Keysight N5990A-101 Test Automation Software Platform for PCIe

User Guide

KEYSIGHT TECHNOLOGIES

Notices

Manual Part Number

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User Guide

1 Introduction

KEYSIGHT TECHNOLOGIES

Test Automation Software Platform

The Keysight N5990A Test Automation software is an open and flexible framework for automating electrical compliance tests for digital buses such as PCI Express digital bus. It is globally marketed and supported by Keysight Technologies as N5990A.

The product runs on a standard PC that controls a wide range of test hardware. Typically, the hardware comprises of instruments for stimulus and response tests such as pattern generators, bit error ratio testers (BERTs), and oscilloscopes. The key elements of the software platform are: a test sequencer, receiver test libraries, and interfaces to oscilloscope applications for transmitter tests.

Additional options are available, e.g. User Programming.

N5990A is implemented in C# within the Microsoft .NET Framework.

The software platform is specified in the data sheet 5989-5483EN, incl. the PC requirements. For PCI Express®, application examples are given in the application notes 5989-5500EN.

Document History

First Edition (September, 2014)

The first edition of this user guide describes functionality of software version N5990A ValiFrame_2.23_PCI-Express3_1.40 or higher.

Second Edition (October, 2014)

The second edition of this user guide describes functionality of software version N5990A ValiFrame_2.23_PCI-Express3_1.41 or higher.

Third Edition (January, 2015)

The third edition of this user guide describes functionality of software version N5990A ValiFrame_2.23_PCI-Express3_1.50 or higher.

Fourth Edition (May, 2015)

The fourth edition of this user guide describes functionality of software version N5990A ValiFrame_2.23_PCI-Express3_1.55 or higher.

Fifth Edition (September, 2015)

The fifth edition of this user guide describes functionality of software version N5990A ValiFrame_2.23_PCI-Express3_1.60 or higher.

Sixth Edition (February, 2018)

The sixth edition of this user guide describes functionality of software version N5990A ValiFrame_2.24_PCIe3_2.00 or higher.

Seventh Edition (December, 2018)

The seventh edition of this user guide describes functionality of software version N5990A ValiFrame_2.24_PCIe3_2.10 or higher.

Eighth Edition (October, 2019)

The eighth edition of this user guide describes functionality of software version N5990A PCIe 2.50 or higher.

Ninth Edition (June, 2020)

The ninth edition of this user guide describes functionality of software version N5990A PCIe 3.04 or higher.

2 N5990A PCIe Station

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N5990A PCIe Station Configuration

PCIe Station Selection

The N5990A Station Configuration needs to be started prior to N5990A. It allows to select the application (i.e. PCIe) and the set of instruments used for it. Start the software with a double-click of the left mouse button on the icon (see Figure 1) or, alternatively, start the application from **All Programs / BitifEye /BitifEye PCIe N5590A/ PCIe Station Configuration.**

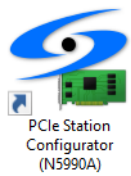


Figure 1 N5990A PCIe Station Configuration Icon

When the software is started, the **Station Selection** window appears as shown in Figure 2. Here the **PCIe Station** is selected by default.

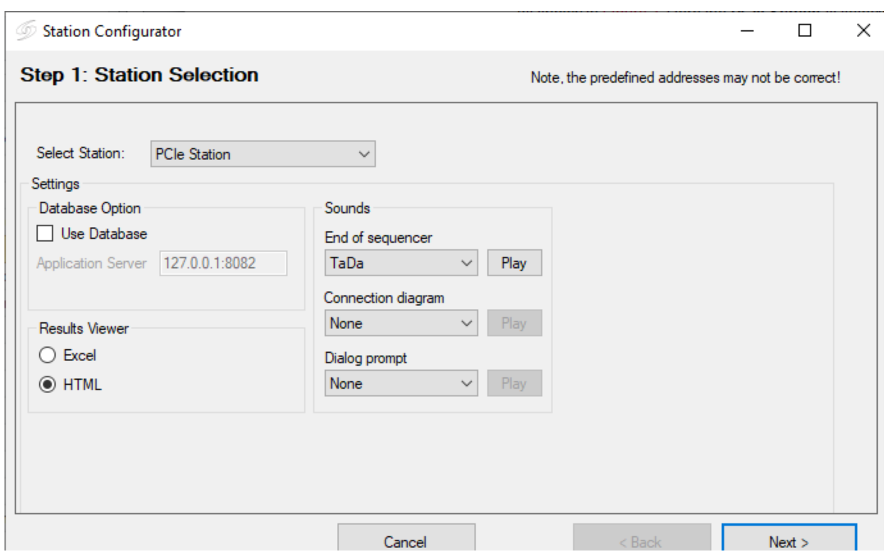


Figure 2 PCIe Station Selection Window

In the **Settings** section the following options are available:

Database Option

In case the option N5990A opt. 001 was purchased, the interface to SQL databases (and web browsers) is available. The connection to the database application server is established by unchecking the default **Database Offline** selection and entering the IP address of the server.

Results Viewer

Select here the viewer for the test results. Choices are (Microsoft) **Excel** or **HTML**.

Sounds

A warning sound can be activated in different states of program:

- **End of Sequencer** plays the selected sound at the end of a sequence.
- **Connection diagram** plays the selected sound every time a connection diagram pops up.
- **Dialog Prompt** plays the selected sound at each dialog prompt.

There are a few different sounds available to select:

- None (deactivates the sound)
- Car brake
- Feep Feep
- Ringing
- TaDa
- Tut

You can also hear the selected sound by clicking **Play** before you set the sound of your choice.

PCIe Station Configuration

After the station has been selected, press **Next** button to continue. The **Station Configuration** window is displayed as shown in Figure 3. It shows the possible instruments combinations that can be used for PCIe testing. All the required instruments can be selected using the drop-down menus. It contains such options as:

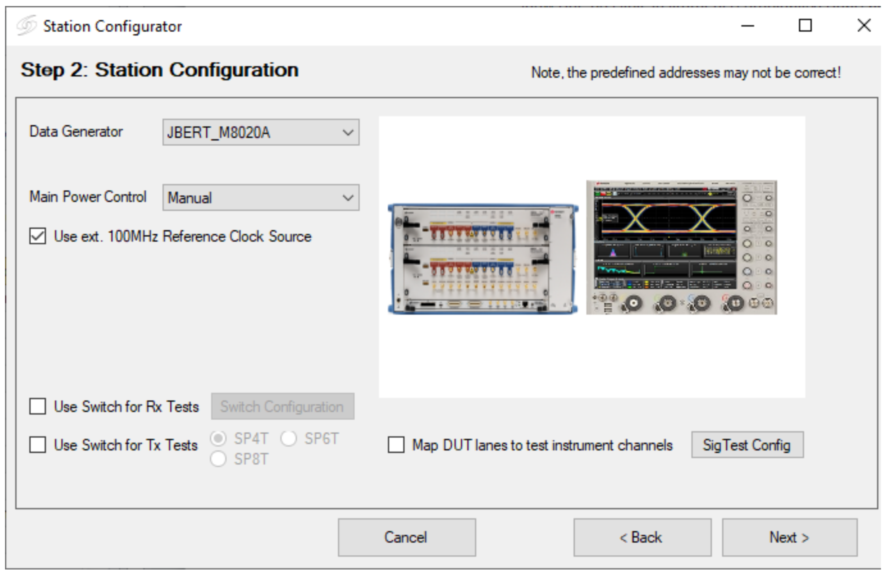


Figure 3 PCIe Station Configuration Window

1 Data Generator
2 Main Power Control
3 Use ext. 100MHz Reference Clock Source
4 Use Switch for Rx Tests
5 Use Switch for Tx Tests
6 Map DUT lanes to test instruments channels
7 Sig Test Config

Data Generator

The Data Generator is used to create patterns with specified stress parameters. The following instrument is available:

- JBERT_M8020A

The selected generator can be used as error detector to check if the data looped back from the DUT contains errors.

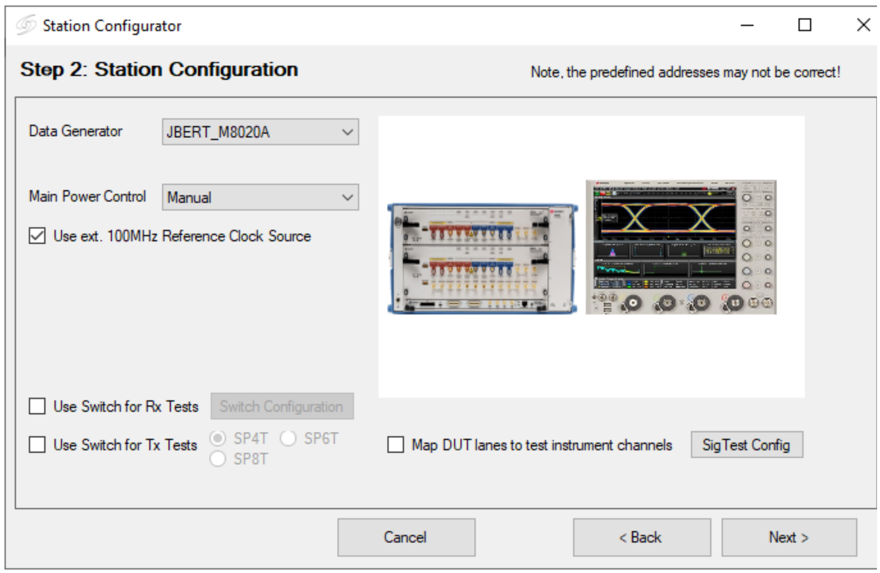


Figure 4 Station Configuration with Data Generator JBERT_M8020A

Main Power Control

Main Power Control has the following options:

- Manual
- Netlo 230 B: It is a Power Distribution Unit (PDU) that integrates one 230 V input and four 230 V outlets. It allows to connect virtually any 230 V powered device.
- ALL4076
- SynAccessNP

NOTE

If Main Power Control is selected as **Manual,** you need to power cycle the DUT manually. For any other option DUT is power cycled automatically.

NOTE

To use Main Power Control, the ValiFrame option 008: Remote Power Management Support is required.

For more details on Main Power Control, refer to the Appendix section Main Power Switch Control on page 465.

Use ext. 100 MHz Reference Clock Source

Select the **Use ext. 100 MHz Reference Clock Source** check box to use 100 MHz reference clock as a clock source for the data generator and the DUT for obtaining a constant clock signal.

It is required only in **Common Clock** architecture for **Asic** and **Cem** (with DUT Type **AddInCard**) Interface Type, otherwise the DUT provides the reference clock in **Systems**.

NOTE

External Reference Clock Source always require **Reference Clock Multiplier.**

Use Switch for Rx Tests

Select the **Use Switch for Rx Tests** check box to enable the **Switch Configuration** button to test more than one lane without changing the connections.

Open the **Rx Switch Configuration** dialog (see Figure 5) to select **Rx Switch Type** and **Tx Switch Type.** For both, the available options are:

- SP4T
- SP6T
- SP8T

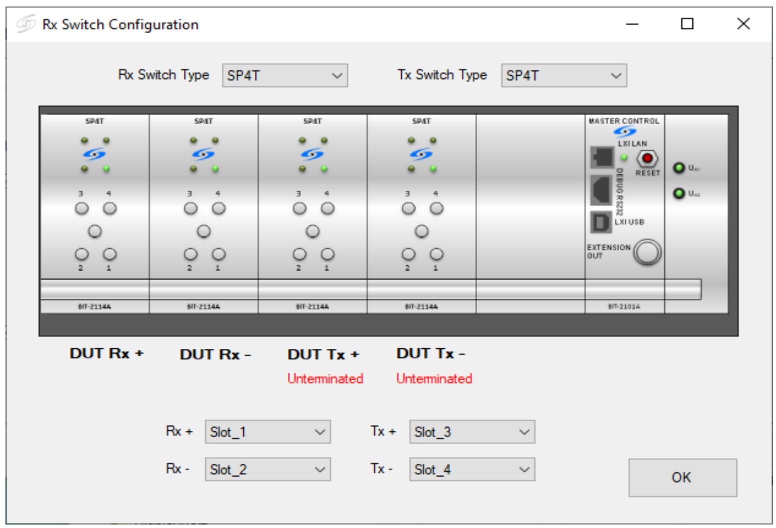


Figure 5 Rx Switch Configuration

This dialog is also used to map the Rx and Tx lines to the different module slots.

NOTE To use a BitifEye 2100 Series Switch System, the ValiFrame option 002 (Switch System Support, available from BitifEye as BIT-2001-0002-0) is required.

Use Switch for Tx Tests

Select the **Use Switch for Tx Tests** check box to enable the following switch module options, which can test more than one lane without changing connections.

- SP4T
- SP6T
- SP8T

Map DUT lanes to test instrument channels

This option is available only for the M8020A data generator. It is an alternative to the Matrix Switch to test several lanes without cabling reconnection. If selected, the different Rx DUT lanes can be mapped to the different M8020A data outputs.

Sig Test Configuration

For 8 Gb/s and 16Gb/s datarate, the SigTest software is used in several calibration procedures in order to calculate the eye height, eye width, and jitter parameters of the generated signal. The **SigTest Configuration** dialog allows to select the Installation directories, Jitter measurement template and EH / Ew measurement template used for the calibrations.

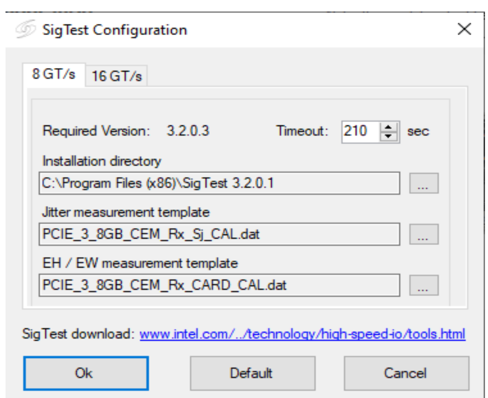


Figure 6 SigTest Configuration dialog box

The SigTest software must be installed separately before ValiFrame is started. PCI-SIG members can download the 8 and 16 Gb/s SigTest installer at the PCI-SIG website.

NOTE The template names sometimes change with the different SigTest versions. To automatically adapt the template names, click on the "Default" button, and the names will be adjusted based on the "required verison".

Once all the settings of the PCIe Station Configuration (see Figure 3) are done, press the **Next** button to continue.

NOTE The user must ensure that all the selected instruments for the test station are connected to the test station PC controller by remote control interfaces such as LAN, USB or GPIB.

Instrument Configuration

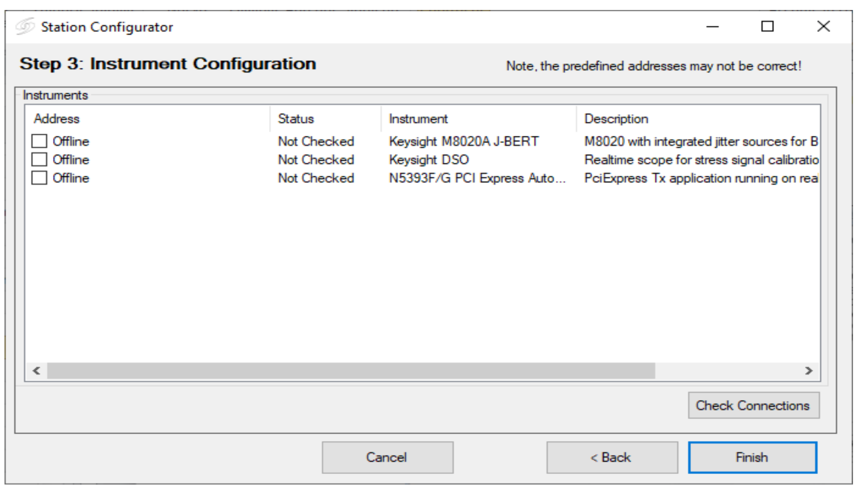


Figure 7 PCIe Instrument Configuration Window

NOTE

When starting a specific test station configuration 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.

After the installation process, all instruments are configured by default in **Offline** mode. In this simulation mode, hardware does not need to be physically connected to the test controller PC. The N5990A can not 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, GPIB (General Purpose Interface Bus) or LAN (Local Area Network). Most of the instruments used in the PCIe station require a VISA (Virtual Instrument System Architecture) connection. To determine the VISA address, run the **VISA Connection Expert** (right-click on the Keysight IO Control icon in the task bar and select the first entry **Keysight Connection Expert**). Enter the instrument addresses in the **Station Configuration Wizard**, for example, by copying and pasting the address strings from the Connection Expert entries. After the address strings have been entered, click on the **Apply Address** button before checking the **Offline** box to set the instruments needed to be online and then press **Check Connections** button to verify that the connections for the instruments are established successfully. If anything is wrong in the Instrument Address, a window is displayed with a message describing the problem.

Starting the N5990A PCIe

Start the N5990A PCIe with a double click on the **N5990A PCIe** icon that appears on the desktop as shown in Figure 8.
Alternatively, start the N5990A PCIe station from **Start / All Programs / BitifEye / BitifEye PCIe N5990A / ValiFrame PCIe.**

Figure 8 N5990A PCIe Icon

Once all connections have been initialized successfully, it is ready for use. Starting the N5990A PCIe opens the following window (Figure 9):

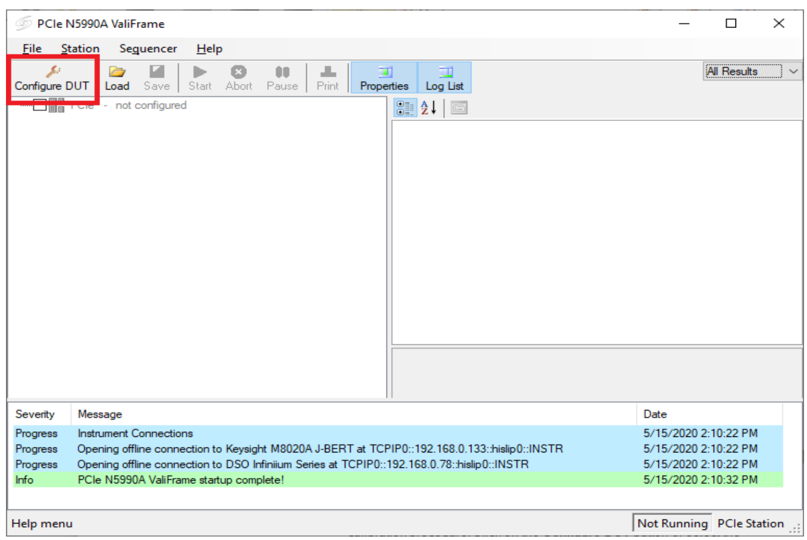


Figure 9 N5990A PCIe User Interface

The test parameters need to be configured before running any test or calibration procedure. Click on the **Configure DUT** button or select the **Configure DUT** option from the **File** menu to pop up the Configure DUT window (Figure 10).

Configuring DUT

In Configure DUT panel (Figure 10), the DUT parameters such as DUT Name, Version, Interface Type, DUT Type, Clock Architecture and also the Parameters related to the Receiver/Transmitter test configuration and Lanes configuration can be selected. Those selected parameters are later used in the calibration and test procedures shown in N5990A main window.

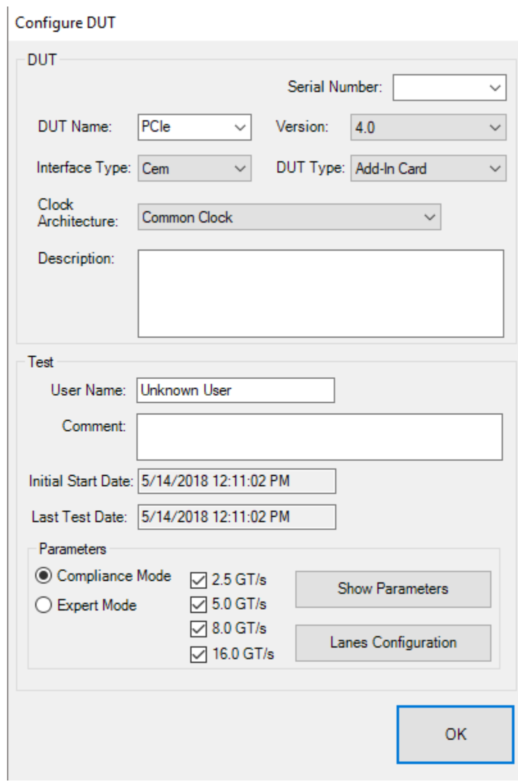


Figure 10 Configure DUT Panel

The parameters selection, available in the **Configure DUT** panel, depend on the specific application. To configure the DUT, select the parameter applicable for particular application.

These selected DUT parameters and the information entered by the user are shown in the measurement reports. If a connection to a SQL database exists, these parameters and information also stored with the measurement data. the stored information is used to retrieve data from the database, select unique identifiers and descriptions.

NOTE

In most applications either Compliance or Expert Mode can be selected. In compliance mode, the tests run according to the specific test specification (such as PCI Express 3.0). In expert mode, the DUT can be characterized to determine performance margins. Expert mode includes some additional tests and parameters to run the test differently than the compliance mode and it is used by advanced users.

Settings of **Configure DUT** panel is described in following sections:

- DUT on page 32
- Test on page 34
- Parameters on page 35

DUT

Serial Number

The selected serial number will be used to identify the product when database option is selected.

DUT Name

By default, the DUT name is set to **PCIe**.

Version

The available PCI Express specification versions are:

- 1.0: supports 2.5 GT/s data rate
- 1.1: supports 2.5 GT/s data rate
- 2.0: supports 2.5 GT/s and 5.0 GT/s data rates
- 3.0: supports 2.5 GT/s, 5.0 GT/s and 8 GT/s data rates
- 4.0: supports 2.5 GT/s, 5.0 GT/s, 8.0 GT/s and 16.0GT/s data rates.

NOTE **The calibrations and tests are defined according to the selected spec version.**

Interface Type

The Interface type can be chosen as:

- Cem
- Asic
- U2

DUT Type

The DUT Type selection is based on selected Interface Type. Following are the description:

- When **Cem** is selected as Interface Type, available options for DUT Type are:
  - Add-In Card: A graphics card (for example) can be tested according to the CEM specification
  - System: A mother board (for example) can be tested according to the CEM specification
- When **Asic** is selected as Interface Type, available options for DUT Type are:
  - EndPoint: A PCIe (for example) endpoint is tested according to the Base specification
  - RootComplex: A PCIe chip (for example) is tested according to the Base specification
- When **U2** is selected as Interface Type, available options for DUT Type are:
  - Host
  - Device

Clock Architecture

It can be selected as:

- Common Clock: The default clock architecture where all parts of the system use the same clock.
- Separate Ref Clocks Independent SSC

- Description: A description of DUT can be added.

Test

User Name

A user name can be added to the test information.

Comment

A comment can be added to the test information.

Initial Start Date

Time stamp of the start of the current test session.

Last Test Date

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

Parameters

Compliance Mode

In Compliance mode only compliance tests are available with limited customization parameters.

Expert Mode

In Expert mode additional debugging tests are added and the compliance tests can be run with customized settings. In Compliance Mode Rx calibrations will be aborted if the scope does not support the BW requirement from the test specification. In Expert Mode a warning is displayed and calibration runs with highest supported BW.

Show Parameters

With a click on the **Show Parameters** button in the **Configure DUT** Panel (Figure 10 on page 30), a window is displayed as shown in Figure 11 on page 36. It allows to set more test parameters.

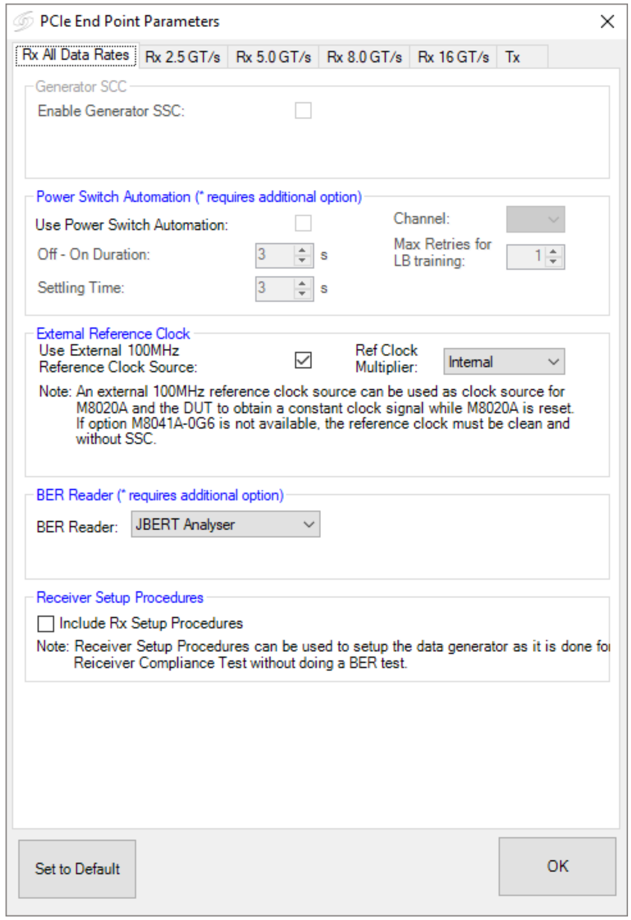


Figure 11 PCIe End Point Parameters

Rx All Data Rates

- Generator SSC
  - When **Common Clock** or **Separate Ref Clock No SSC** is selected in **Clock Architecture**, Generator SSC has only one setting, which is disabled, see Figure 12:

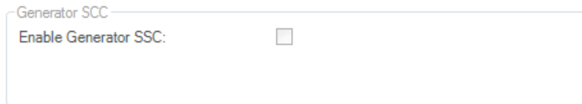


Figure 12 Generator SSC with Common Clock and Separate Ref Clock No SSC

- When **Separate Ref Clocks Independent SSC** is selected in **Clock Architecture**, following parameters can be set:

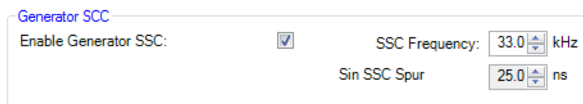


Figure 13 Generator SSC with Separate Ref Clocks Independent SSC

  - SSC Deviation
  - SSC Frequency
  - Sin SSC Spur

- Power Switch Automation: If a Power Switch is used, the user need not to power on/off the DUT manually, the software perform it automatically and the loopback training also run without user interaction.

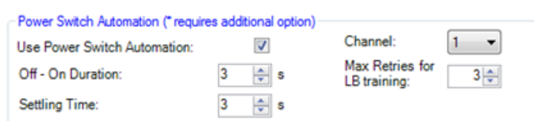


Figure 14 Power switch automation

Following parameters can be set:

- Use Power Switch Automation: Select the corresponding check box to power on/off the DUT manually.
- Channel: Set the number of the switch channel(s) to be used.
- Off - On Duration: Set the time span between power off and on of the switch.

- Max. Retries for LB training: Set the maximum number of times for the software to train the DUT into loopback mode. If it is not possible within these set number of tries, the test is aborted automatically. When the **Use Power Switch Automation** check box is not selected, for every time the loop back fails; the software asks the user to retry.
- Settling Time: Set the time span after power is on.

- External Reference Clock

NOTE External Reference Clock option is available only for Common Clock (Clock Architecture type).

For Interface Type Cem, Asic & U2 with DUT Type AddInCard, Endpoint & Device respectively, external reference clock is required in common clock architecture, see Figure 15

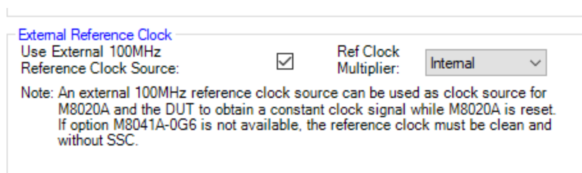


Figure 15 External Reference Clock (case I)

- Select the Use External 100 MHz Reference Clock check box, for an external source to provide the clock to the DUT and the data generator. If it is not selected, the clock output of the data generator is connected directly to the DUT.
- Ref Clock Multiplier: When using an external reference clock there are two options to connect the external clock to the data generator:
- Internal: Connects the external clock to the data generator directly and the data generator uses its internal PLL.
- For Interface Type Cem, Asic & U2 with DUT Type System, RootComplex & Host respectively, External Reference Clock is not required, see Figure 16.

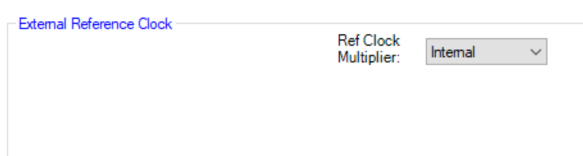


Figure 16 External Reference Clock (case II)

For this case, in common clock architecture, the clock is provided by the DUT.

- Ref Clock Multiplier:
  - Internal: The DUT clock is directly connected to the data generator and is multiplied internally
- BER Reader: The error measurement can be done using the JBERT Analyser or with an Offline BER Reader.

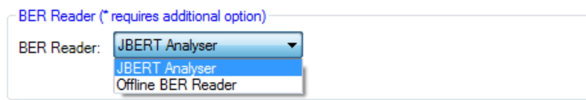


Figure 17 BER Reader

- Receiver Setup Procedures: Select the **Include Rx Setup Procedures** check box to add the receiver setup procedures to the test tree. In these procedures only the data generator is set up for the calibrated compliance conditions, but without BER test.

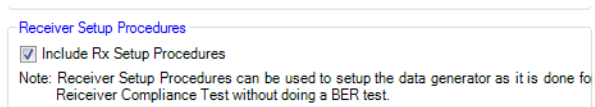


Figure 18 Receiver Setup Procedures

Channels

- Table 1 shows whether the channel is available or not for each possible combinations of Interface Type and DUT Type at each data rate.

Table 1

Version	Interface Type	DUT Type	Channels
2.5 GT/s	Cem	All	Not available,
2.5 GT/s	Asic	All	see Figure and Figure 19
5.0 GT/s	Cem	AddInCard	Not Available,
5.0 GT/s	Cem	System	see Figure 21
5.0 GT/s	Asic	All	see Figure and Figure 19
8.0 GT/s	Cem & U2	All	see Figure 22
8.0 GT/s	Asic	All	see Figure 23 and Figure 23
16.0 GT/s	Cem	All	see Figure 26
16.0 GT/s	Asic	All	see Figure 27

Rx 2.5GT/s ASIC

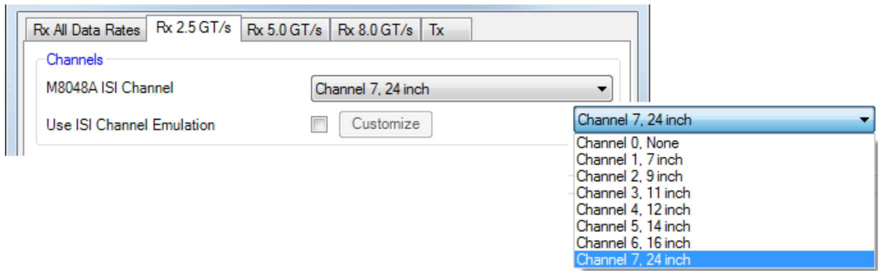


Figure 19 Channels section for 2.5GT/s and 5.0GT/s using JBERT_M8020A

- M8048A ISI Channel: Select the ISI channel from 0 to 7 for the testing.
- Use ISI Channel Emulation: For M8020A setup, if the M8020A JBERT option M8041A-0G5 is available, the ISI can be also generated internally.
  Customize: To enable the **Customize** button, select the check box corresponding it. Clicking on **Customize** button, opens the **ISI Channel Customization** dialog as shown in Figure 20. It allows you to fine tune the selected ISI Channel by modifying the insertion loss.

