N5991P PCI Express Test Automation Software Platform - User Guide

KEYSIGHT

USER GUIDE

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Contents

1 Introduction

Overview

This guide provides a detailed description of the Keysight N5991 PCIe Test Automation Software Platform.

The BitifEye "ValiFrame" Test Automation software is globally marketed and supported by Keysight Technologies as N5991. This document describes in detail the calibrations and test procedures conducted by N5991 ValiFrame for PCI Express.

The N5991 software calibrates the stress conditions and controls all test electronic equipment for automated receiver tolerance tests. The receiver tests described in this document are implemented according to the requirements of the Compliance Test Specification (CTS), and also some custom characterization tests are offered to provide more details about DUT behavior beyond the specification limits.

NOTE The features available with the N5991 PCIe Receiver Test depend on the hardware used. Please contact the Keysight support team for further details.

NOTE The definitions of the acronyms and abbreviations used throughout this User Guide are given in Chapter 11, Appendix C: Acronyms and Abbreviations.

Document History

First Edition (October 2019)

The first edition of this user guide describes the functionality of the software version N5991 ValiFrame PCIe_1.00.

Second Edition (June 2020)

The second edition of this user guide describes the functionality of the software version N5991 ValiFrame PCIe_2.07.

Third Edition (September 2020)

The third edition of this user guide describes the functionality of the software version N5991 ValiFrame PCIe_2.20.

Fourth Edition (October 2021)

The fourth edition of this user guide describes the functionality of the software version N5991 ValiFrame PCIe_3.00.

Fifth Edition (December 2022)

The fifth edition of this user guide describes the functionality of the software version N5991 ValiFrame PCIe_4.1.0.

Sixth Edition (December 2023)

The sixth edition of this user guide describes the functionality of the software version N5991 ValiFrame PCIe_5.0.0.

Support and Troubleshooting

In the case of problems when running the software, check the log list at the bottom of the main window. The log file can be viewed by right-clicking within the log list section (see red frame in Figure 1). The log file is temporarily saved at C:\ProgramData\BitifEye\ValiFrameK1\Tmp. Note that all log information will be lost when the N5991 application is terminated unless you save the log file.

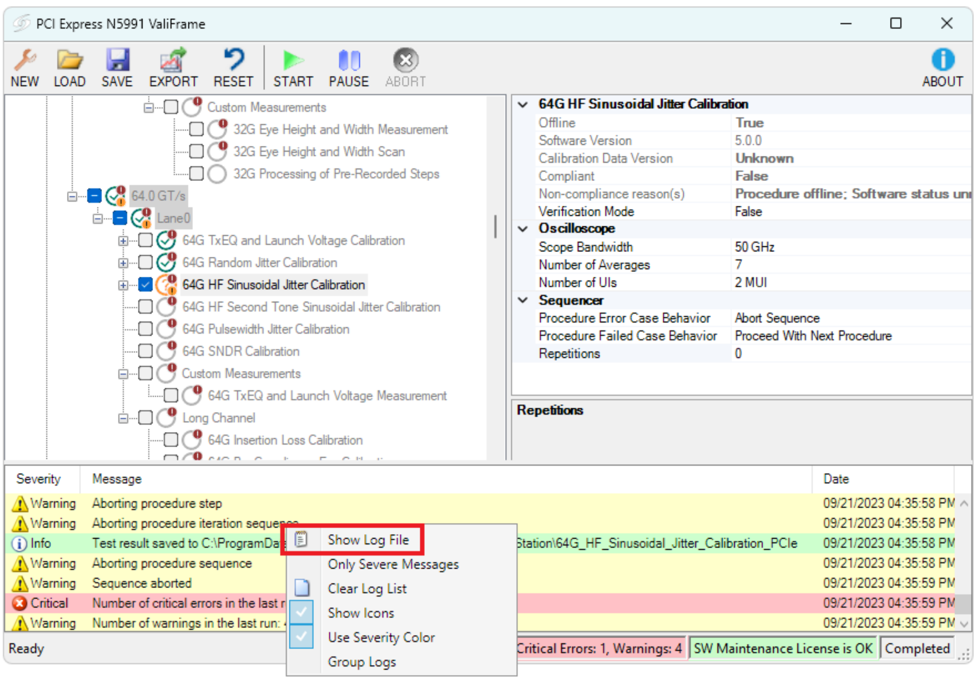


Figure 1 Accessing the log

If a problem with an application persists, send the log file with the problem to Keysight support.

The Keysight support team is also happy to help you should you require further information about a particular application.

For support options, visit www.keysight.com/find/contactus.

2 ValiFrame PCIe Test Station

The test instruments that are together used for Test Automation are referred to as a Test Station. This chapter describes how to configure and start the N5991 ValiFrame PCIe Test Station.

ValiFrame PCIe Station Configuration

The set of test instruments that are used for PCIe test automation is referred to in the following as the “Test Station” or simply “Station”. The test station is controlled by a suitable PC and the N5991 PCI Express Test Automation Software Platform.

First install the BitifEye N5991 ValiFrame PCI Express software. Further details about this and the licenses required can be found in the N5991 Getting Started Guide.

The N5991 PCIe Station Configurator must be started prior to launching ValiFrame. It allows you to select the required set of instruments. Double-click the Station Configurator icon (see Figure 2) to launch the software. Alternatively, to access the ValiFrame Station Configurator on a Windows 10-based PC, click

Start > **BitifEye PCIe N5991** > **PCIe Station Configurator (N5991)**.

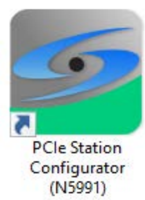


Figure 2 Icon for PCIe Station Configurator (N5991)

Test Station Configuration

When the ValiFrame PCIe Station Configurator is launched, the first ValiFrame Station Configurator window appears as shown in Figure 3. The station is already selected as PCI Express.

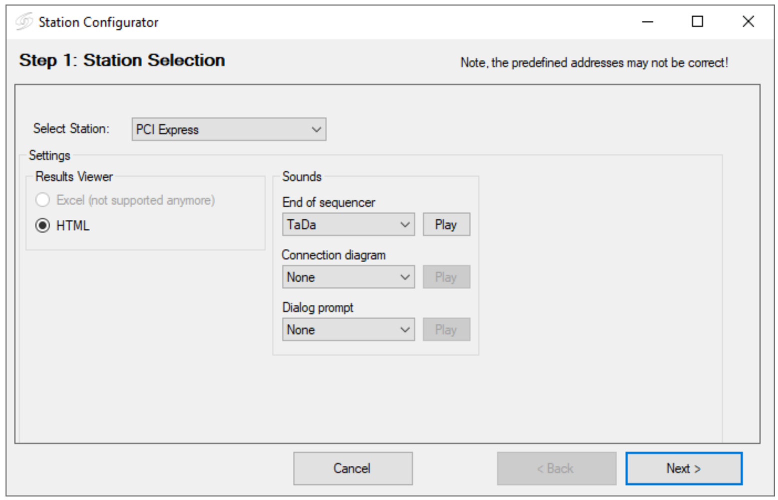


Figure 3 Station Selection window

You may optionally assign sounds to mark different states of the program being reached.

1 **End of sequencer** plays the selected sound at the end of a sequence.
2 **Connection diagram** plays the selected sound every time a connection diagram pops up.
3 **Dialog prompt** plays the selected sound at each dialog prompt.

In each case, select a sound from the drop-down options. 'None' disables the sound for the respective action. Click **Play** to test a sound before assigning it to a specific action.

When you have finished, click **Next** to continue.

The Station Configuration stage of the Station Configurator is displayed as shown in Figure 4. It shows the various options for instruments that can be used for PCIe testing. The options are described here.

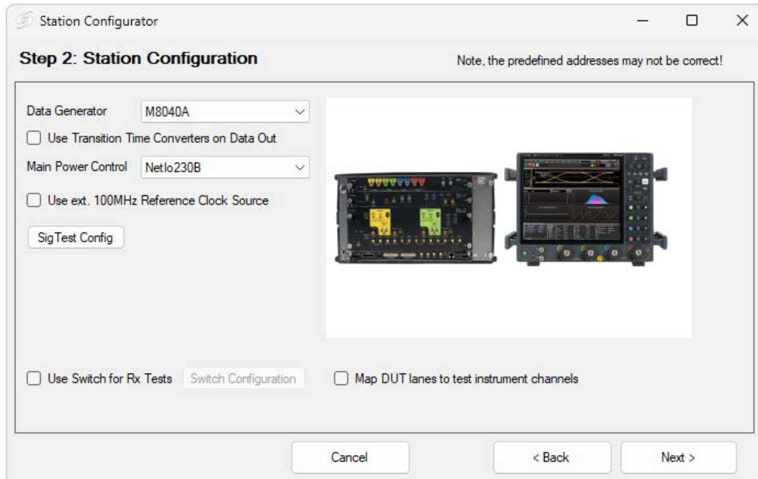


Figure 4 Station Configuration window

Data Generator

The pattern generator is used to create patterns with specified stress parameters. For PCIe the supported options are:

- M8020A (Keysight M8020A J-BERT High-Performance BERT), for data rates up to 16 GT/s, spec versions PCIe4 and PCIe5
- M8040A (Keysight M8040A 64 GBd High-Performance BERT), for spec versions PCIe4, PCIe5 and PCIe6.
- M8050A (Keysight M8050A 120 GBd High-Performance BERT), for spec versions PCIe5 and PCIe6.
  - The M8046A error detector is required if you are using the M8050A.
  - Currently, 2.5 GT/s and 5.0 GT/s data rates are not supported by the M8050A.
  - Similarly, LEQ tests are currently not supported by the M8050A.

The error detector of the selected data generator (BERT system) is used to check for errors contained in the data looped back from the DUT.

For further details about the clock module front end, error detector, recommended oscilloscopes, etc. for each BERT, contact the Keysight support team.

Use Transition Time Converters on Data Out

This option appears only for the M8040A BERT. For all calibrations where the output of the BERT is directly connected to the oscilloscope, it is required to use the high bandwidth (BW) inputs of the scope to avoid any measurement artifacts that may occur due to the fast edges of the M8040A. Using transition time converters (TTCs) slows down the M8040A's edge rates and reduces the required bandwidth of the oscilloscope. Therefore, adding TTCs to the setup allows low-bandwidth inputs to be used for all calibrations, thus avoiding re-connections on the oscilloscope. However, if TTCs are used, the 64 GT/s data rate is not available.

Main Power Control

Select one of the options from the drop-down menu:

- Manual
- NetIo 230B (a power distribution unit with one 230 V input and four 230 V outlets)
- ALL4076
- SynaccessNP

Use External 100 MHz Reference Clock Source

Select the “Use ext. 100 MHz Reference Clock Source” check box to use a 100 MHz reference clock as a clock source for the data generator and the DUT to obtain a constant clock signal. It is required only in Common Clock architecture.

SigTest Configuration

The SigTest software is used in several calibration procedures to calculate the eye height, eye width, and jitter parameters of the generated signal.

The SigTest Configuration dialog (see Figure 5) lets you select the installation directories, jitter measurement template and EH/EW measurement template used for the calibrations.

The SigTest software must be installed separately before ValiFrame is started. The various versions of SigTest can be downloaded from the Intel website. A link to this website is also provided in the SigTest Configuration dialog (see Figure 5).

NOTE There may be instances where the template names may change for different SigTest versions. To automatically modify the template names, click the “Default” button and the names are modified to correlate with the required SigTest version.

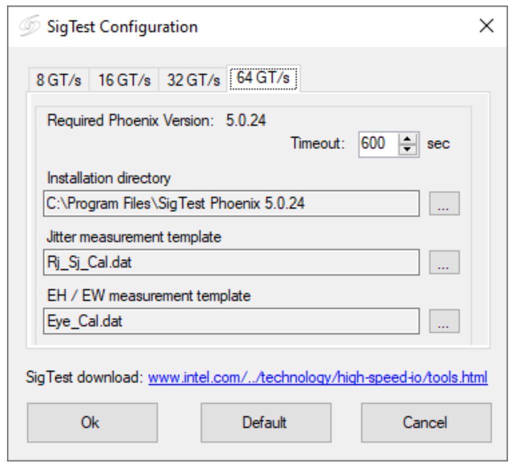


Figure 5 SigTest Configuration window

Use Switch for Rx Tests

If this option is selected, the 64 GT/s data rate is not available.

Using a switch, you can test more than one lane without changing the setup connections. This greatly reduces user interventions during testing.

Select the “Use Switch for Rx Tests” check box to enable the “Switch Configuration” button. Click this button to open the **Rx Switch Configuration** dialog (see Figure 6), where you can select the switch types. The exact appearance of the Rx Switch Configuration window will depend on the switch types chosen.

To use a BIT-2100 Series Switch System, you require a separate license. See the BitifEye License Manager.

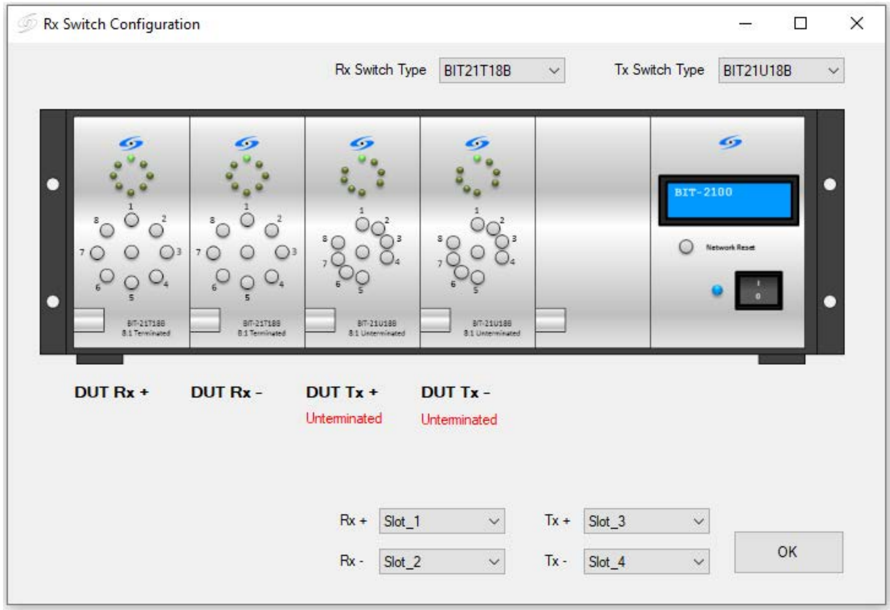


Figure 6 Rx Switch Configuration window

Map DUT lanes to test instrument channels

The “Map DUT lanes to test instrument channels” option is an alternative to “Use Switch for Rx Tests”. They cannot be used together. “Map DUT lanes to test instrument channels” is used to test several lanes without cabling re-connections. If this check box is selected, the Rx DUT lanes can be mapped to different data outputs of the generator instrument.

Test Instrument Configuration

Once the PCIe station is configured, the instrument addresses must be set. An example for instrument configuration is shown in Figure 7.

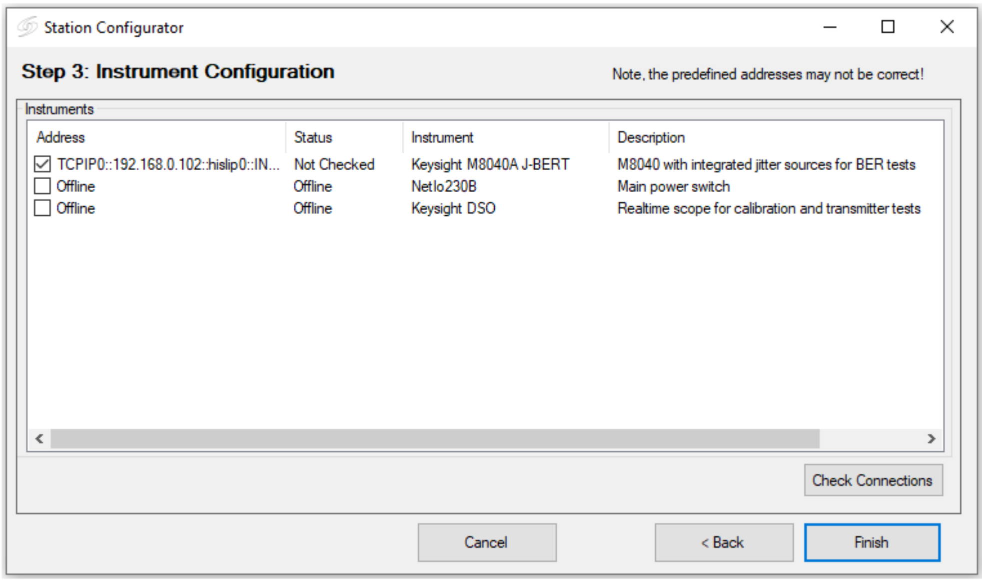


Figure 7 Instrument Configuration window

NOTE A UXR oscilloscope with a sample rate of 512 GSa/s and a bandwidth of at least 59 GHz is required for M8040A setups without TTCs and for M8050A setups.

NOTE Make sure that all the selected instruments for the test station are connected to the test station PC controller by remote control interfaces such as LAN or USB.

After the installation process, all instruments are configured by default in “Offline” mode. In this simulation mode, the hardware need not necessarily be physically connected to the test controller PC. The ValiFrame software cannot connect to any instrument in this mode.

In order to control the instruments that are connected to the PC, the instrument address must be entered. The address depends on the bus type used for the connection, for example, USB or LAN.

Most of the instruments used in the PCIe station require a VISA (Virtual Instrument System Architecture) connection. To determine the VISA address, run the “Keysight Connection Expert”, which is part of the Keysight IO Libraries Suite (IO Libraries Suite Downloads | Keysight). Either right-click the **Keysight IO Control icon** in the task bar and select the first entry “Connection Expert” or select “Keysight Connection Expert” directly from the list of programs. For each instrument, copy the address string from the Connection Expert entries and paste it as the instrument address in the ValiFrame Station Configurator.

For further details about how to use the Keysight Connection Expert see the N5991 Getting Started Guide.

After the address strings have been entered, click **Check Connections** to verify that the connections for the instruments have been established properly. If an erroneous instrument address configuration is performed, the Configurator displays a prompt to indicate so.

Click **Finish** to save the changes and close the ValiFrame Station Configurator.

NOTE

When a specific test station configuration is started for the first time, all instruments are set to the “Offline” mode. In this mode, the test automation software does not connect to any instrument. This mode can be used for demonstrations or checks only. NO VALID DATA IS PRODUCED.

Starting the PCIe Station

Once the test station is configured, you can start the ValiFrame PCIe Test Station by double-clicking the “PCIe ValiFrame (N5991)” icon on the desktop (Figure 8). Alternatively, on a Windows 10 PC, click **Start** > **BitifEye PCIe N5991** > **PCIe ValiFrame (N5991)**.

Figure 8 PCIe ValiFrame (N5991) icon

Clicking the PCIe ValiFrame icon launches the PCI Express N5991 ValiFrame main window (Figure 9).

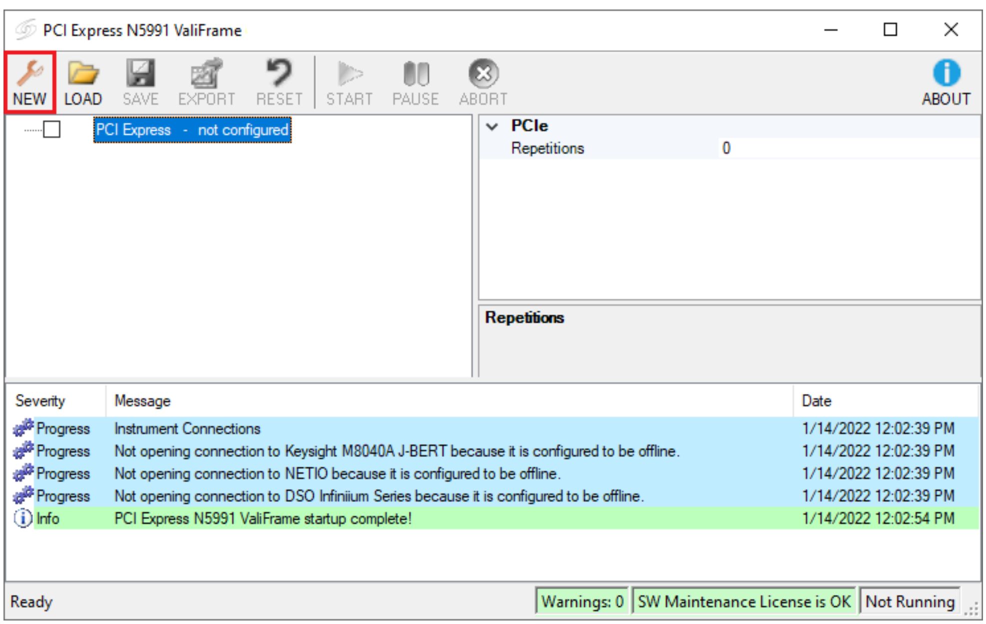


Figure 9 PCIe Express N5991 ValiFrame user interface main window

The test parameters must be configured before you run any test or calibration procedure. Click the **NEW** button to open the Configure DUT window.

Configure DUT Window

The Configure DUT window (Figure 10) allows you to select the DUT parameters, such as DUT Type, Specification Version, Compliance Mode or Expert Mode, and also the test parameters that are related to the receiver test configuration. These parameters will be used later in several calibrations and test procedures.

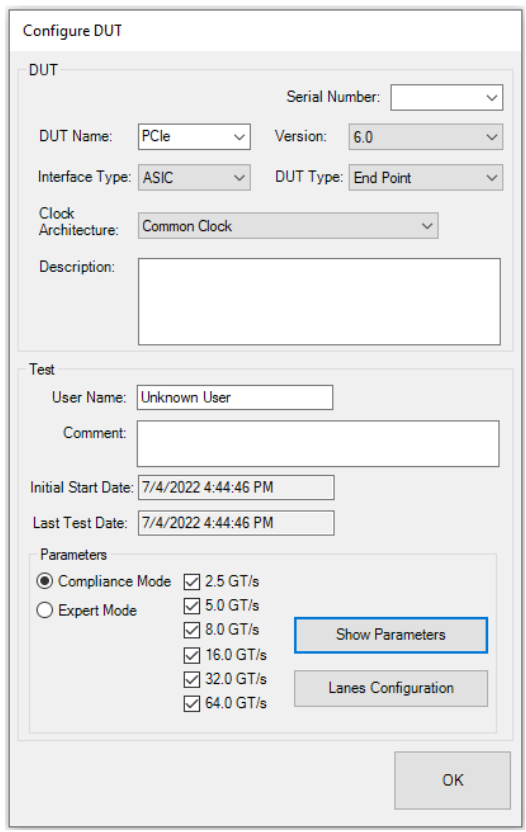


Figure 10 Configure DUT panel

Configuration Parameters

The names and descriptions of parameters that appear in the Configure DUT window are given here. The parameters in the upper part of the Configure DUT dialog box are related to the DUT, while those in the lower part are related to the test(s) to be carried out.

DUT Name

The name of the DUT. This is used to identify the product.

Serial Number

Serial Number of the DUT. This is used to identify the product.

Version

The available PCI Express® Base Specification Revisions (Versions) are:

- 4.0 – supports the 2.5, 5, 8 and 16 GT/s data rates.
- 5.0 – supports the 2.5, 5, 8, 16 and 32 GT/s data rates.
- 6.0 – supports the 2.5, 5, 8, 16, 32 and 64 GT/s data rates.

Interface Type

The supported interface types are:

- ASIC
- CEM (only Versions 4.0 and 5.0)
- U.2 (only Version 4.0; only at 8 GT/s)
- M.2 (only Version 4.0; only at 8 GT/s)

DUT Type

The available DUT types are:

- For Interface Type ‘ASIC’:
  - **End Point**: A PCIe end point (non-root-complex) silicon is tested according to the Base specification
  - **Root Complex**: A PCIe root complex silicon is tested according to the Base specification
- For Interface Type ‘CEM’:
  - **Add-In Card**: An add-in card with CEM connector is tested according to the PHY test specification
  - **System**: A system with CEM connector is tested according to the PHY test specification

- For Interface Type ‘U.2’ or ‘M.2’:
  - **Host**: A motherboard (for example) with U.2 or M.2 connector is tested according to the PHY test specification
  - **Device**: A drive (for example) with U.2 or M.2 connector is tested according to the PHY test specification

Clock Architecture

The available options are:

- **Common Clock**: The default clock architecture, where all parts of the system use the same clock
- **Separate Ref Clocks Independent SSC**: Separate reference clocks with independent spread spectrum clocking (SRIS)

Description

A text field for product description.

User Name

Enter your name in the text field.

Comment

Text field for your comments.

Initial Start Date

Time stamp of the start of the current session.

Last Test Date

Time stamp of the last test conducted in the current session.

Compliance Mode

If Compliance Mode is selected, the tests are conducted as mandated by the CTS. You cannot modify the parameters that are shown in the calibrations and test procedures.

Expert Mode

If Expert Mode is selected, the calibrations and tests can be conducted beyond the limits and constraints of the CTS and to identify the limits of the DUT. You can modify the parameters that are shown in the calibrations and test procedures. Some procedures (“Custom Procedures”) are available only in Expert Mode.

Data Rates

The available data rates depend on the specification version and the interface type selected. This is detailed in Table 1. Note that the M8020A and the M8050A do not (currently) support all data rates. M8050A supports only Spec Version 5.0 and above.

Table 1 Data rates supported by the ValiFrame software for the various interface types and spec versions

Interface Type	Spec Version 4.0*	Spec Version 5.0	Spec Version 6.0
ASIC	2.5, 5, 8 and 16 GT/s	2.5**, 5**, 8, 16 and 32 GT/s***	2.5**, 5**, 8, 16, 32*** and 64 GT/s***
CEM	2.5, 5, 8 and 16 GT/s	2.5**, 5**, 8, 16 and 32 GT/s***	–
U.2	8 GT/s	–	–
M.2	8 GT/s	–	–

* M8050A does not support Spec Version 4.0.
** Support of tests at 2.5 GT/s and 5 GT/s by the M8050A is planned for later releases.
*** M8020A does not support tests at 32 GT/s or 64 GT/s.

Show Parameters

Click the Show Parameters button to open the PCIe Parameters dialog box. See PCIe Parameters on page 29.

Lanes Configuration

Click the Lanes Configuration button to open the Lanes dialog box. See Lanes Configuration on page 39.

PCIe Parameters

In the Configure DUT window, click the **Show Parameters** button. If the DUT Type was selected as **End Point**, the “PCIe End Point Parameters” dialog box is displayed, as shown in Figure 11.

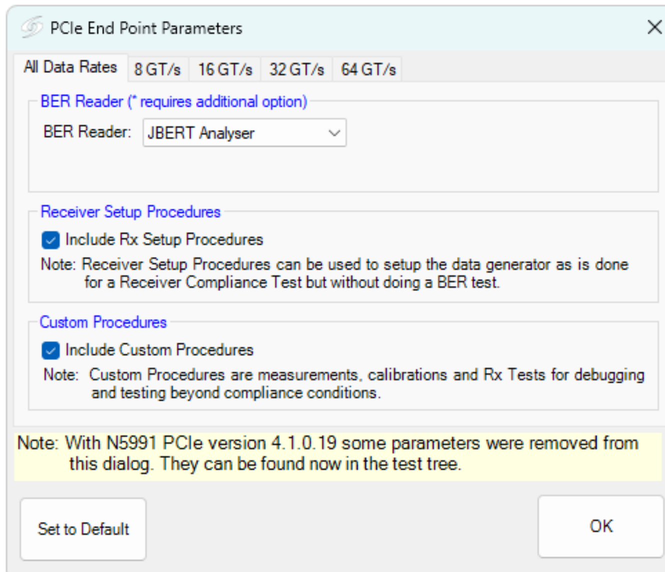


Figure 11 PCIe End Point Parameters configuration window

The selected speed class determines which individual tabs are displayed. The parameters displayed under the “All Data Rates” tab are described first.

BER Reader

BER Reader: The Bit-Error measurement can be done using the J-BERT Analyzer or with an Offline BER reader.

Receiver Setup Procedures

Include Rx Setup Procedures: Select this option to add the receiver setup procedures to the test tree. In these procedures, the data generator is configured for the calibrated compliance conditions, but a BER test is not performed.

Custom Procedures

Include Custom Procedures: Select this option to add to the test tree measurements, calibrations and Rx tests for debugging and testing that go beyond compliance conditions. This option is available only if Expert Mode is selected in the Parameters part of the Configure DUT panel.

2.5 GT/s and 5.0 GT/s Tabs

The 2.5 GT/s tab and 5.0 GT/s tab (Figure 12) of the PCIe Parameters dialogs are very similar and so are described together.

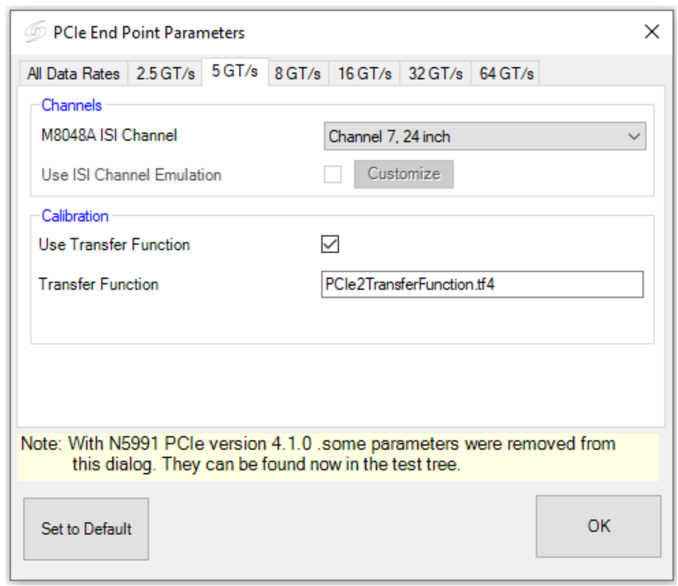


Figure 12 5 GT/s tab of the PCIe End Point Parameters dialog

Channels

- **M8048A ISI Channel**: (Not for CEM.) Select the channel to be used for testing (from Channel 0 (none) to Channel 7 (24 inches)).
- **Use ISI Channel Emulation**: (Not for M8040A or M8050A; the M8020A setup requires the M8020A J-BERT option M8041A-0G5.) Enable this option to generate ISI internally in the M8020A.
  If you click **Customize**, the “ISI Channel Customization” dialog (Figure 13) appears, where you can fine-tune the selected ISI Channel by modifying the insertion loss.

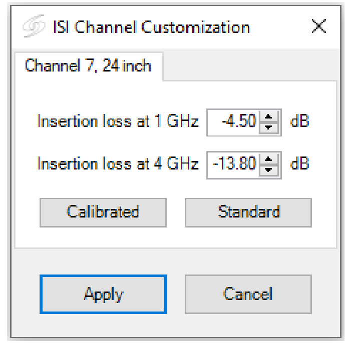


Figure 13 ISI Channel Customization dialog

If you have changed the IL settings in this dialog in the past and run a full calibration, when you restart ValiFrame again you can use the following buttons:

- **Calibrated** to reset the two IL values to the values of the previous calibration or
- **Standard** to reset the two IL values to the default values that ValiFrame used initially.

Calibration

- **Use Transfer Function**: Check this box to embed or de-embed using the transfer function.
- **Transfer Function**: (Only when "Use Transfer Function" is enabled.) Shows the name of the transfer function file for embedding. Generate the transfer function displayed in the dialog (Figure 12 on page 30) and then copy it to C:\ProgramData\BitifEye\ValiFrameK1\PCIe\Settings\TransferFunctions on the PC where ValiFrame is running.

8.0 GT/s Tab

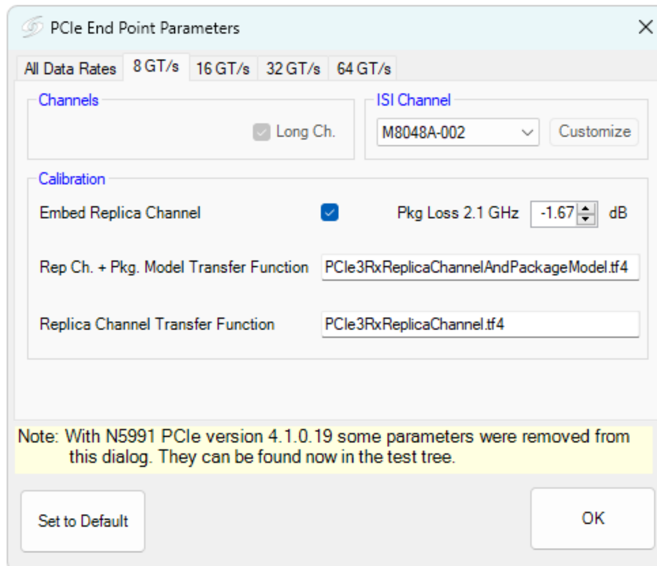


Figure 14 8 GT/s tab of the PCIe End Point Parameters dialog

Channels

- **Long Ch.**: (For ASIC) Long Channel is preselected.
- **CBB rev. 2**: (For CEM) Check this to perform Rx tests with CBB rev. 2, in addition to CBB rev. 3. See Figure 15 on page 33. Disabled for U.2 and M.2.
- **CBB rev. 3 riser card**: (For CEM, U.2 and M.2) The Rx tests must be performed with CBB Gen3; therefore, the CBB rev. 3 riser card check box is preselected and read-only.

ISI Channel (Only ASIC)

- Supported options are
  - M8041A-0G5 (only M8020A)
  - M8048A-002
  - N4915A-014
- **Customize**: (Only for the ISI Channel M8041A-0G5.) Click to open the “ISI Channel Customization” dialog (Figure 13 on page 31), where you can fine-tune the selected ISI Channel by modifying the insertion loss.

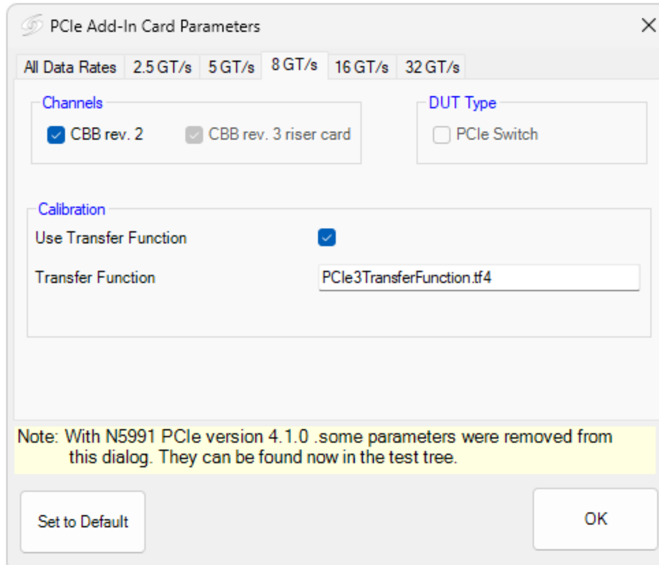


Figure 15 8 GT/s tab of the PCIe Add-In Card Parameters dialog

DUT Type (Only CEM)

- **PCIe Switch**: For Systems, select this if the DUT is a PCIe switch.

Calibration

- **Embed Replica Channel**: (ASIC) Select this option to use a transfer function to embed a replica channel.
- **Pkg Loss 2.1 GHz**: (ASIC) Select the package loss at 2.1 GHz.
- **Package Model Transfer Function**: (ASIC, if “Embed Replica Channel” is not enabled.) The transfer function file for the package model.
- **Rep Ch. + Pkg. Model Transfer Function**: (ASIC, when “Embed Replica Channel” is enabled.) The transfer function file that combines the replica channel and the package model.
- **Replica Channel Transfer Function**: (ASIC, when “Embed Replica Channel” is enabled.) The transfer function file for the replica channel.
- **Use Transfer Function**: (CEM, U.2, M.2) Use this check box to embed or de-embed calibration boards or additional cables using the transfer function on the oscilloscope.
- **Transfer Function**: (CEM, U.2, M.2; when “Use Transfer Function” is enabled.) Shows the path of the transfer function file for the package model.

Transfer Functions

For the 8 GT/s data rate, there are the following transfer functions:

- Package Model Transfer Function – ASIC; Embed Replica Channel is **not** checked
- Replica Channel and Package Model Transfer Function – ASIC; Embed Replica Channel is checked
- Replica Channel Transfer Function – ASIC; Embed Replica Channel is checked
- Transfer Function – CEM, U.2, M.2; Use Transfer Function is checked

In each case the transfer function has to be generated (apart from the Package Model Transfer Function) and then copied to C:\ProgramData\BitifEye\ValiFrameK1\PCIe\Settings\TransferFunctions on the PC where ValiFrame is running.

If you change the name of the Package Model Transfer Function, this must also be copied to C:\ProgramData\BitifEye\ValiFrameK1\PCIe\Settings\TransferFunctions, otherwise it will not be found.

16 GT/s, 32 GT/s and 64 GT/s Tabs

The 16 GT/s tab (Figure 16), 32 GT/s tab and 64 GT/s tab of the PCIe Parameters dialog are very similar and so are described together.

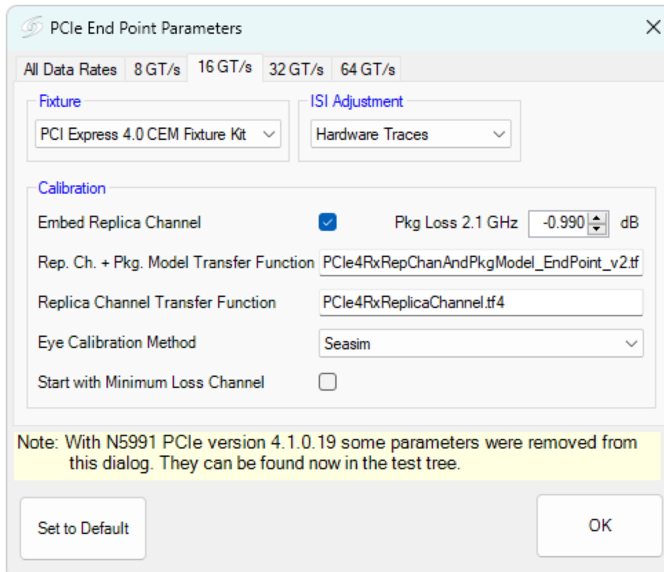


Figure 16 16 GT/s tab of the PCIe End Point Parameters dialog

Fixture (not 64 GT/s)

- Select the fixture. The options are
  - PCI Express 4.0 CEM Fixture Kit
    (ASIC 16 GT/s, Spec Versions 4.0, 5.0, 6.0;
    CEM 16 GT/s, Spec Versions 4.0, 5.0)
  - Generic
    (ASIC 16 GT/s, Spec Versions 4.0, 5.0, 6.0)
  - BIT CEM Connector + M8048A
    (ASIC 16 GT/s, Spec Versions 4.0, 5.0, 6.0)
  - PCIe 5.0 FR4 Base Fixture
    (ASIC 32 GT/s, Spec Version 5.0, 6.0)
  - PCIe 5.0 MEG6 Base Fixture
    (ASIC 32 GT/s, Spec Version 5.0, 6.0)

- PCIe 5.0 CEM Fixture Kit
  (ASIC 32 GT/s, Spec Version 5.0, 6.0;
  CEM 32 GT/s, Spec Version 5.0)

ISI Adjustment (only 16 GT/s)

- The supported options are
  - **Hardware Traces**: Select this to use just the hardware traces to generate the ISI.
  - **Emulated ISI**: (Only M8020A and ASIC) Select this option to combine the internal ISI generated by the M8020A with the selected hardware traces to adjust the insertion loss. Note that the M8020A J-BERT option M8041A-0G5 is required to perform this operation.

NOTE For CEM tests, the CTS allows only the official PCI-SIG fixture sets. Therefore, in this case, the “PCI Express 4.0 CEM Fixture Kit” or the “PCIe 5.0 CEM Fixture Kit” and the ISI Adjustment with “Hardware Traces” are the only available options.

Calibration

- **Embed Replica Channel**: (ASIC) Select this option to use a transfer function to embed a replica channel.
- **Embed Additional Channel**: (CEM) Select this option to use a transfer function to embed an additional channel.
- **Pkg Loss 2.1 GHz**: (ASIC) Select the package loss at 2.1 GHz.
- **Package Model Transfer Function**: (When “Embed Replica Channel” (ASIC) or “Embed Additional Channel” (CEM) is not enabled.) The name of the transfer function file for the package model.
- **Rep. Ch. + Pkg. Model Transfer Function**: (ASIC, when “Embed Replica Channel” is enabled.) The name of the transfer function file that combines the replica channel and the package model.
- **Add. Ch. + Pkg Model Transfer Function**: (CEM, when “Embed Additional Channel” is enabled.) The name of the transfer function file that combines the additional channel and the package model.
- **Replica Channel Transfer Function**: (ASIC, when “Embed Replica Channel” is enabled.) The name of the transfer function file for the replica channel.
- **Additional Channel Transfer Function**: (CEM, when “Embed Additional Channel” is enabled.) The name of the transfer function file for the additional channel.

- **Eye Calibration Method**: Select the tool to be used for the stressed eye calibration. Available options are:
  - *Seasim*: (Only ASIC) This is a processing tool that uses the standard method. A step pattern with 256 ones and zeros is applied at the input of the calibration channel and the step response is captured at the output of the replica channel. The oscilloscope averages the step response, which minimizes the noise. The step response defines the complete electrical behavior of the channel and calculates a statistical eye. Seasim also simulates the different impairments.
  - *SigTest*: This uses the compliance channel methodology. A compliance pattern is applied and different impairments, such as random jitter, sinusoidal jitter and differential and common mode sinusoidal interference, are added to the signal.
- **Start with Minimum Loss Channel**: (Only 16 GT/s)
  - Not enabled: The Initial Equalization Preset Optimization Calibration will start with the maximum specification loss (–30 dB for 16 GT/s). Then the Channel Calibration reduces channel loss in 0.5 dB steps until Eye Height and Eye Width exceed the specification value (and the ratio is similar to the nominal value) or until the channel loss reaches the minimum specification loss (–27 dB for 16 GT/s).
  - Enabled: The Initial Equalization Preset Optimization Calibration will start with the minimum specification loss. Then the Channel Calibration increases channel loss in –0.5 dB steps until Eye Height and Eye Width are slightly below the specification value (and the ratio is close to the ratio of the nominal eye) or until the channel loss reaches the maximum specification loss.

  The remaining calibration procedures will use that channel.

Transfer Functions

For the 16 GT/s, 32 GT/s and 64 GT/s data rates, there are the following transfer functions:

- Package Model Transfer Function – ASIC, CEM; Embed Replica/ Additional Channel is **not** checked
- Replica Channel and Package Model Transfer Function – ASIC; Embed Replica Channel is checked
- Replica Channel Transfer Function – ASIC; Embed Replica Channel is checked
- Additional Channel and Package Model Transfer Function – CEM; Embed Additional Channel is checked
- Additional Channel Transfer Function – CEM; Embed Additional Channel is checked

In each case the transfer function has to be generated (apart from the Package Model Transfer Function) and then copied to C:\ProgramData\BitifEye\ValiFrameK1\PCIe\Settings\TransferFunctions on the PC where ValiFrame is running.

If you change the name of the Package Model Transfer Function, this must also be copied to C:\ProgramData\BitifEye\ValiFrameK1\PCIe\Settings\TransferFunctions, otherwise it will not be found.

Lanes Configuration

If you do not check the ‘Map DUT lanes to test instrument channels’ box in the Station Configurator, the Lanes window appears as shown in Figure 17 when you click the ‘Lanes Configuration’ button in the Configure DUT Panel.

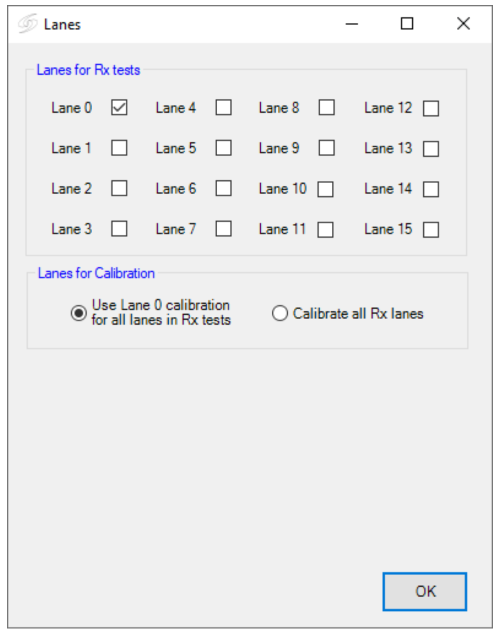


Figure 17 Lanes configuration panel

- **Lanes for Rx tests:** Select the corresponding check box for one or more lanes where testing is to be performed. The selection of one or more lanes depends on the following conditions in the “Station Configuration” stage of the ValiFrame Station Configurator:
  - If the ‘Use Switch for Rx tests’ check box is left unchecked, you can select all lanes for testing. While the tests are being performed, you will be prompted to manually switch cables from lane to lane. This is the only option available for 64 GT/s.
  - If ‘Use Switch for Rx tests’ is enabled (available only up to 32 GT/s), the number of lanes to be tested depends on the module type selected. Module types BIT21T14B, BIT21T16B and BIT21T18B allow testing of up to 4, 6 and 8 lanes, respectively.

- **Lanes for Calibration:** Choose one of the following options:
  - ***Use Lane 0 calibration for all lanes in Rx tests***: Only Lane 0 will be calibrated. These values will be used in the Rx tests for all lanes.
  - ***Calibrate all Rx lanes***: (Not available if 'Use Switch for Rx tests' is enabled.) Calibrations will be performed for each Rx lane selected. Each Rx test uses the corresponding calibration for each specific lane to be tested.

If the 'Map DUT lanes to test instrument channels' check box is selected in the "Station Configuration" stage of the ValiFrame Station Configurator, the Lanes dialog appears as shown in Figure 18. You may select all lanes and each tested lane can be mapped to one of the available generator and analyzer channels. Mapping of different lanes to various instruments can help you avoid cable re-connections.

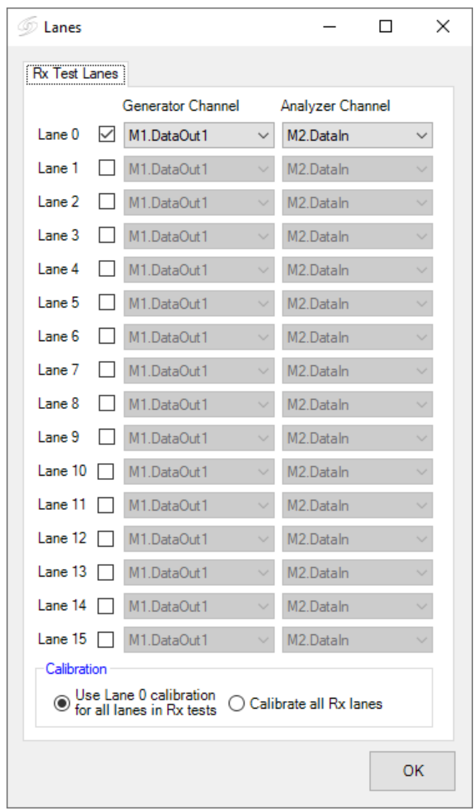


Figure 18 Lanes configuration panel when 'Map DUT lanes to test instrument channels' is selected

3 Using the Software

This chapter describes how to select the calibrations and test procedures that are to be run and how you can modify the parameters if required – in expert mode – to go beyond the tests specified by the CTS.

Introduction

Once the DUT has been configured, click **OK** in the Configure DUT Panel. All calibration and test procedures are included in the respective groups in a manner similar to how they are organized in the CTS document.

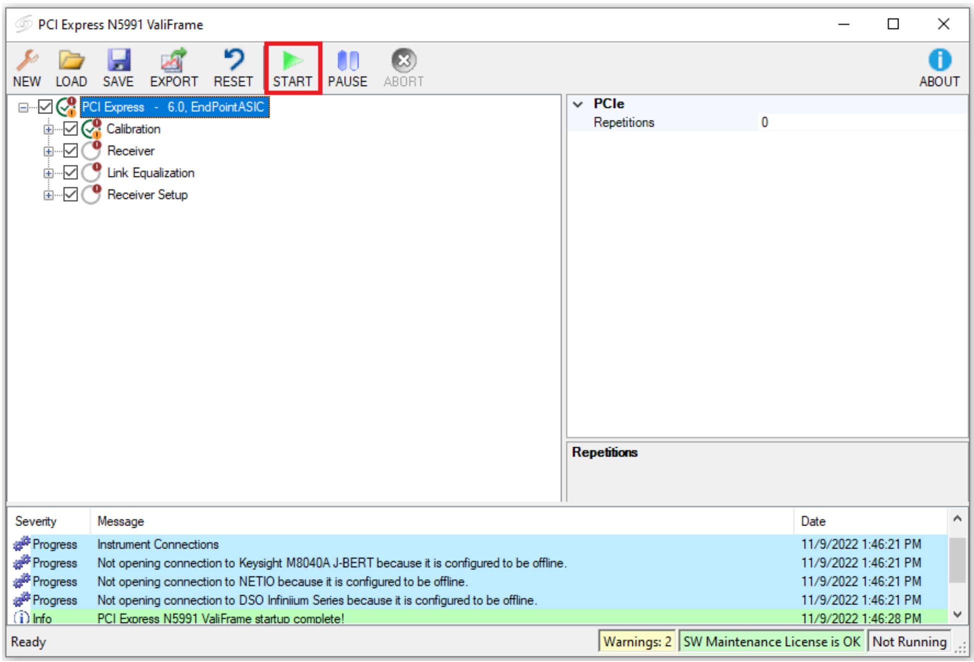


Figure 19 PCI Express N5991 ValiFrame main window with green Start button

The **parameter grid** on the right side of the window shows the parameters that are related to the individual procedure or group of procedures selected on the left.

The **log list** in the bottom pane of the window shows calibration and test status messages (regular progress updates as well as warnings and error messages).

The **status bar** at the very bottom provides information about how many critical errors have occurred, how many warnings have been sent, the status of the software maintenance license and whether ValiFrame is running.

To start one or more procedures, select the corresponding check box(es). Then the Start button is enabled and turns green (outlined in red in Figure 19). Click **Start** to run the selected procedures.

Once all the procedures have been run, the N5991 configuration can be stored as a single *'.vfp'* file using the Save button and recalled using the Load button without the need to configure the DUT again.

CAUTION

Before executing the calibration or test procedures, ensure that the PCIe Station is configured properly with all necessary instruments such as the Infiniium oscilloscope set to “online”. All calibrations can be run in offline mode, that is, without any instrument connected. The offline mode is intended for product demonstrations with simulated data. CALIBRATIONS RUN IN OFFLINE MODE DO NOT GENERATE VALID CALIBRATION DATA.

NOTE

If you have already performed calibrations and tests, when you update ValiFrame and open it, you may see several log messages saying that the measurements are not compliant. This is because ValiFrame now records the exact setup and software version used for the calibrations and, even if your setup has not changed, the information required by ValiFrame to categorize the results as compliant is not available. Compliance information is also available in the result report of each procedure.

Selecting, Modifying & Running Procedures

Selecting Procedures

The calibration, receiver, and transmitter test procedure groups can be selected globally by selecting the check box at the top of the group. Alternatively, an individual test procedure can be selected by checking the corresponding check box. Click **Start** to run the selected test procedures.

Modifying Parameters

Most calibration and test procedures, as well as the groups containing them, have parameters that control the details of how the procedures are run. In compliance mode, most of these parameters are read-only. In expert mode, almost all the parameters can be modified. First, select a specific calibration or test procedure or one of the groups contained in the N5991 procedure tree, as shown in Figure 20. The parameters are displayed in a property list (parameter grid) on the right side of the window. These parameters can be configured only before the selected procedure subgroup or procedure is started. All of the selected test parameters are listed in the test results.

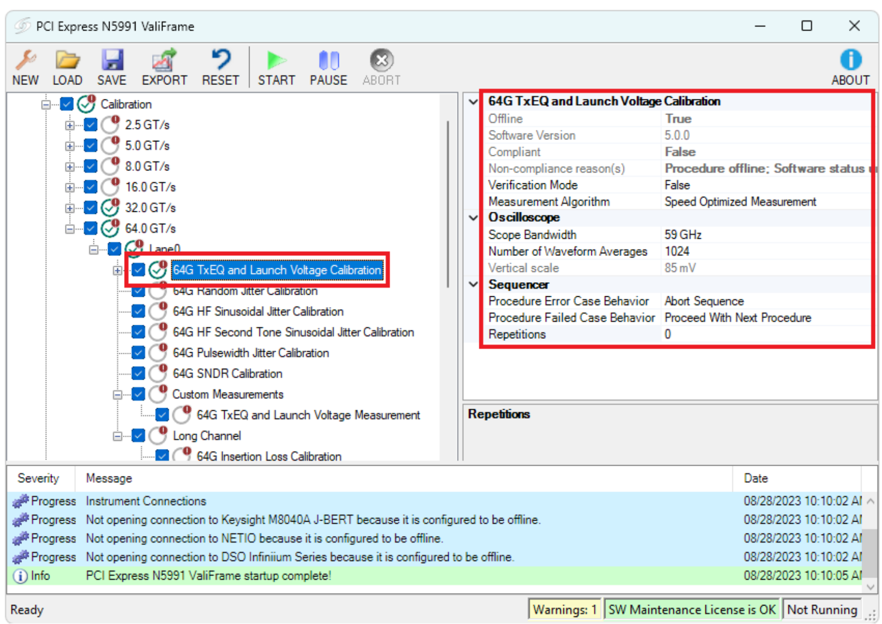


Figure 20 Modifying parameters in the PCI Express N5991 ValiFrame main window

Running Procedures

To run the selected procedures, click the **Start** icon on the toolbar (see Figure 19). The procedures are run sequentially in the order shown in the procedure selection tree. Some procedures may require user intervention, such as changing cable connections or entering DUT parameters. The required action is prompted in pop-up dialog boxes before the calibration/test procedures are run.

Connection Diagrams

To view a particular connection diagram, right-click the desired test or calibration. From the context menu, select “Show Connection...”.

The window that opens consists of a connection diagram surrounded by five buttons, which are outlined in red and numbered in Figure 21.

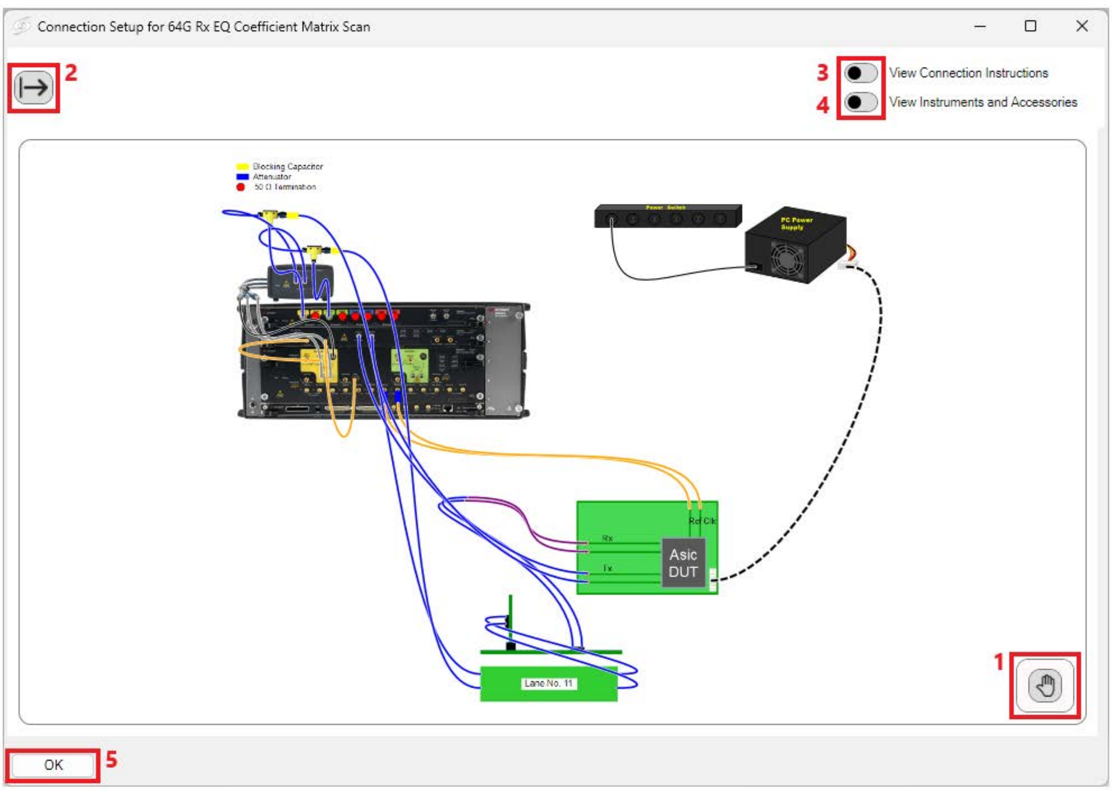


Figure 21 Example connection diagram, default view

1 **Export Mode**: Click here to change the positions of the individual instruments and cables in the connection diagram before exporting it. This is intended to increase the clarity of the connections. For more details about how to manipulate the components, see the N5991Getting Started Guide, which can be downloaded from the BitifEye.com website. Try double-clicking a component and then either drag-and-dropping it or using the mouse wheel.

2 **Export**: Export the diagram as an HTML file.

3 **Connection Instructions**: Toggle to 'on' to view the connection instructions and further information. It is possible to open step-by-step instructions, where the connection currently being made is highlighted.

4 **Instruments and Accessories**: Toggle to 'on' to view the list of required instruments and accessories. A very brief description of how to connect the setup will be displayed as well. If the list of instruments and accessories is expanded, it will be included in the exported HTML report.

5 **OK**: Click here to close the connection diagram window.

Required Calibration Data

Some of the calibration procedures and most of the test procedures require calibration data that has been measured previously. You can see the calibration data required by a particular procedure by right clicking its name in the procedure tree and selecting 'Required Calibrations'. A list of the prerequisite calibrations drops down (Figure 22).

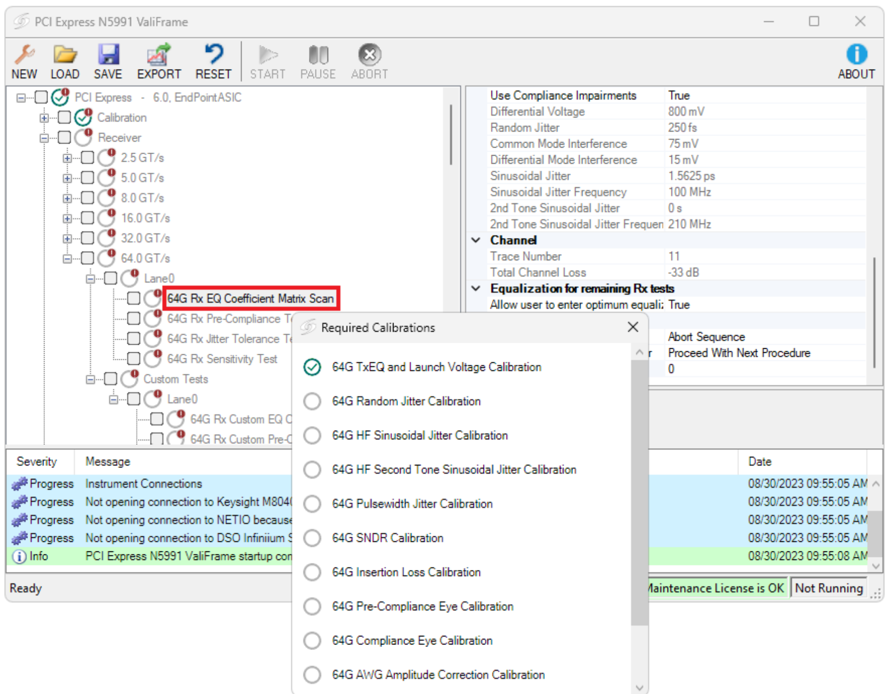


Figure 22 Example list of required calibrations

The icon next to the name of a calibration procedure in the list indicates whether the calibration has been run successfully (green), is incomplete (yellow), failed (red) or has not yet been run (gray).

