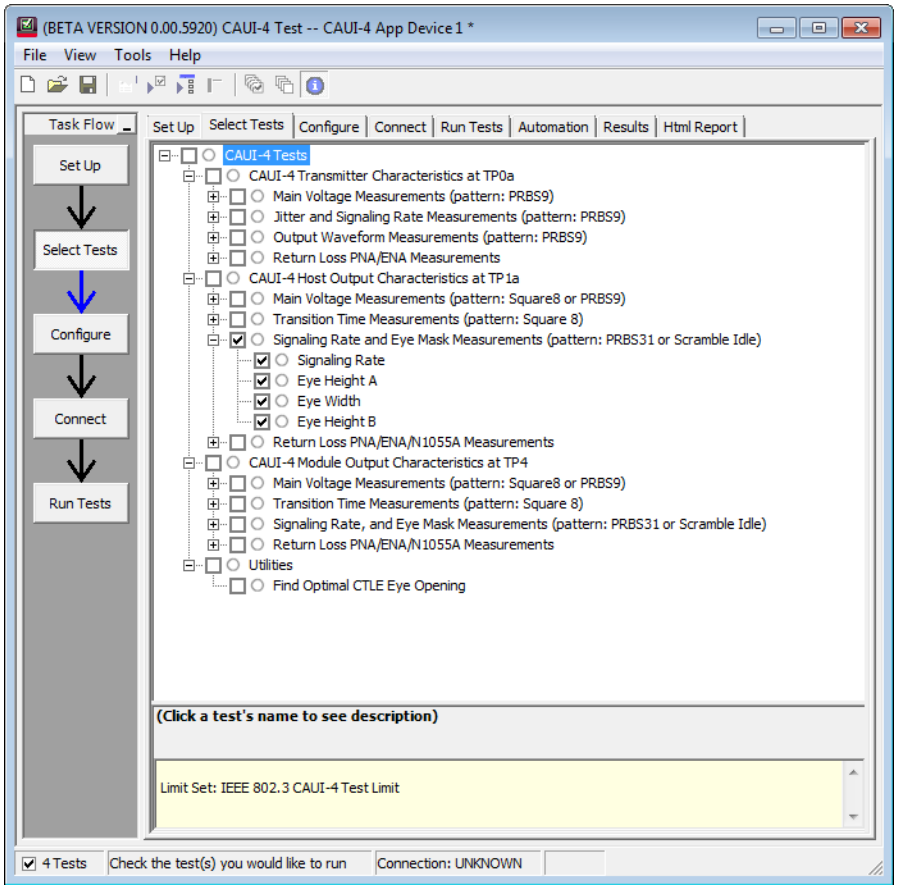

Figure 16 Selecting Signaling Rate and Eye Mask Measurements

Specifications The CAUI-4 specifications can be found in IEEE 802.3bm section 83E.

- Signaling Rate (25.78125 ±100 ppm GBd).
- Eye Mask.
  - Eye Height A (min 95 mV)
  - Eye Width (min 460 mUI)
  - Eye Height B (min 80 mV)

Signaling Rate

The purpose of this test is to verify that the data rate mean is between 25.78125 ±100 ppm GBd.

PASS Condition The mean signaling rate is between 25.78125 ±100 ppm GBd.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Check that signal is connected and data pattern exists (PRBS9 must be used for this test).
3. Set memory depth to capture the number or UI set in the Configure tab.
4. Set data rate measurement to semi-automatic 25.78125 Gb/s.
5. Measure min, max, mean data rate.
6. Report min and max values.
7. Compare and report the mean data rate value to 25.78125 ±100 ppm GBd.

Eye Height A and Eye Width

The purpose of this test is to verify that one of the following CTLE settings Eye Height is greater than 95 mV and Eye Width is greater than 460 mUI. CTLE settings options are:

1. Host Recommended CTLE
2. 1 dB lower than optimal CTLE
3. 1 dB higher than optimal CTLE

PASS Condition The Eye Height measured is greater than 95 mV.