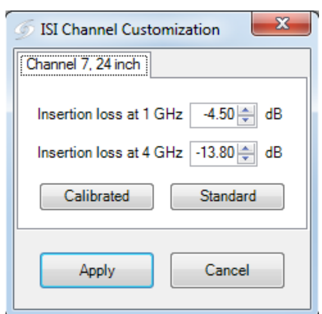


Figure 20 ISI Channel Customization

Rx 5.0GT/s System

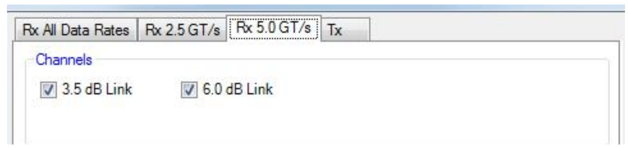


Figure 21 Channels section 5.0GT/s Cem System

3.5 dB Link/6.0 dB Link: Select either 3.5dB Link, 6.0dB Link, or both.

Rx 8.0GT/s CEM & U2

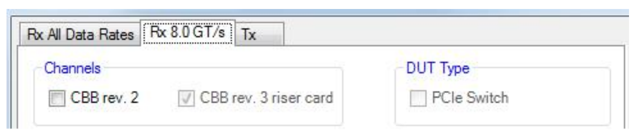


Figure 22 Channels section for 8GT/s CEM and U2

CBB rev.3 riser card: The Rx tests must be done with compliance base board gen 3, so the CBB rev. riser card check box is selected by default.

CBB rev.2: Select the CBB rev. 2 check box to do the receiver test with CBB gen2 additionally.

DUT Type: For System, select the check box PCIe Switch if the DUT is a PCIe switch.

Rx 8.0GT/s ASIC

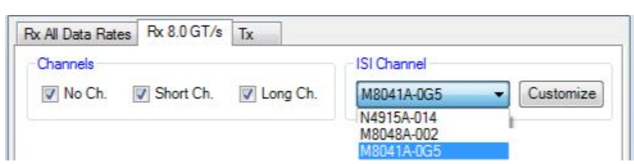


Figure 23 Channel section for 8GT/s with JBERT_M8020A

- Channels: To perform different target applications, three test cases with different channel lengths are defined. Select the corresponding check box for specific channel.

NOTE For spec 4.0 only Long Channel option is available.

- ISI Channel:

  For JBERT_M8020A setup, select the following options (see Figure 23):

  - N915A-014
  - M8048A-002
  - M8041A-0G5

Customize: Click it to open the ISI Channel Customization dialog as shown in Figure 25. It allows you to set the Insertion loss at 0 GHz and 4 GHz.

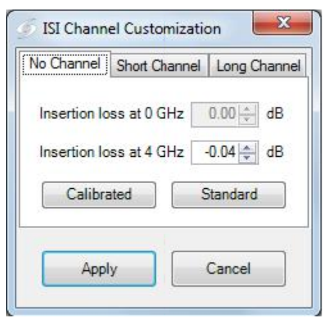


Figure 24 ISI Customization Channel

Rx 16 GT/s CEM:

Figure 25 Rx 16 GT/s for CEM

For Gen4 CEM tests, the CTS only allows the official PCI-SIG Gen4 fixture set. Therefore, the “PCI Express 4.0 CEM Fixture” and the ISI Adjustment with “Hardware Traces” is the only available option.

Rx 16 GT/s ASIC

- Fixture:

  Select the Fixture type PCI Express 4.0 CEM Fixture Kit, the Generic or the BIT CEM Connector + M8048A. to perform the Rx tests.

- ISI Adjustment

  Emulated ISI: Selecting it, allows to combine the internal ISI generated by the M8020A, with the selected Hardware Traces to adjust the insertion loss. For this, the M8020A JBERT option M8041A-0G5 is required.

  Hardware Traces: Selecting it, allows only the Hardware Traces to be used for generating the ISI.

Calibration

For 2.5GT/s-5.0GT/s

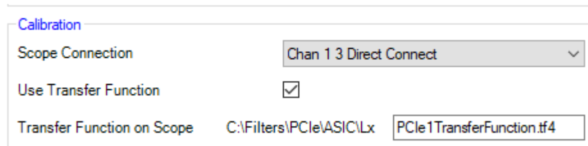


Figure 26 Calibration for CEM and ASIC 2.5 GT/s – 5.0 GT/s

- Scope Connection: Select the Scope Connection type from the button. Connections can be established by Direct Connect channels 1-3 or 2-4.
- Use Transfer Function: On selecting the **Use Transfer Function** check box, adds one more option (see Figure 26). It allows to embed or de-embed the calibration boards, fixtures or additional cables using the transfer function in the scope.

NOTE For Version 1.0, 1.1 and 2.0 available Interface Type are Cem and Asic.

For 8.0 GT/s

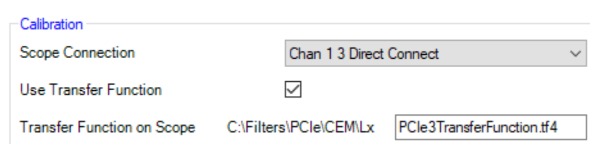


Figure 27 Calibration for CEM and U2 8.0 GT/s

- Connection: Select the Scope Connection type from the corresponding button. Connections can be established by Direct Connect channels 1-3 or 2-4.
- Use Transfer Function: It allows the transfer function file on the scope to embed or de-embed additional components.

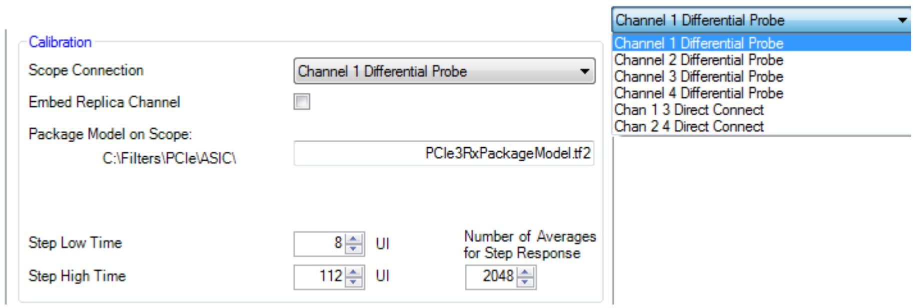


Figure 28 Calibration for ASIC 8.0 GT/s

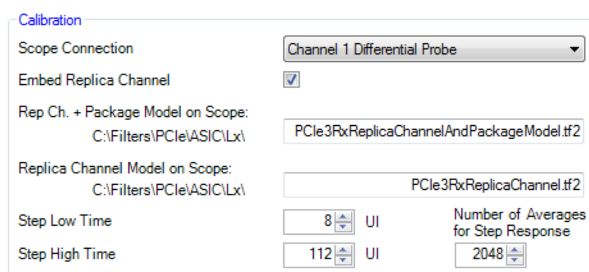


Figure 29 Calibration for ASIC 8.0 GT/s with Embedded Replica Channel

- Scope Connection: Select the Scope Connection type from the corresponding button. Connections can be established by Direct Connect channels 1-3 or 2-4.
- Embed Replica Channel: Select the check box to use a transfer function for embedding the replica channel.
- Package Model on Scope: Shows the transfer function file of the package model.
- Replica Ch. + Package Model on Scope: Shows the transfer function file that combines the package model and replica channel, if replica channel is embedded.

- Replica Channel Model on scope: Shows the transfer function file of the replica channel.
- Step Low Time: Set the time span from the falling edge of the step to the end.
- Step High Time: Set the time span from the rising edge of the step to the end.
- Number of averages for step response: Set the number of times that the step response is averaged to minimize the noise.

For Rx 16GT/s

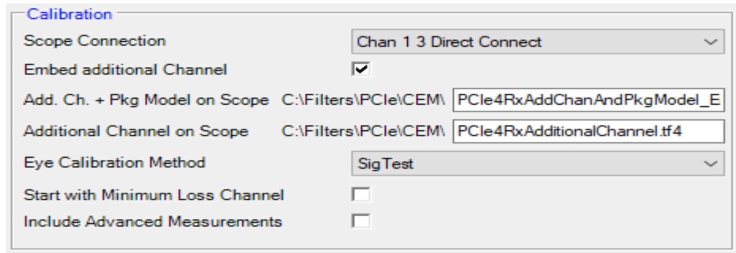


Figure 30 Calibration for ASIC and CEM 16 GT/s

- Scope Connection: Select the Scope Connection type from the corresponding button. Connections can be established by Direct Connect (channels 1-3 or 2-4).
- Check the "Embed additional Channel"/"Embed Replica Channel" (CEM/ASIC) option to include the channel in the embedding.
  If unchecked, is required to specify the file with the transfer function for the package model If checked, is required to select the transfer function of the channel, and the transfer function that combines the channel and the package model.
- Eye Calibration Method: Select the tool used for the stressed eye calibration. Available tools are **Seasim (only for ASIC)** or **SigTest**. Each software uses a different methodology for jitter and eye measurements.
  - Seasim: It is standard method which is a post processing tool. 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. Step response defines the complete electrical behavior of the channel and calculate a statistical eye. Seasim also simulated the different impairments.
  - SigTest: It uses the compliance channel methodology. A compliance pattern is applied and the different impairments like random jitter, sinusoidal jitter and differential & common mode sinusoidal inference are added to the signal.

- Start with Minimum Loss Channel:
  - If not selected, the Initial Equalization Preset Optimation Calibration will start with -30dB. Then the Channel Calibration decreases channel loss in 0.5dB steps until Eye Height and Width is over spec value or channel loss reaches minimum of -27dB. The remaining cal procedures are using this channel. Typically EH and EW is still above spec at -30dB, therefore the calibration process will be much faster (only -30dB channel has to be used).
  - If selected, the Initial Equalization Preset Optimation Calibration will start with -27dB. Then the Channel Calibration increases channel loss in -0.5dB steps until Eye Height and Width is slightly over spec value or channel loss reaches maximum of -30dB. The remaining cal procedures are using this channel.
- Include Advanced Measurement: Select it to add some advanced procedures (for debugging purposes) to the calibration tree.

Receiver

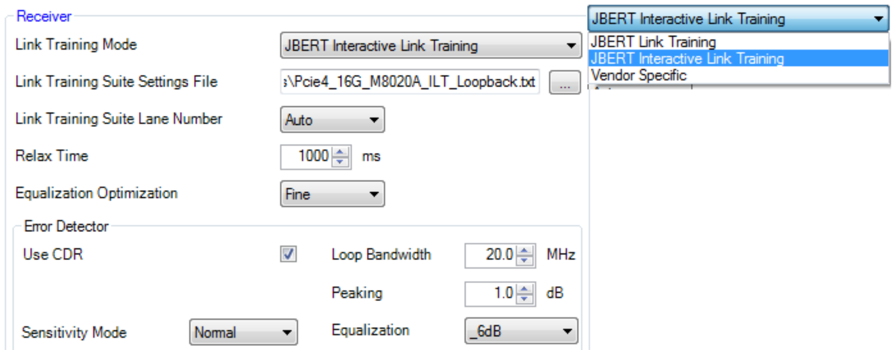


Figure 31 Receiver

- Link Training Mode: Following are the available modes:
  - Static Sequence: JBERT sends a loopback training sequence to the DUT. The training pattern is defined by several blocks, following the standard sequence described in the CTS.
  - Interactive: This feature is only available for the M8020A when the M8020A S02 option is installed. The training sequence consists of three blocks -"Link Down", a "Wait" block, and "Link Up". The loop-back training is managed by the M8020A JBERT internally. It can run the link equalization phase to optimize the performance of communication.
  - Vendor_Specific: The vendor can place his DUT in loopback with his own tools like JTEC, I2C...
- Link Training Suite Setting File: Allows to define the path for the Link training suite setting file (script file) which is used for loopback training.
- Link Training Suite Lane Number: Allows to set the lane number (Lane 0 to Lane 15) used for encoded in the TS1s/TS2s and sent to the DUT during loopback training. If option **Auto** is selected, each lane will be encoded with its own number.
- Relax Time: Select the time span between the points at which the stress signal is changed and the BER measurement begins.
- Equalization Optimization: Select it as **Fine** or **Fast**.

- Error Detector
  - Use CDR: If select, CDR is used to generate a clock signal for the JBERT error detector. If it is not selected, the clock is supplied by the JBERT data generator. With CDR, the JBERT error detector performance is better.
  - Loop Bandwidth: Select the loop bandwidth in MHz (between 0.1 MHz to 20 MHz) of the JBERT error detector CDR.
  - Peaking: Select the CDR Peaking in dB (between 0-1dB).
  - Sensitivity Mode: Allows to set the mode either **Normal** or **High**.
  - Equalization: Allows to set the Equalization to **Off**, **6**, **9** or **12** dB.

Lanes Configuration

Pressing on the **Lanes Configuration** button in the Configure DUT Panel (see Figure 32), the window shown in Figure 33 is displayed.

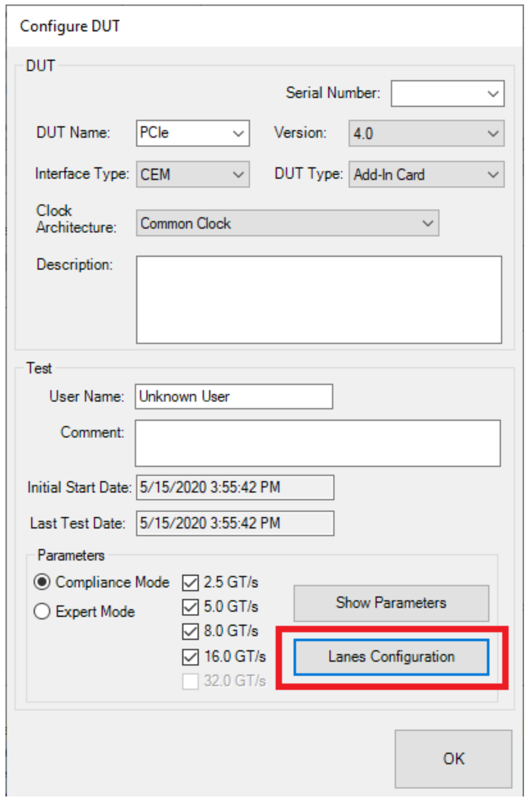


Figure 32 Selecting Lanes Configuration from Configure DUT Panel

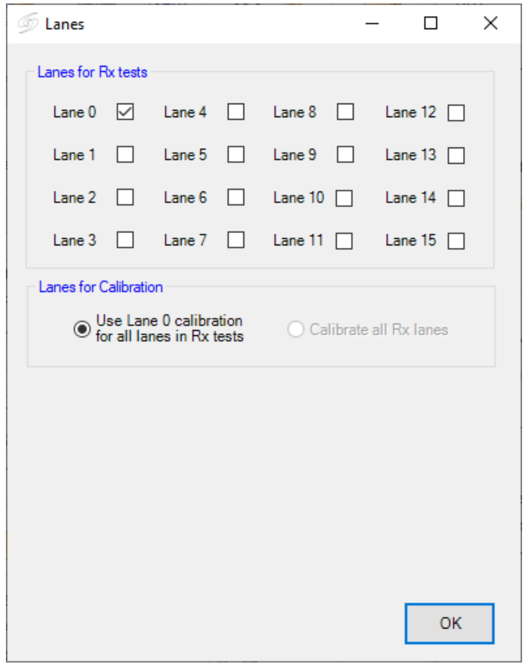


Figure 33 Lanes configuration window

- Lanes for Rx Test: Select the corresponding check box of the specific lane for which the user wants to perform the testing. It depends on the option chosen in Station Configuration, which lane(s) can be selected. Following are the setting:
- If **Use Switch for Rx test** check box is not selected in Station Configuration, all the lanes can be selected for testing. During the tests, it is recommended to switch the cables from lane to lane manually.
- If **Use Switch for Rx test** check box is selected in Station Configuration, the number of lanes to test depends on the module type selected. For example; if SPT4 module type is chosen, up to 4 lanes can be selected for testing, similarly if SPT6 module type is chosen, up to 6 lanes can be selected for testing.

- Lanes for Calibration:
  - Select **Use Lane0 calibration for all lanes in Rx tests** button to calibrate only Lane 0 and its results will be used in the Rx tests for all lanes.

NOTE

Calibrate all Rx lanes option is not available for spec 4.0

  - Select **Calibrate all Rx lanes** button to run the calibrations for each Rx lane selected and each Rx test will use the specific calibration of the lane to be tested.

    If the **Map DUT lanes to test instrument channels** check box is selected in the Station Configuration, the Lanes dialog is as shown in Figure 34. It allows to select all the lanes and each tested lane can be mapped to one of the available generator & analyzer channels. Therefore, mapping of different lanes to different instrument avoids cable reconnection.

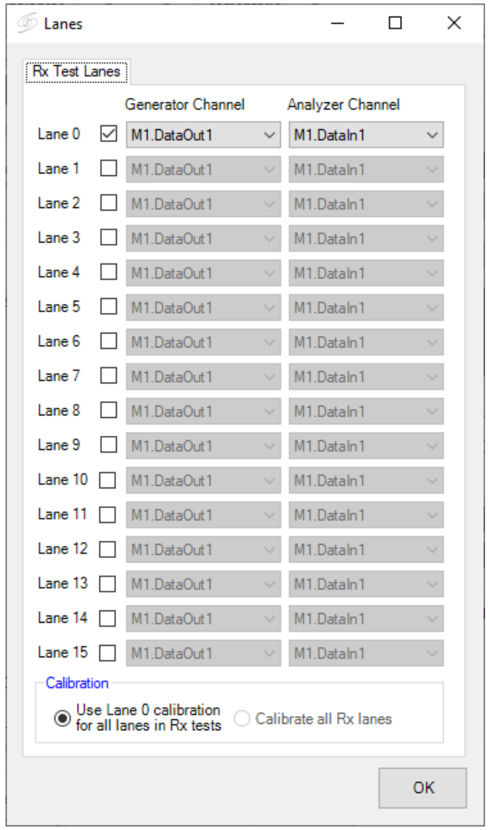


Figure 34 Lanes Configuration for multiple M8020A Channels

3 Using Software

Introduction

During the execution of all the calibration and test procedures, the results are
displayed automatically in a data table as well as graphically. The viewer can be either a MS-Excel or a HTML worksheet; this can be chosen in the **Station Selection** (refer to Figure 2 on page -18). Once a specific calibration or test procedure is finished, the MS-Excel/HTML worksheet is closed. To re-open it at any time, double click on the respective procedure in the respective tree.

All calibration data worksheets can be saved in a workbook by selecting **File** > **Save Results as Workbook...** at any time. It is recommended that this step is carried out at least at the end of each N5990A run. If the calibration and test procedures are conducted several times during the same N5990A run, the result worksheets are combined in the 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. As a safety feature, all calibration and test results are saved by default to the N5990A “Tmp” directory (refer to “*N5990A Getting Started Guide.pdf*”). The sub-folder “Results/PCIe
Station” contains the Excel files of the final results measured at each calibration and test procedure. In addition to the calibration data worksheets, the calibration data files are generated. These files are saved by default to the N5990A calibrations folder. If these calibrations are run again, the data file will be overwritten. In order to save the calibration data files at each configuration, the files must be copied from the directory:
“C:\ProgramData\BitifEye\ValiframeK0\Calibrations\PCIe”
and saved manually in any folder before rerunning the calibrations

Selecting, Modifying, & Running Tests

Once the DUT has been configured, press the **OK** button in **Configure DUT** Panel.

All calibration and test procedures are included in the respective groups in a way similar to how they are organized in the CTS. For most procedures, some specific parameters can be set in expert mode by the user. In Figure 35, the Insertion Loss Calibration is highlighted as an example. The respective parameters are shown on the right side of the N5990A User Interface. This is achieved by clicking on the calibration/test name. To start one or more procedures, check the corresponding box to select them. Then the **Start** button is enabled and colored in green. Clicking on the **Start** button runs the procedure. Once all the procedures are run, the N5990A configuration can be stored as a single ".vfp" file using **Save** button and recalled using **Load** button without configuring the DUT again.

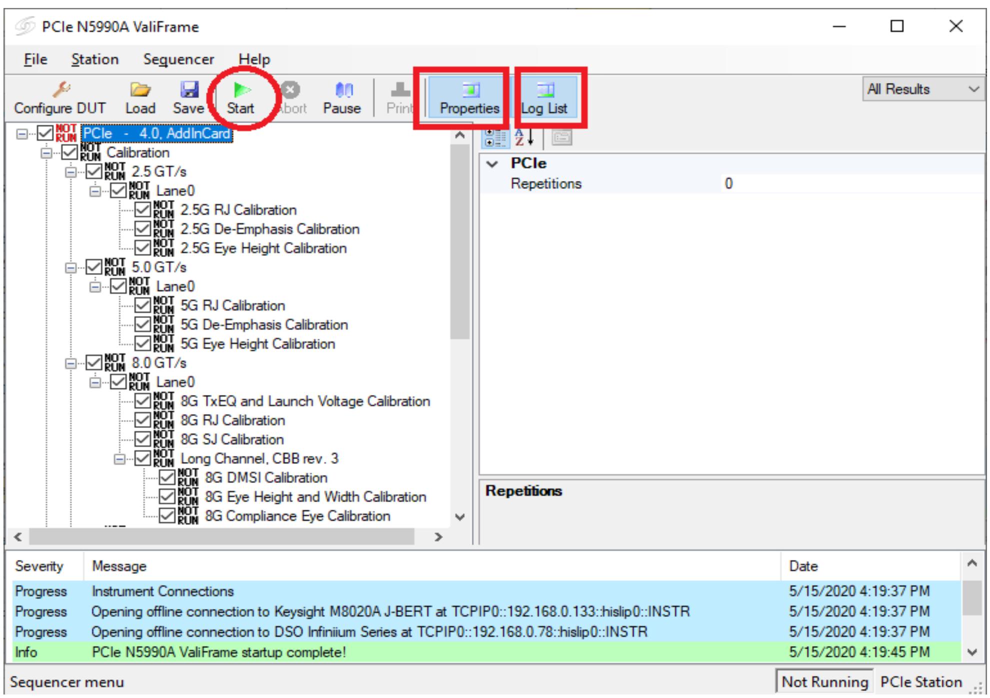


Figure 35 Example of PCIe Calibration / Test Procedure

.

Use the **Properties** and **Log List** buttons of the main menu (highlighted in Figure 35 on page -59) to display additional information on the right side and at the bottom of the N5990A main window respectively. The parameter grid on the right side of the window shows the parameters which are related to the selected calibration or test procedure subgroups or to individual procedures. These parameters can be set only before the execution of the procedure subgroup or procedure is started. The log list at the bottom of the window shows calibration and test status messages (regular progress updates as well as warnings and error messages).

Specific calibration or test procedures can appear multiple times as they might be required for testing the DUT under various conditions. A typical example is multiple data rates supported by the same DUT.

CAUTION

Before executing the calibration or test procedures, ensure that the PCIe Station Configuration is conducted 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.

System Calibration

It is necessary to calibrate the test system before running the first test, in order to ensure that test results are consistent from run to run. It is recommended that the equipments must achieve thermal stability before the calibration is started (typically after 30 min of warm-up). The thermal environment must be stable, and there must be no exchange of elements. The calibration is very stable and may only need to be repeated once a week or even less. The calibration interval depends on the degree of accuracy desired. If the station is not calibrated prior to a DUT test, the results of the previous calibration will be used for the current tests.

Selecting Procedures

The calibration, receiver, and transmitter test procedure groups can be selected globally by clicking on the check box at the top of the group. Alternatively, an individual test procedure can be selected by checking the specific selection boxes in front of the tests. Click on the **Start** button to execute 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 parameters can be modified. First, select a specific calibration or test procedure or one of the groups containing in the N5990A procedure tree. The parameters are displayed in a property list on the right side of the screen (see Figure 36). If they are not displayed, press the **Properties** button. Depending on the user selection on the left side of the top of the list, the list is either ordered alphabetically or in categories. The test parameters available can be changed individually (see Figure 37). The test parameters selected are listed in the MS Excel/HTML test results worksheets, see Figure 40.

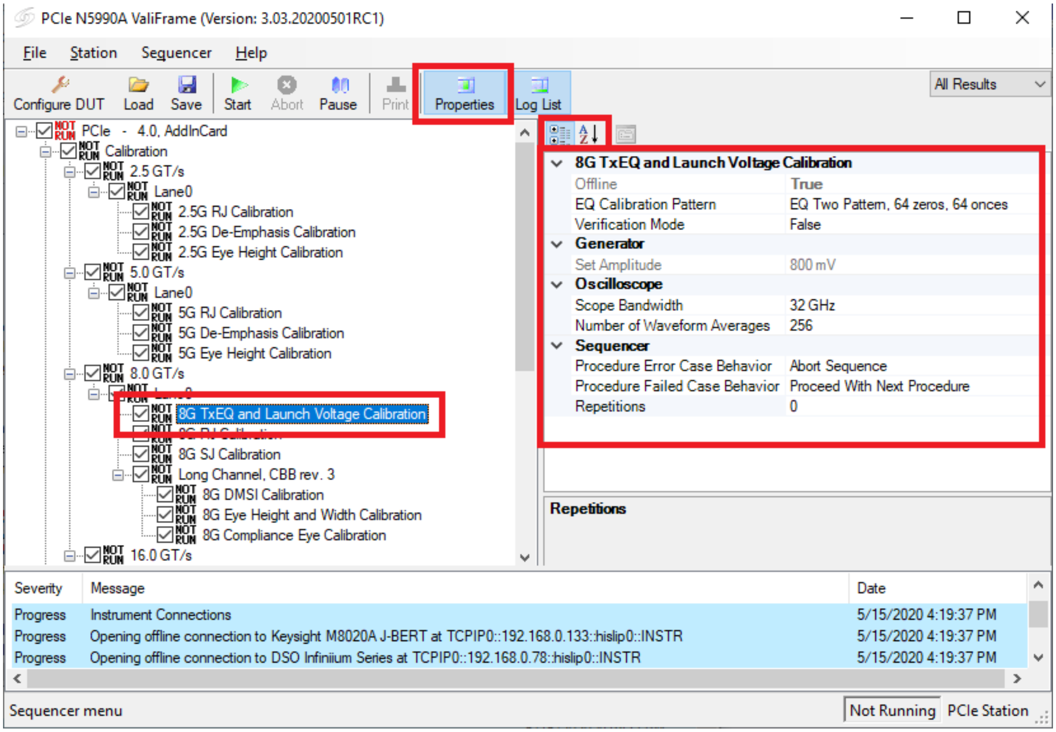


Figure 36 N5990A Procedure Tree

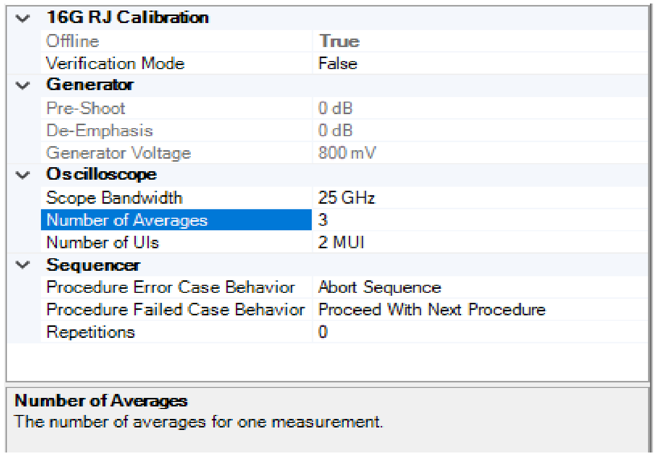


Figure 37 Editing the test parameters

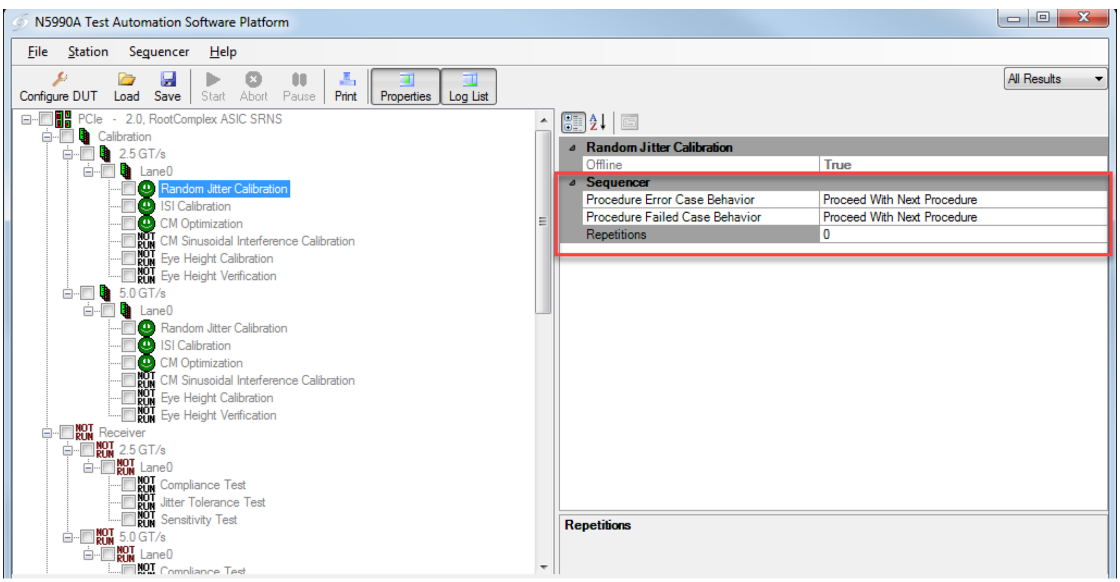


Figure 38 PCIE Sequencer Parameter

Running Procedures

To run the selected procedure, press the **Start** button (see Figure 35 on page -59). The procedures are run in the order, shown in the procedure selection tree. Some procedures may require user interaction such as changing cable connections or entering DUT parameters. The required action is prompted in pop-up dialog boxes prior to the execution. as shown in Figure 39.