Results

Runtime Data Display

Most procedures generate data output. While the procedure is running, the data is displayed in a results window, which opens automatically for each individual procedure.

Any results windows that are open during the procedure runs are closed automatically once the specific procedure is finished. As long as the N5991 Software is running, each result file can be reopened by double-clicking the respective procedure. However, the individual files are lost when the N5991 main window is closed, unless you save the individual files or a collection of them.

Description of Results

In this User Guide, the descriptions of the calibration and test procedures include example descriptions of the results. In addition to a graph and a table, there is a text in each set of results, which notes the conditions under which the procedure was carried out, including a list of instruments used and their associated firmware. In order to save space, the list of instruments is not shown for each procedure in this user guide, because they are very similar, but simply as two examples here (Figure 23, Figure 24).

----Instruments----	
Calibrated Instrument 1	Name: Keysight M8050A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8050A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8050 with integrated jitter sources for BER tests ; Calibrated Instrument
Calibrated Instrument 2	Name: ClkGen ; Company: Keysight Technologies ; Model: M8009A ; SN: MY62400068 ; FW rev.: 1.5.230.4 ; Description: M8050 with integrated jitter sources for BER tests ; Calibrated Instrument
Calibrated Instrument 3	Name: DataOut1 ; Company: Keysight Technologies ; Model: M8042A,M8058A ; SN: 0123456789,DEXXXXXXXX ; FW rev.: 1.5.150.2, ; Description: M8050 with integrated jitter sources for BER tests ; Calibrated Instrument
Calibrated Instrument 4	Name: DataOut1 ; Company: Keysight Technologies ; Model: M8195A ; SN: DE5250000004 ; FW rev.: 4.0.0.0 ; Description: M8050 with integrated jitter sources for BER tests ; Calibrated Instrument
Calibrated Instrument 5	Name: DataOut2 ; Company: Keysight Technologies ; Model: M8195A ; SN: DE5250000004 ; FW rev.: 4.0.0.0 ; Description: M8050 with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for calibration and transmitter tests ; Measurement Instrument

Figure 23 Example “Instruments” section for a calibration

----Instruments----	
Measurement Instrument 1	Name: Keysight M8050A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8050A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8050 with integrated jitter sources for BER tests ; Measurement Instrument
Measurement Instrument 2	Name: ClkGen ; Company: Keysight Technologies ; Model: M8009A ; SN: MY62400068 ; FW rev.: 1.5.230.4 ; Description: M8050 with integrated jitter sources for BER tests ; Measurement Instrument
Measurement Instrument 3	Name: DataOut1 ; Company: Keysight Technologies ; Model: M8042A,M8058A ; SN: 0123456789,DEXXXXXXXX ; FW rev.: 1.5.150.2, ; Description: M8050 with integrated jitter sources for BER tests ; Measurement Instrument
Measurement Instrument 4	Name: DataOut1 ; Company: Keysight Technologies ; Model: M8195A ; SN: DE5250000004 ; FW rev.: 4.0.0.0 ; Description: M8050 with integrated jitter sources for BER tests ; Measurement Instrument
Measurement Instrument 5	Name: DataOut2 ; Company: Keysight Technologies ; Model: M8195A ; SN: DE5250000004 ; FW rev.: 4.0.0.0 ; Description: M8050 with integrated jitter sources for BER tests ; Measurement Instrument
Measurement Instrument 6	Name: DataIn ; Company: Keysight Technologies ; Model: M8046A ; SN: DE5250000003 ; FW rev.: 7.5.700.8 ; Description: M8050 with integrated jitter sources for BER tests ; Measurement Instrument
Measurement Instrument 7	Name: NetIo230B ; Company: Koukaam ; Model: NETIO ; SN: Unknown ; FW rev.: Unknown ; Description: Main power switch ; Measurement Instrument

Figure 24 Example “Instruments” section for an Rx test

Exporting Results

For your convenience, all individual results are summarized in an HTML document at the end of the test run. All calibration and test data worksheets can be saved in a workbook by clicking the **Export** button on the toolbar of the PCIe N5991 ValiFrame main window. Keysight recommends performing this action at least at the end of each N5991 procedure run to avoid any data loss. If the calibration and test procedures are conducted several times during the same N5991 run, the resulting worksheets are combined in a workbook. If a test procedure is conducted without prior execution of calibration procedures in the same test run, only the test results will be saved to the workbook.

NOTE

As a safety feature, all calibration and test results are saved by default to the N5991 “Tmp” directory. The sub-folder “Results/PCIe Station” contains the files of the final results measured at each calibration and test procedure. In addition to the calibration data worksheets, calibration data files are generated. These files are saved by default to the N5991 calibrations folder. If these calibrations are run again, the data file is overwritten. To save the calibration data files at each configuration, the files must be copied from the directory: *C:\ProgramData\BitifEye\N5991\PCIe\Calibrations* and saved manually in any folder before rerunning the calibrations.

ValiFrame HTML Workbook

A workbook consists of a summary of the procedures performed, details of the instruments used and the results of the individual procedures carried out. On the left you can select a test to view, whose results are then displayed on the right. Figure 25 shows an example Test Result Summary.

Figure 25 Example Test Result Summary in a ValiFrame HTML Workbook

- Test Name: The name of the procedure (test or calibration).
- Result: Whether the test was passed or failed.
- Software Version: The version of the ValiFrame software used to perform the procedure.
- Calibration Data Version: Tests, and some calibrations, rely on data obtained in calibrations. The Calibration Data Version gives the version number of the ValiFrame software used to obtain the calibration data.
- Compliant: If True, the procedure was carried out in a way that met all the requirements of the specification. If False, this was not the case.
- Non-Compliance Reason(s): Here the reasons for non-compliance are listed. There may be just one, a few or a large number. In the example in Figure 25, the procedures are never compliant because the software status is “unreleased”. Other possible reasons include
  - Procedure offline: The procedure was performed in “demonstration mode” without instruments connected.
  - Required cal not compliant: The procedure relies on calibrations, and the calibrations listed here are themselves not compliant and have to be repeated.

- Required cal unknown/unreleased: The procedure relies on calibrations, and the software version used to obtain the calibration(s) listed here is either unknown or unreleased.

PCIe Parameters

The PCIe parameters are of three types:

- Sequencer Parameters
- Common Parameters
- Procedure Parameters

Sequencer Parameters

The sequencer parameters control the flow of the test sequencer, not the behavior of individual procedures. They are identical across all versions of ValiFrame for different standards. One of them, Repetitions, is available for all procedures and groups in the procedure tree. The others are only available for procedures. Like all other parameters, the sequencer parameters are shown on the right side of the ValiFrame user interface and you may manually change them, as illustrated in Figure 26.

The sequencer parameters are described in Table 23 on page 323.

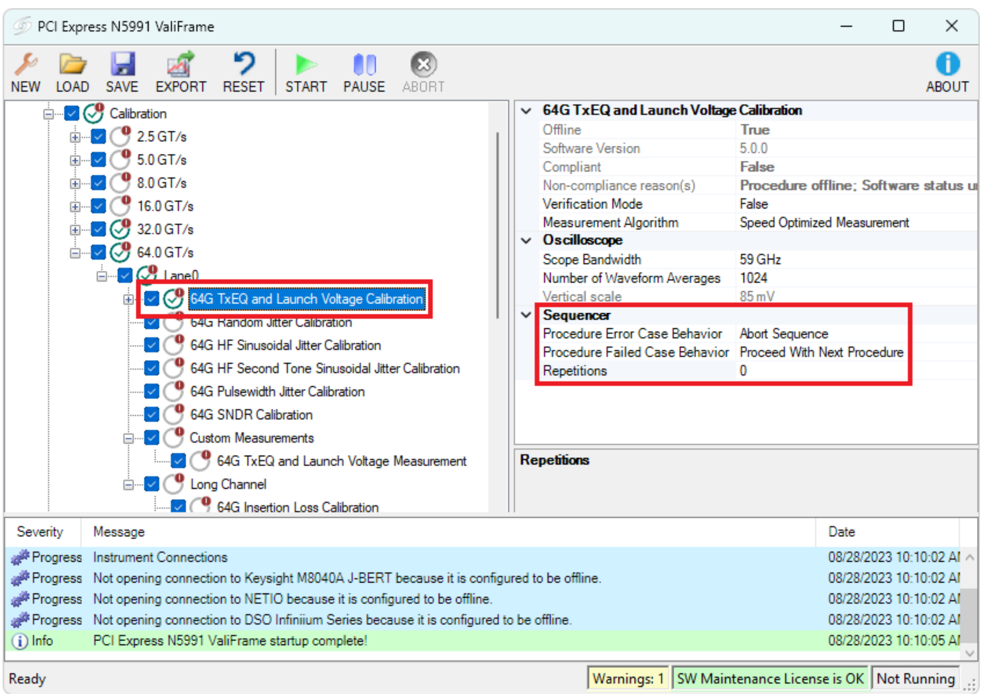


Figure 26 PCIe sequencer parameters

Common Parameters

Common parameters are used for several related calibration or test procedures. They are shown on the right side of the ValiFrame user interface when the selected entry of the procedure tree on the left is a group instead of an individual procedure. The PCIe common parameters are listed and described as follows:

- Common calibration parameters: Table 16 on page 275
- Common receiver parameters: Table 17 on page 281
- Common link equalization parameters: Table 18 on page 291

Procedure Parameters

The Procedure Parameters are all those parameters that are not part of any of the previously described categories. They are shown on the right side of the ValiFrame user interface when the selected entry of the procedure tree on the left is an individual procedure. Their purpose is to modify the behavior of that single procedure. Different procedures often have parameters with the same name, but pre-configured settings always apply to the selected procedure. The meanings of the parameters may differ slightly between procedures. The PCIe parameters for individual procedures that are available in Expert Mode are listed as follows:

- Parameters for (nearly) all individual procedures: Table 19 on page 300
- Calibration parameters for individual procedures: Table 20 on page 301
- Receiver parameters for individual procedures: Table 21 on page 309
- Link equalization parameters for individual procedures: Table 22 on page 318

NOTE Some parameters that are read-only in the user interface main window can be changed in the Station Configurator while others can be changed when you configure the DUT.

NOTE If the value of a parameter appears in boldface type in the parameter grid of the GUI, this indicates that the value is not the default value.

4 Procedure Tree Overview

This chapter provides a convenient way of finding the description of the calibration or procedure that you want to perform.

Introduction

The tables in this chapter list the procedures exactly as in the procedure tree of the ValiFrame software.

NOTE

The order of the procedures varies slightly depending on the method used for eye calibration: Seasim or SigTest. The order used in the tables is that for Seasim for interface type ASIC and SigTest for CEM, U.2 and M.2.

NOTE

Click on the page number in the table to be directed to the description of the corresponding procedure.

The list of procedures in the procedure tree is divided up into the following tables according to calibration or test type and interface type.

Calibration Procedures

Table 2 Calibrations performed for ASIC interfaces

Data Rate	Calibration	Page Number of Description
2.5 GT/s	2.5G RJ Calibration	87
	2.5G ISI Calibration	85
	2.5G CMSI Calibration	77
	2.5G Eye Height Calibration	82
5.0 GT/s	5G RJ Calibration	87
	5G ISI Calibration	85
	5G CMSI Calibration	77
	5G Eye Height Calibration	82
8.0 GT/s	**Direct-Connection Calibrations**	
	8G TxEQ and Launch Voltage Calibration	108
	8G RJ Calibration	100
	Custom Measurements*	
	8G TxEQ and Launch Voltage Measurement	118
	Long Channel	
	8G Insertion Loss Calibration	170
	8G CMSI Calibration	130
	8G DMSI Calibration	151
	8G Stressed Jitter Eye Calibration	182
16.0 GT/s	**Direct-Connection Calibrations**	
	16G TxEQ and Launch Voltage Calibration	108
	16G RJ Calibration	100
	16G HF SJ Calibration	92
	16G HF Second Tone SJ Calibration	89
	Custom Measurements*	
	16G TxEQ and Launch Voltage Measurement	118
	Long Channel	
	16G Insertion Loss Calibration	170
	16G Initial Equalization Preset Optimization	167
	16G Channel Calibration	126
	16G Final Equalization Preset Optimization	163
	16G AWG Amplitude Correction Calibration	124
	16G CMSI Calibration	130
	16G DMSI Calibration	151
	16G Pre Compliance Eye Calibration	178

Data Rate	Calibration	Page Number of Description
	16G Compliance Eye Calibration	133
	Custom Calibrations*	
	16G Custom Eye Calibration	142
	16G Custom Eye Scan Calibration	145
	Custom Measurements*	
	16G Eye Height and Width Measurement	157
	16G Eye Height and Width Scan	160
	16G Processing of Pre-Recorded Steps	181
32 GT/s	**Direct-Connection Calibrations**	
	32G TxEQ and Launch Voltage Calibration	108
	32G Random Jitter Calibration	100
	32G HF Sinusoidal Jitter Calibration	92
	32G HF Second Tone Sinusoidal Jitter Calibration	89
	Custom Measurements*	
	32G TxEQ and Launch Voltage Measurement	118
	Long Channel	
	32G Insertion Loss Calibration	170
	32G Pre Compliance Eye Calibration	178
	32G Compliance Eye Calibration	133
	32G AWG Amplitude Correction Calibration	124
	32G CM Sinusoidal Interference Calibration	130
	32G DM Sinusoidal Interference Calibration	151
	Custom Calibrations*	
	32G Custom Eye Calibration	142
	32G Custom Eye Scan Calibration	145
	Custom Measurements*	
	32G Eye Height and Width Measurement	157
	32G Eye Height and Width Scan	160
	32G Processing of Pre-Recorded Steps	181
64.0 GT/s	**Direct-Connection Calibrations**	
	64G TxEQ and Launch Voltage Calibration	108
	64G Random Jitter Calibration	100
	64G HF Sinusoidal Jitter Calibration	92
	64G HF Second Tone Sinusoidal Jitter Calibration	89
	64G Pulsewidth Jitter Calibration	98
	64G SNDR Calibration	106

Data Rate	Calibration		Page Number of Description
	Custom Measurements*		
		64G TxEQ and Launch Voltage Measurement	118
	Long Channel		
		64G Insertion Loss Calibration	170
		64G Pre-Compliance Eye Calibration	178
		64G Compliance Eye Calibration	133
		64G AWG Amplitude Correction Calibration	124
		64G CM Sinusoidal Interference Calibration	130
		64G DM Sinusoidal Interference Calibration	151
	Custom Calibrations*		
		64G Custom Eye Calibration	142
		64G Custom Eye Scan Calibration	145
	Custom Measurements*		
		64G Eye Height and Width Measurement	157
		64G Eye Height and Width Scan	160
		64G Processing of Pre-Recorded Steps	181

* Procedures listed under these headings are available only if “Include Custom Procedures” is checked in the PCIe Parameters dialog (see page 29).

Table 3 Calibrations performed for CEM interfaces

Data Rate	Calibration		Page Number of Description
2.5 GT/s		2.5G RJ Calibration	87
		2.5G De-Emphasis Calibration	80
		2.5G Eye Height Calibration	82
5.0 GT/s		5G RJ Calibration	87
		5G De-Emphasis Calibration	80
		5G Eye Height Calibration	82
8.0 GT/s	**Direct Connection Calibrations**		
		8G TxEQ and Launch Voltage Calibration	108
		8G RJ Calibration	100
		8G SJ Calibration	103
	Custom Measurements*		
		8G TxEQ and Launch Voltage Measurement	118
	Long Channel, CBB rev. 3		
		8G DMSI Calibration	151

Data Rate	Calibration	Page Number of Description
	8G Eye Height and Width Calibration	154
	8G Compliance Eye Calibration	133
16.0 GT/s	**Direct Connection Calibrations**	
	16G TxEQ and Launch Voltage Calibration	108
	16G RJ Calibration	100
	16G LF SJ Calibration	95
	16G HF SJ Calibration	92
	16G Unit Interval Calibration	122
	Custom Measurements*	
	16G TxEQ and Launch Voltage Measurement	118
	Long Channel, CBB rev. 4	
	16G Insertion Loss Calibration	170
	16G AWG Amplitude Correction Calibration	124
	16G CMSI Calibration	130
	16G DMSI Calibration	151
	16G Initial Equalization Preset Optimization	167
	16G Channel Calibration	126
	16G Final Equalization Preset Optimization	163
	16G Pre Compliance Eye Calibration	178
	16G Compliance Eye Calibration	133
	Custom Calibrations*	
	16G Custom Eye Calibration	142
	16G Custom Eye Scan Calibration	145
	Custom Measurements*	
	16G Eye Height and Width Measurement	157
	16G Eye Height and Width Scan	160
32 GT/s	**Direct Connection Calibrations**	
	32G TxEQ and Launch Voltage Calibration	108
	32G Random Jitter Calibration	100
	32G HF Sinusoidal Jitter Calibration	92
	Custom Measurements*	
	32G TxEQ and Launch Voltage Measurement	118
	Long Channel	
	32G Insertion Loss Calibration	170
	32G AWG Amplitude Correction Calibration	124
	32G CM Sinusoidal Interference Calibration	130
	32G DM Sinusoidal Interference Calibration	151

Data Rate	Calibration	Page Number of Description
	32G Pre Compliance Eye Calibration	178
	32G Compliance Eye Calibration	133
	Custom Calibrations*	
	32G Custom Eye Calibration	142
	32G Custom Eye Scan Calibration	145
	Custom Measurements*	
	32G Eye Height and Width Measurement	157
	32G Eye Height and Width Scan	160

* Procedures listed under these headings are available only if “Include Custom Procedures” is checked in the PCIe Parameters dialog (see page 29).

Table 4 Calibrations performed for U.2 interfaces

Data Rate	Calibration	Page Number of Description
8.0 GT/s	**Direct Connection Calibrations**	
	8G TxEQ and Launch Voltage Calibration	108
	8G RJ Calibration	100
	8G SJ Calibration	103
	Custom Measurement*	
	8G TxEQ and Launch Voltage Measurement	118
	Long Channel, CBB rev. 3	
	8G DMSI Calibration	151
	8G Eye Height and Width Calibration	154
	8G Compliance Eye Calibration	133

* Procedures listed under this heading are available only if “Include Custom Procedures” is checked in the PCIe Parameters dialog (see page 29).

Table 5 Calibrations performed for M.2 interfaces

Data Rate	Calibration	Page Number of Description
8.0 GT/s	**Direct Connection Calibrations**	
	8G TxEQ and Launch Voltage Calibration	108
	8G RJ Calibration	100
	8G SJ Calibration	103
	Custom Measurement*	
	8G TxEQ and Launch Voltage Measurement	118

Data Rate	Calibration	Page Number of Description
	Long Channel, CBB rev. 3	
	8G Device Insertion Loss Calibration	148
	8G DMSI Calibration	151
	8G Host Insertion Loss Calibration	166
	8G Eye Height and Width Calibration	154
	8G Compliance Eye Calibration	133

* Procedures listed under this heading are available only if “Include Custom Procedures” is checked in the PCIe Parameters dialog (see page 29).

Receiver Tests

Table 6 Receiver tests available for ASIC interfaces

Data Rate	Receiver Test	Page Number of Description
2.5 GT/s	2.5G Rx Compliance Test	196
	2.5G Rx Jitter Tolerance Test	205
	2.5G Rx Sensitivity Test	224
5.0 GT/s	5G Rx Compliance Test	196
	5G Rx Jitter Tolerance Test	205
	5G Rx Sensitivity Test	224
8.0 GT/s	8G Rx Coefficient Matrix Scan	199
	8G Rx Pre-Shoot De-Emphasis Scan	218
	8G Rx Stressed Jitter Eye Test	229
	8G Rx Jitter Tolerance Test	205
16.0 GT/s	16G Rx Coefficient Matrix Scan	199
	16G Rx Pre-Shoot De-Emphasis Scan	218
	16G Rx Stressed Jitter Eye Test	229
	16G Rx Jitter Tolerance Test	205
	16G Rx Sensitivity Test	224
	Custom Tests*	
	16G Rx Custom Coefficient Matrix Scan	204
	16G Rx Custom Pre-Shoot De-Emphasis Scan	223
	16G Rx Custom Stressed Jitter Eye Test	235
	16G Rx Custom Jitter Tolerance Test	210
	16G Rx Custom Sensitivity Test	228
32 GT/s	32G Rx EQ Coefficient Matrix Scan	199
	32G Rx Pre-Shoot De-Emphasis Scan	218
	32G Rx Pre-Compliance Test	211
	32G Rx Jitter Tolerance Test	205
	32G Rx Sensitivity Test	224
	Custom Tests*	
	32G Rx Custom EQ Coefficient Matrix Scan	204
	32G Rx Custom Pre-Shoot De-Emphasis Scan	223
	32G Rx Custom Pre-Compliance Test	214
	32G Rx Custom Jitter Tolerance Test	210
	32G Rx Custom Sensitivity Test	228
64 GT/s	64G Rx EQ Coefficient Matrix Scan	199
	64G Rx Pre-Compliance Test	211

Data Rate	Receiver Test	Page Number of Description
	64G Rx Jitter Tolerance Test	205
	64G Rx Sensitivity Test	224
	Custom Tests*	
	64G Rx Custom EQ Coefficient Matrix Scan	204
	64G Rx Custom Pre-Compliance Test	214
	64G Rx Custom Jitter Tolerance Test	210
	64G Rx Custom Sensitivity Test	228

* Procedures listed under these headings are available only if “Include Custom Procedures” is checked in the PCIe Parameters dialog (see page 29).

Table 7 Receiver tests available for CEM interfaces

Data Rate	Receiver Test	Page Number of Description
2.5 GT/s	2.5G Rx Compliance Test	196
	2.5G Rx Jitter Tolerance Test	205
	2.5G Rx Sensitivity Test	224
5.0 GT/s	5G Rx Compliance Test	196
	5G Rx Jitter Tolerance Test	205
	5G Rx Sensitivity Test	224
8.0 GT/s	8G Rx Coefficient Matrix Scan	199
	8G Rx Pre-Shoot De-Emphasis Scan	218
	8G Rx Preset Pre Compliance Test	215
	8G Rx Pre Compliance Test	211
	8G Rx Jitter Tolerance Test	205
	8G Rx Sensitivity Test	224
16.0 GT/s	16G Rx Coefficient Matrix Scan	199
	16G Rx Pre-Shoot De-Emphasis Scan	218
	16G Rx Pre Compliance Test	211
	16G Rx Jitter Tolerance Test	205
	16G Rx Sensitivity Test	224
	Custom Tests*	
	16G Rx Custom Coefficient Matrix Scan	204
	16G Rx Custom Pre-Shoot De-Emphasis Scan	223
	16G Rx Custom Pre Compliance Test	214
	16G Rx Custom Jitter Tolerance Test	210
	16G Rx Custom Sensitivity Test	228

Data Rate	Receiver Test	Page Number of Description
32 GT/s	32G Rx EQ Coefficient Matrix Scan	199
	32G Rx Pre-Shoot De-Emphasis Scan	218
	32G Rx Pre Compliance Test	211
	32G Rx Jitter Tolerance Test	205
	32G Rx Sensitivity Test	224
	Custom Tests*	
	32G Rx Custom EQ Coefficient Matrix Scan	204
	32G Rx Custom Pre-Shoot De-Emphasis Scan	223
	32G Rx Custom Pre Compliance Test	214
	32G Rx Custom Jitter Tolerance Test	210
	32G Rx Custom Sensitivity Test	228

* Procedures listed under these headings are available only if “Include Custom Procedures” is checked in the PCIe Parameters dialog (see page 29).

Table 8 Receiver tests available for U.2 and M.2 interfaces

Data Rate	Receiver Test	Page Number of Description
8 GT/s	8G Rx Coefficient Matrix Scan	199
	8G Rx Pre-Shoot De-Emphasis Scan	218
	8G Rx Preset Pre Compliance Test	215
	8G Rx Pre Compliance Test	211
	8G Rx Jitter Tolerance Test	205
	8G Rx Sensitivity Test	224

Link Equalization Tests

Table 9 Link equalization receiver tests available for ASIC interfaces

Data Rate	Link Equalization Receiver Test	Page Number of Description
8.0 GT/s	8G LEQ Rx Stressed Jitter Eye Test	250
	8G LEQ Rx Jitter Tolerance Test	246
16.0 GT/s	16G LEQ Rx Stressed Jitter Eye Test	250
	16G LEQ Rx Jitter Tolerance Test	246
	16G LEQ Rx Sensitivity Test	248
	Custom Tests*	
	16G LEQ Rx Custom Stressed Jitter Eye Test	251
	16G LEQ Rx Custom Jitter Tolerance Test	247
	16G LEQ Rx Custom Sensitivity Test	249
32 GT/s	32G LEQ Rx Compliance Test	244
	32G LEQ Rx Jitter Tolerance Test	246
	32G LEQ Rx Sensitivity Test	248
	Custom Tests*	
	32G LEQ Rx Custom Compliance Test	245
	32G LEQ Rx Custom Jitter Tolerance Test	247
	32G LEQ Rx Custom Sensitivity Test	249
64 GT/s	64G LEQ Rx Compliance Test	244
	64G LEQ Rx Jitter Tolerance Test	246
	64G LEQ Rx Sensitivity Test	248
	Custom Tests*	
	64G LEQ Rx Custom Compliance Test	245
	64G LEQ Rx Custom Jitter Tolerance Test	247
	64G LEQ Rx Custom Sensitivity Test	249

* Procedures listed under these headings are available only if “Include Custom Procedures” is checked in the PCIe Parameters dialog (see page 29).

Table 10 Link equalization receiver tests available for CEM interfaces

Data Rate	Link equalization receiver test	Page Number of Description
8.0 GT/s	8G LEQ Rx Compliance Test	244
	8G LEQ Rx Jitter Tolerance Test	246
	8G LEQ Rx Sensitivity Test	248

Data Rate	Link equalization receiver test	Page Number of Description
16.0 GT/s	16G LEQ Rx Compliance Test	244
	16G LEQ Rx Jitter Tolerance Test	246
	16G LEQ Rx Sensitivity Test	248
	Custom Tests*	
	16G LEQ Rx Custom Compliance Test	245
	16G LEQ Rx Custom Jitter Tolerance Test	247
	16G LEQ Rx Custom Sensitivity Test	249
32 GT/s	32G LEQ Rx Compliance Test	244
	32G LEQ Rx Jitter Tolerance Test	246
	32G LEQ Rx Sensitivity Test	248
	Custom Tests*	
	32G LEQ Rx Custom Compliance Test	245
	32G LEQ Rx Custom Jitter Tolerance Test	247
	32G LEQ Rx Custom Sensitivity Test	249

* Procedures listed under these headings are available only if “Include Custom Procedures” is checked in the PCIe Parameters dialog (see page 29).

Table 11 Link equalization receiver tests available for U.2 and M.2 interfaces

Data Rate	Link Equalization Receiver Test	Page Number of Description
8.0 GT/s	8G LEQ Rx Compliance Test	244
	8G LEQ Rx Jitter Tolerance Test	246
	8G LEQ Rx Sensitivity Test	248

Table 12 Link equalization transmitter tests available for ASIC, CEM, U.2 and M.2 interfaces

Data Rate	Link Equalization Transmitter Test	Page Number of Description
8.0 GT/s	8G LEQ Tx Initial Preset Compliance Test	252
	8G LEQ Tx Response Time Compliance Test	255
16.0 GT/s*	16G LEQ Tx Initial Preset Compliance Test	252
	16G LEQ Tx Response Time Compliance Test	255
32 GT/s*	32G LEQ Tx Initial Preset Compliance Test	252
	32G LEQ Tx Response Time Compliance Test	255

* These data rates are not available for U.2 or M.2 interfaces.

Receiver Setup Procedures

For details about how to enable these procedures in the procedure tree, see Chapter 8, Receiver Setup Procedures.

Table 13 Receiver setup procedures available for ASIC interfaces

Data Rate	Receiver Setup Procedure	Page Number of Description
2.5 GT/s	2.5G Rx Compliance Setup	269
5.0 GT/s	5G Rx Compliance Setup	269
8.0 GT/s	8G Rx Stressed Jitter Eye Setup	272
16.0 GT/s	16G Rx Stressed Jitter Eye Setup	272
32.0 GT/s	32G Rx Impairments Setup	270
64.0 GT/s	64G Rx Impairments Setup	270

Table 14 Receiver setup procedures available for CEM interfaces

Data Rate	Receiver Setup Procedure	Page Number of Description
2.5 GT/s	2.5G Rx Compliance Setup	269
5.0 GT/s	5G Rx Compliance Setup	269
8.0 GT/s	8G Rx Pre Compliance Setup	271
16.0 GT/s	16G Rx Pre Compliance Setup	271
32.0 GT/s	32G Rx Impairments Setup	270

Table 15 Receiver setup procedure available for U.2 and M.2 interfaces

Data Rate	Receiver Setup Procedure	Page Number of Description
8.0 GT/s	8G Rx Pre Compliance Setup	271

Keysight N5991 PCIe Test Automation Software Platform

User Guide

5 Calibrations

Before any receiver test procedure can be run, the PCIe receiver test system has to be calibrated.

KEYSIGHT TECHNOLOGIES

Overview

The ValiFrame calibration plane is given by the DUT input ports. The receiver test signal characteristics such as the PCIe signal generator output voltage level and jitter parameters are typically affected by the signal transmission between the generator output ports and the DUT input ports. Thus, for any signal output parameter that you select (set value), the jitter and the signal received at the DUT input ports (actual value) deviate from the set value. Additional deviations can be caused by effects such as offset errors, hysteresis, and nonlinear behavior of the signal generator. The ValiFrame calibration procedures compensate for the deviations of the relevant signal output parameter actual values from the set values over the required parameter range.

All calibration procedures required for PCIe receiver testing are included in the ValiFrame software. The ValiFrame calibration procedures are implemented such that the calibration process is automated as much as possible and is conducted as fast as possible, for example, by minimizing the number of re-configurations of the hardware connections.

PCIe Common Calibration Parameters

The PCIe Common Parameters are listed in the parameter grid (right pane) of the main window of the user interface when you click the corresponding group in the procedure tree in the left half of the main window. Clicking a data rate in the procedure tree shows you the data-rate-specific PCIe common parameters for that data rate. Similarly, clicking a lane shows you the corresponding lane-specific common parameters and clicking a channel shows you the corresponding channel-specific common parameters.

Details of PCIe Common Calibration Parameters can be found in Table 16 on page 275.

Parameters in Expert Mode for Individual Calibrations

The PCIe parameters in expert mode for an individual procedure are not listed in this user guide explicitly. They are displayed in the parameter grid (right half) of the main window of the user interface when you click on the corresponding entry in the procedure tree in the left half of the main window.

Details of PCIe Calibration Parameters for individual procedures can be found in Table 20 on page 301.

Connection Diagrams

In this User Guide, only example connection diagrams are given in a separate section near the beginning of each chapter, for example for calibrations. The exact connection diagram for a specific situation can be viewed by right-clicking the appropriate procedure in the procedure tree of the main window of the user interface and selecting “Show Connection...”.

NOTE **A UXR oscilloscope with 512 GSa/s sample rate is required in order to execute calibrations at 64 GT/s.**

Order of the Calibration Descriptions

The calibration descriptions are arranged alphabetically under the headings

- Descriptions of Calibrations at 2.5 GT/s and 5.0 GT/s
- Descriptions of Direct-Connection Calibrations
- Descriptions of Long-Channel Calibrations

The descriptions of calibrations at 2.5 GT/s and 5.0 GT/s are in a separate section because the distinction between Direct Connection and Long Channel had not been introduced when these calibrations were defined.

To find a procedure description easily, go to Chapter 4, Procedure Tree Overview on page 55, where the procedures are listed in tables in the order they appear in the procedure tree in the application. Each procedure has a link to its description.

Prerequisite Calibrations

Prerequisite calibrations are no longer listed in the description of each procedure in this User Guide. Instead, they are displayed in the application itself. Right-click the appropriate procedure in the procedure tree of the main window of the user interface and select “Required Calibration Data...”. See Required Calibration Data on page 47 for details.

Example Connection Diagrams

In each case, for more details, right-click the appropriate procedure in the procedure tree of the user interface and select “Show Connection...”.

Calibrations at 2.5 GT/s and 5.0 GT/s

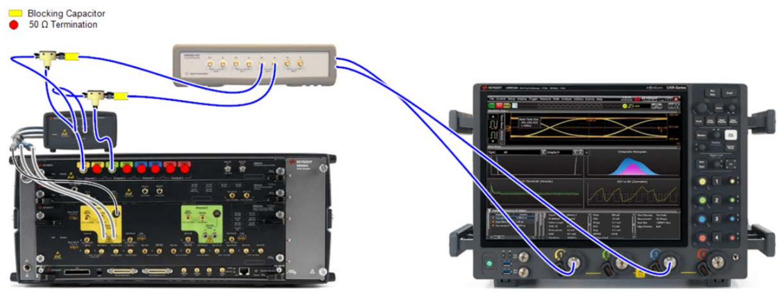


Figure 27 Example connection diagram for ASIC calibrations at 2.5 GT/s and 5.0 GT/s (M8040A)

Figure 28 Example connection diagram for CEM calibrations at 2.5 GT/s and 5.0 GT/s (M8020A)

Direct-Connection Calibrations

Figure 29 Example connection diagram for ASIC and CEM direct-connection calibrations, 8.0 GT/s and above (TP1, no TTC, 4-channel UXR, M8040A)

Figure 30 Example connection diagram for ASIC and CEM direct-connection calibrations, 8.0 GT/s and above (TP1, 4-channel UXR, M8050A)

Long-Channel Calibrations

In each case, for more details, right-click the appropriate procedure in the procedure tree of the user interface and select “Show Connection...”.

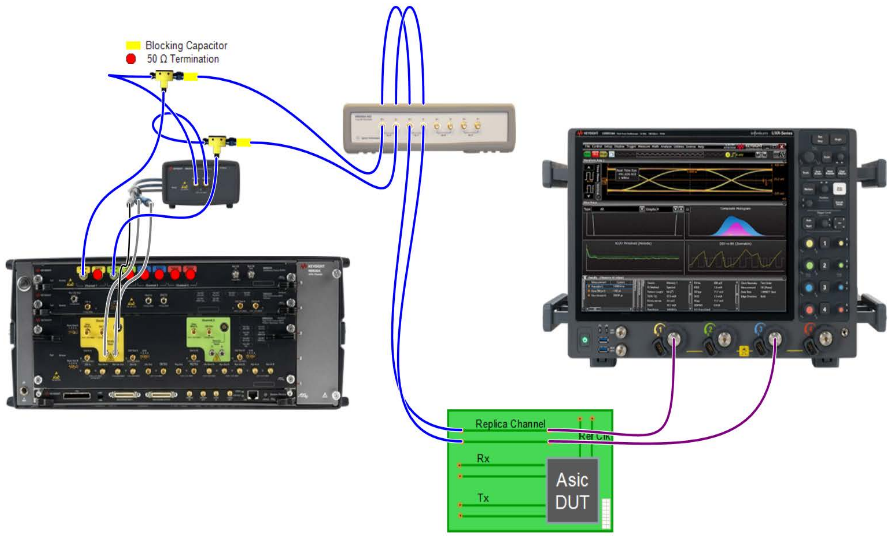


Figure 31 Example connection diagram for ASIC long-channel calibrations (M8040A, 8 GT/s)

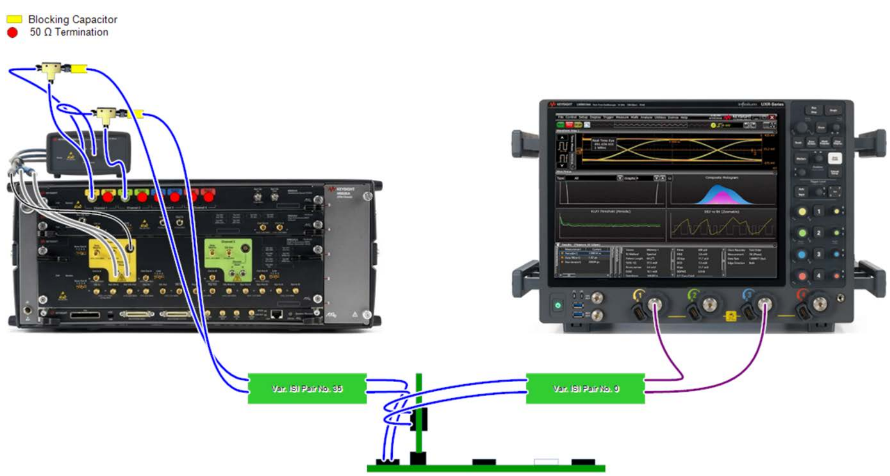


Figure 32 Example connection diagram for CEM long-channel calibrations (M8040A)

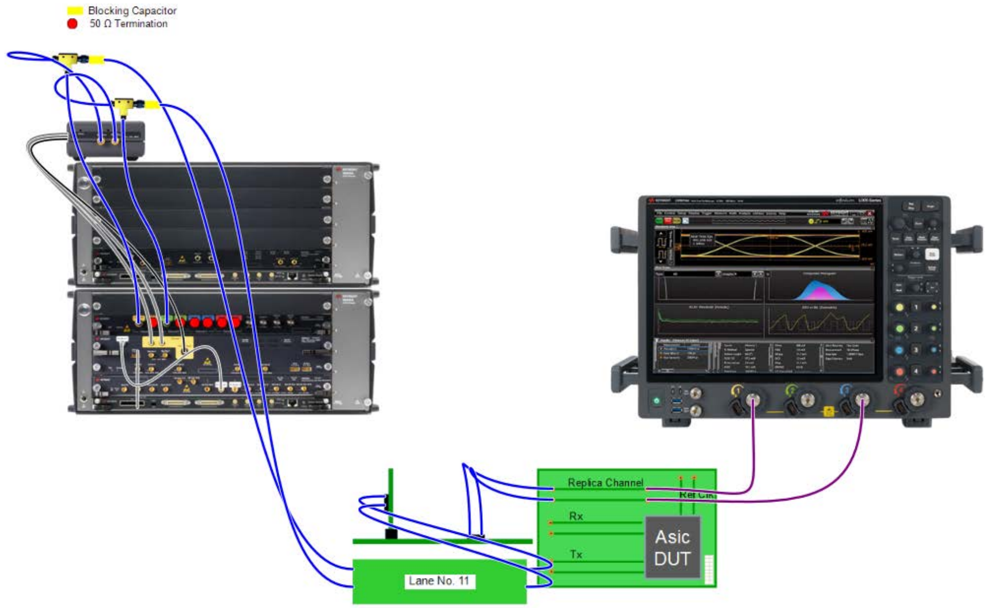


Figure 33 Example connection diagram for ASIC long-channel calibrations (M8050A, 64 GT/s)

Most long-channel calibrations (data rates 8 GT/s and above) are performed on the highest-loss channel. The hardware trace is set to the corresponding number based on the Insertion Loss Calibration. However, for 32 GT/s and 64 GT/s, during the Compliance Eye Calibration the channel (hardware trace) may have to be changed and the channel that is finally used in this calibration should be used for all subsequent calibrations.

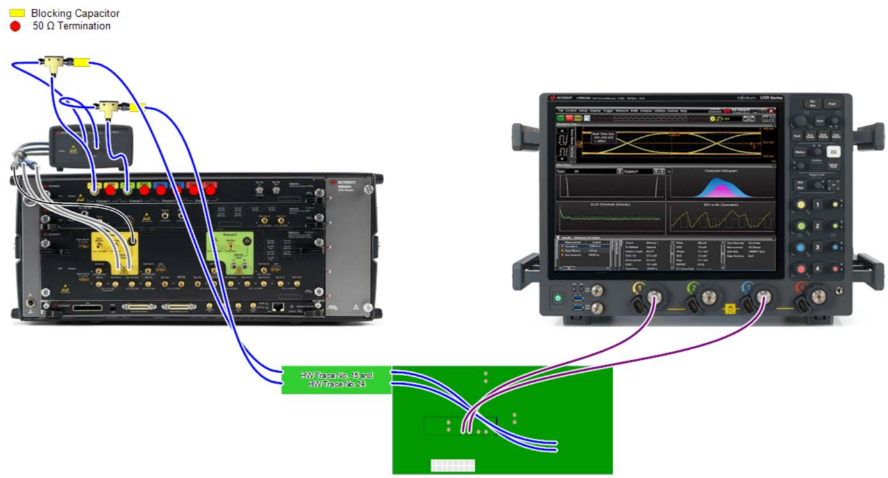


Figure 34 Example connection diagram for M.2 long-channel calibrations (M8040A)

Descriptions of Calibrations at 2.5 GT/s and 5.0 GT/s

CMSI Calibration

Availability

Data Generator:	M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point, Root Complex
Modes:	Compliance, Expert
Data Rates:	2.5 GT/s, 5.0 GT/s

Purpose and Method

The Common Mode Sinusoidal Interference (CMSI) that is generated by the generator setup is attenuated before it reaches the receiver, and therefore the CMSI amplitude at the Rx input must be calibrated.

The test automation starts with a small CMSI amplitude and increases that value in several steps over a defined range. The minimum amplitude is 0 mV and the maximum amplitude is the maximum value that the data generator can generate. For each step, the procedure measures the actual CMSI with a real-time oscilloscope.

The calibration data is stored in a cal-data table. When measurements are performed, these calibration tables are used to adjust the voltage amplitude to the desired output CMSI.

Connection Diagram

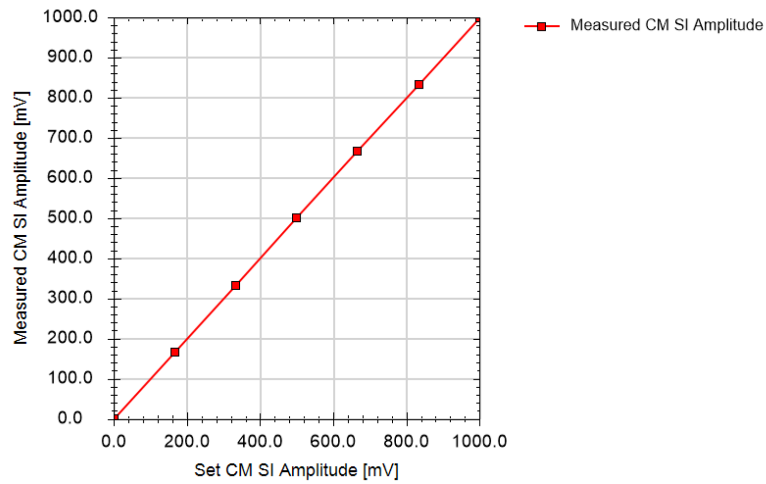
Refer to Figure 27 on page 72.

Result Description

L0_Cal_5GTps_CMSI

[Not Compliant]

for PCIe 6.0 EndPoint ASIC




```
----General----
Offline                              True
Software Version                     5.0.0.
Calibration Data Version             Unknown
Compliant                            False
Non-compliance reason(s)             Procedure offline; Software status unreleased
Number of Averages                   512
Scope Connection for Calibration     Chan 1 3 Direct Connect
Use PCIe2 Transfer Function          False
PCIe2 M8048A ISI Channel             Channel 7, 24 inch
PCIe2 M8048A ISI Channel Emulation   False
----Instruments----
...
```

Set CM SI Amplitude [mV]	Measured CM SI Amplitude [mV]
0	0.00
167	166.67
333	333.33
500	500.00
667	666.67
833	833.33
1000	1000.00

Figure 35 Example result for CMSI Calibration, 2.5 GT/s and 5.0 GT/s

- Set CM SI Amplitude [mV]: The value of CMSI set on the generator.
- Measured CM SI Amplitude [mV]: The value of CMSI measured with the oscilloscope.

De-Emphasis Calibration

Availability

Data Generator:	M8040A, M8020A
Interface Types:	CEM
DUT Types:	Add-In Card, System
Modes:	Compliance, Expert
Data Rates:	2.5 GT/s, 5.0 GT/s

Purpose and Method

This procedure calibrates the de-emphasis.

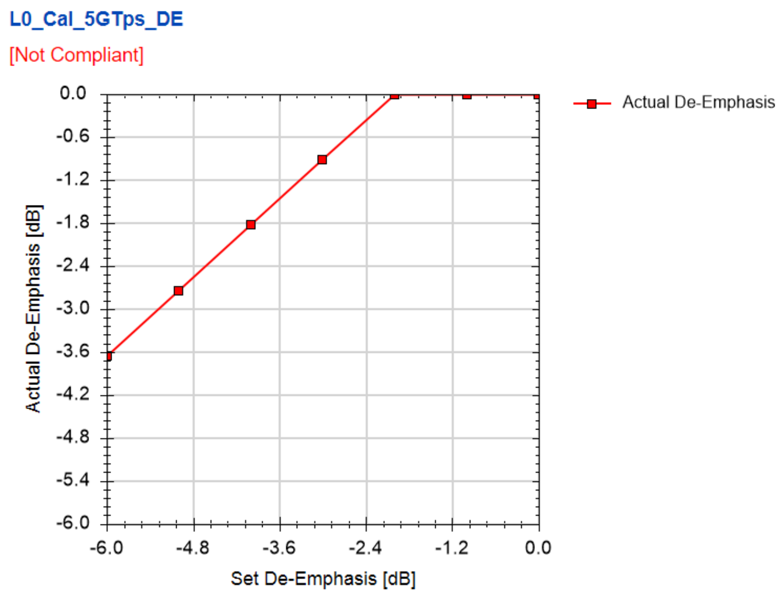
By default, the test automation starts with –6 dB of de-emphasis, increasing it with a step size of 0.5 dB and measuring the corresponding de-emphasis for every set value. The calibration ends when the set de-emphasis is 0 or the measured de-emphasis is above 0 dB.

The calibration data is stored in cal-data tables. These calibration tables are used during measurements to calculate the de-emphasis level that must be set on the generator to get the desired de-emphasis level at the test point.

Connection Diagram

Refer to Figure 28 on page 72.

Result Description




```
----General----
Offline                              True
Software Version                     5.0.0.
Compliant                            False
Non-compliance reason(s)             Procedure offline; Software status unreleased
Eye Height                           225 mV
Start De-Emphasis                    -6 dB
Scope Connection for Calibration     Chan 1 3 Direct Connect
Use PCIe2 Transfer Function          False
----Instruments----
...
```

Set De-Emphasis [dB]	Actual De-Emphasis [dB]
-6.0	-3.656
-5.0	-2.742
-4.0	-1.828
-3.0	-0.914
-2.0	0.000
-1.0	0.000
0.0	0.000

Figure 36 Example result for De-Emphasis Calibration

- Set De-Emphasis [dB]: Value of de-emphasis set on the generator.
- Actual De-Emphasis [dB]: Measured (actual) value of de-emphasis.

Eye Height Calibration

Availability

Data Generator:	M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	2.5 GT/s, 5.0 GT/s	

Purpose and Method

The test fixtures attenuate the data signal. To compensate for the attenuation, the data signal differential swing is calibrated.

The test automation calibrates five equally spaced differential voltage amplitudes. The minimum amplitude is 300 mV and the maximum amplitude is the maximum value that the data generator can generate.

For this calibration, the data generator sends the compliance pattern.

The following impairments are added to the signal.

At the data rate **2.5 GT/s**

- random jitter
- ISI
- swept sinusoidal jitter
- CMSI

At the data rate **5.0 GT/s**

- high-frequency sinusoidal jitter
- SSC residual

The eye height is measured on the oscilloscope using horizontal histograms.

The calibration data is stored in a separate cal-data table for each data rate and DUT type. During measurements, these calibration tables are used to adjust the differential voltage amplitude to the desired eye height.

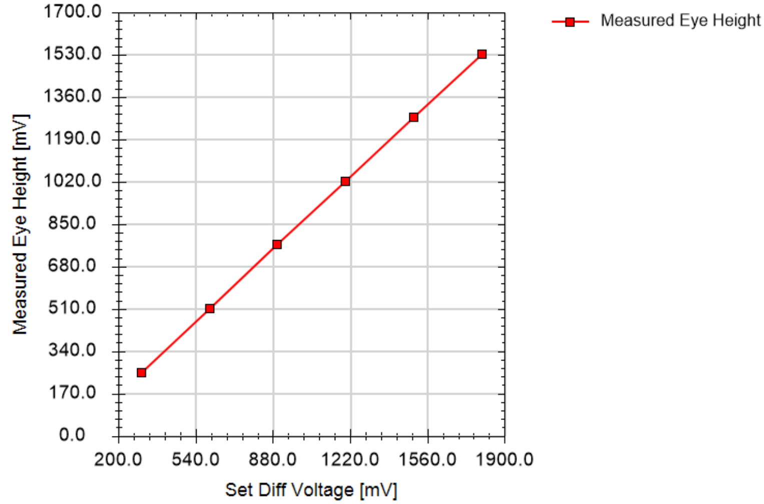
Connection Diagram

Refer to Figure 27 and Figure 28 on page 72.

Result Description

L0_Cal_5GTps_EH

[Not Compliant]



----General----

Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 5G RJ Calibration, 5G ISI Calibration; Required cal offline: 5G RJ Calibration, 5G ISI Calibration; Required cal unknown/unreleased: 5G RJ Calibration, 5G ISI Calibration
Verification Mode	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Use PCIe2 Transfer Function	False
PCIe2 M8048A ISI Channel	Channel 7, 24 inch
PCIe2 M8048A ISI Channel Emulation	False

----Instruments----

...

Final Eye Height	0.1

Set Diff Voltage [mV]	Measured Eye Height [mV]
300	256
600	511
900	767
1200	1022
1500	1278
1800	1533

Figure 37 Example result for Eye Height Calibration, 2.5 GT/s and 5.0 GT/s

- Set Diff Voltage [mV]: Differential voltage set on the generator.
- Measured Eye Height [mV]: Corresponding measured eye height.

ISI Calibration

Availability

Data Generator:	M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point, Root Complex
Modes:	Compliance, Expert
Data Rates:	2.5 GT/s, 5.0 GT/s

Purpose and Method

In ASIC Rx tests, ISI is generated to provide a close-to-real environment. As a result of the system intrinsic jitter, the effective jitter level is different from the value set in the data generator; therefore, the jitter amplitude has to be calibrated.

The test automation calibrates the ISI trace that was selected in the “Configure DUT” dialog. ISI can be injected by routing the signal through the M8048A ISI traces or can be generated internally with the M8020A. The actual value is calculated as the difference between the eye width that is obtained when the J-BERT sends a clock pattern and the eye width that is obtained when it sends a compliance pattern. The eye width is measured with a DSO using horizontal histograms.

The calibration data is stored in a separate cal-data table for each data rate. During measurements, these calibration tables are used to display the ISI amplitude.

Connection Diagram

Refer to Figure 27 on page 72.

Result Description

L0_Cal_5GTps_ISI

[Not Compliant]

----General----

Offline	True
Software Version	5.0.0.
Calibration Data Version	Unknown
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased
Scope Connection for Calibration	Chan 1 3 Direct Connect
Use PCIe2 Transfer Function	False
PCIe2 M8048A ISI Channel	Channel 7, 24 inch
PCIe2 M8048A ISI Channel Emulation	False

----Instruments----

...

Measured ISI [ps]
73.0

Figure 38 Example result for ISI Calibration, 2.5 GT/s and 5.0 GT/s

- Measured ISI [ps]: The ISI measured with the oscilloscope.

RJ Calibration

Availability

Data Generator:	M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	2.5 GT/s, 5.0 GT/s	

Purpose and Method

During Rx tests, the input signal is stressed with a combination of jitter sources to simulate the possible impairments that are expected at the Rx input when operating in a target system. Random jitter is added to simulate the effects of thermal noise. Due to system-intrinsic jitter, the effective jitter level is different from the value set in the data generator; therefore, jitter amplitude has to be calibrated.

The test automation starts with a small RJ amplitude and increases that value in several steps over a defined range. For each step, the procedure measures the actual random jitter.

The generator sends a clock pattern during this calibration procedure.

The measurement is done using a real-time oscilloscope and the RJ/DJ-separation software EZJIT or SigTest. The method used depends on the Eye Calibration Method selected for the particular data rate in the PCIe Parameters dialog during DUT configuration. (If Seasim is selected, EZJIT is used for RJ and SJ calibrations.)

The calibration data is stored in a cal-data table. This calibration table is used during measurements to calculate the RJ amplitude that must be set on the generator to get the expected RJ amplitude at the test point.

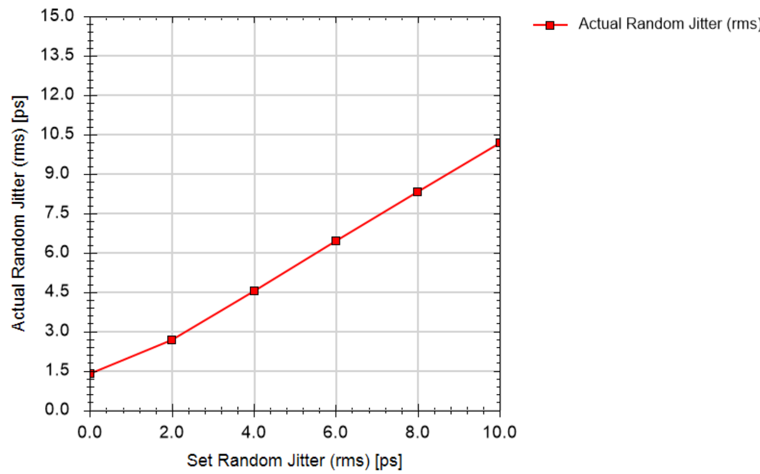
Connection Diagram

Refer to Figure 27 and Figure 28 on page 72.

Result Description

L0_Cal_5GTps_RJ

[Not Compliant]




```
----General----
Offline                              True
Software Version                     5.0.0.
Calibration Data Version             Unknown
Compliant                            False
Non-compliance reason(s)             Procedure offline; Software status unreleased
Scope Connection for Calibration     Chan 1 3 Direct Connect
Use PCIe2 Transfer Function          False
PCIe2 M8048A ISI Channel             Channel 7, 24 inch
PCIe2 M8048A ISI Channel Emulation   False
----Instruments----
...
```

Set Random Jitter (rms) [ps]	Actual Random Jitter (rms) [ps]
0.0	1.40
2.0	2.68
4.0	4.56
6.0	6.44
8.0	8.32
10.0	10.20

Figure 39 Example result for RJ Calibration, 2.5 GT/s and 5.0 GT/s

- Set Random Jitter (rms) [ps]: Rms amplitude of random jitter set on the generator.
- Actual Random Jitter (rms) [ps]: Rms amplitude of random jitter measured with the oscilloscope.

Descriptions of Direct-Connection Calibrations

HF Second Tone SJ Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point Root Complex
Modes:	Compliance, Expert
Data Rates:	16 GT/s (M8050A, M8040A, M8020A) 32 GT/s (M8050A, M8040A) 64 GT/s (M8050A, M8040A)

Purpose and Method

This procedure calibrates the second tone sinusoidal jitter amplitude for two frequencies (150 MHz and 250 MHz).

The test automation starts with small SJ amplitude and increases that value in steps over a defined range. For each step, the procedure measures the actual sinusoidal jitter for both frequencies. The measurement is done using a real-time oscilloscope and the RJ/DJ-separation software EZJIT.

The calibration data is stored in a cal-data table. This calibration table is used during measurements to adjust the second tone SJ amplitude to the desired output second tone SJ amplitudes.

Connection Diagram

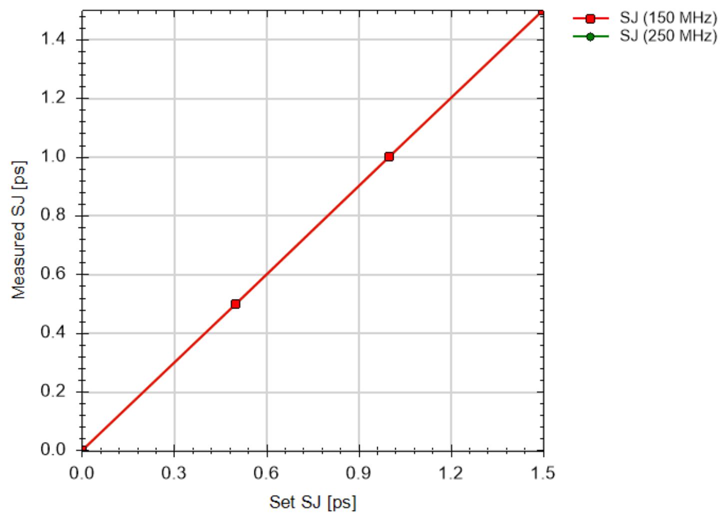
Refer to Figure 29 and Figure 30 on page 73.

Result Description

L0_Cal_64GTps_HF2ndSJ

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 64G TxEQ and Launch Voltage Calibration; Required cal offline: 64G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 64G TxEQ and Launch Voltage Calibration
Verification Mode	False
----Oscilloscope----	
Scope Bandwidth	50 GHz
Number of Averages	7
Number of UIs	2 MUI
----Instruments----	

...

Set SJ [ps]	SJ (150 MHz) [ps]	SJ (250 MHz) [ps]
0.00	0.00	0.00
0.50	0.50	0.50
1.00	1.00	1.00
1.50	1.50	1.50

Figure 40 Example result for Second Tone HF Sinusoidal Jitter Calibration

- Set SJ [ps]: Sinusoidal jitter set at the instrument.
- SJ (x MHz) [ps]: Sinusoidal jitter measured at the frequency x MHz.

HF SJ Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

Purpose and Method

This procedure calibrates the sinusoidal jitter amplitude for two high frequencies (15 MHz and 100 MHz).

The test automation starts with small SJ amplitude and increases that value in steps over a defined range. For each step, the procedure measures the actual sinusoidal jitter for both frequencies. The measurement is done using a real-time oscilloscope and the RJ/DJ-separation software EZJIT or SigTest. The method used depends on the Eye Calibration Method selected for the particular data rate in the PCIe Parameters dialog during DUT configuration. (If Seasim is selected, EZJIT is used for RJ and SJ calibrations.)

The calibration data is stored in a cal-data table. This calibration table is used during measurements to adjust the SJ amplitude to the desired output SJ amplitudes.

Connection Diagram

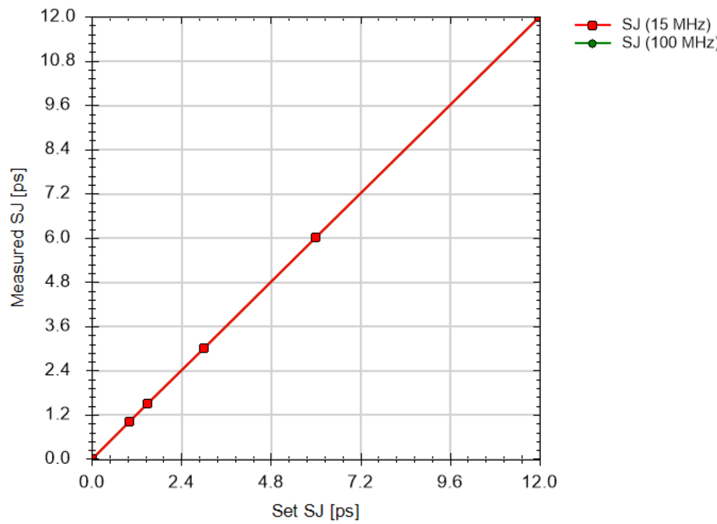
Refer to Figure 29 and Figure 30 on page 73.

Result Description

L0_Cal_64GTps_HFSJ

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----

Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 64G TxEQ and Launch Voltage Calibration; Required cal offline: 64G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 64G TxEQ and Launch Voltage Calibration
Verification Mode	False

----Oscilloscope----

Scope Bandwidth	50 GHz
Number of Averages	7
Number of UIs	2 MUI

----Instruments----

...

Set SJ [ps]	SJ (15 MHz) [ps]	SJ (100 MHz) [ps]
0.00	0.00	0.00
1.00	1.00	1.00
1.50	1.50	1.50
3.00	3.00	3.00
6.00	6.00	6.00
12.00	12.00	12.00

Figure 41 Example result for HF Sinusoidal Jitter Calibration

- Set SJ [ps]: The sinusoidal jitter set at the instrument.
- SJ (x MHz) [ps]: The sinusoidal jitter measured at the frequency x MHz.