Measurement Algorithm

1. To automatically find the optimal CTLE setting, first run the **Find Optimal CTLE Eye Opening** test unter **Utilities** (in the Select Tests tab). To manually set the optimal CTLE setting, select the setting under **Use Optimized CTLE for Eye Opening** in the Configure tab.
2. Select which CTLE setting to test in the Config tab (Host Recommended CTLE, 1 dB lower than optimal CTLE, or 1 dB higher than optimal CTLE).
3. Obtain sample or acquire signal data.
4. Set memory depth to capture the number or UI set in the Configure tab.
5. Set selected CTLE setting as per table 83E-2.
6. Set clock recovery to First Order PLL with Loop BW = 10 MHz.
7. Measure Eye Height and Eye Width at 1E-6.
8. Compare and Eye Height to 95 mV and Eye Width to 460 mUI and report.

Eye Height B

The purpose of this test is to verify that all of the following CTLE settings Eye Height are greater than 80 mV. CTLE settings are:

1. Host Recommended CTLE
2. 1 dB lower than optimal CTLE
3. 1 dB higher than optimal CTLE

PASS Condition

The Eye Height measured is greater than 95 mV.

Measurement Algorithm

1. To automatically find the optimal CTLE setting, first run the **Find Optimal CTLE Eye Opening** test unter **Utilities** (in the Select Tests tab). To manually set the optimal CTLE setting, select the setting under **Use Optimized CTLE for Eye Opening** in the Configure tab.
2. Select the Host Recommended CTLE setting in the config tabe "Host – Recommended CTLE value".
3. Obtain sample or acquire signal data.
4. Set memory depth to capture the number or UI set in the Configure tab.
5. Set CTLE setting to 1 dB lower than optimal.
6. Set clock recovery to First Order PLL with Loop BW = 10 MHz.
7. Measure Eye Height at 1E-6.
8. Repeat steps 3-7 with remaining CTLE settings – 1 dB lower than optimal CTLE and Host Recommended CTLE.
9. Compare all Eye Height measurements to 80 mV.

Return Loss ENA/PNA Measurements

This section provides the Methods of Implementation (MOIs) for the Return Loss Measurements using a Keysight Infiniium oscilloscope, PNA or ENA, and the N8841A Compliance Test Application. The Compliance test application controls the PNA/ENA to set the test limits and run the test. The calibration must be done on the PNA/ENA.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Calibrate the PNA or ENA.
3. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
4. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
5. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
6. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.
7. Click **Run**. The test limits are automatically calculated.