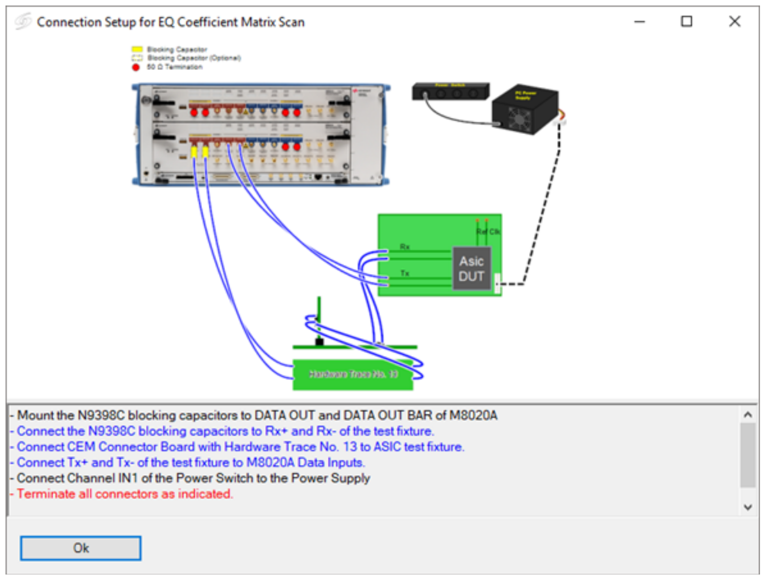
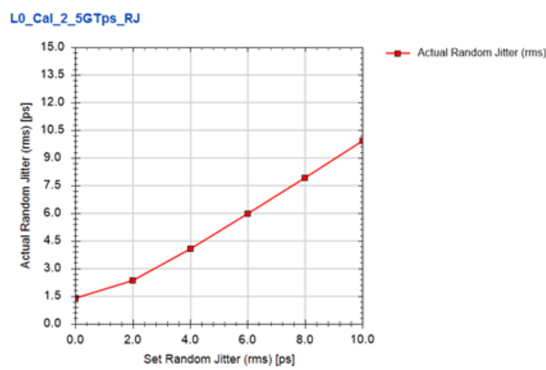


Figure 39 Connection diagram pop-up window

Results

Run-Time Data Display

Most procedures generate data output. While the procedure is running, the data is displayed in a temporary MS Excel worksheet or HTML page (depending on the selected viewer in the Station), which opens automatically for each individual procedure. An example is given in Figure 40. See the Appendix for more details about the file directories.



BERT System	Agilent M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Jitter Unit	Time

Set Random Jitter (rms) [ps]	Actual Random Jitter (rms) [ps]
0.0	1.39
2.0	2.34
4.0	4.05
6.0	5.97
8.0	7.91
10.0	9.94

Figure 40 Result MS-Excel worksheet example

The MS-Excel worksheet or the HTML page are opened during the procedure run and closed once the specific procedure is finished. As long as the N5990A Software is running, each worksheet or page can be reopened with a double-click on the respective procedure. However, the individual worksheets or pages will be lost when the N5990A main window is closed, unless they were saved by the user.

NOTE

If a test or calibration procedure was run more than once, the list of results is visible below the particular procedure after expanding the tree below the procedure (see Figure 41).

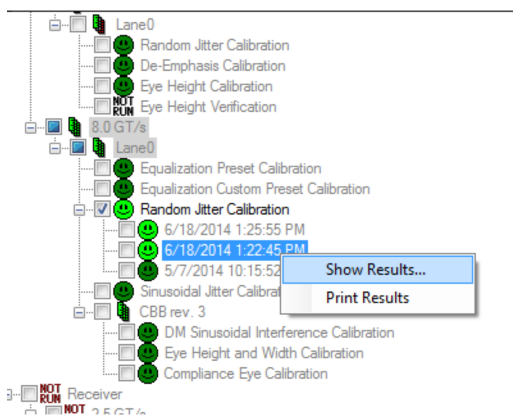


Figure 41 Selecting the repeated procedure and show test results

Results Workbook

For user convenience, all individual results are combined in a summary MS Excel workbook or HTML document at the end of the test run. The workbook must be saved explicitly (File > Save Results as Workbook...) as shown in Figure 42, otherwise it will be lost. After all tests have been run, a test report document can be generated additionally for easy documentation and printing with the standard Print function of the File menu (see Figure 42). An example test report for PCIe is shown in Figure 43.

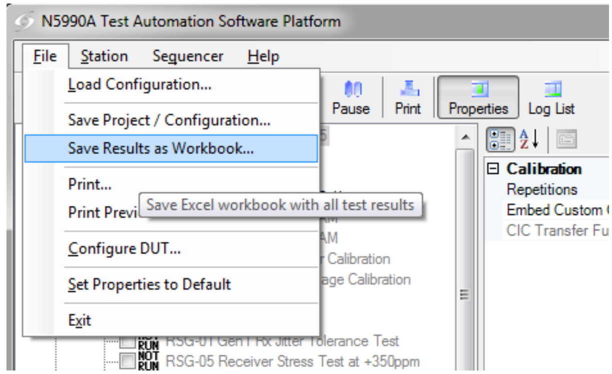
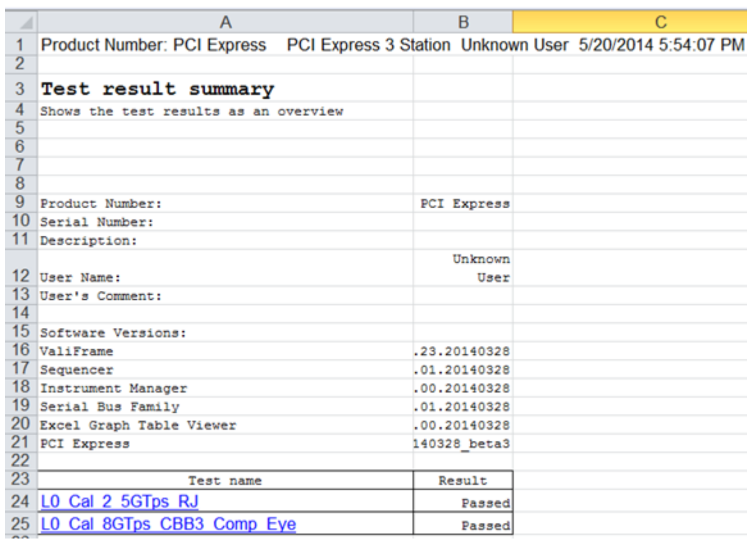


Figure 42 Save results as workbook



	A	B	C
1	Product Number: PCI Express	PCI Express 3 Station	Unknown User 5/20/2014 5:54:07 PM
2			
3	**Test result summary**		
4	Shows the test results as an overview		
5			
6			
7			
8			
9	Product Number:	PCI Express	
10	Serial Number:		
11	Description:		
12	User Name:	Unknown User	
13	User's Comment:		
14			
15	Software Versions:		
16	ValiFrame	.23.20140328	
17	Sequencer	.01.20140328	
18	Instrument Manager	.00.20140328	
19	Serial Bus Family	.01.20140328	
20	Excel Graph Table Viewer	.00.20140328	
21	PCI Express	140328_beta3	
22			
23	Test name	Result	
24	L0_Cal_2_5GTps_RJ	Passed	
25	L0_Cal_8GTps_CBB3_Comp_Eye	Passed	

Figure 43 Test report example

PCIe Parameter

Sequencer Parameters

The Sequencer parameters control the flow of the test sequencer, not the behavior of individual procedures. They are identical across all the versions of N5990A. 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 N5990A user interface and you can change them (see Figure 44).

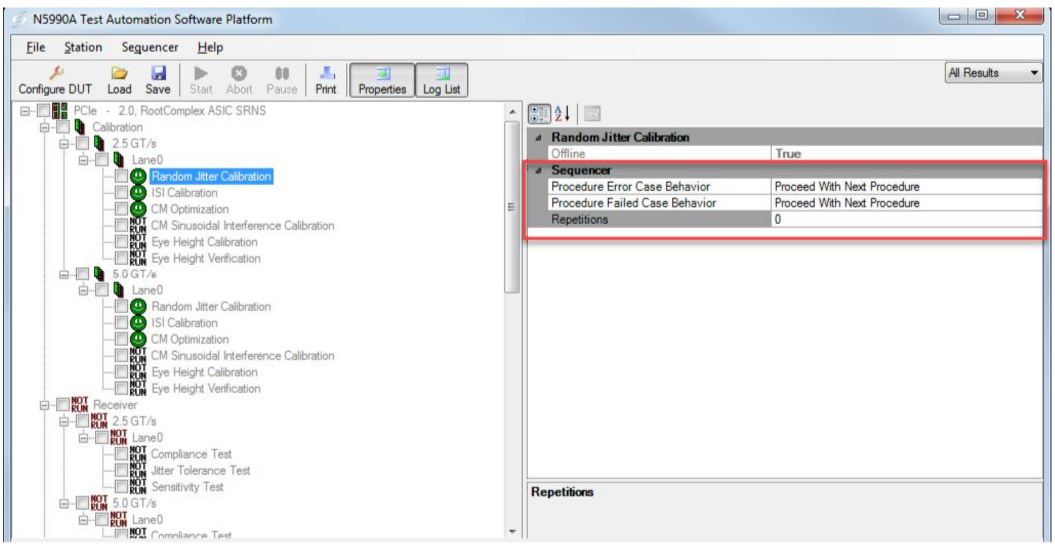


Figure 44 PCIE Sequencer Parameter

All sequencer parameters are listed in alphabetical order in Table 2.

Table 2 PCIe Sequencer Parameters

Parameter Name	Parameter Description
Procedure Error Case Behavior	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 the execution of the sequence.
Procedure Failed Case Behavior	Proceed With Next Procedure - If the current test or calibration procedure fails, continue by running the next procedure in the sequence. Abort Sequence - Abort the execution of the sequence.
Repetitions	The number of times the group or procedure is going to be repeated. If the value is '0', it runs only once.

Common Parameters

The 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

Common Parameters for Calibration groups

Table 3 Common Parameters for Calibration groups

Parameter Name	Parameter Description
	Same for all Data rate
Scope Connection for Calibration	All calibrations can be done with either direct connect channel 1&3 or direct connect channel 2&4.
UXR Calibration Mode	▪ "Compliance: Sampling Rate and Range to Signal Ratio is optimized to get similar calibration results to scopes with higher noise floor compared to UXR (V- or Z-Series scopes) ▪ "Low Noise: Sampling Rate and Range to Signal Ratio is optimized to get the lowest scope noise. Compared to other scopes like V- or Z-Series this results in more open eye. To close the eye to the target values higher impairment values than setup calibrated with Z-Series and V-Series are required. ▪ "Custom: The User can choose Sampling Rate and Range to Signal Ratio.
Sampling Rate	Sampling Rate for the calibrations. The higher the less noise is added.
Range to Signal Ratio	Scope vertical range divided by signal amplitude. The higher the more noise is added.
	2.5GT/s ASIC
PCIe 1 Transfer Function on Scope	This is the path to the package model, which is located on the oscilloscope. The package model has to be embedded for some calibrations. The file cannot be copied to the scope by the automation software. If the file is not on the oscilloscope, the automation software will instruct the user to copy the package model file manually.
PCIe1 M8048A ISI Channel	The M8048A ISI Channel used for PCIe1 ASIC Rx Calibration.

Parameter Name	Parameter Description
PCIe1 M8048A ISI Channel Emulation	Set to true if use the internal ISI of the M8020A, otherwise false
PCIe1 JBERT ISI Channel	The JBERT ISI Channel used for PCIe1 ASIC Rx Calibration
	5.0GT/s ASIC
PCIe 2 Transfer Function on Scope	This is the path to the package model, which is located on the oscilloscope. The package model has to be embedded for some calibrations. The file cannot be copied to the scope by the automation software. If the file is not on the oscilloscope, the automation software will instruct the user to copy the package model file manually
PCIe2 M8048A ISI Channel	The M8048A ISI Channel used for PCIe2 ASIC Rx Calibration
PCIe2 M8048A ISI Channel	Set to true if use the internal ISI of the M8020A, otherwise false
Emulation	
PCIe2 JBERT ISI Channel	The JBERT ISI Channel used for PCIe2 ASIC Rx Calibration
	8.0GT/s ASIC
Transfer Function File for Package Model on Scope	This is the path to the package model, which is located on the oscilloscope. The package model has to be embedded for some calibrations. The file cannot be copied to the scope by the automation software. If the file is not on the oscilloscope, the automation software will instruct the user to copy the package model file manually.
Transfer Function File for Replica on Scope	This is available only if "Embeded Replica Channel" was selected in Configure DUT > Show Parameters > Rx 8.0GT/s. This is the path to the transfer function of the replica channel, which is located on the oscilloscope.
Transfer Function File for Replica and Package Model on Scope	This is available only if "Embeded Replica Channel" was selected in Configure DUT > Show Parameters > Rx 8.0GT/s. This is the path to the transfer function, which includes replica channel and package model, located on the oscilloscope.
Step Response Low Time	The length before the low to high transition in UIs.
Step Response High Time	The length after the low to high transition in UIs.
Number of Averages for Step Response	The number of averages for the step response.
	16.0GT/s
Gen4 Fixture	The Rx tests can be performed either with the Generic fixtures or with the BIT CEM Connector + M8048A

Parameter Name	Parameter Description
Gen4 ISI Adjustment	The Inter Symbol Interference can be generated with Hardware Traces or can be emulated internally if the M8020A JBERT option M8041A-0G5 is available.
Gen4 ASIC Eye Calibration Method	It can be selected as Seasim or SigTest. The selected software will be used for jitter and eye measurements
Start With Minimum Loss Channel	If defines how the Initial Equalization Preset Optimization Calibration starts. If true, the calibration starts with minimum loss channel and increases it until the spec eye is reached. If false, the calibration starts with maximum loss channel and decreases it until the spec eye is reached.

Common Receiver Parameters

- Receiver Specific
  - Reference Clock
- Data Rate Specific
  - Loopback Training
    - Link Training Mode
    - Link Training Suite Settings File,
    - Default Link Training Lane Number for every Lane
    - Suppress Loopback Training Messages
    - Use Gen3 EIEOS
    - Use Custom Training Voltage
  - Error Detector
    - Use CDR
    - CDR Loop Bandwidth
    - CDR Use SSC
    - Filter Gen1/Gen2 SKPOs for BER test
    - Peaking
    - Analyzer Equalization
    - Sensitivity Mode
    - Polarity
  - BER Measurement
    - Relax Time
- Lane Specific

- Link Training Lane Number

Table 4 Common Parameters for Receiver groups

Parameter Name	Parameter Description
Reference Clock	The frequency of the reference clock.
Generator Output Voltage Compensation	Compensation for voltage attenuation caused by the combination of power splitters and attenuators
Oscilloscope channels for Link EQ Tx Tests	For Link EQ Tx tests, if direct connect is selected, the four channels of the oscilloscope are used for the measurement. When the 4 channel are used simultaneously, the maximum bandwidth available is divided by two. If differential probe is selected only two channels are used and the maximum bandwidth is available. For Gen4 and direct connect, the available bandwidth could not be enough for the waveform decodification.
Skip BER Check	If true, LTSSM trains DUT into loopback but then skips the BER check. This can be helpful when at some DUT Tx preset the error detector shows a constant BER because of high insertion loss.
Loopback Training	
Link Training Mode	Link Training Modes are following; Static Sequence: JBERT sends a loopback training sequence to the DUT. The training pattern is defined by several blocks, following the standard sequence described in the CTS. Interactive: This feature is available only for the M8020A when the M8020A S02 option is installed. The training sequence consists of three blocks -“Link Down”, a “Wait” block, and “Link Up”. The loop-back training is managed by the M8020A JBERT internally. It can run the link equalization phase to optimize the performance of communication. Vendor Specific: The vendor can place the DUT in loopback with specific tools like JTEC, I2C...
Link Training Suite Settings File, Interactive Training Script File, Link EQ Tx Test Script File	The Link Training Suite settings file (script file) is used for loopback training NOTE: Some DUTs require a special training sequence which can be optimized with the PCIe Link Suite. This sequence can be used for Rx testing
Default Link Training Lane Number for every Lane	This parameter is only available when the link training mode is “static sequence”. In that case during the loopback training, the lane number are encoded in the TS1s/TS2s and sent to the DUT. This value is set by default for all lanes. If Auto option is selected, each lane will be encoded with its own number
Suppress Loopback Training Messages	When set to true this hides all popup messages related to loopback training.
Use Gen3 EIEOS	
Use Custom Training Voltage	Set to true to specify the diferential voltage amplitude used during the DUT training.
Interactive Link Training	
Training Through	For 8 and 16G Receiver Tests when Interactive Link Training Mode is selected, it can be choosen if training should go through L0-Recovery or Configuration. Note: if Static Sequence is selected as Link Training Mode, training always goes through Configuration.

Parameter Name	Parameter Description
Generator Start Preset	The generator will use this preset in link equalization phase 1. Note that this setting will be applied in the Jitter Tolerance and Sensitivity test only
DUT Initial Preset	The DUT Tx will use this preset in link equalization phase 0
DUT Target Preset	The generator (downstream port) will request this preset in link equalization phase 3
Drop Link Method	It selects the method to drop the link during link training
Error Detector	
Use CDR	If true, CDR is used to generate a clock signal for the JBERT error detector. If false, the clock is supplied by the JBERT data generator. With CDR the JBERT error detector performance is better.
CDR Loop Bandwidth	It is the loop bandwidth of the JBERT error detector CDR
Peaking	Select the CDR Peaking in dB (between 0-1dB).
Analyzer Equalization	Select the equalization to Off, 6, 9 or 12dB.
Sensitivity Mode	Set to Normal or High.
Capture and Compare Mode	If it is enabled, the received data is captured and saved in a pattern. A new analyzer sequence is generated with a single block containing the captured pattern. This mode is available only with a common reference clock architecture
Pause before Auto-Align	It is the pause before the BER measurement, so that the user can perform manual optimization of the DUT receiver
Polarity	Set to Normal or Inverted
BER Measurement	
Relax Time	Time span between the point the stress signal is changed and the BER measurement begins
Lane Specific	
Link Training Lane Number	During the loopback training, the lane number are encoded in the TS1/TS2s and sent to the DUT
Equalization	
Use Preset	Set to true to use a preset.
Generator Preset	Select the generator preset (P7 as default)
Pre Shoot	Pre-shoot level of the signal. It is 0 by default.
De Emphasis	De Emphasis level of the signal. It is set to the optimum de-emphasis using the Insertion Loss Calibration.

Procedure Parameters

The Procedure Parameters are all parameters that do not fall into one 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. They only change the behavior of that single procedure. Procedures often have parameters with the same name, but set settings always apply on the selected procedure, and the meaning may be slightly different. The procedure parameters are listed in Table 3: Procedure Parameters

Table 5 Procedure Parameters for Calibrations

Parameter Name	Parameter Description
	Calibrations
Number of Waveforms Averages	Number of waveform that are averaged during the scope acquisition, This will reduce the noise floor.
Number of Averages for Jitter Measurements	
Verification Mode	If it is set to false, the procedure behaves as a normal calibration and the results are saved as usually. If it is set to true, the procedure uses a previous calibration to set the calibrated parameter. In this case, the purpose of the procedure is to certificate that the available calibration is valid and the desire values can be achieved.
Save Calibration Data	Set to true to save the results in a cal table.
	Generator (16.0GT/s)
Generator Voltage	Nominal differential voltage amplitude used for the calibration. The default value is 800mV and should not be changed.
DMSI	Differential mode sinusoidal interference added to the signal
CMSI	Common mode sinusoidal interference added to the signal
Random Jitter	The amount of RJ added to the signal
Sinusoidal Jitter Frequency	The amount of SJ added to the signal
	Oscilloscope (16GT/s)
Scope Bandwidth	Bandwidth selected in the oscilloscope
Number of Averages	Number of averages for each jitter measurement
Number of UIs	Number of unit interval tested
	Insertion Loss (16GT/s)

Parameter Name	Parameter Description
Measurement Method	If Step Response is selected, the tes automation will measure the insertion loss for the different traces. If VNA is selected, the test automation does not perform any measurement, the user must measure the trace with a VNA.
Automatic Trace Selection	If True the Trace Number Start Value and Trace Number Stop Value will be internally calculated. They are calculated to be closest to the target ISI at 8GHz.
Generator Cable Loss	Insertion Loss at 8GHz of te 1m SMA cable which was used at TP1 calibrations.
Trace Loss Increment	It is the expected insertion loss variation between each trace number
Trace Number Start Value	The minimum trace number that is calibrated
Trace Number Stop Value	The maximum trace number that is calibrated
Channel (16GT/s)	
Trace Number	Hardware trace number used
Total Channel Loss	Total insertion loss of the calibration channel
ISI from M8020A	ISI trace set internally in the M8020A
CBB var. ISI pair	The ISI trace number of the CBB
CLB var. ISI pair	The ISI trace number of the CLB
Total Channel Loss	Total insertion loss of the calibration channel.

Table 6 Procedure Parameters for Receivers

Parameter Name	Parameter Description
Paramters 2.5GT/S and 5.0GT/s	
ISI	The amount of ISI introduced by the selected trace.
CMSI Frequency	Frequency of the Common Mode Sinusoidal Interference
CMSI Amplitude	It is the Common Mode Sinusoidal Interference amplitude added to the signal.
Random Jitter	It is the amount of random jitter (rms) added to the test signal
Swept sinusoidal Jitter	It is the amplitude of the sinusoidal jitter component that is swept continuously from 1.5 to 100MHz during the test.
HF Sinusoidal Jitter	The amount of high frequency sinusoidal jitter added to the test signal. It should be >= 27ps
HF Sinusoidal Jitter Frequency	Frequency of the HF sinusoidal jitter component.
SSC Residual	The SSC Residual emulates the residual which is caused by path length differences in the clock distribution and SSC modulation in real world systems. The residual SSC is triangular. It should be >= 75 ps
Eye Height	It is the eye height set to the signal.
Parameters 8.0/s	
Use Compliance Impairments	If set to true, the impairments are setup according the compliance eye calibration and cannot by change If set to false, user can modify the impairments
Enable Impairments for Loopback Training	If false, the loopback training will be performed with a clean signal. If true, the signal will be stressed the same as for the BER measurement.
Eye-Height	The eye height of the signal when it is stressed with all the impairments
Eye-Width	The eye width of the signal when it is stressed with all the impairments.
Random Jitter	The amount of random jitter added to the signal
Sinusoidal Jitter	The amount of sinusoidal jitter added to the signal
Sinusoidal Jitter Frequency	The frequency of the sinusoidal jitter component.
Differential Mode Sinusoidal Jitter	The amount of DMSI added to the signal
Generator Launch Voltage	Launch Voltage added to the signal
Common Mode Sinusoidal Interference	The amount of CMSI added to the signal
Force Retraining on Each Frequency	Re-train the DUT at each tested jitter frequency
16 GT/s parameters	

Parameter Name	Parameter Description
Residual SSC	SSC added to the clock signal for Common Clock architectures.
Force training at each BER measurement	Force retraining at each BER measurement for different PS/DE combination
Random Jitter	The amount of RJ added to the signal. By default it is set to the nominal value (1ps)
Sinusoidal Jitter	The amount of SJ added to the signal. It is always set to the nominal value (6.25ps). When the required amount of SJ for getting the compliance eye, is below the nominal, that difference is subtracted to the RJ component. When the required amount is above the nominal, that difference is added to a second tone of SJ at 210MHz.
2nd Tone Sinusoidal Jitter	The amount of SJ at 210MHz added to the signal.
Sinusoidal Jitter Frequency	The frequency of the sinusoidal jitter component
Common Mode Sinusoidal Interference	Common Mode Sinusoidal Interference amplitude added to the signal.
Differential Mode Sinusoidal Interference	The amount of DMSI added to the signal to obtain the desired eye
Generator Launch Voltage	Launch Voltage used to obtain the desired eye
EQ Pre-Shoot DeEmphasis Scan	
Scan Order	Select if de-emphasis or pre-shoot is tested first.
Initial De Emphasis	The initial de-emphasis used for BER adjustment and pre-shoot scan.
Initial Pre Shoot	The initial pre-shoot used for BER adjustment and de-emphasis scan.
Force training at each Preset	If true, every time the de-emphasis or the pre-shoot is changed the DUT is trained into loopback again
Start De Emphasis:	Start amplitude for the de-emphasis scan.
Stop De Emphasis	Stop amplitude for the de-emphasis scan.
De Emphasis Step Size	Step size for the de-emphasis scan
Start Pre Shoot	Start amplitude for the pre-shoot scan
Stop Pre Shoot	Stop amplitude for the pre-shoot scan.
De Pre Shoot Size	Step size for the pre-shoot scan.
Jitter Tolerance: Sinusoidal Jitter Variation	
Frequency Mode	Specifies the distribution of the frequency points to be tested. It can be: Compliance Frequencies: The frequencies defined in the specification for compliance testing. Equally Spaced Frequencies. User Defined Frequencies. Single Frequency.
Frequency Scale	The results can be represented in logarithmic or linear scaling. For “Equally Spaced Frequencies” the frequency points depend on the chosen frequency scale.

Parameter Name	Parameter Description
Start Frequency	Start frequency for “Equally Spaced Frequencies”.
Stop Frequency	Stop frequency for “Equally Spaced Frequencies”
Frequency Steps	Number of frequency points for “Equally Spaced Frequencies”.
Jitter Frequency	Single frequency point for “Single Frequency”.
Frequency Points	Frequency points for “User Defined Frequencies”
Search Algorithm	The search algorithm used to find the maximum sinusoidal jitter that passes the BER test.
Jitter Step Size	The size of the smallest sinusoidal jitter amplitude step used to search the “Max passed jitter” at each frequency. For “User Defined Frequencies”, the jitter step size can be defined individually for each frequency point.
Jitter Start Value	The start jitter amplitude used to search the “Max passed jitter” at each frequency. For “User Defined Frequencies”, the start amplitude can be defined individually for each frequency point
Show Min Failed Points	The results graph can show the minimum failed jitter in addition to the maximum passed jitter for each tested frequency.
Coefficient Variation	
Test Calibrated Presets only	If true tests only calibrated presets (P0-P9). If false scans the whole coefficient matrix with uncalibrated pre-shoot and de-emphasis values.
Coefficient Divider	The coefficient divider for C-1 and C+1
Maximum Boost	Coefficient c+1 is increased until this Boots level is exceeded.
Start De-Emphasis	It is Start De-Emphasis value in dB
Start Pre-Shoot	It is Start Pre-Shoot value in dB.
BER Measurement	
BER Mode	The BER measurement can be executed for a fixed time or until a target BER is achieved.
Target BER	The Target BER for the BER measurement used in the test. For a Target BER of 1E-12 and a Confidence Level of 95%, the test will run 10 minutes for 5 Gbit/s and 20 minutes for 2.5 Gbit/s if no bit error occurs
Confidence Level	The confidence level value when BER mode is TargetBer
BER Measurement Duration	The duration of the BER measurement when mode is FixedTime.
Allowed Bit Error	The allowed number of bit errors during the BER measurement when mode is FixedTime.
Channel	
Trace Number	Hardware trace number used.
Total Channel Loss	Total insertion loss of the calibration channel

Parameter Name	Parameter Description
ISI from M8020A	ISI trace set internally in the M8020A
CBB var. ISI pair	
Equalization for remaining Rx Tests	
Allow user to enter optimum equalization for remaining Rx tests	Controls, if a window appears at the end of the test to let the user set the pre-shoot and de-emphasis values to use for the following tests.

4 2.5 GT/s & 5.0 GT/s ASIC Tests

Gen1 & Gen2 ASIC Tests are shown in Figure 45.

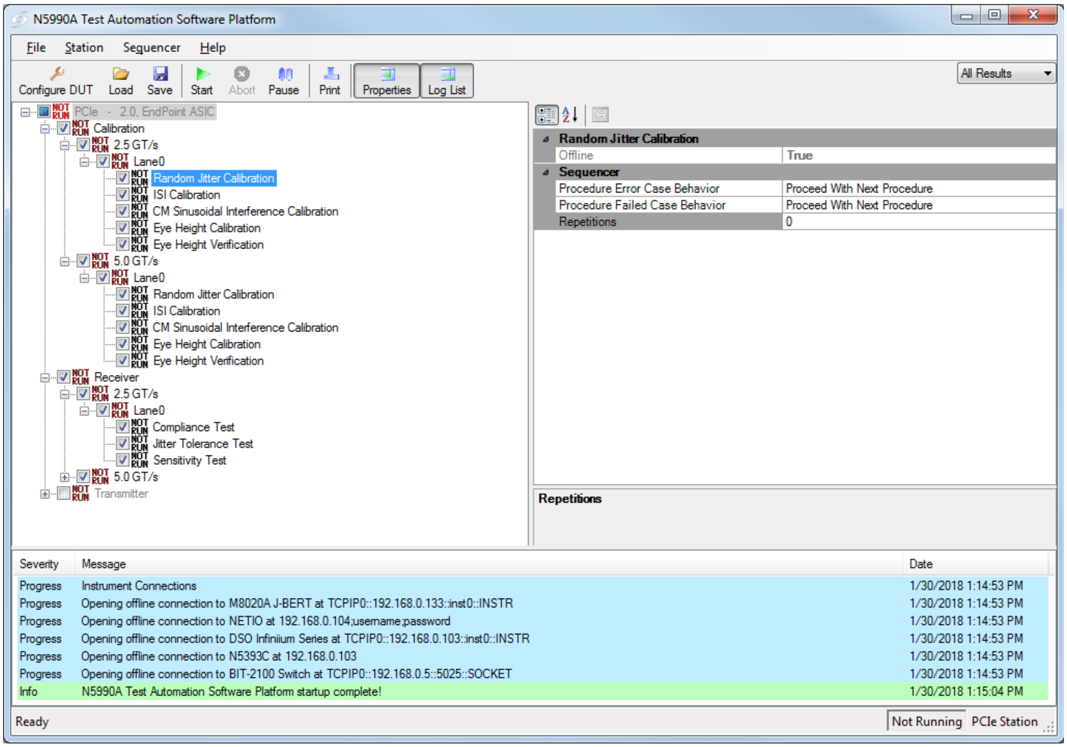


Figure 45 Gen1 & Gen2 ASIC Tests

Calibration

Common Calibration Parameters:

- Scope Connection for Calibration:

  All calibrations can be done with either a differential probe or a single ended direct connection on two channels, with one exception that the Common Mode Optimization can only be done with a differential probe.
- Jitter Unit:

  All the jitter parameters can be displayed in time or in unit interval. The graphics results are represented in the chosen unit.
- PCIe1 M8048A ISI Channel:

  The M8048A ISI Channel used for PCIe1 ASIC Rx Calibration.
- PCIe1 M8048A ISI Channel Emulation:

  Set to true if use the internal ISI of the M8020A, otherwise false.
- PCIe2 M8048A ISI Channel:

  The M8048A ISI Channel used for PCIe2 ASIC Rx Calibration.
- PCIe2 M8048A ISI Channel Emulation:

  Set to true if use the internal ISI of the M8020A, otherwise false.
- PCIe1 JBERT ISI Channel:

  The JBERT ISI Channel used for PCIe1 ASIC Rx Calibration.
- PCIe2 JBERT ISI Channel:

  The JBERT ISI Channel used for PCIe2 ASIC Rx Calibration.

2.5G/5G RJ Calibration

Purpose and Method

In the Rx tests, the input signal will be stressed with a combination of jitter sources to simulate the possible impairments 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, so the jitter amplitude is calibrated.