LF SJ Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A
Interface Types:	CEM
DUT Types:	Add-In Card System
Modes:	Compliance, Expert
Data Rates:	16 GT/s

Purpose and Method

This procedure calibrates the sinusoidal jitter amplitude for a set of low frequencies (200 kHz, 500 kHz, 1 MHz, 2 MHz and 4 MHz).

The test automation starts with small SJ amplitude and increases that value in several steps over a defined range. For each step, the procedure measures the actual sinusoidal jitter for all the frequencies.

The calibration data is stored in a cal-data table. This calibration table is used during measurements to adjust the SJ amplitude to the desired output SJ amplitudes.

Connection Diagram

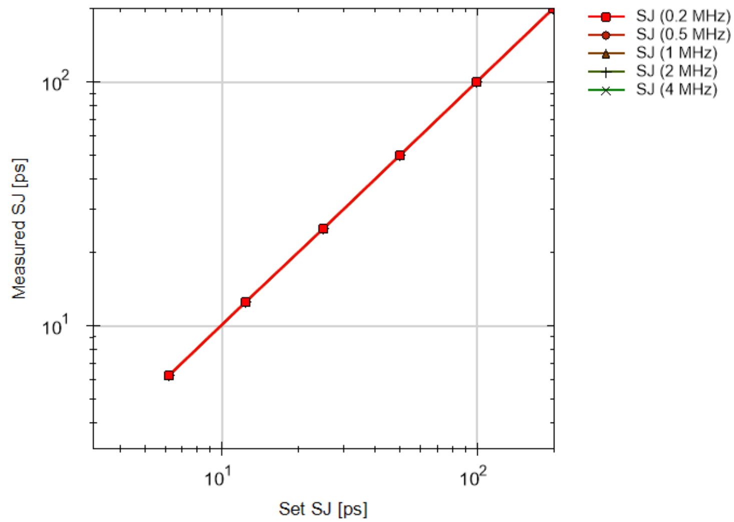
Refer to Figure 29 and Figure 30 on page 73.

Result Description

L0_Cal_16GTps_LFSJ

[Not Compliant]

for PCIe 5.0 AddInCard



----General----

Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 16G TxEQ and Launch Voltage Calibration; Required cal offline: 16G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 16G TxEQ and Launch Voltage Calibration
Verification Mode	False
Start With Minimum Loss Channel	False
SigTest Version	4.0.52

----Oscilloscope----

Scope Bandwidth	25 GHz
Number of Averages	7
Number of UIs	2 MUI
Scope Connection for Calibration	Chan 1 3 Direct Connect

----Generator----

Pre-Shoot	0 dB
De-Emphasis	0 dB
Differential Voltage	800 mV

----Instruments----

...

Set SJ [ps]	SJ (0.2 MHz) [ps]	SJ (0.5 MHz) [ps]	SJ (1 MHz) [ps]	SJ (2 MHz) [ps]	SJ (4 MHz) [ps]
6.25	6.25	6.25	6.25	6.25	6.25
12.50	12.50	12.50	12.50	12.50	12.50
25.00	25.00	25.00	25.00	25.00	25.00
50.00	50.00	50.00	50.00	50.00	50.00
100.00	100.00	100.00	100.00	100.00	100.00
200.00	200.00	200.00	200.00	200.00	200.00

Figure 42 Example result for LF Sinusoidal Jitter Calibration

- Set SJ [ps]: The SJ jitter amplitude set on the instrument.
- SJ (X MHz) [ps]: The measured sinusoidal jitter amplitude for the set SJ amplitude and frequency X.

Pulsewidth Jitter Calibration

Availability

Data Generator:	M8050A, M8040A
Interface Types:	ASIC
DUT Types:	End Point Root Complex
Modes:	Compliance, Expert
Data Rates:	64 GT/s

Purpose and Method

This procedure calibrates the pulsewidth data-dependent jitter (DDJ) and pulsewidth random jitter.

During eye calibrations using Seasim, the pulsewidth DDJ and pulsewidth RJ of the generator need to be included in the simulation.

The generator sends the modified compliance pattern for 32 GT/s during this calibration procedure.

The measurement is done using a real-time oscilloscope and the SigTest application.

As a result, two calibration data tables are generated. Then, in further eye measuring procedures, these calibrations are used to provide the correct pulsewidth values for simulation with Seasim.

Connection Diagram

Refer to Figure 29 and Figure 30 on page 73.

Result Description

This calibration produces two similar pages of results, one for DDJ and one for RJ. Only an example for DDJ is shown here.

L0_Cal_64GTps_Pulsewidth_DDJ

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 64G TxEQ and Launch Voltage Calibration; Required cal offline: 64G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 64G TxEQ and Launch Voltage Calibration
SigTest Version	5.0.24
----Oscilloscope----	
Scope Bandwidth	50 GHz
Number of Averages	10
Number of UIs	2 MUI
----Instruments----	

...

Pulsewidth DDJ [ps]
1.000

Figure 43 Example result for Pulsewidth Jitter Calibration

- Pulsewidth DDJ [ps]: Measured pulsewidth data-dependent jitter.
- Pulsewidth RJ [ps]: Measured pulsewidth random jitter.

RJ Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Compliance, Expert		
Data Rates:	8 GT/s (M8050A: ASIC, CEM; M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

Purpose and Method

During Rx tests, the input signal is stressed with a combination of jitter sources to simulate the possible impairments that are expected at the Rx input when operating in a target system. Random jitter is added to simulate the effects of thermal noise. Due to system intrinsic jitter, the effective jitter level is different from the value set in the data generator; therefore, jitter amplitude is calibrated.

The test automation starts with a small RJ amplitude and increases that value in several steps over a defined range. For each step, the procedure measures the actual random jitter.

The generator sends a clock pattern during this calibration procedure.

The measurement is done using a real-time oscilloscope and the RJ/DJ-separation software EZJIT or SigTest. The method used depends on the Eye Calibration Method selected for the particular data rate in the PCIe Parameters dialog during DUT configuration. (If Seasim is selected, EZJIT is used for RJ and SJ calibrations.)

The calibration data is stored in a cal-data table. This calibration table is used during measurements to calculate the RJ amplitude that must be set on the generator to get the expected RJ amplitude at the test point.

Connection Diagram

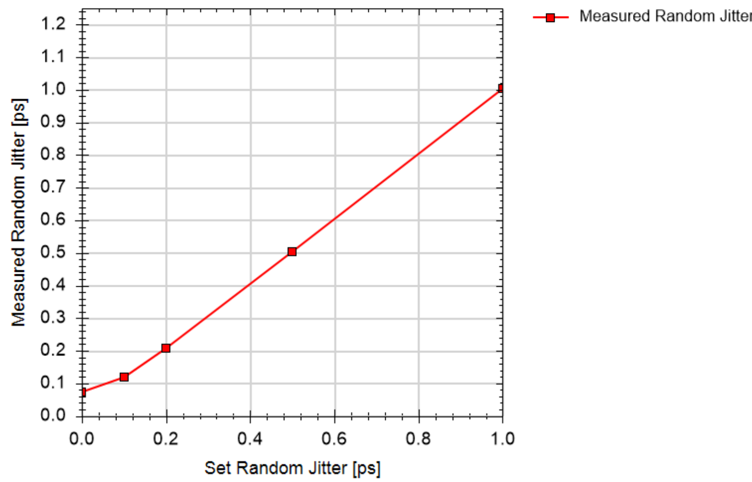
Refer to Figure 29 and Figure 30 on page 73.

Result Description

L0_Cal_64GTps_RJ

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 64G TxEQ and Launch Voltage Calibration; Required cal offline: 64G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 64G TxEQ and Launch Voltage Calibration
Verification Mode	False
----Oscilloscope----	
Scope Bandwidth	50 GHz
Number of Averages	7
Number of UIs	2 MUI
----Instruments----	

...

Set Random Jitter [ps]	Measured Random Jitter [ps]
0.00	0.075
0.10	0.119
0.20	0.208
0.50	0.505
1.00	1.003

Figure 44 Example result for Random Jitter Calibration

- Set Random Jitter [ps]: The jitter amplitude set on the instrument.
- Measured Random Jitter [ps]: The jitter amplitude measured at the oscilloscope.

SJ Calibration

Availability

Data Generator:	M8050A (only CEM), M8040A, M8020A	
Interface Types:	CEM	U.2 and M.2
DUT Types:	Add-In Card System	Device Host
Modes:	Compliance, Expert	
Data Rates:	8 GT/s	

Purpose and Method

This procedure calibrates the sinusoidal jitter amplitude for two frequencies (16 MHz and 100 MHz).

The test automation starts with small SJ amplitude and increases that value in several steps over a defined range. For each step, the procedure measures the actual sinusoidal jitter for all the frequencies. The measurement is done using a real-time oscilloscope and the SigTest Application.

The calibration data is stored in a cal-data table. This calibration table is used during measurements to adjust the SJ amplitude to the desired output SJ amplitudes.

NOTE **For Z-Series DSOs without TTCs, the oscilloscope connections must be changed from the Real-Edge channels to channels (1-3) or (2-4).**

Connection Diagram

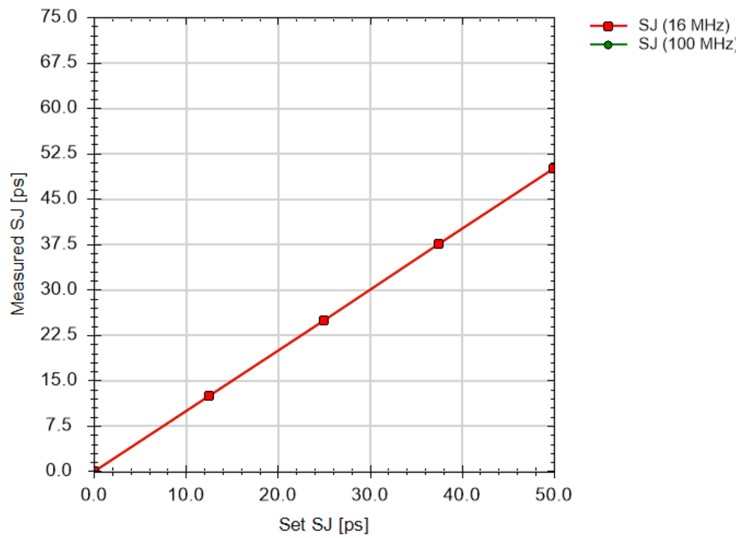
Refer to Figure 29. and Figure 30 on page 73.

Result Description

L0_Cal_8GTps_SJ

[Not Compliant]

for PCIe 5.0 AddInCard



----General----

Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 8G TxEQ and Launch Voltage Calibration; Required cal offline: 8G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 8G TxEQ and Launch Voltage Calibration
Verification Mode	False
CDR loop-bandwidth	50 kHz
Number of averages for jitter measurement	5
SigTest Version	3.2.0.3

----Oscilloscope----

Scope Connection for Calibration	Chan 1 3 Direct Connect

----Instruments----

...

Set SJ [ps]	SJ (16 MHz) [ps]	SJ (100 MHz) [ps]
0.00	0.00	0.00
12.50	12.50	12.50
25.00	25.00	25.00
37.50	37.50	37.50
50.00	50.00	50.00

Figure 45 Example result for Sinusoidal Jitter Calibration

- Set SJ [ps]: The SJ jitter amplitude set on the instrument.
- SJ (x MHz) [ps]: The measured sinusoidal jitter amplitude for the set SJ amplitude and frequency x MHz.

SNDR Calibration

Availability

Data Generator:	M8050A, M8040A
Interface Types:	ASIC
DUT Types:	End Point Root Complex
Modes:	Compliance, Expert
Data Rates:	64 GT/s

Purpose and Method

This procedure measures the ratio of signal to noise and distortion of the generator (SNDR: signal-to-(noise and distortion) ratio).

As a result, a calibration data table is generated. Then, in further eye-measuring procedures, these calibrations are used to provide the correct SNDR value for simulation with Seasim.

Connection Diagram

Refer to Figure 29 and Figure 30 on page 73.

Result Description

L0_Cal_64GTps_SNDR

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 64G TxEQ and Launch Voltage Calibration; Required cal offline: 64G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 64G TxEQ and Launch Voltage Calibration
----Oscilloscope----	
Number of Averages	10
----Instruments----	

...

SNDR [dB]
34.0

Figure 46 Example result for SNDR Calibration

- SNDR [dB]: Measured signal-to-(noise and distortion) ratio.

TxEQ and Launch Voltage Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Compliance, Expert		
Data Rates:	8 GT/s (M8050A: ASIC, CEM; M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

Purpose and Method

This procedure calibrates the De-Emphasis, Pre-Shoot (Pre-Shoot 1 and Pre-Shoot 2 for 64 GT/s) and Differential Voltage at TP1.

The pattern generator sends an equalization pattern to the oscilloscope and performs a sweep of the equalization range according to the **measurement algorithm** selected in the user interface.

- **Speed Optimized Measurement:** The default – and recommended – algorithm for 64 GT/s. In this case, the test measures only a subset of the possible combinations of pre-cursor 2, pre-cursor 1 and post-cursor. This subset provides the best possible accuracy for the preset values Q0–Q9 and acceptable accuracy for the rest of the range.
- **Measure All Coefficients:**
  8 GT/s, 16 GT/s, 32 GT/s: The pre-cursor is set to the initial value (–0.28). For this set value, the post cursor is swept from –0.28 to 0.02 in linear steps of 0.02.
  64 GT/s: With this algorithm you can set the start value, stop value and step value for the pre-cursors and post-cursor. This procedure takes a very long time.

At each combination of values of the pre-cursor(s) and post-cursor, the de-emphasis, pre-shoot(s) and differential voltage are measured with the oscilloscope. The set Differential Voltage always remains fixed at 800 mV.

NOTE

The procedure explained above is specific to the M8040A data generator setup. For the M8020A setup, the procedure is very similar but the sweep is performed not over the pre-cursor and post-cursor values but directly for the de-emphasis (from –6 dB to 2 dB) and pre-shoot (from 6 dB to –1 dB).

As a result, a single cal-data table is generated. In subsequent procedures, this calibration data is used to set equalization values that provide the desired de-emphasis, pre-shoot(s) and differential voltage at the test point.

Connection Diagram

Refer to Figure 29 and Figure 30 on page 73.

Result Description (8 GT/s, 16 GT/s and 32 GT/s)

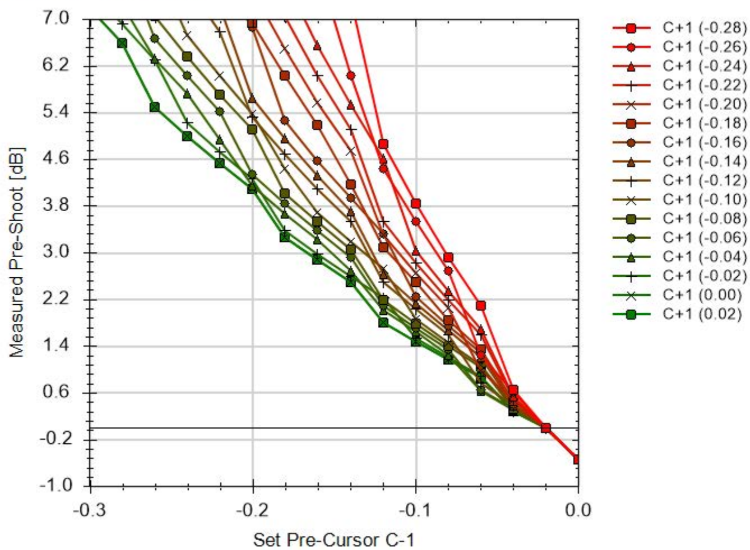
Pre-Shoot, De-Emphasis and Launch Voltage are presented separately.

Pre-Shoot

L0_Cal_16GTps_PS

[Not Compliant]

for PCIe 6.0 EndPoint ASIC




```
----General----
Offline                              True
Software Version                     5.0.0.
Compliant                            False
Non-compliance reason(s)             Procedure offline; Software status unreleased
EQ Calibration Pattern               EQ Two Pattern, 64 zeros, 64 ones
Verification Mode                    False
Measure all Generator voltages       False
Select Measurement Algorithm         Measure All Coefficients
Gen4 Fixture                         PCI Express 4.0 CEM Fixture Kit
Gen4 ISI Adjustment                  Hardware Traces
Gen4 Asic Eye Calibration Method     Seasim
Start With Minimum Loss Channel      False
----Oscilloscope----
Scope Bandwidth                      50 GHz
Number of Waveform Averages          256
----Generator----
Set Amplitude                        800 mV
----Instruments----
```

...

Set Pre-Cursor C-1 []	C+1 (-0.28) [dB]	C+1 (-0.26) [dB]	C+1 (-0.24) [dB]	C+1 (-0.22) [dB]	C+1 (-0.20) [dB]	C+1 (-0.18) [dB]	C+1 (-0.16) [dB]	C+1 (-0.14) [dB]	C+1 (-0.12) [dB]	C+1 (-0.10) [dB]	C+1 (-0.08) [dB]	C+1 (-0.06) [dB]	C+1 (-0.04) [dB]	C+1 (-0.02) [dB]	C+1 (0.00) [dB]	C+1 (0.02) [dB]
-0.28	N/A	N/A	N/A	N/A	N/A	N/A	14.81	13.26	12.04	10.24	9.54	8.94	8.42	7.55	7.18	7.18
-0.26	N/A	N/A	N/A	N/A	N/A	14.40	12.87	11.67	9.54	9.21	8.63	8.12	7.26	6.90	6.58	6.58
-0.24	N/A	N/A	N/A	N/A	13.53	12.04	9.95	9.17	8.52	7.96	7.04	6.66	6.33	6.31	5.49	5.49
-0.22	N/A	N/A	N/A	13.06	11.60	10.46	8.79	8.15	7.60	6.72	6.35	6.02	5.73	5.22	5.00	5.00
-0.20	N/A	N/A	12.57	11.13	10.01	8.38	7.76	7.23	6.78	6.02	5.70	5.42	4.93	4.72	4.53	4.53
-0.18	N/A	11.48	10.63	9.54	7.51	6.94	6.85	5.65	5.33	5.38	5.11	4.33	4.14	4.25	4.08	4.08
-0.16	10.88	9.54	7.71	7.04	6.49	6.02	5.26	4.96	4.68	4.44	4.02	3.84	3.67	3.38	3.25	3.25
-0.14	8.94	7.96	6.55	6.02	5.58	5.19	4.57	4.31	4.08	3.69	3.52	3.37	3.23	2.98	2.87	2.87
-0.12	7.36	6.02	5.52	5.11	4.75	4.17	3.93	3.71	3.52	3.19	3.05	2.92	2.69	2.59	2.50	2.50
-0.10	4.86	4.44	4.61	3.52	3.30	3.10	3.33	2.63	2.50	2.72	2.18	2.09	2.01	2.22	1.80	1.80
-0.08	3.84	3.52	3.03	2.83	2.65	2.50	2.24	2.13	2.03	1.86	1.78	1.71	1.64	1.53	1.48	1.48
-0.06	2.92	2.69	2.33	2.18	2.05	1.84	1.74	1.66	1.58	1.45	1.39	1.34	1.24	1.20	1.16	1.16
-0.04	2.09	1.24	1.69	1.58	0.97	1.34	1.27	1.21	0.76	1.06	1.02	0.64	0.62	0.88	0.86	0.86
-0.02	0.64	0.60	0.53	0.50	0.47	0.45	0.40	0.39	0.37	0.35	0.33	0.32	0.30	0.28	0.28	0.28
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.02	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55	-0.55

Figure 47 Example result for TxEQ and Launch Voltage Calibration (Pre-Shoot, 16 GT/s)

- Set Pre-Cursor C-1: The pre-cursor value set on the data generator.
- The remaining table entries are the values of the Pre-Shoot [dB] measured for the combination of the Pre-Cursor values (C-1), listed in the first column, and the Post-Cursor values (C+1 (x)), listed in the first row, that are set on the data generator.

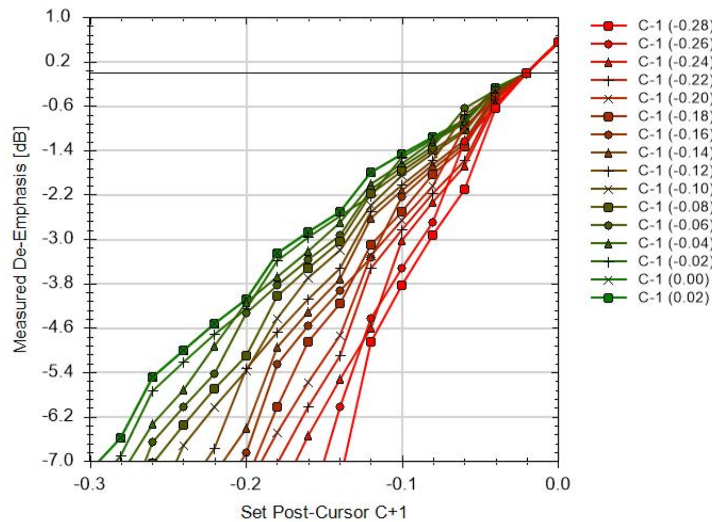
De-Emphasis

For De-Emphasis, the text in the results is the same as for Pre-Shoot (see Figure 47 on page 111) and is not shown here.

L0_Cal_16GTps_DE

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



Set Post-Cursor C+1 []	C-1 (-0.28) [dB]	C-1 (-0.26) [dB]	C-1 (-0.24) [dB]	C-1 (-0.22) [dB]	C-1 (-0.20) [dB]	C-1 (-0.18) [dB]	C-1 (-0.16) [dB]	C-1 (-0.14) [dB]	C-1 (-0.12) [dB]	C-1 (-0.10) [dB]	C-1 (-0.08) [dB]	C-1 (-0.06) [dB]	C-1 (-0.04) [dB]	C-1 (-0.02) [dB]	C-1 (0.00) [dB]	C-1 (0.02) [dB]
-0.28	N/A	N/A	N/A	N/A	N/A	N/A	-14.81	-13.26	-12.04	-10.24	-9.54	-8.94	-8.42	-7.55	-7.18	-7.18
-0.26	N/A	N/A	N/A	N/A	N/A	-14.40	-12.87	-11.67	-9.54	-9.21	-8.63	-8.12	-7.26	-6.90	-6.58	-6.58
-0.24	N/A	N/A	N/A	N/A	-13.53	-12.04	-9.95	-9.17	-8.52	-7.96	-7.04	-6.66	-6.33	-5.74	-5.49	-5.49
-0.22	N/A	N/A	N/A	-13.06	-11.60	-10.46	-8.79	-8.15	-7.60	-6.72	-6.35	-6.02	-5.73	-5.22	-5.00	-5.00
-0.20	N/A	N/A	-12.57	-11.13	-10.01	-8.38	-7.76	-7.23	-6.78	-6.02	-5.70	-5.42	-4.93	-4.72	-4.53	-4.53
-0.18	N/A	-11.48	-10.63	-9.54	-7.51	-7.36	-6.85	-6.41	-5.33	-5.38	-5.11	-4.33	-4.14	-4.25	-4.08	-4.08
-0.16	-10.88	-9.54	-7.71	-7.04	-6.49	-6.02	-5.26	-4.96	-4.68	-4.44	-4.02	-3.84	-3.67	-3.38	-3.25	-3.25
-0.14	-8.94	-7.96	-6.55	-6.02	-5.58	-4.86	-4.57	-4.31	-4.08	-3.69	-3.52	-3.37	-3.23	-2.98	-2.87	-2.87
-0.12	-7.36	-6.02	-5.52	-5.11	-4.75	-4.17	-3.93	-3.71	-3.52	-3.19	-3.05	-2.92	-2.69	-2.59	-2.50	-2.50
-0.10	-4.86	-4.44	-4.61	-3.52	-3.30	-3.10	-3.33	-2.63	-2.50	-2.38	-2.18	-2.09	-2.01	-2.22	-1.80	-1.80
-0.08	-3.84	-3.52	-3.03	-2.83	-2.65	-2.50	-2.24	-2.13	-2.03	-1.86	-1.78	-1.71	-1.64	-1.53	-1.48	-1.48
-0.06	-2.92	-2.69	-2.33	-2.18	-2.05	-1.84	-1.74	-1.66	-1.58	-1.45	-1.39	-1.34	-1.24	-1.20	-1.16	-1.16
-0.04	-2.09	-1.24	-1.69	-1.58	-0.97	-1.34	-1.27	-1.21	-0.76	-1.06	-1.02	-0.64	-0.92	-0.88	-0.86	-0.86
-0.02	-0.64	-0.60	-0.56	-0.50	-0.47	-0.45	-0.40	-0.39	-0.37	-0.35	-0.33	-0.32	-0.30	-0.28	-0.28	-0.28
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55

Figure 48 Example result for TxEQ and Launch Voltage Calibration (De-Emphasis, 16 GT/s)

- Set Post-Cursor C+1: The post-cursor value set on the data generator.
- The remaining table entries are the values of the De-Emphasis [dB] measured for the combination of the Post-Cursor values (C+1), listed in the first column, and the Pre-Cursor values (C-1 (x)), listed in the first row, that are set on the data generator.

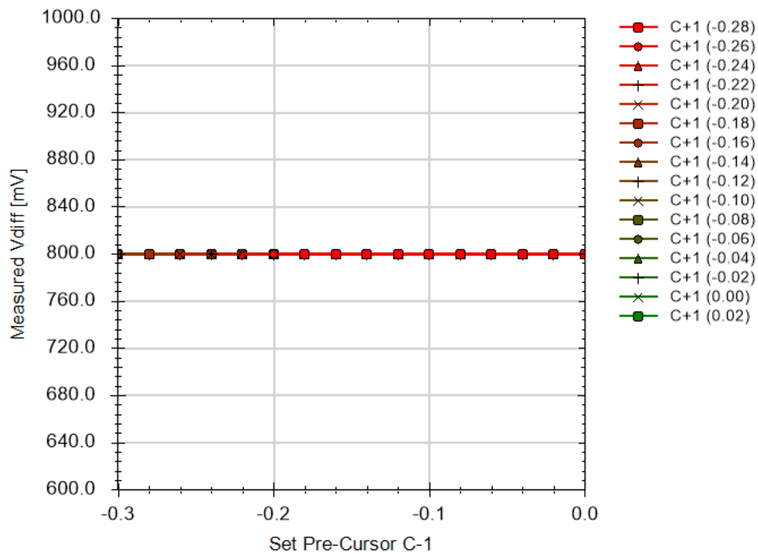
Launch Voltage

For Launch Voltage, the text in the results is the same as for Pre-Shoot (see Figure 47 on page 111) and is not shown here.

L0_Cal_16GTps_Vdiff

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



Set Pre-Cursor C-1 []	C+1 (-0.28) [mV]	C+1 (-0.26) [mV]	C+1 (-0.24) [mV]	C+1 (-0.22) [mV]	C+1 (-0.20) [mV]	C+1 (-0.18) [mV]	C+1 (-0.16) [mV]	C+1 (-0.14) [mV]	C+1 (-0.12) [mV]	C+1 (-0.10) [mV]	C+1 (-0.08) [mV]	C+1 (-0.06) [mV]	C+1 (-0.04) [mV]	C+1 (-0.02) [mV]	C+1 (0.00) [mV]	C+1 (0.02) [mV]
-0.28	N/A	N/A	N/A	N/A	N/A	N/A	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.26	N/A	N/A	N/A	N/A	N/A	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.24	N/A	N/A	N/A	N/A	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.22	N/A	N/A	N/A	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.20	N/A	N/A	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.18	N/A	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.16	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.14	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.12	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.10	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.08	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.06	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.04	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.02	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
0.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
0.02	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00

Figure 49 Example result for TxEQ and Launch Voltage Calibration (Launch Voltage, 16 GT/s)

- Set Pre-Cursor C-1: The post-cursor value set on the data generator.
- The remaining table entries are the values of the Differential Voltage [mV] measured for the combination of the Pre-Cursor values (C-1), listed in the first column, and the Post-Cursor values (C+1 (x)), listed in the first row, that are set on the data generator.

Result Description (64 GT/s)

For the TxEQ and Launch Voltage Calibration at data rate 64 GT/s, there are no plots.

L0_Cal_64GTps_TxEq

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

```
----General----
Offline                      True
Software Version             5.0.0.11_RC
Compliant                    False
Non-compliance reason(s)     Procedure offline; Software status unreleased
Verification Mode            False
Measurement Algorithm        Speed Optimized Measurement
----Oscilloscope----
Scope Bandwidth              59 GHz
Number of Waveform Averages  1024
Vertical scale               85 mV
----Instruments----
```

...

Set PreCursor2 []	Set PreCursor1 []	Set PostCursor []	Set VDiff [mV]	Measured PreShoot2 [dB]	Measured PreShoot1 [dB]	Measured DeEmphasis [dB]	Measured VDiff [mV]
0.00	-0.28	-0.17	800	0.00	16.39	-12.87	800
0.00	-0.28	-0.16	800	0.00	15.07	-11.29	800
0.00	-0.28	-0.15	800	0.00	13.98	-9.95	800
0.00	-0.28	-0.14	800	0.00	13.06	-8.79	800
0.00	-0.28	-0.13	800	0.00	12.28	-7.76	800
0.00	-0.28	-0.12	800	0.00	11.60	-6.85	800
0.00	-0.28	-0.11	800	0.00	10.99	-6.02	800
0.00	-0.28	-0.10	800	0.00	10.46	-5.26	800
0.00	-0.28	-0.09	800	0.00	9.98	-4.57	800
0.00	-0.28	-0.08	800	0.00	9.54	-3.93	800
0.00	-0.28	-0.07	800	0.00	9.15	-3.33	800
0.00	-0.28	-0.06	800	0.00	8.79	-2.77	800
0.00	-0.28	-0.05	800	0.00	8.46	-2.24	800
0.00	-0.28	-0.04	800	0.00	8.15	-1.74	800
0.00	-0.28	-0.03	800	0.00	7.87	-1.27	800
0.00	-0.28	-0.02	800	0.00	7.60	-0.83	800
0.00	-0.28	-0.01	800	0.00	7.36	-0.40	800
0.00	-0.28	0.00	800	0.00	7.13	0.00	800
0.00	-0.27	-0.18	800	0.00	16.12	-13.26	800
0.00	-0.27	-0.14	800	0.00	12.04	-8.15	800
0.00	-0.27	0.00	800	0.00	6.74	0.00	800
0.00	-0.26	-0.19	800	0.00	15.85	-13.62	800
0.00	-0.26	-0.14	800	0.00	11.13	-7.60	800
0.00	-0.26	0.00	800	0.00	6.38	0.00	800

...

Figure 50 Example result for TxEQ and Launch Voltage Calibration (64 GT/s, just the beginning of the table)

- Set Precursor2: Value of Pre-Cursor 2 set on the instrument.
- Set PreCursor1: Value of Pre-Cursor 1 set on the instrument.
- Set PostCursor: Value of Post-Cursor set on the instrument.
- Set VDiff: Value of Differential Voltage set on the instrument.
- Measured PreShoot2 [dB]: Value of Pre-Shoot 2 measured at the oscilloscope.
- Measured PreShoot1 [dB]: Value of Pre-Shoot 1 measured at the oscilloscope.
- Measured DeEmphasis [dB]: Value of De-Emphasis measured at the oscilloscope.
- Measured VDiff [mV]: Value of Differential Voltage measured at the oscilloscope.

TxEQ and Launch Voltage Measurement

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Expert – Custom Procedure		
Data Rates:	8 GT/s (M8050A: ASIC, CEM; M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

The "Include Custom Procedures" option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure sets the calibrated Differential Voltage, Pre-Shoot (Pre-Shoot 2 and Pre-Shoot 1 for 64 GT/s) and De-Emphasis values at TP1 and re-measures them. The measurement can be repeated as many times as a new impairment combination is selected.

The procedure is useful for checking whether the TxEQ and Launch Voltage Calibration is correct and the desired values at TP1 can be achieved.

Connection Diagram

Refer to Figure 29 and Figure 30 on page 73.

Result Description

The presentation of results for 64 GT/s differs from that for the other data rates.

L0_Meas_64GTps_EQ_Vdiff

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----

Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 64G TxEQ and Launch Voltage Calibration; Required cal offline: 64G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 64G TxEQ and Launch Voltage Calibration
Scope Bandwidth	50 GHz
Number of Waveform Averages	1024

----Instruments----

...

Requested Pre-Shoot2 [dB]	Requested Pre-Shoot1 [dB]	Requested De-Emphasis [dB]	Requested Differential Voltage [mV]	Set Coefficient 0 []	Set Coefficient 1 []	Set Coefficient 3 []	Set Generator Voltage [mV]	Measured Pre-Shoot2 [dB]	Measured Pre-Shoot1 [dB]	Measured De-Emphasis [dB]	Measured Differential Voltage [mV]
0.00	0.00	0.00	800	0.000	0.000	0.000	0	0.00	0.00	0.00	800
0.00	7.00	-10.00	800	0.000	0.000	0.000	0	0.00	7.00	-10.00	800
0.00	8.00	-10.00	800	0.000	0.000	0.000	0	0.00	8.00	-10.00	800
0.00	9.00	-10.00	800	0.000	0.000	0.000	0	0.00	9.00	-10.00	800
0.00	9.00	-9.00	800	0.000	0.000	0.000	0	0.00	9.00	-9.00	800
0.00	9.00	-8.00	800	0.000	0.000	0.000	0	0.00	9.00	-8.00	800
0.00	9.00	-7.00	800	0.000	0.000	0.000	0	0.00	9.00	-7.00	800
0.00	9.00	-6.00	800	0.000	0.000	0.000	0	0.00	9.00	-6.00	800
0.00	9.00	-5.00	800	0.000	0.000	0.000	0	0.00	9.00	-5.00	800
-1.00	9.00	-5.00	800	0.000	0.000	0.000	0	-1.00	9.00	-5.00	800
-2.00	9.00	-5.00	800	0.000	0.000	0.000	0	-2.00	9.00	-5.00	800

Figure 51 Example result for 64G TxEQ and Launch Voltage Measurement procedure

- Requested Pre-Shoot2 [dB]: Entered value of Pre-Shoot 2.
- Requested Pre-Shoot1 [dB]: Entered value of Pre-Shoot 1.
- Requested De-Emphasis [dB]: Entered value of De-Emphasis.
- Requested Differential Voltage [mV]: Entered voltage value set in ValiFrame.
- Set Coefficient 0: Value of Pre-Cursor 2 applied at the generator according to calibration.
- Set Coefficient 1: Value of Pre-Cursor 1 applied at the generator according to calibration.

- Set Coefficient 3: Value of Post-Cursor applied at the generator according to calibration.
- Set Generator Voltage [mV]: Value of Generator Voltage according to calibration.
- Measured Pre-Shoot2 [dB]: Measured value of Pre-Shoot 2.
- Measured Pre-Shoot1 [dB]: Measured value of Pre-Shoot 1.
- Measured De-Emphasis [dB]: Measured value of De-Emphasis.
- Measured Differential Voltage [mV]: Measured value of differential voltage at the generator output.

L0_Meas_16GTps_EQ_Vdiff

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----

Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 16G TxEQ and Launch Voltage Calibration; Required cal offline: 16G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 16G TxEQ and Launch Voltage Calibration
EQ Calibration Pattern	EQ Two Pattern, 64 zeros, 64 ones
Gen4 Fixture	PCI Express 4.0 CEM Fixture Kit
Gen4 ISI Adjustment	Hardware Traces
Gen4 Asic Eye Calibration Method	Seasim
Start With Minimum Loss Channel	False

----Oscilloscope----

Scope Bandwidth	50 GHz
Number of Waveform Averages	256

----Instruments----

...

Requested Pre-Shoot [dB]	Requested De-Emphasis [dB]	Requested Differential Voltage [mV]	Set Coefficient 1 []	Set Coefficient 3 []	Set Generator Voltage [mV]	Measured Pre-Shoot [dB]	Measured De-Emphasis [dB]	Measured Differential Voltage [mV]
0.00	0.00	800	0.000	0.000	400	0.00	0.00	800
0.00	0.00	800	0.000	0.000	400	0.00	0.00	800
0.00	-2.00	800	0.000	-0.106	400	0.00	-2.00	800
1.00	-2.00	800	-0.038	-0.099	400	1.00	-2.00	800
2.00	-2.00	800	-0.089	-0.089	400	2.00	-2.00	800
3.00	-2.00	800	-0.119	-0.079	400	3.00	-2.00	800
3.00	-3.00	800	-0.112	-0.112	400	3.00	-3.00	800
3.00	-4.00	800	-0.105	-0.147	400	3.00	-4.00	800
3.00	-5.00	800	-0.098	-0.173	400	3.00	-5.00	800

Figure 52 Example result for 16G TxEQ and Launch Voltage Measurement procedure

- Requested Pre-Shoot [dB]: Entered value of Pre-Shoot.
- Requested De-Emphasis [dB]: Entered value of De-Emphasis.
- Requested Differential Voltage [mV]: Entered value of voltage set in ValiFrame.
- Set Coefficient 1: Value of Pre-Cursor applied at the generator according to calibration.
- Set Coefficient 3: Value of Post-Cursor applied at the generator according to calibration.
- Set Generator Voltage [mV]: Value of Generator Voltage according to calibration.
- Measured Pre-Shoot [dB]: Measured value of Pre-Shoot.
- Measured De-Emphasis [dB]: Measured value of De-Emphasis.
- Measured Differential Voltage [mV]: Measured value of differential voltage at the generator output.

Unit Interval Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A
Interface Types:	CEM
DUT Types:	Add-In Card System
Modes:	Compliance, Expert
Data Rates:	16 GT/s

Purpose and Method

This procedure measures the unit interval of the signal.

The test automation sends a clean signal without adding any jitter sources. Then the actual unit interval is measured with the oscilloscope.

The calibration data is stored in a cal-data table. This calibration table is used by SigTest to measure eye height and eye width.

Connection Diagram

Refer to Figure 29 and Figure 30 on page 73.

Result Description

L0_Cal_16GTps_UI

[Not Compliant]

for PCIe 5.0 AddInCard

----General----

Offline	True
Software Version	Unknown
Calibration Data Version	Unknown
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 16G TxEQ and Launch Voltage Calibration; Required cal offline: 16G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 16G TxEQ and Launch Voltage Calibration
Start With Minimum Loss Channel	False
SigTest Version	4.0.52

...

----Oscilloscope----

Scope Bandwidth	25 GHz
Number of Averages	7
Number of UIs	2 MUI

----Generator----

Pre-Shoot	0 dB
De-Emphasis	0 dB
Differential Voltage	800 mV

Mean Unit Interval [ps]
62.50

Figure 53 Example result for Unit Interval Calibration

- Mean Unit Interval [ps]: Average (mean) unit interval of the signal.

Descriptions of Long-Channel Calibrations

AWG Amplitude Correction Calibration

Availability

Data Generator:	M8050A, M8040A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	32 GT/s, 64 GT/s (only ASIC)	

Purpose and Method

This procedure calibrates the correction factor of the AWG.

The test automation measures the amplitude of each channel at TP2 with the oscilloscope when the AWG corrector factor is set to 1. With the measured values, the new correction factor is calculated.

Connection Diagram

Refer to Figure 32 on page 74 and Figure 33 on page 75.

If Seasim is used, the hardware trace is set to the optimal number based on the final channel from the Compliance Eye Calibration on page 133.

If SigTest is used, the calibration is done at the nominal loss channel.

Result Description

L0_Cal_32GTps_AWG_Correction

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased 32G Insertion Loss Calibration, 32G Pre Compl offline: 32G TxEQ and Launch Voltage Calibrat 32G Compliance Eye Calibration; Required cal Insertion Loss Calibration, 32G Pre Complianc
Gen5 Fixture	PCIe 5.0 FR4 Base Fixture
Gen5 Asic Eye Calibration Method	Seasim
----Oscilloscope----	
Scope Bandwidth	5 GHz
Number of Averages	7
Number of Waveform Averages	1024
Gen5 Embed Replica Channel	False
Gen5 Transfer Function File for Package Model on Scope	PCIe5RxPackageModel_08_01_2019_EndPoint.tf4
Package Loss at 2.1GHz	-0.82 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Channel----	
Trace Number	37
Total Channel Loss	-37 dB
----Instruments----	

...

Amplitude Correction Factor [x/x]
1.000

Figure 54 Example result for AWG Amplitude Correction Calibration

- Amplitude Correction Factor [x/x]: The correction factor that must be applied to the data channels of the AWG.

Channel Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	16 GT/s	

Purpose and Method

This procedure searches for the calibration channel loss that produces an eye closest to the target.

When the “Start with Minimum Loss Channel” option is not selected in the “Configure DUT” dialog, the hardware trace is set to achieve –30 dB at 8 GHz and the Tx EQ preset to the value that gets the largest eye. Then, at each step, the channel loss is decreased by 0.5 dB and the eye measured until the eye width and the eye height exceed the target, or until the insertion loss at 8 GHz reaches the minimum of –27 dB.

When the “Start with Minimum Loss Channel” option is selected, the hardware trace is set to achieve –27 dB at 8 GHz and the Tx EQ preset to the value that gets the largest eye. Then, at each step, the channel loss is increased, by changing the hardware trace, and the eye measured until either the eye width or the eye height have fallen below the target, or until the insertion loss at 8 GHz reaches –30 dB.

The calibration data is stored in a cal-data table. This calibration data is used to evaluate the optimum ISI trace for the Rx tests.

Connection Diagram

The initial setup is that for Long Channel (refer to Figure 32 on page 74 and Figure 33 on page 75) with the var. ISI Pair set to either the one that gives the maximum loss channel (if “Start with Minimum Loss Channel” is unchecked under ‘Configure DUT’ – ‘Show Parameters’ – ‘16 GT/s’) or the one that gives the minimum loss channel (if “Start with Minimum Loss Channel” is checked). Note that for each step you will be prompted to change the hardware trace until the optimum channel is found.

Result Description

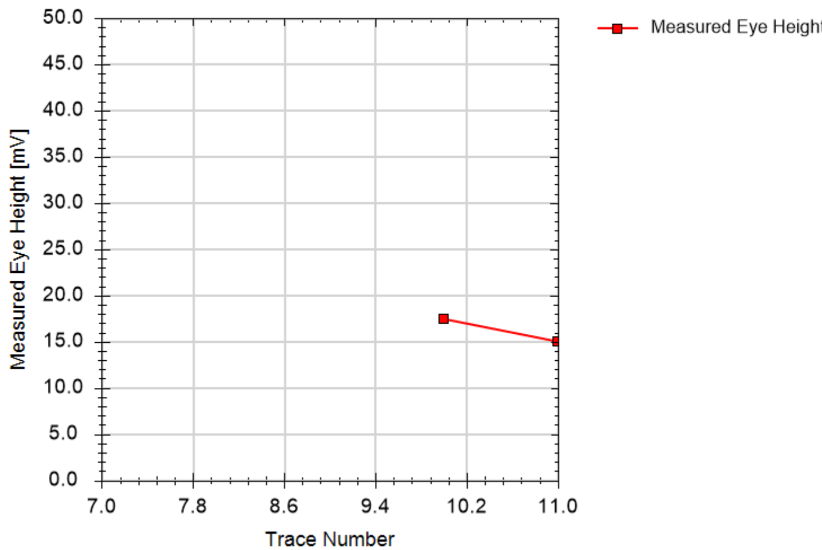
There are two sets of results, one for Eye Height (Figure 55) and one for Eye Width (Figure 56).

Eye Height

L0_Cal_16GTps_Chan_EH

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unrelea Calibration, 16G Insertion Loss Calibratio offline: 16G TxEQ and Launch Voltage Calib Equalization Preset Optimization; Required Calibration, 16G Insertion Loss Calibratio
Trace Number Start Value	11
Trace Number Stop Value	7
Gen4 Fixture	PCI Express 4.0 CEM Fixture Kit
Gen4 ISI Adjustment	Hardware Traces
Gen4 Asic Eye Calibration Method	Seasim
Start With Minimum Loss Channel	False

```
----Oscilloscope----
Scope Bandwidth                                           25 GHz
Number of Averages                                        7
Number of Waveform Averages                               1024
Gen4 Embed Replica Channel                                False
Gen4 Transfer Function File for Package Model on Scope    PCIe4RxPackageModel_EndPoint_
Package Loss at 2.1GHz                                    -0.99 dB
Step Response Low Time                                    8 UI
Step Response High Time                                   120 UI
Scope Connection for Calibration                          Chan 1 3 Direct Connect
----Seasim----
Number of UI                                              120
Used Pattern                                              Clock Div 512
----Generator----
Pre-Shoot                                                 0 dB
De-Emphasis                                               -6 dB
Generator Launch Voltage                                  800 mV
DMSI                                                      14 mV
CMSI                                                      0 V
Random Jitter                                             1 ps
Sinusoidal Jitter                                         6.25 ps
Sinusoidal Jitter Frequency                               100 MHz
----Instruments----
...
```

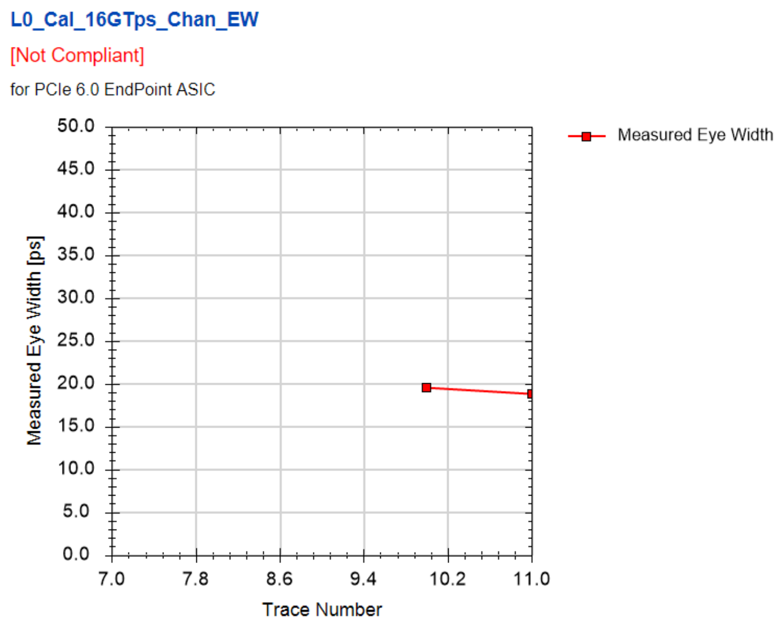
Set Trace Number []	Measured Eye Height [mV]
11.00	15.00
10.00	17.50

Figure 55 Example result for Channel Calibration (Eye Height)

- Set Trace Number: The number of the trace used.
- Measured Eye Height [mV]: Value of the eye height for the set trace number.

Eye Width

For Eye Width, the text in the results is the same as for Eye Height (see Figure 55 on page 128) and is not shown here.



Set Trace Number []	Measured Eye Width [ps]
11.00	18.75
10.00	19.50

Figure 56 Example result for Channel Calibration (Eye Width)

- Set Trace Number: The number of the trace used.
- Measured Eye Width [ps]: Value of the eye width for the set trace number.

CMSI Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	8 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

Purpose and Method

The Common Mode Sinusoidal Interference (CMSI) that is generated by the generator setup is attenuated before it reaches the receiver, and therefore the CMSI amplitude at the Rx input must be calibrated.

The test automation starts with a small CMSI amplitude and increases that value in several steps over a defined range. The minimum amplitude is 0 mV and the maximum amplitude is the maximum value that the data generator can generate. For each step, the procedure measures the actual CMSI with a real-time oscilloscope.

The calibration data is stored in a cal-data table. When measurements are performed, these calibration tables are used to adjust the voltage amplitude to the desired output CMSI.

NOTE **With N5991 PCIe ValiFrame version 5.0, the calibration method for CMSI/DMSI has changed, which means that the calibration data and files from previous versions of the application will not work or will be shown as missing.**

Connection Diagram

The setup is that for Long Channel (refer to Figure 31, Figure 32 and Figure 33 on page 75).

For Seasim as the Eye Calibration Method, the hardware trace is set to the optimal one according to

- the Channel Calibration (16 GT/s),
- the Compliance Eye Calibration (32, 64 GT/s)

while for 8 GT/s the hardware trace is fixed and not changed during the calibrations.

For SigTest as the Eye Calibration Method, the nominal channel is used:

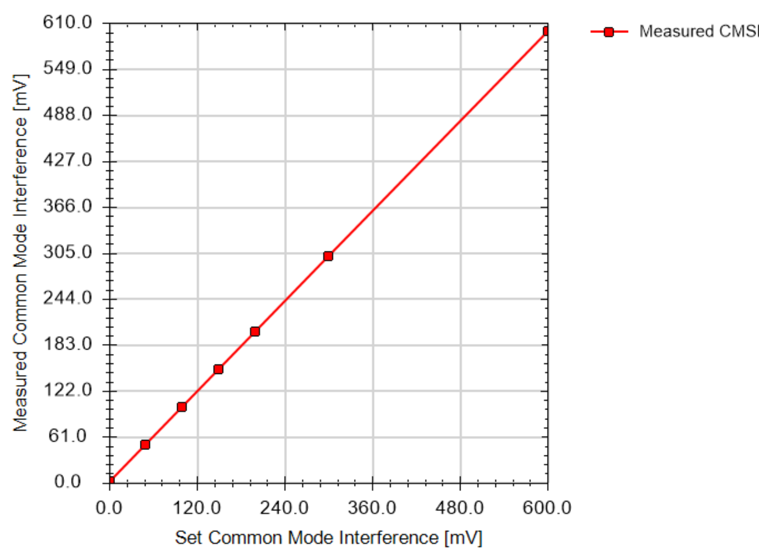
- a –28 dB loss channel for 16 GT/s,
- a –36 dB loss channel for 32 GT/s,

Result Description

L0_Cal_64GTps_CMSI

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline

```
Verification Mode                                       False
----Oscilloscope----
Scope Bandwidth                                         5 GHz
Gen6 Embed Replica Channel                              False
Gen6 Transfer Function File for Package Model on Scope  PCIe6_rev0p7_refpkg_EndPoin
Package Loss at 2.1GHz                                  -0.868 dB
Scope Connection for Calibration                        Chan 1 3 Direct Connect
----Channel----
Trace Number                                            9
Total Channel Loss                                      -33 dB
----Generator----
Set DMSI                                                100 mV
----Instruments----
...
```

Set CMSI [mV]	Measured CMSI [mV]
0.00	2.00
50.00	50.50
100.00	100.22
150.00	150.13
200.00	200.08
300.00	300.04
600.00	600.01

Figure 57 Example result for CM Sinusoidal Interference Calibration

- Set CMSI [mV]: Value of CMSI set on the generator.
- Measured CMSI [mV]: Value of CMSI measured with the oscilloscope.

Compliance Eye Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Compliance, Expert		
Data Rates:	8 GT/s (M8040A, M8020A: U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

Purpose and Method

For 32 GT/s and 64 GT/s

This calibration searches for the optimum combination of DMSI, SJ and Launch Voltage values to generate an eye with values of eye height and eye width that are the closest possible to the Compliance Eye Height and Eye Width.

The calibration starts at the channel with the highest loss. In the first step, the eye is measured when the impairments are set to the nominal values. Then, a search algorithm is used to re-calculate the optimum amount of SJ, DMSI and Vdiff. This process is repeated until the eye is in the middle of the specification values or until the “Max Number of Search Steps per Channel” is reached.

If no suitable combination is found, you are requested to connect the channel that is one step down in loss, as specified in the Insertion Loss Calibration.

The search is repeated for each channel (in order of decreasing loss) until a suitable combination of channel, DMSI, SJ and Launch Voltage is found.

If the minimum loss channel is reached and no combination is found, the calibration is considered to have failed.

For 16 GT/s

This calibration searches for the optimum combination of DMSI, SJ and Launch Voltage values to generate an eye with values of eye height and eye width that are the closest possible to the Compliance Eye Height and Eye Width.

In the first step, the eye is measured with the impairments set to their nominal values and the channel loss previously determined by the Channel Calibration. Then, a search algorithm is used to re-calculate the optimum amount of SJ, DMSI and V_{diff}. This process is repeated until the eye is in the middle of the specifications or until the “Max number of Search Steps” is reached.

If the automatic search does not find a suitable combination of impairments that generates an eye within the specifications (EH between 14 mV and 16 mV and EW between 18.5 ps and 19 ps), it is possible to perform a manual search by manually setting the SJ, DMSI and V_{diff} values.

For 8 GT/s

This procedure checks the possibility of generating an eye height and an eye width that meet the specifications by adding Random Jitter and Differential Mode Sinusoidal Interference.

The method starts with nominal RJ and DMSI values and checks if the obtained eye height and eye width are the target values. If they are not, RJ and DMSI are recalculated with an algorithm that uses the difference between the measured and the target values of the eye amplitudes. The procedure is repeated until the target values are reached or until the “Max Number of Search Steps” is reached. If the “Max Number of Search Steps” is reached, the algorithm checks whether or not the optimum combination of the tested RJ and DMSI meets the specification.

Connection Diagram

Refer to Figure 33 on page 75 (ASIC), Figure 32 on page 74 (CEM) and Figure 34 on page 76 (M.2).

Result Description

For 64G (Compliance Eye Calibration)

L0_Cal_64GTps_CompEye

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Calibration, 64G Pulsewidth Jitter Calibratior Compliance Eye Calibration; Required cal offli Calibration, 64G SNDR Calibration, 64G Inserti cal unknown/unreleased: 64G TxEQ and Launch Vc Calibration, 64G Insertion Loss Calibration, 6
Verification Mode	False
Skip Preset and CTLE Optimization	False
Re-calibrate on Final Channel	False
----Oscilloscope----	
Scope Skew	0 s
Fixed Vertical Scale of Scope Channels	38.1 mV
Do Auto Scale	False
Number of Averages	7
Gen6 Embed Replica Channel	False
Gen6 Transfer Function File for Package Model on Scope	PCIe6_rev0p7_refpkg_EndPoint_pad2pin_60ghz_202
Package Loss at 2.1GHz	-0.868 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 1024
----Generator----	
Pre-Shoot2	-1.3 dB
Pre-Shoot1	4.7 dB
De-Emphasis	0 dB
CMSI	0 V
Random Jitter	250 fs
----Search Algorithm----	
Minimum Vdiff	720 mV
Maximum DMSI	25 mV
Minimum SJ	1.5625 ps
Maximum SJ	3 ps
Max Number of Search Steps	7
----Preset and CTLE Optimization----	
Equalization Preset Range	Q0;Q1;Q2;Q3;Q4;Q5;Q6;Q7;Q8;Q9
DMSI	15 mV
Sinusoidal Jitter	1.5625 ps
Number of Averages	7
----Instruments----	

...

Trace []	Loss [dB]	CTLE [dB]	Vertical Scaling [mV]	Pre-Shoot 2 [dB]	Pre-Shoot 1 [dB]	De-Emphasis [dB]	DMSI [mV]	SJ [ps]	VDiff [mV]	Eye Height [mV]	Eye Width [ps]
9	-33.0	NaN	NaN	0.0	0.0	0.0	5.0	1.000	800	6.00	3.13
9	-33.0	NaN	NaN	0.0	0.0	0.0	5.0	1.000	800	6.00	3.13

Figure 58 Example result for Compliance Eye Calibration (ASIC, 64 GT/s)

- Trace: Number of the trace used.
- Loss: The channel loss corresponding to the trace.
- CTLE [dB]: CTLE DC gain [dB] that results in the maximum eye area (eye height times eye width) for the current channel.
- Vertical Scaling [mV]: The vertical scaling used on the oscilloscope for the measurement.
- Pre-Shoot 2 [dB]: Value of Pre-Shoot 2 that results in the maximum eye area (eye height times eye width) for the current channel.
- Pre-Shoot 1 [dB]: Value of Pre-Shoot 1 that results in the maximum eye area (eye height times eye width) for the current channel.
- De-Emphasis [dB]: Value of de-emphasis that results in the maximum eye area (eye height times eye width) for the current channel.
- DMSI [mV]: The amount of DMSI set using the calibrations.
- SJ [ps]: The amount of SJ set using the calibrations.
- VDiff [mV]: The differential voltage set using the calibrations.
- Eye Height [mV]: The measured eye height.
- Eye Width [ps]: The measured eye width.

For 32G (Compliance Eye Calibration)

L0_Cal_32GTps_CompEye

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Re Voltage Calibration, 32G Insertion Loss Calibrati Required cal offline: 32G TxEQ and Launch Voltage 32G Pre Compliance Eye Calibration; Required cal Calibration, 32G Insertion Loss Calibration, 32G
Verification Mode	False
Gen5 Fixture	PCIe 5.0 FR4 Base Fixture
Gen5 Asic Eye Calibration Method	Seasim
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	7
Number of Waveform Averages	1024
Gen5 Embed Replica Channel	False
Gen5 Transfer Function File for Package Model on Scope	PCIe5RxPackageModel_08_01_2019_EndPoint.tf4
Package Loss at 2.1GHz	-0.82 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 512
----Calibration Flow----	
Skip Preset and CTLE Optimization	False
Re-calibrate on Final Channel	False
----Preset and CTLE Optimization----	
Presets Range	P5;P6;P9
DMSI	15 mV
SJ	5 ps
Number of Averages	7
----Channel----	
Trace Number	37
Total Channel Loss	-37 dB
----Generator----	
Pre-Shoot	1.9 dB
De-Emphasis	0 dB
Sinusoidal Jitter Frequency	100 MHz
Common Mode Interference	0 V
Random Jitter	500 fs
----Search Algorithm----	
Minimum Vdiff	720 mV
Maximum DMSI	30 mV
Maximum SJ	5 ps
Max Number of Search Steps per Channel	4
----Instruments----	

...

ISI Pair []	Channel Loss [dB]	CTLE [dB]	Pre-Shoot [dB]	De-Emphasis [dB]	DMSI [mV]	SJ [ps]	Vdiff [mV]	Eye Height [mV]	Eye Width [ps]
37	-37.0	0	1.9	0.0	10.0	3.125	800	15.00	9.38
37	-37.0	0	1.9	0.0	10.0	3.125	800	15.00	9.38
37	-37.0	0	1.9	0.0	10.0	3.125	800	15.00	9.38

Figure 59 Example result for Compliance Eye Calibration (ASIC, 32 GT/s)

- ISI Pair: Number of the ISI pair used.
- Channel Loss [dB]: Loss of the channel used.
- CTLE [dB]: Value of the applied CTLE.
- Pre-Shoot [dB]: Value of Pre-Shoot that results in the maximum eye area (eye height times eye width) for the current channel.
- De-Emphasis [dB]: Value of de-emphasis that results in the maximum eye area (eye height times eye width) for the current channel.
- DMSI [mV]: The amount of DMSI set using the calibrations.
- SJ [ps]: The amount of SJ set using the calibrations.
- VDiff [mV]: The differential voltage set using the calibrations.
- Eye Height [mV]: The measured eye height.
- Eye Width [ps]: The measured eye width.

For 16G (Compliance Eye Calibration)

L0_Cal_16GTps_CompEye

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Channel Calibration, 16G Final Equalization Pr Initial Equalization Preset Optimization, 16G Voltage Calibration, 16G Insertion Loss Calibr Calibration
Verification Mode	False
Gen4 Fixture	PCI Express 4.0 CEM Fixture Kit
Gen4 ISI Adjustment	Hardware Traces
Gen4 Asic Eye Calibration Method	Seasim
Start With Minimum Loss Channel	False
----Oscilloscope----	
Scope Bandwidth	25 GHz
Number of Averages	21
Number of Waveform Averages	1024
Gen4 Embed Replica Channel	False
Gen4 Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint_v2.tf4
Package Loss at 2.1GHz	-0.99 dB
Step Response Low Time	8 UI
Step Response High Time	120 UI
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 512
----Channel----	
Trace Number	10
Total Channel Loss	-29 dB
----Generator----	
Pre-Shoot	0 dB
De-Emphasis	-6 dB
Sinusoidal Jitter Frequency	100 MHz
Common Mode Interference	0 V
Random Jitter	1 ps
----Search Algorithm----	
Minimum Vdiff	720 mV
Maximum DMSI	25 mV
Maximum SJ	10 ps
Max Number of Search Steps	7
Use nominal EH/EW results from Pre Comp Cal	True
----Instruments----	

...