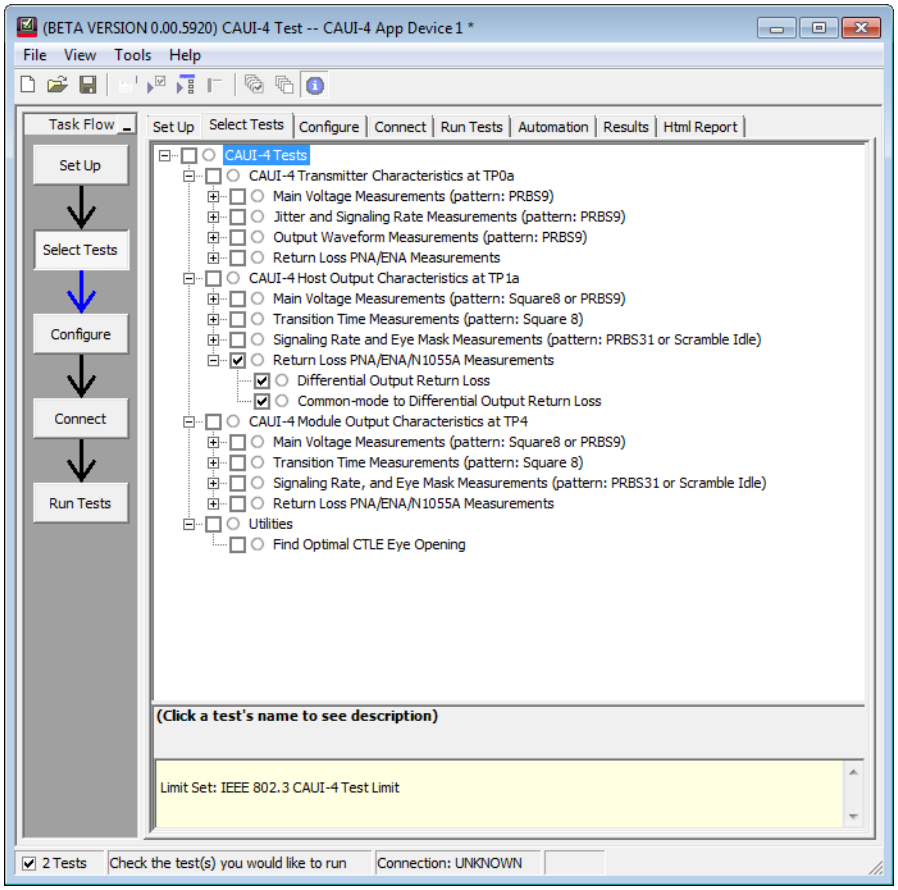

Figure 17 Selecting Return Loss Measurement

4 CAUI-4 Host Output Characteristics at TP1a

5 CAUI-4 Module Output Characteristics at TP4

This section provides the Methods of Implemenation for the CAUI-4 Host Output Characteristics at TP4 as specified in IEEE802.3bm Table 83E-3. Measurements are made at TP4.

Main Voltage Measurements

This section provides the Methods of Implementation (MOIs) for the CAUI-4 Main Voltage Measurements using a Keysight Infiniium oscilloscope and the N8841A Compliance Test Application.

Probing and Connection

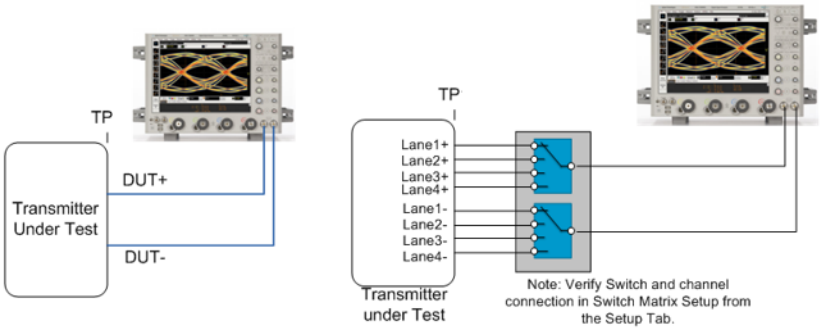

Figure 18 Probing for Main Voltage Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