The test automation calibrates six equally spaced RJ values (from 0 to 10ps). The JBERT sends a clock pattern during this calibration procedure. The actual jitter is measured on a DSO using the RJ/DJ-separation software EzJIT.

The calibration data is stored in a caltable (Pcie<generation>_ASIC_RandomJitter_<ISI trace>.txt). There is a caltable for Gen1 ASIC and Gen2 ASIC. For the measurements, these calibration tables are used to calculate the RJ amplitude that needs to be set on the generator to get the desired RJ amplitude at the test point.

Connection Setup for Random Jitter Calibration

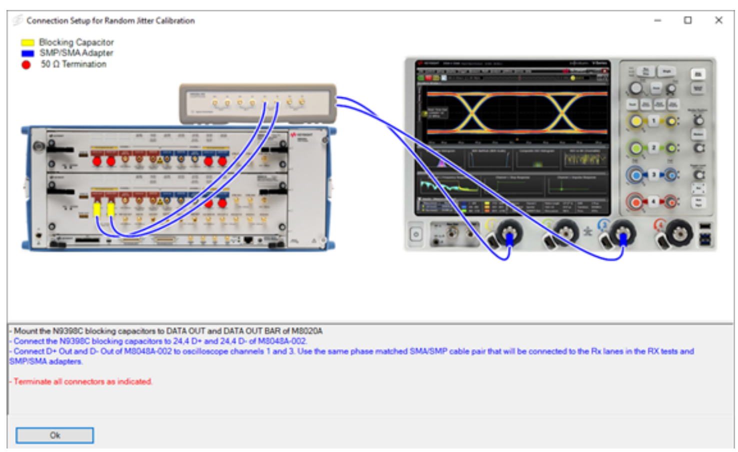


Figure 46 Connection Setup using JBERT_M8020A (with M8048A-002)

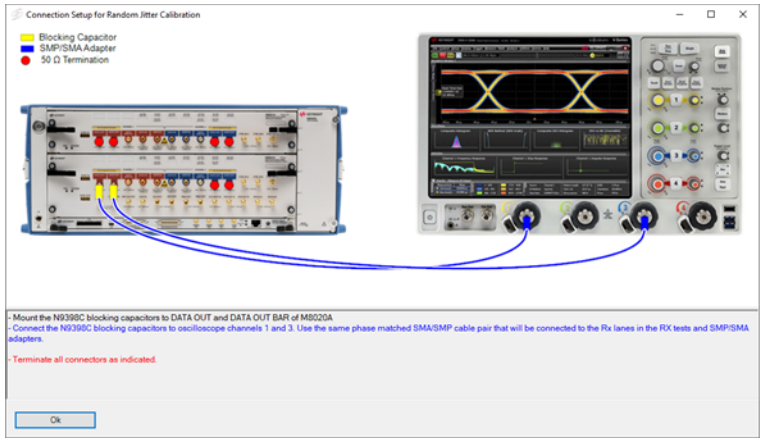


Figure 47 Connection Setup using JBERT_M8020A (with ISI Channel Emulation)

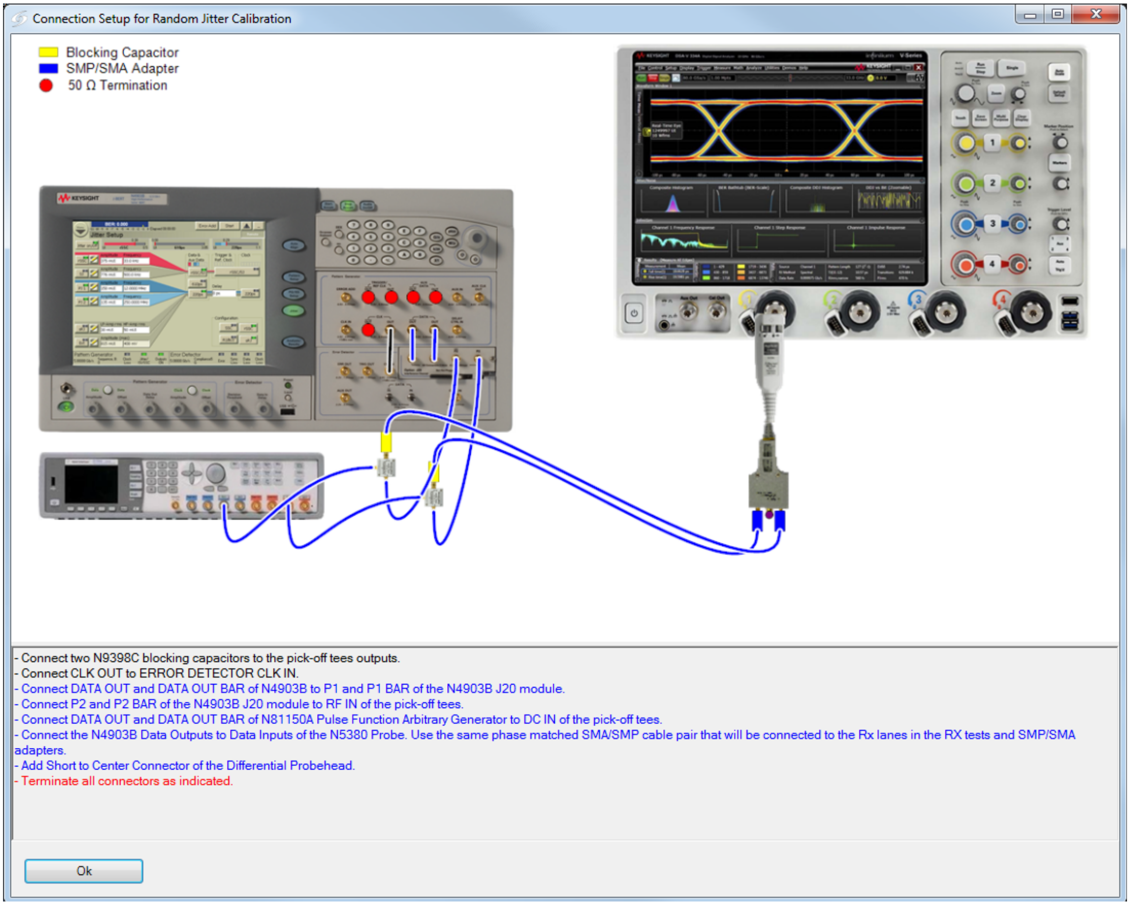


Figure 48 Connection Setup for Random Jitter Calibration with JBERT_N4903B

Parameters in Expert Mode

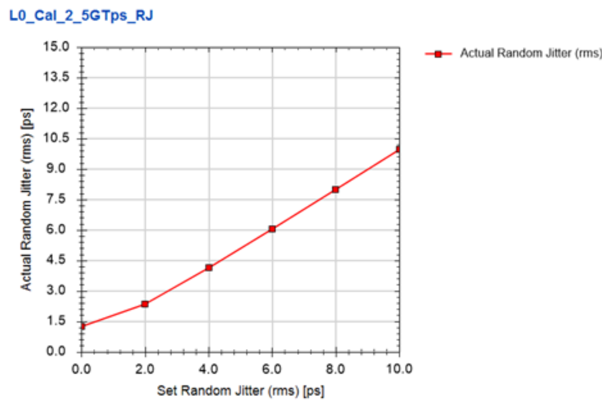
- None

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Random Jitter Calibration procedure is shown in Figure 49.



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Jitter Unit	UnitInterval
PCIe1 M8048A ISI Channel	Channel 7, 24 inch
PCIe1 M8048A ISI Channel Emulation	False

Set Random Jitter (rms) [ps]	Actual Random Jitter (rms) [ps]
0.0	1.26
2.0	2.35
4.0	4.13
6.0	6.05
8.0	7.99
10.0	9.98

Figure 49 Result Description of Random Jitter Calibration

- Column 1:
  - Set Random Jitter: It is the jitter amplitude set in the instrument.
- Column 2
  - Actual Jitter: It is the measured jitter amplitude.

2.5G/5G ISI Calibration

Purpose and Method

In ASIC Rx tests, Inter Symbol Interference is generated to provide a close to real environment. Due to system intrinsic jitter, the effective jitter level is different from the value set in the data generator, so the jitter amplitude is calibrated.

The test automation calibrates the ISI trace that has been previously selected in the Configure DUT dialog (see Figure , “”). ISI can be injected routing the signal though the M8048A ISI traces or can be generate internally with the M8020A (see Figure 19, “Channels section for 2.5GT/s and 5.0GT/s using JBERT_M8020A”. The actual value is calculated as the difference between the eye width when the JBERT sends a clock pattern and the eye width when it sends the compliance pattern. The eye width is measured with a DSO using horizontal histograms.

The calibration data is stored in a caltable (Pcie<generation>_ASIC_ISI_<ISI trace>.txt). There is a caltable for gen1 ASIC and one for gen2 ASIC. For the measurements, these calibration tables will be used to display the ISI amplitude.

Connection Setup for ISI Calibration

Same as Connection Setup for Random Jitter Calibration on page 84.

Parameters in Expert Mode

- None

Used Calibrations

- None

Procedure Report

- Examples of HTML worksheet for ISI Calibration procedure are shown in Figure 50.

L0_Cal_2_5GTps_ISI Cal

BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Offline	True
Scope Connection for Calibration	Chan 1 3 Direct Connect

Measured ISI [ps]
48.0

Figure 50 Result Description of ISI Calibration using JBERT_M8020A

- Column 1:
  - Measured ISI: It is the measured ISI.

2.5G/5G CM SI Calibration

Purpose and Method

For the N4903B setup, Common Mode Sinusoidal Interference (CMSI) is generated with a 81150A function generator and coupled into to the data signal with pick off tees. For M8020A setup, the CMSI is generated internally. In both cases, the resulting amplitude at the input of the Rx is attenuated and needs to be calibrated.

The test automation calibrates seven equally spaced CMSI amplitudes. The minimum amplitude is 0mV and the maximum, is the maximum value that the data generator can generate.

For this calibration, the data generator sends the IDLE pattern. In every step, the CMSI injected is measured with a DSO.

The calibration data is stored in a caltable (Pcie<generation>_ASIC_CmInterference_<ISI trace>.txt). There is a caltable for gen1 ASIC and one for gen2 ASIC. For the measurements these calibration tables will be used to adjust the voltage amplitude to the desired output CMSI.

Connection Setup for CM Sinusoidal Interference Calibration

Same as Connection Setup for Random Jitter Calibration on page 84.

Parameters

- Number of Averages: For details, refer to Table 3, “Common Parameters for Calibration groups”.

Used Calibrations

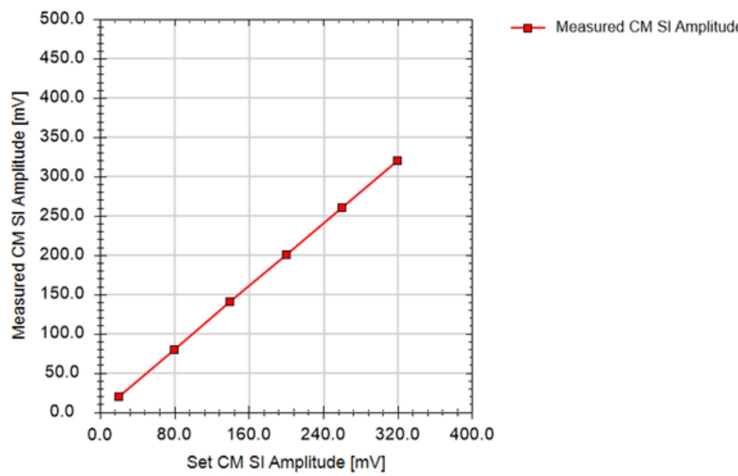
- None

Procedure Report

An example of HTML worksheet for CM Sinusoidal Interference Calibration procedure is shown in Figure 51.

L0_Cal_2_5GTps_CM_SI

for PCIe 1.1 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Offline	True
Scope Connection for Calibration	Chan 1 3 Direct Connect

Set CM SI Amplitude [mV]	Measured CM SI Amplitude [mV]
20	20.00
80	80.00
140	140.00
200	200.00
260	260.00
320	320.00

Figure 51 Result Description of CM Sinusoidal Interference Calibration

- Column 1:
  - Set CM SI Amplitude [mV]: It is the CM SI set at the 81150A.
- Column 2:
  - Measured CM SI Amplitude [mV]: It is the measured jitter amplitude.

2.5G/5G Eye Height Calibration

Purpose and Method

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

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

For this calibration, the data generator sends the compliance pattern. It adds random jitter, ISI, swept sinusoidal jitter, CMSI to the signal. For generation 2, it adds high frequency sinusoidal jitter and SSC residual to the signal. The eye height is measured in the scope using horizontal histograms.

The calibration data is stored in a caltable (Pcie<generation>_ASIC_EyeHeight_<ISI trace>.txt). There is a caltable for gen1 ASIC and one for gen2 ASIC. For the measurements these calibration tables will be used to adjust the differential voltage amplitude to the desired eye height.

Connection Setup for Eye Height Calibration

Same as Connection Setup for Random Jitter Calibration on page 84.

Parameters in Expert Mode

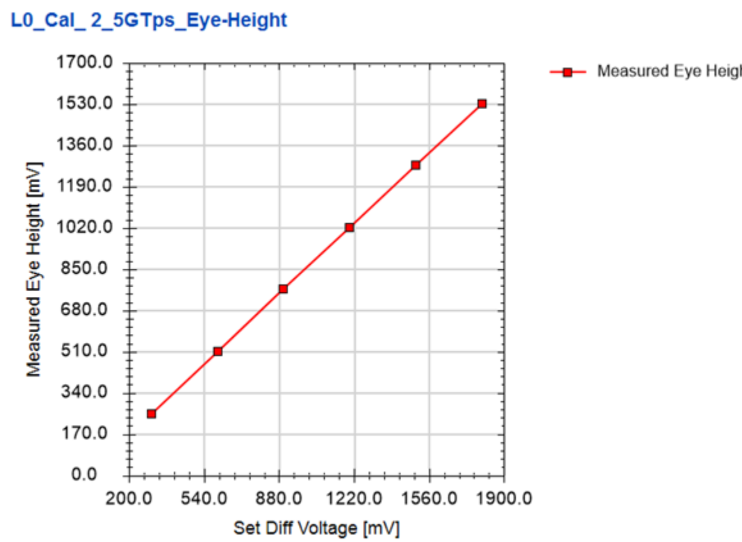
- Verification Mode

Used Calibrations

- Random Jitter Calibration
- ISI Calibration
- CM Sinusoidal Interference

Procedure Report

An example of HTML worksheet for Eye Height Calibration procedure is shown in Figure 52.



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Offline	True
Scope Connection for Calibration	Chan 1 3 Direct Connect

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

Figure 52 Result Description of Eye Height Calibration

- Column 1:
  - Set Diff Voltage [mV]: It is the differential voltage amplitude set in the instrument.
- Column 2:
  - Measured Eye Height [mV]: It is the measured eye height amplitude.

Procedure Report

- An example of HTML worksheet for Eye Height Verification procedure is shown in Figure 53.

L0_Ver_2_5GTps_Eye Height

Offline	True
Scope Connection for Calibration	Chan 1 3 Direct Connect
PCIe1 M8048A ISI Channel	Ch7 24inch
PCIe1 M8048A ISI Channel Emulation	False

Result	Measured Eye Height [mV]	Target Eye Height [mV]	Min Spec Eye Height [mV]	Max Spec Eye Height [mV]
pass	175.0	175.0	157.5	192.5

Figure 53 Result Description of Eye Height Verification

- Column 1:
  - Result: Pass or Fail
- Column 2:
  - Measured Eye Height [mV]: It is the measured eye height amplitude.
- Column 3:
  - Target Eye Height [mV]: It is the target eye height amplitude.
- Column 4:
  - Min Spec Eye Height [mV]: It is the minimum spec eye height amplitude.
- Column 5:
  - Max Spec Eye Height [mV]: It is the maximum spec eye height amplitude.

Receiver

Common Receiver Parameters

Receiver Specific

Reference Clock

Data Rate Specific

Loopback Training

- Link Training Mode
- Link Training Suite Settings File,
- Default Link Training Lane Number for every Lane
- Suppress Loopback Training Messages
- Use Gen3 EIEOS
- Use Custom Training Voltage

Error Detector

- Use CDR
- CDR Loop Bandwidth
- CDR Use SSC
- Filter Gen1/Gen2 SKPOs for BER test
- Peaking
- Analyzer Equalization
- Sensitivity Mode
- Polarity

BER Measurement

- Relax Time

Lane Specific

Link Training Lane Number

Please refer to Table 4, “Common Parameters for Receiver groups”.

2.5G/5G Rx Compliance Test

Purpose and Method

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

Connection Setup for Compliance Test

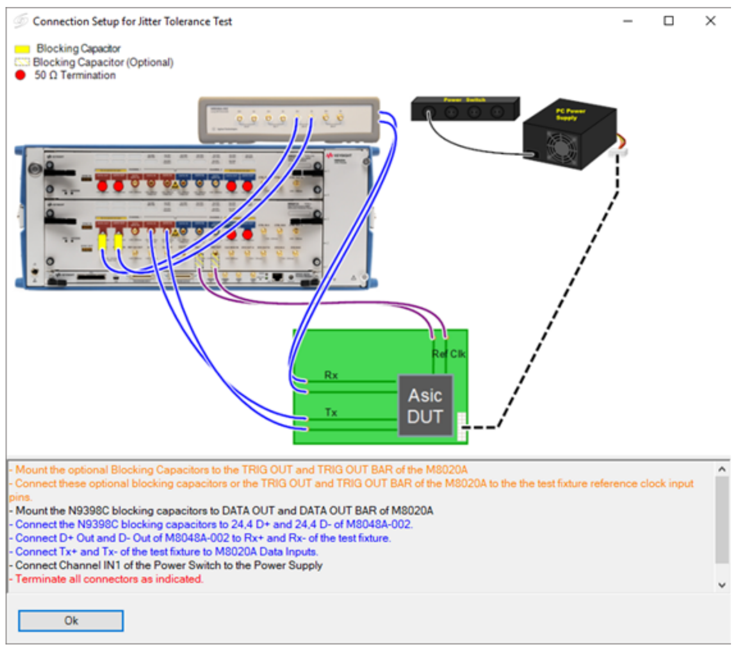


Figure 54 Connection Setup using JBERT_M8020A for Common Clock Architecture and no External ref clock

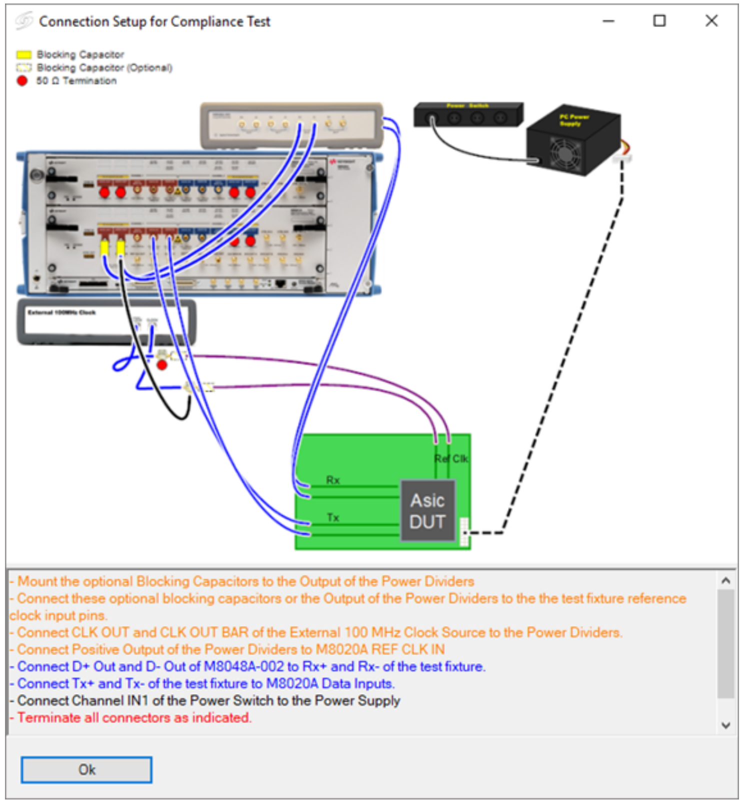


Figure 55 Connection Setup using JBERT_M8020A for common clock architecture external ref clock

Parameters in Expert Mode

1 Compliance Test
- ISI:
- CMSI Frequency
- CMSI Amplitude

2 Generator Jitter
- Random Jitter
- Swept sinusoidal Jitter
- SSC Residual (only for 5.0Gbit/s)

3 Eye Height
   - Eye Height
4 BER Measurement
   - BER Mode
   - Target BER
   - Confidence Level
   - BER Measurement Duration
   - Allowed Bit Error

Used Calibrations

- Random Jitter Calibration
- ISI Calibration
- CM Sinusoidal Interference Calibration
- Eye Height Calibration

Procedure Report

An example of HTML worksheet for Compliance Test is shown in Figure 56.

L0_Rx_2_5GTps_Complian

PCIe 1.1 EndPoint ASIC

```
Specification:
Eye Height for Transition Bits <= 175 mV
Total Jitter(peak-peak) >= 240.0 ps
Test Properties:
Offline                                     False
Link Training Lane Number                   0
Link Training Mode                          JBERT Link Training
Link Training Suite Settings File           C:\ProgramData\BitifEye\
Suppress Loopback Training Messages         False
Use CDR                                     True
CDR Loop Bandwidth                          3.75 MHz
Peaking                                     1 dB
Analyzer Equalization                       Off
Sensitivity                                 Normal
Polarity                                    Normal
Relax Time                                  1 s
```

Result	Target BER [ ]	BER [ ]
pass	1.000E-012	0.000E+000

Figure 56 Result Description of Compliance Test

- Column1:
   - Result: The BER measured should be smaller than the Target BER.

- Column 2:
  - BER: It is the target BER.
- Column 3:
  - BER: It is the measured BER.

2.5G/5G Rx Jitter Tolerance Test

Purpose and Method

This test procedure searches the maximum sinusoidal jitter at which the DUT passes the BER test.

There are different methods to find the jitter tolerance limits. It can be selected with “search algorithm” parameter as: Binary, Linear, Linear with two sizes, Linear with Hysteresis or Logarithmic.

- If Binary is selected, the binary search algorithm is used. At first, the jitter amplitude is set to the middle of the tested range. When the BER test passes it goes forward and when the test fails it goes down, At each step, the step size is reduced until the target resolution is reached.
- If Linear is selected, the test uses the defined step size to go linearly from “Start Jitter” up until the BER test fails.
- If Linear with two step size is selected, the test first uses relatively large steps to go linearly from “Start Jitter” up. When BER test fails it goes back to the last passed point and steps up again with small steps until an error is found again.
- If Linear with Hysteresis is selected, the test first uses relatively large steps to go linearly from “Start Jitter” up. When BER test fails it goes back down with mid-sized steps until it passes again. From there it 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 with a logarithmic scale from “Start Jitter” up until the BER test fails.

The maximum passed value is the last test point that did not return an error. All of this happens separately for each frequency.

NOTE Jitter Tolerance Test is available only in Expert Mode.

Connection Setup for Jitter Tolerance Test

Same as Connection Setup for Compliance Test on page 96”.

Parameters in Expert Mode

1 Jitter Tolerance Test
   - ISI .

- CMSI Frequency
- CMSI Amplitude

2 Sinusoidal Jitter Variation

- Frequency Mode
- Frequency Scale
- Start Frequency:
- Stop Frequency
- Frequency Steps
- Search Algorithm:

NOTE **The Binary search is not recommended for devices with a long recovery time.**

- Frequency Points
- Jitter Step Size
- Jitter Step Factor
- Jitter Start Value: The start jitter amplitude used to search the "Max passed jitter" at each frequency. For "User Defined Frequencies", the start amplitude can be defined individually for each frequency point.
- Show Min Failed Points

3 Parameter

- Force Retraining on Each Frequency

4 Generator Jitter

- Random Jitter
- HF Sinusoidal Jitter (only for 5.0Gbit/s)
- HF Sinusoidal Jitter Frequency (only for 5.0Gbit/s)
- SSC Residual (only for 5.0Gbit/s)

5 Eye Height

- Eye Height

6 BER Measurement

- BER Mode
- Target BER
- Confidence Level
- BER Measurement Duration
- Allowed Bit Error

For details refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

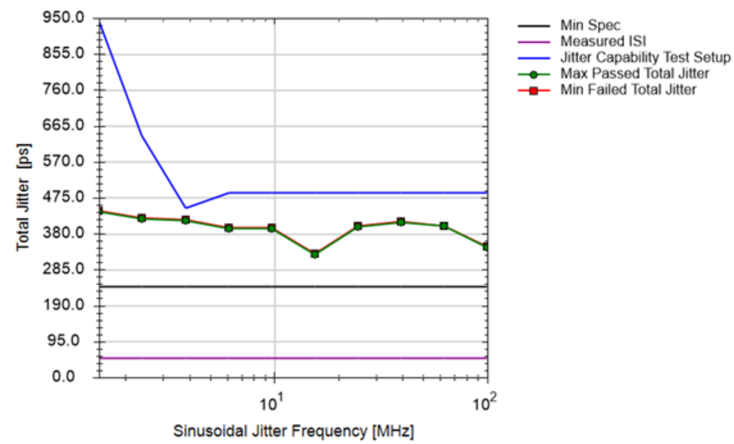
- Random Jitter Calibration
- ISI Calibration
- CM Sinusoidal Interference Calibration
- Eye Height Calibration

Procedure Report

An example of HTML worksheet for Jitter Tolerance Test procedure is shown in Figure 57.

L0_Rx_2_5GTps_Jit Tol

PCIe 1.1 EndPoint ASIC



Random Jitter	5.4 ps
BER Mode	TargetBer
Target BER	1E-9
Confidence Level	95 %
Force retraining on each frequency	False
Link Training Lane Number	0
Data Rate Deviation	0 ppm
Link Training Mode	JBERT Link Training
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrame\Settings\PCIe\TrainingScripts\Pcie1_25G_M8020A_Loopback.tx
Default Link Training Lane Number for every Lane	Auto
Suppress Loopback Training Messages	False
Use CDR	True
CDR Loop Bandwidth	3.75 MHz
Peaking	1 dB
Analyzer Equalization	Off
Sensitivity	Normal
Polarity	Normal
Relax Time	1 s
Jitter Unit	Time

Result	Sinusoidal Jitter Frequency [MHz]	Min Failed Total Jitter [ps]	Max Passed Total Jitter [ps]	Jitter Capability Test Setup [ps]	Measured ISI [ps]	Min Spec [ps]	Margin [%]
pass	1.500	440.37	438.37	945.17	51.57	240.00	82.7
pass	2.392	421.25	419.25	640.17	51.57	240.00	74.7
pass	3.814	417.30	415.30	448.17	51.57	240.00	73.0
pass	6.082	394.66	392.66	488.17	51.57	240.00	63.6
pass	9.699	394.66	392.66	488.17	51.57	240.00	63.6
pass	15.466	327.11	325.11	488.17	51.57	240.00	35.5
pass	24.662	399.44	397.44	488.17	51.57	240.00	65.6
pass	39.327	411.44	409.44	488.17	51.57	240.00	70.6
pass	62.711	401.44	399.44	488.17	51.57	240.00	66.4
pass	100.000	345.89	343.89	488.17	51.57	240.00	43.3

Figure 57 Result Description of Jitter Tolerance Test

- Column1:
  - Result: Max passed jitter should be bigger than min spec.
- Column 2:
  - Sinusoidal Jitter Frequency [MHz]: It is the tested frequency points.
- Column 3:

- Min Failed Total Jitter [ps]: It is the minimum jitter that failed the test.
- Column 4:
  - Max Passed Total Jitter [ps]: It is the maximum jitter that passed the test.
- Column 5:
  - Jitter Capability Test Setup [ps]: It is the maximum jitter that the hardware can generate.
- Column 6:
  - Measured ISI [ps]: It is the measured BER.
- Column 7:
  - Min Spec [ps]: It is the minimum jitter that has to pass the test to meet the specification.
- Column 8:
  - Margin [%]: It is the margin between the max passed jitter and the specification.

2.5G/5G Rx Sensitivity Test

Purpose and Method

This test searches the minimum eye height at which the DUT passes the BER test. The method starts with “Start Eye Height” and decreases with steps of “Step Size”. The minimum passed value is the last test point that did not return an error.

NOTE

Sensitivity Test is available only in Expert Mode.

Connection Set up for Sensitivity Test

Same as Connection Setup for Compliance Test on page 96.

Parameters in Expert Mode

1. Sensitivity Test
   - ISI
   - CMSI Frequency
   - CMSI Amplitude
2. Generator Jitter
   - Use Jitte.
   - Random Jitter
   - Swept sinusoidal Jitter
   - HF Sinusoidal Jitter (only for 5.0Gbit/s)
   - HF Sinusoidal Jitter Frequency (only for 5.0Gbit/s)
   - SSC Residual (only for 5.0Gbit/s)
3. Eye Height
   - Loopback Training Eye Height
   - Start Eye Height
   - Stop Eye Height
   - Step Size
4. BER Measurement
   - BER Mode
   - Target BER
   - Confidence Level

- BER Measurement Duration
- Allowed Bit Error

For details refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Random Jitter Calibration
- ISI Calibration
- CM Sinusoidal Interference Calibration
- Eye Height Calibration

Procedure Report

- An example of HTML worksheet for Sensitivity Test Calibration procedure is shown in Figure 58.

L0_Rx_2_5GTps_Sensitiv

PCIe 1.1 EndPoint ASIC

Specification:
Eye Height for Transition Bits <= 175 mV
Test Properties:

Offline	False
Loopback Training Eye Height	175 mV
CMSI Frequency	120 MHz
CMSI Amplitude	300 mV
Use Jitter	True
Random Jitter	5.4 ps
Swept Sinusoidal Jitter	112.83 ps
Start Eye Height	185 mV
Stop Eye Height	50 mV
Step Size	10 mV
BER Mode	TargetBer
Target BER	1E-9
Confidence Level	95 %
Link Training Lane Number	0
Data Rate Deviation	0 ppm
Link Training Mode	JBERT Link Training
Link Training Suite Settings File	C:\ProgramData\BitifEye\V
Default Link Training Lane Number for every Lane	Auto
Suppress Loopback Training Messages	False
Use CDR	True
CDR Loop Bandwidth	3.75 MHz
Peaking	1 dB
Analyzer Equalization	Off
Sensitivity	Normal
Polarity	Normal
Relax Time	1 s
Jitter Unit	Time

Result	Min Passed Eye Height [mV]	Min Spec [mV]	Margin [%]
pass	65.0	175.0	62.9

Figure 58 Result Description of Sensitivity Test

- Column1:
  - Result: It is the Min Passed Eye Height measured that should be smaller than the Min Spec.
- Column 2:
  - Min Passed Eye Height [mV]: It is the smallest eye height at which the DUT passes the BER test.
- Column 3:
  - Min Spec [mV]: It is the smallest eye height at which the DUT has to pass the BER test to meet the specification.