DMSI [mV]	SJ [ps]	Vdiff [mV]	Eye Height [mV]	Eye Width [ps]	CTLE [dB]
14.0	6.25	800	15.00	18.75	-8.00

Figure 60 Example result for Compliance Eye Calibration (ASIC, 16 GT/s)

- DMSI [mV]: Optimum value of DMSI.
- SJ [ps]: Optimum value of SJ.
- Vdiff [mV]: Optimum value of Differential Voltage.
- Eye Height [mV]: The measured Eye Height.
- Eye Width [ps]: The measured Eye Width.
- CTLE [dB]: Value of the applied CTLE.

For 8G (Compliance Eye Calibration)

L0_Cal_8GTps_LnCh_CompEye

[Not Compliant]

for PCIe 5.0 U.2 Device

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Require DMSI Calibration, 8G Eye Height and Width Calibration; DMSI Calibration, 8G Eye Height and Width Calibration; Calibration, 8G DMSI Calibration, 8G Eye Height and Wi
Verification Mode	False
Target Eye Height	44.5 mV
Target Eye Width	40.5 ps
Max Number of Search Steps	14
Number of Averages	21
Use PCIe3 Transfer Function	False
SigTest Version	3.2.0.3
----Oscilloscope----	
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Instruments----	

...

Step	DMSI [mV]	RJ [ps]	Eye Height [mV]	Eye Width [ps]
Step 0, Auto Search	25.7	1.01	44.5	40.5
Final Result	25.7	1.01	44.5	40.5

Figure 61 Example result for Compliance Eye Calibration (U.2, 8 GT/s)

- Step: Number of the step in the procedure.
- DMSI [mV]: Optimum value of DMSI.
- RJ [ps]: Optimum value of RJ.
- Eye Height [mV]: The measured Eye Height.
- Eye Width [ps]: The measured Eye Width.

Custom Eye Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Compliance Eye Calibration except that, in the custom case, multiple combinations of impairments that lead to values of Eye Height and Eye Width that are within the CTS limits are saved in a custom cal-data table. You can use this data later to select combinations of impairments for Receiver Custom Tests or Link Equalization Custom Tests.

You will be asked to enter values for Differential Voltage, DMSI and Sinusoidal Jitter. All other impairments are fixed. The eye is measured each time a new impairment combination is entered when prompted. If the Eye Height and Eye Width are within the CTS tolerance, this combination will be stored as a cal-data point.

Connection Diagram

Refer to Figure 33 on page 75 (ASIC) and Figure 32 on page 74 (CEM).

The hardware trace is set to the optimal number according to

- Channel Calibration on page 126 (16 GT/s) or
- Compliance Eye Calibration on page 133 (32 GT/s and 64 GT/s).

Result Description

L0_Cal_64GTps_CustEye

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Rec 64G SNDR Calibration, 64G Insertion Loss Calibrati TxEQ and Launch Voltage Calibration, 64G Pulsewidt Calibration, 64G Compliance Eye Calibration; Requi Calibration, 64G SNDR Calibration, 64G Insertion I
----Oscilloscope----	
Scope Skew	0 s
Fixed Vertical Scale of Scope Channels	NaN PV
Do Auto Scale	False
Number of Averages	21
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 1024
----Channel----	
Trace Number	9
Total Channel Loss	-33 dB
----Generator----	
Pre-Shoot2	0 dB
Pre-Shoot1	0 dB
De-Emphasis	0 dB
CMSI	0 V
Random Jitter	250 fs
Generator Launch Voltage	800 mV
DMSI	5 mV
Sinusoidal Jitter	1 ps
----Instruments----	

...

Result	Step	DMSI [mV]	SJ [ps]	VDiff [mV]	Eye Height [mV]	Eye Width [ps]
pass	0	5.0	1.00	800	6.00	3.13
pass	1	10.0	1.00	800	6.00	3.13
pass	2	15.0	1.00	800	6.00	3.13
pass	3	20.0	1.00	800	6.00	3.13
pass	4	25.0	1.00	800	6.00	3.13

Figure 62 Example result for Custom Eye Calibration

- Result: Pass/Fail. “Pass” indicates that the eye height and eye width are within the range required by the specification. When the procedure is running, all points, regardless of whether they pass or fail, are added to the results table, but only the points that pass are added to the cal-data table.
- Step: The number of the step of the procedure.

- DMSI [mV]: Applied differential mode sinusoidal interference.
- SJ [ps]: Applied sinusoidal jitter.
- VDiff [mV]: Applied differential voltage (launch voltage).
- Eye Height [mV]: Measured eye height.
- Eye Width [ps]: Measured eye width.

Custom Eye Scan Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Custom Eye Calibration except that, in the scan case, the values of the impairments are swept instead of being set by the user.

The “Loop levels” property determines the number of impairments to be scanned. For each loop, it is necessary to specify the impairment type and define the range to scan. Then, the test automation combines the defined loops and the eye is measured at each step.

Connection Diagram

Refer to Figure 33 on page 75 (ASIC) and Figure 32 on page 74 (CEM).

The hardware trace is set to the optimal number according to

- Channel Calibration on page 126 (16 GT/s) or
- Compliance Eye Calibration on page 133 (32 GT/s and 64 GT/s).

Results Description

L0_Cal_64GTps_CustScanEye

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Requ Pulsewidth Jitter Calibration, 64G SNDR Calibration Compliance Eye Calibration; Required cal offline: 6 SNDR Calibration, 64G Insertion Loss Calibration, 6 cal unknown/unreleased: 64G TxEQ and Launch Voltage Insertion Loss Calibration, 64G Pre-Compliance Eye
Loop Levels	2
----Oscilloscope----	
Scope Skew	0 s
Fixed Vertical Scale of Scope Channels	NaN PV
Do Auto Scale	False
Number of Averages	21
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 1024
----Loop 1----	
Scan Parameter (Loop 1)	DifferentialModeSinusoidalInterference
DMSI Start Value	5 mV
DMSI Stop Value	25 mV
DMSI Scale Type	Linear
DMSI Number of Steps	11
----Loop 2----	
Scan Parameter (Loop 2)	SinusoidalJitter
Sinusoidal Jitter Start Value	1 ps
Sinusoidal Jitter Stop Value	3 ps
Sinusoidal Jitter Scale Type	Linear
Sinusoidal Jitter Number of Steps	9
----Fixed Parameters----	
Generator Launch Voltage	800 mV
----Channel----	
Trace Number	9
Total Channel Loss	-33 dB
----Generator----	
Pre-Shoot2	0 dB
Pre-Shoot1	0 dB
De-Emphasis	0 dB
CMSI	0 V
Random Jitter	250 fs
----Instruments----	

...

Result	Step	DMSI [mV]	SJ [ps]	VDiff [mV]	Eye Height [mV]	Eye Width [ps]
pass	0	5.0	1.00	800	6.00	3.13
pass	1	5.0	1.25	800	6.00	3.13
pass	2	5.0	1.50	800	6.00	3.13
pass	3	5.0	1.75	800	6.00	3.13
pass	4	5.0	2.00	800	6.00	3.13
pass	5	5.0	2.25	800	6.00	3.13
pass	6	5.0	2.50	800	6.00	3.13
pass	7	5.0	2.75	800	6.00	3.13
pass	8	5.0	3.00	800	6.00	3.13
pass	9	7.0	1.00	800	6.00	3.13
pass	10	7.0	1.25	800	6.00	3.13
pass	11	7.0	1.50	800	6.00	3.13
pass	12	7.0	1.75	800	6.00	3.13
pass	13	7.0	2.00	800	6.00	3.13
pass	14	7.0	2.25	800	6.00	3.13
pass	15	7.0	2.50	800	6.00	3.13
pass	16	7.0	2.75	800	6.00	3.13
pass	17	7.0	3.00	800	6.00	3.13
pass	18	9.0	1.00	800	6.00	3.13
pass	19	9.0	1.25	800	6.00	3.13
pass	20	9.0	1.50	800	6.00	3.13
pass	21	9.0	1.75	800	6.00	3.13
pass	22	9.0	2.00	800	6.00	3.13
pass	23	9.0	2.25	800	6.00	3.13
pass	24	9.0	2.50	800	6.00	3.13
pass	25	9.0	2.75	800	6.00	3.13
pass	26	9.0	3.00	800	6.00	3.13

Figure 63 Example result for Custom Eye Scan Calibration (shows only the beginning of the table)

- Result: Pass/Fail. “Pass” indicates that the eye height and eye width are within the range required by the specification. When the procedure is running, all points, regardless of whether they pass or fail, are added to the results table, but only the points that pass are added to the cal-data table.
- Step: The number of the step of the procedure.
- DMSI [mV]: Applied differential mode sinusoidal interference.
- SJ [ps]: Applied sinusoidal jitter.
- VDiff [mV]: Applied differential voltage (launch voltage).
- Eye Height [mV]: Measured eye height.
- Eye Width [ps]: Measured eye width.

Device Insertion Loss Calibration

Availability

Data Generator:	M8040A, M8020A
Interface Types:	M.2
DUT Types:	Device
Modes:	Compliance, Expert
Data Rates:	8 GT/s

Purpose and Method

The Insertion Loss (IL) of the calibration channels has to be in a well-defined range. This procedure calibrates the insertion loss for different hardware traces.

If the “Measurement Method” parameter is set to VNA (manual), the procedure does not perform any measurement. At the beginning of the calibration it is necessary to specify the variable ISI pair numbers that generate a channel loss of –16.5 dB. In this case, the var ISI pair number for the particular channel must be determined manually by a VNA. The package loss must be added to VNA IL value. With these values, the procedure calculates for every ISI trace the insertion loss from 1 GHz to 4 GHz in steps of 100 MHz. This is the default and recommended method.

If the “Measurement Method” parameter is set to Step Response Scope (auto), the test automation calibrates several traces given by the parameters “Trace Number Start Value” and “Trace Number Stop Value”. For every ISI trace the insertion loss is measured from 1 GHz to 4 GHz in steps of 100 MHz. The IL is measured using the Seasim software.

The calibration data is stored in a cal-data table. This calibration data is used to evaluate the optimal ISI trace for the Rx tests.

Connection Diagram

If the Measurement Method is set to VNA (manual), no connections are needed.

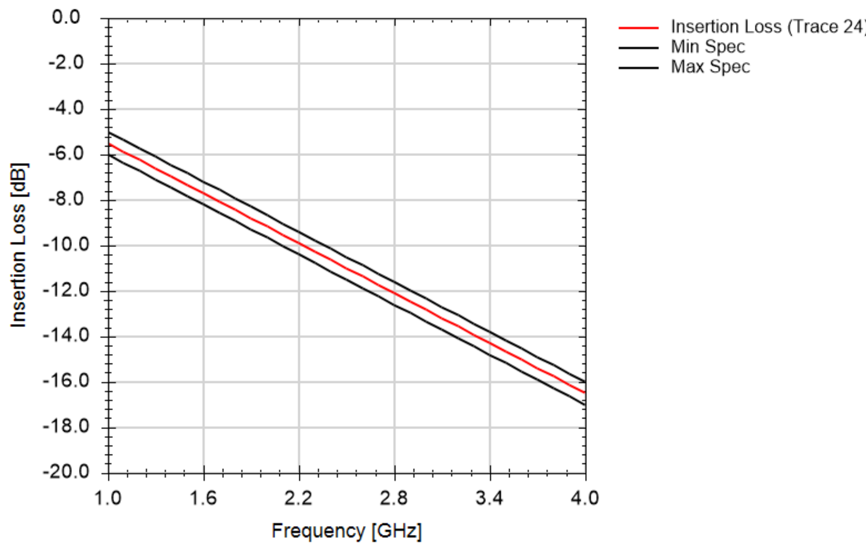
If the Measurement Method is set to Step Response Scope (auto), then the connection setup similar to that shown in Figure 34 on page 76 will be required. At each step, the software will prompt you to increase the hardware trace.

Results Description

L0_Cal_8GTps_Device_IL

[Not Compliant]

for PCIe 5.0 M.2 Device



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required Launch Voltage Calibration; Required cal offline: 8G TxE Calibration; Required cal unknown/unreleased: 8G TxEQ ar
Measurement Method	VNA (manual)
Trace Loss Increment	-0.28 dB
Save Calibration Data	True
Use PCIe3 Transfer Function	False
----Channel----	
ISI Pair Number for Device Setup	24
Channel Loss	0 dB
----Oscilloscope----	
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Instruments----	

...

Frequency [GHz]	Insertion Loss (Trace 24) [dB]	Min Spec [dB]	Max Spec [dB]
1.00	-5.50	-6.00	-5.00
1.10	-5.87	-6.37	-5.37
1.20	-6.23	-6.73	-5.73
1.30	-6.60	-7.10	-6.10
1.40	-6.97	-7.47	-6.47
1.50	-7.33	-7.83	-6.83
1.60	-7.70	-8.20	-7.20
1.70	-8.07	-8.57	-7.57
1.80	-8.43	-8.93	-7.93
1.90	-8.80	-9.30	-8.30
2.00	-9.17	-9.67	-8.67
2.10	-9.53	-10.03	-9.03
2.20	-9.90	-10.40	-9.40
2.30	-10.27	-10.77	-9.77
2.40	-10.63	-11.13	-10.13
2.50	-11.00	-11.50	-10.50
2.60	-11.37	-11.87	-10.87
2.70	-11.73	-12.23	-11.23
2.80	-12.10	-12.60	-11.60
2.90	-12.47	-12.97	-11.97
3.00	-12.83	-13.33	-12.33
3.10	-13.20	-13.70	-12.70
3.20	-13.57	-14.07	-13.07
3.30	-13.93	-14.43	-13.43
3.40	-14.30	-14.80	-13.80
3.50	-14.67	-15.17	-14.17
3.60	-15.03	-15.53	-14.53
3.70	-15.40	-15.90	-14.90
3.80	-15.77	-16.27	-15.27
3.90	-16.13	-16.63	-15.63
4.00	-16.50	-17.00	-16.00

Figure 64 Example result for Device Insertion Loss Calibration (VNA (manual) measurement method)

- Frequency [GHz]: Frequency used in the calculation.
- Insertion Loss (Trace 24) [dB]: Measured insertion loss of Trace 24.
- Min Spec [dB]: Minimum allowed value according to the specification.
- Max Spec [dB]: Maximum allowed value according to the specification.

DMSI Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Compliance, Expert		
Data Rates:	8 GT/s (M8050A: ASIC, CEM; M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

Purpose and Method

The Differential Mode Sinusoidal Interference (DMSI) that is generated by the generator setup is attenuated before it reaches the receiver, and therefore the DMSI amplitude at the Rx input must be calibrated.

The test automation starts with a small DMSI amplitude and increases that value in several steps over a defined range.

For each step, the procedure measures the actual DMSI with a real-time oscilloscope. Measurements are made for two values of CMSI (0 V and 150 mV).

The calibration data is stored in a cal-data table. When measurements are performed, this calibration table is used to adjust the DMSI amplitude to the desired value at the Rx input.

NOTE

With N5991 PCIe ValiFrame version 5.0, the calibration method for CMSI/DMSI has changed, which means that the calibration data and files from previous versions of the application will not work or will be shown as missing.

Connection Diagram

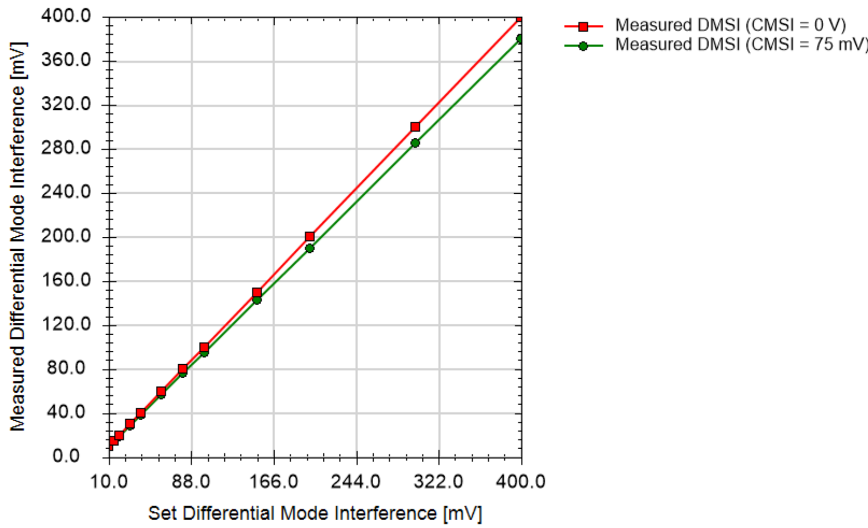
The setup is that for Long Channel (refer to Figure 31 on page 74 and Figure 32, Figure 33, Figure 34) with the hardware trace set to the optimal number according to the Insertion Loss Calibration on page 170 or based on the final channel from the Channel Calibration on page 126 (16 GT/s) or the Compliance Eye Calibration on page 133 (32 GT/s, 64 GT/s).

Result Description

L0_Cal_64GTps_DMSI

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleas 64G Pre-Compliance Eye Calibration, 64G Com Calibration, 64G Pulsewidth Jitter Calibrat Calibration, 64G CM Sinusoidal Interference Loss Calibration, 64G Pre-Compliance Eye Ca
Verification Mode	False
----Oscilloscope----	
Gen6 Embed Replica Channel	False
Gen6 Transfer Function File for Package Model on Scope	PCIe6_rev0p7_refpkg_EndPoint_pad2pin_60ghz_
Package Loss at 2.1GHz	-0.868 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
Scope Bandwidth	5 GHz
----Channel----	
Trace Number	9
Total Channel Loss	-33 dB
----Instruments----	

...

Set DMSI [mV]	Measured DMSI (CMSI = 0 V) [mV]	Measured DMSI (CMSI = 75 mV) [mV]
10.00	10.20	9.70
15.00	15.05	14.30
20.00	20.02	19.02
30.00	30.01	28.51
40.00	40.01	38.01
60.00	60.01	57.01
80.00	80.00	76.00
100.00	100.00	95.00
150.00	150.00	142.50
200.00	200.00	190.00
300.00	300.00	285.00
400.00	400.00	380.00

Figure 65 Example result for DM Sinusoidal Interference Calibration

- Set DMSI [mV]: The value of DMSI set on the data generator.
- Measured DMSI (CMSI = x V) [mV]: The actual DMSI measured with the oscilloscope when CMSI = x V.

Eye Height and Width Calibration

Availability

Data Generator:	M8050A (only CEM), M8040A, M8020A	
Interface Types:	CEM	U.2 and M.2
DUT Types:	Add-In Card System	Device Host
Modes:	Compliance, Expert	
Data Rates:	8 GT/s	

Purpose and Method

This procedure calibrates Eye Height and Eye Width by adding random jitter and differential mode sinusoidal interference (DMSI).

Starting with “Start DMSI”, the Jitter is increased with equally spaced steps from “Start RJ” to “Stop RJ” and the Eye Height and Eye Width are measured. This procedure is then repeated for all remaining DMSI amplitudes.

The eye is measured using the SigTest software.

The calibration data is stored in a cal-data table. When measurements are performed, this calibration table is used to evaluate the optimum amount of DMSI and Random Jitter to get the desired Eye Height and Width.

Connection Diagram

Refer to Figure 32 and Figure 34 on page 76.

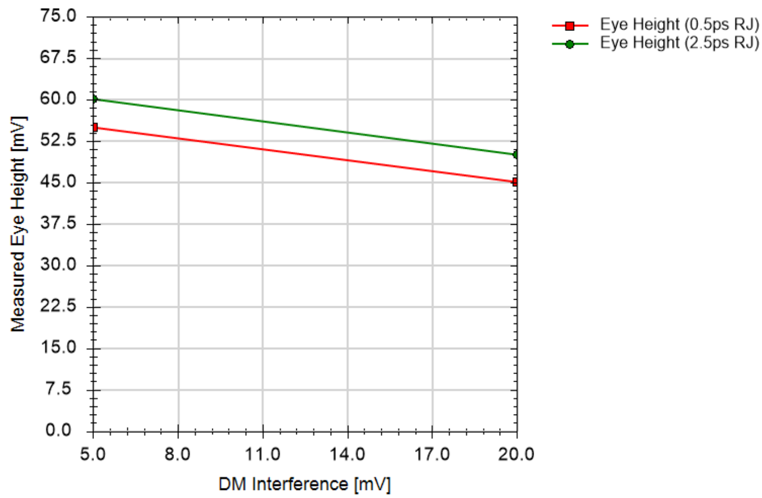
Result Description

Eye Height and Eye Width are presented separately. Since the graphs and tables are very similar, only the results for Eye Height are included here.

L0_Cal_8GTps_CBB3_EH

[Not Compliant]

for PCIe 5.0 AddInCard




```
----General----
Offline                          True
Software Version                 5.0.0.
Calibration Data Version         5.0.0.
Compliant                        False
                                 Procedure offline; Software status unreleased; Re
Non-compliance reason(s)         Calibration, 8G SJ Calibration, 8G DMSI Calibrati
                                 Calibration, 8G SJ Calibration, 8G DMSI Calibrati
                                 Calibration, 8G RJ Calibration, 8G SJ Calibration
Optimize CTLE                    False
CTLE Index                       7
Start DMSI                       5 mV
Stop DMSI                        20 mV
Start RJ                         500 fs
Stop RJ                          2.5 ps
Number of Averages               21
Use PCIe3 Transfer Function      False
----Oscilloscope----
Scope Connection for Calibration Chan 1 3 Direct Connect
----Instruments----
```

...

Set DM Interference [mV]	Eye Height (0.5ps RJ) [mV]	Eye Height (2.5ps RJ) [mV]
5	55.0	60.0
20	45.0	50.0

Figure 66 Example result for Eye Height and Width Calibration (eye height)

- Set DM Interference [mV]: The DMSI set on the instrument.
- Eye Height (X ps RJ) [mV]: The measured eye height for random jitter amplitude of X picoseconds.

Eye Height and Width Measurement

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Compliance Eye Calibration on page 133 except that, here, multiple combinations of impairments that lead to values of eye height and eye width that are within the CTS limits are saved in a report. You can use this data later to select combinations of impairments for Receiver Custom Measurements or Link Equalization Custom Tests.

The Pre-Shoot (Pre-Shoot 2 and Pre-Shoot 1 for 64 GT/s), De-Emphasis, Generator Launch Voltage, DMSI, Random Jitter and Sinusoidal Jitter values can be defined. All other impairments are fixed. The eye is measured each time a new impairment combination is selected when prompted. If the eye height and eye width are within the CTS tolerance, this combination will be stored as a cal-data point.

Connection Diagram

Refer to Figure 33 on page 75 (ASIC) and Figure 32 on page 74 (CEM).

The hardware trace is set to the optimal number based on the Insertion Loss Calibration on page 170.

Result Description

L0_Meas_64GTps_EHEW

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Requi Jitter Calibration, 64G SNDR Calibration, 64G Insert Calibration; Required cal offline: 64G TxEQ and Laun Calibration, 64G Insertion Loss Calibration, 64G Pre unknown/unreleased: 64G TxEQ and Launch Voltage Cali Loss Calibration, 64G Pre-Compliance Eye Calibration
----Oscilloscope----	
Scope Skew	0 s
Fixed Vertical Scale of Scope Channels	38.1 mV
Do Auto Scale	False
Number of Waveform Averages	1024
Number of Averages	7
CTLE	-11 dB
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 1024
Optimize CTLE	True
----Generator----	
Pre-Shoot2	-1.3 dB
Pre-Shoot1	4.7 dB
De-Emphasis	0 dB
Generator Launch Voltage	800 mV
DMSI	15 mV
Random Jitter	250 fs
Sinusoidal Jitter	1.5625 ps
----Instruments----	

...

Set Pre-Shoot2 [dB]	Set Pre-Shoot1 [dB]	Set De-Emphasis [dB]	Set Generator Launch Voltage [mV]	Set DMSI [mV]	Set Random Jitter [ps]	Set Sinusoidal Jitter [ps]	Measured Eye Height [mV]	Measured Eye Width [ps]
-1.30	4.70	0.00	800.00	15.00	0.25	1.56	6.00	3.13
-1.30	4.70	-1.00	800.00	15.00	0.25	1.56	6.00	3.13
-1.30	4.70	-2.00	800.00	15.00	0.25	1.56	6.00	3.13
-1.30	4.70	-3.00	800.00	15.00	0.25	1.56	6.00	3.13

Figure 67 Example result for Eye Height and Width Measurement

- Set Pre-Shoot2 [dB]: The value of Pre-Shoot 2 set in the ValiFrame user interface.
- Set Pre-Shoot1 [dB]: The value of Pre-Shoot 1 set in the ValiFrame user interface.

- Set De-Emphasis [dB]: The value of De-Emphasis set in the ValiFrame user interface.
- Set Generator Launch Voltage [V]: The value of Generator Launch Voltage set in the ValiFrame user interface.
- Set DMSI [mV]: The value of DMSI set in the ValiFrame user interface.
- Set Random Jitter [ps]: The value of Random Jitter set in the ValiFrame user interface.
- Set Sinusoidal Jitter [ps]: The value of Sinusoidal Jitter set in the ValiFrame user interface.
- Measured Eye Height [mV]: The eye height measured on the oscilloscope.
- Measured Eye Width [ps]: The eye width measured with Seasim.

Eye Height and Width Scan

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Eye Height and Width Measurement on page 157 except that, in the scan case, the values of the impairments are swept instead of being set by the user.

The “Loop levels” property determines the number of impairments to be scanned. For each loop, it is necessary to specify the impairment type and to define the range to scan. Then the test automation combines the defined loops and the eye is measured at each step.

Connection Diagram

Refer to Figure 33 on page 75 (ASIC) and Figure 32 on page 74 (CEM).

The hardware trace is set to the optimal number based on the Insertion Loss Calibration on page 170.

Result Description

L0_Scan_64GTps_EHEW

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Requi 64G SNDR Calibration, 64G Insertion Loss Calibratior TxEQ and Launch Voltage Calibration, 64G Pulsewidth Calibration, 64G Compliance Eye Calibration; Require Calibration, 64G SNDR Calibration, 64G Insertion Los
Show Plots	False
Equalization Mode	Presets
Loop Levels	2
----Oscilloscope----	
Scope Skew	0 s
Fixed Vertical Scale of Scope Channels	38.1 mV
Do Auto Scale	False
Number of Waveform Averages	1024
Number of Averages	7
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 1024
Optimize CTLE	True
----Loop 1----	
Scan Parameter (Loop 1)	EqualizationPreset
Equalization Preset Range	Q0;Q1;Q2;Q3;Q4;Q5;Q6;Q7;Q8;Q9
----Loop 2----	
Scan Parameter (Loop 2)	SinusoidalJitter
Sinusoidal Jitter Start Value	1 ps
Sinusoidal Jitter Stop Value	3 ps
Sinusoidal Jitter Scale Type	Linear
Sinusoidal Jitter Number of Steps	9
----Fixed Parameters----	
Generator Launch Voltage	800 mV
DMSI	15 mV
CMSI	0 V
Random Jitter	250 fs
Sinusoidal Jitter Frequency	100 MHz
CTLE	-11 dB
----Instruments----	

...

Set Equalization Preset	Set Sinusoidal Jitter [ps]	Measured Eye Height [mV]	Measured Eye Width [ps]
Q0	1.00	6.00	3.13
Q0	1.25	6.00	3.13
Q0	1.50	6.00	3.13
Q0	1.75	6.00	3.13
Q0	2.00	6.00	3.13
Q0	2.25	6.00	3.13
Q0	2.50	6.00	3.13
Q0	2.75	6.00	3.13
Q0	3.00	6.00	3.13
Q1	1.00	6.00	3.13
Q1	1.25	6.00	3.13
Q1	1.50	6.00	3.13
Q1	1.75	6.00	3.13
Q1	2.00	6.00	3.13
Q1	2.25	6.00	3.13
Q1	2.50	6.00	3.13
Q1	2.75	6.00	3.13
Q1	3.00	6.00	3.13
Q2	1.00	6.00	3.13
Q2	1.25	6.00	3.13
Q2	1.50	6.00	3.13
Q2	1.75	6.00	3.13
Q2	2.00	6.00	3.13

Figure 68 Example result for Eye Height and Width Scan (64 GT/s). Just the beginning of the table is shown here

- Set Equalization Preset: Equalization Preset used.
- Set Sinusoidal Jitter [ps]: Value of SJ used.
- Measured Eye Height [mV]: The eye height measured on the oscilloscope.
- Measured Eye Width [ps]: The eye width measured on the oscilloscope.

Final Equalization Preset Optimization

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	16 GT/s	

Purpose and Method

This procedure measures the Eye Height and Eye Width for each Tx equalization preset when the channel loss has been adjusted to the optimum value. Depending on the Eye Calibration Method selected when configuring the DUT, the eye measurement is performed with either Seasim or SigTest software. Only SigTest is available for CEM.

The calibration data is stored in a cal-data table. This calibration data is used in subsequent procedures to set the preset that gets the largest eye.

Connection Diagram

The setup is that for Long Channel (refer to Figure 33 on page 75 for ASIC and Figure 32 on page 74 for CEM) with the var. ISI Pair set to the optimal one according to the Channel Calibration.

Result Description

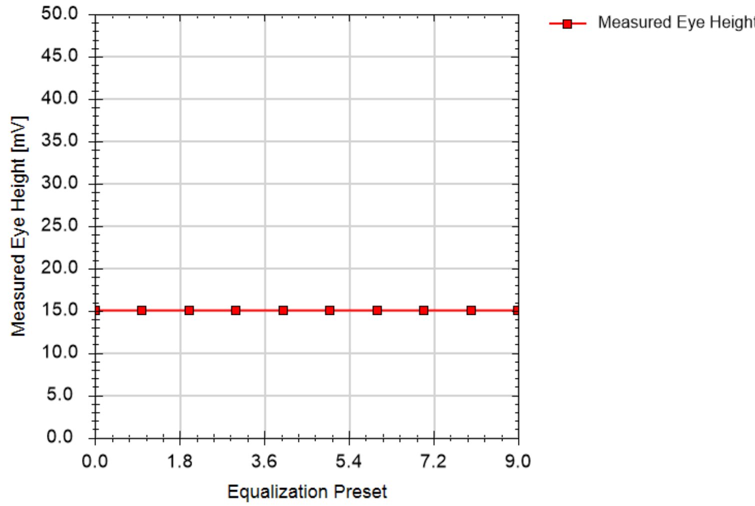
There are two sets of results, one for Eye Height and one for Eye Width. Since the results are very similar, just the results for Eye Height are given here as an example (Figure 69).

The results report the Set Equalization Preset and the Measured Eye Height (Eye Width). If SigTest is used, several values of Eye Height (Eye Width) are reported for various CTLE values.

L0_Cal_16GTps_FinPres_EH

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unre Initial Equalization Preset Optimizatic Calibration, 16G Initial Equalization I Calibration, 16G Insertion Loss Calibra
Equalization Preset Range	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
Gen4 Fixture	PCI Express 4.0 CEM Fixture Kit
Gen4 ISI Adjustment	Hardware Traces
Gen4 Asic Eye Calibration Method	Seasim
Start With Minimum Loss Channel	False
----Oscilloscope----	
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Gen4 Embed Replica Channel	False
Gen4 Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint_v2.tf4
Package Loss at 2.1GHz	-0.99 dB
Step Response Low Time	8 UI
Step Response High Time	120 UI
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 512
----Channel----	
Trace Number	10
Total Channel Loss	-29 dB

```
----Generator----
Generator Launch Voltage                800 mV
DMSI                                    14 mV
CMSI                                    0 V
Random Jitter                           1 ps
Sinusoidal Jitter                       6.25 ps
Sinusoidal Jitter Frequency             100 MHz
----Instruments----
...
```

Set Equalization Preset []	Measured Eye Height [mV]
0.00	15.00
1.00	15.00
2.00	15.00
3.00	15.00
4.00	15.00
5.00	15.00
6.00	15.00
7.00	15.00
8.00	15.00
9.00	15.00

Figure 69 Example result for Final Equalization Preset Optimization (Eye Height) when using Seasim

- Set Equalization Preset: The number of the equalization preset used.
- Measured Eye Height [mV]: Value of the eye height measured for the corresponding preset.

Host Insertion Loss Calibration

Availability

Data Generator:	M8040A, M8020A
Interface Types:	M.2
DUT Types:	Host
Modes:	Compliance, Expert
Data Rates:	8 GT/s

See Device Insertion Loss Calibration on page 148 for all further details of this calibration.

Initial Equalization Preset Optimization

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	16 GT/s	

Purpose and Method

This procedure measures the Eye Height and Eye Width for each Tx equalization preset and several values of CTLE (when using SigTest). When the “Start with Minimum Loss Channel” option is not selected in the Configure DUT dialog, the measurement is performed with a channel loss of –30 dB. When the “Start with Minimum Loss Channel” option is selected, the measurement is performed with a channel loss of –27 dB.

The eye measurement is performed with SigTest or Seasim software. (Seasim is only available for ASIC interfaces.)

A compliance pattern is applied and different impairments, such as random jitter, sinusoidal jitter and differential and common mode sinusoidal inference, are added to the signal.

The calibration data is stored in a cal-data table. This calibration data is used in the Channel Calibration to set the preset that gets the largest eye.

Connection Diagram

The setup is that for Long Channel (refer to Figure 33 on page 75 for ASIC and Figure 32 on page 74 for CEM) with the var. ISI Pair set to either the one that gives the maximum-loss channel (if “Start with Minimum Loss Channel” is unchecked) or the one that gives the minimum-loss channel (if “Start with Minimum Loss Channel” is checked).

Result Description

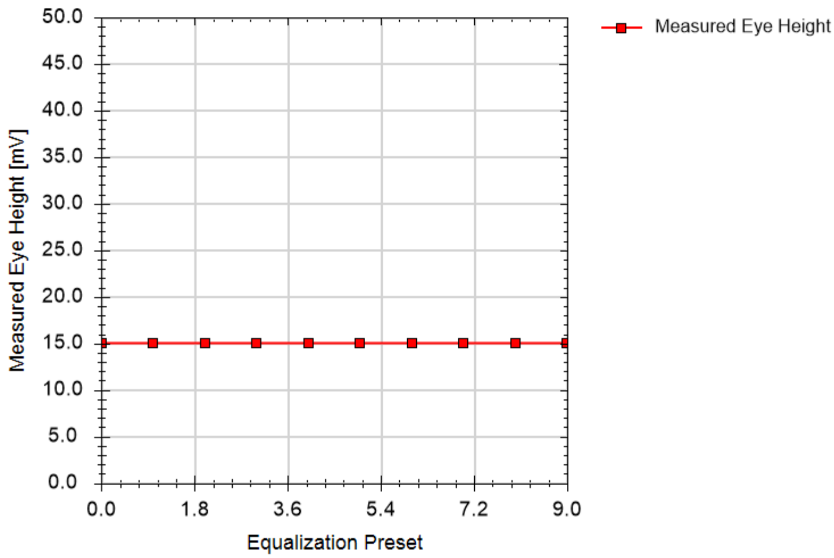
There are two sets of results, one for Eye Height and one for Eye Width. Since the two results are very similar, just the one for Eye Height is presented here.

The results report the Set Equalization Preset and the Measured Eye Height (Eye Width). If SigTest is used, several values of Eye Height (Eye Width) are reported for various CTLE values.

L0_Cal_16GTps_IniPres_EH

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unrel Calibration; Required cal offline: 16G T 16G TxEQ and Launch Voltage Calibration,
Equalization Preset Range	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
Gen4 Fixture	PCI Express 4.0 CEM Fixture Kit
Gen4 ISI Adjustment	Hardware Traces
Gen4 Asic Eye Calibration Method	Seasim
Start With Minimum Loss Channel	False
----Oscilloscope----	
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Gen4 Embed Replica Channel	False
Gen4 Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint_v2.tf4
Package Loss at 2.1GHz	-0.99 dB
Step Response Low Time	8 UI
Step Response High Time	120 UI
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 512

```
----Channel----
Trace Number                                            11
Total Channel Loss                                      -30 dB
----Generator----
Generator Launch Voltage                                800 mV
DMSI                                                    14 mV
CMSI                                                    0 V
Random Jitter                                           1 ps
Sinusoidal Jitter                                       6.25 ps
Sinusoidal Jitter Frequency                             100 MHz
----Instruments----
...
```

Set Equalization Preset []	Measured Eye Height [mV]
0.00	15.00
1.00	15.00
2.00	15.00
3.00	15.00
4.00	15.00
5.00	15.00
6.00	15.00
7.00	15.00
8.00	15.00
9.00	15.00

Figure 70 Example result for Initial Equalization Preset Optimization (Eye Height) when using SigTest

- Set Equalization Preset: The number of the equalization preset used.
- Measured Eye Height [mV]: Value of the eye height for the corresponding preset.

Insertion Loss Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	8 GT/s (M8050A, M8040A, M8020A: ASIC) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

Purpose and Method

The Insertion Loss (IL) of the calibration channels + the replica/additional channel must be in a well-defined range.

For 32 GT/s, 64 GT/s

This procedure calibrates the insertion loss for different hardware traces.

The procedure does not perform any measurement. At the beginning of the calibration, it is necessary to specify the variable ISI pair numbers that generate a channel loss of

- –34 dB to –37 dB in 0.5 dB steps for 32 GT/s
- –30 dB to –33 dB in 0.5 dB steps for 64 GT/s

See Figure 71. Note:

- The var. ISI pair number for the channels must be determined manually using a VNA.
- For 32 and 64 GT/s, the cable from the generator to the ISI traces must **not** be included in the VNA measurement.
- The package model IL must be added to the VNA IL value.
- If no trace can be found with the specified loss, the value “–1” can be entered to mark this trace as not available.

The package model can be changed in the user interface using the parameter “Transfer Function File for Package Model on Scope”. It is a channel-specific common parameter and is visible in the parameter grid when you select “Long Channel” in the left half of the main window of the PCIe ValiFrame user interface.

The calibration data is stored in a cal-data table. This calibration table is used to evaluate the optimum ISI trace for the Rx tests.

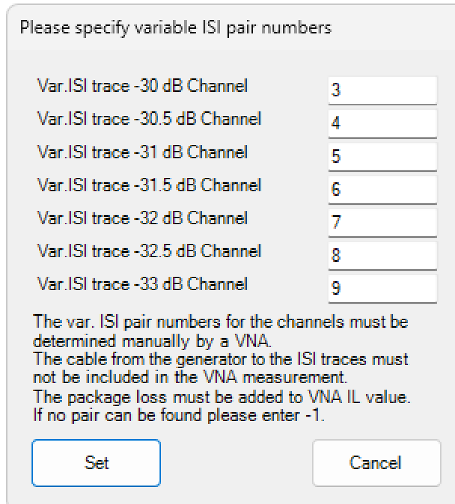


Figure 71 Panel for specifying variable ISI pair numbers in the Insertion Loss Calibration (example for 64 GT/s)

For 16 GT/s

The procedure for 16 GT/s is essentially the same as for 32 GT/s and 64 GT/s except that you can enter only the variable ISI pair numbers that generate the minimum, nominal and maximum channel loss (e.g., for –27 dB, –28 dB and –30 dB). The channels in between will be interpolated. See Figure 72 on page 172.

- The var. ISI pair number for the channels must be determined manually using a VNA.
- For 16 GT/s, the cable from the generator to the ISI traces **must** be included in the VNA measurement.
- The package model IL must be added to the VNA IL value.

The calibration data is stored in a cal-data table. This calibration table is used to evaluate the optimum ISI trace for the Rx tests.

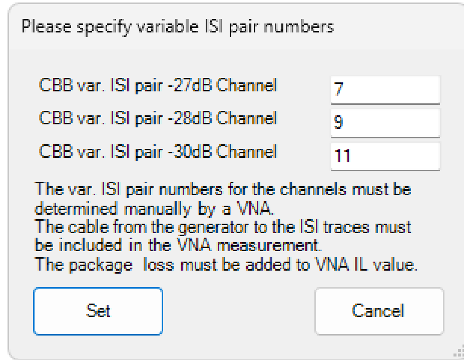


Figure 72 Dialog box for specifying variable ISI pair numbers in the 16G Insertion Loss Calibration

For 8 GT/s

This calibration calculates the Insertion Loss from the step response at three different de-emphasis levels. By adding de-emphasis, IL can be reduced to a certain degree. This procedure is used to compensate IL during the Rx tests.

For every de-emphasis level, the insertion loss is measured from 1 GHz to 4 GHz in steps of 100 MHz. The IL is measured using the Seasim software.

The calibration data is stored in a cal-data table. This calibration data is used to evaluate the optimum amount of de-emphasis for the Rx tests.

Connection Diagram

For 64G, 32G and 16G: None.

For 8G: Refer to Figure 31 on page 74.

Result Description

Example results are shown for 64G, 16G and 8G.

For 64G

L0_Cal_64GTps_IL

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

```
----General----
Offline                                                 True
Software Version                                        5.0.0.
Calibration Data Version                                Unknown
Compliant                                               False
Non-compliance reason(s)                                Procedure offline; Software status
----Oscilloscope----
Gen6 Embed Replica Channel                              False
Gen6 Transfer Function File for Package Model on Scope  PCIe6_rev0p7_refpkg_EndPoint_pad2pi
                                                        08-06_thru.tf4
Package Loss at 2.1GHz                                  -0.868 dB
Scope Connection for Calibration                        Chan 1 3 Direct Connect
----Instruments----
```

...

Channel Loss [dB]	Trace Number []
-30.0	3
-30.5	4
-31.0	5
-31.5	6
-32.0	7
-32.5	8
-33.0	9

Figure 73 Example result for Insertion Loss Calibration (64 GT/s)

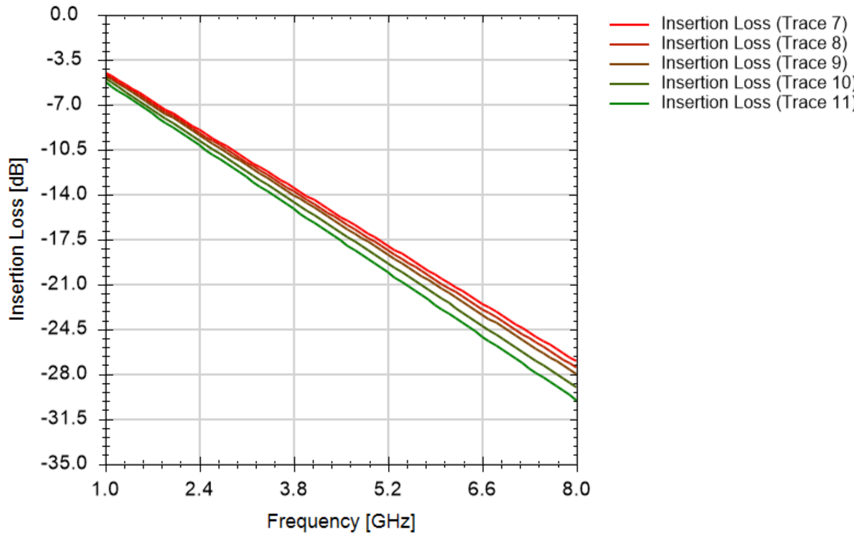
- Channel Loss [dB]: Calculated insertion loss of the channel.
- Trace Number: Number of the trace corresponding to the Channel Loss.

For 16G

L0_Cal_16GTps_IL

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unrel TxEQ and Launch Voltage Calibration; Req Voltage Calibration; Required cal unknow Voltage Calibration
Measurement Method	VNA (manual)
Trace Loss Increment	-0.5 dB
Save Calibration Data	True
Gen4 Fixture	PCI Express 4.0 CEM Fixture Kit
Gen4 ISI Adjustment	Hardware Traces
Gen4 Asic Eye Calibration Method	Seasim
Start With Minimum Loss Channel	False
----Variable ISI pairs----	
CBB var. ISI pair -27dB Channel	7
CBB var. ISI pair -28dB Channel	9
CBB var. ISI pair -30dB Channel	11

```
----Oscilloscope----
Gen4 Embed Replica Channel                            False
Gen4 Transfer Function File for Package Model on Scope   PCIe4RxPackageModel_EndPoin
Package Loss at 2.1GHz                                 -0.99 dB
Step Response Low Time                                 8 UI
Step Response High Time                                120 UI
Scope Connection for Calibration                       Chan 1 3 Direct Connect
----Instruments----
...
```

Frequency [GHz]	Insertion Loss (Trace 7) [dB]	Insertion Loss (Trace 8) [dB]	Insertion Loss (Trace 9) [dB]	Insertion Loss (Trace 10) [dB]	Insertion Loss (Trace 11) [dB]
1.00	-4.45	-4.58	-4.70	-4.95	-5.20
1.10	-4.77	-4.90	-5.03	-5.29	-5.55
1.20	-5.09	-5.23	-5.37	-5.64	-5.91
1.30	-5.42	-5.56	-5.70	-5.98	-6.26
1.40	-5.74	-5.89	-6.03	-6.32	-6.62
1.50	-6.06	-6.21	-6.36	-6.67	-6.97
1.60	-6.38	-6.54	-6.70	-7.01	-7.33
1.70	-6.71	-6.87	-7.03	-7.36	-7.68
1.80	-7.03	-7.20	-7.36	-7.70	-8.03
1.90	-7.35	-7.52	-7.70	-8.04	-8.39
2.00	-7.67	-7.85	-8.03	-8.39	-8.74
2.10	-7.99	-8.18	-8.36	-8.73	-9.10
2.20	-8.32	-8.51	-8.69	-9.07	-9.45
2.30	-8.64	-8.83	-9.03	-9.42	-9.81
2.40	-8.96	-9.16	-9.36	-9.76	-10.16
2.50	-9.28	-9.49	-9.69	-10.10	-10.51
2.60	-9.60	-9.82	-10.03	-10.45	-10.87
2.70	-9.93	-10.14	-10.36	-10.79	-11.22
2.80	-10.25	-10.47	-10.69	-11.13	-11.58
2.90	-10.57	-10.80	-11.02	-11.48	-11.93
3.00	-10.89	-11.13	-11.36	-11.82	-12.29
3.10	-11.22	-11.45	-11.69	-12.17	-12.64
3.20	-11.54	-11.78	-12.02	-12.51	-12.99
3.30	-11.86	-12.11	-12.36	-12.85	-13.35

Figure 74 Example result for Insertion Loss Calibration (16 GT/s)
Just the beginning of the table is shown here

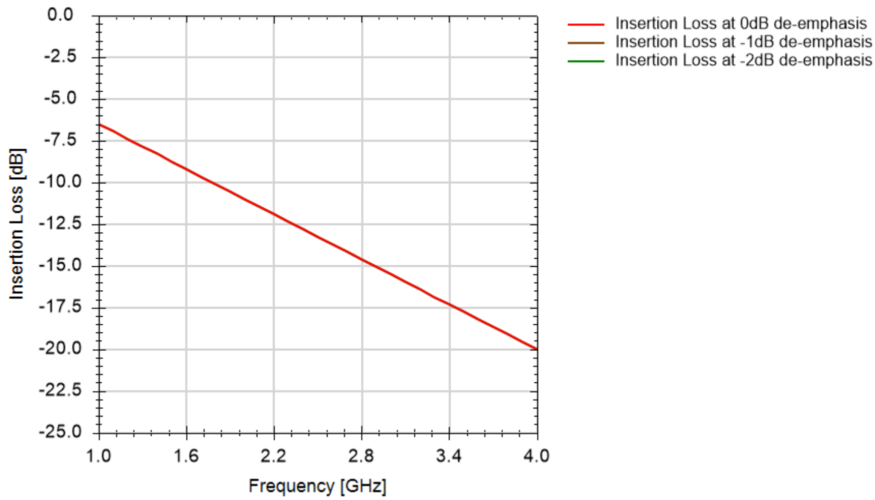
- Frequency [GHz]: Frequency used in the calculation.
- Insertion Loss (Trace X) [dB]: Calculated Insertion Loss for Trace X at the given frequency.

For 8G

L0_Cal_8GTps_LnCh_IL

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 8G TxEQ and Launch Voltage Calibration; Required cal offline: 8G TxEQ and Launch Voltage Calibration; Required cal unknown/unreleased: 8G TxEQ and Launch Voltage Calibration
----Oscilloscope----	
Embed Replica Channel	False
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf4
Package Loss at 2.1GHz	-1.67 dB
Step Response Low Time	8 UI
Step Response High Time	120 UI
Number of Averages for Step Response	2048
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Instruments----	

...

Frequency [GHz]	Insertion Loss at 0dB de-emphasis [dB]	Insertion Loss at -1dB de-emphasis [dB]	Insertion Loss at -2dB de-emphasis [dB]
1.00	-6.50	-6.50	-6.50
1.10	-6.95	-6.95	-6.95
1.20	-7.40	-7.40	-7.40
1.30	-7.85	-7.85	-7.85
1.40	-8.30	-8.30	-8.30
1.50	-8.75	-8.75	-8.75
1.60	-9.20	-9.20	-9.20
1.70	-9.65	-9.65	-9.65
1.80	-10.10	-10.10	-10.10
1.90	-10.55	-10.55	-10.55
2.00	-11.00	-11.00	-11.00
2.10	-11.45	-11.45	-11.45
2.20	-11.90	-11.90	-11.90
2.30	-12.35	-12.35	-12.35
2.40	-12.80	-12.80	-12.80
2.50	-13.25	-13.25	-13.25
2.60	-13.70	-13.70	-13.70
2.70	-14.15	-14.15	-14.15
2.80	-14.60	-14.60	-14.60
2.90	-15.05	-15.05	-15.05
3.00	-15.50	-15.50	-15.50
3.10	-15.95	-15.95	-15.95
3.20	-16.40	-16.40	-16.40
3.30	-16.85	-16.85	-16.85
3.40	-17.30	-17.30	-17.30
3.50	-17.75	-17.75	-17.75
3.60	-18.20	-18.20	-18.20
3.70	-18.65	-18.65	-18.65
3.80	-19.10	-19.10	-19.10
3.90	-19.55	-19.55	-19.55
4.00	-20.00	-20.00	-20.00

Figure 75 Example result for Insertion Loss Calibration (8 GT/s)

- Frequency [GHz]: Frequency used in the calculation.
- Insertion Loss at XdB de-emphasis [dB]: Calculated value of Insertion Loss at X dB de-emphasis at the given frequency.

Pre-Compliance Eye Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

Purpose and Method

This procedure measures the effects on the Eye Height and Eye Width of changes made to each impairment (SJ, DMSI and Launch Voltage) individually.

The calibration measures the eye in a series of four situations, which differ slightly according to data rate.

For 64 GT/s

- All the impairments are set to the minimum values.
- The DMSI is set to the nominal value from the specification.
- The SJ is set to the maximum specification amplitude.
- The differential voltage is set to the minimum specification level.

For 16 GT/s and 32 GT/s

- All the impairments are set to their nominal values.
- The DMSI is set to a value greater than the nominal value from the specification.
- The SJ is set to the maximum specification amplitude.
- The differential voltage is set to the minimum specification level.

At each step, the eye is measured with either Seasim or SigTest software.

The calibration data is stored in a cal-data table. This calibration data is used in the Compliance Eye Calibration to calculate DMSI, SJ and V_{diff} adjustment to meet the target eye.

Connection Diagram

Refer to Figure 33 on page 75 (ASIC) and Figure 32 on page 74 (CEM).

The hardware trace is set to the optimal number based on

- Insertion Loss Calibration on page 170 (for 32 GT/s and 64 GT/s)
- Channel Calibration on page 126 (for 16 GT/s, maximum loss trace)

Result Description

L0_Cal_64GTps_PreComp

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unrel Calibration, 64G SNDR Calibration, 64G I Pulsewidth Jitter Calibration, 64G SNDR Voltage Calibration, 64G Pulsewidth Jitt
----Oscilloscope----	
Scope Skew	0 s
Fixed Vertical Scale of Scope Channels	NaN PV
Do Auto Scale	True
Number of Averages	7
CTLE	NaN dB
Gen6 Embed Replica Channel	False
Gen6 Transfer Function File for Package Model on Scope	PCIe6_rev0p7_refpkg_EndPoint_pad2pin_60g
Package Loss at 2.1GHz	-0.868 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Number of UI	120
Used Pattern	Clock Div 1024
----Channel----	
Trace Number	9
Total Channel Loss	-33 dB
----Generator----	
Pre-Shoot2	0 dB
Pre-Shoot1	0 dB
De-Emphasis	0 dB
CMSI	0 V
Random Jitter	250 fs
----Preset and CTLE Optimization----	
Equalization Preset Range	Q0;Q1;Q2;Q3;Q4;Q5;Q6;Q7;Q8;Q9
DMSI	15 mV
Sinusoidal Jitter	1.5625 ps
Number of Averages	7
----Instruments----	

...

DMSI [mV]	SJ [ps]	VDiff [mV]	Eye Height [mV]	Eye Width [ps]
5.0	1.000	800	5.50	2.83
15.0	1.000	800	4.50	2.50
5.0	3.000	800	3.50	2.00
5.0	1.000	720	4.50	2.50

Figure 76 Example result for Pre-Compliance Eye Calibration

- DMSI [mV]: The amount of applied DMSI.
- SJ [ps]: The amount of applied SJ.
- VDiff [mV]: The applied differential voltage.
- Eye Height [mV]: The measured eye height.
- Eye Width [ps]: The measured eye width.

Processing of Pre-Recorded Steps

Availability

Data Generator:	M8050A, M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point, Root Complex
Modes:	Expert – Custom Procedure
Data Rates:	16 GT/s (M8050A, M8040A, M8020A) 32 GT/s (M8050A, M8040A) 64 GT/s (M8050A, M8040A)

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to Eye Height and Width Scan on page 160, except that the waveform is not measured on the oscilloscope. Previously recorded step responses selected by the user can be used.

Connection Diagram

Refer to Figure 33 on page 75.

The hardware trace is set to the optimal number based on the Insertion Loss Calibration on page 170.

Result Description

The Result Description is the same as that for Eye Height and Width Scan on page 160.

Stressed Jitter Eye Calibration

Availability

Data Generator:	M8050A, M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point Root Complex
Modes:	Compliance, Expert
Data Rates:	8 GT/s

Purpose and Method

This procedure calibrates the eye height and eye width by adding differential mode sinusoidal interference (DMSI) at different random jitter levels.

The calibration is done for random jitter amplitudes of 1 ps, 1.5 ps, 2 ps, 2.5 ps and 3 ps. For each jitter amplitude value, the DMSI is increased from 0 to 30 mV in equally spaced steps. The eye height and width are measured by capturing a step response and using Seasim software. Sinusoidal jitter is always kept at 12.5 ps.

The calibration data is stored in two cal-data tables. This calibration data is used to evaluate the optimum amount of random jitter and DM voltage to get the desired eye.

Connection Diagram

Refer to Figure 31 on page 74.

Result Description

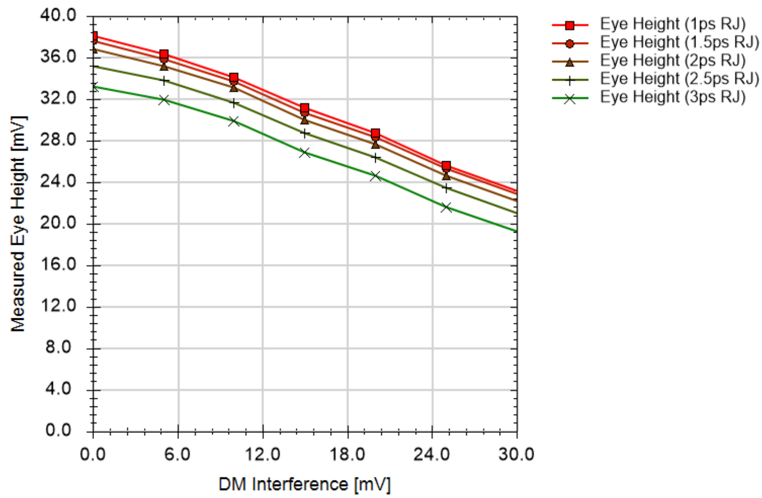
There are two sets of results, one for Eye Height (Figure 77) and one for Eye Width (Figure 78 on page 186).

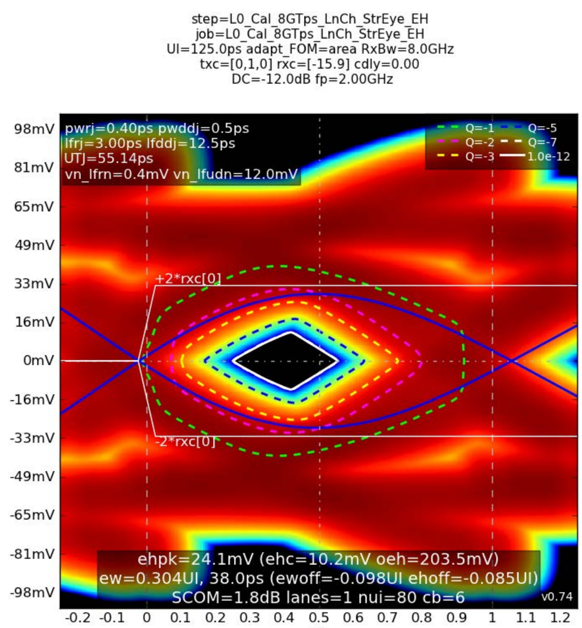
Eye Height

L0_Cal_8GTps_LnCh_StrEye_EH

[Not Compliant]

for PCIe 6.0 EndPoint ASIC





----General----	
Offline	False
Software Version	5.0.0.
Calibration Data Version	5.0.0. '5.0.0.
Compliant	False
Non-compliance reason(s)	Software status unrelease compliant: 8G TxEQ and La Insertion Loss Calibratio unknown/unreleased: 8G Tx Calibration, 8G Insertion
Verification Mode	False
Sinusoidal Jitter	12.5 ps
DM Interference Step Size	5 mV
----Oscilloscope----	
UXR Calibration Mode	Compliance
Sampling Rate	64 GSa/s
Range to Signal Ratio	1.2
Embed Replica Channel	False
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf4
Package Loss at 2.1GHz	-1.67 dB
Step Response Low Time	8 UI
Step Response High Time	120 UI
Number of Averages for Step Response	2048
Scope Connection for Calibration	Chan 1 2 Direct Connect
----Instruments----	

...

Set DM Interference [mV]	Eye Height (1ps RJ) [mV]	Eye Height (1.5ps RJ) [mV]	Eye Height (2ps RJ) [mV]	Eye Height (2.5ps RJ) [mV]	Eye Height (3ps RJ) [mV]
0	38.1	37.6	36.8	35.2	33.2
5	36.3	35.9	35.2	33.8	31.9
10	34.1	33.7	33.1	31.7	29.9
15	31.2	30.7	30.0	28.7	26.9
20	28.7	28.3	27.6	26.4	24.6
25	25.6	25.3	24.6	23.4	21.6
30	23.2	22.9	22.2	21.0	19.2

Figure 77 Example result for Stressed Jitter Eye Calibration (eye height)

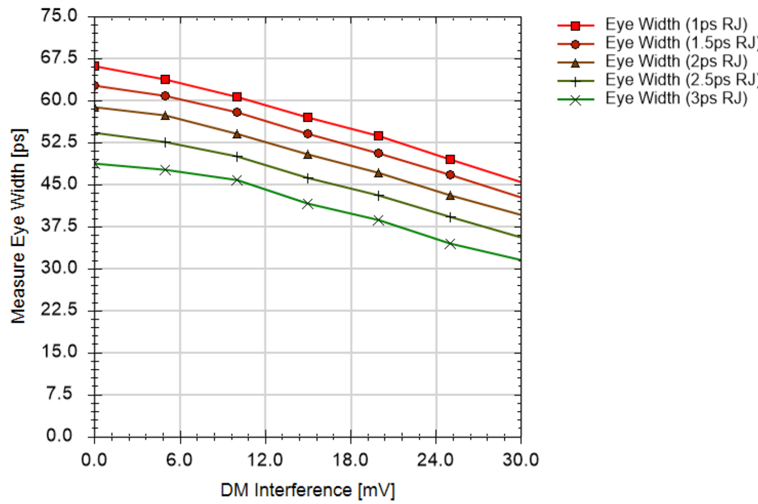
- Set DM Interference [mV]: The amount of DM Interference set on the data generator.
- Eye Height (x ps RJ) [mV]: The measured Eye Height for the set RJ (x ps) and set DM interference.