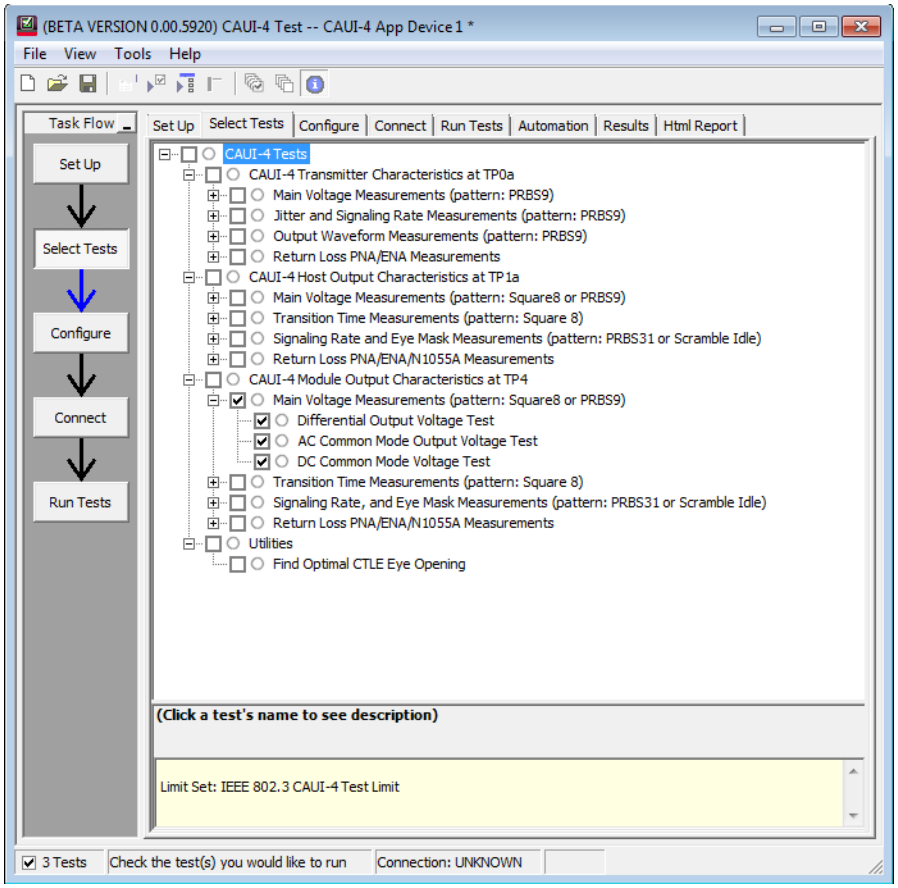

Figure 19 Selecting Main Voltage Measurement Tests

Specifications

The CAUI-4 specifications can be found in IEEE 802.3bm section 83E.

- Differential Output Voltage (max 900 mV).
- AC Common Mode Output Voltage (max 17.5 mV).
- DC Common Mode Output Voltage (-350 mV – 2.85V).

Differential Output Voltage Test

The purpose of this test is to verify that the peak-to-peak voltage of the differential signal on a SQ8 or PRBS9 pattern is less than 900 mV.

PASS Condition

The differential signal max peak-to-peak voltage on a SQ8 or PRBS9 pattern is less than 900 mV.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Verify that there is a signal is connected and has a SQ8 or PRBS9 pattern.
3. Measure the peak-to-peak voltage of the differential signal of DUT+ and DUT-.

4 Compare the max peak-to-peak voltage to 900 mV.

AC Common Mode Output Voltage Test

The purpose of this test is to verify that the common mode signal of the differential pair rms voltage does not exceed 17.5 mV.

NOTE **This measurement can be done with a dual-single ended connection only; it cannot be done with a differential probing connection.**

PASS Condition The signal is less than 17.5 mV.

Measurement Algorithm

1 Obtain sample or acquire signal data.
2 Verify that there is a signal and that the connection is dual-single ended.
3 Measure the peak-to-peak voltage of the addition of the channel 1 and 3 or channel 2 and 4.
4 Compare the voltage measurement to 17.5 mV.

DC Common Mode Output Voltage Test

The purpose of this test is to verify that the common mode signal of the differential pair is between -300 mV to 2.85 V.

NOTE **This measurement can be done with a dual-single ended connection only; it cannot be done with a differential probing connection.**

PASS Condition The signal is between -350 mV to 2.85 V.

Measurement Algorithm

1 Obtain sample or acquire signal data.
2 Verify that there is a signal and that the connection is dual-single ended.
3 Measure the peak-to-peak voltage of the addition of the channel 1 and 3 or channel 2 and 4.
4 Compare the voltage measurement to -350 mV to 2.85 V.

Transition Time Measurements

This section provides the Methods of Implementation (MOIs) for the CAUI-4 Transition Time Measurements using a Keysight Infiniium oscilloscope and the N8841A Compliance Test Application.

Probing and Connection

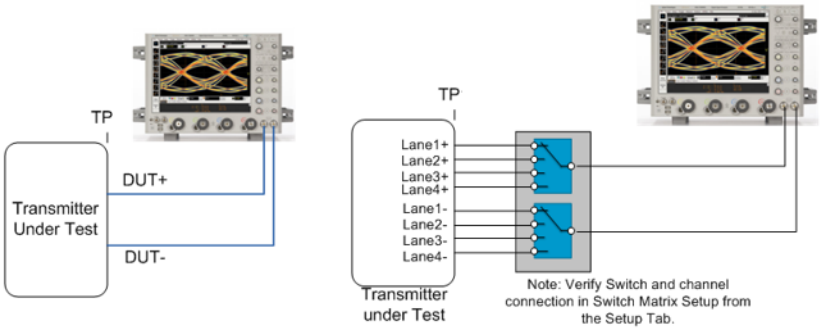

Figure 20 Probing for Transition Time Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