- Column 4:
  - Margin [%]: It is the margin between the Min Passed Eye Height and the Min Spec.

Receiver Setup (Only for Debugging) -

2.5G/5G Rx Compliance Setup

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Compliance Rx test using the calibration data saved on the PC where N5990A software is running. The method begins like Compliance test but then the test will not run, it only leaves the setup prepared. The set parameters are the differential amplitude, random jitter, swept sinusoidal jitter and common mode sinusoidal interference.

Connection Setup for Receiver Setup

Same as Connection Setup for Compliance Test on page 96.

Parameters in Expert Mode

1. Compliance Test
   - ISI
   - CMSI Frequency
   - CMSI Amplitude
2. Generator Jitter
   - Random Jitter
   - Swept sinusoidal Jitter
   - SSC Residual (only for 5.0Gbit/s)
3. Eye Height
   - Eye Height

Used Calibrations

- Random Jitter Calibration
- ISI Calibration
- CM Sinusoidal Interference Calibration
- Eye Height Calibration

For details refer to Table 6, “Procedure Parameters for Receivers”.

Procedure Report

- None

Keysight N5990A-101 Test Automation Software Platform for PCIe

User Guide

5 8.0 GT/s ASIC Tests

Calibration

For details refer to Table 6, “Procedure Parameters for Receivers”.

Common Calibration Parameters

- Scope Connection for Calibration
- Transfer Function File for Package Model on Scope:
- Transfer Function File for Replica on Scope:
- Transfer Function File for Replica and Package Model on Scope:
- Step Response Low Time:

  The length before the low to high transition in UIs.
- Step Response High Time:
- Number of Averages for Step Response
- UXR Calibration Mode
- Sampling Rate
- Range to Signal Ratio

For details refer to Table 5, “Procedure Parameters for Calibrations”.

8G TxEq and Launch Voltage Calibration

Purpose and Method

This procedure calibrates the De-emphasis, Pre-shoot and DC amplitude right behind the couplers which add the DM and CM interference to the test signal (TP1).

This calibration has to be done with a equalization pattern. The whole de-emphasis and pre-shoot range are calibrated. For this, the de-emphasis is set from -6 to 0 dB with 1dB step. At each step, the de-emphasis, pre-shoot and differential voltage amplitude are measured with the oscilloscope. This is repeated for several pre-shoot settings: from 0 to 6 dB with 1dB step. The Launch Voltage is always fixed to 800mV.

The Launch Voltage should be initially calibrated to 800mV for all other calibrations. It is allowed to change the Launch Voltage later to adjust the eye height or eye width.

For the short and long channel the voltage cannot be measured directly at TP1 because it is inside a box and thus not accessible. In that case, the voltage is measured at the end of the channel and the voltage at TP1 is calculated over the DC resistance of the channel.

The calibration data is stored in a caltable caltable (Pcie3Asic_<channel>_Vdiff.txt, Pcie3Asic_<channel>_DeEmphasis.txt, Pcie3Asic_<channel>_PreShoot.txt) . For the measurements these calibration tables will be used to adjust the differential voltage amplitude to the desired output value.

Connection Setup for TxEq and Launch Voltage Calibration

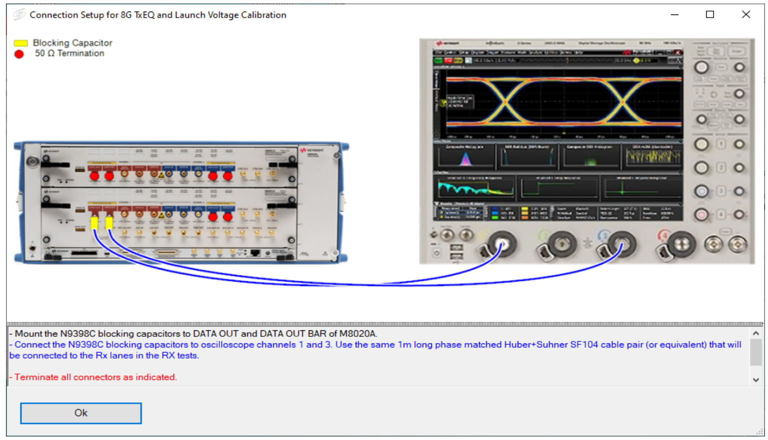


Figure 59 Connection Setup for TxEq and Launch Voltage Calibration using JBERT_M8020A

Parameters in Expert Mode

- EQ Calibration Pattern
- Verification Mode
- Generator
    - Set Amplitude
- Oscilloscope
    - Scope Bandwidth
    - Number of Waveform Averages

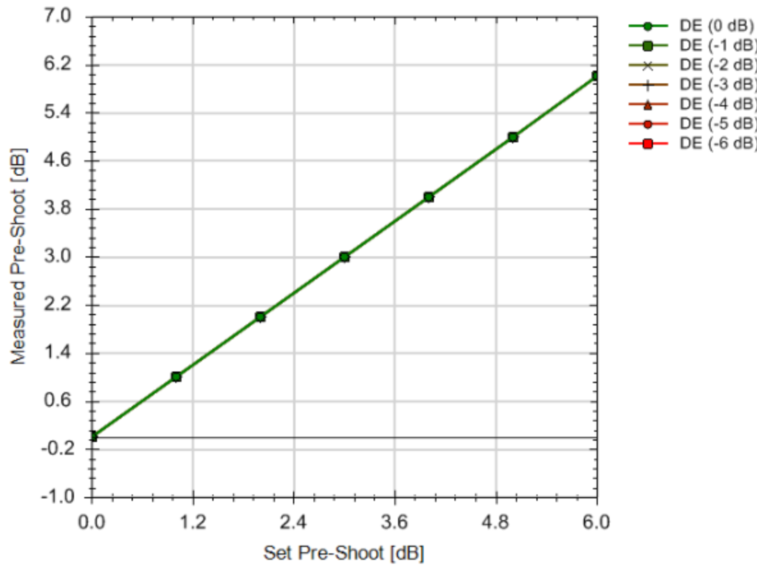
For details refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

- None

Procedure Report

Examples of HTML worksheet for TxEq and Launch Voltage Calibration procedure are shown in Figure 60, Figure 61 and Figure 62.



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Number of Waveform Averages	128
Verification Mode	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

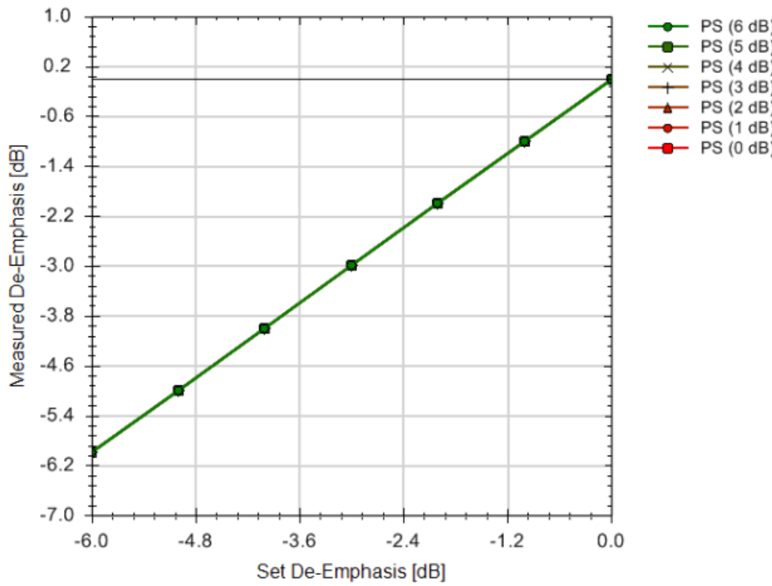
Set Pre-Shoot [dB]	DE (-6 dB) [dB]	DE (-5 dB) [dB]	DE (-4 dB) [dB]	DE (-3 dB) [dB]	DE (-2 dB) [dB]	DE (-1 dB) [dB]	DE (0 dB) [dB]
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00

Figure 60 Result Description of TxEq and Launch Voltage Calibration

- Column1:
  - Set Pre-Shoot: It is the pre-shoot value set at the signal generator
- Column 2,3,4,5,6,7,8:
  - DE (x dB): It is the pre-shoot measured with the scope when the de-emphasis is set to xdB.

L0_Cal_8GTps_DE

for PCIe 3.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Number of Waveform Averages	128
Verification Mode	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

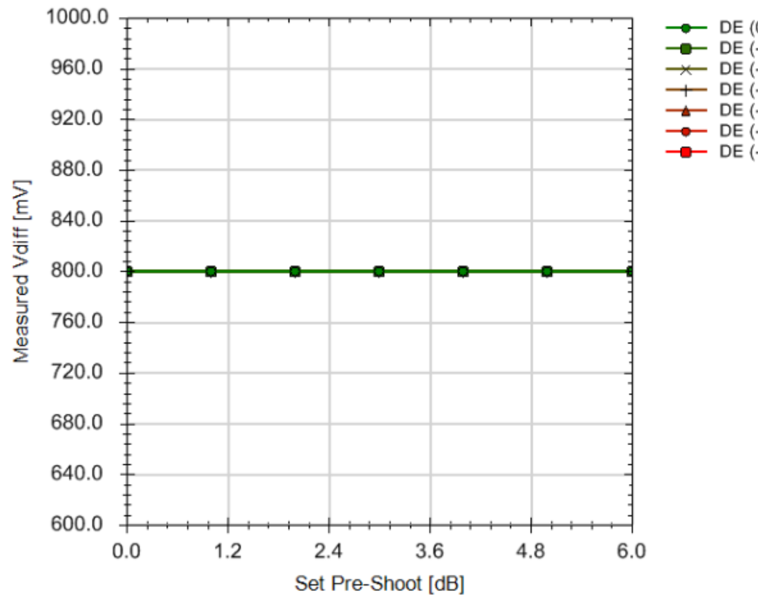
Set De-Emphasis [dB]	PS (0 dB) [dB]	PS (1 dB) [dB]	PS (2 dB) [dB]	PS (3 dB) [dB]	PS (4 dB) [dB]	PS (5 dB) [dB]	PS (6 dB) [dB]
-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00	-6.00
-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00	-5.00
-4.00	-4.00	-4.00	-4.00	-4.00	-4.00	-4.00	-4.00
-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00
-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 61 Result Description of TxEq and Launch Voltage Calibration

- Column1:
  - Set De-Emphasis: It is the de-emphasis value set at the signal generator
- Column 2,3,4,5,6,7,8:
  - PS (x dB): It is the de-emphasis measured with the scope when the pre-shoot is set to xdB.

L0_Cal_8GTps_Vdiff

for PCIe 3.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8020A J-BERT,
Generator Channel Channel	M1.DataOut1
Offline	True
Number of Waveform Averages	128
Verification Mode	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

Set Pre-Shoot [dB]	DE (-6 dB) [mV]	DE (-5 dB) [mV]	DE (-4 dB) [mV]	DE (-3 dB) [mV]	DE (-2 dB) [mV]	DE (-1 dB) [mV]	DE [
0.00	800.00	800.00	800.00	800.00	800.00	800.00	80
1.00	800.00	800.00	800.00	800.00	800.00	800.00	80
2.00	800.00	800.00	800.00	800.00	800.00	800.00	80
3.00	800.00	800.00	800.00	800.00	800.00	800.00	80
4.00	800.00	800.00	800.00	800.00	800.00	800.00	80
5.00	800.00	800.00	800.00	800.00	800.00	800.00	80
6.00	800.00	800.00	800.00	800.00	800.00	800.00	80

Figure 62 Result Description of TxEq and Launch Voltage Calibration

- Column1:
  - Set Pre-Shoot: It is the pre-shoot value set at the signal generator
- Column 2,3,4,5,6,7,8:
  - DE (x dB): It is the pre-shoot measured with the scope when the de-emphasis is set to xdB.

8G RJ Calibration

Purpose and Method

In the Rx tests, the input signal will be stressed with a combination of jitter sources to simulate the possible impairments 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, so the jitter amplitude is calibrated.

The test automation starts with small RJ amplitudes and increases them in steps defined by the “Random Jitter Step Size” parameter under “Stop Jitter”. It measures the corresponding amplitude for every set amplitude. For this purpose, the EasyJit+ application running on the real time scope is used.

The calibration data is stored in a caltable (Pcie3Asic_<channel>_RandomJitter.txt). For the measurements these calibration tables will be used to adjust the RJ amplitude to the desired output RJ amplitudes.

Connection Setup for Random Jitter Calibration

Same as Connection Setup for TxEq and Launch Voltage Calibration on page 114.

Parameters in Expert Mode

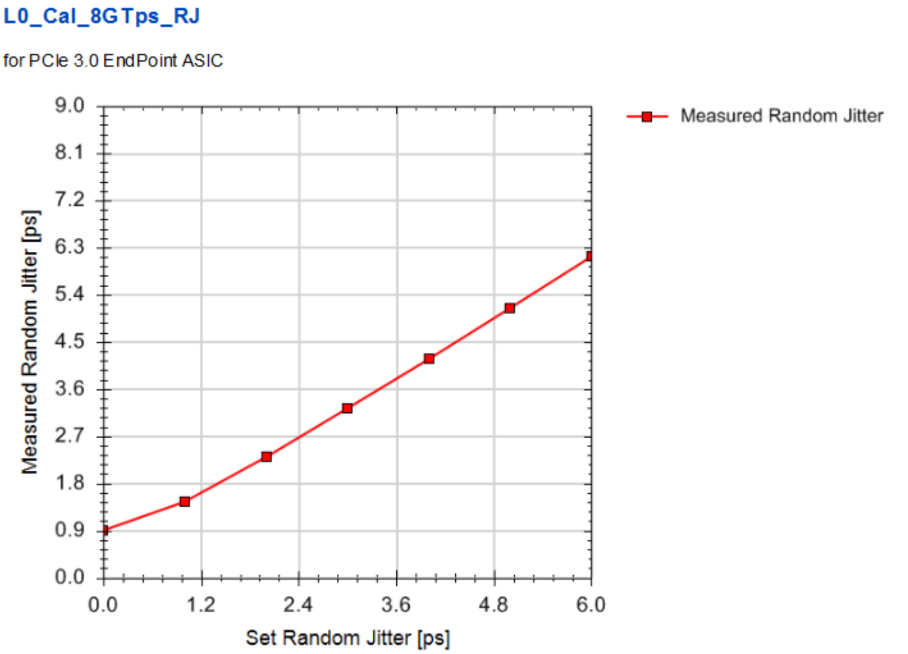
- Verification Mode
- Random Jitter Step Size: It is the step size that define how much jitter is increased for every step.
- Stop Random Jitter: It is the maximum RJ amplitude that is calibrated.

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Random Jitter Calibration procedure is shown in Figure 63.



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Stop Random Jitter	48 mUI
Random Jitter Step Size	8 mUI
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

Set Random Jitter [ps]	Measured Random Jitter [ps]
0.00	0.90
1.00	1.45
2.00	2.30
3.00	3.23
4.00	4.18
5.00	5.15
6.00	6.13

Figure 63 Result Description of Random Jitter Calibration

- Column 1:
  - Set Random Jitter [ps]: It is the jitter amplitude set in the instrument.
- Column 2:
  - Measured Random Jitter [ps]: It is the measured jitter amplitude.

8G Insertion Loss Calibration

Purpose and Method

The Insertion Loss (IL) of the calibration channels + the replica channel must be in a well defined range. This calibration calculates the Insertion Loss from the step response at 3 different de-emphasis levels. By adding de-emphasis, IL can be reduced to a certain degree. This is used to compensate IL during the Rx tests.

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

The calibration data is stored in a caltable (Pcie3Asic_<channel>_IL). This cal data is used to evaluate the optimum amount of de-emphasis for the Rx tests.

Available for hardware configurations

- All

Connection Setup for Insertion Loss Calibration

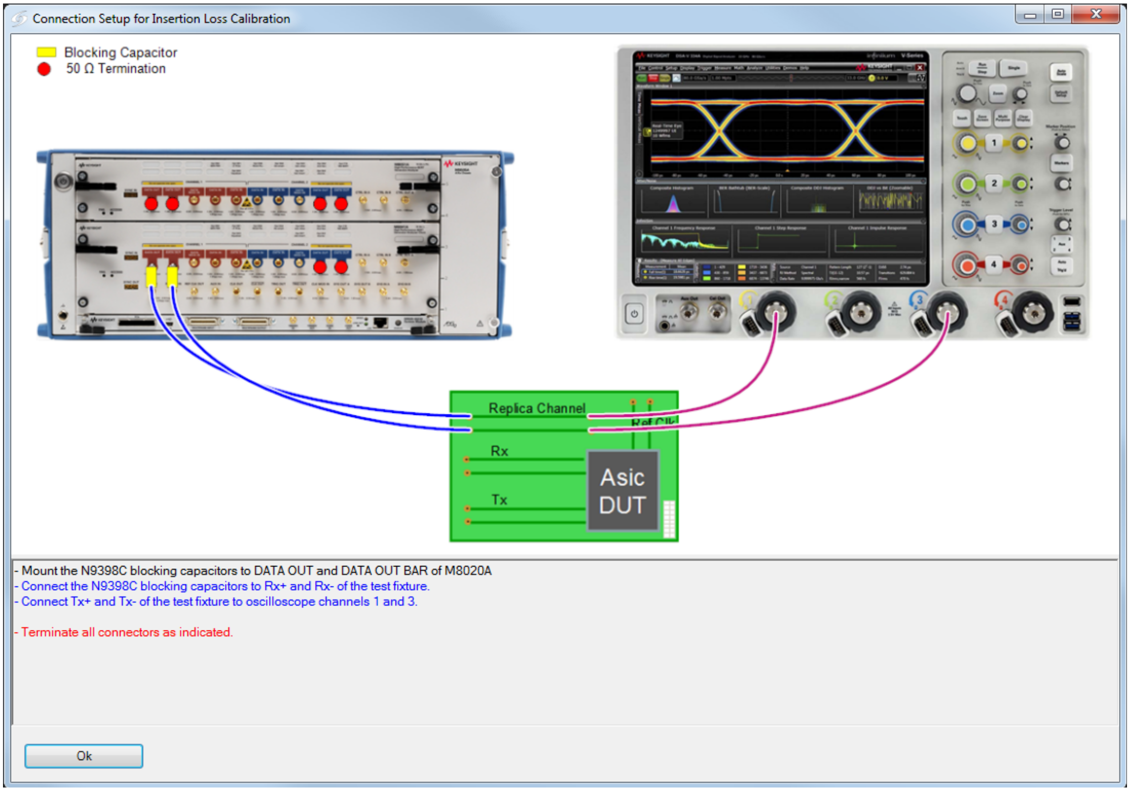


Figure 64 Connection Setup for Insertion Loss Calibration with JBERT_M8020A-Without Channel (channel with internal ISI)

NOTE

For JBERT_M8020A, there are three ISI Channels; N915A-014, M8048A-002 and M8041A-0G5. To set this ISI Channel, refer to ISI Channel Customization on page 42.

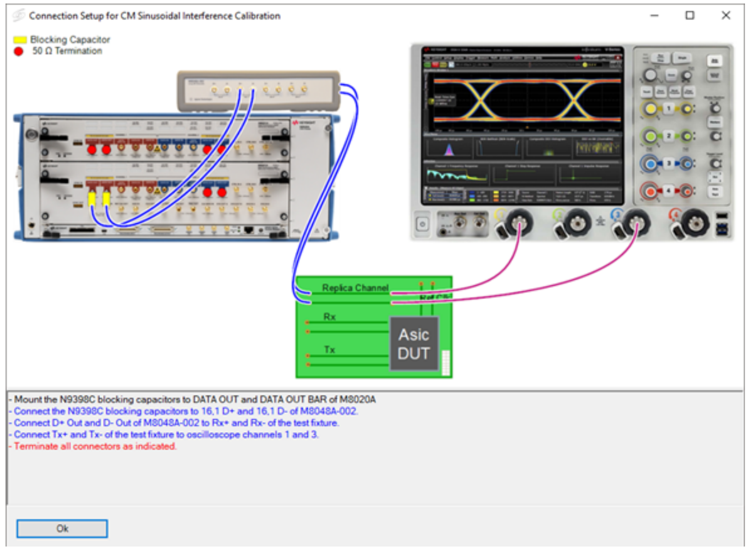


Figure 65 Connection Setup for Insertion Loss Calibration with JBERT_M8020A-Short Channel (with ISI Channel M8048A-002)

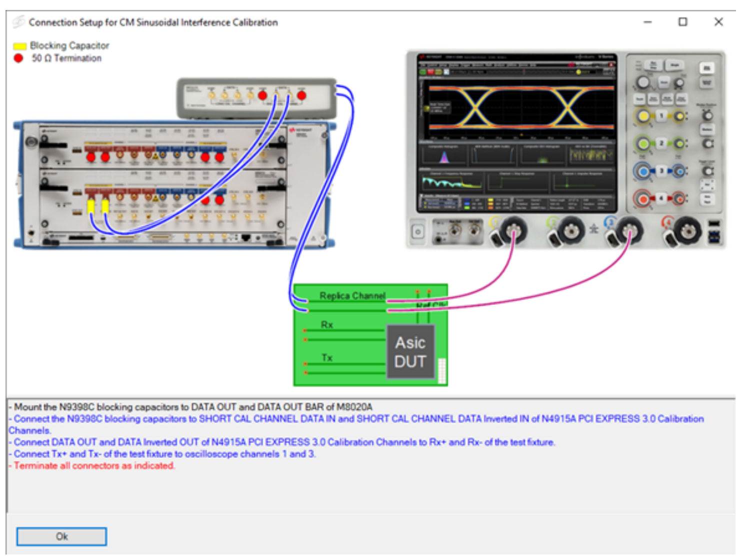


Figure 66 Connection Setup for Insertion Loss Calibration with JBERT_M8020A-Short Channel (with ISI Channel N4915A)

Parameters in Expert Mode

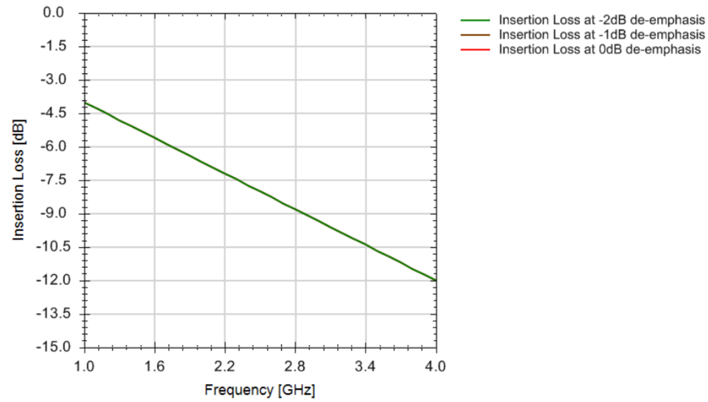
- None

Used Calibrations

- Generator Launch Voltage Calibration

L0_Cal_8GTps_ShCh_IL

for PCIe 3.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

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 67 Result Description of Insertion Loss Calibration

- Column 1:
  - Frequency [GHz]
- Column 2:
  - Insertion Loss at 0 dB deemphasis [dB]: It is the insertion loss at 0 dB de-emphasis.
- Column 3:
  - Insertion Loss at 1 dB deemphasis [dB]: It is the insertion loss at 1 dB de-emphasis.
- Column 4:
  - Insertion Loss at 2 dB deemphasis [dB]: It is the insertion loss at 2 dB de-emphasis.

8G CM SI Calibration

Purpose and Method

The method used to calibrate the CMSI at 8.0GT/s is the same as for 2.5GT/s and 5.0GT/s. For more details please refer to 2.5G/5G CM SI Calibration on page 90.

The calibration data is stored in a caltable (Pcie3Asic_<channel>_CmInterference.txt). For the measurements these calibration tables will be used to adjust the amplitude of the function generator to the desired output CMSI.

Connection Setup for CM Sinusoidal Interference Calibration

Same as Connection Setup for Insertion Loss Calibration on page 124.

Parameters in Expert Mode.

- Verification Mode
- Number of Averages: For details refer to Table 5, “Procedure Parameters for Calibrations”

Used Calibrations

- CM Optimization

Procedure Report

An example of HTML worksheet for CM Sinusoidal Interference Calibration procedure is shown in Figure 51, “Result Description of CM Sinusoidal Interference Calibration”.

8G DM SI Calibration

Purpose and Method

The Differential Mode Sinusoidal Interference (DMSI) is generated internally. The resulting amplitude at the input of the Rx is attenuated and needs to be calibrated.

DMSI is generated in a range from 0 to 400 mV in steps of 50 mV. It is measured with a real time oscilloscope. For this calibration, CMSI is set to 150mV.

The calibration data is stored in a caltable (Pcie3Asic_<channel>_DmInterference.txt). For the measurements, these calibration tables will be used to adjust the DMSI amplitude to the desired value in the RX input.

Connection Setup for DM Sinusoidal Interference Calibration

Same as Connection Setup for Insertion Loss Calibration on page 124.

Parameters in Expert Mode

- Verification Mode; For detail, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

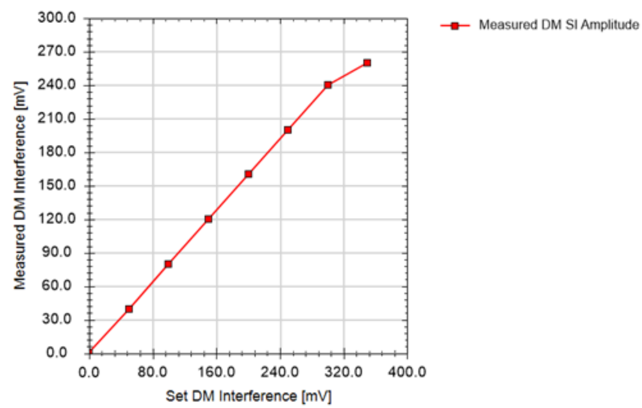
- CM Optimization
- CM Sinusoidal Interference Calibration

Procedure Report

An example of HTML worksheet for DM Sinusoidal Interference Calibration procedure is shown in Figure 68.

L0_Cal_8GTps_ShCh_DM_SI

for PCIe 3.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Number of Averages	256
ISI Channel	1 GHz: -3 dB, 4 GHz: -9.6 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

Set DM Interference [mV]	Measured DM SI Amplitude [mV]
0	1
50	40
100	80
150	120
200	160
250	200
300	240
350	260

Figure 68 Result Description of DM Sinusoidal Interference Calibration

- Column 1:
  - Set DM Interference [mV]: It is the jitter amplitude set in the instrument.
- Column 2:
  - Measured DM SI Amplitude [mV]: The measured DM SI amplitude.

8G Stressed Voltage Calibration

This calibration is only available if Gen3 spec is selected.

Purpose and Method

This procedure calibrates the Eye-Height and Eye-Width by adding Differential Mode Sinusoidal Interference (DMSI) at different Launch Voltage levels.

Due to the low signal levels at the end of the channel, there is a lot of noise on the measured signal. At that point, the eye is nearly closed. It is not sufficient to just capture a waveform at this point with an 8 Gbps Compliance Pattern as it would be too inaccurate to calibrate the Eye Height.

For this reason another approach is used. A step (128 zeros followed by 128 ones) is applied at the input of the calibration channel. The step response is captured at the output of the replica channel. The oscilloscope averages the step response which minimizes noise. With the step response, the complete electrical behavior of the channel is defined. With this data, a statistical eye can by calculated. This is done with the Seasim software. Additionally different impairments like random jitter, sinusoidal jitter and differential mode sinusoidal inference (DMSI) are simulated by Seasim. For the Stressed Voltage calibration RJ and SJ are always fixed, however, DMSI is increased at every step. The simulation is done for 600, 800 and 1000 mV of launch voltages.

The calibration data is stored in a caltable (Pcie3Asic_<channel>_StrVoltEyeHeight). This cal data is used to evaluate the optimum amount of DMSI and Launch voltage to get the desired Eye Height.

Connection Setup for Stressed Voltage Calibration

Same as Connection Setup for Insertion Loss Calibration on page 124.

Parameters in Expert Mode

- Verification Mode
- Random Jitter: It is the amount of RJ added to the simulation of the Stressed Eye.
- Sinusoidal Jitter: It is the amount of SJ added to the simulation of the Stressed Eye.
- DM Interference Step Size: It is the amount of DMSI added to the simulation at every step.

Used Calibrations

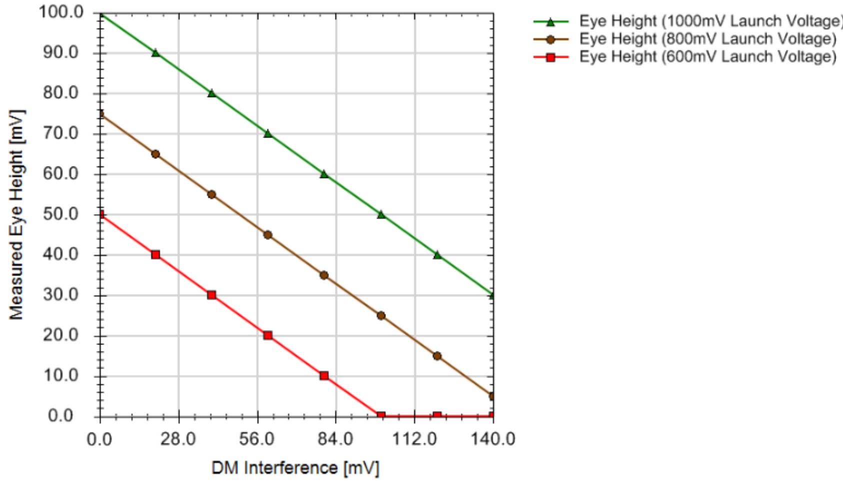
- Launch Voltage Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference

Procedure Report

Examples of HTML worksheet for Stressed Voltage Calibration procedure are shown in Figure 69 and Figure 70.