Eye Width

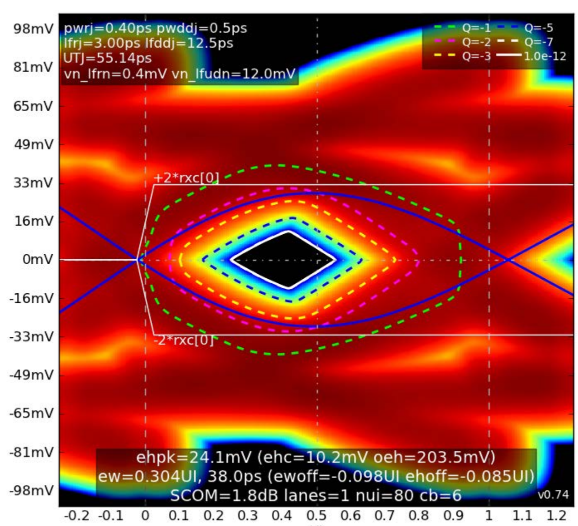
L0_Cal_8GTps_LnCh_StrEye_EW

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



step=L0_Cal_8GTps_LnCh_StrEye_EH
job=L0_Cal_8GTps_LnCh_StrEye_EH
UI=125.0ps adapt_FOM=area RxBw=8.0GHz
txc=[0,1,0] rxc=[-15.9] cdly=0.00
DC=-12.0dB fp=2.00GHz



----General----	
Offline	False
Software Version	5.0.0.
Calibration Data Version	5.0.0. '5.0.0.
Compliant	False
Non-compliance reason(s)	Software status unrelease compliant: 8G TxEQ and La Insertion Loss Calibratio unknown/unreleased: 8G Tx Calibration, 8G Insertion
Verification Mode	False
Sinusoidal Jitter	12.5 ps
DM Interference Step Size	5 mV
----Oscilloscope----	
UXR Calibration Mode	Compliance
Sampling Rate	64 GSa/s
Range to Signal Ratio	1.2
Embed Replica Channel	False
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf4
Package Loss at 2.1GHz	-1.67 dB
Step Response Low Time	8 UI
Step Response High Time	120 UI
Number of Averages for Step Response	2048
Scope Connection for Calibration	Chan 1 2 Direct Connect
----Instruments----	

...

Set DM Interference [mV]	Eye Width (1ps RJ) [ps]	Eye Width (1.5ps RJ) [ps]	Eye Width (2ps RJ) [ps]	Eye Width (2.5ps RJ) [ps]	Eye Width (3ps RJ) [ps]
0	66.1	62.6	58.8	54.3	48.8
5	63.8	60.8	57.3	52.5	47.6
10	60.6	57.9	54.1	50.0	45.8
15	57.0	54.1	50.4	46.1	41.6
20	53.6	50.6	47.0	43.1	38.6
25	49.4	46.6	43.1	39.3	34.5
30	45.5	42.6	39.5	35.6	31.5

Figure 78 Example result for Stressed Jitter Eye Calibration (eye width)

- Set DM Interference [mV]: The amount of DM Interference set on the data generator.
- Eye Width (x ps RJ) [ps]: The measured Eye Width for the set RJ (x ps) and DM interference.

6 Receiver Tests

Once the PCIe Test Station has been calibrated, receiver test procedures can be run.

Overview

The basic principles underlying all PCIe receiver tests are:

- Train the DUT into loopback mode
- Send the training pattern with defined stress characteristics
- Use the error detector to verify that the DUT loops back the correct pattern without errors

Most of the Rx tests constantly change the signal stress to collect more data and re-initialize the loopback mode if the DUT terminates from it. If calibration data is available, the data confirms that the signal stress is at the specified level and test point. If calibration data is missing, a warning message pops up. If you ignore the warning messages explicitly, you can run tests without the calibration data.

NOTE

You do not require a real-time oscilloscope to perform Receiver Tests.

NOTE

Some Rx tests are available only in Expert Mode. This is the case when only "Expert" appears as the Mode under the heading Availability.

PCIe Common Receiver Parameters

The PCIe Common Parameters are listed in the parameter grid (right half) of the main window of the user interface when you click the corresponding group in the procedure tree in the left half of the main window. Clicking a data rate in the procedure tree shows you the data-rate-specific PCIe Common Parameters for that data rate. Similarly, clicking a lane shows you the corresponding lane-specific common parameters and clicking a channel shows you the corresponding channel-specific common parameters.

Details of PCIe Common Receiver Parameters can be found in Table 17 on page 281.

Parameters in Expert Mode for Individual Tests

The PCIe Parameters in expert mode for an individual procedure are not listed in this User Guide explicitly. They are displayed in the parameter grid (right half) of the main window of the user interface when you click the corresponding entry in the procedure tree in the left half of the main window.

Details of PCIe Receiver Parameters for individual procedures can be found in Table 21 on page 309.

Connection Diagrams

In this User Guide, only example connection diagrams are given at the beginning of each chapter, for example for receiver tests. The exact connection diagram for a specific situation can be viewed by right-clicking the appropriate procedure in the procedure tree of the main window of the user interface and selecting “Show Connection...”.

Order of Descriptions of Receiver Tests

The receiver test descriptions are arranged alphabetically (except for “Custom” tests, which are placed directly after their “basic” versions).

To find a procedure description easily, go to Chapter 4, Procedure Tree Overview on page 55, where the procedures are listed in tables in the order they appear in the procedure tree in the application. Each procedure has a link to its description.

Prerequisite Calibrations

Prerequisite calibrations are no longer listed in the description of each procedure in this User Guide. Instead, they are displayed in the application itself. Right-click the appropriate procedure in the procedure tree of the main window of the user interface and select “Required Calibration Data...”. See Required Calibration Data on page 47 for details.

Example Connection Diagrams

For more details, right-click the appropriate procedure in the procedure tree of the user interface and select “Show Connection...”.

Figure 79 shows the connection diagram for receiver tests for ASIC end-point DUTs for M8040A. Note that the setup can differ depending on the ISI channel, clock architecture and external reference clock selection.

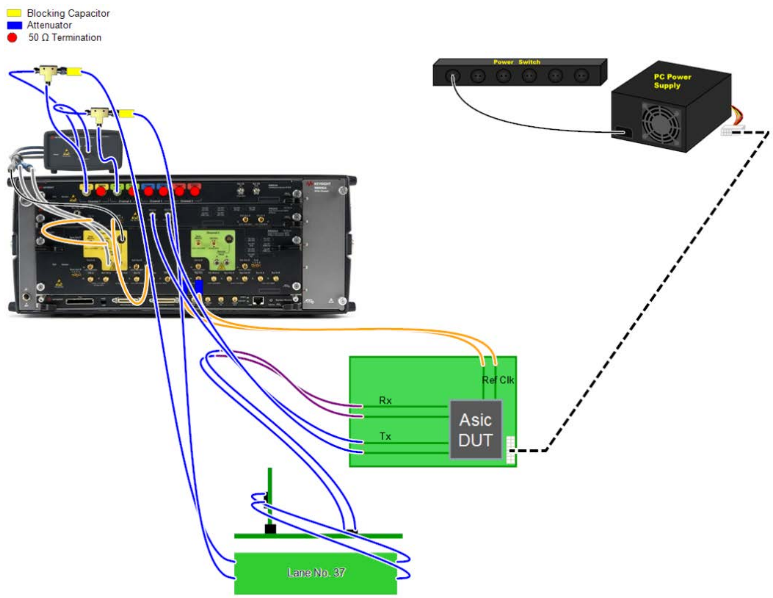


Figure 79 Example connection diagram for ASIC receiver tests (M8040A, 32 GT/s, End Point)

For ASIC Root Complex DUTs the setup differs in the reference clock connection.

NOTE

If an M8047 Redriver is used, it must be connected between the test fixture Tx outputs and the BERT data inputs.

For Redrivers it is important that the setup includes the couplers that are shown in the Connection Diagram in the application.

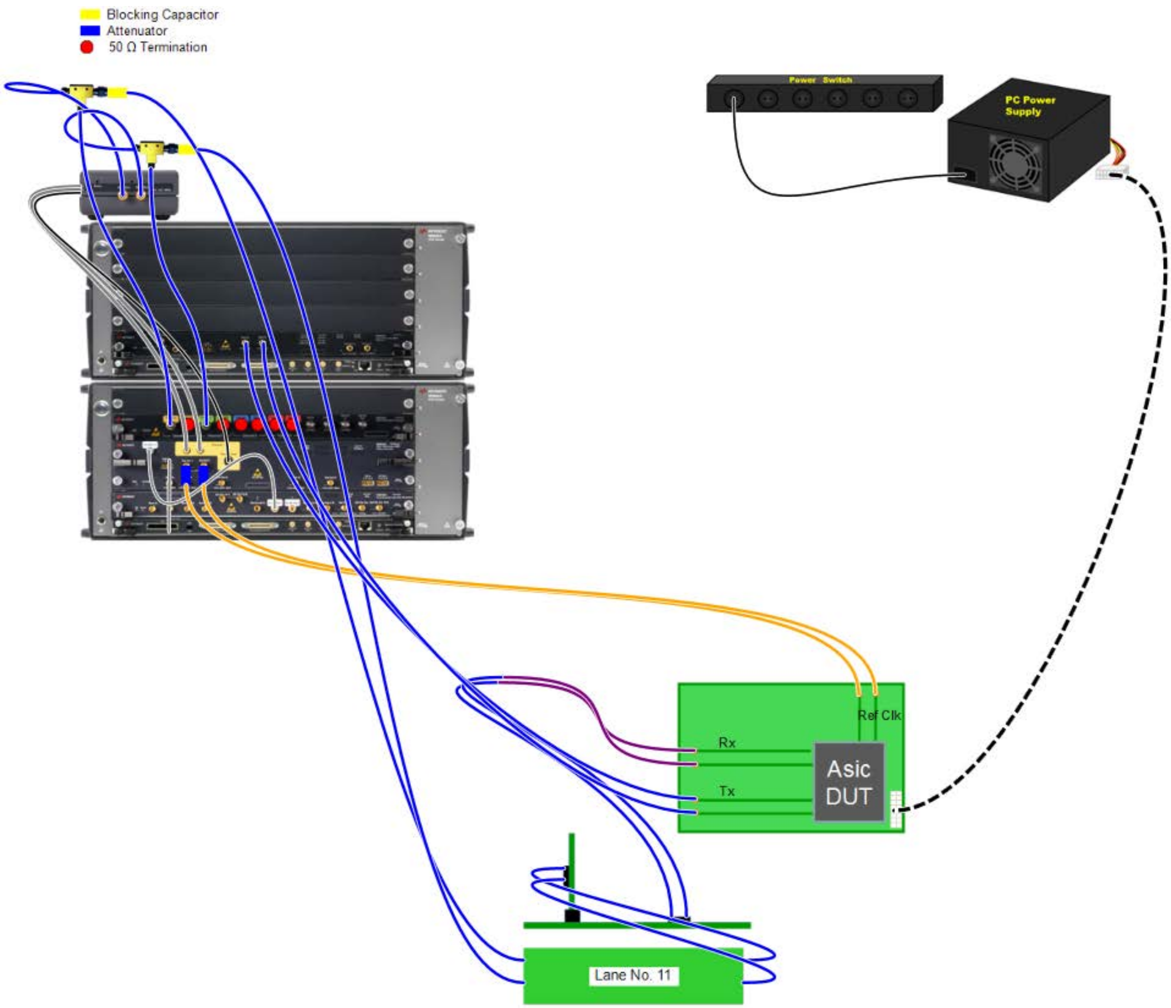


Figure 80 Example connection diagram for ASIC receiver tests (M8050A, 64 GT/s, End Point)

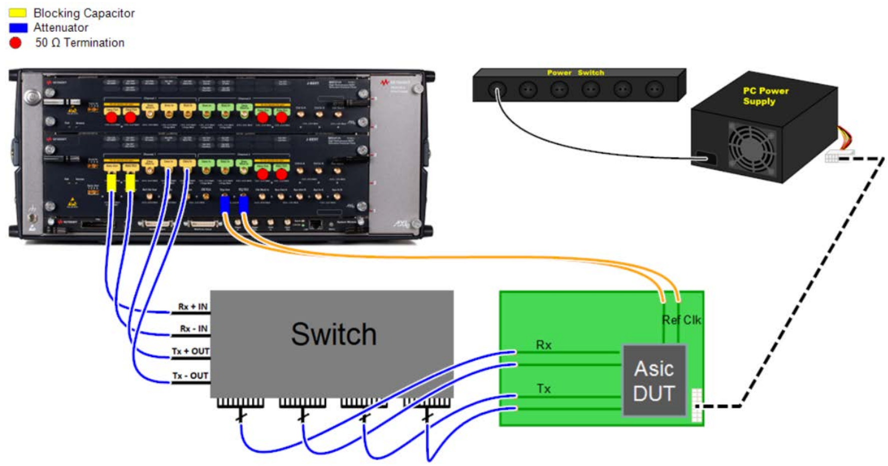


Figure 81 Example connection diagram for ASIC receiver tests with a switch (M8020A, 8 GT/s, End Point)

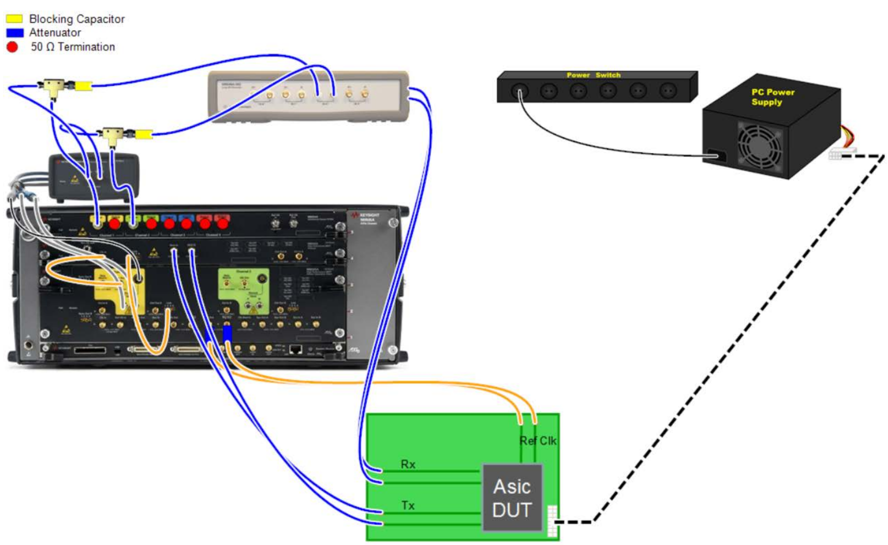


Figure 82 Example connection diagram for ASIC receiver tests (M8040A, 5 GT/s, End Point)

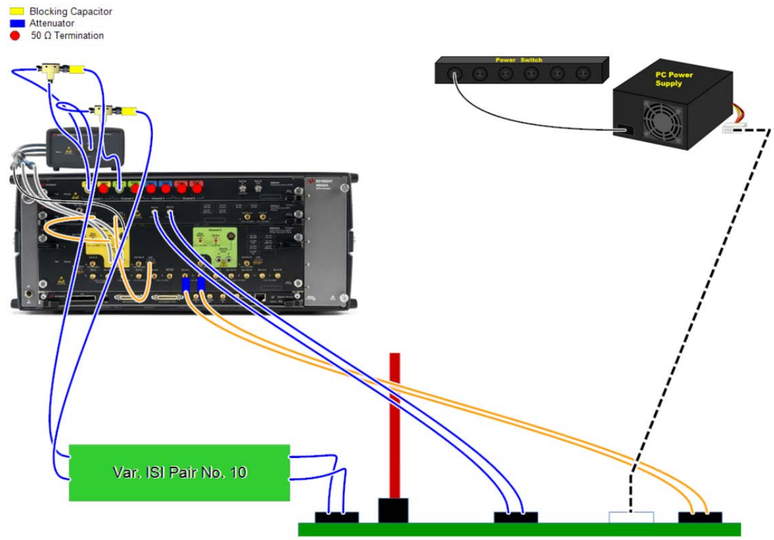


Figure 83 Example connection diagram for CEM receiver tests (M8040A, 16 GT/s, Add-In Card)

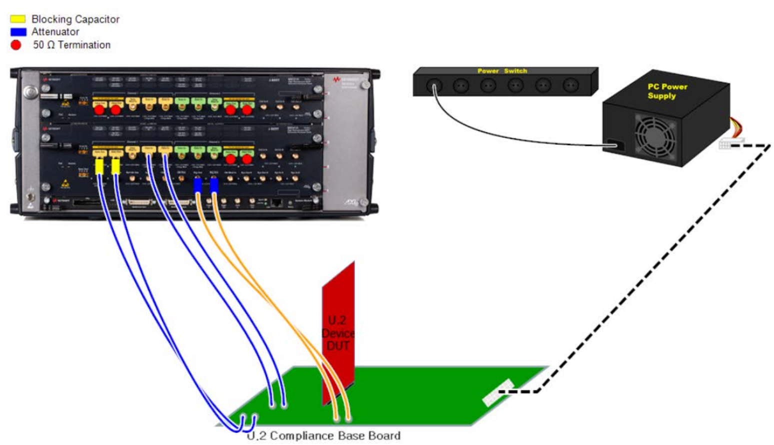


Figure 84 Example connection diagram for U.2 receiver tests (M8020A, 8 GT/s, Device)

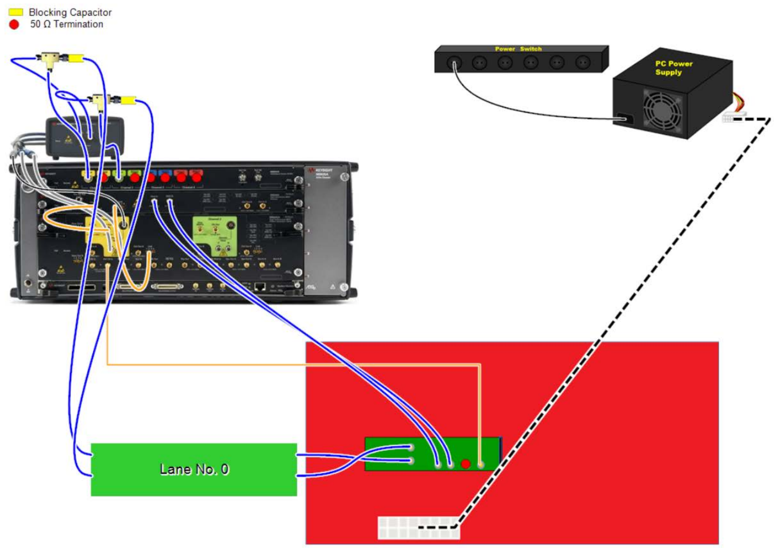


Figure 85 Example connection diagram for M.2 receiver tests (M8040A, 8 GT/s, Host)

Descriptions of Receiver Tests

Rx Compliance Test

Availability

Data Generator:	M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	2.5, 5 GT/s	

Purpose and Method

This test determines whether the DUT meets the receiver specifications. The procedure measures the BER when all jitter types and the eye height are set to their specification limit values (that is, maximum values for jitter, minimum value for eye height). In expert mode, these values can be changed.

Connection Diagram

Refer to Figure 82 on page 193.

Result Description

L0_Rx_5GTps_Complian

[Not Compliant]

PCIe 5.0 AddInCard

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required not compliant: 5G RJ Calibration, 5G De-Emphasis Calibration, 5G Eye Height Calibration; Required cal offline: 5G RJ Calibration, 5G De-Emphasis Calibration, Eye Height Calibration; Required cal unknown/unreleased: RJ Calibration, 5G De-Emphasis Calibration, 5G Eye Heigh Calibration

Specification:
Eye Height for Transition Bits <= 225 mV
Random Jitter(rms) (LF+HF) >= 5.4 ps
SSC Residual(peak-peak) >= 75.0 ps
Low Frequency Deterministic Jitter(peak-peak)(1.5 - 100MHz) >= 30.0 ps
High Frequency Deterministic Jitter(peak-peak)(>100MHz) >= 27.0 ps

Test Properties:

----Eye Height----	
Eye Height	225 mV
----Loopback Training----	
Enable Impairments during Loopback Training	True
Link Training Lane Number	0
Link Training Mode	Static Sequence
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie2_5G_M8040A_Loopback.
Training through	Configuration
----Impairments----	
Use Compliance Impairments	True
Random Jitter	5.4 ps
HF Sinusoidal Jitter	27 ps
HF Sinusoidal Jitter Frequency	150 MHz
SSC Residual	75 ps
----Generator Jitter----	
LF Sinusoidal Jitter Amplitude	30 ps
----BER Measurement----	
BER Mode	TargetBer
Target BER	1E-12
Confidence Level	95 %
Relax Time	3 s

```
----Generator Clock----
Data Rate Deviation                                    0 ppm
Use SSC                                                False
32 GT/s Use SSC                                        True
32 GT/s SSC Deviation                                  5000 ppm
----Loopback Training Settings----
Suppress Loopback Training Messages                    False
----Error Detector----
Manually align error detector sampling point.          False
Fast Alignment                                         False
CDR Loop Bandwidth                                     7.5 MHz
Analyzer Equalization                                  80
Use Auto Analyzer Equalization                         False
Input Range for Loopback Training                      600 mV
CDR Loop Selection                                     Loop1
Threshold                                              0 V
Polarity                                               Normal
----Power Switch Automation----
Use Power Switch Automation                            True
Power Switch Channel Number                            1
Power Cycle Off On Duration                            3 s
Power Cycle Settling Time                              3 s
Power Cycle max. Retries for LB Training               1
----Instruments----
...
```

Result	SJ Frequency [MHz]	SJ Amplitude [ps]	Target BER [ ]	BER [ ]
pass	100.000	30.0	1.000E-012	0.000E+000
pass	15.000	30.0	1.000E-012	0.000E+000
pass	1.500	30.0	1.000E-012	0.000E+000

Figure 86 Example result for Rx Compliance Test

- Result: (pass/fail) “Pass” if the measured BER is smaller than the target BER.
- SJ Frequency [MHz]: Frequency of the applied SJ.
- SJ Amplitude [ps]: Amplitude of the applied SJ.
- Target BER: BER to be achieved.
- BER: Measured BER.

Rx EQ Coefficient Matrix Scan

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Expert		
Data Rates:	8 GT/s (M8050A: ASIC, CEM; M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

Purpose and Method

For 64 GT/s: This procedure measures the BER with a combination of coefficients C+1 (Post-Cursor), C–1 (Pre-Cursor1) and C–2 (Pre-Cursor2) to create a coefficient matrix with the BER results. At each step, for a certain C–2, the BER value is measured for different values of C–1 and C+1. After repeating for different values of C–2, the resulting values are mapped onto triangular matrices, where each element contains four entries (measured BER, pre-shoot, de-emphasis, and boost). Note that the BER level, which determines the color of each tile, will change if FEC is enabled.

For Other Data Rates: This procedure measures the BER with a combination of coefficients C+1 (Post-Cursor) and C–1 (Pre-Cursor) to create a coefficient matrix with the BER results. At each step, the BER value is measured for different values of C+1 coefficients while the C–1 coefficient value is kept constant. The resulting values are mapped onto a triangular matrix, where each element contains four entries (measured BER, pre-shoot, de-emphasis, and boost).

Elements on a diagonal line from bottom left to top right in each triangle have the same maximum boost value. The elements of the matrix are displayed in different colors depending on the measured BER value. If the element appears in green, the entry values are valid and they can be used for testing. As the color changes to red, such values are invalid for testing.

If the parameter “Allow user to enter optimum equalization for remaining tests” (in the parameter grid of the main window of the user interface) is set to ‘True’, a window appears where you can select the values of pre-shoot and de-emphasis from the resulting graph.

Connection Diagram

Refer to Figure 79 on page 191 and Figure 80, Figure 81, Figure 83, Figure 84, Figure 85.

Result Description

L0_Rx_64GTps_EQtable

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unreleased; Required cal not compliant: 6 Jitter Calibration, 64G Pulsewidth Jitter Calibration, 64G SNDR Calibration, Calibration, 64G CM Sinusoidal Interference Calibration, 64G DM Sinusoidal I Jitter Calibration, 64G HF Second Tone Sinusoidal Jitter Calibration, 64G Pu Calibration, 64G AWG Amplitude Correction Calibration, 64G CM Sinusoidal Int 64G Random Jitter Calibration, 64G HF Sinusoidal Jitter Calibration, 64G HF Compliance Eye Calibration, 64G Compliance Eye Calibration, 64G AWG Amplitud
----Impairments----	
Use Compliance Impairments	True
Differential Voltage	800 mV
Random Jitter	190 fs
Common Mode Interference	75 mV
Differential Mode Interference	5 mV
Sinusoidal Jitter	1.5625 ps
Sinusoidal Jitter Frequency	100 MHz
2nd Tone Sinusoidal Jitter	0 s
2nd Tone Sinusoidal Jitter Frequency	210 MHz
Treat 33kHz as separate SJ frequency	True
----Loopback Training----	
Enable Impairments during LB Training	True
Force Retraining at each BER measurement	False
Pre-Shoot2 used for LB Training	-1.3 dB
Pre-Shoot1 used for LB Training	4.7 dB
De-Emphasis used for LB Training	0 dB
Link Training Lane Number	0
Link Training Mode	Interactive
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie6_64G_M8040A_ILT_Loopback_FEC_disabled.tx
Training through	L0-Recovery
Precoding Auto Detection	False
----BER Measurement----	
BER Mode	TargetBer
Target BER	10E-6
Confidence Level	95 %
Relax Time	3 s
----Channel----	
Trace Number	9
Total Channel Loss	-33 dB

----Coefficient Variation----	
Coefficient Divider	24
Maximum Pre-Shoot2 for C-1 = 0 & C+1 = 0	2 dB
Maximum Pre-Shoot1 for C-2 = 0 & C+1 = 0	6 dB
Maximum Boost	9.5 dB
Start Pre-Shoot2	0 dB
Start Pre-Shoot1	0 dB
Start De-Emphasis	0 dB
----Equalization for remaining Rx tests----	
Allow user to enter optimum equalization for remaining Rx tests	True
----Equalization----	
Use Preset	True
Generator Preset	Q5
Pre-Shoot 2	-1.3 dB
Pre-Shoot 1	4.7 dB
De-Emphasis	0 dB
----Generator Clock----	
Data Rate Deviation	0 ppm
Use SSC	False
32 GT/s Use SSC	False
64 GT/s Use SSC	False
Reference Clock	100 MHz
----Loopback Training Settings----	
Use Custom Training Voltage	False
Suppress Loopback Training Messages	False
----Error Detector----	
Enable FEC	False
Manually align error detector sampling point.	False
Fast Alignment	False
CDR Loop Bandwidth	20 MHz
Initial Analyzer Equalization	0
Use Auto Analyzer Equalization	True
Retries for Auto Analyzer Equalization	1
Input Range for Loopback Training	600 mV
Input Range	600 mV
CDR Loop Selection	Loop1
Upper Analyzer Threshold	150 mV
Middle Analyzer Threshold	0 V
Lower Analyzer Threshold	-150 mV
Polarity	Normal
----Interactive Link Training----	
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Select Start Preset Gen4	User Defined
Generator Start Preset Gen4	P5
DUT Initial Preset Gen4	P5
DUT Target Preset Gen4	P5
Select Start Preset Gen5	User Defined
Generator Start Preset Gen5	P5
DUT Initial Preset Gen5	P5
DUT Target Preset Gen5	P6
Select Start Preset Gen6	User Defined
Generator Start Preset Gen6	Q5
DUT Initial Preset Gen6	Q5
DUT Target Preset Gen6	Q5
Drop Link Method	LTSSM

----Power Switch Automation----	
Use Power Switch Automation	True
Power Switch Channel Number	1
Power Cycle Off On Duration	3 s
Power Cycle Settling Time	3 s
Power Cycle max. Retries for LB Training	1

C-2	C-1 C+1	0/24	1/24	2/24	3/24	4/24	5/24	6/24	7/24	8/24
0/24	0/24	BER: 0 Errors PS2: 0.0dB PS1: 0.0dB DE: 0.0dB Boost: 0.0dB	BER: 0 Errors PS2: 0.0dB PS1: 0.0dB DE: -0.8dB Boost: 0.8dB	BER: 0 Errors PS2: 0.0dB PS1: 0.0dB DE: -1.6dB Boost: 1.6dB	BER: 3 Errors PS2: 0.0dB PS1: 0.0dB DE: -2.5dB Boost: 2.5dB	BER: 4.00e-10 PS2: 0.0dB PS1: 0.0dB DE: -3.5dB Boost: 3.5dB	BER: 5.00e-8 PS2: 0.0dB PS1: 0.0dB DE: -4.7dB Boost: 4.7dB	BER: 6.00e-6 PS2: 0.0dB PS1: 0.0dB DE: -6.0dB Boost: 6.0dB	BER: no sync PS2: 0.0dB PS1: 0.0dB DE: -7.6dB Boost: 7.6dB	BER: no sync PS2: 0.0dB PS1: 0.0dB DE: -9.5dB Boost: 9.5dB
0/24	1/24	BER: 0 Errors PS2: 0.0dB PS1: 0.8dB DE: 0.0dB Boost: 0.8dB	BER: 0 Errors PS2: 0.0dB PS1: 0.8dB DE: -0.8dB Boost: 1.6dB	BER: 0 Errors PS2: 0.0dB PS1: 0.9dB DE: -1.7dB Boost: 2.5dB	BER: 4 Errors PS2: 0.0dB PS1: 1.0dB DE: -2.8dB Boost: 3.5dB	BER: 5.00e-10 PS2: 0.0dB PS1: 1.2dB DE: -3.9dB Boost: 4.7dB	BER: 6.00e-8 PS2: 0.0dB PS1: 1.3dB DE: -5.3dB Boost: 6.0dB	BER: 7.00e-6 PS2: 0.0dB PS1: 1.6dB DE: -6.8dB Boost: 7.6dB	BER: no sync PS2: 0.0dB PS1: 1.9dB DE: -8.8dB Boost: 9.5dB	
0/24	2/24	BER: 0 Errors PS2: 0.0dB PS1: 1.6dB DE: 0.0dB Boost: 1.6dB	BER: 0 Errors PS2: 0.0dB PS1: 1.7dB DE: -0.9dB Boost: 2.5dB	BER: 0 Errors PS2: 0.0dB PS1: 1.9dB DE: -1.9dB Boost: 3.5dB	BER: 5 Errors PS2: 0.0dB PS1: 2.2dB DE: -3.1dB Boost: 4.7dB	BER: 6.00e-10 PS2: 0.0dB PS1: 2.5dB DE: -4.4dB Boost: 6.0dB	BER: 7.00e-8 PS2: 0.0dB PS1: 2.9dB DE: -6.0dB Boost: 7.6dB	BER: 8.00e-6 PS2: 0.0dB PS1: 3.5dB DE: -8.0dB Boost: 9.5dB		
0/24	3/24	BER: 0 Errors PS2: 0.0dB PS1: 2.5dB DE: 0.0dB Boost: 2.5dB	BER: 0 Errors PS2: 0.0dB PS1: 2.8dB DE: -1.0dB Boost: 3.5dB	BER: 0 Errors PS2: 0.0dB PS1: 3.1dB DE: -2.2dB Boost: 4.7dB	BER: 6 Errors PS2: 0.0dB PS1: 3.5dB DE: -3.5dB Boost: 6.0dB	BER: 7.00e-10 PS2: 0.0dB PS1: 4.1dB DE: -5.1dB Boost: 7.6dB	BER: 8.00e-8 PS2: 0.0dB PS1: 4.9dB DE: -7.0dB Boost: 9.5dB			
0/24	4/24	BER: 0 Errors PS2: 0.0dB PS1: 3.5dB DE: 0.0dB Boost: 3.5dB	BER: 0 Errors PS2: 0.0dB PS1: 3.9dB DE: -1.2dB Boost: 4.7dB	BER: 0 Errors PS2: 0.0dB PS1: 4.4dB DE: -2.5dB Boost: 6.0dB	BER: 7.00e-12 PS2: 0.0dB PS1: 5.1dB DE: -4.1dB Boost: 7.6dB	BER: 8.00e-10 PS2: 0.0dB PS1: 6.0dB DE: -6.0dB Boost: 9.5dB				
0/24	5/24	BER: 0 Errors PS2: 0.0dB PS1: 4.7dB DE: 0.0dB Boost: 4.7dB	BER: 0 Errors PS2: 0.0dB PS1: 5.3dB DE: -1.3dB Boost: 6.0dB	BER: 0 Errors PS2: 0.0dB PS1: 6.0dB DE: -2.9dB Boost: 7.6dB	BER: 8.00e-12 PS2: 0.0dB PS1: 7.0dB DE: -4.9dB Boost: 9.5dB					
1/24	0/24	BER: 0 Errors PS2: -0.8dB PS1: 0.0dB DE: 0.0dB Boost: 0.0dB	BER: 0 Errors PS2: -0.8dB PS1: 0.0dB DE: -0.8dB Boost: 0.8dB	BER: 0 Errors PS2: -0.9dB PS1: 0.0dB DE: -1.6dB Boost: 1.6dB	BER: 3 Errors PS2: -1.0dB PS1: 0.0dB DE: -2.5dB Boost: 2.5dB	BER: 4.00e-10 PS2: -1.2dB PS1: 0.0dB DE: -3.5dB Boost: 3.5dB	BER: 5.00e-8 PS2: -1.3dB PS1: 0.0dB DE: -4.7dB Boost: 4.7dB	BER: 6.00e-6 PS2: -1.6dB PS1: 0.0dB DE: -6.0dB Boost: 6.0dB	BER: no sync PS2: -1.9dB PS1: 0.0dB DE: -7.6dB Boost: 7.6dB	BER: no sync PS2: -2.5dB PS1: 0.0dB DE: -9.5dB Boost: 9.5dB
1/24	1/24	BER: 0 Errors PS2: -0.8dB PS1: 0.8dB DE: 0.0dB Boost: 0.8dB	BER: 0 Errors PS2: -0.9dB PS1: 0.8dB DE: -0.8dB Boost: 1.6dB	BER: 0 Errors PS2: -1.0dB PS1: 0.9dB DE: -1.7dB Boost: 2.5dB	BER: 4 Errors PS2: -1.2dB PS1: 1.0dB DE: -2.8dB Boost: 3.5dB	BER: 5.00e-10 PS2: -1.3dB PS1: 1.2dB DE: -3.9dB Boost: 4.7dB	BER: 6.00e-8 PS2: -1.6dB PS1: 1.3dB DE: -5.3dB Boost: 6.0dB	BER: 7.00e-6 PS2: -1.9dB PS1: 1.6dB DE: -6.8dB Boost: 7.6dB	BER: no sync PS2: -2.5dB PS1: 1.9dB DE: -8.8dB Boost: 9.5dB	
1/24	2/24	BER: 0 Errors PS2: -0.9dB PS1: 1.6dB DE: 0.0dB Boost: 1.6dB	BER: 0 Errors PS2: -1.0dB PS1: 1.7dB DE: -0.9dB Boost: 2.5dB	BER: 0 Errors PS2: -1.2dB PS1: 1.9dB DE: -1.9dB Boost: 3.5dB	BER: 5 Errors PS2: -1.3dB PS1: 2.2dB DE: -3.1dB Boost: 4.7dB	BER: 6.00e-10 PS2: -1.6dB PS1: 2.5dB DE: -4.4dB Boost: 6.0dB	BER: 7.00e-8 PS2: -1.9dB PS1: 2.9dB DE: -6.0dB Boost: 7.6dB	BER: 8.00e-6 PS2: -2.5dB PS1: 3.5dB DE: -8.0dB Boost: 9.5dB		
1/24	3/24	BER: 0 Errors PS2: -1.0dB PS1: 2.5dB DE: 0.0dB Boost: 2.5dB	BER: 0 Errors PS2: -1.2dB PS1: 2.8dB DE: -1.0dB Boost: 3.5dB	BER: 0 Errors PS2: -1.3dB PS1: 3.1dB DE: -2.2dB Boost: 4.7dB	BER: 6 Errors PS2: -1.6dB PS1: 3.5dB DE: -3.5dB Boost: 6.0dB	BER: 7.00e-10 PS2: -1.9dB PS1: 4.1dB DE: -5.1dB Boost: 7.6dB	BER: 8.00e-8 PS2: -2.5dB PS1: 4.9dB DE: -7.0dB Boost: 9.5dB			
1/24	4/24	BER: 0 Errors PS2: -1.2dB PS1: 3.5dB DE: 0.0dB Boost: 3.5dB	BER: 0 Errors PS2: -1.3dB PS1: 3.9dB DE: -1.2dB Boost: 4.7dB	BER: 0 Errors PS2: -1.6dB PS1: 4.4dB DE: -2.5dB Boost: 6.0dB	BER: 7.00e-12 PS2: -1.9dB PS1: 5.1dB DE: -4.1dB Boost: 7.6dB	BER: 8.00e-10 PS2: -2.5dB PS1: 6.0dB DE: -6.0dB Boost: 9.5dB				
1/24	5/24	BER: 0 Errors PS2: -1.3dB PS1: 4.7dB DE: 0.0dB Boost: 4.7dB	BER: 0 Errors PS2: -1.6dB PS1: 5.3dB DE: -1.3dB Boost: 6.0dB	BER: 0 Errors PS2: -1.9dB PS1: 6.0dB DE: -2.9dB Boost: 7.6dB	BER: 8.00e-12 PS2: -2.5dB PS1: 7.0dB DE: -4.9dB Boost: 9.5dB					

2/24	0/24	BER: 0 Errors PS2: -1.6dB PS1: 0.0dB DE: 0.0dB Boost: 0.0dB	BER: 0 Errors PS2: -1.7dB PS1: 0.0dB DE: -0.8dB Boost: 0.8dB	BER: 0 Errors PS2: -1.9dB PS1: 0.0dB DE: -1.6dB Boost: 1.6dB	BER: 3 Errors PS2: -2.2dB PS1: 0.0dB DE: -2.5dB Boost: 2.5dB	BER: 4.00e-10 PS2: -2.5dB PS1: 0.0dB DE: -3.5dB Boost: 3.5dB	BER: 5.00e-8 PS2: -2.9dB PS1: 0.0dB DE: -4.7dB Boost: 4.7dB	BER: 6.00e-6 PS2: -3.5dB PS1: 0.0dB DE: -6.0dB Boost: 6.0dB	BER: no sync PS2: -4.4dB PS1: 0.0dB DE: -7.6dB Boost: 7.6dB	BER: no sync PS2: -6.0dB PS1: 0.0dB DE: -9.5dB Boost: 9.5dB
2/24	1/24	BER: 0 Errors PS2: -1.7dB PS1: 0.8dB DE: 0.0dB Boost: 0.8dB	BER: 0 Errors PS2: -1.9dB PS1: 0.8dB DE: -0.8dB Boost: 1.6dB	BER: 0 Errors PS2: -2.2dB PS1: 0.9dB DE: -1.7dB Boost: 2.5dB	BER: 4 Errors PS2: -2.5dB PS1: 1.0dB DE: -2.8dB Boost: 3.5dB	BER: 5.00e-10 PS2: -2.9dB PS1: 1.2dB DE: -3.9dB Boost: 4.7dB	BER: 6.00e-8 PS2: -3.5dB PS1: 1.3dB DE: -5.3dB Boost: 6.0dB	BER: 7.00e-6 PS2: -4.4dB PS1: 1.6dB DE: -6.8dB Boost: 7.6dB	BER: no sync PS2: -6.0dB PS1: 1.9dB DE: -8.8dB Boost: 9.5dB	
2/24	2/24	BER: 0 Errors PS2: -1.9dB PS1: 1.6dB DE: 0.0dB Boost: 1.6dB	BER: 0 Errors PS2: -2.2dB PS1: 1.7dB DE: -0.9dB Boost: 2.5dB	BER: 0 Errors PS2: -2.5dB PS1: 1.9dB DE: -1.9dB Boost: 3.5dB	BER: 5 Errors PS2: -2.9dB PS1: 2.2dB DE: -3.1dB Boost: 4.7dB	BER: 6.00e-10 PS2: -3.5dB PS1: 2.5dB DE: -4.4dB Boost: 6.0dB	BER: 7.00e-8 PS2: -4.4dB PS1: 2.9dB DE: -6.0dB Boost: 7.6dB	BER: 8.00e-6 PS2: -6.0dB PS1: 3.5dB DE: -8.0dB Boost: 9.5dB		
2/24	3/24	BER: 0 Errors PS2: -2.2dB PS1: 2.5dB DE: 0.0dB Boost: 2.5dB	BER: 0 Errors PS2: -2.5dB PS1: 2.8dB DE: -1.0dB Boost: 3.5dB	BER: 0 Errors PS2: -2.9dB PS1: 3.1dB DE: -2.2dB Boost: 4.7dB	BER: 6 Errors PS2: -3.5dB PS1: 3.5dB DE: -3.5dB Boost: 6.0dB	BER: 7.00e-10 PS2: -4.4dB PS1: 4.1dB DE: -5.1dB Boost: 7.6dB	BER: 8.00e-8 PS2: -6.0dB PS1: 4.9dB DE: -7.0dB Boost: 9.5dB			
2/24	4/24	BER: 0 Errors PS2: -2.5dB PS1: 3.5dB DE: 0.0dB Boost: 3.5dB	BER: 0 Errors PS2: -2.9dB PS1: 3.9dB DE: -1.2dB Boost: 4.7dB	BER: 0 Errors PS2: -3.5dB PS1: 4.4dB DE: -2.5dB Boost: 6.0dB	BER: 7.00e-12 PS2: -4.4dB PS1: 5.1dB DE: -4.1dB Boost: 7.6dB	BER: 8.00e-10 PS2: -6.0dB PS1: 6.0dB DE: -6.0dB Boost: 9.5dB				
2/24	5/24	BER: 0 Errors PS2: -2.9dB PS1: 4.7dB DE: 0.0dB Boost: 4.7dB	BER: 0 Errors PS2: -3.5dB PS1: 5.3dB DE: -1.3dB Boost: 6.0dB	BER: 0 Errors PS2: -4.4dB PS1: 6.0dB DE: -2.9dB Boost: 7.6dB	BER: 8.00e-12 PS2: -6.0dB PS1: 7.0dB DE: -4.9dB Boost: 9.5dB					

Figure 87 Example result for Rx EQ Coefficient Matrix Scan (64 GT/s)

- Matrix of the BER, Pre-Shoot 2, Pre-Shoot 1, De-Emphasis and Boost values for combinations of C−2 (values listed in first column), C−1 (values listed in second column) and C+1 (values listed in first row).

Rx Custom EQ Coefficient Matrix Scan

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)	

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Rx EQ Coefficient Matrix Scan on page 199, with the difference that you can use combinations of impairments that have been obtained with the Custom Eye Calibration on page 142 or Custom Eye Scan Calibration on page 145.

Rx Jitter Tolerance Test

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Expert		
Data Rates:	2.5 GT/s (M8040A, M8020A: ASIC, CEM) 5 GT/s (M8040A, M8020A: ASIC, CEM) 8 GT/s (M8050A: ASIC, CEM; M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

Purpose and Method

The Rx Jitter Tolerance Test determines how much jitter a DUT can tolerate at different SJ frequencies.

The test procedure applies a search algorithm that is used sequentially over a number of jitter frequencies, which are defined by the parameters in the category Sinusoidal Jitter Variation in the parameter grid.

Frequencies to be tested are defined with the “Frequency Mode” property.

- If ‘User Defined’, ‘Compliance Frequencies’ or ‘Single Frequency’ is selected, the enabled parameter is
  - Jitter frequencies/y
- If ‘Equally Spaced Frequencies’ is selected, the enabled parameters are
  - Start frequency value
  - Stop frequency value
  - Number of frequency steps
  - Frequency sweep scale

Other parameters that govern the jitter variation are

- Start jitter amplitude(s)
- Use fixed number of steps, which can be defined in terms of
  - Jitter step sizes or factors
  - Number of jitter steps
- Show min failed points

At each jitter frequency value, the minimum failed jitter value and the maximum passed jitter value are saved. The passed values are either the maximum jitter amplitudes where the DUT produced no more bit errors than the number of allowed bit errors (if BER Mode is “Fixed Time”) or the maximum jitter amplitude where the BER did not exceed the target BER (if BER Mode is “Target BER”). The results are curves that show the maximum jitter that the DUT can tolerate as a function of the SJ frequency.

There are different methods of finding the maximum passed jitter amplitude. Search Algorithm can be selected as Binary, Linear, Linear with two step sizes, Linear with two step sizes and hysteresis, or Logarithmic.

- With the “Binary” search algorithm, the jitter amplitude is initially set to the middle of the tested range. If the BER test is passed, the jitter amplitude is increased and if the BER test is failed, the amplitude is decreased. The step size is reduced at each step until the target resolution is reached.
- If “Linear” is selected, the test uses the defined step size to increase the jitter amplitude linearly from “Start Jitter” until the BER test fails.
- If “Linear with two step sizes” is selected, the test first uses relatively large steps to increase the jitter amplitude linearly from “Start Jitter”. When the BER test is failed, the jitter amplitude is returned to the last passed point and steps up again with small steps until an error is found again.
- If “Linear with two step sizes and hysteresis” is selected, the test first uses relatively large steps to increase the jitter amplitude linearly from “Start Jitter”. When the BER test is failed, the jitter amplitude goes back down with mid-sized steps (hysteresis) until the BER test is passed again. From that point, the jitter amplitude steps up again with small steps until an error is found again.
- If “Logarithmic” is selected, the test uses the defined step factor to increase the jitter amplitude on a logarithmic scale from “Start Jitter” until the BER test is failed.

Connection Diagram

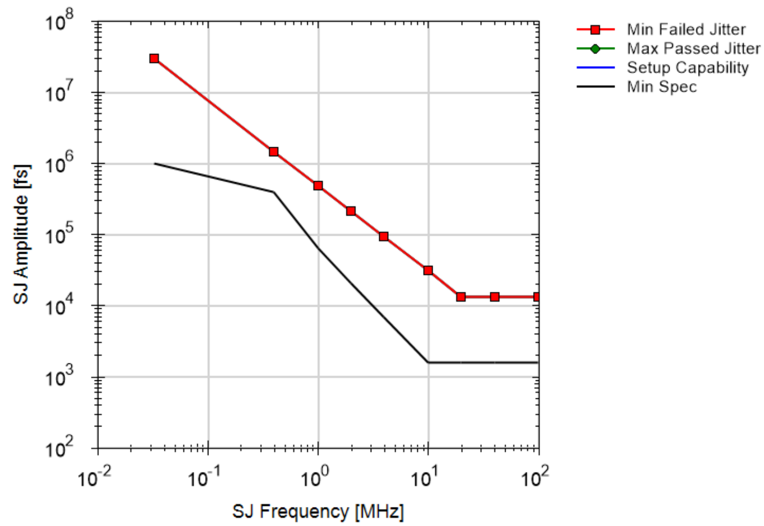
Refer to Figure 79 on page 191 and Figure 80, Figure 81, Figure 82, Figure 83, Figure 84, Figure 85.

Result Description

L0_Rx_64GTps_JTol

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline
----Impairments----	
Use Compliance Impairments	True
Differential Voltage	800 mV
Random Jitter	190 fs
Common Mode Interference	75 mV
Differential Mode Interference	5 mV
2nd Tone Sinusoidal Jitter	0 s
2nd Tone Sinusoidal Jitter Frequency	210 MHz
Treat 33kHz as separate SJ frequency	True
----Loopback Training----	
Enable Impairments during LB Training	True
Force retraining on each frequency	False
Link Training Lane Number	0
Link Training Mode	Interactive
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie6_
Training through	L0-Recovery
Precoding Auto Detection	False

```
----BER Measurement----
BER Mode                                          TargetBer
Target BER                                        10E-6
Confidence Level                                  95 %
Relax Time                                        3 s
----Channel----
Trace Number                                      9
Total Channel Loss                                -33 dB
----Sinusoidal Jitter Variation----
Search Algorithm                                  Linear with 2 step sizes
Frequency mode                                    Compliance Frequencies
Use fixed number of steps                         False
Show min failed points                            True
----Equalization----
Use Preset                                        False
Pre-Shoot 2                                       -0.8 dB
Pre-Shoot 1                                       0.8 dB
De-Emphasis                                       0 dB
----Generator Clock----
Data Rate Deviation                               0 ppm
Use SSC                                           False
32 GT/s Use SSC                                   False
64 GT/s Use SSC                                   False
Reference Clock                                   100 MHz
----Loopback Training Settings----
Use Custom Training Voltage                       False
Suppress Loopback Training Messages               False
----Error Detector----
Enable FEC                                        False
Manually align error detector sampling point.     False
Fast Alignment                                    False
CDR Loop Bandwidth                                20 MHz
Initial Analyzer Equalization                     0
Use Auto Analyzer Equalization                    True
Retries for Auto Analyzer Equalization            1
Input Range for Loopback Training                 600 mV
Input Range                                       600 mV
CDR Loop Selection                                Loop1
Upper Analyzer Threshold                          150 mV
Middle Analyzer Threshold                         0 V
Lower Analyzer Threshold                          -150 mV
Polarity                                          Normal
----Interactive Link Training----
Generator Full Swing                              24
Generator Start Preset                            P5
DUT Initial Preset                                P5
DUT Target Preset                                 P5
Select Start Preset Gen4                          User Defined
Generator Start Preset Gen4                       P5
DUT Initial Preset Gen4                           P5
DUT Target Preset Gen4                            P5
Select Start Preset Gen5                          User Defined
Generator Start Preset Gen5                       P5
DUT Initial Preset Gen5                           P5
DUT Target Preset Gen5                            P6
```

```
Select Start Preset Gen6                    User Defined
Generator Start Preset Gen6                 Q5
DUT Initial Preset Gen6                     Q5
DUT Target Preset Gen6                      Q5
Drop Link Method                            LTSSM
----Power Switch Automation----
Use Power Switch Automation                 True
Power Switch Channel Number                 1
Power Cycle Off On Duration                 3 s
Power Cycle Settling Time                   3 s
Power Cycle max. Retries for LB Training    1
----Instruments----
...
```

Result	SJ Frequency [MHz]	Min Failed Jitter [fs]	Max Passed Jitter [fs]	Setup Capability [fs]	Min Spec [fs]	Margin [%]
pass	0.03	29021500.00	29021500.00	29021500.0	1000000.00	2802.2
pass	0.40	1453600.00	1453600.00	1453600.0	389404.76	273.3
pass	1.00	484100.00	484100.00	484100.0	62465.46	675.0
pass	2.00	210700.00	210700.00	210700.0	20575.95	924.0
pass	4.00	91700.00	91700.00	91700.0	6777.66	1253.0
pass	10.00	30500.00	30500.00	30500.0	1562.50	1852.0
pass	20.00	12900.00	12900.00	12900.0	1562.50	725.6
pass	40.00	12900.00	12900.00	12900.0	1562.50	725.6
pass	100.00	12900.00	12900.00	12900.0	1562.50	725.6

Figure 88 Example result for Rx Jitter Tolerance Test

- Result: “Pass” or “fail”.
- SJ Frequency [MHz]: The frequency of the sinusoidal jitter applied to the test signal.
- Min Failed Jitter [fs]: The first value of SJ amplitude where the DUT did not pass the BER test at a specific frequency.
- Max Passed Jitter [fs]: The maximum value of SJ that the DUT can tolerate at a specific SJ frequency.
- Setup Capability [fs]: The maximum value of jitter that the test setup can generate at a specific SJ frequency.
- Min Spec [fs]: Lower specification limit for jitter.
- Margin [%]: The margin between the max passed jitter and the specification.

Rx Custom Jitter Tolerance Test

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s 32 GT/s 64 GT/s	(M8050A, M8040A, M8020A: ASIC, CEM) (M8050A, M8040A: ASIC, CEM) (M8050A, M8040A: ASIC)

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Rx Jitter Tolerance Test on page 205, with the difference that you can use combinations of impairments that have been obtained with the Custom Eye Calibration on page 142 or Custom Eye Scan Calibration on page 145.

Rx Pre-Compliance Test

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Expert		
Data Rates:	8 GT/s (M8050A: CEM M8040A, M8020A: CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

Purpose and Method

This test verifies that the DUT functions properly in the presence of the compliance eye defined in the specification.

The target eye height and eye width are generated by adding the optimum combination of Differential Mode Sinusoidal Interference, Sinusoidal Jitter and Launch Voltage. Random Jitter and Common Mode Sinusoidal interference are fixed to the nominal values. Then, the BER test is performed for different amplitudes of the sinusoidal jitter. For ASIC the frequency is also varied; otherwise the frequency is kept fixed at 100 MHz.

Connection Diagram

Refer to Figure 79 on page 191 and Figure 80, Figure 83, Figure 84, Figure 85.

Result Description

L0_Rx_64GTps_Comp

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----

Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline

----Impairments----	
Use Compliance Impairments	True
Differential Voltage	800 mV
Random Jitter	190 fs
Common Mode Interference	75 mV
Differential Mode Interference	5 mV
2nd Tone Sinusoidal Jitter	0 s
2nd Tone Sinusoidal Jitter Frequency	210 MHz
Treat 33kHz as separate SJ frequency	True
----Loopback Training----	
Enable Impairments during LB Training	True
Link Training Lane Number	0
Link Training Mode	Interactive
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie6_
Training through	L0-Recovery
Precoding Auto Detection	False
----BER Measurement----	
BER Mode	TargetBer
Target BER	1E-6
Confidence Level	95 %
Relax Time	3 s
----Channel----	
Trace Number	9
Total Channel Loss	-33 dB
----Equalization----	
Use Preset	False
Pre-Shoot 2	-0.8 dB
Pre-Shoot 1	0.8 dB
De-Emphasis	0 dB
----Generator Clock----	
Data Rate Deviation	0 ppm
Use SSC	False
32 GT/s Use SSC	False
64 GT/s Use SSC	False
Reference Clock	100 MHz
----Loopback Training Settings----	
Use Custom Training Voltage	False
Suppress Loopback Training Messages	False
----Error Detector----	
Enable FEC	False
Manually align error detector sampling point.	False
Fast Alignment	False
CDR Loop Bandwidth	20 MHz
Initial Analyzer Equalization	0
Use Auto Analyzer Equalization	True
Retries for Auto Analyzer Equalization	1
Input Range for Loopback Training	600 mV
Input Range	600 mV
CDR Loop Selection	Loop1
Upper Analyzer Threshold	150 mV
Middle Analyzer Threshold	0 V
Lower Analyzer Threshold	-150 mV
Polarity	Normal

```
----Interactive Link Training----
Generator Full Swing                        24
Generator Start Preset                      P5
DUT Initial Preset                          P5
DUT Target Preset                           P5
Select Start Preset Gen4                    User Defined
Generator Start Preset Gen4                 P5
DUT Initial Preset Gen4                     P5
DUT Target Preset Gen4                      P5
Select Start Preset Gen5                    User Defined
Generator Start Preset Gen5                 P5
DUT Initial Preset Gen5                     P5
DUT Target Preset Gen5                      P6
Select Start Preset Gen6                    User Defined
Generator Start Preset Gen6                 Q5
DUT Initial Preset Gen6                     Q5
DUT Target Preset Gen6                      Q5
Drop Link Method                            LTSSM
----Power Switch Automation----
Use Power Switch Automation                 True
Power Switch Channel Number                 1
Power Cycle Off On Duration                 3 s
Power Cycle Settling Time                   3 s
Power Cycle max. Retries for LB Training    1
----Instruments----
...
```

Result	SJ Frequency [MHz]	SJ Amplitude [ps]	Target BER [ ]	Measured BER [ ]
pass	100.000	1.5625	1.000E+000	1.000E+000
pass	40.000	1.5625	1.000E+000	1.000E+000
pass	20.000	1.5625	1.000E+000	1.000E+000
pass	10.000	1.5625	1.000E+000	1.000E+000
pass	4.000	6.7777	1.000E+000	1.000E+000
pass	2.000	20.5759	1.000E+000	1.000E+000
pass	1.000	62.4655	1.000E+000	1.000E+000
pass	0.400	389.4048	1.000E+000	1.000E+000
pass	0.033	1000.0000	1.000E+000	1.000E+000

Figure 89 Example result for Rx Pre-Compliance Test

- Result: “Pass” or “fail”.
- SJ Frequency [MHz]: The calibrated frequency of the sinusoidal jitter.
- SJ Amplitude [ps]: The calibrated amplitude of the sinusoidal jitter.
- Target BER: The maximum value of BER allowed for a “pass” result.
- Measured BER: The measured BER value.

OR, if the BER Mode is selected as Fixed Time,

- Allowed Bit Error: The maximum number of bit errors allowed for a “pass” result.
- Measured Bit Error: The number of bit errors measured.

Rx Custom Pre-Compliance Test

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s 32 GT/s 64 GT/s	(M8040A, M8020A: CEM) (M8050A, M8040A: ASIC, CEM) (M8050A, M8040A: ASIC)

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Rx Pre-Compliance Test on page 211, with the difference that you can use combinations of impairments that have been obtained with the Custom Eye Calibration on page 142 or Custom Eye Scan Calibration on page 145.

Rx Preset Pre-Compliance Test

Availability

Data Generator:	M8050A (only CEM), M8040A, M8020A	
Interface Types:	CEM	U.2 and M.2
DUT Types:	Add-In Card	Device
Modes:	Expert	
Data Rates:	8 GT/s	

Purpose and Method

This test determines if the DUT meets the receiver specifications for different presets.

Eye height, Eye width and sinusoidal jitter are set to the specified values. Eye height and Eye width are generated by adding the appropriate amount of random jitter and DMSI.

The procedure measures the number of errors during “BER Measurement duration” and checks if the “Target BER” is met. In this procedure, presets P7 and P8 are tested.

Connection Diagram

Refer to Figure 84 on page 194.

Result Description

L0_Rx_8GTps_CBB3_PresPreComp

[Not Compliant]

for PCIe 5.0 AddInCard

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline

----Loopback Training----	
Enable Impairments during Loopback Training	True
Link Training Lane Number	0
Link Training Mode	Interactive
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie3_8G_M8040A_ILT_Loopback.
Training through	L0-Recovery
----Impairments----	
Use Compliance Impairments	True
Random Jitter	1.01 ps
Differential Mode Sinusoidal Interference	25.7 mV
Sinusoidal Jitter	12.5 ps
Sinusoidal Jitter Frequency	100 MHz
----Parameter----	
Eye Height	44.5 mV
Eye Width	40.5 ps
----BER Measurement----	
BER Measurement Duration	12.5 s
Target BER	100E-6
Relax Time	3 s
----Equalization----	
Use Preset	True
Generator Preset	P7
Pre-Shoot	3.5 dB
De-Emphasis	-6 dB
----Generator Clock----	
Data Rate Deviation	0 ppm
Use SSC	False
32 GT/s Use SSC	True
32 GT/s SSC Deviation	5000 ppm
----Loopback Training Settings----	
Use Custom Training Voltage	False
Suppress Loopback Training Messages	False
----Interactive Link Training----	
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Drop Link Method	LTSSM
----Error Detector----	
Pause before Auto-Align	False
Manually align error detector sampling point.	False
Fast Alignment	False
CDR Loop Bandwidth	12 MHz
Analyzer Equalization	80
Use Auto Analyzer Equalization	False
Input Range for Loopback Training	600 mV
Input Range	600 mV
CDR Loop Selection	Loop1
Threshold	0 V
Polarity	Normal

```
----Power Switch Automation----
Use Power Switch Automation                True
Power Switch Channel Number                1
Power Cycle Off On Duration                3 s
Power Cycle Settling Time                  3 s
Power Cycle max. Retries for LB Training   1
----Instruments----
...
```

Result	Preset	Target BER [ ]	Measured BER [ ]
pass	P7	1.000E-004	0.000E+000
pass	P8	1.000E-004	0.000E+000

Figure 90 Example result for Rx Preset Pre-Compliance Test

- Result: “Pass” or “fail”.
- Preset: The preset used for the measurement.
- Target BER: The maximum value of BER allowed for a “pass” result.
- Measured BER: The measured BER value.

Rx Pre-Shoot De-Emphasis Scan

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Expert		
Data Rates:	8 GT/s (M8050A: ASIC, CEM; M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM)		

Purpose and Method

The purpose of this test is to find the optimum combination of de-emphasis and pre-shoot amplitudes. As a first step, the procedure sets initial de-emphasis and pre-shoot values and adjusts the eye height to obtain the desired BER (slightly above 1e-9). Then, it retains the initial pre-shoot and performs a de-emphasis scan, measuring the BER for every de-emphasis value. After that, it retains the initial de-emphasis amplitude and makes a pre-shoot scan. Finally, the test shows the result tables, one for the de-emphasis scan and one for the pre-shoot scan. The results let you see the best combination with the initial values that were selected.