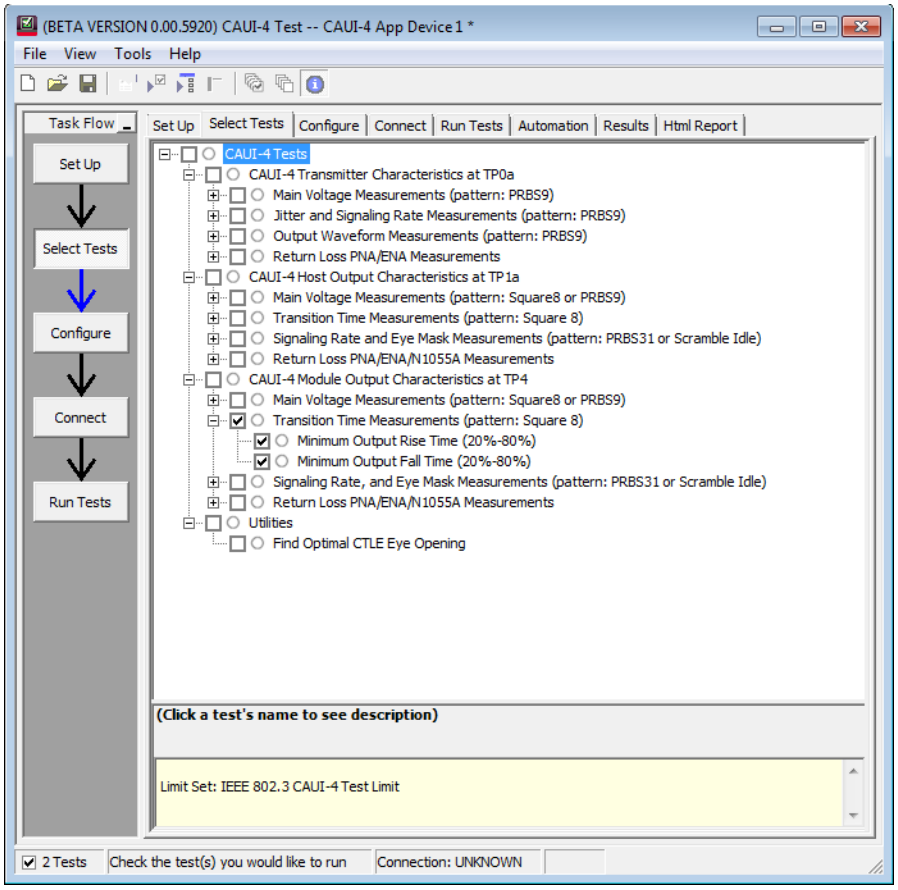

Figure 21 Selecting Transition Time Tests

Specifications

The CAUI-4 specifications can be found in IEEE 802.3bm section 83E.

- Minimum Output Rise Time (20%-80%) (min 12 ps).
- Minimum Output Fall Time (20%-80%) (min 12 ps).

Minimum Output Rise and Fall Time

The purpose of this test is to verify that the minimum rise and fall times are 12 ps.

PASS Condition

The min rise and fall times are greater than 12 ps.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Verify signal is SQ8.
3. Measure rise and fall times from 20% to 80% of signal amplitude.
4. Compare the min rise and fall times to 12 ps.

Signaling Rate and Eye Mask Measurements

This section provides the Methods of Implementation (MOIs) for the Signaling Rate and Eye Mask Measurements using a Keysight Infiniium oscilloscope and the N8841A CAUI-4 Compliance Test Application.