L0_Cal_8GTps_ShCh_StVol_EH

for PCIe 3.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Random Jitter	16 mUI
Sinusoidal Jitter	100 mUI
DM Interference Step Size	20 mV
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

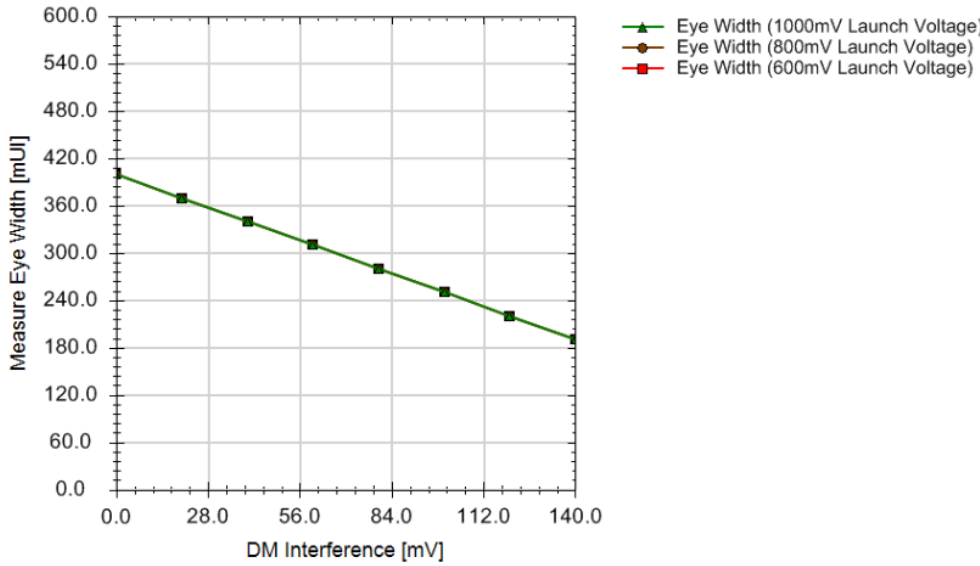
Set DM Interference [mV]	Eye Height (600mV Launch Voltage) [mV]	Eye Height (800mV Launch Voltage) [mV]	Eye Height (1000mV Launch Voltage) [mV]
0	50.0	75.0	100.0
20	40.0	65.0	90.0
40	30.0	55.0	80.0
60	20.0	45.0	70.0
80	10.0	35.0	60.0
100	0.0	25.0	50.0
120	0.0	15.0	40.0
140	0.0	5.0	30.0

Figure 69 Result Description of Stressed Voltage Calibration

- Column 1:
  - Set DM Interference [mV]: It is the DMSI amplitude set in the simulation.
- Column 2:

  - Eye Height at 600mV Launch Voltage: It is the simulated Eye-Height with 600 mV LV.
- Column 3:
  - Eye Height at 800mV Launch Voltage: It is the simulated Eye-Height with 800 mV LV.
- Column 4:
  - Eye Height at 1000mV Launch Voltage: It is the simulated Eye-Height with 1000 mV LV.

for PCIe 3.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Random Jitter	16 mUI
Sinusoidal Jitter	100 mUI
DM Interference Step Size	20 mV
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

Set DM Interference [mV]	Eye Width (600mV Launch Voltage) [mUI]	Eye Width (800mV Launch Voltage) [mUI]	Eye Width (1000mV Launch Voltage) [mUI]
0	400.0	400.0	400.0
20	370.0	370.0	370.0
40	340.0	340.0	340.0
60	310.0	310.0	310.0
80	280.0	280.0	280.0
100	250.0	250.0	250.0
120	220.0	220.0	220.0
140	190.0	190.0	190.0

Figure 70 Result Description of Stressed Voltage Calibration

- Column 1:
  - Set DM Interference [mV]: It is the DMSI amplitude set in the simulation.
- Column 2:
  - Eye Width at 600mV Launch Voltage[mUI]: It is the simulated Eye-Width with 600mV LV.
- Column 3:
  - Eye Width at 800mV Launch Voltage [mUI]: It is the simulated Eye-Width with 800mV LV.
- Column 4:
  - Eye Width at 1000mV Launch Voltage [mUI]: It is the simulated Eye-Width with 1000mV LV.

8G Stressed Jitter Calibration

This calibration is only available if Gen3 spec is selected.

Purpose and Method

This procedure calibrates the eye-width by adding random jitter at different launch voltage levels.

The calibration is done for 600, 800 and 1000 mV of launch voltages. For each amplitude, random jitter is increased from 0 with equally spaced steps. The eye width is measured by capturing a step response and using Seasim software. Sinusoidal Jitter is always fixed to 12.5 ps.

The calibration data is stored in a caltable (Pcie3Asic_<channel>_StrVoltEyeWidth). This cal data is used to evaluate the optimum amount of random jitter and launch voltage to get the desired eye width.

Available for following hardware configurations

- Only for Long Channel

Connection Setup for Stressed Jitter Calibration

Same as Connection Setup for Insertion Loss Calibration on page 124.

Parameters in Expert Mode

- Verification Mode
- Sinusoidal Jitter: It is the amount of SJ added to the simulation of the Stressed Eye.
- End Random Jitter: It is the maximum amount of RJ added.
- Random Jitter Step Size: It is the amount that RJ is increased in each step.

Used Calibrations

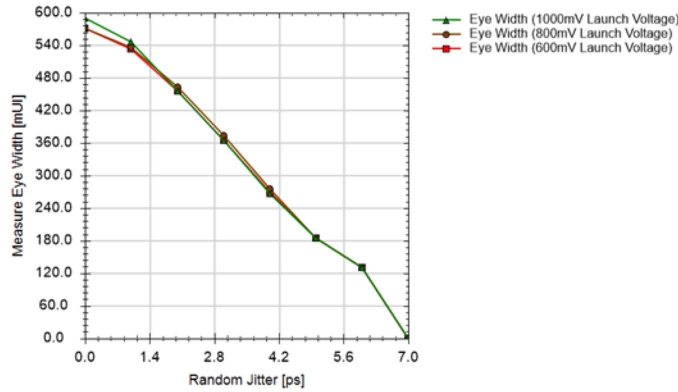
- Launch Voltage Calibration
- Insertion Loss Calibration
- Random Jitter Calibration

Procedure Report

An example of HTML worksheet for Stressed Jitter Calibration procedure is shown in Figure 72.

L0_Cal_8GTps_LnCh_StJit_EW

for PCIe 3.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Sinusoidal Jitter	100 mUI
End Random Jitter	56 mUI
Random Jitter Step Size	8 mUI
ISI Channel	1 GHz: -5.6 dB, 4 GHz: -17.9 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

Set Random Jitter [ps]	Eye Width (600mV Launch Voltage) [mUI]	Eye Width (800mV Launch Voltage) [mUI]	Eye Width (1000mV Launch Voltage) [mUI]
0	571.0	571.0	591.0
1	534.0	537.0	547.0
2	456.0	463.0	456.0
3	365.0	373.0	365.0
4	269.0	275.0	267.0
5	185.0	185.0	185.0
6	130.0	130.0	130.0
7	0.0	0.0	0.0

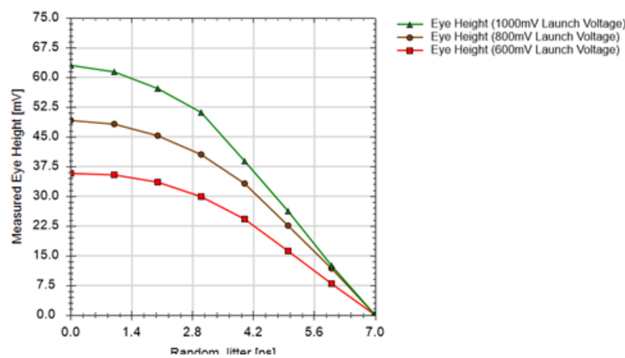
Figure 71 Result Description of Stressed Jitter Calibration

- Column 1:
  - Set Random Jitter [ps]: It is the RJ amplitude set in the simulation.
- Column 2:
  - Eye Width (600 mV Launch Voltage)[mUI]: It is the simulated Eye-Width with 600 mV LV.

- Column 3:
  - Eye Width (800 mV Launch Voltage) [mUI]: The simulated Eye-Width with 800 mV LV.
- Column 4:
  - Eye Width (1000 mV Launch Voltage) [mUI]: The simulated Eye-Width with 1000 mV LV.

L0_Cal_8GTps_LnCh_StJit_EH

for PCIe 3.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Sinusoidal Jitter	100 mUI
End Random Jitter	56 mUI
Random Jitter Step Size	8 mUI
ISI Channel	1 GHz: -5.6 dB, 4 GHz: -17.9 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf2
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048
Jitter Unit	UnitInterval

Set Random Jitter [ps]	Eye Height (600mV Launch Voltage) [mV]	Eye Height (800mV Launch Voltage) [mV]	Eye Height (1000mV Launch Voltage) [mV]
0	35.8	49.1	63.0
1	35.3	48.2	61.4
2	33.5	45.2	57.2
3	29.9	40.5	51.2
4	24.2	33.1	38.8
5	16.1	22.6	26.2
6	7.8	11.8	12.4
7	0.0	0.0	0.0

Figure 72 Result Description of Stressed Jitter Calibration

- Column 1:
  - Set Random Jitter [ps]: It is the RJ amplitude set in the simulation.
- Column 2:
  - Eye Height (600mV Launch Voltage) [mV]: It is the simulated Eye-Height with 600mV LV.
- Column 3:

  Eye Height (800mV Launch Voltage) [mV]: The simulated Eye-Height with 800mV LV.
- Column 4:
  - Eye Height (600mV Launch Voltage) [mV]: The simulated Eye-Height with 1000mV LV.

8G Stressed Jitter Eye Calibration

This calibration is only available if Gen4 spec is selected.

Purpose and Method

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

The calibration is done for 1, 1.5, 2, 2.5 and 3 ps of random jitter. For each jitter value, the DM sinusoidal interference is increased from 0 to 30 mV with equally spaced steps. The eye height and width is measured by capturing a step response and using Seasim software. Sinusoidal Jitter is always fixed to 12.5 ps.

The calibration data is stored in two caltables

(Pcie3Asic_<channel>_ M8041A_StrEyeWidth and Pcie3Asic_<channel>_ M8041A_StrEyeHeight). This cal data is used to evaluate the optimum amount of random jitter and DM voltage to get the desired eye.

Available for following hardware configurations

- Only for Long Channel

Connection Setup for Stressed Jitter Calibration

- Same as Connection Setup for Insertion Loss Calibration on page 130.

Parameters in Expert Mode

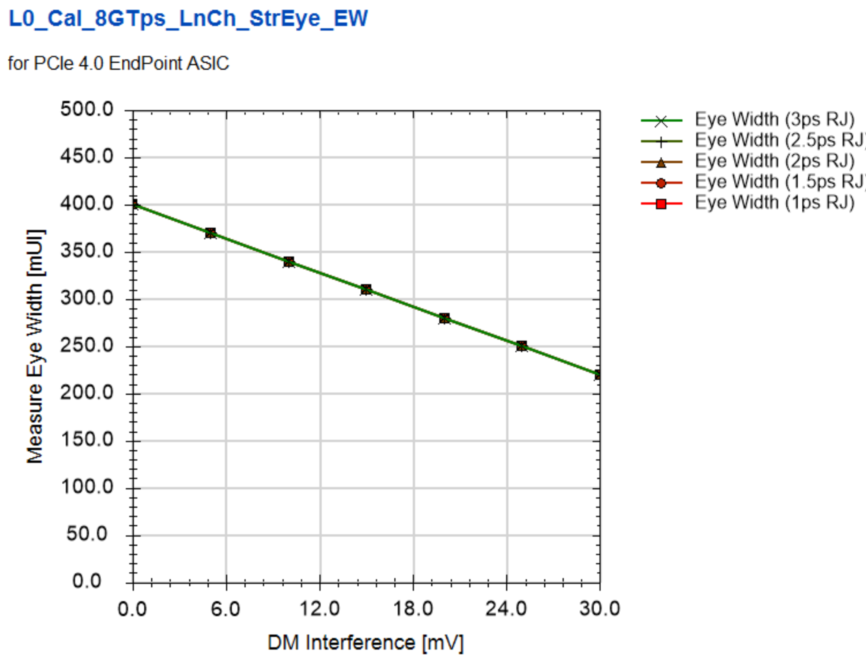
- Verification Mode
- Sinusoidal Jitter: It is the amount of SJ added to the simulation of the Stressed Eye.
- DM Interference Step Size: It is the amount of DM interference voltage increased at each step.

Used Calibrations

- Launch Voltage Calibration
- Insertion Loss Calibration
- Random Jitter Calibration

Procedure Report

An example of HTML worksheet for Stressed Jitter Calibration procedure is shown in Figure 97.



BERT System	Keysight M8020A J-BERT, Keysight M8020A J-BERT,
Generator Channel Channel	M1.DataOut1
Offline	True
Sinusoidal Jitter	12.5 ps
DM Interference Step Size	5 mV
ISI Channel	1 GHz: -5.6 dB, 4 GHz: -17.9 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf4
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048

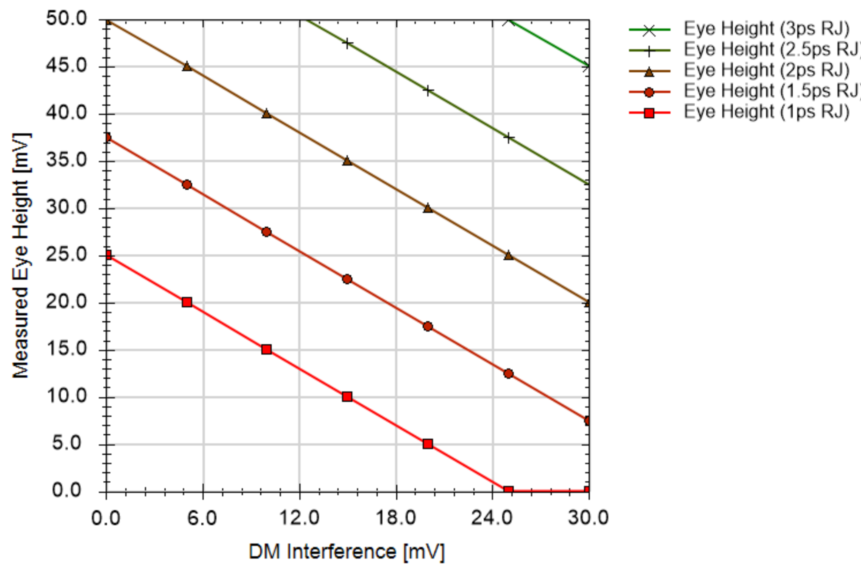
Set DM Interference [mV]	Eye Width (1ps RJ) [mUI]	Eye Width (1.5ps RJ) [mUI]	Eye Width (2ps RJ) [mUI]	Eye Width (2.5ps RJ) [mUI]	Eye Width (3ps RJ) [mUI]
0	400.0	400.0	400.0	400.0	400.0
5	370.0	370.0	370.0	370.0	370.0
10	340.0	340.0	340.0	340.0	340.0
15	310.0	310.0	310.0	310.0	310.0
20	280.0	280.0	280.0	280.0	280.0
25	250.0	250.0	250.0	250.0	250.0
30	220.0	220.0	220.0	220.0	220.0

Figure 73 Result Description of Stressed Jitter Eye Width Calibration

- Column 1:
  - Set DM Interference [mV]: It is the DM sinusoidal interference amplitude set in the simulation.
- Column 2:
  - Eye Width (x ps RJ): It is the simulated Eye-Width with x ps Random Jitter.

L0_Cal_8GTps_LnCh_StrEye_EH

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, Keysight
Generator Channel Channel	M1.DataOut1
Offline	True
Sinusoidal Jitter	12.5 ps
DM Interference Step Size	5 mV
ISI Channel	1 GHz: -5.6 dB, 4 GHz: -17.9 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
Transfer Function File for Package Model on Scope	PCIe3RxPackageModel.tf4
Step Response Low Time	8 UI
Step Response High Time	112 UI
Number of Averages for Step Response	2048

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	25.0	37.5	50.0	62.5	75.0
5	20.0	32.5	45.0	57.5	70.0
10	15.0	27.5	40.0	52.5	65.0
15	10.0	22.5	35.0	47.5	60.0
20	5.0	17.5	30.0	42.5	55.0
25	0.0	12.5	25.0	37.5	50.0
30	0.0	7.5	20.0	32.5	45.0

Figure 74 Result Description of Stressed Jitter Eye Height Calibration

- Column 1:
  - Set DM Interference [mV]: It is the DM sinusoidal interference amplitude set in the simulation.
- Column 2:
  - Eye Height (x ps RJ): It is the simulated Eye-Height with x ps of Random Jitter.

Receiver

The set of 8.0G/s ASIC tests depend on the specification selected.

For Gen3, the DUT needs to be tested for three cases: No-Channel, Short-Channel and Long-Channel. For Gen4 only the Long Channel is tested.

Common Receiver Parameters

Receiver Specific

- Reference Clock

Data Rate Specific

1. Loopback Training
   - Link Training Mode
   - Link Training Suite Settings File,
   - Default Link Training Lane Number for every Lane
   - Suppress Loopback Training Messages
   - Use Custom Training Voltage
2. Interactive Link Training
   - Training Through
   - Generator Start Preset
   - DUT Initial Preset
   - DUT Target Preset
   - Drop Link Method
3. Error Detector
   - Use CDR
   - CDR Loop Bandwidth
   - CDR Use SSC
   - Filter Gen3 SKPOs for BER test
   - Peaking
   - Analyzer Equalization
   - Sensitivity Mode
   - Capture and Compare Mode
   - Pause before Auto-Align
   - Polarity

4 BER Measurement
   - Relax Time

Channel Specific

- Pre Shoot
- De Emphasis

Lane Specific

- Link Training Lane Number

For more details, refer to Table 4, “Common Parameters for Receiver groups”.

8G Rx Coefficient Matrix Scan

Purpose and Method

This procedure measures the BER with the combination of coefficients C+1 (Pre-cursor) and C-1 (Post-cursor) to create a co-efficient matrix with the BER results. At each step, the BER value is measured for different values of C+1 coefficient while the C-1 coefficient value is kept constant. The result values are mapped on to 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 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 color, the entry values are valid and they can be used for testing. As the color reaches to red they are invalid for testing.

If the parameter **Allow user to enter optimum equalization for remaining tests** is set to **True**, a window appears to let the user select the values of pre-shoot and de-emphasis from the result graph. These selected values are used as the initial values of pre-shoot and de-emphasis for the EQ Pre-Shoot De-Emphasis Scan.

Connection Setup for EQ Coefficient Matrix Scan

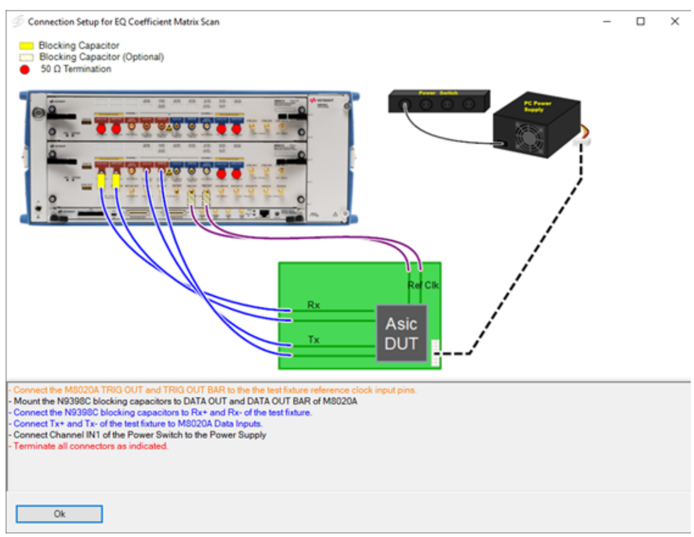


Figure 75 Connection Setup using JBERT_M8020A with Common Clock Architecture and no external ref clock- Without Channel or Internal ISI

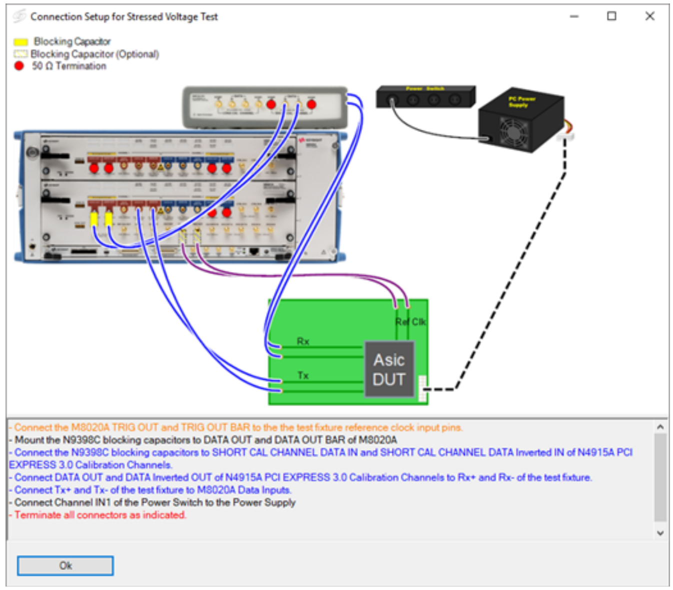


Figure 76 Connection Setup using JBERT_M8020A with Common Clock Architecture and no external ref clock -Short channel (with ISI Channel N4915A)

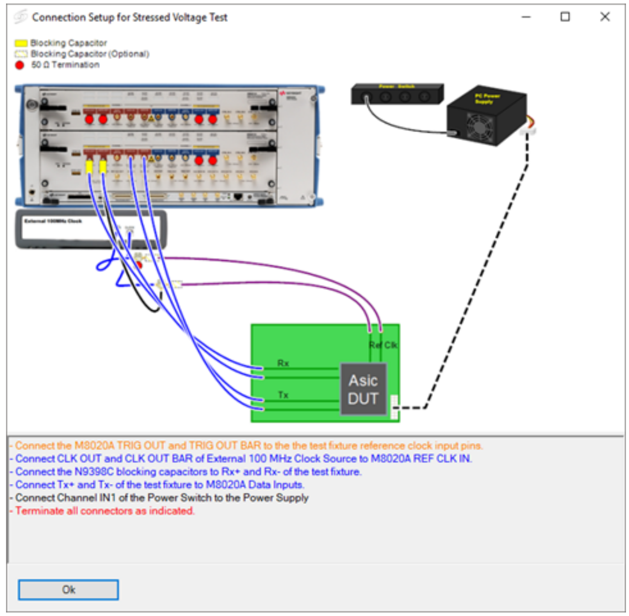


Figure 77 Connection Setup using JBERT_M8020A with Common Clock Architecture and with external ref clock -Without Channel or -Internal ISI

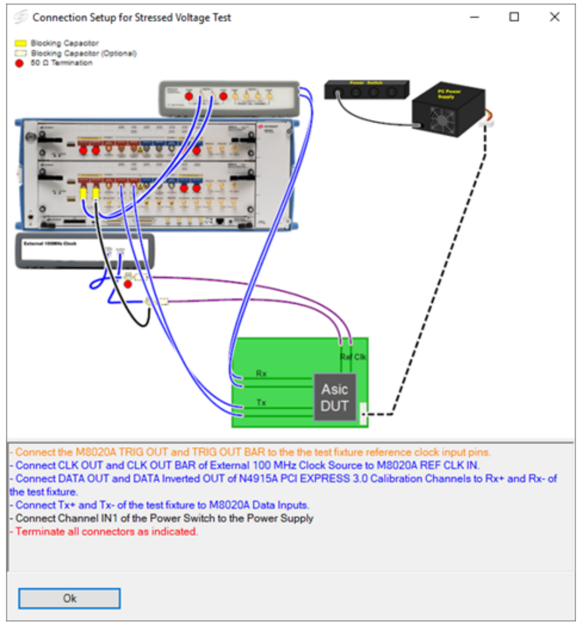


Figure 78 Connection Setup using JBERT_M8020A with Common Clock Architecture and with external ref clock- Long channel (with ISI Channel N4915A)

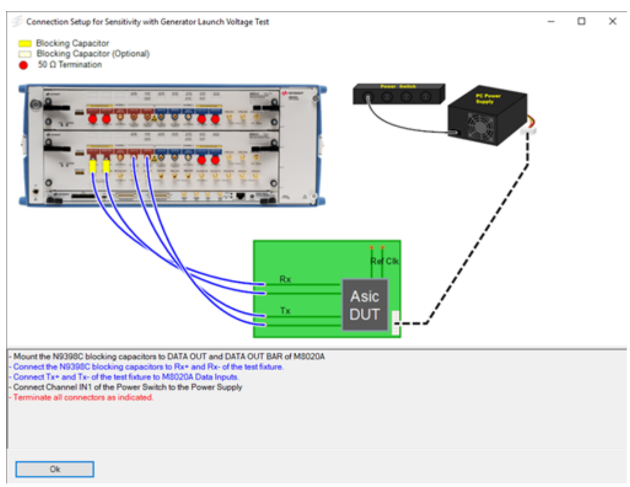


Figure 79 Connection Setup using JBERT_M8020A with Separated Clock Architecture - Without Channel- or Internal ISI

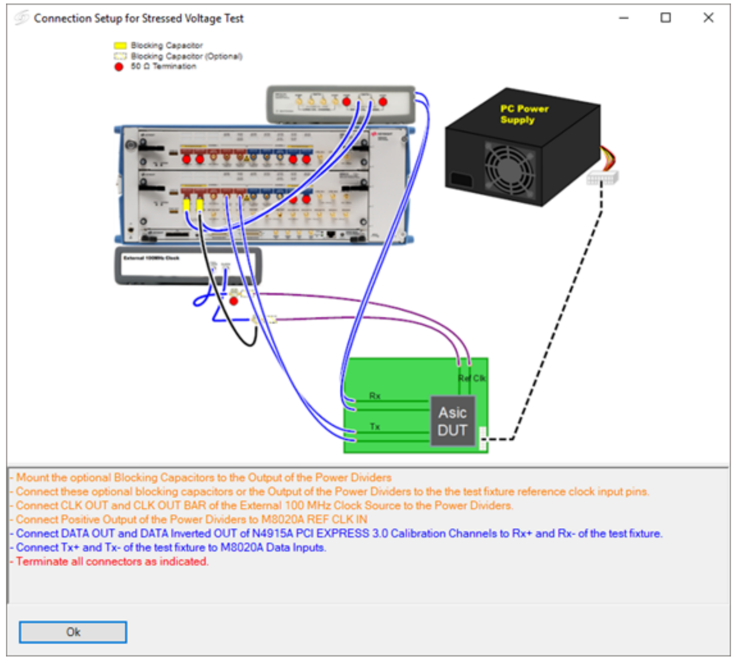


Figure 80 Connection Setup using JBERT_M8020A with Separated Clock Architecture - Short Channel (with ISI Channel N4915A)

Parameters in Expert Mode

1 Loopback Training
   - Force training at each BER measurement
   - Pre-Shoot user for LB Training
   - De-Emphasis used for LB Training
2 Eye Parameter
   - Eye-Height
   - Eye-Width
   - Common Mode Sinusoidal Interference
   - Differential Mode Sinusoidal Interference: The amount of DMSI added to the signal to obtain the desired eye.
   - Generator Launch Voltage: It is the Launch Voltage used to obtain the desired eye.

- Random Jitter: The amount of RJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Voltage Calibration. To change, it is necessary to repeat that calibration
- Sinusoidal Jitter: The amount of SJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Voltage Calibration. To change, it is necessary to repeat that calibration.
- Sinusoidal Jitter Frequency

3 .Coefficient Variation

- Coefficient Divider
- Maximum Boost
- Start De-Emphasis
- Start Pre-Shoot

4 BER Measurement

- BER Mode
- Target BER.
- Confidence Level

5 Equalization for remaining Rx Tests

- Allow user to enter optimum equalization for remaining Rx tests

For details, refer to Table 6, "Procedure Parameters for Receivers".

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height Calibration
- Eye Width Calibration

Procedure Report

An example of HTML worksheet for EQ Coefficient Matrix Scan procedure is shown in

L0Rx_8GTps_EQtable

for PCIe 3.0 EndPoint ASIC

Offline	True
Eye Height	200 mV
Eye Width	325 mUI
Sinusoidal Jitter Frequency	100 MHz
Target BER	30E-12
Confidence Level	95 %
Force Retraining at each BER measurement	True
Coefficient Divider	24
Maximum Boost	9.5 dB
Start Pre-Shoot	0 dB
Start De-Emphasis	0 dB
Allow user to enter optimum equalization for remaining Rx tests	True
Common Mode Sinusoidal Interference	250 mV
Pre-Shoot	0 dB
De-Emphasis	0 dB
Link Training Mode	JBERT Interactive Link Training

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

Figure 81 Result Description of EQ Coefficient Matrix Scan

8G Rx Pre-Shoot De-Emphasis Scan

Purpose and Method

The purpose of this test is to find the optimum combination of de-emphasis and pre-shoot amplitude. 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 keeps the initial pre-shoot and makes a de-emphasis scan, measuring the BER for every de-emphasis value. After that, it keeps 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. Those let the user see the best combination with the selected initial values.

Connection Setup for EQ Pre-Shoot De-Emphasis Scan

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

1. Parameter
   - Scan Order
   - Initial De Emphasis
   - Initial Pre Shoot
   - Force training at each Preset
   - Common Mode Sinusoidal Interference
2. De-Emphasis Variation
   - Start De Emphasis
   - Stop De Emphasis
   - De Emphasis Step Size
3. Pre-Shoot Variation
   - Start Pre Shoot
   - Stop Pre Shoot
   - De Pre Shoot Size
4. BER Measurement
   - BER Mode
   - Confidence Level
   - Target BER
   - BER Measurement Duration
   - Allowed Bit Error
5. Equalization for remaining Rx Tests

- Allow user to enter optimum equalization for remaining Rx tests.

Used Calibrations

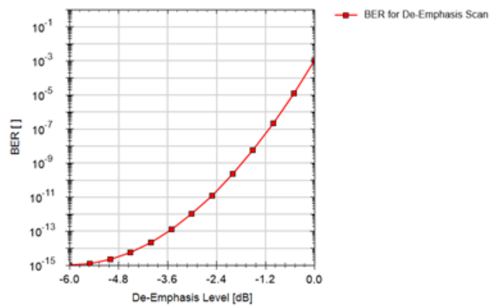
- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height Calibration
- Eye Width Calibration

Procedure Report

Examples of HTML worksheet for EQ Pre-Shoot De-Emphasis Scan procedure are shown in Figure 82 and Figure 83.

L0Rx_8GTps_DeEmphasis_Scan

for PCIe 3.0 EndPoint ASIC



DUT Target Preset	P4
Drop Link Method	JBERT LTSSM
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	1 s
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	3

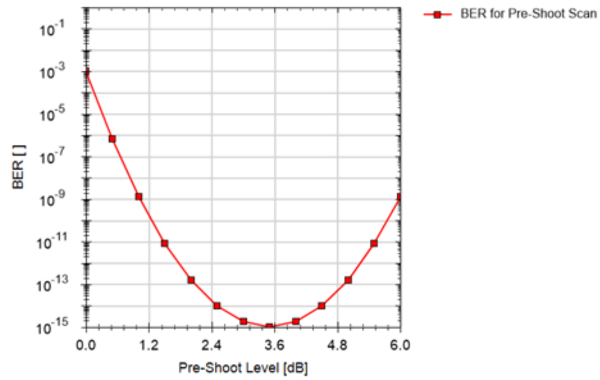
x-column [dB]	BER for De-Emphasis Scan [ ]
0.000	1.000E-003
-0.500	1.212E-005
-1.000	2.154E-007
-1.500	5.623E-009
-2.000	2.154E-010
-2.500	1.212E-011
-3.000	1.000E-012
-3.500	1.212E-013
-4.000	2.154E-014
-4.500	5.623E-015
-5.000	2.154E-015
-5.500	1.212E-015
-6.000	1.000E-015

Figure 82 Result Description of EQ Pre-Shoot De-Emphasis Scan

- Column1:
  - x-column [dB]: It is the de-Emphasis level added to the signal at each step.
- Column 2:
  - BER for Pre-Shoot Scan: It is the BER measured at each step.