Connection Diagram

Refer to Figure 79 on page 191 and Figure 80, Figure 81, Figure 83, Figure 84, Figure 85.

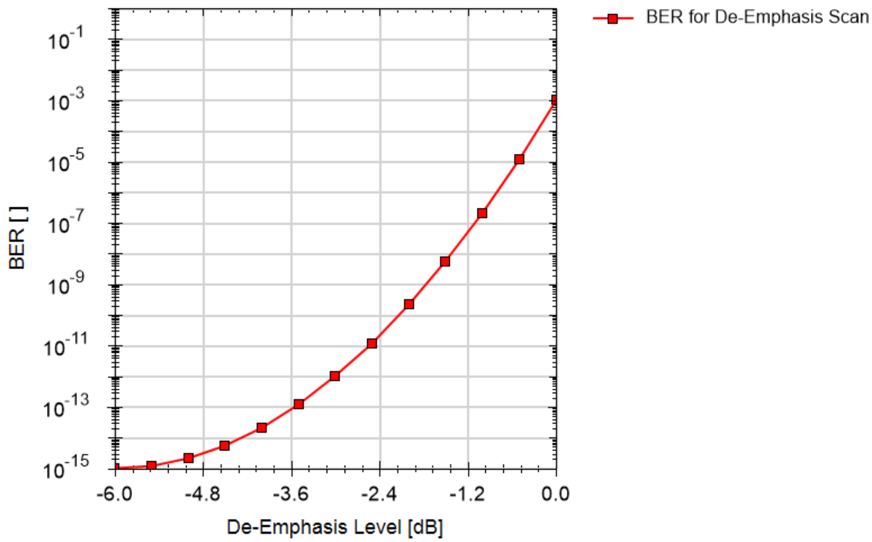
Result Description

The de-emphasis scan and the pre-shoot scan are presented separately.

L0_Rx_32GTps_DeEmphasis_Scan

[Not Compliant]

for PCIe 6.0 EndPoint ASIC




```
----General----
Offline                                  True
Software Version                         5.0.0.
Calibration Data Version                 5.0.0.
Compliant                                False
Non-compliance reason(s)                 Procedure offline

----Impairments----
Use Compliance Impairments                                True
Differential Voltage                                      800 mV
Random Jitter                                             500 fs
Common Mode Interference                                  150 mV
Differential Mode Interference                            0 V
Sinusoidal Jitter                                         3.125 ps
Sinusoidal Jitter Frequency                               100 MHz
2nd Tone Sinusoidal Jitter                                0 s
2nd Tone Sinusoidal Jitter Frequency                      210 MHz
Treat 33kHz as separate SJ frequency                      True
----Loopback Training----
Enable Impairments during Loopback Training               True
Force Retraining at each Preset                           False
Link Training Lane Number                                 0
Link Training Mode                                        Interactive
Link Training Suite Settings File                         C:\ProgramData\BitifEye\ValiFra
                                                          \PCIe\Settings\TrainingScripts\
Training through                                          L0-Recovery
Precoding Auto Detection                                  False
```

----Channel----	
Trace Number	37
Total Channel Loss	-37 dB
----Parameter----	
Scan Order	DeEmphasis first
Initial De-Emphasis	0 dB
Initial Pre-Shoot	1.9 dB
----De-Emphasis Variation----	
Start De-Emphasis	0 dB
Stop De-Emphasis	-6 dB
De-Emphasis Step Size	-0.5 dB
----Pre-Shoot Variation----	
Start Pre-Shoot	0 dB
Stop Pre-Shoot	6 dB
Pre-Shoot Step Size	0.5 dB
----BER Measurement----	
BER Mode	TargetBer
Target BER	30E-12
Confidence Level	95 %
Relax Time	3 s
----Equalization for remaining Rx tests----	
Allow user to enter optimum equalization for remaining Rx tests	True
----Equalization----	
Use Preset	True
Generator Preset	P5
Pre-Shoot	1.9 dB
De-Emphasis	0 dB
----Generator Clock----	
Data Rate Deviation	0 ppm
Use SSC	False
32 GT/s Use SSC	False
64 GT/s Use SSC	False
Reference Clock	100 MHz
----Loopback Training Settings----	
Use Custom Training Voltage	False
Suppress Loopback Training Messages	False
----Interactive Link Training----	
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Select Start Preset Gen4	User Defined
Generator Start Preset Gen4	P5
DUT Initial Preset Gen4	P5
DUT Target Preset Gen4	P5
Select Start Preset Gen5	User Defined
Generator Start Preset Gen5	P5
DUT Initial Preset Gen5	P5
DUT Target Preset Gen5	P6
Drop Link Method	LTSSM
----Error Detector----	
Manually align error detector sampling point.	False
Fast Alignment	False
CDR Loop Bandwidth	20 MHz

```
Analyzer Equalization                                80
Use Auto Analyzer Equalization                       False
Input Range for Loopback Training                    600 mV
Input Range                                          600 mV
CDR Loop Selection                                   Loop1
Threshold                                            0 V
Polarity                                             Normal
----Power Switch Automation----
Use Power Switch Automation                          True
Power Switch Channel Number                          1
Power Cycle Off On Duration                          3 s
Power Cycle Settling Time                            3 s
Power Cycle max. Retries for LB Training             1
----Instruments----
...
```

De-Emphasis Level [dB]	BER for De-Emphasis Scan [ ]
0.00	1.000E-003
-0.50	1.212E-005
-1.00	2.154E-007
-1.50	5.623E-009
-2.00	2.154E-010
-2.50	1.212E-011
-3.00	1.000E-012
-3.50	1.212E-013
-4.00	2.154E-014
-4.50	5.623E-015
-5.00	2.154E-015
-5.50	1.212E-015
-6.00	1.000E-015

Figure 91 Example result for Rx Pre-Shoot De-Emphasis Scan (de-emphasis)

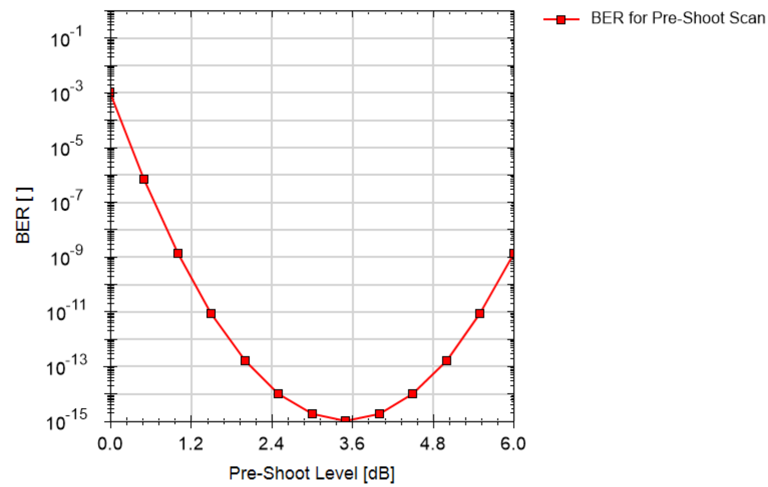
- De-Emphasis Level [dB]: The value of de-emphasis added to the signal for each step.
- BER for De-Emphasis Scan: The BER measured at each de-emphasis level.

The text part of the result for the pre-shoot scan is exactly the same as for the de-emphasis scan in Figure 91 and so is not repeated here.

L0_Rx_32GTps_PreShoot_Scan

[Not Compliant]

for PCIe 6.0 EndPoint ASIC



Pre-Shoot Level [dB]	BER for Pre-Shoot Scan [ ]
0.00	1.000E-003
0.50	6.551E-007
1.00	1.326E-009
1.50	8.286E-012
2.00	1.600E-013
2.50	9.541E-015
3.00	1.758E-015
3.50	1.000E-015
4.00	1.758E-015
4.50	9.541E-015
5.00	1.600E-013
5.50	8.286E-012
6.00	1.326E-009

Figure 92 Example result for Rx Pre-Shoot De-Emphasis Scan (pre-shoot)

- Pre-Shoot Level [dB]: The value of pre-shoot added to the signal for each step.
- BER for Pre-Shoot Scan: The BER measured at each pre-shoot level.

Rx Custom Pre-Shoot De-Emphasis Scan

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s 32 GT/s	(M8050A, M8040A, M8020A: ASIC, CEM) (M8050A, M8040A: ASIC, CEM)

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Rx Pre-Shoot De-Emphasis Scan on page 218, with the difference that you can use combinations of impairments that have been obtained with the Custom Eye Calibration on page 142 or Custom Eye Scan Calibration on page 145.

Rx Sensitivity Test

Availability

Data Generator:	M8050A, M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Expert		
Data Rates:	2.5 GT/s (M8040A, M8020A: ASIC, CEM) 5 GT/s (M8040A, M8020A: ASIC, CEM) 8 GT/s (M8050A: CEM; M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8050A, M8040A, M8020A: ASIC, CEM) 32 GT/s (M8050A, M8040A: ASIC, CEM) 64 GT/s (M8050A, M8040A: ASIC)		

Purpose and Method

This test searches for the minimum Eye Height at which the DUT passes the BER test.

For 16 GT/s, 32 GT/s and 64 GT/s: The procedure starts with “Start DMSI” and increases it in steps of “DMSI Step Size”, which reduces the Eye Height. (Vdiff could also be used to reduce the Eye Height.) The random jitter is held fixed at the compliance value. The Eye Height corresponding to each DMSI value is reported. The minimum passed Eye Height value is the last test point that did not return an error.

For 2.5 GT/s, 5 GT/s and 8 GT/s: The method starts with “Start Eye Height” and decreases it in steps of “Step Size”. The minimum passed value is the last test point that did not return an error.

In principle, it is possible for a DUT to work without error even when the Eye Height is zero, because the Eye Height was calibrated with a reference receiver and the DUT may be better than that.

Connection Diagram

Refer to Figure 79 on page 191 and Figure 80, Figure 82, Figure 83, Figure 84, Figure 85.

Result Description

L0_Rx_64GTps_Sens

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline
----Impairments----	
Use Compliance Impairments	True
Differential Voltage	800 mV
Random Jitter	190 fs
Common Mode Interference	75 mV
Sinusoidal Jitter	1.5625 ps
Sinusoidal Jitter Frequency	100 MHz
2nd Tone Sinusoidal Jitter	0 s
2nd Tone Sinusoidal Jitter Frequency	210 MHz
Treat 33kHz as separate SJ frequency	True
----Loopback Training----	
Enable Impairments during LB Training	True
Link Training Lane Number	0
Link Training Mode	Interactive
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie6_
Training through	L0-Recovery
Precoding Auto Detection	False
----BER Measurement----	
BER Mode	TargetBer
Target BER	10E-6
Confidence Level	95 %
Relax Time	3 s
----Channel----	
Trace Number	9
Total Channel Loss	-33 dB
----Sensitivity Variation----	
Sensitivity Mode	DifferentialModeInterference
Start DMSI	15 mV
Stop DMSI	50 mV
DMSI Step Size	2.5 mV
----Equalization----	
Use Preset	False
Pre-Shoot 2	-0.8 dB
Pre-Shoot 1	0.8 dB
De-Emphasis	0 dB

```
----Generator Clock----
Data Rate Deviation                          0 ppm
Use SSC                                      False
32 GT/s Use SSC                              False
64 GT/s Use SSC                              False
Reference Clock                              100 MHz
----Loopback Training Settings----
Use Custom Training Voltage                  False
Suppress Loopback Training Messages          False
----Error Detector----
Enable FEC                                   False
Manually align error detector sampling point. False
Fast Alignment                               False
CDR Loop Bandwidth                           20 MHz
Initial Analyzer Equalization                0
Use Auto Analyzer Equalization               True
Retries for Auto Analyzer Equalization       1
Input Range for Loopback Training            600 mV
Input Range                                  600 mV
CDR Loop Selection                           Loop1
Upper Analyzer Threshold                     150 mV
Middle Analyzer Threshold                    0 V
Lower Analyzer Threshold                     -150 mV
Polarity                                     Normal
----Interactive Link Training----
Generator Full Swing                         24
Generator Start Preset                       P5
DUT Initial Preset                           P5
DUT Target Preset                            P5
Select Start Preset Gen4                     User Defined
Generator Start Preset Gen4                  P5
DUT Initial Preset Gen4                      P5
DUT Target Preset Gen4                       P5
Select Start Preset Gen5                     User Defined
Generator Start Preset Gen5                  P5
DUT Initial Preset Gen5                      P5
DUT Target Preset Gen5                       P6
Select Start Preset Gen6                     User Defined
Generator Start Preset Gen6                  Q5
DUT Initial Preset Gen6                      Q5
DUT Target Preset Gen6                       Q5
Drop Link Method                             LTSSM
----Power Switch Automation----
Use Power Switch Automation                  True
Power Switch Channel Number                  1
Power Cycle Off On Duration                  3 s
Power Cycle Settling Time                    3 s
Power Cycle max. Retries for LB Training     1
----Instruments----
...
```

Result	Max Passed DMSI [mV]	Eye Height [mV]	Spec Limit [mV]	Margin [%]
pass	47.5	2.8	15.0	216.7

Figure 93 Example result for Rx Sensitivity Test

- Result: Either “pass” or “fail”.
- Max Passed DMSI [mV]: The maximum value of DMSI for which the BER test was passed.
- Eye Height [mV]: The eye height corresponding to the Max Passed DMSI value.
- Spec Limit [mV]: The lower limit of DMSI required by the specification.
- Margin [%]: The margin of the Max Passed DMSI to the Spec Limit.

Rx Custom Sensitivity Test

Availability

Data Generator:	M8050A, M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s 32 GT/s 64 GT/s	(M8050A, M8040A, M8020A: ASIC, CEM) (M8050A, M8040A: ASIC, CEM) (M8050A, M8040A: ASIC)

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Rx Sensitivity Test on page 224, with the difference that you can use combinations of impairments that have been obtained with the Custom Eye Calibration on page 142 or Custom Eye Scan Calibration on page 145.

Rx Stressed Jitter Eye Test

Availability

Data Generator:	M8050A, M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point, Root Complex
Modes:	Expert
Data Rates:	8 GT/s, 16 GT/s

Purpose and Method

For 8 GT/s: This test verifies that the receiver meets the eye width specification. Eye width is set to the minimum of the specification, which is 37.5 ps, and the eye height must be between 22.5 and 27.5 mVpp.

Eye width is generated by adding the combination of Random Jitter and DMSI that also gets as close as possible to the desired eye height. Launch Voltage is fixed to the value used in Stressed Jitter Eye Calibration. Then, the BER test is performed for different frequencies and amplitudes of the sinusoidal jitter.

For 16 GT/s: This test verifies that the DUT properly functions in the presence of the compliance eye defined in the specification.

The target eye height and eye width is generated by adding the optimum combination of Differential Mode Sinusoidal Interference, Sinusoidal Jitter and Launch Voltage. Random Jitter and Common Mode Sinusoidal interference are fixed to the nominal values. Then, the BER test is performed for different frequencies and amplitudes of the sinusoidal jitter.

Connection Diagram

Refer to Figure 80 on page 192 and Figure 81 on page 193.

Result Description

For 8G

L0_Rx_8GTps_LnCh_Stres_Eye

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline
----Impairments----	
Use Compliance Impairments	True
Generator Launch Voltage	800 mV
Random Jitter	2.6 ps
Differential Mode Sinusoidal Interference	6.2 mV
Common Mode Sinusoidal Interference	150 mV
Treat 33kHz as separate SJ frequency	True
----Loopback Training----	
Enable Impairments during Loopback Training	True
Force retraining on each frequency	False
Link Training Lane Number	0
Link Training Mode	Interactive
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie3_
Training through	L0-Recovery
----Eye Parameter----	
Eye Width	300 mUI
Eye Height	25 mV
----BER Measurement----	
BER Mode	TargetBer
Target BER	1E-12
Confidence Level	95 %
Relax Time	3 s
----Equalization----	
Pre-Shoot	0 dB
De-Emphasis	0 dB
----Generator Clock----	
Data Rate Deviation	0 ppm
Use SSC	False
32 GT/s Use SSC	False
64 GT/s Use SSC	False
Reference Clock	100 MHz
----Loopback Training Settings----	
Use Custom Training Voltage	False
Suppress Loopback Training Messages	False

```
----Interactive Link Training----
Generator Full Swing                          24
Generator Start Preset                        P5
DUT Initial Preset                            P5
DUT Target Preset                             P5
Drop Link Method                              LTSSM
----Error Detector----
Pause before Auto-Align                       False
Manually align error detector sampling point. False
Fast Alignment                                False
CDR Loop Bandwidth                            12 MHz
Analyzer Equalization                         80
Use Auto Analyzer Equalization                False
Input Range for Loopback Training             600 mV
Input Range                                   600 mV
CDR Loop Selection                            Loop1
Threshold                                     0 V
Polarity                                      Normal
----Power Switch Automation----
Use Power Switch Automation                   True
Power Switch Channel Number                   1
Power Cycle Off On Duration                   3 s
Power Cycle Settling Time                     3 s
Power Cycle max. Retries for LB Training      1
----Instruments----
...
```

Result	Sinusoidal Jitter Frequency [MHz]	Sinusoidal Jitter [ps]	Target BER [ ]	BER [ ]
pass	100.00	12.50	1.000E-012	0.000E+000
pass	40.00	12.50	1.000E-012	0.000E+000
pass	20.00	12.50	1.000E-012	0.000E+000
pass	10.00	12.50	1.000E-012	0.000E+000
pass	3.00	41.67	1.000E-012	0.000E+000
pass	1.00	125.00	1.000E-012	0.000E+000
pass	0.30	125.00	1.000E-012	0.000E+000
pass	0.03	125.00	1.000E-012	0.000E+000

Figure 94 Example result for 8G Rx Stressed Jitter Eye Test

- Result: “Pass” or “Fail”.
- Sinusoidal Jitter Frequency [MHz]: The sinusoidal jitter frequency set at each step.
- Sinusoidal Jitter [ps]: The sinusoidal jitter amplitude set at each step.
- Allowed Bit Errors: The maximum number of allowed errors to consider the BERT test as a Pass.
- Measured Bit Errors: The number of bit errors that occurred during the test.

OR

- Target BER: The required BER.
- Measured BER: The BER measured.

For 16G

L0_Rx_16GTps_Comp

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Calibration Data Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline
Pause before Auto-Align	False
Sinusoidal Jitter	6.25 ps
----Loopback Training----	
Enable Impairments during Loopback Training	True
Force retraining on each frequency	False
Link Training Lane Number	0
Link Training Mode	Interactive
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie4_
Training through	L0-Recovery
----Channel----	
Trace Number	10
Total Channel Loss	-29 dB
----Impairments----	
Use Compliance Impairments	True
Generator Launch Voltage	800 mV
Random Jitter	1 ps
Common Mode Sinusoidal Interference	150 mV
Differential Mode Sinusoidal Interference	14 mV
2nd Tone Sinusoidal Jitter	0 s
Treat 33kHz as separate SJ frequency	True
----BER Measurement----	
BER Mode	TargetBer
Target BER	1E-12
Confidence Level	95 %
Relax Time	3 s
----Equalization----	
Use Preset	True
Generator Preset	P5
Pre-Shoot	1.9 dB
De-Emphasis	0 dB

```
----Generator Clock----
Data Rate Deviation                              0 ppm
Use SSC                                          False
32 GT/s Use SSC                                  False
64 GT/s Use SSC                                  False
Reference Clock                                  100 MHz
----Loopback Training Settings----
Use Custom Training Voltage                      False
Suppress Loopback Training Messages              False
Use Gen3 EIEOS                                   False
----Interactive Link Training----
Generator Full Swing                             24
Generator Start Preset                           P5
DUT Initial Preset                               P5
DUT Target Preset                                P5
Select Start Preset Gen4                         User Defined
Generator Start Preset Gen4                      P5
DUT Initial Preset Gen4                          P5
DUT Target Preset Gen4                           P5
Drop Link Method                                 LTSSM
----Error Detector----
Manually align error detector sampling point.    False
Fast Alignment                                   False
CDR Loop Bandwidth                               20 MHz
Analyzer Equalization                            80
Use Auto Analyzer Equalization                   False
Input Range for Loopback Training                600 mV
Input Range                                      600 mV
CDR Loop Selection                               Loop1
Threshold                                        0 V
Polarity                                         Normal
----Power Switch Automation----
Use Power Switch Automation                      True
Power Switch Channel Number                      1
Power Cycle Off On Duration                      3 s
Power Cycle Settling Time                        3 s
Power Cycle max. Retries for LB Training         1
----Instruments----
...
```

Result	Sinusoidal Jitter Frequency [MHz]	Sinusoidal Jitter [ps]	Target BER [ ]	BER [ ]
pass	100.000	6.25	1.000E-012	0.000E+000
pass	40.000	6.25	1.000E-012	0.000E+000
pass	20.000	6.25	1.000E-012	0.000E+000
pass	10.000	6.25	1.000E-012	0.000E+000
pass	4.000	15.63	1.000E-012	0.000E+000
pass	2.000	31.25	1.000E-012	0.000E+000
pass	1.000	62.50	1.000E-012	0.000E+000
pass	0.400	221.24	1.000E-012	0.000E+000
pass	0.033	1000.00	1.000E-012	0.000E+000

Figure 95 Example result for 16G Rx Stressed Jitter Eye Test

- Result: “Pass” or “Fail”.
- Sinusoidal Jitter Frequency [MHz]: The sinusoidal jitter frequency set at each step.
- Sinusoidal Jitter [ps]: The sinusoidal jitter amplitude set at each step.
- Allowed Bit Errors: The maximum number of allowed errors to consider the BERT test as a Pass.
- Measured Bit Errors: The number of bit errors that occurred during the test.

OR

- Target BER: The required BER.
- Measured BER: The BER measured.

Rx Custom Stressed Jitter Eye Test

Availability

Data Generator:	M8050A, M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point, Root Complex
Modes:	Expert – Custom Procedure
Data Rates:	16 GT/s

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the Rx Stressed Jitter Eye Test on page 229, with the difference that you can use combinations of impairments that have been obtained with the Custom Eye Calibration on page 142 or Custom Eye Scan Calibration on page 145.

7 Link Equalization Tests

This chapter describes tests that use the link training feature of the BERT (M8040A or M8020A) to put the DUT in loopback mode.

Overview

PCIe Common Link Equalization Parameters

The PCIe Common Parameters are listed in the parameter grid (right half) of the main window of the user interface when you click the corresponding group in the procedure tree in the left half of the main window. Clicking a data rate in the procedure tree shows you the data-rate-specific PCIe Common Parameters for that data rate. Similarly, clicking “Custom Tests” shows you the parameters specific to custom tests.

Details of PCIe Common Link Equalization Parameters can be found in Table 18 on page 291.

Parameters in Expert Mode for Individual LEQ Tests

The PCIe Parameters in expert mode for an individual procedure are not listed in this User Guide explicitly. They are displayed in the parameter grid (right half) of the main window of the user interface when you click on the corresponding entry in the procedure tree in the left half of the main window.

Details of PCIe Parameters for Individual LEQ Tests can be found in Table 22 on page 318.

Connection Diagrams

In this User Guide, only example connection diagrams are given near the beginning of each chapter, for example for link equalization tests. The exact connection diagram for a specific situation can be viewed by right-clicking the appropriate procedure in the procedure tree of the main window of the user interface and selecting “Show Connection...”.

Order of Description of Link Equalization Receiver Tests

The LEQ test descriptions are arranged alphabetically (except for “Custom” tests, which are placed directly after their “basic” versions).

To find a procedure description easily, go to Chapter 4, Procedure Tree Overview on page 55, where the procedures are listed in tables in the order they appear in the procedure tree in the application. Each procedure has a link to its description.

Prerequisite Calibrations

Prerequisite calibrations are no longer listed in the description of each procedure in this User Guide. Instead, they are displayed in the application itself. Right-click the appropriate procedure in the procedure tree of the main window of the user interface and select "Required Calibration Data...". See Required Calibration Data on page 47 for details.

Example Connection Diagrams

LEQ Rx Tests

Figure 96 and Figure 97 show example connection diagrams for LEQ Rx tests. Note that the setup can differ depending on the DUT type, ISI channel, clock architecture and external reference clock selection. For more details, right-click the appropriate procedure in the procedure tree of the user interface and select “Show Connection...”.

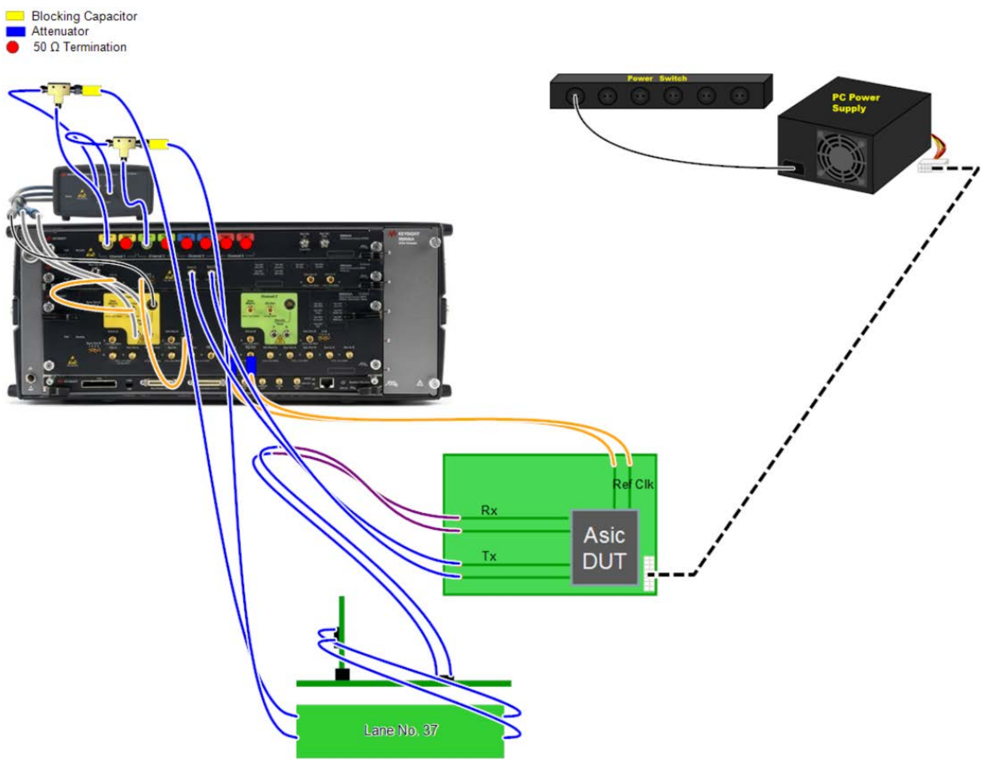


Figure 96 Example connection diagram for an LEQ Rx test (32G LEQ Rx Compliance Test; ASIC, End Point, M8040A)

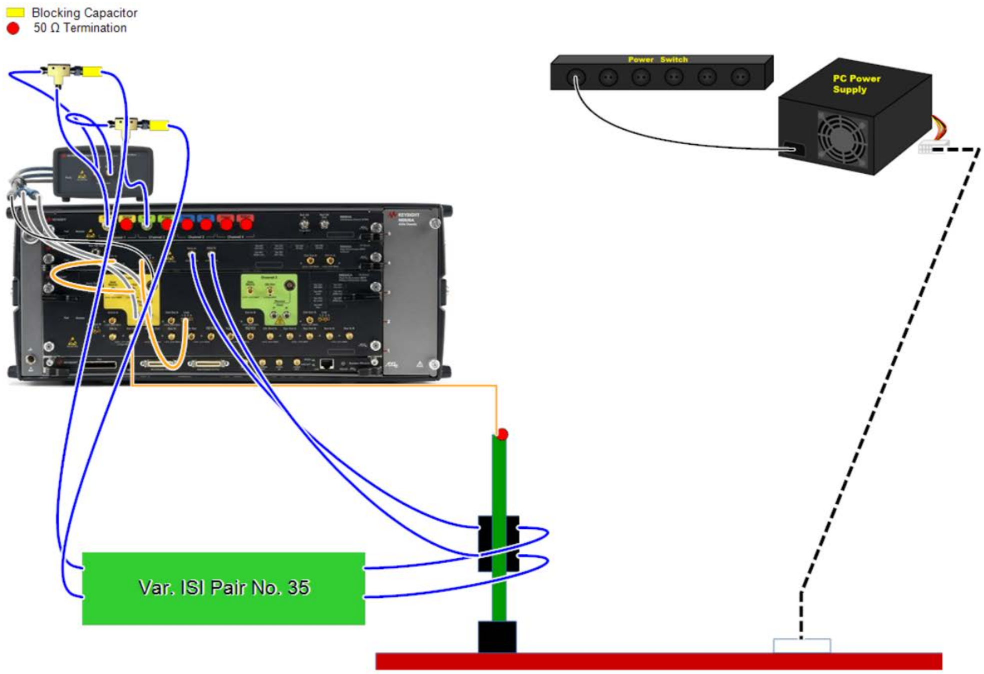


Figure 97 Example connection diagram for an LEQ Rx test (32G LEQ Rx Compliance Test; CEM, System, M8040A)

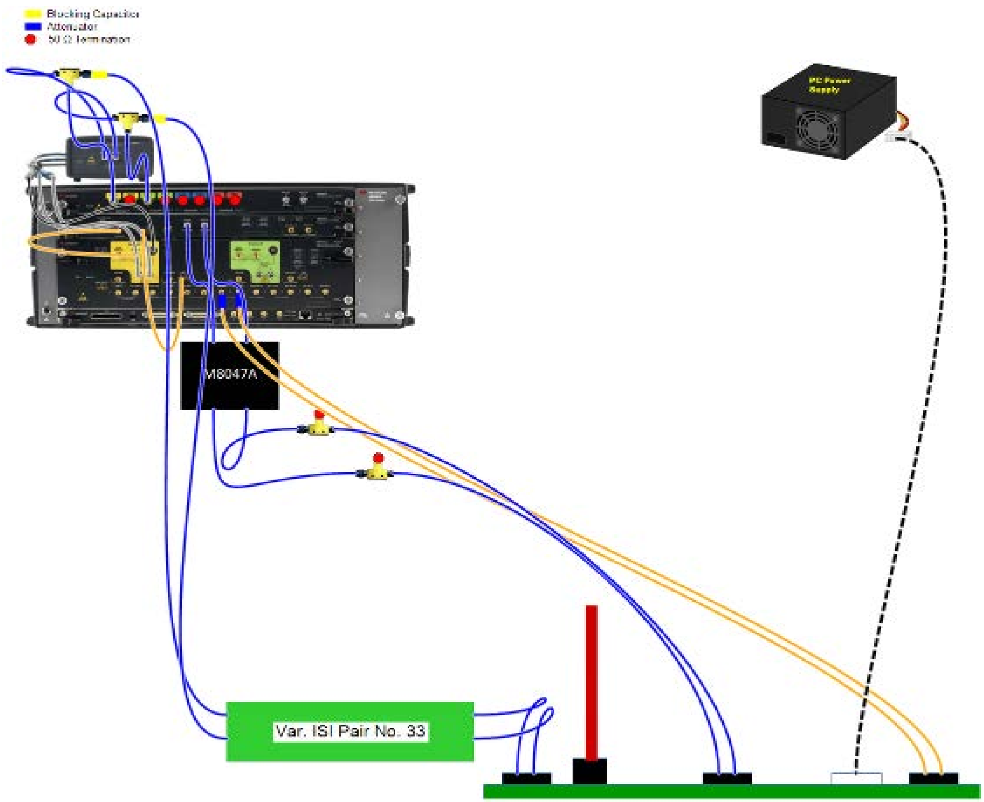


Figure 98 Example connection diagram for an LEQ Rx test with a redriver (32G LEQ Rx Compliance Test; CEM, Add-In Card, M8040A; redriver M8047A)

LEQ Tx Tests

Figure 99 shows an example connection diagram for LEQ Tx tests. For more details, right-click the appropriate procedure in the procedure tree of the user interface and select “Show Connection...”.

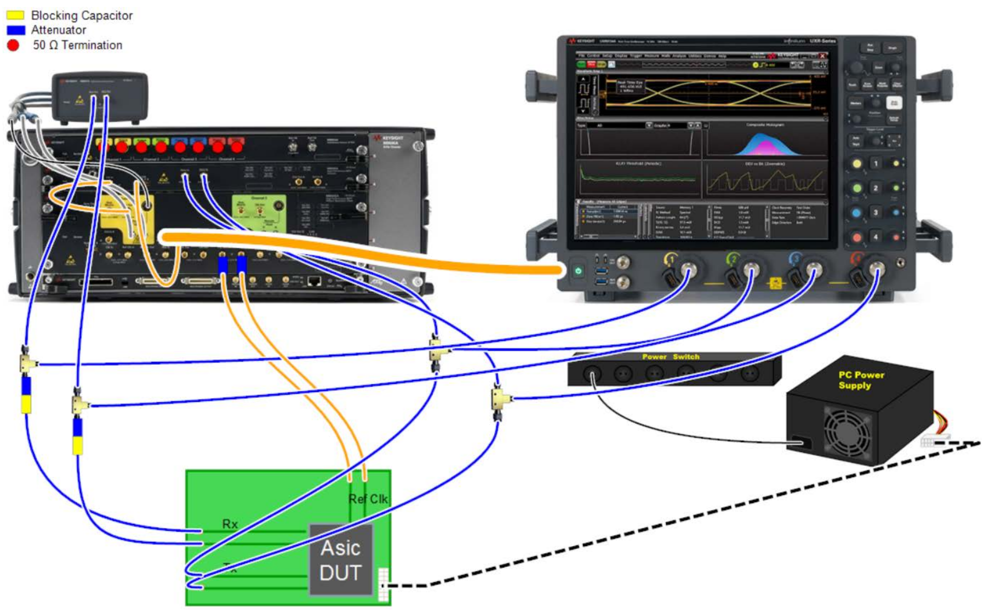


Figure 99 Example connection diagram for an LEQ Tx test (32G LEQ Tx Initial Preset Compliance Test; ASIC, M8040A)

Descriptions of LEQ Receiver Tests

NOTE LEQ Rx tests are very similar to the usual Rx tests described in Chapter 6. The main difference is that LEQ Rx tests always use interactive training with TxEQ negotiation.

LEQ Rx Compliance Test

Availability

Data Generator:	M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Compliance, Expert		
Data Rates:	8 GT/s (M8040A, M8020A: CEM, U.2, M.2) 16 GT/s (M8040A, M8020A: CEM) 32 GT/s (M8040A: ASIC, CEM) 64 GT/s (M8040A: ASIC)		

Purpose and Method

This test uses the interactive link training feature of the J-BERT to let the DUT negotiate the generator transmitter preset to be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves in the same manner as the Rx Pre-Compliance Test on page 211.

The final transmitter equalization (TxEQ) settings (Pre-Shoot and De-Emphasis) are reported in the test results.

LEQ Rx Custom Compliance Test

Availability

Data Generator:	M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s (M8040A, M8020A: CEM) 32 GT/s (M8040A: ASIC, CEM) 64 GT/s (M8040A: ASIC)	

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the LEQ Rx Compliance Test on page 244, with the difference that you can use combinations of impairments that have been obtained with custom calibrations.

Click “Custom Tests” under the appropriate data rate in the procedure tree in the GUI to select (in the right-hand pane)

- the Custom Calibration Source (either Custom Eye Calibration or Custom Eye Scan Calibration)
- the Custom Eye Calibration Point (from the drop-down list)

LEQ Rx Jitter Tolerance Test

Availability

Data Generator:	M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Expert		
Data Rates:	8 GT/s (M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8040A, M8020A: ASIC, CEM) 32 GT/s (M8040A: ASIC, CEM) 64 GT/s (M8040A: ASIC)		

Purpose and Method

This test characterizes how much jitter a DUT can tolerate at different frequencies of sinusoidal jitter.

It uses the interactive link training feature of the J-BERT to let the DUT negotiate the generator transmitter preset to be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves in the same manner as the Rx Jitter Tolerance Test on page 205.

For the LEQ Rx Jitter Tolerance Test, the final transmitter equalization (TxEQ) settings (Pre-Shoot and De-Emphasis) are reported in the test results. In addition, the Final Generator Preset and the Final Generator Cursors are also reported. (Note that the Final Generator Cursors are not reported for the M8020A.)

LEQ Rx Custom Jitter Tolerance Test

Availability

Data Generator:	M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s (M8040A, M8020A: ASIC, CEM) 32 GT/s (M8040A: ASIC, CEM) 64 GT/s (M8040A: ASIC)	

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the LEQ Rx Jitter Tolerance Test on page 246, with the difference that you can use combinations of impairments that have been obtained with custom calibrations.

Click “Custom Tests” under the appropriate data rate in the procedure tree in the GUI to select (in the right-hand pane)

- the Custom Calibration Source (either Custom Eye Calibration or Custom Eye Scan Calibration)
- the Custom Eye Calibration Point (from the drop-down list)

LEQ Rx Sensitivity Test

Availability

Data Generator:	M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Expert		
Data Rates:	8 GT/s (M8040A, M8020A: CEM, U.2, M.2) 16 GT/s (M8040A, M8020A: ASIC, CEM) 32 GT/s (M8040A: ASIC, CEM) 64 GT/s (M8040A: ASIC)		

Purpose and Method

This test uses the interactive link training feature of the J-BERT to let the DUT negotiate the generator transmitter preset that must be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves in the same manner as the Rx Sensitivity Test on page 224.

The final transmitter equalization (TxEQ) settings (Pre-Shoot and De-Emphasis) are reported in the test results.

LEQ Rx Custom Sensitivity Test

Availability

Data Generator:	M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Expert – Custom Procedure	
Data Rates:	16 GT/s (M8040A, M8020A: ASIC, CEM) 32 GT/s (M8040A: ASIC, CEM) 64 GT/s (M8040A: ASIC)	

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the LEQ Rx Sensitivity Test on page 248, with the difference that you can use combinations of impairments that have been obtained with custom calibrations.

Click “Custom Tests” under the appropriate data rate in the procedure tree in the GUI to select (in the right-hand pane)

- the Custom Calibration Source (either Custom Eye Calibration or Custom Eye Scan Calibration)
- the Custom Eye Calibration Point (from the drop-down list)

LEQ Rx Stressed Jitter Eye Test

Availability

Data Generator:	M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point, Root Complex
Modes:	Compliance, Expert
Data Rates:	8 GT/s, 16 GT/s

Purpose and Method

This test uses the interactive link training feature of the J-BERT to let the DUT negotiate the generator transmitter preset to be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves in the same manner as the Rx Stressed Jitter Eye Test on page 229.

The final transmitter equalization (TxEQ) settings (Pre-Shoot and De-Emphasis) are reported in the test results.

LEQ Rx Custom Stressed Jitter Eye Test

Availability

Data Generator:	M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point, Root Complex
Modes:	Expert – Custom Procedure
Data Rates:	16 GT/s

The “Include Custom Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

This procedure is similar to the LEQ Rx Stressed Jitter Eye Test on page 250, with the difference that you can use combinations of impairments that have been obtained with custom calibrations.

Click “Custom Tests” under the appropriate data rate in the procedure tree in the GUI to select (in the right-hand pane)

- the Custom Calibration Source (either Custom Eye Calibration or Custom Eye Scan Calibration)
- the Custom Eye Calibration Point (from the drop-down list)

Descriptions of LEQ Transmitter Tests

LEQ Tx Initial Preset Compliance Test

Availability

Data Generator:	M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point	Add-In Card	Device
Modes:	Compliance, Expert		
Data Rates:	8 GT/s (M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8040A, M8020A: ASIC, CEM) 32 GT/s (M8040A: ASIC, CEM)		

Purpose and Method

This test uses the interactive link training feature of the J-BERT.

The J-BERT runs the link training, setting several initial equalization transmitter presets on the DUT and skipping the link equalization phase. Once the DUT is in loopback, the DUT signal is captured and analyzed to check whether the DUT is using the preset requested by the J-BERT.

NOTE **The specification has a special case for this test at 32 GT/s. For details see Special Case for LEQ Tx Tests at 32 GT/s on page 259.**

Connection Diagram

Refer to Figure 99 on page 243.

Result Description

L0_EqTx_32GTps_IniPreset

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unrele
SigTest Preset Measurement Method	AC Fit
SigTest Version	Offline
----Parameter----	
Presets	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
Scope Connection for Link EQ Tx Tests	Chan 1 2 3 4 Direct Connect
Generator Output Voltage Compensation	6 dB
Skip BER Check	True
----Loopback Training----	
Link Training Lane Number	0
Training through	L0-Recovery
Interactive Training Script File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie5_32G_
----Loopback Training Settings----	
Use Custom Training Voltage	False
Suppress Loopback Training Messages	False
----Interactive Link Training----	
Generator Start Preset	P5
Generator Start Preset Gen4	P5
Generator Start Preset Gen5	P5
----Error Detector----	
Fast Alignment	False
CDR Loop Bandwidth	20 MHz
Analyzer Equalization	80
Use Auto Analyzer Equalization	False
Input Range for Loopback Training	450 mV
Input Range	350 mV
Threshold	0 V
Polarity	Normal
----Power Switch Automation----	
Use Power Switch Automation	True
Power Switch Channel Number	1
Power Cycle Off On Duration	3 s
Power Cycle Settling Time	3 s
Power Cycle max. Retries for LB Training	1
----Instruments----	

...

Result	DUT Initial Preset	Pre-Shoot [dB]	Min Spec PS [dB]	Max Spec PS [dB]	De-Emphasis [dB]	Min Spec DE [dB]	Max Spec DE [dB]	Comment
pass	P0	NaN	N/A	N/A	-6.00	-7.50	-4.50	
pass	P1	NaN	N/A	N/A	-3.50	-4.50	-2.50	
pass	P2	NaN	N/A	N/A	-4.40	-5.90	-2.90	
pass	P3	NaN	N/A	N/A	-2.50	-3.50	-1.50	
pass	P4	NaN	N/A	N/A	NaN	N/A	N/A	
pass	P5	1.90	0.90	2.90	NaN	N/A	N/A	
pass	P6	2.50	1.50	3.50	NaN	N/A	N/A	
pass	P7	3.50	2.50	4.50	-6.00	-7.50	-4.50	
pass	P8	3.50	2.50	4.50	-3.50	-4.50	-2.50	
pass	P9	3.50	2.50	4.50	NaN	N/A	N/A	
pass	Overall Result	N/A	N/A	N/A	N/A	N/A	N/A	

Figure 100 Example result for the LEQ Tx Initial Preset Compliance Test

- Result: (pass/fail) The measured Pre-Shoot and De-Emphasis must be within the specification limits.
- DUT Initial Preset: Set by the J-BERT.
- Pre-Shoot [dB]: Measured Pre-Shoot on the DUT waveform.
- Min Spec PS [dB]: Pre-Shoot lower specification limit.
- Max Spec PS [dB]: Pre-Shoot upper specification limit.
- De-Emphasis [dB]: Measured De-Emphasis on the DUT waveform.
- Min Spec DE [dB]: De-Emphasis lower specification limit.
- Max Spec DE [dB]: De-Emphasis upper specification limit.
- Comment: A comment may be added to each test step if it fails, explaining why.

LEQ Tx Response Time Compliance Test

Availability

Data Generator:	M8040A, M8020A		
Interface Types:	ASIC	CEM	U.2 and M.2
DUT Types:	End Point Root Complex	Add-In Card System	Device Host
Modes:	Compliance, Expert		
Data Rates:	8 GT/s (M8040A, M8020A: ASIC, CEM, U.2, M.2) 16 GT/s (M8040A, M8020A: ASIC, CEM) 32 GT/s (M8040A: ASIC, CEM)		

Purpose and Method

This test uses the interactive link training feature of the J-BERT to train the DUT into loopback mode, running the link equalization phase completely.

A certain initial transmitter preset is set to the DUT. A successful link training raises an event, which is used to capture the waveforms of the J-BERT and the DUT. At that moment, the captured waveform from the J-BERT contains the preset change request and the waveform from the DUT contains the acknowledgment of that request. Additionally, the waveform from the DUT also contains the physical transition from the initial transmitter preset to the requested preset.

The captured data is decoded and two time intervals are calculated: one between the request and the acknowledgment, and other between the request and the electrical transition.

Finally, once the DUT is in loopback mode, a similar preset measurement is performed for the Initial Preset.

The test is divided into two parts. In the first part, the J-BERT requests transmitter presets. In the second part, the J-BERT requests the pre-cursor, cursor and post-cursor reported by the DUT.

For End Point DUTs (or Add-In-Cards or Devices), the initial transmitter preset is set by the J-BERT. For Root Complex DUTs (or Systems or Hosts), you must manually set the DUT initial transmitter preset.

NOTE The specification has a special case for this test at 32 GT/s. For details see Special Case for LEQ Tx Tests at 32 GT/s on page 259.

Connection Diagram

Refer to Figure 99 on page 243.

Result Description

L0_EqTx_32GTps_RespTime

[Not Compliant]

for PCIe 6.0 EndPoint ASIC

----General----	
Offline	True
Software Version	5.0.0.
Compliant	False
Non-compliance reason(s)	Procedure offline; Software status unrele
SigTest Preset Measurement Method	AC Fit
SigTest Version	Offline
----Parameter----	
Presets	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
Skip response time measurements	False
Measure protocol response times	False
Max Number of Retries	1
Scope Connection for Link EQ Tx Tests	Chan 1 2 3 4 Direct Connect
Generator Output Voltage Compensation	6 dB
Skip BER Check	True
----Oscilloscope----	
Scope Horizontal Range	10 us
Scope Request Vertical Range	800 mV
Scope Response Vertical Range	200 mV
----Loopback Training----	
Link Training Lane Number	0
Training through	L0-Recovery
Interactive Training Script File	C:\ProgramData\BitifEye\ValiFrameK1 \PCIe\Settings\TrainingScripts\Pcie5_32G_
----Loopback Training Settings----	
Use Custom Training Voltage	False
Suppress Loopback Training Messages	False
----Interactive Link Training----	
Generator Start Preset	P5
Generator Start Preset Gen4	P5
Generator Start Preset Gen5	P5
----Error Detector----	
Fast Alignment	False
CDR Loop Bandwidth	20 MHz
Analyzer Equalization	80
Use Auto Analyzer Equalization	False
Input Range for Loopback Training	450 mV
Input Range	350 mV
Threshold	0 V
Polarity	Normal

```
----Power Switch Automation----
Use Power Switch Automation              True
Power Switch Channel Number              1
Power Cycle Off On Duration              3 s
Power Cycle Settling Time                3 s
Power Cycle max. Retries for LB Training 1
----Instruments----
...
```

Result	DUT Target Preset	Electrical response time [ns]	Pre-Shoot [dB]	Min Spec PS [dB]	Max Spec PS [dB]	De-Emphasis [dB]	Min Spec DE [dB]	Max Spec DE [dB]	Comment
pass	P0	100.00	NaN	N/A	N/A	-6.00	-7.50	-4.50	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P1	100.00	NaN	N/A	N/A	-3.50	-4.50	-2.50	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P2	100.00	NaN	N/A	N/A	-4.40	-5.90	-2.90	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P3	100.00	NaN	N/A	N/A	-2.50	-3.50	-1.50	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P4	100.00	NaN	N/A	N/A	NaN	N/A	N/A	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P5	100.00	1.90	0.90	2.90	NaN	N/A	N/A	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P6	100.00	2.50	1.50	3.50	NaN	N/A	N/A	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P7	100.00	3.50	2.50	4.50	-6.00	-7.50	-4.50	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P8	100.00	3.50	2.50	4.50	-3.50	-4.50	-2.50	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P9	100.00	3.50	2.50	4.50	NaN	N/A	N/A	Warning: Reported cursors (0, 0, 0) are not within valid PS and DE range.
pass	P0' (0, 0, 0)	100.00	NaN	N/A	N/A	-6.00	-7.50	-4.50	
pass	P1' (0, 0, 0)	100.00	NaN	N/A	N/A	-3.50	-4.50	-2.50	
pass	P2' (0, 0, 0)	100.00	NaN	N/A	N/A	-4.40	-5.90	-2.90	
pass	P3' (0, 0, 0)	100.00	NaN	N/A	N/A	-2.50	-3.50	-1.50	
pass	P4' (0, 0, 0)	100.00	NaN	N/A	N/A	NaN	N/A	N/A	
pass	P5' (0, 0, 0)	100.00	1.90	0.90	2.90	NaN	N/A	N/A	
pass	P6' (0, 0, 0)	100.00	2.50	1.50	3.50	NaN	N/A	N/A	
pass	P7' (0, 0, 0)	100.00	3.50	2.50	4.50	-6.00	-7.50	-4.50	
pass	P8' (0, 0, 0)	100.00	3.50	2.50	4.50	-3.50	-4.50	-2.50	

pass	P9' (0, 0, 0)	100.00	3.50	2.50	4.50	NaN	N/A	N/A	
pass	Overall Result	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Figure 101 Example result for LEQ Tx Response Time Compliance Test

- Result: (pass/fail) The values of Pre-Shoot and De-Emphasis should lie between the upper and lower specification limits and the electrical response time should not exceed the maximum specification limit.
- DUT Target Preset: The transmitter preset that is requested to the DUT at each step.
- Electrical response time [ns]: The calculated timespan between the request from the J-BERT and the physical preset transition on the DUT waveform.
- Pre-Shoot [dB]: The measured Pre-Shoot on the DUT waveform.
- Min Spec PS [dB]: The Pre-Shoot lower specification limit.
- Max Spec PS [dB]: The Pre-Shoot upper specification limit.
- De-Emphasis [dB]: The measured De-Emphasis on the DUT waveform.
- Min Spec DE [dB]: The De-Emphasis lower specification limit.
- Max Spec DE [dB]: The De-Emphasis upper specification limit.
- Comment: If the test step fails, a comment may be added to explain why.

Special Case for LEQ Tx Tests at 32 GT/s

For both LEQ Tx Initial Preset Compliance Test and LEQ Tx Response Time Compliance Test the specification includes a special case at 32 GT/s.

In each case, the usual ValiFrame analysis consists of up to two stages. If the DUT fails the first stage, where the AC fir method is used to measure the presets, i.e., some of the pre-shoot or de-emphasis values lie outside the spec limits, ValiFrame automatically checks to see if the values lie within the spec limits with extended tolerance. If the DUT fails this too, then the test is failed. However, if this second stage is passed, the user dialog window shown in Figure 102 opens.

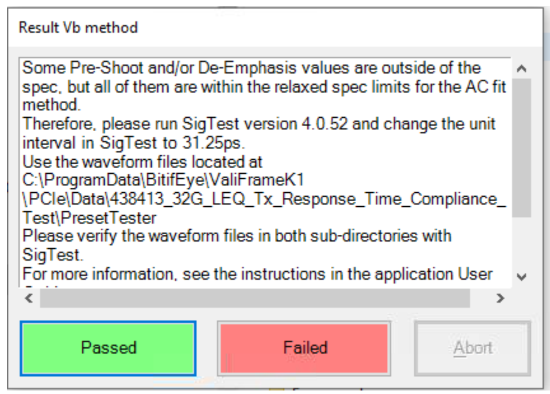


Figure 102 User dialog for LEQ Tx tests special cases at 32 GT/s

The brief outline there of the procedure to be followed – manual testing by the Vb method – is described in more detail here. In both cases SigTest is used to compute the presets.

Using SigTest to Compute the Presets Using the Vb Method

1 Start SigTest 4.0.52 and click ‘EnablePTest’ (Figure 103).

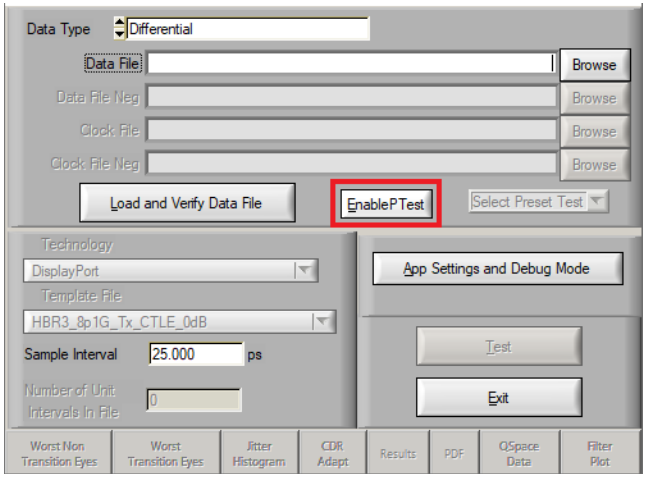


Figure 103 Enabling the Preset Test in SigTest 4.0.52

2 Select ‘PCIE_4_0_PRESET’ as the Technology and ‘PCIE_GEN4_SYS_PRESET’ as the Template File (Figure 104). This can be used for End Point, Root Complex, Add-In-Card and System DUTs.

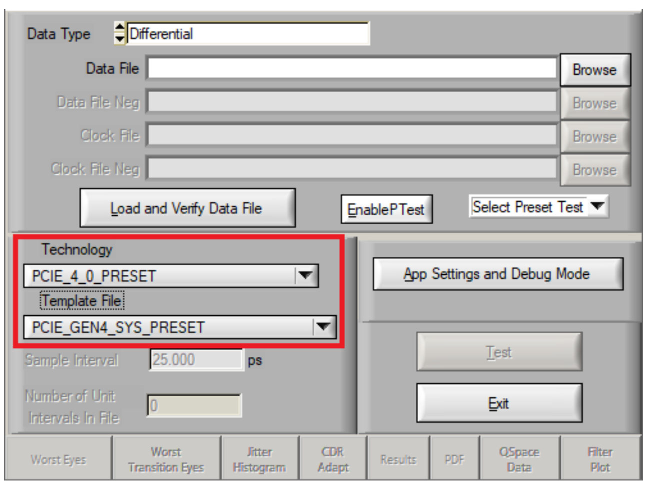


Figure 104 Selecting the Technology and the Template File

3 Select ‘PCIe Gen4 Presets’ from the drop-down menu under ‘Select Preset Test’ (Figure 105).

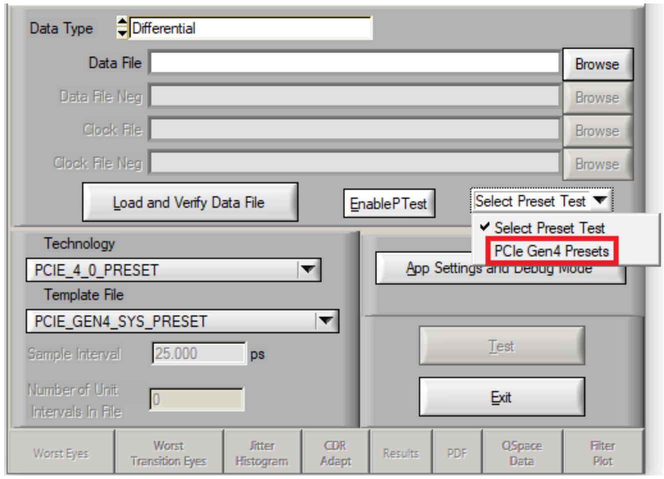


Figure 105 Select the preset test as ‘PCIe Gen4 Presets’

4 Change the Unit Interval to 31.25 ps (Figure 106).

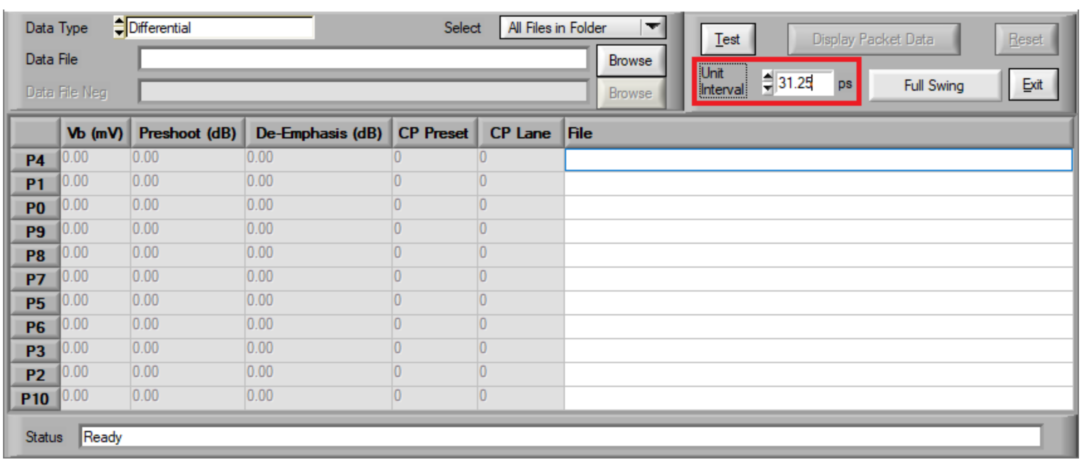


Figure 106 Changing the unit interval

5 Use the ‘Browse’ button to select the folder where the preset waveform files are located, then click ‘Test’ (Figure 107). The location of the preset files is given in the pop-up dialog window shown in Figure 102 on page 259.

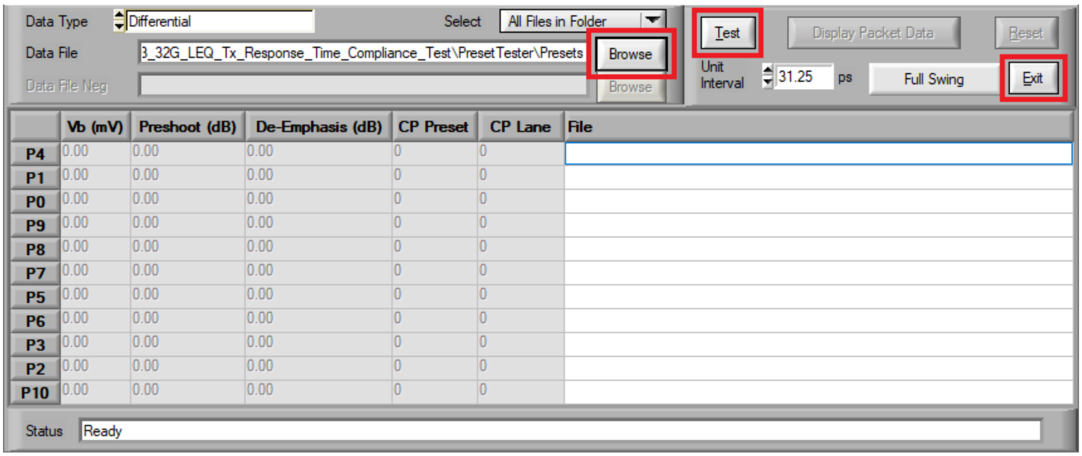


Figure 107 Select the folder for preset files then begin test

6 All of the presets (except P10) must pass in order to achieve an overall pass. When the run is finished, click ‘Exit’ (Figure 107) and a result file will be created in the same folder.

Procedure for 32G LEQ Tx Initial Preset Compliance Test (Special Case)

Compute the presets manually, as described above. The pop-up dialog window (Figure 102 on page 259) asks for the result. Click on ‘Passed’ or ‘Failed’, as appropriate. The result of the 32G LEQ Tx Initial Preset Compliance Test is marked accordingly, and a comment is added to the ‘Overall Result’ row of the test report.

Procedure for 32G LEQ Tx Response Time Compliance Test (Special Case)

This is similar to the procedure for the 32G LEQ Tx Initial Preset Compliance Test (Special Case), except that the test against the relaxed limits is performed not only for the defined presets but also for the reported cursors. Again, the pop-up window appears and the presets must be computed manually. The waveform files for the cursors as well as for the defined precursors must be used. If one or more presets or reported cursors do not comply, the procedure is considered failed. Once you have the result, click on ‘Passed’ or ‘Failed’ in the pop-up dialog (Figure 102 on page 259) to report the result to ValiFrame.

8 Receiver Setup Procedures

Receiver Setup Procedures can be used to set up the data generator as for a Receiver Compliance Test but without doing a BER test.

Overview

Receiver Setup Procedures are available in either Compliance or Expert Mode but only if “Include Rx Setup Procedures” is checked when configuring the DUT. To set this option, refer to Figure 11 on page 29.