Probing and Connection

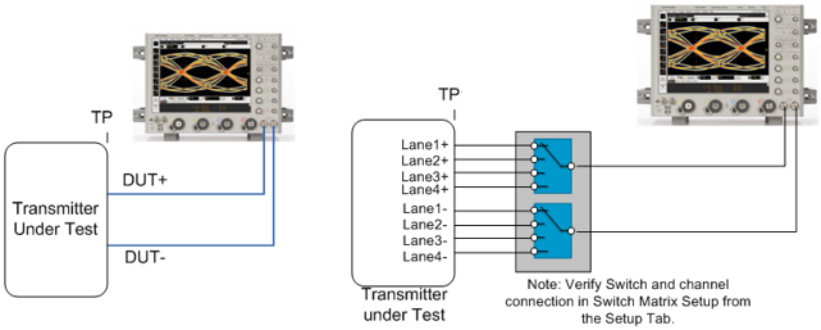

Figure 22 Probing for Signaling Rate and Eye Mask Measurements

You can use any of the oscilloscope channels as Signal source channel; however, for proper BW, use the Real Edge channels. Select lane options in the Set Up tab. You can identify the channels used for the measurement signal in the Set Up tab of the Compliance Test Application.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Connect the probes to the signals on the DUT.
3. Connect the oscilloscope probes or cables to the channel(s) of the oscilloscope that you have set up in the **Configuration** tab.
4. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
5. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
6. Set up InfiniiSim if needed.
7. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
8. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

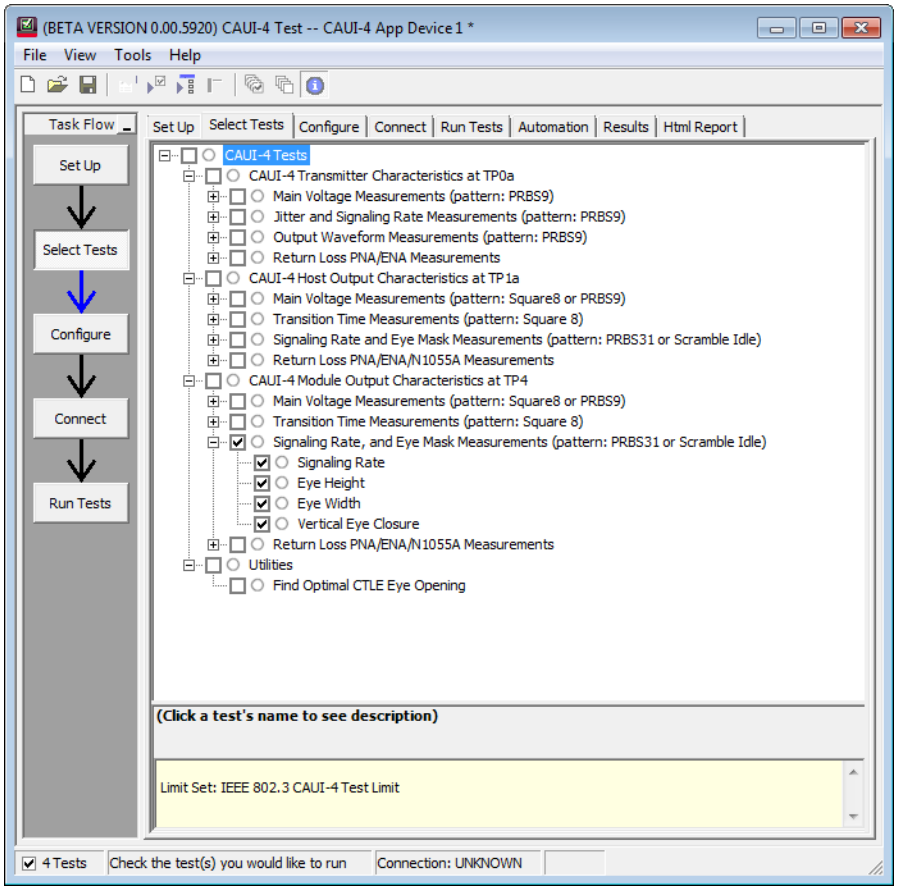

Figure 23 Selecting Signaling Rate and Eye Mask Measurements

Specifications

The CAUI-4 specifications can be found in IEEE 802.3bm section 83E.

- Signaling Rate (25.78125 ±100 ppm GBd).
- Eye Mask.
  - Eye Height (min 228 mV)
  - Eye Width (min 570 mUI)

Signaling Rate

The purpose of this test is to verify that the data rate mean is between 25.78125 ±100 ppm GBd.