L0Rx_8GTps_PreShoot_Scan

for PCIe 3.0 EndPoint ASIC



DUT Target Preset	P4
Drop Link Method	JBERT LTSSM
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	1 s
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	3

x-column [dB]	BER for Pre-Shoot Scan [ ]
0.000	1.000E-003
0.500	6.551E-007
1.000	1.326E-009
1.500	8.286E-012
2.000	1.600E-013
2.500	9.541E-015
3.000	1.758E-015
3.500	1.000E-015
4.000	1.758E-015
4.500	9.541E-015
5.000	1.600E-013
5.500	8.286E-012
6.000	1.326E-009

Figure 83 Result Description of EQ Pre-Shoot De-Emphasis Scan

- Column1:
  - x-column [dB]: It is the pre-shoot level added to the signal at each step.
- Column 2:
  - BER for Pre-Shoot Scan: It is the BER measured at each step.

8G Rx Stressed Voltage Test

This procedure is only available if Gen3 spec is selected.

Purpose and Method

This test verifies that the DUT works properly in the presence of the minimum eye height, allowed in specification. The minimum value of eye height depends on the calibration channel. The eye width must be between 0.3 and 0.35 UI. Eye height is generated by adding the combination of Differential Mode Sinusoidal Interference and Launch Voltage that also gets as close as possible to the desired eye width. Random Jitter and Sinusoidal Jitter are fixed to the values, used in Stressed Voltage Calibration.

Connection Setup for Stressed Voltage Test

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

- Enable Impairments for Loopback Training
- Eye-Height
- Eye-Width
- Random Jitter: The amount of RJ added to the signal. It cannot
- be changed; it is fixed to the value used in the Stressed Voltage
- Calibration. To change it is necessary to repeat that calibration.
- Sinusoidal Jitter: The amount of SJ added to the signal. It cannot
- e changed; it is fixed to the value used in the Stressed Voltage
- Calibration. To change it is necessary to repeat that calibration.
- Sinusoidal Jitter Frequency
- Differential Mode Sinusoidal Interference: The amount of DMSI
- added to the signal to obtain the desired eye.
- Generator Launch Voltage: Launch Voltage used to obtain the
- desired eye.
- Common Mode Sinusoidal Interference
- BER Mode
- Target BER.
- Confidence Level
- BER Measurement Duration
- Allowed Bit Error

For details, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Voltage Calibration

Procedure Report

An example of HTML worksheet for Stressed Voltage Test procedure is shown in Figure 84.

L0_Rx_8GTps_ShCh_Stress_Volt

for PCIe 3.0 EndPoint ASIC

Random Jitter	16 mUI
Sinusoidal Jitter	100 mUI
Differential Mode Sinusoidal Interference	50 mV
Generator Launch Voltage	800 mV
Offline	True
Enable Impairments for Loopback Training	True
Eye Height	50 mV
Eye Width	325 mUI
Sinusoidal Jitter Frequency	100 MHz
Common Mode Sinusoidal Interference	150 mV
BER Mode	FixedTime
BER Measurement Duration	375 s
Allowed Bit Error	1
Pre-Shoot	3.5 dB
De-Emphasis	-6 dB
Link Training Mode	JBERT Interactive Link Training
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrame\Settings\PCIe\TrainingScripts\Pcie3_8G_M8020A_ILT_Loopback.txt
Suppress Loopback Training Messages	False
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P4
Drop Link Method	JBERT LTSSM
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	1 s
Jitter Unit	UnitInterval
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	3

Result	Allowed Bit Errors []	Measured Bit Errors []
pass	1	0

Figure 84 Result Description of Stressed Voltage Test

- Column 1:
  - Result: The number of errors should be smaller than “Allowed Bit Error”.

- Column 2:
  - Received Bits: It is the number of bits received during the test.
- Column 3:
  - Bit Errors: It is the number of errors.

8G Rx Stressed Jitter Test

This procedure is only available if Gen3 spec is selected.

Purpose and Method

This test verifies that the receiver meets the eye width specification. Eye width is set to the minimum of the specification, which is 0.3UI, and the eye height must be between 25 and 35 mVpp. Eye width is generated by adding the combination of Random Jitter and Launch Voltage that also gets as close as possible to the desired eye height. Sinusoidal Jitter is fixed to the value used in Stressed Jitter Calibration.

Available for following hardware configurations

Only for Long Channel

Connection Setup for Stressed Jitter Test

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

- Enable Impairments for Loopback Training
- Eye-Height
- Eye-Width
- Random Jitter: The amount of RJ added to the signal that, in combination with the Launch Voltage, creates an eye with the desired eye width.
- Sinusoidal Jitter: The amount of SJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Jitter Calibration. To change it is necessary to repeat that calibration.
- Differential Mode Sinusoidal Interference: It is the amount of DMSI, added to the signal. It is fixed to 0V for this test and is a read-only parameter for reference only.
- Generator Launch Voltage: It is the Launch Voltage added to the signal that, in combination with the RJ, creates an eye with the desired eye width.
- Common Mode Sinusoidal Interference
- BER Mode
- Target BER.
- Confidence Level
- BER Measurement Duration
- Allowed Bit Error

For details, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Voltage Calibration

Procedure Report

The HTML worksheet for Stressed Jitter Test procedure is similar to Figure 84 on page -162.

8G Rx Sensitivity with Generator Launch Voltage Test

This procedure is only available if Gen3 spec is selected.

Purpose and Method

This test characterizes the minimum eye height at which the DUT passes the BER test. The method starts with “Start Eye Height” and decreases with steps of “Eye Height Step Size” until the number of bit errors is bigger than 0. The Eye height is generated by adjusting the Generator Launch Voltage. Differential Mode Sinusoidal Interference is fixed.

Connection Setup for Sensitivity with Generator Launch Voltage Test

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

1 Sensitivity Variation
   - Start Eye Height: The eye height where the test starts.
   - Stop Eye Height: The eye height where the test stops.
   - Eye Height Step Size: The amount the eye height is decreased by one step to search the “Min passed Eye Height”.
2 Parameter
   - Random Jitter: The amount of RJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Voltage Calibration. To change it is necessary to repeat that calibration.
   - Sinusoidal Jitter: The amount of SJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Voltage Calibration. To change it is necessary to repeat that calibration.
   - Sinusoidal Jitter Frequency
   - Differential Mode Sinusoidal Interference: The amount of DMSI added to the signal to achieve the desired eye height.
   - Common Mode Sinusoidal Interference
3 BER Measurement
   - BER Mode
   - Target BER
   - Confidence Level
   - BER Measurement Duration
   - Allowed Bit Error

For details refer to Table 6 on page 76.

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Voltage Calibration

Procedure Report

An example of HTML worksheet for Sensitivity with Generator Launch Voltage Test procedure is shown in Figure 84.

L0_Rx_8GTps_Sens_LVolt

for PCIe 3.0 EndPoint ASIC

Offline	True
Differential Mode Interference	14 mV
Start Eye Height	300 mV
Eye Height Step Size	20 mV
Sinusoidal Jitter Frequency	100 MHz
Common Mode Sinusoidal Interference	250 mV
BER Mode	TargetBer
Target BER	1E-9
Confidence Level	95 %
Pre-Shoot	0 dB
De-Emphasis	0 dB
Link Training Mode	JBERT Interactive Link Training
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrame\
Suppress Loopback Training Messages	False
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P4
Drop Link Method	JBERT LTSSM
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	1 s
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	3

Result	Min Passed Eye Height [mV]	Spec Limit [mV]	Margin [%]
pass	0.0	200.0	100.0

Figure 85 Result Description of Sensitivity with Generator Launch Voltage Test

- Column 1:
  - Result: Min Passed Eye Height should be smaller than the Spec Limit.
- Column 2:
  - Min Passed Eye Height: The smallest eye height at which the DUT passes the error test.

- Column 3:
  - Spec Limit [mV]: The smallest eye height at which the DUT has to pass the error test to meet the specifications.
- Column 4:
  - Margin [%]: It is the margin between the min eye height passed and the minimum spec value.

8G Rx Sensitivity with Differential Mode Interference Test

This procedure is only available if Gen3 spec is selected.

Purpose and Method

This test characterizes the minimum eye height at which the DUT passes the BER test. The method starts with “Start Eye Height” and decreases with steps of “Eye Height Step Size” until the number of bit errors is bigger than 0. The Eye height is generated by adjusting the Differential Mode Sinusoidal Interference. Generator Launch Voltage is fixed.

Connection Setup for Sensitivity with Differential Mode Interference Test

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

1 Sensitivity Variation
   - Start Eye Height: The eye height where the test starts.
   - Stop Eye Height: The eye height where the test stops.
   - Eye Height Step Size: The amount the eye height is decreased by one step to search the “Min passed Eye Height”.
2 Parameter
   - Random Jitter: The amount of RJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Voltage Calibration. To change it is necessary to repeat that calibration.
   - Sinusoidal Jitter: The amount of SJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Voltage Calibration. To change it is necessary to repeat that calibration.
   - Sinusoidal Jitter Frequency
   - Generator Launch Voltage: Launch Voltage used to obtain the desired eye height.
   - Common Mode Sinusoidal Interference
3 BER Measurement
   - BER Mode
   - Target BER
   - Confidence Level
   - BER Measurement Duration
   - Allowed Bit Error

For details refer to Table 6 on page 76.

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Voltage Calibration

Procedure Report

The HTML worksheet for Sensitivity with Differential Mode Interference Test procedure is similar to Figure on page -177.

8G Rx Stressed Jitter Eye Test

This procedure is only available if Gen4 spec is selected.

Purpose and Method

This test verifies that the receiver meets the eye width specification. Eye width is set to the minimum of the specification, which is 37.5ps, 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. Sinusoidal Jitter and Launch Voltage is fixed to the value used in Stressed Jitter Eye Calibration.

This procedure is only available for spec. version 4.0.

Available for following hardware configurations

Only for Long Channel

Connection Setup for Stressed Jitter Test

Same as Connection Setup for EQ Coefficient Matrix Scan on page 162.

Parameters in Expert Mode

- Enable Impairments for Loopback Training
- Eye-Width
- Eye-Height
- Random Jitter: The amount of RJ added to the signal that, in combination with the DMSI; generates an eye with the desired eye width.
- Sinusoidal Jitter: The amount of SJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Jitter Eye Calibration. To change it is necessary to repeat that calibration.
- Differential Mode Sinusoidal Interference: It is the amount of DMSI added to the signal that, in combination with the RJ, creates an eye with the desired eye width.
- Generator Launch Voltage: It is the Launch Voltage added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Jitter Eye Calibration.
- Common Mode Sinusoidal Interference
- BER Mode
- BER Measurement Duration
- Allowed Bit Error
- Target BER

- Confidence Level

For details, refer to Table 6 on page 76.

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Jitter Eye Calibration

Procedure Report

The HTML worksheet for Stressed Jitter Eye Test procedure is similar to Figure 84 on page -162

8G Rx Jitter Tolerance Test

Purpose and Method

Same as for 2.5GT/s ASIC procedure. For details refer to 2.5G/5G Rx Jitter Tolerance Test on page 100.

Connection Setup for Jitter Tolerance Test

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

- Sinusoidal Jitter Variation
  - Frequency Mode
  - Frequency Scale
  - Start Frequency
  - Stop Frequency
  - Frequency Steps
  - Frequency Points
  - Search algorithm
  - Jitter Step Size
  - Jitter Step Factor
  - Jitter Start Value
  - Show Min Failed Points
- Parameter
  - Use Compliance ImpairmentsGenerator Launch Voltage
  - Differential Mode Sinusoidal Interference
  - Random Jitter
  - Common Mode Sinusoidal Interference
  - Force retraining on each frequency
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error

For details, refer to Table 6 on page 76.

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Voltage Calibration

Procedure Report

The HTML worksheet for Jitter Tolerance Test procedure is similar to Result Description of Jitter Tolerance Test on page 103.

Link Equalization Receiver Tests

To access the link equalization tests, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Rx Test Parameters

Data Rate Specific

1. Loopback Training
   - Interactive Training Script File
   - Suppress Loopback Training Messages
   - Use Custom Training Voltage
2. Interactive Link Training
   - Generator Start Preset
   - DUT Initial Preset
   - DUT Target Preset
   - Drop Link Method

For details, refer to Table 4 on page 72.

8G LEQ Rx Stressed Voltage Test

This procedure is only available if Gen3 spec is selected.

Purpose and Method

This tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Stressed Voltage Rx Test (for details, refer to 8G Rx Stressed Voltage Test on page 160).

8G LEQ Rx Stressed Jitter Test

This procedure is available only if Gen3 spec is selected.

Purpose and Method

This tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Stressed Jitter Rx Test (for details, refer to 8G Rx Stressed Jitter Test on page 164).

8G LEQ Rx Sensitivity with Generator Launch Voltage Test

This procedure is only available if Gen3 spec is selected.

Purpose and Method

This test uses the interactive link training feature of the JBERT_M8020A which allows the DUT to negotiate the generator transmitter preset.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Sensitivity with Generator Launch Voltage Rx Test (for details, refer to 8G Rx Sensitivity with Generator Launch Voltage Test on page 166).

8G LEQ Rx Sensitivity with Differential Mode Interference Test

Purpose and Method

This test uses the interactive link training feature of the M8020A JBERT which allows the DUT to negotiate the generator transmitter preset.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Sensitivity with Differential Interference Mode Rx Test (for details, refer to 8G Rx Sensitivity with Differential Mode Interference Test on page 170).

8G LEQ Rx Stressed Jitter Eye Test

This procedure is only available if Gen4 spec is selected.

Purpose and Method

This tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Stressed Jitter Eye Test (for details, refer to 8G Rx Stressed Jitter Eye Test on page 172).

8G LEQ Rx Jitter Tolerance Test

Purpose and Method

This tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Receiver Jitter Tolerance (for details, refer to 8G Rx Jitter Tolerance Test on page 174).

Link Equalization Transmitter Tests

In order to have access to the link equalization tests, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Tx Test Parameters

Link Equalization Tx

1 Generator Output Voltage Compensation
2 Scope Connection channels for Link EQ Tx Tests
3 Skip BER Check

Data Rate Specific

1 Loopback Training
   - Link EQ Transmitter Test Script File
   - Generator Start Preset
2 Error Detector
   - Sensitivity Mode

For details, refer to Table 4 on page 72.

NOTE

Lane 0 is the only available lane for Link Equalization Tests.

8G LEQ Tx Initial Preset Compliance Test

Purpose and Method

This test is valid for End Point DUTs (or addInCards or devices) only. It uses the interactive link training feature of the JBERT_M8020A. The JBERT_M8020A 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 JBERT_M8020A or not.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Initial Preset Test

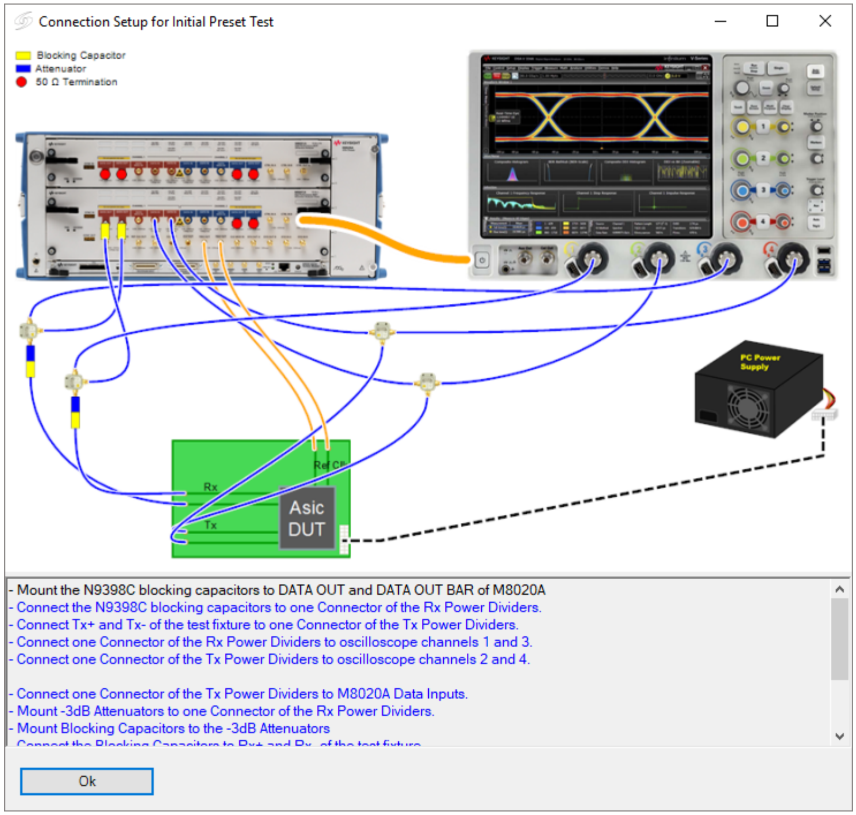


Figure 86 Connection Setup for Initial Preset Test

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Initial Preset Test procedure is shown in Figure 87.

L0_EqTx_8GTps_IniPreset

for PCIe 3.0 EndPoint ASIC

Offline	True
Link EQ Tx Test Script File	C:\ProgramData\BitifEye\ValiFrame\Settings\PCIe\TrainingScripts\Pcie3_8G_M8020A_EqTx_Loopback.txt
Suppress Loopback Training Messages	False
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Capture and Compare Mode	False
Pause before Auto-Align	False
Sensitivity	Normal
Polarity	Normal
EQ Preset Measurement	SigTest
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	3

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	0.00	0.00	0.00	-6.00	-7.50	-4.50	
pass	P1	0.00	0.00	0.00	-3.50	-4.50	-2.50	
pass	P2	0.00	0.00	0.00	-4.40	-5.90	-2.90	
pass	P3	0.00	0.00	0.00	-2.50	-3.50	-1.50	
pass	P4	0.00	0.00	0.00	0.00	0.00	0.00	
pass	P5	1.90	0.90	2.90	0.00	0.00	0.00	
pass	P6	2.50	1.50	3.50	0.00	0.00	0.00	
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	0.00	0.00	0.00	

Figure 87 Result Description of Initial Preset Test

- Column1:
  - Result: The measured Pre-Shoot and De-Emphasis must be within the specification limits.
- Column 2:
  - DUT Initial Preset: Set by the JBERT_M8020A
- Column 3:
  - Pre-Shoot [dB]: Measured Pre-Shoot on the DUT waveform.
- Column 4:
  - Min Spec PS [dB]: Pre-Shoot lower specification limit.
- Column 5:
  - Max Spec PS [dB]: Pre-Shoot upper specification limit.
- Column 6:
  - De-Emphasis [dB]: Measured De-Emphasis on the DUT waveform.
- Column 7:
  - Min Spec DE [dB]: De-Emphasis lower specification limit.

- Column 8:
  - Max Spec DE [dB]: De-Emphasis upper specification limit.
- Column 9:
  - Comment: A comment can be added to each test step if fails, explaining the reason.

8G LEQ Tx Response Time Compliance Test

Purpose and Method

These test uses the interactive link training feature of the JBERT_M8020A 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 rises an event which is used to capture the waveforms of the JBERT_M8020A and the DUT. At that moment, the captured waveform from the JBERT_M8020A contains the preset change request and the waveform from the DUT contains the acknowledgment of that request. Additionally, 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-spans are calculated: one between the request and the acknowledgment, and other between the request and the electrical transition.

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

The test is divided in two parts. In the first part, the JBERT_M8020A requests for transmitter presets. In the second part, the JBERT_M8020A requests the pre-cursor, cursor and post-cursor reported by the DUT.

For End Point DUTs, (or AddInCards or devices)the initial transmitter preset is set by the JBERT_M8020A. For Root Complex DUT (or Systems or Hosts), the user has to manually set the DUT initial transmitter preset.

Available for following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for Response Time Test

Same as **Connection Setup for Initial Preset Test** on page 181.

Parameters in Expert Mode

- Max Number of Retries: If the acquired data cannot be decoded, the link training can be repeated to get new data.
- Scope visible range: Waveform range, used at the moment when the link equalization phase is performed.

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Response Time Test procedure is shown in Figure 84.

L0_EqTx_8GTps_RespTime

for PCIe 3.0 EndPoint ASIC

Offline	True
Max Number of Retries	1
Scope Visible Range	10 us
Link EQ Tx Test Script File	C:\ProgramData\BitifEye\ValiFrame\Settings\PCIe\TrainingScripts\Pcie3_8G_M8020A_EqTx_Loopback.txt
Suppress Loopback Training Messages	False
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Capture and Compare Mode	False
Pause before Auto-Align	False
Sensitivity	Normal
Polarity	Normal
EQ Preset Measurement	SigTest
Use Power Switch Automation	False

Result	DUT Target Preset	Electrical response time [ns]	Protocol 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	176.00	0.00	0.00	0.00	-6.00	-7.50	-4.50	DUT reported cursors: (0, 0, 0)
pass	P1	100.00	176.00	0.00	0.00	0.00	-3.50	-4.50	-2.50	DUT reported cursors: (0, 0, 0)
pass	P2	100.00	176.00	0.00	0.00	0.00	-4.40	-5.90	-2.90	DUT reported cursors: (0, 0, 0)
pass	P3	100.00	176.00	0.00	0.00	0.00	-2.50	-3.50	-1.50	DUT reported cursors: (0, 0, 0)
pass	P4	100.00	176.00	0.00	0.00	0.00	0.00	0.00	0.00	DUT reported cursors: (0, 0, 0)
pass	P5	100.00	176.00	1.90	0.90	2.90	0.00	0.00	0.00	DUT reported cursors: (0, 0, 0)
pass	P6	100.00	176.00	2.50	1.50	3.50	0.00	0.00	0.00	DUT reported cursors: (0, 0, 0)
pass	P7	100.00	176.00	3.50	2.50	4.50	-6.00	-7.50	-4.50	DUT reported cursors: (0, 0, 0)
pass	P8	100.00	176.00	3.50	2.50	4.50	-3.50	-4.50	-2.50	DUT reported cursors: (0, 0, 0)
pass	P9	100.00	176.00	3.50	2.50	4.50	0.00	0.00	0.00	DUT reported cursors: (0, 0, 0)

Figure 88 Result Description of Response Time Test

- Column1:
  - Result: Max passed Jitter should be bigger than Min Spec.
- Column 2:
  - DUT Target Preset: It is the transmitter preset that is requested to the DUT at each step.
- Column 3:
  - Electrical response time [ns]: calculated timespan between the request from the M8020A JBERT and the physical preset transition on the DUT waveform.
- Column 4:
  - Protocol response time [ns]: calculated timespan between the request from the M8020A JBERT and the acknowledgement.
- Column 5:
  - Pre-Shoot [dB]: Measured Pre-Shoot on the DUT waveform.
- Column 6:
  - Min Spec ps [dB]: Pre-Shoot lower specification limit.

- Column 7:
  - Max Spec ps [dB]: Pre-Shoot upper specification limit.
- Column 8:
  - De-Emphasis [dB]: Measured De-Emphasis on the DUT waveform.
- Column 9:
  - Min Spec DE[dB]:De-Emphasis lower specification limit.
- Column 10:
  - Max Spec DE[dB]:De-Emphasis upper specification limit.
- Column 11:
  - Comment: A comment can be added to each test step.

Receiver Setup (Only for Debugging)

Common Parameters

Channel Specific

- Pre Shoot
- De Emphasis

For details, refer to Table 4 on page 72.

8G Rx Stressed Voltage Setup

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Stressed Voltage Rx test using the calibration data saved on the PC where ValiFrame is running. The method begins like Rx Stressed Voltage test but then the test will not run, it only leaves the setup prepared. The set parameters are the differential amplitude, random jitter, sinusoidal jitter, common mode sinusoidal interference jitter and differential mode sinusoidal interference. The differential amplitude and the DMSI are defined by the eye height and width desired using the stressed voltage calibration.

Connection Diagram

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

- Eye-Height
- Eye-Width
- Random Jitter: The amount of RJ added to the signal. It cannot be changed; it is fixed to the value used in the Stressed Voltage Calibration. To change it is necessary to repeat that calibration.
- Sinusoidal Jitter: The amount of SJ added to the signal. It cannot be changed; it is fixed to the value use in the Stressed Voltage Calibration. To change it is necessary to repeat that calibration.
- Sinusoidal Jitter Frequency
- Differential Mode Sinusoidal Interference: The amount of DMSI added to the signal to obtain the desired eye.
- Generator Launch Voltage: Launch Voltage used to obtain the desired eye.

- Common Mode Sinusoidal Interference

For details, refer to Table 6 on page 76.

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Voltage Calibration

Result Description

- None

8G Rx Stressed Jitter Setup

This procedure is only available if Gen3 spec is selected.

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Stressed Jitter Rx. This procedure is only available for Long Channel setup. The set parameters are the differential amplitude, random jitter, common mode sinusoidal interference jitter and differential mode sinusoidal interference.

Connection Setup for Stressed Jitter Rx Setup

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

- Eye-Height
- Eye-Width
- Common Mode Sinusoidal Interference

For details, refer to Table 6 on page 76.

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Jitter Calibration

Result Description

- None

8G Rx Stressed Voltage Characterization Setup

This procedure is only available if Gen3 spec is selected.

Purpose and Method

The purpose of this procedure is the same as the Stressed Voltage Rx Setup. The only difference is that in this case the user can directly select the generator launch voltage and the differential mode sinusoidal interference instead of the eye height and width.

Connection Set up for Stressed Voltage Characterization Rx Setup

Same as Connection Setup for EQ Coefficient Matrix Scan on page 149.

Parameters in Expert Mode

- Generator Voltage
- Random Jitter
- DMSI
- Sinusoidal Jitter
- Sinusoidal Jitter Frequency
- Common Mode Sinusoidal Interference

For details, refer to Table 6 on page 76

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Voltage Calibration

Result Description

- None

8G Rx Stressed Jitter Eye Setup

This procedure is only available if Gen4 spec is selected.

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Stressed Jitter Eye Rx. This procedure is only available for Long Channel setup. The set parameters are the differential amplitude, random jitter, common mode sinusoidal interference jitter and differential mode sinusoidal interference.

Connection Setup for Stressed Jitter Rx Setup

Same as Connection Setup for EQ Coefficient Matrix Scan on page 162.

Parameters in Expert Mode

- Eye-Height
- Eye-Width
- Common Mode Sinusoidal Interference

Used Calibrations

- Launch Voltage Calibration
- CM Optimization
- CM Sinusoidal Interference Calibration
- DM Sinusoidal Interference Calibration
- Random Jitter Calibration
- Insertion Loss Calibration
- Stressed Jitter Eye Calibration

For details refer to Table 6 on page 76.

Result Description

- None

6 16.0 GT/s ASIC Tests

Calibration

Common Calibration Parameters

- Calibration Specific
- Data Rate Specific
  - Scope Connection
  - Gen4 ASIC Fixtures
  - Gen4 ISI Adjustment
  - Gen4 ASIC Eye Calibration Method
  - Start Width Minimum Loss Channel
  - UXR Calibration Mode
  - Sampling Rate
  - Range to Signal Ratio

For details refer to Table 3 on page 69.

16G TxEq and Launch Voltage Calibration

Purpose and Method

This procedure calibrates the De-emphasis, Pre-shoot and DC amplitude at TP1. It uses the same method as for 8.0GT/s, for more details refer to TxEq and Launch Voltage Calibration.

The calibration data is stored in a caltable (Pci4_Vdiff.txt, Pci4_DeEmphasis.txt, Pci4_PreShoot.txt). For the measurements these calibration tables will be used to adjust the differential voltage amplitude to the desired output value.

Available for the following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for TxEq and Launch Voltage Calibration

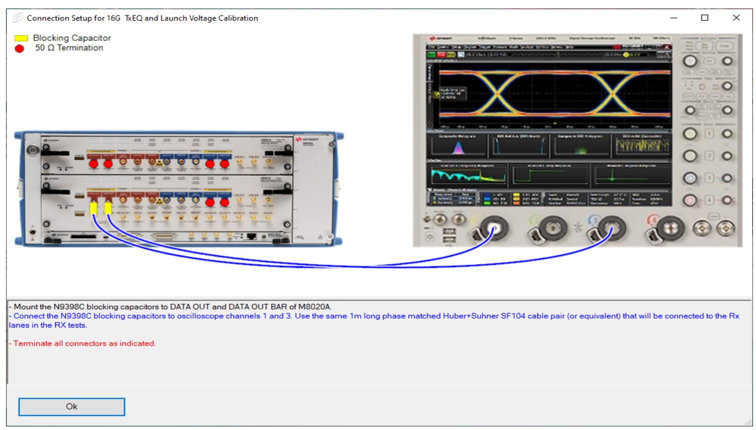


Figure 89 Connection setup with JBERT_M8020A Without Channel

Parameters in Expert Mode

- TXEQ and Launch Voltage Calibration
  - EQ Calibration Pattern
  - Verification Mode
- Generator
  - Set Amplitude
- Oscilloscope

- Scope Bandwidth
- Number of Waveform Averages

For details, refer to Table 5 on page 74.

Used Calibrations

- None

Procedure Report

Examples of HTML worksheet for TxEq and Launch Voltage Calibration procedure are shown in Figure 60, Figure 61 and Figure 62.

16G RJ Calibration

Purpose and Method

In the Rx tests the input signal will be stressed with a combination of jitter sources to simulate the possible impairments 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, so the jitter amplitude is calibrated.

The test automation starts with small RJ amplitudes and increases until 4ps. It measures the corresponding random jitter for every set amplitude. For this purpose either the EasyJit+ or the SigTest application running on the real time scope is used.

The calibration data is stored in a caltable (Pci4_< calMethod >_RandomJitter.txt). For the measurements these calibration tables will be used to adjust the RJ amplitude to the desired output RJ amplitudes.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Random Jitter Calibration

Same as Connection Setup for TxEq and Launch Voltage Calibration on page 195.

Parameters in Expert Mode

- Random Jitter Calibration
  - Verification Mode: I.
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs

Used Calibrations

- None

Procedure Report

The HTML worksheet for Random Jitter Calibration procedure is similar to Figure 63.

16G LF SJ Calibration

Purpose and Method

This procedure calibrates the sinusoidal jitter amplitude for a set of low frequencies (200KMHz, 500KHz, 1MHz, 2MHz and 4MHz). The test automation starts with small SJ amplitude and increases that value with 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 caltable (Pci4_<calMethod>_LfSinusoidalJitter.txt). For the measurements these calibration tables will be used to adjust the SJ amplitude to the desired output SJ amplitudes.

Available for following hardware configurations

Data Generator: JBERT_M8020A (only is available when SigTest is selected as Eye Calibration Method)

Connection Setup for LF Sinusoidal Jitter Calibration

Same as Connection Setup for TxEq and Launch Voltage Calibration on page 195.

Parameters in Expert Mode

- LF Sinusoidal Jitter Calibration
  - Verification Mode
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs

For details, refer to Table 5 on page 74.