PCIe Common Receiver Parameters

The PCIe Common Parameters are listed in the parameter grid (right pane) of the main window of the user interface when you click the corresponding group in the procedure tree in the left half of the main window. Clicking a data rate in the procedure tree shows you the data-rate-specific PCIe Common Parameters for that data rate. Similarly, clicking a lane shows you the corresponding lane-specific common parameters and clicking a channel shows you the corresponding channel-specific common parameters.

Details of PCIe Common Receiver Parameters can be found in Table 17 on page 281.

Parameters in Expert Mode for Individual Tests

The PCIe Parameters in expert mode for an individual procedure are not listed in this User Guide explicitly. They are displayed in the parameter grid (right half) of the main window of the user interface when you click on the corresponding entry in the procedure tree in the left half of the main window.

Details of PCIe Receiver Parameters for individual procedures can be found in Table 21 on page 309.

Connection Diagrams

In this User Guide, only example connection diagrams are given at the beginning of each chapter, for example for receiver setup procedures. The exact connection diagram for a specific situation can be viewed by right-clicking the appropriate procedure in the procedure tree of the main window of the user interface and selecting “Show Connection...”.

Order of Descriptions of Receiver Setup Procedures

The descriptions of the Receiver Setup Procedures are arranged alphabetically.

To find a procedure description easily, go to Chapter 4, Procedure Tree Overview on page 55, where the procedures are listed in tables in the order they appear in the procedure tree in the application. Each procedure has a link to its description.

Prerequisite Calibrations

Prerequisite calibrations are no longer listed in the description of each procedure in this User Guide. Instead, they are displayed in the application itself. Right-click the appropriate procedure in the procedure tree of the main window of the user interface and select “Required Calibration Data...”. See Required Calibration Data on page 47 for details.

Example Connection Diagrams

The connections to the base boards for Rx setup procedures vary greatly depending on the data rate and interface type. For more details, right-click the appropriate procedure in the procedure tree of the user interface and select “Show Connection...”.

Figure 108 shows the connection diagram for receiver setup procedures for ASIC end-point DUTs for M8040A. Note that the setup can differ depending on the ISI channel, clock architecture and external reference clock selection.

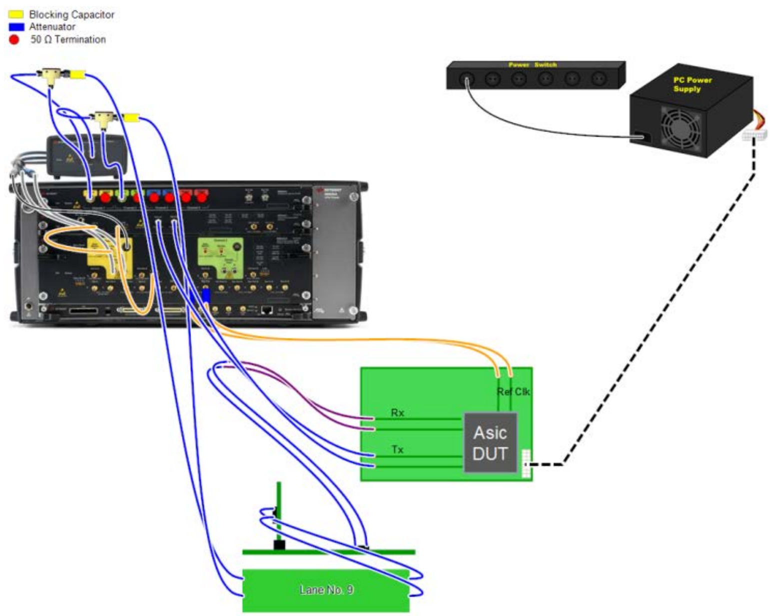


Figure 108 Example connection diagram for the Rx Impairments Setup procedure (M8040A, ASIC, 32 GT/s)

For ASIC Root Complex DUTs the setup differs in the reference clock connection.

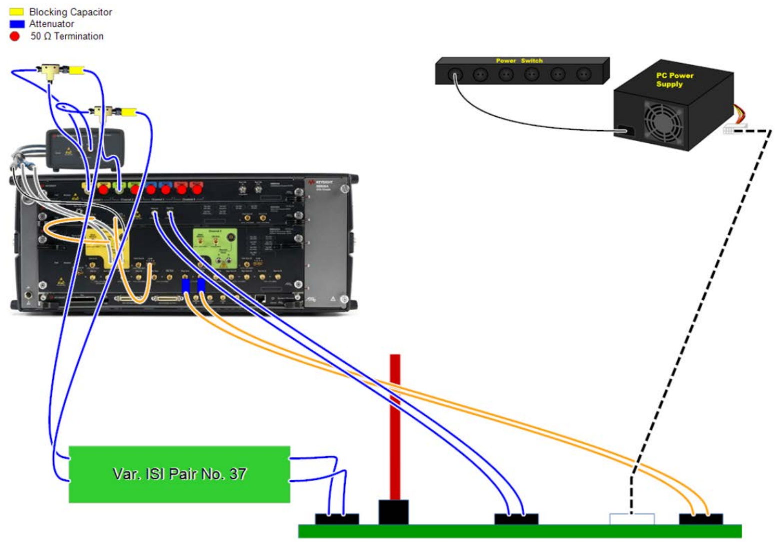


Figure 109 Example connection diagram for the Rx Impairments Setup procedure (M8040A, CEM, 32 GT/s)

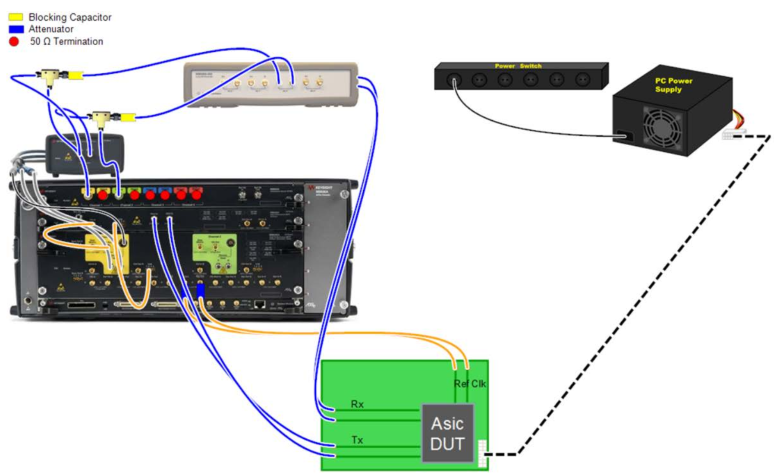


Figure 110 Example connection diagram for the Rx Compliance Setup procedure (M8040A, ASIC, 5 GT/s)

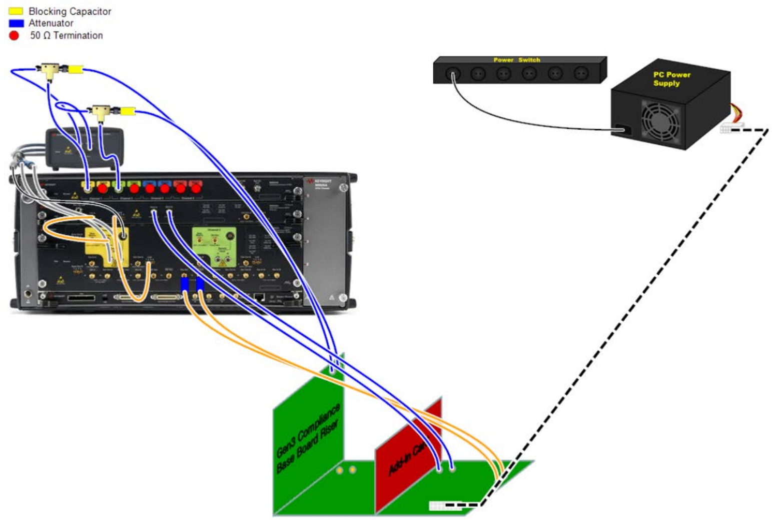


Figure 111 Example connection diagram for the Rx Pre-Compliance Setup procedure (M8040A, CEM, 8 GT/s)

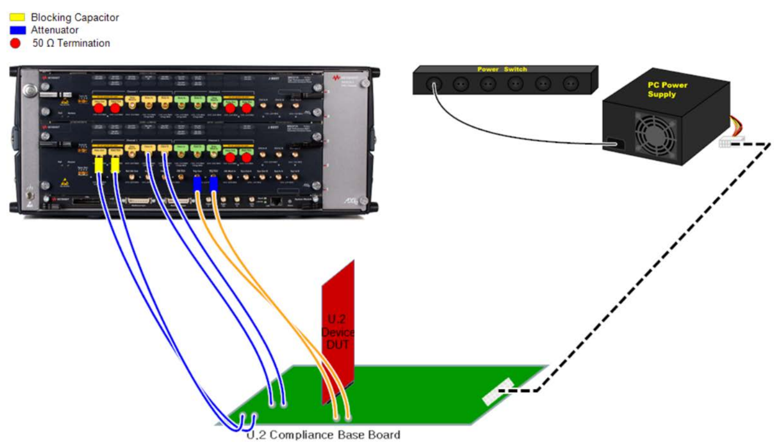


Figure 112 Example connection diagram for the Rx Pre-Compliance Setup procedure (M8020A, U.2, 8 GT/s)

Descriptions of Receiver Setup Procedures

Rx Compliance Setup

Availability

Data Generator:	M8040A, M8020A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	2.5, 5 GT/s	

The “Include Receiver Setup Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

The purpose of this procedure is to configure the data generator with those parameters that are needed in the Rx Compliance Test, using the calibration data saved on the PC where the N5991 software is running. The method initiates in the same manner as the Rx Compliance Test but it does not proceed any further after the setup is prepared. The set parameters are differential amplitude, random jitter, swept sinusoidal jitter and common mode sinusoidal interference.

Connection Diagram

Refer to Figure 110 on page 267.

Result Description

None

Rx Impairments Setup

Availability

Data Generator:	M8040A	
Interface Types:	ASIC	CEM
DUT Types:	End Point Root Complex	Add-In Card System
Modes:	Compliance, Expert	
Data Rates:	32 GT/s (M8040A: ASIC, CEM) 64 GT/s (M8040A: ASIC)	

The “Include Receiver Setup Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters that are required in the Rx Pre-Compliance Test, using the calibration data saved on the machine where ValiFrame is running. The method initiates, in the correct sequence, differential voltage, CMSI, DMSI, RJ and SJ, but it does not proceed any further after the setup has been prepared.

Connection Diagram

Refer to Figure 108 on page 266 (ASIC) and Figure 109 on page 267 (CEM).

Result Description

None

Rx Pre-Compliance Setup

Availability

Data Generator:	M8040A, M8020A	
Interface Types:	CEM	U.2 and M.2
DUT Types:	Add-In Card System	Device Host
Modes:	Compliance, Expert	
Data Rates:	8 GT/s (M8040A, M8020A: CEM, U.2, M.2) 16 GT/s (M8040A, M8020A: CEM)	

The “Include Receiver Setup Procedures” option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters that are required in the Rx Pre-Compliance Test on page 211, using the calibration data saved on the machine where ValiFrame is running. The method initiates in the same manner as the Rx Compliance Test but it does not proceed any further after the setup has been prepared. The set parameters are the eye height and the eye width.

Connection Diagram

Refer to Figure 111 (CEM) and Figure 112 on page 268 (U.2).

Result Description

None

Rx Stressed Jitter Eye Setup

Availability

Data Generator:	M8040A, M8020A
Interface Types:	ASIC
DUT Types:	End Point, Root Complex
Modes:	Compliance, Expert
Data Rates:	8, 16 GT/s

The "Include Receiver Setup Procedures" option must be selected when configuring the DUT; refer to Figure 11 on page 29.

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters that are required in the Rx Stressed Jitter Eye Test, using the calibration data saved on the machine where ValiFrame is running. The method initiates in the same manner as the Rx Stressed Jitter Eye Test but it does not proceed any further after the setup has been prepared. The set parameters are the differential amplitude, random jitter, common mode sinusoidal interference and differential mode sinusoidal interference.

Connection Diagram

Refer to Figure 111 (CEM) and Figure 112 on page 268 (U.2).

Result Description

None

9 Appendix A: PCIe Parameters

This Appendix contains lists and descriptions of parameters used in the Keysight N5991 PCIe Test Automation Software Platform user interface.

Overview

The parameters used in PCI Express are divided here into

- PCIe Common Calibration Parameters (Table 16 on page 275)
- PCIe Common Receiver Parameters (Table 17 on page 281)
- PCIe Common Link Equalization Parameters (Table 18 on page 291)
- PCIe Parameters used for (nearly) all individual procedures (Table 19 on page 300)
- PCIe Calibration Parameters for Individual Procedures (Table 20 on page 301)
- PCIe Receiver Parameters for Individual Procedures (Table 21 on page 309)
- PCIe Link Equalization Parameters for Individual Procedures (Table 22 on page 318)
- Sequencer Parameters (Table 23 on page 323)

In each table, the parameters are listed under the categories that they appear under in the parameter grid of the GUI (e.g. Oscilloscope, Power Switch Automation), with the categories approximately in the order in which they appear in the GUI. It is not possible to keep to the exact order, because this varies from procedure to procedure. Within each category, the parameters are listed alphabetically.

NOTE If the value of a parameter appears in boldface type in the parameter grid of the GUI, this indicates that the value is not the default value.

NOTE If a parameter is read-only (gray) in the parameter grid, it can usually be set either in the Station Configurator or when configuring the DUT. If you are working in Compliance Mode, the grayed-out parameter may be editable in Expert Mode.

NOTE In several of the following tables, the relevant data rates are listed. Remember that, in addition, 64 GT/s is available only for PCIe Ver. 6.0 and 32 GT/s only for PCIe Ver. 5.0 and 6.0.

PCIe Common Parameters

PCIe Common Parameters — Calibration

These parameters are displayed in the GUI at a level higher than an individual procedure in the Calibration part of the procedure tree.

NOTE

In this release, the specification version PCIe Ver. 6.0 is available only for ASIC interfaces, that is, only End Point and Root Complex DUT types. Any other DUT types given in this table apply to PCIe Ver. 4.0 and 5.0 only.

Table 16 PCIe Common Calibration Parameters

Category/ Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
None				
Gen4 ASIC Eye Calibration Method	End Point Root Complex	Data rates	Seasim, SigTest	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s
Gen4 Fixture	End Point Root Complex	Data rates	Name of Fixture	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s
Gen4 ISI Adjustment	End Point Root Complex	Data rates	Hardware Traces Emulated ISI (only M8020A and ASIC)	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s
Gen5 ASIC Eye Calibration Method	End Point Root Complex	Data rates	Seasim, SigTest	PCIe Ver 5.0, 6.0 32 GT/s
Gen5 Fixture	End Point Root Complex	Data rates	Name of fixture	PCIe Ver 5.0, 6.0 32 GT/s
PCIe1/PCIe2 M8048A ISI Channel	End Point Root Complex	Data rates	Channel 0, None, ... Channel 8, 34 inch	PCIe Ver. 4.0, 5.0, 6.0 2.5 GT/s (PCIe1) and 5 GT/s (PCIe2) Default: Channel 7, 24 inch. The M8048A ISI channel used for PCIe1/PCIe2 ASIC Rx Calibration.
PCIe1/PCIe2 M8048A ISI Channel Emulation	End Point Root Complex	Data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 2.5 GT/s (PCIe1) and 5 GT/s (PCIe2) Set to True if the internal ISI of the M8020A is used, otherwise set to False.

Category/ Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
PCIe3 Transfer Function File on Scope	Add-In Card System Device Host	Long Channel	Name of transfer function file	PCIe Ver. 4.0, 5.0 8 GT/s Visible only if “Use Transfer Function” was selected in Configure DUT > Show Parameters > 8 GT/s. This is the name of the transfer function that is located on the oscilloscope.
Repetitions	All DUT types	All Calibration group levels	0, ..., 2147483647	PCIe Ver. 4.0, 5.0, 6.0 The number of times the group of procedures is going to be repeated. If the value is '0', it runs only once.
Scope Connection for Calibration	End Point Root Complex Add-In Card System Device Host	Data rates	Chan 1 3 Direct Connect Chan 2 4 Direct Connect	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5 GT/s (for other data rates see under “Oscilloscope”) All calibrations can be done with a single-ended direct connection to either channels 1&3 or channels 2&4. Note: The values available depend on the connected oscilloscope. The values given here are for a four-channel model, they will differ for a two-channel model.
Start with Minimum Loss Channel	End Point Root Complex Add-In Card System	Data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s Enable or disable via Configure DUT > Show Parameters > 16 GT/s.
Use PCIe1/PCIe2 Transfer Function	End Point Root Complex Add-In Card System	Data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 2.5 GT/s (PCIe1) and 5 GT/s (PCIe2)
Use PCIe3 Transfer Function	Add-In Card System Device Host	Long Channel	True, False	PCIe Ver. 4.0, 5.0 8.0 GT/s Visible only if “Use Transfer Function” was selected in Configure DUT > Show Parameters > 8 GT/s.
Oscilloscope				
Embed Replica Channel	End Point Root Complex	Data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 8 GT/s
Gen4 Embed Replica Channel	End Point Root Complex Add-In Card System	Long Channel	True, False	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s
Gen4 Transfer Function File for Additional Channel on Scope	Add-In Card System	Long Channel	Name of transfer function file	PCIe Ver. 4.0, 5.0 16 GT/s

Category/ Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Gen4 Transfer Function File for Additional Channel and Package Model on Scope	Add-In Card System	Long Channel	Name of transfer function file	PCIe Ver. 4.0, 5.0 16 GT/s Visible only if “Embed Additional Channel” was selected in Configure DUT > Show Parameters > 16 GT/s.
Gen4 Transfer Function File for Package Model on Scope	End Point Root Complex Add-In Card System	Long Channel	Name of transfer function file	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s This is the name of the package model file that is located on the oscilloscope. The package model must be embedded to perform some calibrations. Not visible if “Embed Additional Channel” was selected in Configure DUT > Show Parameters > 16 GT/s.
Gen4 Transfer Function File for Replica Channel on Scope	End Point Root Complex	Long Channel	Name of transfer function file	PCIe Ver. 4.0, 5.0 16 GT/s Visible only if “Embed Additional Channel” was selected in Configure DUT > Show Parameters > 16 GT/s.
Gen4 Transfer Function File for Replica Channel and Package Model on Scope	End Point Root Complex	Long Channel	Name of transfer function file	PCIe Ver. 4.0, 5.0 16 GT/s Visible only if “Embed Additional Channel” was selected in Configure DUT > Show Parameters > 16 GT/s.
Gen5 Embed Replica Channel	End Point Root Complex Add-In Card System	Long Channel	True, False	PCIe Ver. 5.0, 6.0 32 GT/s Visible only if “Embed Replica Channel” was selected in Configure DUT > Show Parameters > 32 GT/s.
Gen5 Transfer Function File for Additional Channel on Scope	Add-In Card System	Long Channel	Name of transfer function file	PCIe Ver. 5.0 32 GT/s Not visible if “Embed Additional Channel” was selected in Configure DUT > Show Parameters > 32 GT/s.
Gen5 Transfer Function File for Additional Channel and Package Model on Scope	Add-In Card System	Long Channel	Name of transfer function file	PCIe Ver. 5.0 32 GT/s
Gen5 Transfer Function File for Package Model on Scope	End Point Root Complex Add-In Card System	Long Channel	Name of transfer function file	PCIe Ver. 5.0, 6.0 32 GT/s This is the name of the package model file that is located on the oscilloscope. The package model must be embedded to perform some calibrations.

Category/ Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Gen5 Transfer Function File for Replica Channel on Scope	End Point Root Complex	Data rates	Name of transfer function file	PCIe Ver. 5.0, 6.0 32, 64 GT/s Visible only if “Embed Replica Channel” was selected in Configure DUT > Show Parameters > 32 GT/s. This is the name of the transfer function of the replica channel, which is located on the oscilloscope.
Gen5 Transfer Function File for Replica Channel and Package Model on Scope	End Point Root Complex	Data rates	Name of transfer function file	PCIe Ver. 5.0, 6.0 32, 64 GT/s Visible only if “Embed Replica Channel” was selected in Configure DUT > Show Parameters > 32 GT/s. This is the name of the transfer function that includes the replica channel and package model, which is located on the oscilloscope.
Gen6 Embed Replica Channel	End Point Root Complex	Long Channel	True, False	PCIe Ver. 6.0 64 GT/s
Gen6 Transfer Function File for Package Model on Scope	End Point Root Complex	Long Channel	Name of transfer function file	PCIe Ver. 6.0 64 GT/s This is the name of the package model file that is located on the oscilloscope. The package model must be embedded to perform some calibrations.
Gen6 Transfer Function File for Replica Channel on Scope	End Point Root Complex	Data rates	Name of transfer function file	PCIe Ver. 6.0 64 GT/s Visible only if “Embed Replica Channel” was selected in Configure DUT > Show Parameters > 64 GT/s. This is the name of the transfer function of the replica channel, which is located on the oscilloscope.
Gen6 Transfer Function File for Replica Channel and Package Model on Scope	End Point Root Complex	Data rates	Name of transfer function file	PCIe Ver. 6.0 64 GT/s Visible only if “Embed Replica Channel” was selected in Configure DUT > Show Parameters > 64 GT/s. This is the name of the transfer function that includes the replica channel and package model, which is located on the oscilloscope.
Number of Averages for Step Response	End Point Root Complex	Data rates		PCIe Ver. 4.0, 5.0, 6.0 8 GT/s The number of measurements averaged for the step response.
Package Loss at 2.1GHz	End Point Root Complex	Data rate (8 GT/s) Long Channel (16, 32, 64 GT/s)		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s The value of this parameter is the loss at 2.1 GHz of the Package Model on Scope. It is important to ensure a correct result of the eye calibrations using Seasim. The default value is the loss of the default package model provided with ValiFrame. If the package model is changed, this value needs to be changed to match the loss in the package model.

Category/ Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Range to Signal Ratio	End Point Root Complex Add-In Card System Device, Host	Long Channel (8, 16 GT/s) Data rate (32, 64 GT/s)	1.1 to 10	PCIe Ver. 4.0, 5.0, 6.0 8, 16 GT/s Visible only if a UXR oscilloscope is connected.
Sampling Rate	End Point Root Complex Add-In Card System Device, Host	Long Channel (8, 16 GT/s) Data rate (32 GT/s)		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32 GT/s Visible only if a UXR oscilloscope is connected
Scope Connection for Calibration	End Point Root Complex Add-In Card System Device Host	Data rates	Chan 1 3 Direct Connect Chan 2 4 Direct Connect, Real Edge	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (see under 'None' for 2.5, 5 GT/s) The values can be selected/preselected for some kinds of calibrations (all 32 GT/s calibrations and the TxEQ and Launch Voltage Calibration at 8 GT/s and 16 GT/s). All calibrations can be done with a single-ended direct connection to either channels 1&3 or channels 2&4. Note: The values available depend on the connected oscilloscope. The values given here are for a four-channel model, they will differ for a two-channel model.
Step Response High Time	End Point Root Complex	Long Channel		PCIe Ver. 4.0, 5.0, 6.0 8 GT/s The length in UIs after the low-to-high transition.
Step Response Low Time	End Point Root Complex	Long Channel		PCIe Ver. 4.0, 5.0, 6.0 8 GT/s The length in UIs prior to the low-to-high transition.
Transfer Function File for Package Model on Scope	End Point Root Complex	Data rates	Name of transfer function file	PCIe Ver. 4.0, 5.0, 6.0 8 GT/s This is the file name of the package model, which is located on the oscilloscope. The package model must be embedded to perform some calibrations.
Transfer Function File for Replica (Channel) on Scope	End Point Root Complex	Data rates	Name of transfer function file	PCIe Ver. 4.0, 5.0, 6.0 8 GT/s Available only if "Embed Replica Channel" was selected in Configure DUT > Show Parameters > 8 GT/s. This is the name of the transfer function of the replica channel, which is located on the oscilloscope.
Transfer Function File for Replica (Channel) and Package Model on Scope	End Point Root Complex	Data rates	Name of transfer function file	PCIe Ver. 4.0, 5.0, 6.0 8 GT/s Available only if "Embed Replica Channel" was selected in Configure DUT > Show Parameters > 8 GT/s. This is the name of the transfer function that includes the replica channel and package model, which is located on the oscilloscope.

Category/ Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
UXR Calibration Mode	End Point Root Complex Add-In Card System Device, Host	Long Channel (8, 16 GT/s) Data rate (32 GT/s)	Compliance Custom	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32 GT/s Visible only if a UXR oscilloscope is connected.
Waveform Interpolation	End Point Root Complex Add-In Card System	Long Channel	OFF INT2	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s Visible only if a UXR oscilloscope is connected. When the value is INT2 (two-point interpolation), an additional data point will be interpolated between each of the original points. This increases the resolution by a factor of 2.

PCIe Common Parameters – Receiver

These parameters are displayed in the GUI at a level higher than an individual procedure in the Receiver and Receiver Setup parts of the procedure tree.

NOTE

In this release, the specification version PCIe Ver. 6.0 is available only for ASIC interfaces, that is, only End Point and Root Complex DUT types. Any other DUT types given in this table apply to PCIe Ver. 4.0 and 5.0 only.

Table 17 PCIe Common Receiver Parameters

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
None				
Custom Calibration Source	End Point Root Complex Add-In Card System	Custom Tests	Custom Eye Calibration Custom Eye Scan Calibration	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s
Custom Eye Calibration Point	End Point Root Complex Add-In Card System	Custom Tests		PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s The values are impairment combinations (that give a valid eye) taken from the calibration chosen under 'Custom Calibration Source'.
Pause Before Auto-Align	End Point Root Complex Add-In Card System	Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s
Repetitions	All DUT types	All Receiver and Receiver Setup group levels	0, ..., 2147483647	The number of times the group of procedures is going to be repeated. If the value is '0', it runs only once.
Loopback Training Settings (see Note on page 290)				
Custom Voltage	End Point Root Complex Add-In Card System Device, Host	Rx data rates	100 mV – 12 V	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s Specify the Custom Training Voltage. Available only if 'Use Custom Training Voltage' is True.
Suppress Loopback Training Messages	End Point Root Complex Add-In Card System Device, Host	Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Use Custom Training Voltage	End Point Root Complex Add-In Card System Device, Host	Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s
Use Gen3 EIEOS	End Point Root Complex Add-In Card System	Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s
Clock Setup				
Use End Point Clock Setup	Root Complex	Receiver Receiver Setup	True, False	PCIe Ver. 4.0, 5.0, 6.0 If set to True, the same clock setup will be used as for End Point DUTs.
Generator Clock				
32 GT/s SSC Deviation	Add-In Card	Receiver		PCIe Ver. 5.0
32 GT/s Use SSC	End Point Add-In Card	Receiver Receiver Setup	True, False	PCIe Ver. 5.0, 6.0
64 GT/s Use SSC	End Point	Receiver Receiver Setup	True, False	PCIe Ver. 6.0
Data Rate Deviation	End Point Add-In Card Device	Data rates		PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s
Ref Clock Multiplier Bandwidth	Root Complex System Host	Receiver Receiver Setup	100 kHz, 2 MHz, 5 MHz	PCIe Ver. 4.0, 5.0, 6.0
Reference Clock	End Point	Receiver Receiver Setup		PCIe Ver. 4.0, 5.0, 6.0 Frequency of the reference clock.
Use SSC	End Point Add-In Card Device	Receiver Receiver Setup	True, False	PCIe Ver. 4.0, 5.0, 6.0 In Ver. 4.0, read only.
Power Switch Automation				
Power Cycle max. Retries for LB Training	End Point Root Complex Add-In Card System Device, Host	Receiver Receiver Setup		PCIe Ver. 4.0, 5.0, 6.0 Available only if ‘Use Power Switch Automation’ is set to True. Maximum number of times that ValiFrame tries to train the DUT into loopback mode. If it is not possible within these tries, the test is aborted automatically. When **Power Switch Automation** is not checked, ValiFrame prompts you to retry every time loopback fails.

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Power Cycle Off On Duration	End Point Root Complex Add-In Card System Device, Host	Receiver Receiver Setup		PCIe Ver. 4.0, 5.0, 6.0 Available only if 'Use Power Switch Automation' is set to True. The duration between powering the DUT off and then powering it on again.
Power Cycle Settling Time	End Point Root Complex Add-In Card System Device, Host	Receiver Receiver Setup		PCIe Ver. 4.0, 5.0, 6.0 Available only if 'Use Power Switch Automation' is set to True. The wait time after the DUT is powered on and before the test continues with loopback (LB) training.
Power Switch Channel Number	End Point Root Complex Add-In Card System Device, Host	Receiver Receiver Setup		PCIe Ver. 4.0, 5.0, 6.0 Available only if 'Use Power Switch Automation' is set to True. This sets the channel number of the power switch channel that is connected to the DUT.
Use Power Switch Automation	End Point Root Complex Add-In Card System Device Host	Receiver Receiver Setup	True, False	PCIe Ver. 4.0, 5.0, 6.0 This is visible only if a power switch has been configured in the Station Configurator. If True, the DUT is powered on/off automatically by the software and the loopback training can be run without user intervention.
Impairments				
Treat 33kHz as separate SJ frequency	End Point Root Complex	Receiver Receiver Setup	True, False	PCIe Ver. 6.0 According to PCIe Ver. 6.0, the 33 kHz frequency must be treated as a separate frequency point. Read-only in Compliance Mode, editable in Expert Mode. Default value: True.
Loopback Training				
Link Training Lane Number	End Point Root Complex Add-In Card System Device, Host	Lane		PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s
Link Training Mode	End Point Root Complex Add-In Card System Device, Host	Rx data rates	Static Sequence Vendor Specific Interactive	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s "Interactive" is not available for 2.5, 5 GT/s. "Static Sequence" is not available for 64 GT/s.
Link Training Suite Settings File	End Point Root Complex Add-In Card System Device, Host	Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s The path to the link training suite settings file (script file) that will be used for loopback training.

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Rx Setup Link Training Mode	End Point Root Complex Add-In Card System Device, Host	Rx Setup data rates	Vendor Specific Static Sequence	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s "Static Sequence" is not available for 64 GT/s.
Rx Setup Training Script File	End Point Root Complex Add-In Card System Device, Host	Rx Setup data rates		PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s The Rx Setup Training Script File is used for loopback training.
Training through	End Point Root Complex Add-In Card System Device Host	Rx data rates	L0-Recovery Configuration L0-Recovery with Speed Bypass (32, 64 GT/s) Configuration with Equalization (32, 64 GT/s)	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s Default: L0-Recovery For 2.5 and 5 GT/s, 'Training through' is read only and set to 'Configuration'.
Interactive Link Training (see Note on page 290)				
Drop Link Method	End Point Root Complex Add-In Card System Device, Host	Rx data rates	LTSSM Power Cycle	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s Select the method of dropping the link during link training.
DUT Initial Preset	End Point Add-In Card Device	Rx data rates	P0, ..., P9	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s The DUT Tx will use this preset in link equalization phase 0.
DUT Initial Preset Gen4	End Point Add-In Card	Rx data rates	P0, ..., P9	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s
DUT Initial Preset Gen5	End Point Add-In Card	Rx data rates	P0, ..., P9	PCIe Ver. 5.0, 6.0 32, 64 GT/s
DUT Initial Preset Gen6	End Point	Rx data rates	Q0, ..., Q10	PCIe Ver. 6.0 64 GT/s
DUT Start Preset Choice Gen4	Root Complex System	Rx data rates	System Board Defined User Defined	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s The properties "DUT Start Preset Choice GenX" (for X = 4, 5, 6) are linked. Once you have chosen the value for one of them, the same value is used for the others.
DUT Start Preset Choice Gen5	Root Complex System	Rx data rates	System Board Defined User Defined	PCIe Ver. 5.0, 6.0 32, 64 GT/s The properties "DUT Start Preset Choice GenX" (for X = 4, 5, 6) are linked. Once you have chosen the value for one of them, the same value is used for the others.

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
DUT Start Preset Choice Gen6	Root Complex	Rx data rates	System Board Defined User Defined	PCIe Ver. 6.0 64 GT/s The properties “DUT Start Preset Choice GenX” (for X = 4, 5, 6) are linked. Once you have chosen the value for one of them, the same value is used for the others.
DUT Target Preset	End Point Root Complex Add-In Card System Device, Host	Rx data rates	P0, ..., P10	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s The generator (downstream port) will request this preset in link equalization phase 3.
DUT Target Preset Gen4	End Point Root Complex Add-In Card System	Rx data rates	P0, ..., P10	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s
DUT Target Preset Gen5	End Point Root Complex Add-In Card System	Rx data rates	P0, ..., P10	PCIe Ver. 5.0, 6.0 32, 64 GT/s
DUT Target Preset Gen6	End Point Root Complex	Rx data rates	Q0, ..., Q10	PCIe Ver. 6.0 64 GT/s
Generator Full Swing	End Point Root Complex Add-In Card System Device, Host	Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s Full swing of generator used with LTSSM.
Generator Start Preset	End Point Add-In Card Device	Rx data rates	P0, ..., P9	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s The generator Tx will use this preset in link equalization phase 1. Note: This setting will be applied in the Jitter Tolerance and Sensitivity tests only.
Generator Start Preset Gen4	End Point Root Complex Add-In Card System	Rx data rates	P0, ..., P9	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s For Root Complex and System, only editable if ‘DUT Start Preset Gen4’ is set to ‘User Defined’.
Generator Start Preset Gen5	End Point Root Complex Add-In Card System	Rx data rates	P0, ..., P9	PCIe Ver. 5.0, 6.0 32, 64 GT/s For Root Complex and System, only editable if ‘DUT Start Preset Gen5’ is set to ‘User Defined’.
Generator Start Preset Gen6	End Point Root Complex	Rx data rates	Q0, ..., Q10	PCIe Ver. 6.0 64 GT/s For Root Complex, only editable if ‘DUT Start Preset Gen6’ is set to ‘User Defined’.

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Precoding Auto Detection	End Point Root Complex Add-In Card System	Rx data rates	True, False	PCIe Ver. 5.0, 6.0 32, 64 GT/s If set to True, the test automation will automatically switch to a precoded test pattern at the generator if the DUT has requested it during loopback training. When set to True, the test automation will also try to re-sync on a precoded pattern if the synchronization did not work with a non-precoded pattern at the first attempt. Please note that link training can take significantly longer when Precoding Auto Detection is enabled.
Select Start Preset Gen4	End Point Add-In Card	Rx data rates	User Defined LTSSM Defined LTSSM EQTS2 Defined	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s
Select Start Preset Gen5	End Point Add-In Card	Rx data rates	User Defined LTSSM Defined LTSSM EQTS2 Defined	PCIe Ver. 5.0, 6.0 32, 64 GT/s The value ‘LTSSM Defined’ is available only when the property ‘Training Through’ (under ‘Loopback Training’) is selected as ‘Configuration’ or ‘L0-Recovery’.
Select Start Preset Gen6	End Point	Rx data rates	User Defined LTSSM Defined LTSSM EQTS2 Defined	PCIe Ver. 6.0 64 GT/s The value ‘LTSSM EQTS2 Defined’ is available only when the property ‘Training Through’ (under ‘Loopback Training’) is selected as ‘Configuration’ or ‘L0-Recovery’.
Speed Change Control	Root Complex System Host	Rx data rates	BERT, DUT	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s Select the device that will control the speed change during link training. Default: BERT.
Error Detector				
Analyzer Equalization	End Point Root Complex Add-In Card System Device, Host	Rx data rates	1, ..., 120. For 64 GT/s: 1, ..., 55 For M8020A: Off, –6 dB, –9 dB, –12 dB	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s Available only if ‘Use Auto Analyzer Equalization’ is set to False.
CDR Loop Bandwidth	End Point Root Complex Add-In Card System Device, Host	Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s The loop bandwidth of the JBERT error detector CDR.

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
CDR Loop Selection	End Point Root Complex Add-In Card System Device, Host	Rx data rates	For 2.5 GT/s: Loop1, Loop2 Otherwise: Loop1, ..., Loop4	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s The loops available depend on the value of the CDR Loop Bandwidth as follows: Always: Loop1 CDR Loop Bandwidth ≥ 3 MHz: Loop1, Loop2 CDR Loop Bandwidth ≥ 5 MHz: Loop1, Loop2, Loop3 CDR Loop Bandwidth ≥ 8 MHz: Loop1, Loop2, Loop3, Loop4
Enable FEC	End Point Root Complex	Rx data rates	True, False	PCIe Ver. 6.0 64 GT/s If True, forward error correction is enabled.
Fast Alignment	End Point Root Complex Add-In Card System Device, Host	Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s
Initial Analyzer Equalization	End Point Root Complex Add-In Card System Device, Host	Rx data rates	1, ..., 120. For 64 GT/s: 1, ..., 55	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s Available only if 'Use Auto Analyzer Equalization' is set to True.
Input Range	End Point Root Complex Add-In Card System Device, Host	Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s
Input Range for Loopback Training	End Point Root Complex Add-In Card System Device, Host	Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s
Lower Analyzer Threshold	End Point Root Complex	Rx data rates	-400 mV to -1 mV	PCIe Ver. 6.0 64 GT/s
Manually align error detector sampling point	End Point Root Complex Add-In Card System Device, Host	Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0
Middle Analyzer Threshold	End Point Root Complex	Rx data rates	-124 mV to +124 mV	PCIe Ver. 6.0 64 GT/s

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Pause Before Auto-Align	End Point Root Complex Add-In Card System Device, Host	Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 8 GT/s The execution is paused to allow manual optimization of the DUT Rx.
Polarity	End Point Root Complex Add-In Card System Device, Host	Rx data rates	Normal Inverted	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s Polarity of the analyzer input. Depending on the connected signal, the applied value at the instrument might change when auto-align is performed.
Retries for Auto Analyzer Equalization	End Point Root Complex Add-In Card System Device Host	Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s Defines how often the Error Detector FFE Optimization will be performed. Available only if 'Use Auto Analyzer Equalization' is set to True.
Threshold	End Point Root Complex Add-In Card System Device Host	Rx data rates	-400 mV to +400 mV	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32 GT/s
Upper Analyzer Threshold	End Point Root Complex	Rx data rates	+1 mV to +400 mV	PCIe Ver. 6.0 64 GT/s
Use Auto Analyzer Equalization	End Point Root Complex Add-In Card System Device, Host	Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s This optimization will not be performed if "Manually align error detector sampling point" is enabled.
Redriver				
Boost	End Point Root Complex Add-In Card System Device, Host	Rx data rates	0 to 33	Only if a redriver is connected. Sets Equalizer Boost for the Linear Equalization.
Eye Expander	End Point Root Complex Add-In Card System Device, Host	Rx data rates	0 to 3	Only if a redriver is connected. Sets Equalizer Eye Expander for the Linear Equalization.

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
DC Gain	End Point Root Complex Add-In Card System Device, Host	Rx data rates	0 to 3	Only if a redriver is connected. Sets Equalizer DC Gain for the Linear Equalization.
Driver Gain	End Point Root Complex Add-In Card System Device, Host	Rx data rates	0 to 3	Only if a redriver is connected. Sets Driver Gain.
BER Measurement				
Relax Time	End Point Root Complex Add-In Card System Device, Host	Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 2.5, 5, 8, 16, 32, 64 GT/s The time between when the stress signal is changed and the start of a BER measurement. This delay is to allow the DUT to adjust to the new settings.
Equalization				
De-Emphasis	End Point Root Complex Add-In Card System Device, Host	Channel (ASIC 8 GT/s) Lane		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s Read-only if “Use Preset” is True.
Generator Preset	End Point Root Complex Add-In Card System Device, Host	Lane	P0, ..., P9. For 64 GT/s: Q0, ..., Q9	PCIe Ver. 4.0, 5.0, 6.0 8 GT/s (not ASIC), 16, 32, 64 GT/s Available only if “Use Preset” is set to True.
Pre-Shoot	End Point Root Complex Add-In Card System Device, Host	Channel (ASIC 8 GT/s) Lane		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32 GT/s
Pre-Shoot 1	End Point Root Complex	Lane		PCIe Ver. 6.0 64 GT/s Read-only if “Use Preset” is True.
Pre-Shoot 2	End Point Root Complex	Lane		PCIe Ver. 6.0 64 GT/s Read-only if “Use Preset” is True.
Use Preset	End Point Root Complex Add-In Card System Device, Host	Lane	True, False	PCIe Ver. 4.0, 5.0, 6.0 8 GT/s (not ASIC), 16, 32, 64 GT/s

NOTE

The parameters listed under “Loopback Training Settings” exhibit a peculiarity in the current release. If you change the value of one of the parameters under Rx, then this same change will be made automatically under LEQ Rx and LEQ Tx for the same data rate, if the parameters occur there.

For example, if you set a new custom voltage for the data rate 32 GT/s under Rx, you will find that this new custom voltage has also been set for 32 GT/s under LEQ Rx (but in this case not under LEQ Tx because the parameter Custom Voltage does not occur there).

NOTE

The parameters listed under “Interactive Link Training” exhibit a peculiarity in the current release. If you change the value of one of the parameters for one data rate, then this same change will be made automatically for all data rates. Also, the Rx and LEQ Rx parameters are linked.

For example, if you change “DUT Initial Preset” to P2 for 64 GT/s under Rx, you will find that “DUT Initial Preset” has been changed to P2 for 32 GT/s, 16 GT/s and 8 GT/s as well, for both Rx and LEQ Rx.

Similarly, if you change the value of one of the parameters for one data rate under LEQ Tx, then this same change will be made automatically for all data rates there.

PCIe Common Parameters — Link Equalization

These parameters are displayed in the GUI at a level higher than an individual procedure in the Link Equalization part of the procedure tree.

NOTE In this release, the specification version PCIe Ver. 6.0 is available only for ASIC interfaces, that is, only End Point and Root Complex DUT types. Any other DUT types given in this table apply to PCIe Ver. 4.0 and 5.0 only.

Table 18 PCIe Common Link Equalization Parameters

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
None				
Custom Calibration Source	End Point Root Complex Add-In Card System	LEQ Custom Tests (exist only for LEQ Rx data rates)	Custom Eye Calibration Custom Eye Scan Calibration	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s
Custom Eye Calibration Point	End Point Root Complex Add-In Card System	LEQ Custom Tests (exist only for LEQ Rx data rates)		PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s The values are impairment combinations (that give a valid eye) taken from the calibration chosen under 'Custom Calibration Source'.
Pause before Auto-Align	End Point Root Complex Add-In Card System	LEQ Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s
Repetitions	All DUT types	All LEQ group levels	0, ..., 2147483647	The number of times the group of procedures is going to be repeated. If the value is '0', it runs only once.
SigTest Preset Measurement Method	End Point Root Complex Add-In Card System Device, Host	LEQ Tx data rates	Vb AC Fit (not 8 GT/s)	PCIe Ver 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for End Point)
Clock Setup				
Use End Point Clock Setup	Root Complex	Link Equalization	True, False	PCIe Ver. 4.0, 5.0, 6.0 If set to True, the same clock setup will be used as for End Point DUTs.
Power Switch Automation				
Power Cycle max. Retries for LB Training	End Point Root Complex Add-In Card System Device, Host	Link Equalization		Maximum number of times that ValiFrame tries to train the DUT into loopback mode. If it is not possible within these tries, the test is aborted automatically. When **Power Switch Automation** is not checked, ValiFrame prompts you to retry every time loopback fails.

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Power Cycle Off On Duration	End Point Root Complex Add-In Card System Device, Host	Link Equalization		The duration between powering the DUT off and then powering it on again.
Power Cycle Settling Time	End Point Root Complex Add-In Card System Device, Host	Link Equalization		The wait time after the DUT is powered on and before the test continues with loopback (LB) training.
Power Switch Channel Number	End Point Root Complex Add-In Card System Device, Host	Link Equalization		This sets the channel number of the power switch channel that is connected to the DUT
Use Power Switch Automation	End Point Root Complex Add-In Card System Device, Host	Link Equalization	True, False	This is visible only if a power switch has been configured in the Station Configurator. If True, the DUT is powered on/off automatically by the software and the loopback training can be run without user intervention.
Loopback Training Settings (see Note on page 290)				
Custom Voltage	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates	100 mV to 1.2 V	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s
Suppress Loopback Training Messages	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates)
Use Custom Training Voltage	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s
Use Gen3 EIEOS	End Point Root Complex Add-In Card System	LEQ Rx data rates LEQ Tx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 16 GT/s

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Generator Clock				
32 GT/s Sinusoidal SSC Spur	End Point Root Complex	LEQ Receiver	0 to 25 ns	PCIe Ver. 5.0, 6.0 Only available/editable if “Clock Architecture” (in Configure DUT dialog box) is set to “Separate Ref Clocks Independent SSC” and “Treat 33kHz as separate SJ frequency” (under “Impairments” for the LEQ Receiver node) is set to False.
32 GT/s SSC Deviation	Add-In Card	LEQ Receiver	0 to 5000 ppm	PCIe 5.0 Available only if ‘32 GT/s Use SSC’ is True.
32 GT/s Use SSC	End Point Add-In Card	LEQ Receiver	True, False	PCIe 5.0, 6.0 For End Point, only available if “Clock Architecture” (in Configure DUT dialog box) is set to “Separate Ref Clocks Independent SSC”.
64 GT/s Sinusoidal SSC Spur	End Point	LEQ Receiver	0 to 25 ns	PCIe 6.0 Available only if ‘64 GT/s Use SSC’ is True.
64 GT/s Use SSC	End Point	LEQ Receiver	True, False	PCIe 6.0 Only available/editable if “Clock Architecture” (in Configure DUT dialog box) is set to “Separate Ref Clocks Independent SSC” and “Treat 33kHz as separate SJ frequency” (under “Impairments” for the LEQ Receiver node) is set to False.
Data Rate Deviation	End Point Root Complex Add-In Card System Device Host	LEQ Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s For End Point, Root Complex: Not 8 GT/s.
Ref Clock Multiplier Bandwidth	Root Complex System Host	LEQ Receiver	100 kHz, 2 MHz, 5 MHz	PCIe Ver. 4.0, 5.0, 6.0
Sinusoidal SSC Spur	End Point	LEQ Receiver		PCIe Ver. 4.0, 5.0, 6.0
SSC Deviation	Add-In Card Device	LEQ Receiver		PCIe Ver. 4.0, 5.0
SSC Frequency	End Point Add-In Card Device	LEQ Receiver		PCIe Ver. 4.0, 5.0, 6.0 Only available/editable if “Clock Architecture” (in Configure DUT dialog box) is set to “Separate Ref Clocks Independent SSC”. Additionally, for PCIe Ver. 6.0, “Treat 33kHz as separate SJ frequency” (under “Impairments” for the LEQ Receiver node) must be set to False.
Use SSC	End Point Add-In Card Device	LEQ Receiver	True, False	PCIe Ver. 4.0, 5.0, 6.0

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Impairments				
Treat 33kHz as separate SJ frequency	End Point Root Complex	LEQ Receiver	True, False	PCIe Ver. 6.0 According to PCIe Ver. 6.0, the 33 kHz frequency must be treated as a separate frequency point. Read-only in Compliance Mode, editable in Expert Mode. Default value: True.
Loopback Training				
Interactive Training Script File	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only LEQ Rx data rates and only End Point.) The link training suite settings file (script file), and path, that will be used for loopback training.
Link Training Lane Number	End Point Root Complex Add-In Card System Device, Host	Lane		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s LEQ Rx and LEQ Tx are coupled for the same lane and data rate.
Precoding Auto Detection	End Point Root Complex Add-In Card System	LEQ Rx data rates	True, False	PCIe 5.0, 6.0 32, 64 GT/s If set to True, the test automation will automatically switch to a precoded test pattern at the generator if the DUT has requested it during loopback training. When set to True, the test automation will also try to re-sync on a precoded pattern if the synchronization did not work with a non-precoded pattern at the first attempt. Please note that link training can take significantly longer when Precoding Auto Detection is enabled.
Training through	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	L0-Recovery L0-Recovery with Speed Bypass Configuration with Equalization	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (For 64 GT/s, only LEQ Rx data rates.) Not all training methods are available for all data rates.
Interactive Link Training (see Note on page 290)				
Drop Link Method	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates	LTSSM Power Cycle	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s Select the method used to drop the link during link training.
DUT Initial Preset	End Point Add-In Card Device	LEQ Rx data rates	P0, ... P9	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s
DUT Initial Preset Gen4	End Point Add-In Card	LEQ Rx data rates	P0, ..., P9	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
DUT Initial Preset Gen5	End Point Add-In Card	LEQ Rx data rates	P0, ..., P9	PCIe Ver. 5.0, 6.0 32, 64 GT/s
DUT Initial Preset Gen6	End Point	LEQ Rx data rates	Q0, ..., Q10	PCIe Ver. 6.0 64 GT/s
DUT Start Preset Choice Gen4	Root Complex System	LEQ Rx data rates	System Board Defined User Defined	PCIe Ver, 4.0, 5.0, 6.0 16, 32, 64 GT/s The properties “DUT Start Preset Choice GenX” (for X = 4, 5, 6) are linked. Once you have chosen the value for one of them, the same value is used for the others.
DUT Start Preset Choice Gen5	Root Complex System	LEQ Rx data rates	System Board Defined User Defined	PCIe Ver. 5.0, 6.0 32, 64 GT/s The properties “DUT Start Preset Choice GenX” (for X = 4, 5, 6) are linked. Once you have chosen the value for one of them, the same value is used for the others.
DUT Start Preset Choice Gen6	Root Complex	LEQ Rx data rates	System Board Defined User Defined	PCIe Ver. 6.0 64 GT/s The properties “DUT Start Preset Choice GenX” (for X = 4, 5, 6) are linked. Once you have chosen the value for one of them, the same value is used for the others.
DUT Target Preset	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates	P0, ..., P10	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s
DUT Target Preset Gen4	End Point Root Complex Add-In Card System	LEQ Rx data rates	P0, ..., P10	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s
DUT Target Preset Gen5	End Point Root Complex Add-In Card System	LEQ Rx data rates	P0, ..., P10	PCIe Ver. 5.0, 6.0 32, 64 GT/s
DUT Target Preset Gen6	End Point Root Complex	LEQ Rx data rates	Q0, ..., Q10	PCIe Ver. 6.0 64 GT/s
Generator Full Swing	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates		PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s
Generator Start Preset	End Point Add-In Card Device	LEQ Rx data rates LEQ Tx data rates	P0, ..., P9	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.)

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Generator Start Preset Gen4	End Point Root Complex Add-In Card System	LEQ Rx data rates LEQ Tx data rates	P0, ..., P9	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.) The generator Tx will use this preset in link equalization phase 1. Note: This setting will be applied in the Jitter Tolerance and Sensitivity tests only. For Root Complex and System: This parameter is visible/editable only if the parameter “DUT Start Preset Choice Gen4” is set to “User Defined”.
Generator Start Preset Gen5	End Point Root Complex Add-In Card System	LEQ Rx data rates LEQ Tx data rates	P0, ..., P9	PCIe Ver. 5.0, 6.0 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.) The generator Tx will use this preset in link equalization phase 1. Note: This setting will be applied in the Jitter Tolerance and Sensitivity tests only. For Root Complex and System: This parameter is visible/editable only if the parameter “DUT Start Preset Choice Gen5” is set to “User Defined”.
Generator Start Preset Gen6	End Point Root Complex	LEQ Rx data rates	Q0, ..., Q10	PCIe Ver. 6.0 64 GT/s The generator Tx will use this preset in link equalization phase 1. Note: This setting will be applied in the Jitter Tolerance and Sensitivity tests only. For Root Complex and System: This parameter is visible/editable only if the parameter “DUT Start Preset Choice Gen6” is set to “User Defined”.
Select Start Preset Gen4	End Point Add-In Card	LEQ Rx data rates	User Defined LTSSM Defined LTSSM EQTS2 Defined	PCIe Ver. 4.0, 5.0, 6.0 16, 32, 64 GT/s
Select Start Preset Gen5	End Point Add-In Card	LEQ Rx data rates	User Defined LTSSM Defined LTSSM EQTS2 Defined	PCIe Ver. 5.0, 6.0 32, 64 GT/s The value ‘LTSSM Defined’ is available only when the property ‘Training Through’ (under ‘Loopback Training’) is selected as ‘Configuration’ or ‘L0-Recovery’.
Select Start Preset Gen6	End Point	LEQ Rx data rates	User Defined LTSSM Defined LTSSM EQTS2 Defined	PCIe Ver. 6.0 64 GT/s The value ‘LTSSM EQTS2 Defined’ is available only when the property ‘Training Through’ (under ‘Loopback Training’) is selected as ‘Configuration’ or ‘L0-Recovery’.
Speed Change Control	Root Complex System Host	LEQ Rx data rates	BERT, DUT	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Error Detector				
Analyzer Equalization	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	1, ..., 120. 1, ..., 55 for 64 GT/s	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.) Available only if 'Use Auto Analyzer Equalization' is set to False.
CDR Loop Bandwidth	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	5 kHz to 20 MHz	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.) The loop bandwidth of the JBERT error detector CDR.
CDR Loop Selection	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates	Loop1, ..., Loop4	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s The loops available depend on the value of the CDR Loop Bandwidth as follows: Always: Loop1 CDR Loop Bandwidth ≥ 3 MHz: Loop1, Loop2 CDR Loop Bandwidth ≥ 5 MHz: Loop1, Loop2, Loop3 CDR Loop Bandwidth ≥ 8 MHz: Loop1, Loop2, Loop3, Loop4
Enable FEC	End Point Root Complex	LEQ Rx data rates	True, False	PCIe Ver. 6.0 64 GT/s
Fast Alignment	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.)
Initial Analyzer Equalization	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	0, ..., 120	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.) Available only if 'Use Auto Analyzer Equalization' is enabled.
Input Range	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	100 mV to 800 mV	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.)
Input Range for Loopback Training	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	100 mV to 800 mV	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.)
Lower Analyzer Threshold	End Point Root Complex	LEQ Rx data rates	-400 mV to -1 mV	PCIe Ver. 6.0 64 GT/s

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Manually align error detector sampling point	End Point Root Complex Add-In Card System Device, Host	LEQ Receiver	True, False	PCIe Ver. 4.0, 5.0, 6.0
Middle Analyzer Threshold	End Point Root Complex	LEQ Rx data rates	-124 mV to +124 mV	PCIe Ver. 6.0 64 GT/s
Pause Before Auto-Align	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 8 GT/s The execution is paused to let the user carry out manual optimization of the DUT receiver.
Polarity	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	Normal Inverted	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.) Polarity of the analyzer input.
Retries for Auto Analyzer Equalization	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	1, ..., 5	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.) Available only if 'Use Auto Analyzer Equalization' is enabled. This defines how often the Error Detector FFE Optimization will be performed. Between each optimization the sample delay will be aligned.
Threshold	End Point Root Complex Add-In Card System Device Host	LEQ Rx data rates LEQ Tx data rates	-400 mV to +400 mV	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32 GT/s
Upper Analyzer Threshold	End Point Root Complex	LEQ Rx data rates	+1 mV to +400 mV	PCIe Ver. 6.0 64 GT/s
Use Auto Analyzer Equalization	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	True, False	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s (64 GT/s only for LEQ Rx data rates.) This optimization will not be performed if 'Manually align error detector sampling point' is enabled.
Redriver				
Boost	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	0 to 33	Only if a redriver is connected. Sets Equalizer Boost for the Linear Equalization.

Category/Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Eye Expander	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	0 to 3	Only if a redriver is connected. Sets Equalizer Eye Expander for the Linear Equalization.
DC Gain	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	0 to 3	Only if a redriver is connected. Sets Equalizer DC Gain for the Linear Equalization.
Driver Gain	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates LEQ Tx data rates	0 to 3	Only if a redriver is connected. Sets Driver Gain.
BER Measurement				
Relax Time	End Point Root Complex Add-In Card System Device, Host	LEQ Rx data rates	100 ms, ..., 37 500 s	PCIe Ver. 4.0, 5.0, 6.0 8, 16, 32, 64 GT/s The time between when the eye-opening is changed and the start of a BER measurement. This delay is to allow the DUT to adjust to the new settings.
Parameter				
Generator Output Voltage Compensation	End Point Root Complex Add-In Card System Device, Host	LEQ Transmitter	0 dB, ..., 6 dB	PCIe Ver. 4.0, 5.0, 6.0 Compensation for voltage attenuation caused by the combination of power splitters and attenuators.
Scope Connection for Link EQ Tx Tests	End Point Root Complex Add-In Card System Device, Host	LEQ Transmitter	Chan 1 2 3 4 Direct Connect Channel 1 3 Differential Probe Channel 2 4 Differential Probe	PCIe Ver. 4.0, 5.0, 6.0 Oscilloscope Channels for LEQ Tx Tests
Skip BER Check	End Point Root Complex Add-In Card System Device, Host	LEQ Transmitter	True, False	PCIe Ver. 4.0, 5.0, 6.0 If True, LTSSM trains DUT into loopback but then skips the BER check. It can be helpful if at some DUT Tx preset the error detector shows a constant BER because of high insertion loss.

PCIe Parameters for Individual Procedures

PCIe Parameters for Individual Procedures — All Procedures

These parameters are displayed in the GUI at the level of an individual procedure in the procedure tree and are the same for (nearly) all procedures.

Table 19 PCIe Parameters for (Nearly) All Individual Procedures

Parameter	Description
Calibration Data Version	The version of the N5991 ValiFrame software that was used to obtain the data of the prerequisite calibrations, i.e., the calibration data required in order to perform the current procedure (test or calibration).
Compliant	Read-only in the parameter grid. It indicates whether the procedure you are running is compliant with the PCIe specification. ▪ True: You are working in Compliance Mode OR you are working in Expert Mode but all parameters that can be edited only in Expert Mode have their default values. ▪ False: You are working in Expert mode and a parameter that can be edited only in Expert Mode does not have its default value. The mode can be selected in the Configure DUT panel. False is also shown if you are working offline or if any of the prerequisite calibrations were not performed in compliant conditions. If the value is False, an additional property (Non-compliance reason(s)) is shown to indicate why the data is not compliant.
Non-compliance reason(s)	Possible reasons include: the required calibrations were run offline, with unreleased software, with old firmware.
Offline	▪ If True, the test automation software is not connected to any instrument. This mode should be used for demonstrations and checks only. It is not valid for calibrations or measurements. ▪ If False, the software is connected to instruments and produces valid data. It is read-only in the parameter grid. It can be set in the Instrument Configuration step of the Station Configurator.
Software Version	The version of the N5991 ValiFrame software currently being used.

PCIe Parameters for Individual Procedures — Calibration

These parameters are displayed in the GUI at the level of an individual procedure in the Calibration part of the procedure tree. See also Table 19 on page 300 for parameters that are used in practically all procedures and Table 23 on page 323 for sequencer parameters.