PASS Condition

The mean signaling rate is between 25.78125 ±100 ppm GBd.

Measurement Algorithm

1. Obtain sample or acquire signal data.
2. Check that signal is connected and data pattern exists (PRBS9 must be used for this test).

3 Set memory depth to capture the number or UI set in the Configure tab.

4 Set data rate measurement to semi-automatic 25.78125 Gb/s.

5 Measure min, max, mean data rate.

6 Report min and max values.

7 Compare and report the mean data rate value to 25.78125 ±100 ppm GBd.

Eye Height A and Eye Width

The purpose of this test is to verify that one of the optimal CTLE settings Eye Height is greater than 228 mV and Eye Width is greater than 570 mUI.

PASS Condition The Eye Height measured is greater than 228 mV and Eye Width is greater than 570 mUI.

Measurement Algorithm

1 To automatically find the optimal CTLE setting, first run the **Find Optimal CTLE Eye Opening** test unter **Utilities** (in the Select Tests tab). To manually set the optimal CTLE setting, select the setting under **Use Optimized CTLE for Eye Opening** in the Configure tab.

2 Obtain sample or acquire signal data.

3 Set memory depth to capture the number or UI set in the Configure tab.

4 Set selected CTLE setting as per table 83E-2.

5 Set clock recovery to First Order PLL with Loop BW = 10 MHz.

6 Measure Eye Height and Eye Width at 1E-6.

7 Compare and Eye Height to 228 mV and Eye Width to 570 mUI and report.

Vertical Eye Closure

The purpose of this test is to verify that the Vertical Eye Closure at EH15 (1E-15) is less than 5.5 dB.

PASS Condition The Vertical Eye Closure at 1E-15 is less than 5.5 dB.

Measurement Algorithm

1 To automatically find the optimal CTLE setting, first run the **Find Optimal CTLE Eye Opening** test unter **Utilities** (in the Select Tests tab). To manually set the optimal CTLE setting, select the setting under **Use Optimized CTLE for Eye Opening** in the Configure tab.

2 Obtain sample or acquire signal data.

3 Set memory depth to capture the number or UI set in the Configure tab.

4 Set selected CTLE setting as per table 83E-2.

5 Set clock recovery to First Order PLL with Loop BW = 10 MHz.

6 Measure Eye Height at 1E-15 (EH15).

7 Measure and calculate AV as the mean value of logic 1 minus the mean value of logic 0 at the central 5% of the eye.

8 Calculate and compare the VEC = 20log(AV/EH15).

Return Loss ENA/PNA Measurements

This section provides the Methods of Implementation (MOIs) for the Return Loss Measurements using a Keysight Infiniium oscilloscope, PNA or ENA, and the N8841A Compliance Test Application. The Compliance test application controls the PNA/ENA to set the test limits and run the test. The calibration must be done on the PNA/ENA.

Test Procedure

1. Start the automated test application as described in "Starting the Compliance Test Application" on page 13.
2. Calibrate the PNA or ENA.
3. In the Test application, click the **Set Up** tab. Select **Measurement Option**, **Lane Option**, and **Channels**.
4. Set up Switch matrix (if used) by clicking on the **Switch Matrix Setup** button.
5. Type in or select the **Device Identifier** as well as the **User Description** from the drop-down list. Enter your comments in the **Comments** text box.
6. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.
7. Click **Run**. The test limits are automatically calculated.