Table 20 PCIe Calibration Parameters for Individual Procedures

Category/Parameter	Description, Values, Where shown in GUI (which procedures)	
None		
DM Interference Step Size	The amount of additional DM interference added to the simulation at each step.	
	Stressed Jitter Eye Calibration (8 GT/s)	
EQ Calibration Pattern	Two pattern is usually used in order to remove reflections. Values: EQ Two Pattern, 64 zeros, 64 ones; EQ Two Pattern, 16 zeros, 16 ones; EQ One Pattern, 64 zeros, 64 ones	
	TxEQ and Launch Voltage Calibration (8, 16, 32 GT/s)	TxEQ and Launch Voltage Measurement (8, 16, 32 GT/s)
Equalization Mode	Values: Presets, Custom Values, Cursors	
	Eye Height and Width Scan (16, 32, 64 GT/s)	
Equalization Preset Range	Values: P0 ... P9	
	Final Equalization Preset Optimization (16 GT/s)	Initial Equalization Preset Optimization (16 GT/s)
Loop Levels	Values: 2 to 14	
	Custom Eye Scan Calibration (16, 32, 64 GT/s) Eye Height and Width Scan (16, 32, 64 GT/s)	Processing of Pre-Recorded Steps (64 GT/s)
Measure All Generator Voltages	For M8040A: If True, all generator voltages are measured. If False, only voltages where the cursors have different signs are measured. This increases the speed of the calibration. With the M8020A, all generator voltages are always measured.	
	TxEQ and Launch Voltage Calibration (8, 16, 32 GT/s)	
Measurement Algorithm	For details of the algorithms, see TxEQ and Launch Voltage Calibration on page 108. Values: Precision Presets, Measure All Coefficients, Speed-Optimized Measurement	
	TxEQ and Launch Voltage Calibration (64 GT/s)	
Measurement Method	Values: VNA (manual), Step Response Scope (auto)	
	Insertion Loss Calibration (16 GT/s)	
Number of Averages	The number of measurements averaged for each value.	
	End Point	CMSI Calibration (2.5, 5, 8 GT/s)
Random Jitter Step Size	The amount by which the random jitter amplitude is increased at each step.	
	RJ Calibration (8 GT/s)	
Re-calibrate on Final Channel	If True, the calibration starts on the final channel from the previous compliance eye calibration instead of the highest loss channel. A successful previous compliance eye calibration is required when selecting this. Values: True, False	
	Compliance Eye Calibration (64 GT/s)	

Category/Parameter	Description, Values, Where shown in GUI (which procedures)	
Save Calibration Data	Choose whether to save the created calibration data (True) or not (False). If False, the calibration will have to be rerun when ValiFrame is restarted.	
	Insertion Loss Calibration (16 GT/s)	
Select Measurement Algorithm	For details of the algorithms, see TxEQ and Launch Voltage Calibration on page 108. Values: Measure All Coefficients, Speed-Optimized Measurement	
	TxEQ and Launch Voltage Calibration (8, 16, 32 GT/s)	
Show Plots	Values: True, False	
	Eye Height and Width Scan (16, 32, 64 GT/s)	Processing of Pre-Recorded Steps (64 GT/s)
Sinusoidal Jitter	The amount of sinusoidal jitter added to the simulation of the stressed eye.	
	Stressed Jitter Eye Calibration (8 GT/s)	
Skip Preset and CTLE Optimization	Values: True, False	
	Compliance Eye Calibration (64 GT/s)	
Stop Random Jitter	The maximum RJ amplitude that is calibrated.	
	RJ Calibration (8 GT/s)	
Trace Loss Increment	The amount by which the trace loss is increased at each step.	
	Insertion Loss Calibration (16 GT/s)	
Trace Number Start Value	Channel Calibration (16 GT/s)	
Trace Number Stop Value	Channel Calibration (16 GT/s)	
Verification Mode	If True, instead of calibrating, the procedure uses the last successful calibration to apply values to the instrument. This can be used to confirm the calibration data if necessary. Values: True, False	
	CMSI Calibration (8, 16, 32, 64 GT/s) Compliance Eye Calibration (16, 32, 64 GT/s) DMSI Calibration (8, 16, 32, 64 GT/s) Eye Height Calibration (2.5, 5 GT/s) HF Second Tone SJ Calibration (64 GT/s)	HF SJ Calibration (16, 32, 64 GT/s) RJ Calibration (8, 16, 32, 64 GT/s) Stressed Jitter Eye Calibration (8_GT/s) TxEQ and Launch Voltage Calibration (8, 16, 32, 64 GT/s)
Generator		
CMSI	Common mode sinusoidal interference added to the signal.	
	Channel Calibration (16 GT/s) Compliance Eye Calibration (64 GT/s) Custom Eye Calibration (64 GT/s) Custom Eye Scan Calibration (64 GT/s)	Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s) Pre-Compliance Eye Calibration (64 GT/s)
Common Mode Interference	Common mode interference added to the signal.	
	Compliance Eye Calibration (16, 32 GT/s) Custom Eye Calibration (16, 32 GT/s)	Custom Eye Scan Calibration (16, 32 GT/s) Pre-Compliance Eye Calibration (16, 32 GT/s)

Category/Parameter	Description, Values, Where shown in GUI (which procedures)	
De-Emphasis	Value of De-Emphasis in dB applied to the signal.	
	Channel Calibration (16 GT/s) Compliance Eye Calibration (16, 32, 64 GT/s) Custom Eye Calibration (16, 32, 64 GT/s) Custom Eye Scan Calibration (16, 32, 64 GT/s) Eye Height and Width Measurement (16, 32, 64 GT/s)	HF SJ Calibration (16, 32 GT/s) Pre-Compliance Eye Calibration (16, 32, 64 GT/s) RJ Calibration (16, 32 GT/s) TxEQ and Launch Voltage Measurement (8, 16, 32 GT/s)
Differential Mode Interference	Differential mode interference added to the signal.	
	Custom Eye Calibration (16, 32 GT/s)	Eye Height and Width Measurement (16, 32 GT/s)
Differential Voltage	Value of differential voltage at the generator.	
	Custom Eye Calibration (16, 32 GT/s)	Eye Height and Width Measurement (16, 32 GT/s)
DMSI	Differential mode sinusoidal interference added to the signal.	
	Channel Calibration (16 GT/s) Custom Eye Calibration (64 GT/s) Eye Height and Width Measurement (64 GT/s)	Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s)
Generator Launch Voltage	Value of launch voltage at the generator.	
	Channel Calibration (16 GT/s) Custom Eye Calibration (64 GT/s) Eye Height and Width Measurement (64 GT/s)	Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s)
Generator Voltage	Value of voltage at the generator.	
	HF SJ Calibration (16, 32 GT/s) RJ Calibration (16, 32 GT/s)	TxEQ and Launch Voltage Measurement (8, 16, 32 GT/s)
Pre-Shoot	Value of Pre-Shoot in dB applied to the signal.	
	Channel Calibration (16 GT/s) Compliance Eye Calibration (16, 32 GT/s) Custom Eye Calibration (16, 32 GT/s) Custom Eye Scan Calibration (16, 32 GT/s) Eye Height and Width Measurement (16, 32 GT/s)	HF SJ Calibration (16, 32 GT/s) Pre-Compliance Eye Calibration (16, 32 GT/s) RJ Calibration (16, 32 GT/s) TxEQ and Launch Voltage Measurement (8, 16, 32 GT/s)
Pre-Shoot1	Value of Pre-Shoot1 in dB applied to the signal.	
	Compliance Eye Calibration (64 GT/s) Custom Eye Calibration (64 GT/s) Custom Eye Scan Calibration (64 GT/s)	Eye Height and Width Measurement (64 GT/s) Pre-Compliance Eye Calibration (64 GT/s)
Pre-Shoot2	Value of Pre-Shoot2 in dB applied to the signal.	
	Compliance Eye Calibration (64 GT/s) Custom Eye Calibration (64 GT/s) Custom Eye Scan Calibration (64 GT/s)	Eye Height and Width Measurement (64 GT/s) Pre-Compliance Eye Calibration (64 GT/s)
Random Jitter	Amount of random jitter added to the signal.	
	Channel Calibration (16 GT/s) Compliance Eye Calibration (16, 32, 64 GT/s) Custom Eye Calibration (16, 32, 64 GT/s) Custom Eye Scan Calibration (16, 32, 64 GT/s)	Eye Height and Width Measurement (16, 32, 64 GT/s) Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s) Pre-Compliance Eye Calibration (16, 32, 64 GT/s)

Category/Parameter	Description, Values, Where shown in GUI (which procedures)
Set Amplitude	Value of launch voltage at the generator. TxEQ and Launch Voltage Calibration (8, 16, 32 GT/s)
Sinusoidal Jitter	Amount of sinusoidal jitter added to the signal. Channel Calibration (16 GT/s) Custom Eye Calibration (16, 32, 64 GT/s) Eye Height and Width Measurement (16, 32, 64 GT/s) Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s)
Sinusoidal Jitter Frequency	Frequency of sinusoidal jitter added to the signal. Channel Calibration (16 GT/s) Compliance Eye Calibration (16, 32 GT/s) Custom Eye Calibration (16, 32 GT/s) Custom Eye Scan Calibration (16, 32 GT/s) Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s)
Loop n	Here n can take the values 1 to 14. There must be at least two loops.

Scan Parameter (Loop n)	▪ For Custom Eye Scan Calibration (16, 32, 64 GT/s):
	  ▪ By default, Scan Parameter (Loop 1) is set to Differential Mode Sinusoidal Interference
	  ▪ The other available parameters are Generator Launch Voltage and Sinusoidal Jitter.
	▪ For Eye Height and Width Scan (16, 32, 64 GT/s):
	  ▪ By default, Scan Parameter (Loop 1) is set to Equalization Preset.
	▪ For Processing of Pre-Recorded Steps (64 GT/s):
	  ▪ By default, Scan Parameter (Loop 1) is set to PreCursor2.
	  ▪ The values Equalization Preset and Generator Launch Voltage are not available to be scanned.
	Values: Equalization Preset, Generator Launch Voltage, Differential Mode Sinusoidal Interference, Common Mode Sinusoidal Interference, Random Jitter, Sinusoidal Jitter, Sinusoidal Jitter Frequency, CTLE, ISI/Trace Number
	
	Custom Eye Scan Calibration (16, 32, 64 GT/s)
	Eye Height and Width Scan (16, 32, 64 GT/s)
	Processing of Pre-Recorded Steps (64 GT/s)

Equalization Preset Range	Available if Scan Parameter (Loop n) is set to Equalization Preset. Values: Q0–Q9 Eye Height and Width Scan (16, 32, 64 GT/s)
“Parameter” Start Value	Here “Parameter” can be any of the values given for Scan Parameter (Loop n), apart from Equalization Preset. Custom Eye Scan Calibration (16, 32, 64 GT/s) Eye Height and Width Scan (16, 32, 64 GT/s) Processing of Pre-Recorded Steps (64 GT/s)
“Parameter” Stop Value	Here “Parameter” can be any of the values given for Scan Parameter (Loop n), apart from Equalization Preset. Custom Eye Scan Calibration (16, 32, 64 GT/s) Eye Height and Width Scan (16, 32, 64 GT/s) Processing of Pre-Recorded Steps (64 GT/s)
“Parameter” Scale Type	Here “Parameter” can be any of the values given for Scan Parameter (Loop n), apart from Equalization Preset. Values: Linear, Logarithmic Custom Eye Scan Calibration (16, 32, 64 GT/s) Eye Height and Width Scan (16, 32, 64 GT/s) Processing of Pre-Recorded Steps (64 GT/s)
“Parameter” Number of Steps	Here “Parameter” can be any of the values given for Scan Parameter (Loop n), apart from Equalization Preset. Custom Eye Scan Calibration (16, 32, 64 GT/s) Eye Height and Width Scan (16, 32, 64 GT/s) Processing of Pre-Recorded Steps (64 GT/s)

Category/Parameter	Description, Values, Where shown in GUI (which procedures)	
Fixed Parameters		
“Parameter”	The parameters listed under “Fixed Parameters” are those listed under “Scan Parameter (Loop n)” (see Loop n just above) that are not scanned but held fixed. ISI is not included here.	
	Custom Eye Scan Calibration (16, 32, 64 GT/s) Eye Height and Width Scan (32, 64 GT/s)	Processing of Pre-Recorded Steps (64 GT/s)
Oscilloscope		
CTLE	The value of CTLE in dB.	
	Eye Height and Width Measurement (16, 32, 64 GT/s)	Pre-Compliance Eye Calibration (32, 64 GT/s)
Do Auto Scale	If True, the vertical scale of the oscilloscope channel is set automatically. Value: True, False	
	Compliance Eye Calibration (64 GT/s) Custom Eye Calibration (64 GT/s) Custom Eye Scan Calibration (64 GT/s) Eye Height and Width Measurement (64 GT/s)	Eye Height and Width Scan (64 GT/s) Pre-Compliance Eye Calibration (64 GT/s) Processing of Pre-Recorded Steps (64 GT/s)
Fixed Vertical Scale of Scope Channels	The vertical scale of the oscilloscope channel. If “Do Auto Scale” is set to True, the value here is read only.	
	Compliance Eye Calibration (64 GT/s) Custom Eye Calibration (64 GT/s) Custom Eye Scan Calibration (64 GT/s) Eye Height and Width Measurement (64 GT/s)	Eye Height and Width Scan (64 GT/s) Pre-Compliance Eye Calibration (64 GT/s) Processing of Pre-Recorded Steps (64 GT/s)
Horizontal Range	The Horizintal Range that will be set on the oscilloscope during the calibration. This will determine how many UIs will be displayed during the calibration.	
	DMSI Calibration (16 GT/s)	
Number of Averages	Number of measurements averaged for each (jitter) value.	
	AWG Amplitude Correction Calibration (32 GT/s) Channel Calibration (16 GT/s) Compliance Eye Calibration (16, 32, 64 GT/s) Custom Eye Calibration (16, 32, 64 GT/s) Custom Eye Scan Calibration (16, 32, 64 GT/s) Eye Height and Width Measurement (16, 32, 64 GT/s) Eye Height and Width Scan (16, 32, 64 GT/s) Final Equalization Preset Optimization (16 GT/s) HF Second Tone SJ Calibration (64 GT/s)	HF SJ Calibration (16, 32, 64 GT/s) Initial Equalization Preset Optimization (16 GT/s) Insertion Loss Calibration (16, 32 GT/s) Pre-Compliance Eye Calibration (16, 32, 64 GT/s) Processing of Pre-Recorded Steps (64 GT/s) Pulsewidth Jitter Calibration (64 GT/s) RJ Calibration (16, 32, 64 GT/s) SNDR Calibration (64 GT/s)
Number of Waveform Averages	Number of waveforms that are averaged during the scope acquisition. A higher number will reduce the noise floor.	
	AWG Amplitude Correction Calibration (32 GT/s) Channel Calibration (16 GT/s) CMSI Calibration (16, 32 GT/s) Compliance Eye Calibration (16, 32, 64 GT/s) Custom Eye Calibration (16, 32, 64 GT/s) Custom Eye Scan Calibration (16, 32, 64 GT/s) DMSI Calibration (16, 32 GT/s) Eye Height and Width Measurement (16, 32, 64 GT/s) Eye Height and Width Scan (16, 32, 64 GT/s)	Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s) Insertion Loss Calibration (16, 32 GT/s) Pre-Compliance Eye Calibration (16, 32, 64 GT/s) Processing of Pre-Recorded Steps (64 GT/s) TxEQ and Launch Voltage Calibration (8, 16, 32, 64 GT/s) TxEQ and Launch Voltage Measurement (8, 16, 32, 64 GT/s)

Category/Parameter	Description, Values, Where shown in GUI (which procedures)	
Number of UIs	Number of unit intervals tested. Values: 1 to 1000.	
	CMSI Calibration (16 GT/s) HF Second Tone SJ Calibration (64 GT/s) HF SJ Calibration (16, 32, 64 GT/s)	Pulsewidth Jitter Calibration (64 GT/s) RJ Calibration (16, 32, 64 GT/s)
Optimize CTLE	Values: True, False	
	Eye Height and Width Measurement (16 GT/s)	Eye Height and Width Scan (16 GT/s)
Scope Bandwidth	Bandwidth selected on the oscilloscope.	
	AWG Amplitude Correction Calibration (32, 64 GT/s) Channel Calibration (16 GT/s) CMSI Calibration (16, 32, 64 GT/s) Compliance Eye Calibration (16, 32 GT/s) Custom Eye Calibration (16, 32 GT/s) Custom Eye Scan Calibration (16, 32 GT/s) DMSI Calibration (16, 32, 64 GT/s) Eye Height and Width Measurement (16, 32 GT/s) Eye Height and Width Scan (16, 32 GT/s) Final Equalization Preset Optimization (16 GT/s) HF Second Tone SJ Calibration (64 GT/s)	HF SJ Calibration (16, 32, 64 GT/s) Initial Equalization Preset Optimization (16 GT/s) Insertion Loss Calibration (16, 32 GT/s) Pre-Compliance Eye Calibration (16, 32 GT/s) Pulsewidth Jitter Calibration (64 GT/s) RJ Calibration (16, 32, 64 GT/s) TxEQ and Launch Voltage Calibration (8, 16, 32, 64 GT/s) TxEQ and Launch Voltage Measurement (8, 16, 32, 64 GT/s)
Scope Skew	If the used channels have an inter-channel skew, the value can be added here and will be compensated during measurements.	
	Compliance Eye Calibration (64 GT/s) Custom Eye Calibration (64 GT/s) Custom Eye Scan Calibration (64 GT/s) Eye Height and Width Measurement (64 GT/s)	Eye Height and Width Scan (64 GT/s) Pre-Compliance Eye Calibration (64 GT/s) Processing of Pre-Recorded Steps (64 GT/s)
Vertical Scale	Scale of the vertical axis on the oscilloscope.	
	TxEQ and Launch Voltage Calibration (64 GT/s)	
Preset and CTLE Optimization		
DMSI	Differential mode sinusoidal interference added to the signal.	
	Compliance Eye Calibration (32, 64 GT/s)	Pre-Compliance Eye Calibration (32, 64 GT/s)
Equalization Preset Range	Compliance Eye Calibration (64 GT/s)	Pre-Compliance Eye Calibration (64 GT/s)
Number of Averages	Number of measurements averaged for each jitter value.	
	Compliance Eye Calibration (32, 64 GT/s)	Pre-Compliance Eye Calibration (32, 64 GT/s)
Presets Range	Compliance Eye Calibration (32 GT/s)	Pre-Compliance Eye Calibration (32 GT/s)
Sinusoidal Jitter	Sinusoidal jitter added to the signal.	
	Compliance Eye Calibration (64 GT/s)	Pre-Compliance Eye Calibration (64 GT/s)
SJ	Sinusoidal jitter added to the signal.	
	Compliance Eye Calibration (32 GT/s)	Pre-Compliance Eye Calibration (32 GT/s)
Search Algorithm		
Maximum DMSI	Compliance Eye Calibration (16, 32, 64 GT/s)	
Maximum SJ	Compliance Eye Calibration (16, 32, 64 GT/s)	

Category/Parameter	Description, Values, Where shown in GUI (which procedures)	
Max Number of Search Steps	Compliance Eye Calibration (16, 64 GT/s)	
Max Number of Search Steps per Channel	Compliance Eye Calibration (32 GT/s)	
Minimum SJ	Values: 1 ps to 1.5625 ps	
	Compliance Eye Calibration (64 GT/s)	
Minimum Vdiff	Compliance Eye Calibration (16, 32, 64 GT/s)	
Use Nominal EH/EW Results from Pre Comp Cal	Values: True, False	
	Compliance Eye Calibration (16 GT/s)	
Calibration Flow		
Skip Preset and CTLE Optimization	Values: True, False	
	Compliance Eye Calibration (32 GT/s)	
Re-calibrate on Final Channel	Values: True, False	
	Compliance Eye Calibration (32 GT/s)	
Capture		
Capture Mode	This allows waveforms to be saved for the current configuration for each step of the procedure. Values: ▪ Do only local eye measurement ▪ Only save waveform on the oscilloscope – The waveforms are saved but no measurement is performed. ▪ Do local eye measurement and save waveform on the oscilloscope – The normal calibration/measurement is performed and additionally the waveforms are saved on the oscilloscope.	
	Eye Height and Width Measurement (32 GT/s)	Eye Height and Width Scan (32 GT/s)
Seasim		
Directory that contains the step responses to process	Here you can specify the directory where the files that are to be used for the procedure are stored.	
	Processing of Pre-Recorded Steps (64 GT/s)	
Number of UI	Values: 10 to 1000	
	Compliance Eye Calibration (32, 64 GT/s) Custom Eye Calibration (32, 64 GT/s) Custom Eye Scan Calibration (32, 64 GT/s) Eye Height and Width Measurement (32, 64 GT/s)	Eye Height and Width Scan (32, 64 GT/s) Pre-Compliance Eye Calibration (32, 64 GT/s) Processing of Pre-Recorded Steps (32, 64 GT/s)
Optimize CTLE	Value: True, False	
	Custom Eye Calibration (64 GT/s) Custom Eye Scan Calibration (64 GT/s)	Eye Height and Width Measurement (32, 64 GT/s) Eye Height and Width Scan (32, 64 GT/s)
Used Pattern	Values: Clock Div 512, Clock Div 1024, Clock Div 2048	
	Compliance Eye Calibration (32, 64 GT/s) Custom Eye Calibration (32, 64 GT/s) Custom Eye Scan Calibration (32, 64 GT/s) Eye Height and Width Measurement (32, 64 GT/s)	Eye Height and Width Scan (32, 64 GT/s) Pre-Compliance Eye Calibration (32, 64 GT/s) Processing of Pre-Recorded Steps (32, 64 GT/s)

Category/Parameter	Description, Values, Where shown in GUI (which procedures)	
Channel		
Total Channel Loss	Total insertion loss of the calibration channel.	
	AWG Amplitude Correction Calibration (32, 64 GT/s) CMSI Calibration (16, 32, 64 GT/s) Compliance Eye Calibration (16, 32 GT/s) Custom Eye Calibration (16, 32, 64 GT/s) Custom Eye Scan Calibration (16, 32, 64 GT/s)	DMSI Calibration (16, 32, 64 GT/s) Eye Height and Width Measurement (16, 32, 64 GT/s) Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s) Pre-Compliance Eye Calibration (16, 32, 64 GT/s)
Trace Number	Hardware trace number used for the procedure.	
	AWG Amplitude Correction Calibration (32, 64 GT/s) CMSI Calibration (16, 64 GT/s) Compliance Eye Calibration (16, 32 GT/s) Custom Eye Calibration (16, 32, 64 GT/s) Custom Eye Scan Calibration (16, 32, 64 GT/s)	DMSI Calibration (16, 32, 64 GT/s) Eye Height and Width Measurement (16 GT/s) Final Equalization Preset Optimization (16 GT/s) Initial Equalization Preset Optimization (16 GT/s) Pre-Compliance Eye Calibration (16, 32, 64 GT/s)
Sequencer		
	The parameters listed in the category Sequencer in the parameter grid are described in Table 23 on page 323.	
Variable ISI Pairs		
CBB var. ISI pair –XXdB Channel	The number of the variable ISI pair on the CCB side required for –XX dB.	
	Insertion Loss Calibration (16, 32 GT/s)	

PCIe Parameters for Individual Procedures — Receiver

These parameters are displayed in the GUI at the level of an individual procedure in the Receiver and Receiver Setup parts of the procedure tree. See also Table 19 on page 300 for parameters that are used in practically all procedures and Table 23 on page 323 for sequencer parameters.

For more details of the parameters listed in the category Sinusoidal Jitter Variation and the relationships between them, see Rx Jitter Tolerance Test on page 205.

Table 21 PCIe Receiver Parameters for Individual Procedures

Category/ Parameter	Description/ Values/Where shown in GUI	
None		
CMSI Amplitude	Rx Compliance Setup (2.5, 5 GT/s) Rx Compliance Test (2.5, 5 GT/s)	Rx Jitter Tolerance Test (2.5, 5 GT/s) Rx Sensitivity Test (2.5, 5 GT/s)
Eye Height	Rx Stressed Jitter Eye Setup (8_GT/s)	Rx Stressed Jitter Eye Test (8_GT/s)
Eye Width	Rx Stressed Jitter Eye Setup (8_GT/s)	Rx Stressed Jitter Eye Test (8_GT/s)
ISI	Rx Compliance Setup (2.5, 5_GT/s) Rx Compliance Test (2.5, 5_GT/s)	Rx Jitter Tolerance Test (2.5, 5_GT/s) Rx Sensitivity Test (2.5, 5_GT/s)
Repeat Setup	Values: True, False Rx Impairments Setup (32, 64 GT/s)	
Sensitivity Mode	Values: Differential Mode Interference, Generator Launch Voltage Rx Custom Sensitivity Test (16, 32 GT/s)	 Rx Sensitivity Test (16, 32 GT/s)
Sinusoidal Jitter	Rx Stressed Jitter Eye Setup (8_GT/s)	Rx Stressed Jitter Eye Test (8_GT/s)
Sinusoidal Jitter Frequency	Rx Stressed Jitter Eye Setup (8_GT/s)	
Swap HF PJ Sources	Swap the HF jitter sources PJ1 and PJ2. When True, ValiFrame uses the same sources as the M8070B JTOL plugin. Rx Impairments Setup (32 GT/s)	
Loopback Training		
De-Emphasis used for LB Training	Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s)
Enable Impairments during Loopback Training	Values: True, False Rx Compliance Test (2.5, 5 GT/s) Rx Custom EQ Coefficient Matrix Scan (32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Sensitivity Test (16 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s)	 Rx EQ Coefficient Matrix Scan (32, 64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Sensitivity Test (2.5, 5, 16, 32 GT/s) Rx Stressed Jitter Eye Test (8, 16 GT/s)
Force Retraining at each BER Measurement	Values: True, False. If True, retraining is forced at each BER measurement for different Pre-Shoot2/Pre-Shoot1/DE combinations. Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s)	 Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Force Retraining on each Frequency	Values: True, False	
	Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)	Rx Stressed Jitter Eye Test (8_GT/s)
Pre-Shoot used for LB Training	Rx Custom EQ Coefficient Matrix Scan (16, 32 GT/s)	Rx EQ Coefficient Matrix Scan (8, 32, 16 GT/s)
Pre-Shoot1 used for LB Training	Rx EQ Coefficient Matrix Scan (64 GT/s)	Rx EQ Custom Coefficient Matrix Scan (64 GT/s)
Pre-Shoot2 used for LB training	Rx EQ Coefficient Matrix Scan (64 GT/s)	Rx EQ Custom Coefficient Matrix Scan (64 GT/s)
Eye Parameter		
Eye Height	Rx EQ Coefficient Matrix Scan (8_GT/s)	
Eye Width	Rx EQ Coefficient Matrix Scan (8_GT/s)	
Sinusoidal Jitter	Rx EQ Coefficient Matrix Scan (8_GT/s)	
Sinusoidal Jitter Frequency	Frequency of the SJ applied during the test.	
	Rx EQ Coefficient Matrix Scan (8_GT/s)	
Coefficient Variation		
Coefficient Divider	The coefficient divider (for C−2, C−1 and C+1 for 64 GT/s).	
	Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s)
Maximum Boost	Coefficient C+1 is increased until this Boost level is exceeded.	
	Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s)
Maximum Pre-Shoot1 for C−2 = 0 & C+1 = 0	Maximum pre-shoot1 for C−2 = 0 (0 dB pre-shoot2) and C+1 = 0 (0 dB de-emphasis). Coefficient C−1 is increased until this pre-shoot1 level is exceeded.	
	Rx Custom EQ Coefficient Matrix Scan (64 GT/s)	Rx EQ Coefficient Matrix Scan (64 GT/s)
Maximum Pre-Shoot2 for C−1 = 0 & C+1 = 0	Maximum pre-shoot2 for C−1 = 0 (0 dB pre-shoot1) and C+1 = 0 (0 dB de-emphasis). Coefficient C−2 is increased until this pre-shoot2 level is exceeded.	
	Rx Custom EQ Coefficient Matrix Scan (64 GT/s)	Rx EQ Coefficient Matrix Scan (64 GT/s)
Start De-Emphasis	Start De-Emphasis value in dB	
	Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s)
Start Pre-Shoot	Start Pre-Shoot value in dB.	
	Rx Custom EQ Coefficient Matrix Scan (16, 32 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32 GT/s)
Start Pre-Shoot1	Start Pre-Shoot1 value in dB.	
	Rx Custom EQ Coefficient Matrix Scan (64 GT/s)	Rx EQ Coefficient Matrix Scan (64 GT/s)
Start Pre-Shoot2	Start Pre-Shoot2 value in dB.	
	Rx Custom EQ Coefficient Matrix Scan (64 GT/s)	Rx EQ Coefficient Matrix Scan (64 GT/s)
Parameter		
Scan Order	Values: De-emphasis first, Pre-shoot first	
	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Initial De-Emphasis	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Initial Pre-Shoot	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Force Retraining at each Preset	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Force Retraining on each Frequency	Rx Custom Stressed Jitter Eye Test (16 GT/s) Rx Stressed Jitter Eye Setup (16 GT/s)	Rx Stressed Jitter Eye Test (16 GT/s)
De-Emphasis Variation		
Start De-Emphasis	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Stop De-Emphasis	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
De-Emphasis Step Size	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Pre-Shoot Variation		
Start Pre-Shoot	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Stop Pre-Shoot	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Pre-Shoot Step Size	Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Generator Jitter		
LF Sinusoidal Jitter Amplitude	Rx Compliance Test (2.5, 5 GT/s)	Rx Sensitivity Test (2.5, 5 GT/s)
LF Sinusoidal Jitter Frequency	Rx Sensitivity Test (2.5, 5 GT/s)	
Use Jitter	If True, jitter is added to the test signal. Rx Sensitivity Test (2.5, 5 GT/s)	
Sinusoidal Jitter Variation (see Rx Jitter Tolerance Test on page 205)		
Frequency Mode	Defines jitter frequencies that will be tested. Values: Compliance Frequencies, Equally Spaced Frequencies, User Defined Frequencies, Single Frequency. Default: Compliance frequencies. Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Frequency sweep scale	Defines how the frequency values are calculated. Values: Logarithmic, Linear Enabled when Frequency Mode is Equally Spaced Frequencies. Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Jitter Frequencies/Frequency	Read-only when Frequency Mode is Compliance Frequencies. Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Jitter step size(s) or factor(s)	Read-only when Frequency Mode is Compliance Frequencies and Use fixed number of steps is False. Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Number of frequency steps	Enabled when Frequency Mode is Equally Spaced Frequencies. Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Number of jitter steps	Available when Use fixed number of steps is True. Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Search Algorithm	Values: Binary, Linear, Linear with 2 step sizes, Linear with 2 step sizes and hysteresis, Logarithmic. Default: Linear with 2 step sizes. The binary search algorithm is recommended for DUTs with short recovery time. For more details about the search algorithms, see Rx Jitter Tolerance Test on page 205.	
	Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Show min failed points	If True, the minimum sinusoidal jitter amplitude at which the BER test failed is included in the results graph.	
	Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Start frequency value	Enabled when Frequency Mode is Equally Spaced Frequencies.	
	Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Start Jitter Amplitude(s)	Read-only when Frequency Mode is Compliance Frequencies.	
	Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Stop frequency value	Enabled when Frequency Mode is Equally Spaced Frequencies.	
	Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Use fixed number of steps	▪ If True, the range from the start amplitude to the jitter capability at each frequency is divided into a fixed number of steps. ▪ If False, the jitter steps are calculated depending on the Frequency Mode.	
	Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s)
Eye Height		
Eye Height	Rx Compliance Setup (2.5, 5 GT/s) Rx Compliance Test (2.5, 5 GT/s)	Rx Jitter Tolerance Test (2.5, 5 GT/s)
Loopback Training Eye Height	The eye height used for loopback training.	
	Rx Sensitivity Test (2.5, 5 GT/s)	
Start Eye Height	The eye height with which the test starts.	
	Rx Sensitivity Test (2.5, 5 GT/s)	
Step Size	The amount by which the eye height is decreased in each step to search for the “Min Passed Eye Height”. “Min Passed Eye Height” is the smallest eye height at which the DUT passes the BER test. At the next lower eye height the DUT fails the BER test.	
	Rx Sensitivity Test (2.5, 5 GT/s)	
Stop Eye Height	The eye height at which the test is aborted if the DUT does not fail the BER test before.	
	Rx Sensitivity Test (2.5, 5 GT/s)	
Sensitivity Variation		
Sensitivity Mode	Values: Differential Mode Interference, Generator Launch Voltage	
	Rx Custom Sensitivity Test (64 GT/s)	Rx Sensitivity Test (64 GT/s)
Start “Parameter”	Start value of “Parameter”, where “Parameter” refers to the parameter selected in Sensitivity Mode, e.g., Differential Mode Interference, Generator Launch Voltage.	
	Rx Custom Sensitivity Test (16, 32, 64 GT/s)	Rx Sensitivity Test (16, 32, 64 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Stop "Parameter"	Stop value of "Parameter", where "Parameter" refers to the parameter selected in Sensitivity Mode, e.g., Differential Mode Interference, Generator Launch Voltage.	
	Rx Custom Sensitivity Test (16, 32, 64 GT/s)	Rx Sensitivity Test (16, 32, 64 GT/s)
"Parameter" Step Size	Step size of "PArameter", where "Parameter" refers to the parameter selected in Sensitivity Mode, e.g., Differential Mode Interference, Generator Launch Voltage.	
	Rx Custom Sensitivity Test (16, 32, 64 GT/s)	Rx Sensitivity Test (16, 32, 64 GT/s)
BER Measurement		
Abort BER measurement when failed	Values: True, False. If True, the BER measurement is aborted when the allowed bit errors are exceeded (for BER Mode Fixed Time).	
	Rx Compliance Test (2.5, 5 GT/s) Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s) Rx Impairments Setup (64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s) Rx Sensitivity Test (2.5, 5, 16, 32, 64 GT/s) Rx Stressed Jitter Eye Test (8, 16 GT/s)
Allowed Bit Error	Number of bit errors that are allowed when BER Mode is Fixed Time.	
	Rx Compliance Test (2.5, 5 GT/s) Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s) Rx Impairments Setup (64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s) Rx Sensitivity Test (2.5, 5, 16, 32, 64 GT/s) Rx Stressed Jitter Eye Test (8, 16 GT/s)
BER Measurement Duration	Duration of the BER measurement in seconds when BER Mode is Fixed Time.	
	Rx Compliance Test (2.5, 5 GT/s) Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s) Rx Impairments Setup (64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s) Rx Sensitivity Test (2.5, 5, 16, 32, 64 GT/s) Rx Stressed Jitter Eye Test (8, 16 GT/s)
BER Mode	Values: Target BER, Fixed Time	
	Rx Compliance Test (2.5, 5 GT/s) Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s) Rx Impairments Setup (64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s) Rx Sensitivity Test (2.5, 5, 16, 32, 64 GT/s) Rx Stressed Jitter Eye Test (8, 16 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Confidence Level	The value of the confidence level when BER Mode is Target BER.	
	Rx Compliance Test (2.5, 5 GT/s) Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s) Rx Impairments Setup (64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s) Rx Sensitivity Test (2.5, 5, 16, 32, 64 GT/s) Rx Stressed Jitter Eye Test (8, 16 GT/s)
Target BER	The target value of BER to be reached when BER Mode is Target BER.	
	Rx Compliance Test (2.5, 5 GT/s) Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s) Rx Impairments Setup (64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s) Rx Sensitivity Test (2.5, 5, 16, 32, 64 GT/s) Rx Stressed Jitter Eye Test (8, 16 GT/s)
Impairments (Most of the parameters listed under Impairments are read-only unless Use Compliance Impairments is set to False)		
2nd Tone Sinusoidal Jitter	Only for ASIC or if the Jitter Eye Adjustment Mode is set to ASIC (Rx Jitter Tolerance Test only).	
	Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s) Rx EQ Coefficient Matrix Scan (16, 32, 64 GT/s)	Rx Impairments Setup (32, 64 GT/s) Rx Jitter Tolerance Test (16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Sensitivity Test (16, 32, 64 GT/s) Rx Stressed Jitter Eye Setup (16 GT/s)
2nd Tone Sinusoidal Jitter Frequency	Only for ASIC or if the Jitter Eye Adjustment Mode is set to ASIC (Rx Jitter Tolerance Test only).	
	Rx Custom EQ Coefficient Matrix Scan (32, 64 GT/s) Rx Custom Jitter Tolerance Test (32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (32 GT/s) Rx Custom Sensitivity Test (32, 64 GT/s) Rx EQ Coefficient Matrix Scan (32, 64 GT/s)	Rx Impairments Setup (32, 64 GT/s) Rx Jitter Tolerance Test (64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (32 GT/s) Rx Sensitivity Test (32, 64 GT/s) Rx Stressed Jitter Eye Test (16, 32 GT/s)
Common Mode Interference	Rx Custom EQ Coefficient Matrix Scan (32, 64 GT/s) Rx Custom Jitter Tolerance Test (32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (32 GT/s) Rx Custom Sensitivity Test (32, 64 GT/s) Rx EQ Coefficient Matrix Scan (32, 64 GT/s)	Rx Impairments Setup (32, 64 GT/s) Rx Jitter Tolerance Test (32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (32 GT/s) Rx Sensitivity Test (32, 64 GT/s)
Common Mode Sinusoidal Interference	Rx Custom EQ Coefficient Matrix Scan (16 GT/s) Rx Custom Jitter Tolerance Test (16 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16 GT/s) Rx Custom Sensitivity Test (16 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s) Rx EQ Coefficient Matrix Scan (16 GT/s)	Rx Jitter Tolerance Test (8, 16 GT/s) Rx Pre-Shoot De-Emphasis Scan (16 GT/s) Rx Sensitivity Test (16 GT/s) Rx Stressed Jitter Eye Setup (16 GT/s) Rx Stressed Jitter Eye Test (16 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Differential Mode Interference	Rx Custom EQ Coefficient Matrix Scan (32, 64 GT/s) Rx Custom Jitter Tolerance Test (32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (32 GT/s) Rx EQ Coefficient Matrix Scan (32, 64 GT/s)	Rx Impairments Setup (32, 64 GT/s) Rx Jitter Tolerance Test (32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (32 GT/s) Rx Sensitivity Test (64 GT/s)
Differential Mode Sinusoidal Interference	Rx Custom EQ Coefficient Matrix Scan (16 GT/s) Rx Custom Jitter Tolerance Test (16 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s) Rx EQ Coefficient Matrix Scan (16 GT/s)	Rx Jitter Tolerance Test (8, 16 GT/s) Rx Pre-Shoot De-Emphasis Scan (16 GT/s) Rx Stressed Jitter Eye Setup (16 GT/s) Rx Stressed Jitter Eye Test (16 GT/s)
Differential Voltage	Rx Custom EQ Coefficient Matrix Scan (32 GT/s) Rx Custom Jitter Tolerance Test (32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (32 GT/s) Rx Custom Sensitivity Test (32, 64 GT/s) Rx EQ Coefficient Matrix Scan (32, 64 GT/s)	Rx Impairments Setup (32, 64 GT/s) Rx Jitter Tolerance Test (32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (32 GT/s) Rx Sensitivity Test (32, 64 GT/s)
Generator Launch Voltage	Rx Custom EQ Coefficient Matrix Scan (16 GT/s) Rx Custom Jitter Tolerance Test (16 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16 GT/s) Rx Custom Sensitivity Test (16 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s) Rx EQ Coefficient Matrix Scan (16 GT/s)	Rx Jitter Tolerance Test (8, 16 GT/s) Rx Pre-Shoot De-Emphasis Scan (16 GT/s) Rx Sensitivity Test (16 GT/s) Rx Stressed Jitter Eye Setup (16 GT/s) Rx Stressed Jitter Eye Test (16 GT/s)
HF Sinusoidal Jitter	The amplitude of the SJ component fixed at a high frequency during the test. Rx Jitter Tolerance Test (5 GT/s)	 Rx Sensitivity Test (5 GT/s)
HF Sinusoidal Jitter Frequency	The frequency of the HF SJ component. Rx Jitter Tolerance Test (5 GT/s)	 Rx Sensitivity Test (5 GT/s)
Jitter Eye Adjustment Mode	Values: ASIC, CEM ASIC: Either a 2nd tone SJ or RJ reduction is used to adjust to the target EH and EW. SJ pass/fail limit is nominal SJ. Rx Custom Jitter Tolerance Test (16, 32 GT/s)	 Rx Jitter Tolerance Test (16, 32 GT/s)
LF Sinusoidal Jitter	Rx Compliance Setup (2.5, 5 GT/s)	
LF Sinusoidal Jitter Frequency	Rx Compliance Setup (2.5, 5 GT/s)	
Random Jitter	The amount of random jitter (rms) added to the test signal. Rx Compliance Setup (2.5, 5 GT/s) Rx Compliance Test (2.5, 5 GT/s) Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s)	 Rx EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Impairments Setup (32, 64 GT/s) Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Sensitivity Test (2.5, 5, 16, 32, 64 GT/s) Rx Stressed Jitter Eye Setup (16 GT/s) Rx Stressed Jitter Eye Test (16 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
RJ Low Pass Filter Frequency	1000 MHz low-pass filter frequency is compliant with the spec but it reduces the total amount of SJ for high jitter frequencies. In order to have the full amount of SJ, change to 500 MHz. This is only available for M8020A and M8040A.	
	Rx Custom Jitter Tolerance Test (16, 32 GT/s)	Rx Jitter Tolerance Test (2.5, 5, 8, 16, 32 GT/s)
Sinusoidal Jitter	Amplitude of the sinusoidal jitter added to the signal.	
	Rx Custom EQ Coefficient Matrix Scan (16, 32 GT/s) Rx Custom Pre-Compliance Test (32 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx EQ Coefficient Matrix Scan (16, 32 GT/s)	Rx Impairments Setup (32, 64 GT/s) Rx Pre-Compliance Test (32 GT/s) Rx Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Sensitivity Test (16, 32, 64 GT/s)
Sinusoidal Jitter Frequency	Frequency of the sinusoidal jitter added to the signal.	
	Rx Custom EQ Coefficient Matrix Scan (16, 32 GT/s) Rx Custom Pre-Compliance Test (32 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx EQ Coefficient Matrix Scan (16, 32 GT/s)	Rx Impairments Setup (32, 64 GT/s) Rx Pre-Compliance Test (32 GT/s) Rx Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Sensitivity Test (16, 32, 64 GT/s)
SSC Residual	This emulates the residual that is caused in "real world systems" by path length differences in the clock distribution and SSC modulation. See Chapter 10.	
	Rx Compliance Setup (5 GT/s) Rx Compliance Test (5 GT/s)	Rx Jitter Tolerance Test (5 GT/s) Rx Sensitivity Test (5 GT/s)
Use Compliance Impairments	If True, the compliance values of impairments are used. The listed impairments are read only. If False, all the parameters listed under "Impairments" become editable and their values can be changed.	
	All Rx and Rx Custom tests for all data rates.	
Channel		
Total Channel Loss	Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s) Rx EQ Coefficient Matrix Scan (16, 32, 64 GT/s)	Rx Impairments Setup (32, 64 GT/s) Rx Jitter Tolerance Test (16, 32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Sensitivity Test (16, 32, 64 GT/s) Rx Stressed Jitter Eye Setup (16 GT/s) Rx Stressed Jitter Eye Test (16 GT/s)
Trace Number	Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) Rx Custom Pre-Compliance Test (32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Custom Sensitivity Test (16, 32, 64 GT/s) Rx Custom Stressed Jitter Eye Test (16 GT/s) Rx EQ Coefficient Matrix Scan (16, 32, 64 GT/s)	Rx Jitter Tolerance Test (16, 32, 64 GT/s) Rx Impairments Setup (32, 64 GT/s) Rx Pre-Compliance Test (32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (16, 32 GT/s) Rx Sensitivity Test (16, 32, 64 GT/s) Rx Stressed Jitter Eye Setup (16 GT/s) Rx Stressed Jitter Eye Test (16 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Equalization for Remaining Rx tests		
Allow user to enter optimum equalization for remaining Rx tests	Values: True, False.	
	Rx Custom EQ Coefficient Matrix Scan (16, 32, 64 GT/s) Rx Custom Pre-Shoot De-Emphasis Scan (16, 32 GT/s)	Rx EQ Coefficient Matrix Scan (8, 16, 32, 64 GT/s) Rx Pre-Shoot De-Emphasis Scan (8, 16, 32 GT/s)
Sequencer		
	The parameters listed in the category Sequencer in the parameter grid are described in Table 23 on page 323.	

PCIe Parameters for Individual Procedures — Link Equalization

These parameters are displayed in the GUI at the level of an individual procedure in the Link Equalization part of the procedure tree. See also Table 19 on page 300 for parameters that are used in practically all procedures and Table 23 on page 323 for sequencer parameters.

For more details of the parameters listed in the category Sinusoidal Jitter Variation and the relationships between them, see Rx Jitter Tolerance Test on page 205.

Table 22 PCIe Parameters for Individual Link Equalization Tests

Category/ Parameter	Description/ Values/Where shown in GUI	
None		
Eye Height	LEQ Rx Stressed Jitter Eye Test (8 GT/s)	
Eye Width	LEQ Rx Stressed Jitter Eye Test (8 GT/s)	
Sensitivity Mode	Values: Differential Mode Interference, Generator Launch Voltage	
	LEQ Rx Custom Sensitivity Test (16, 32 GT/s)	LEQ Rx Sensitivity Test (16, 32 GT/s)
Sinusoidal Jitter	LEQ Rx Stressed Jitter Eye Test (8 GT/s)	
Loopback Training		
Enable Impairments during Loopback Training	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32 GT/s) LEQ Rx Stressed Jitter Eye Test (8, 16 GT/s)
Force Retraining on each Frequency	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Jitter Tolerance Test (8, 32, 64 GT/s)	LEQ Rx Stressed Jitter Eye Test (8 GT/s)
Parameter		
Force Retraining on each Frequency	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s)	LEQ Rx Stressed Jitter Eye Test (16 GT/s)
Max Number of Retries	The maximum number of tries if the electrical and/or protocol response time cannot be evaluated. If it is not possible within these tries, the test is aborted automatically.	
	LEQ Tx Response Time Compliance Test (8, 16, 32 GT/s)	
Measure Protocol Response Times	Values: True, False.	
	LEQ Tx Response Time Compliance Test (8, 16, 32 GT/s)	
Presets	The presets used in the test.	
	LEQ Tx Initial Preset Compliance Test (8, 16, 32 GT/s)	LEQ Tx Response Time Compliance Test (8, 16 GT/s)
Skip Response Time Measurements	If you are only interested in the reported pre-shoot, de-emphasis or cursor values, setting this to True allows you to skip the response time measurements and thus save test time.	
	LEQ Tx Response Time Compliance Test (8, 16, 32 GT/s)	

Category/ Parameter	Description/ Values/Where shown in GUI	
Sensitivity Variation		
Sensitivity Mode	Values: Differential Mode Interference, Generator Launch Voltage	
	LEQ Rx Custom Sensitivity Test (64 GT/s)	LEQ Rx Sensitivity Test (64 GT/s)
Start “Parameter”	“Parameter” is that selected in Sensitivity Mode.	
	LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Sensitivity Test (16, 32, 64 GT/s)
Stop “Parameter”	“Parameter” is that selected in Sensitivity Mode.	
	LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Sensitivity Test (16, 32, 64 GT/s)
“Parameter” Step Size	“Parameter” is that selected in Sensitivity Mode.	
	LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Sensitivity Test (16, 32, 64 GT/s)
Sinusoidal Jitter Variation (see Rx Jitter Tolerance Test on page 205)		
Frequency Mode	Defines jitter frequencies that will be tested. Values: Compliance Frequencies, Equally Spaced Frequencies, User Defined Frequencies, Single Frequency. Default: Compliance frequencies.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Frequency sweep scale	Defines how the frequency values are calculated. Values: Logarithmic, Linear Enabled when Frequency Mode is Equally Spaced Frequencies.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Jitter Frequencies/Frequency	Read-only when Frequency Mode is Compliance Frequencies.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Jitter step size(s) or factor(s)	Read-only when Frequency Mode is Compliance Frequencies and Use fixed number of steps is False.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Number of frequency steps	Enabled when Frequency Mode is Equally Spaced Frequencies.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Number of jitter steps	Available when Use fixed number of steps is True.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Search Algorithm	Values: Binary, Linear, Linear with 2 step sizes, Linear with 2 step sizes and hysteresis, Logarithmic. Default: Linear with 2 step sizes. The binary search algorithm is recommended for DUTs with short recovery time. For more details about the search algorithms, see Rx Jitter Tolerance Test on page 205.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Show min failed points	If True, the minimum sinusoidal jitter amplitude at which the BER test failed is included in the results graph.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Start frequency value	Enabled when Frequency Mode is Equally Spaced Frequencies.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Start Jitter Amplitude(s)	Read-only when Frequency Mode is Compliance Frequencies.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Stop frequency value	Enabled when Frequency Mode is Equally Spaced Frequencies.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
Use fixed number of steps	▪ If True, the range from the start amplitude to the jitter capability at each frequency is divided into a fixed number of steps. ▪ If False, the jitter steps are calculated depending on the Frequency Mode.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s)
BER Measurement		
Abort BER measurement when failed	Enabled for BER Mode Fixed Time. Values: True, False. If True, the BER measurement is aborted when the allowed bit errors are exceeded.	
	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (8, 16 GT/s)
Allowed Bit Error	Number of bit errors that are allowed when BER Mode is Fixed Time.	
	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (8, 16 GT/s)
BER Measurement Duration	Duration of the BER measurement in seconds when BER Mode is Fixed Time.	
	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (8, 16 GT/s)
BER Mode	Values: Target BER, Fixed Time	
	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (8, 16 GT/s)
Confidence Level	The value of the confidence level when BER Mode is Target BER.	
	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (8, 16 GT/s)
Target BER	The target value of BER to be reached when BER Mode is Target BER.	
	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (8, 16 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Impairments (Most of the parameters listed under Impairments are read-only unless Use Compliance Impairments is set to False)		
2nd Tone Sinusoidal Jitter	Sinusoidal jitter used to fine adjust the eye height and width. Only for ASIC or if the Jitter Eye Adjustment Mode is set to ASIC (LEQ Rx Jitter Tolerance Test only).	
	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (16 GT/s)
2nd Tone Sinusoidal Jitter Frequency	Only for ASIC or if the Jitter Eye Adjustment Mode is set to ASIC (LEQ Rx Jitter Tolerance Test only).	
	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (32, 64 GT/s)	LEQ Rx Custom Sensitivity Test (32, 64 GT/s) LEQ Rx Jitter Tolerance Test (32, 64 GT/s) LEQ Rx Sensitivity Test (32, 64 GT/s)
Common Mode Interference	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (32, 64 GT/s)	LEQ Rx Custom Sensitivity Test (32, 64 GT/s) LEQ Rx Jitter Tolerance Test (32, 64 GT/s) LEQ Rx Sensitivity Test (32, 64 GT/s)
Common Mode Sinusoidal Interference	LEQ Rx Custom Jitter Tolerance Test (16 GT/s) LEQ Rx Custom Sensitivity Test (16 GT/s) LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16 GT/s) LEQ Rx Sensitivity Test (16 GT/s) LEQ Rx Stressed Jitter Eye Test (16 GT/s)
Differential Mode Interference	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s)	LEQ Rx Custom Jitter Tolerance Test (32, 64 GT/s) LEQ Rx Jitter Tolerance Test (32, 64 GT/s)
Differential Mode Sinusoidal Interference	LEQ Rx Custom Jitter Tolerance Test (16 GT/s) LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16 GT/s) LEQ Rx Stressed Jitter Eye Test (16 GT/s)
Differential Voltage	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (32, 64 GT/s)	LEQ Rx Custom Sensitivity Test (32, 64 GT/s) LEQ Rx Jitter Tolerance Test (32, 64 GT/s) LEQ Rx Sensitivity Test (32, 64 GT/s)
Generator Launch Voltage	LEQ Rx Custom Jitter Tolerance Test (16 GT/s) LEQ Rx Custom Sensitivity Test (16 GT/s) LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16 GT/s) LEQ Rx Sensitivity Test (16 GT/s) LEQ Rx Stressed Jitter Eye Test (16 GT/s)
Jitter Eye Adjustment Mode	Values: ASIC, CEM For CEM, only one SJ frequency is used and swept. For ASIC, the first SJ frequency is fixed while the second frequency is swept.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32 GT/s)	LEQ Rx Jitter Tolerance Test (16, 32 GT/s)
Random Jitter	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (8, 16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (16 GT/s)
RJ Low Pass Filter Frequency	Values: 500 MHz, 1000 MHz. The 1000 MHz low-pass filter frequency is compliant with the specification, but it reduces the total amount of SJ for high jitter frequencies. In order to have the full amount of SJ, switch to 500 MHz. This is only available for M8020A and M8040A.	
	LEQ Rx Custom Jitter Tolerance Test (16, 32 GT/s)	LEQ Rx Jitter Tolerance Test (8, 16, 32 GT/s)

Category/ Parameter	Description/ Values/Where shown in GUI	
Sinusoidal Jitter	Sinusoidal jitter applied during the test.	
	LEQ Rx Compliance Test (32 GT/s) LEQ Rx Custom Compliance Test (32 GT/s)	LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s)
Sinusoidal Jitter Frequency	Frequency of the sinusoidal jitter applied during the test.	
	LEQ Rx Compliance Test (32 GT/s) LEQ Rx Custom Compliance Test (32 GT/s)	LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s)
Use Compliance Impairments	Values: True, False. Editable only in Expert Mode. If True, the amount of RJ and DMSI used during the compliance test is applied. Together with 12.5 ps SJ, this results in the eye height and eye width specified for the compliance test.	
	All LEQ Rx and LEQ Rx Custom tests at all data rates	
Channel		
Total Channel Loss	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (16 GT/s)
Trace Number	LEQ Rx Compliance Test (32, 64 GT/s) LEQ Rx Custom Compliance Test (32, 64 GT/s) LEQ Rx Custom Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Custom Sensitivity Test (16, 32, 64 GT/s)	LEQ Rx Custom Stressed Jitter Eye Test (16 GT/s) LEQ Rx Jitter Tolerance Test (16, 32, 64 GT/s) LEQ Rx Sensitivity Test (16, 32, 64 GT/s) LEQ Rx Stressed Jitter Eye Test (16 GT/s)
Oscilloscope		
Scope Horizontal Range	LEQ Tx Response Time Compliance Test (8, 16, 32 GT/s)	
Scope Request Vertical Range	The vertical range on the scope display used for the request signal.	
	LEQ Tx Response Time Compliance Test (8, 16, 32 GT/s)	
Scope Response Vertical Range	The vertical range on the scope display used for the response signal.	
	LEQ Tx Response Time Compliance Test (8, 16, 32 GT/s)	
Sequencer		
	The parameters listed in the category Sequencer in the parameter grid are described in Table 23 on page 323.	

Sequencer Parameters for Individual Procedures

These parameters are displayed in the GUI at the level of an individual procedure in the Calibration, Receiver and Receiver Setup parts of the procedure tree. They appear at the end of the parameter grid list.

Table 23 Sequencer Parameters for Individual Procedures

Category/ Parameter	DUT Type	Level (where shown in GUI)	Values	Conditions/Description/Where it can be changed
Sequencer				
Procedure Error Case Behavior	End Point, Root Complex	All individual procedures	Proceed with Next Procedure, Abort Sequence	Instruction for sequencer in error cases. ▪ “Proceed With Next Procedure”: If an error occurs in the current test or calibration procedure, continue by running the next procedure in the sequence. ▪ “Abort Sequence”: Abort further running of the sequence.
Procedure Failed Case Behavior	End Point, Root Complex	All individual procedures	Proceed with Next Procedure, Abort Sequence	Instruction for sequencer if the procedure is failed. ▪ “Proceed With Next Procedure”: If the current test or calibration procedure is failed, continue by running the next procedure in the sequence. ▪ “Abort Sequence”: Abort further running of the sequence.
Repetitions	End Point, Root Complex	All individual procedures	0, ..., 2147483647	The number of times the procedure is going to be repeated. If the value is '0', it runs only once.

10 Appendix B: SSC Settings

This Appendix contains tables that list the SSC settings according to specification version, interface type, clock architecture and data rate.

SSC Settings

The CTSs lay down exactly which type and value of SSC should be used. In addition to the specification version, this depends on the interface type (ASIC or CEM), clock architecture (CC or SRIS) and data rate. Table 24 to Table 26 provide details.

Table 24 SSC settings for PCIe Specification Version 6.0

Data rate [GT/s]	CC	SRIS
ASIC		
2.5	N/A	25 ns sinusoidal SSC Spur (1)
5	75 ps residual triangular SSC	25 ns sinusoidal SSC Spur (1)
8	N/A	25 ns sinusoidal SSC Spur (1)
16	1 ns residual sinusoidal SSC (1)	25 ns sinusoidal SSC Spur (1)
32	1 ns residual sinusoidal SSC (1)	15 ns sinusoidal SSC Spur (1)
64	1 ns residual sinusoidal SSC (1)	15 ns sinusoidal SSC Spur (1)

(1) Using LF PJ12 and tested as a separate 33 kHz frequency point. Not applied for other SJ frequencies. Always using nominal DR.

Table 25 SSC settings for PCIe Specification Version 5.0

Data rate [GT/s]	CC	SRIS
ASIC		
2.5	N/A	25 ns sinusoidal SSC Spur (1)
5	75 ps residual triangular SSC	25 ns sinusoidal SSC Spur (1)
8	N/A	25 ns sinusoidal SSC Spur (1)
16	1 ns residual sinusoidal SSC (4)	25 ns sinusoidal SSC Spur (1)
32	1 ns residual sinusoidal SSC (4)	15 ns sinusoidal SSC Spur (1)
CEM		
2.5	N/A	triangular 5000 ppm ds. (2)
5	75 ps residual triangular SSC	triangular 5000 ppm ds. (2)
8	N/A	triangular 5000 ppm ds. (2)
16	Optional: 500 ps res. triang. SSC (3)	triangular 5000 ppm ds. (2)
32	triangular 5000 ppm ds. (2)	triangular 5000 ppm ds. (2)

(1) Using custom sinusoidal SSC profile and setting the data rate (DR) in the middle: (DR = nominal DR – (SSC deviation)/2).
(2) Using center-spread triangular SSC and setting the DR in the middle: (DR = nominal DR – (SSC deviation)/2).
(3) Using residual SSC from LF RJ (triangular profile). Always using nominal DR.
(4) Using LF RJ2 because 100 MHz should not contain that tone in CC. Always using nominal DR.

Table 26 SSC settings for PCIe Specification Version 4.0

Data rate [GT/s]	CC	SRIS
ASIC		
2.5	N/A	25 ns sinusoidal SSC (1)
5	75 ps residual triangular SSC (3)	25 ns sinusoidal SSC (1)
8	N/A	25 ns sinusoidal SSC (1)
16	500 ps residual triangular SSC (3)	25 ns sinusoidal SSC (1)
CEM		
2.5	N/A	triangular 5000 ppm ds. (2)
5	75 ps residual triangular SSC (3)	triangular 5000 ppm ds. (2)
8	N/A	triangular 5000 ppm ds. (2)
16	Optional: 500 ps res. triang. SSC (3)	triangular 5000 ppm ds. (2)

(1) Using custom sinusoidal SSC profile and setting the data rate (DR) in the middle: (DR = nominal DR – (SSC deviation)/2).
(2) Using center-spread triangular SSC and setting the DR in the middle: (DR = nominal DR – (SSC deviation)/2).
(3) Using residual SSC from LF RJ (triangular profile). Always using nominal DR.

11 Appendix C: Acronyms and Abbreviations

This Appendix contains a list of acronyms and abbreviations used in the Keysight N5991 PCIe Test Automation Software Platform User Guide.

List of Acronyms

Acronym	Definition
ASIC	Application-Specific Integrated Circuit
AWG	Arbitrary Waveform Generator
BER	Bit Error Ratio
BERT	Bit Error Ratio Tester
BW	Bandwidth
CBB	Compliance Base Board
CC	Common Clock
CDR	Clock Data Recovery
CE	Circuit Emulation
CMSI	Common Mode Sinusoidal Interference
CTLE	Continuous Time Linear Equalization
CTS	Compliance Test Specification
DDJ	Data-Dependent Jitter
DE	De-Emphasis
DJ	Deterministic Jitter
DMSI	Differential Mode Sinusoidal Interference
DR	Data Rate
ds	Downspread
DSO	Digital Storage Oscilloscope
DUT	Device Under Test
EH	Eye Height
EIEOS	Electric Idle Exit Ordered Set
EW	Eye Width
FEC	Forward Error Correction
GPIB	General Purpose Interface Bus

Acronym	Definition
GSa/s	Gigasamples per second
GT/s	Gigatransfers per second
GUI	Graphical User Interface
HF	High Frequency
HTML	Hypertext Markup Language
IL	Insertion Loss
IO	Input–Output
ISI	Inter-Symbol Interference
LAN	Local Area Network
LB	Loopback
LEQ	Link Equalization
LF	Low Frequency
LTSSM	Link Training and Status State Machine
N/A	Not Applicable
NaN	Not a Number
PC	Personal Computer
PCIe	Peripheral Component Interconnect Express
PCI-SIG	Peripheral Component Interconnect Special Interest Group
PJ	Periodic jitter
PLL	Phase-Locked Loop
PS	Pre-Shoot
RJ	Random Jitter
Rx	Receiver
SJ	Sinusoidal Jitter
SNDR	Signal-to-(Noise and Distortion) Ratio
SRIS	Separate Reference Clock with Independent SSC
SSC	Spread Spectrum Clocking

Acronym	Definition
TP	Test Point
TTC	Transition Time Converter
Tx	Transmitter
TxEQ	Transmitter Equalization
UI	Unit Interval
USB	Universal Serial Bus
VISA	Virtual Instrument System Architecture
VNA	Vector Network Analyzer

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