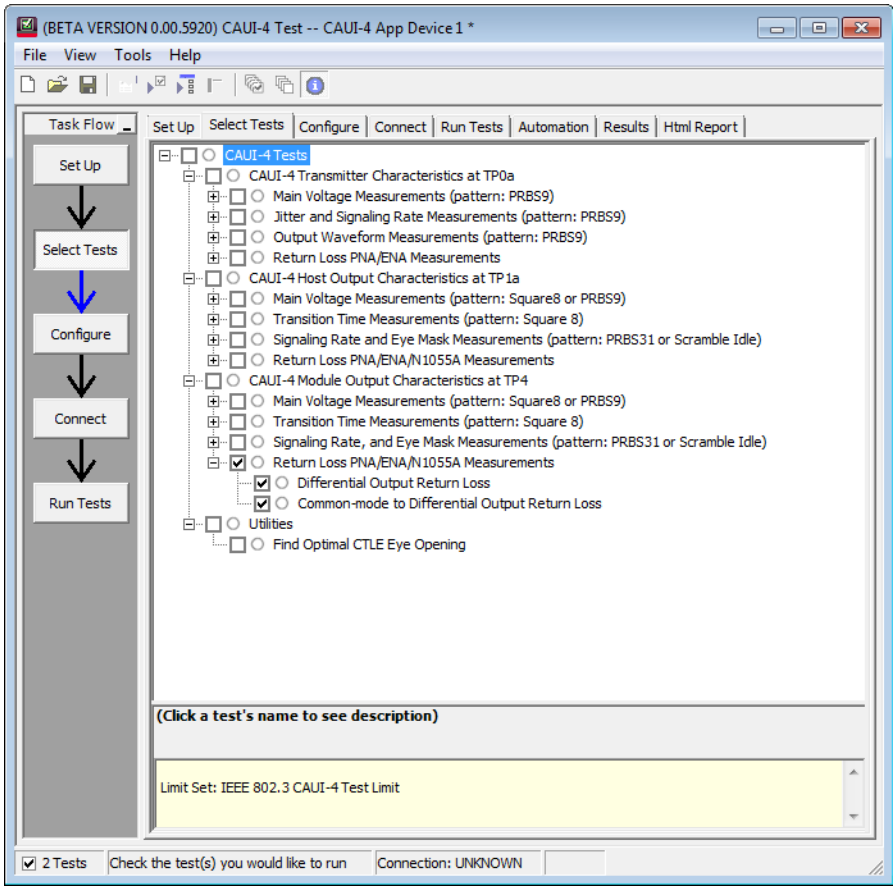

Figure 24 Selecting Return Loss Measurement

6 Debug Mode

Debug mode can be selected to enable the ability to change jitter measurement options. In the **Configuration** tab, select the **Debug** radio button. This will add the following options:

- **Rj Bandwidth** – Choose the Rj Filter. Options are Narrow (Pink) or Wide (White). This changes the amount of DC jitter in the Rj measurement.
- **Jitter Pattern Length** – Choose Periodic or Arbitrary. Periodic is used for data patterns that are periodic and repeat through the oscilloscope memory. Arbitrary is used for random data patterns or long data patterns (for example, PRBS31) that do not repeat through the oscilloscope memory. If Arbitrary is selected, set the ISI filters.
- **ISI Filter Lead** – When using Arbitrary mode for the Jitter Pattern Length, set the Leading ISI filter coefficient. To help select the correct ISI filter, see Application Note 1574: Choosing the ISI Filter Size for EZJIT Plus Arbitrary Data Jitter Analysis (at www.keysight.com, literature part number 5989-4974EN).
- **ISI Filter Lag** – When using Arbitrary mode for the Jitter Pattern Length, set the Lagging ISI filter coefficient. Again, to help select the correct ISI filter, see Application Note 1574: Choosing the ISI Filter Size for EZJIT Plus Arbitrary Data Jitter Analysis.

A Calibrating the Infiniium Oscilloscope and Probe

This section tells where to find information on oscilloscope and probe calibration procedures.

Oscilloscope Internal Calibration

For information on performing the internal diagnostic and calibration cycle for your Keysight Infiniium oscilloscope, refer to the "User Calibration" topic in your oscilloscope's online help.

Probe Calibration

Before performing the automated tests, you should calibrate the probes. Calibration of the solder-in probe heads consists of a vertical calibration and a skew calibration. The vertical calibration should be performed before the skew calibration. Both calibrations should be performed for best probe measurement performance.

For information on performing probe vertical and skew calibration in your Keysight Infiniium oscilloscope, refer to the "DC Attenuation/Offset Calibration" and "Skew Calibration" topics in your oscilloscope's online help.

For more information on calibration/deskew procedures for your particular probe, refer to the probe's *user's guide* in the Probe Resource Center.

Index

S

T

V

W