Used Calibrations

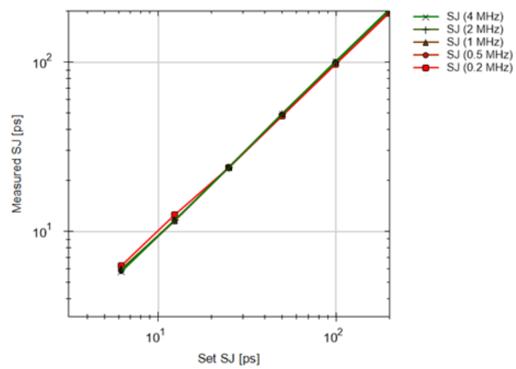
- None

Procedure Report

An example of HTML worksheet for LF Sinusoidal Jitter Calibration procedure is shown in Figure 90.

L0_Cal_16GTps_LFSJ

for PCIe 4.0 EndPoint ASIC



SigTest Version	4.0.29
BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Scope Bandwidth	25 GHz
Number of Averages	3
Pre-Shoot	0 dB
De-Emphasis	0 dB
Generator Voltage	800 mV
Number of UIs	1.6 MUI
Verification Mode	False
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Emulated ISI
Eye Calibration Method	SigTest
Gen4 Do Channel Calibration	False
Gen4 Eye Calibration Method	SigTest

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	5.80	6.00	5.93	5.73
12.50	12.50	11.47	11.52	11.61	11.63
25.00	23.59	23.89	23.76	23.63	23.74
50.00	47.83	49.03	49.14	49.10	49.30
100.00	96.77	99.29	99.86	99.59	100.43
200.00	193.18	199.51	199.53	200.58	202.68

Figure 90 Result Description of LF Sinusoidal Jitter Calibration

- Column 1:
  - Set SJ [ps]: The sinusoidal jitter amplitude set in the instrument.
- Column 2:
  - SJ (x frequency) [ps]: The measured jitter amplitude at x frequency.

16G HF SJ Calibration

Purpose and Method

This procedure calibrates the sinusoidal jitter amplitude at three different high frequencies (5 MHz, 10MHz and 100 MHz). The test automation starts with 0 ps of SJ and increases that value in linear steps. For each step, the procedure measures the actual amplitude for all the frequencies.

The calibration data is stored in a caltable (Pci4_<calMethod>_HfSinusoidalJitter.txt). For the measurements these calibration tables will be used to adjust the SJ amplitude to the desired output SJ amplitudes.

Available for following hardware configurations:

Data Generator: JBERT_M8020A

Connection Setup for HF Sinusoidal Jitter Calibration

Same as Connection Setup for TxEq and Launch Voltage Calibration on page 195.

Parameters in Expert Mode

- HF Sinusoidal Jitter Calibration
  - Verification Mode
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs

For details, refer to Table 5 on page 74.

Used Calibrations

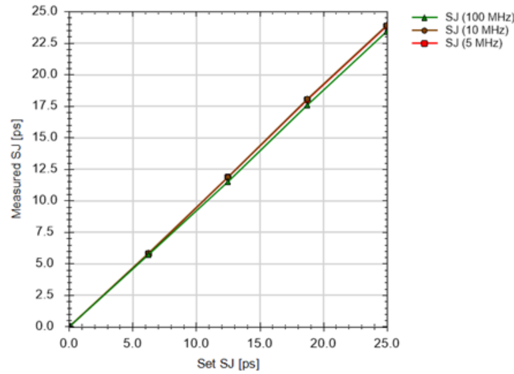
- None

Procedure Report

An example of HTML worksheet for HF Sinusoidal Jitter Calibration procedure is shown in Figure 91.

L0_Cal_16GTps_HFSJ

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Scope Bandwidth	25 GHz
Number of Averages	3
Pre-Shoot	0 dB
De-Emphasis	0 dB
Generator Voltage	800 mV
Number of UIs	1.6 MUI
Verification Mode	False
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	Generic
Gen4 ISI Adjustment	Emulated ISI
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	False

Set SJ [ps]	SJ (5 MHz) [ps]	SJ (10 MHz) [ps]	SJ (100 MHz) [ps]
0.00	0.00	0.00	0.00
6.25	5.80	5.81	5.69
12.50	11.85	11.86	11.52
18.75	18.00	18.03	17.60
25.00	23.83	23.89	23.44

Figure 91 Result Description of HF Sinusoidal Jitter Calibration

- Column 1:
  - Set SJ [ps]: The sinusoidal jitter amplitude set in the instrument.
- Column 2:
  - SJ (x frequency) [ps]: The measured jitter amplitude at x frequency.

16G Unit Interval Calibration

Purpose and Method

This procedure is only required when the SigTest software is used. It 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 measure with the oscilloscope.

The calibration data is stored in a caltable (Pci4_UnitInteval.txt). This calibration table will be used to help measuring eye height and eye width with SigTest.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Unit Interval Calibration

Same as Connection Setup for TxEq and Launch Voltage Calibration on page 195.

Parameters in Expert Mode

- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs

For details, refer to Table 5 on page 74.

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Unit Interval Calibration procedure is shown in Figure 92.

L0_Cal_16GTps_UI

for PCIe 4.0 EndPoint ASIC

SigTest Version	4.0.29
BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Scope Bandwidth	25 GHz
Number of Averages	4
Pre-Shoot	3.5 dB
De-Emphasis	0 dB
Generator Voltage	800 mV
Number of UIs	1.6 MUI
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	SigTest
Gen4 Do Channel Calibration	True

Mean Unit Interval [ps]
62.500215312

Figure 92 Result Description of Unit Interval Calibration

- Column 1:
  - Mean Unit Interval [ps]: It is the unit interval measured.

16G TxEq and Launch Voltage Measurement

Purpose and Method

This procedure sets the calibrated Differential Voltage, Pre-Shoot and De-Emphasis values at TP1 and re-measure it. The measurement can be repeated as many times as a new impairment combination is selected

The procedure is useful to check if the TxEq and Launch Voltage Calibration is correct and the desired values at TP1 can be achieved.

It is only available for **Expert Mode** when the **Include Advanced Measurement** option is selected. For setting the option, refer to section For Rx 16GT/s on page 49 of Chapter 2, N5990A PCIe Station.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Diagram

Same as Connection Setup for TxEq and Launch Voltage Calibration on page 195.

Parameters in Expert Mode

- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages

For details, refer to Table 5 on page 74.

Used Calibrations

- None

Procedure Report

An examples of HTML worksheet for TxEq and Launch Voltage Measurement procedure is shown in Figure 93.

L0_Meas_16GTps_EQ_Vdiff

for PCIe 4.0 EndPoint ASIC

BERT System	Keysight M8020A J-BERT, M8020A J-BERT
Generator Channel Channel	M1.DataOut1
Offline	True
Scope Bandwidth	32 GHz
Number of Averages	128
Pre-Shoot	3.5 dB
De-Emphasis	0 dB
Generator Voltage	800 mV
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	Generic
Gen4 ISI Adjustment	Emulated ISI
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True

Pre-Shoot [dB]	De-Emphasis [dB]	Generator Voltage [mV]	Measured Pre-Shoot [dB]	Measured De-Emphasis [dB]	Measured Differential Voltage [mV]
3.50	0.00	800	NaN	NaN	0
4.00	-5.00	800	NaN	NaN	0
5.00	-5.00	800	NaN	NaN	0

Figure 93 Result Description of TxEq and Launch Voltage Measurement

- Column1:
  - Pre-Shoot [dB]: The pre-shoot value set at the signal generator.
- Column 2:
  - De-Emphasis [dB]: The de-emphasis value set at the signal generator.
- Column 3:
  - Generator Voltage [mV]: The generator voltage value set at the signal generator.
- Column 4:
  - Measured Pre-Shoot [dB]: The pre-shoot measured with the scope.
- Column 5:
  - Measured De-Emphasis [dB]: The de-emphasis measured with the scope.
- Column 6:
  - Measured Differential Voltage [dB]: The generator measured with the scope.

16G Insertion Loss Calibration

Purpose and Method

The Insertion Loss of the calibration channels + the replica channel has to be in a well defined range.

If the "Measurement Method" parameter is set to Step Response, 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 1GHz to 8GHz with steps of 100MHz. The IL is measured using the Seasim software.

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 -27, -28 and -30dB respectively . In this case, the var ISI pair number for the certain channels 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 1GHz to 8GHz with steps of 100MHz

NOTE At 8GHz is applied a compensation of -1.0dB because of the 1m SMA cable connected to the generator. This cable counts per CTS to total channel loss but the calibration reference point is after that cable. Therefore the cable is not included in the step rep IL measurement and its insertion loss needs to be added after the measurement.

The calibration data is stored in a caltable (Pcie4_Asic_<DUT Type>_<FixtureType>_InsertionLoss). This cal data is used to evaluate the optimum ISI trace for the Rx tests.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Insertion Loss Calibration

If the Measurement Method is set as Step Response, then the following connection setup will be required. At each step, the software will ask to increase the hardware trace.

If VNA Method is set, no connections are needed.

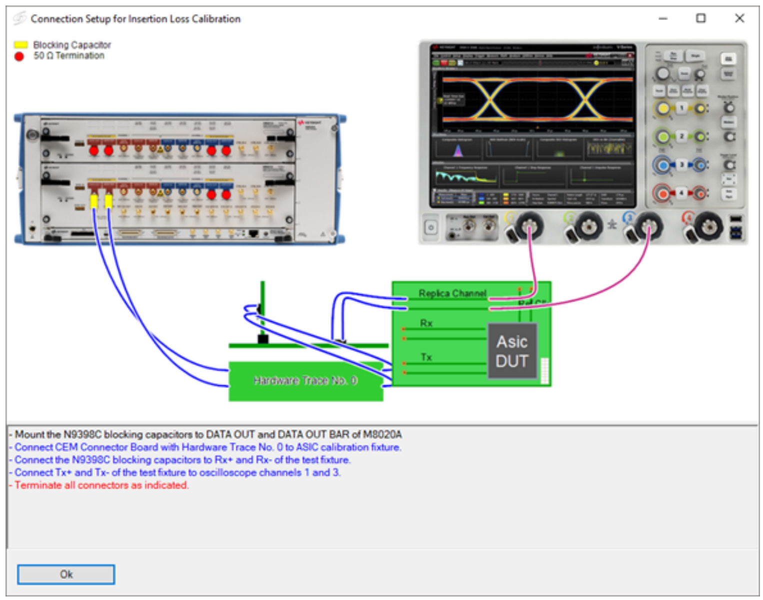


Figure 94 Connection Setup for Insertion Loss Calibration with JBERT_M8020A-Long channel (Generic Fixture)

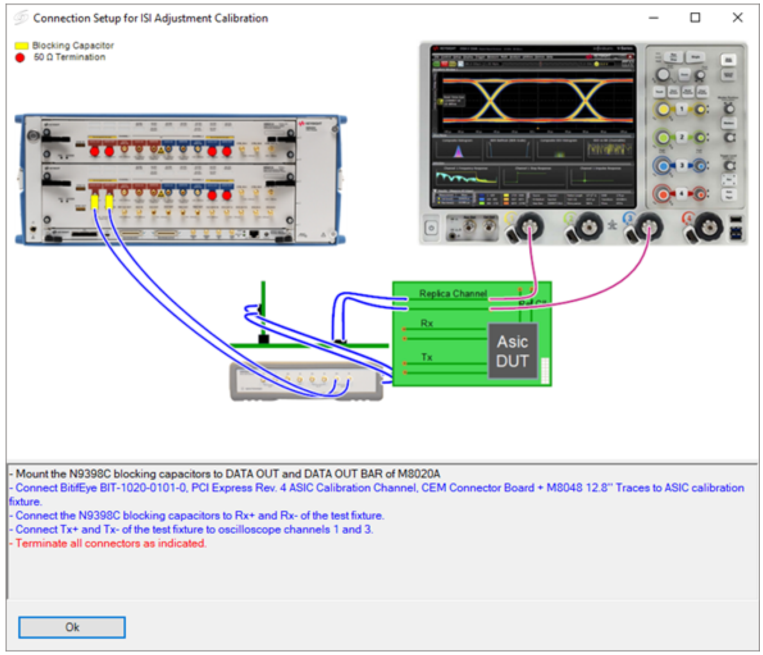


Figure 95 Connection Setup for Insertion Loss Calibration with JBERT_M8020A-Long channel (BIT CEM connector + M8048A)

Parameters in Expert Mode

- Insertion Loss Calibration
  - Automatic Trace Selection
  - Trace Loss Increment
  - Trace Number Start Value
  - Trace Number Stop Value
  - Save Calibration Data: Set to true to save the results in a cal table.
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of Waveform Averages

Used Calibrations

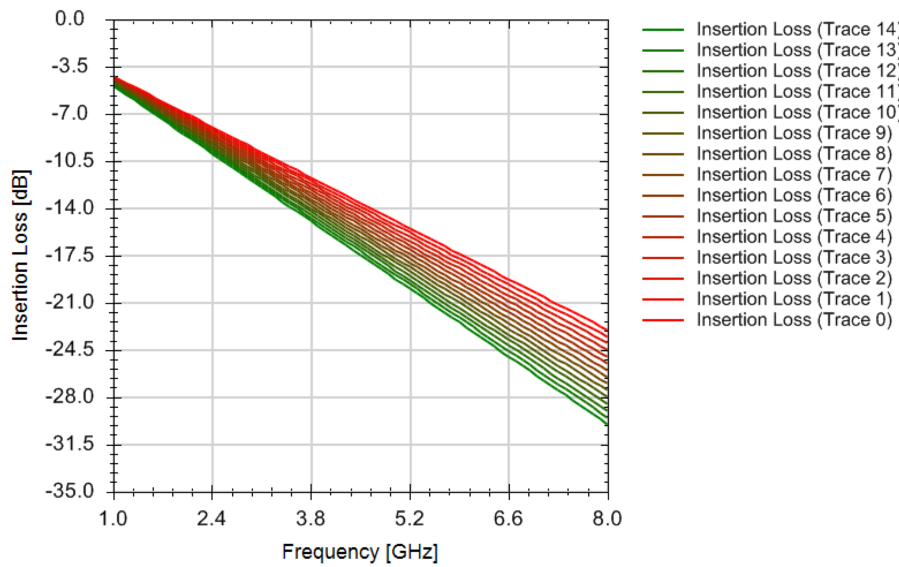
- TxEq and Launch Voltage Calibration

Procedure Report

An examples of HTML worksheet for Insertion Loss Calibration procedure is shown in Figure 96.

L0_Cal_16GTps_IL

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Switch Channel	1
Offline	True
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Automatic Trace Selection	True
Trace Loss Increment	-0.5 dB
Trace Number Start Value	0
Trace Number Stop Value	15
Save Calibration Data	True
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	Generic
Gen4 ISI Adjustment	Emulated ISI
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	False

Frequency [GHz]	Insertion Loss (Trace 0) [dB]	Insertion Loss (Trace 1) [dB]	Insertion Loss (Trace 2) [dB]	Insertion Loss (Trace 3) [dB]	Insertion Loss (Trace 4) [dB]	Insertion Loss (Trace 5) [dB]	Insertion Loss (Trace 6) [dB]	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]	Insertion Loss (Trace 12) [dB]	Insertion Loss (Trace 13) [dB]	Insertion Loss (Trace 14) [dB]
1.00	-4.20	-4.25	-4.30	-4.35	-4.40	-4.45	-4.50	-4.55	-4.60	-4.65	-4.70	-4.75	-4.80	-4.85	-4.90
1.10	-4.47	-4.53	-4.58	-4.64	-4.69	-4.75	-4.81	-4.86	-4.92	-4.98	-5.03	-5.09	-5.15	-5.20	-5.26
1.20	-4.74	-4.80	-4.86	-4.93	-4.99	-5.05	-5.11	-5.18	-5.24	-5.30	-5.37	-5.43	-5.49	-5.55	-5.62
1.30	-5.01	-5.08	-5.14	-5.21	-5.28	-5.35	-5.42	-5.49	-5.56	-5.63	-5.70	-5.77	-5.84	-5.91	-5.98
1.40	-5.27	-5.35	-5.43	-5.50	-5.58	-5.65	-5.73	-5.80	-5.88	-5.96	-6.03	-6.11	-6.18	-6.26	-6.33
1.50	-5.54	-5.63	-5.71	-5.79	-5.87	-5.95	-6.04	-6.12	-6.20	-6.28	-6.36	-6.45	-6.53	-6.61	-6.69
1.60	-5.81	-5.90	-5.99	-6.08	-6.17	-6.25	-6.34	-6.43	-6.52	-6.61	-6.70	-6.79	-6.87	-6.96	-7.05
1.70	-6.08	-6.18	-6.27	-6.37	-6.46	-6.56	-6.65	-6.75	-6.84	-6.94	-7.03	-7.13	-7.22	-7.32	-7.41
1.80	-6.35	-6.45	-6.55	-6.65	-6.75	-6.86	-6.96	-7.06	-7.16	-7.26	-7.36	-7.46	-7.57	-7.67	-7.77
1.90	-6.62	-6.73	-6.83	-6.94	-7.05	-7.16	-7.26	-7.37	-7.48	-7.59	-7.70	-7.80	-7.91	-8.02	-8.13
2.00	-6.89	-7.00	-7.11	-7.23	-7.34	-7.46	-7.57	-7.69	-7.80	-7.91	-8.03	-8.14	-8.26	-8.37	-8.49
2.10	-7.15	-7.28	-7.40	-7.52	-7.64	-7.76	-7.88	-8.00	-8.12	-8.24	-8.36	-8.48	-8.60	-8.72	-8.84
2.20	-7.42	-7.55	-7.68	-7.80	-7.93	-8.06	-8.19	-8.31	-8.44	-8.57	-8.69	-8.82	-8.95	-9.08	-9.20
2.30	-7.69	-7.83	-7.96	-8.09	-8.23	-8.36	-8.49	-8.63	-8.76	-8.89	-9.03	-9.16	-9.29	-9.43	-9.56
2.40	-7.96	-8.10	-8.24	-8.38	-8.52	-8.66	-8.80	-8.94	-9.08	-9.22	-9.36	-9.50	-9.64	-9.78	-9.92
2.50	-8.23	-8.38	-8.52	-8.67	-8.81	-8.96	-9.11	-9.25	-9.40	-9.55	-9.69	-9.84	-9.99	-10.13	-10.28
2.60	-8.50	-8.65	-8.80	-8.96	-9.11	-9.26	-9.41	-9.57	-9.72	-9.87	-10.03	-10.18	-10.33	-10.48	-10.64
2.70	-8.77	-8.93	-9.08	-9.24	-9.40	-9.56	-9.72	-9.88	-10.04	-10.20	-10.36	-10.52	-10.68	-10.84	-11.00
2.80	-9.03	-9.20	-9.37	-9.53	-9.70	-9.86	-10.03	-10.19	-10.36	-10.53	-10.69	-10.86	-11.02	-11.19	-11.35
2.90	-9.30	-9.48	-9.65	-9.82	-9.99	-10.16	-10.34	-10.51	-10.68	-10.85	-11.02	-11.20	-11.37	-11.54	-11.71
3.00	-9.57	-9.75	-9.93	-10.11	-10.29	-10.46	-10.64	-10.82	-11.00	-11.18	-11.36	-11.54	-11.71	-11.89	-12.07
3.10	-9.84	-10.03	-10.21	-10.40	-10.58	-10.77	-10.95	-11.14	-11.32	-11.51	-11.69	-11.88	-12.06	-12.25	-12.43
3.20	-10.11	-10.30	-10.49	-10.68	-10.87	-11.07	-11.26	-11.45	-11.64	-11.83	-12.02	-12.21	-12.41	-12.60	-12.79
3.30	-10.38	-10.58	-10.77	-10.97	-11.17	-11.37	-11.56	-11.76	-11.96	-12.16	-12.36	-12.55	-12.75	-12.95	-13.15
3.40	-10.65	-10.85	-11.05	-11.26	-11.46	-11.67	-11.87	-12.08	-12.28	-12.48	-12.69	-12.89	-13.10	-13.30	-13.51
3.50	-10.91	-11.13	-11.34	-11.55	-11.76	-11.97	-12.18	-12.39	-12.60	-12.81	-13.02	-13.23	-13.44	-13.65	-13.86
3.60	-11.18	-11.40	-11.62	-11.83	-12.05	-12.27	-12.49	-12.70	-12.92	-13.14	-13.35	-13.57	-13.79	-14.01	-14.22
3.70	-11.45	-11.68	-11.90	-12.12	-12.35	-12.57	-12.79	-13.02	-13.24	-13.46	-13.69	-13.91	-14.13	-14.36	-14.58
3.80	-11.72	-11.95	-12.18	-12.41	-12.64	-12.87	-13.10	-13.33	-13.56	-13.79	-14.02	-14.25	-14.48	-14.71	-14.94
3.90	-11.99	-12.23	-12.46	-12.70	-12.93	-13.17	-13.41	-13.64	-13.88	-14.12	-14.35	-14.59	-14.83	-15.06	-15.30
4.00	-12.26	-12.50	-12.74	-12.99	-13.23	-13.47	-13.71	-13.96	-14.20	-14.44	-14.69	-14.93	-15.17	-15.41	-15.66
4.10	-12.53	-12.78	-13.02	-13.27	-13.52	-13.77	-14.02	-14.27	-14.52	-14.77	-15.02	-15.27	-15.52	-15.77	-16.02
4.20	-12.79	-13.05	-13.31	-13.56	-13.82	-14.07	-14.33	-14.58	-14.84	-15.10	-15.35	-15.61	-15.86	-16.12	-16.37
4.30	-13.06	-13.33	-13.59	-13.85	-14.11	-14.37	-14.64	-14.90	-15.16	-15.42	-15.68	-15.95	-16.21	-16.47	-16.73
4.40	-13.33	-13.60	-13.87	-14.14	-14.41	-14.67	-14.94	-15.21	-15.48	-15.75	-16.02	-16.29	-16.55	-16.82	-17.09
4.50	-13.60	-13.88	-14.15	-14.43	-14.70	-14.98	-15.25	-15.53	-15.80	-16.08	-16.35	-16.63	-16.90	-17.18	-17.45
4.60	-13.87	-14.15	-14.43	-14.71	-14.99	-15.28	-15.56	-15.84	-16.12	-16.40	-16.68	-16.96	-17.25	-17.53	-17.81
4.70	-14.14	-14.43	-14.71	-15.00	-15.29	-15.58	-15.86	-16.15	-16.44	-16.73	-17.02	-17.30	-17.59	-17.88	-18.17
4.80	-14.41	-14.70	-14.99	-15.29	-15.58	-15.88	-16.17	-16.47	-16.76	-17.05	-17.35	-17.64	-17.94	-18.23	-18.53
4.90	-14.67	-14.98	-15.28	-15.58	-15.88	-16.18	-16.48	-16.78	-17.08	-17.38	-17.68	-17.98	-18.28	-18.58	-18.88
5.00	-14.94	-15.25	-15.56	-15.86	-16.17	-16.48	-16.79	-17.09	-17.40	-17.71	-18.01	-18.32	-18.63	-18.94	-19.24
5.10	-15.21	-15.53	-15.84	-16.15	-16.47	-16.78	-17.09	-17.41	-17.72	-18.03	-18.35	-18.66	-18.97	-19.29	-19.60
5.20	-15.48	-15.80	-16.12	-16.44	-16.76	-17.08	-17.40	-17.72	-18.04	-18.36	-18.68	-19.00	-19.32	-19.64	-19.96
5.30	-15.75	-16.08	-16.40	-16.73	-17.05	-17.38	-17.71	-18.03	-18.36	-18.69	-19.01	-19.34	-19.67	-19.99	-20.32
5.40	-16.02	-16.35	-16.68	-17.02	-17.35	-17.68	-18.01	-18.35	-18.68	-19.01	-19.35	-19.68	-20.01	-20.34	-20.68
5.50	-16.29	-16.63	-16.96	-17.30	-17.64	-17.98	-18.32	-18.66	-19.00	-19.34	-19.68	-20.02	-20.36	-20.70	-21.04
5.60	-16.55	-16.90	-17.25	-17.59	-17.94	-18.28	-18.63	-18.97	-19.32	-19.67	-20.01	-20.36	-20.70	-21.05	-21.39
5.70	-16.82	-17.18	-17.53	-17.88	-18.23	-18.58	-18.94	-19.29	-19.64	-19.99	-20.34	-20.70	-21.05	-21.40	-21.75
5.80	-17.09	-17.45	-17.81	-18.17	-18.53	-18.88	-19.24	-19.60	-19.96	-20.32	-20.68	-21.04	-21.39	-21.75	-22.11
5.90	-17.36	-17.73	-18.09	-18.46	-18.82	-19.19	-19.55	-19.92	-20.28	-20.65	-21.01	-21.38	-21.74	-22.11	-22.47
6.00	-17.63	-18.00	-18.37	-18.74	-19.11	-19.49	-19.86	-20.23	-20.60	-20.97	-21.34	-21.71	-22.09	-22.46	-22.83
6.10	-17.90	-18.28	-18.65	-19.03	-19.41	-19.79	-20.16	-20.54	-20.92	-21.30	-21.68	-22.05	-22.43	-22.81	-23.19
6.20	-18.17	-18.55	-18.93	-19.32	-19.70	-20.09	-20.47	-20.86	-21.24	-21.62	-22.01	-22.39	-22.78	-23.16	-23.55
6.30	-18.43	-18.83	-19.22	-19.61	-20.00	-20.39	-20.78	-21.17	-21.56	-21.95	-22.34	-22.73	-23.12	-23.51	-23.90
6.40	-18.70	-19.10	-19.50	-19.89	-20.29	-20.69	-21.09	-21.48	-21.88	-22.28	-22.67	-23.07	-23.47	-23.87	-24.26
6.50	-18.97	-19.38	-19.78	-20.18	-20.59	-20.99	-21.39	-21.80	-22.20	-22.60	-23.01	-23.41	-23.81	-24.22	-24.62
6.60	-19.24	-19.65	-20.06	-20.47	-20.88	-21.29	-21.70	-22.11	-22.52	-22.93	-23.34	-23.75	-24.16	-24.57	-24.98
6.70	-19.51	-19.93	-20.34	-20.76	-21.17	-21.59	-22.01	-22.42	-22.84	-23.26	-23.67	-24.09	-24.51	-24.92	-25.34
6.80	-19.78	-20.20	-20.62	-21.05	-21.47	-21.89	-22.31	-22.74	-23.16	-23.58	-24.01	-24.43	-24.85	-25.27	-25.70
6.90	-20.05	-20.48	-20.90	-21.33	-21.76	-22.19	-22.62	-23.05	-23.48	-23.91	-24.34	-24.77	-25.20	-25.63	-26.06
7.00	-20.31	-20.75	-21.19	-21.62	-22.06	-22.49	-22.93	-23.36	-23.80	-24.24	-24.67	-25.11	-25.54	-25.98	-26.41
7.10	-20.58	-21.03	-21.47	-21.91	-22.35	-22.79	-23.24	-23.68	-24.12	-24.56	-25.00	-25.45	-25.89	-26.33	-26.77
7.20	-20.85	-21.30	-21.75	-22.20	-22.65	-23.09	-23.54	-23.99	-24.44	-24.89	-25.34	-25.79	-26.23	-26.68	-27.13
7.30	-21.12	-21.58	-22.03	-22.49	-22.94	-23.40	-23.85	-24.31	-24.76	-25.22	-25.67	-26.13	-26.58	-27.04	-27.49
7.40	-21.39	-21.85	-22.31	-22.77	-23.23	-23.70	-24.16	-24.62	-25.08	-25.54	-26.00	-26.46	-26.93	-27.39	-27.85
7.50	-21.66	-22.13	-22.59	-23.06	-23.53	-24.00	-24.46	-24.93	-25.40	-25.87	-26.34	-26.80	-27.27	-27.74	-28.21
7.60	-21.93	-22.40	-22.87	-23.35	-23.82	-24.30	-24.77	-25.25	-25.72	-26.19	-26.67	-27.14	-27.62	-28.09	-28.57
7.70	-22.19	-22.68	-23.16	-23.64	-24.12	-24.60	-25.08	-25.56	-26.04	-26.52	-27.00	-27.48	-27.96	-28.44	-28.92
7.80	-22.46	-22.95	-23.44	-23.92	-24.41	-24.90	-25.39	-25.87	-26.36	-26.85	-27.33	-27.82	-28.31	-28.80	-29.28
7.90	-22.73	-23.23	-23.72	-24.21	-24.71	-25.20	-25.69	-26.19	-26.68	-27.17	-27.67	-28.16	-28.65	-29.15	-29.64
8.00	-23.00	-23.50	-24.00	-24.50	-25.00	-25.50	-26.00	-26.50	-27.00	-27.50	-28.00	-28.50	-29.00	-29.50	-30.00

Figure 96 Result Description of Insertion Loss Calibration

- Column 1:
  - Frequency [GHz]: It is the frequency at which the insertion loss is measured.
- Column 2:
  - Insertion Loss (Trace X) [dB]: Insertion loss measured at each frequency when Trace X is selected.

16G ISI Adjustment Calibration

Purpose and Method

If the M8020A internal ISI feature is available, the emulated ISI can be combined with the hardware traces to adjust the desired insertion loss. The test automation calibrates several internal traces given by the parameters “ISI M8020A Start Value” and “ISI M8020A Stop Value”.

For every M8020A ISI trace the insertion loss is measured from 1GHz to 8GHz with steps of 100MHz. The IL is measured using the Seasim software.

The calibration data is stored in a caltable (Pcie4_Asic_<DUT Type>_<FixtureType>_ISIAdjustment). This cal data is used to evaluate the optimum ISI trace for the Rx tests.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for ISI Adjustment Calibration

Same as Connection Setup for Insertion Loss Calibration on page 208.

Parameters in Expert Mode

- Insertion Loss Calibration
  - ISI form M8020A Start Value: The minimum trace number that is calibrated.
  - ISI form M8020A Stop Value: The maximum trace number that is calibrated.
  - Trace Number
  - Save Calibration Data
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of Waveform Averages

For details, refer to Table 5 on page 74.

Used Calibrations

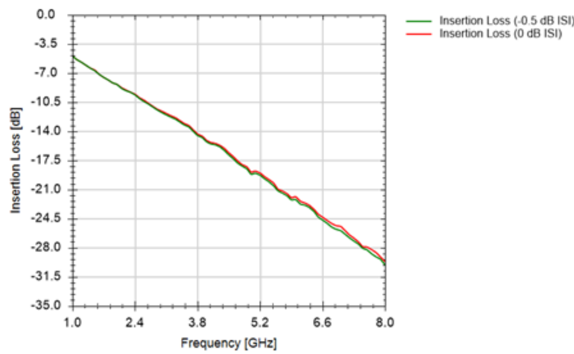
- TxEq and Launch Voltage Calibration
- Insertion Loss Calibration

Procedure Report

An examples of HTML worksheet for ISI Adjustment Calibration procedure is shown in Figure 97.

L0_Cal_16GTps_ISI

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Trace Number	13
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	Generic
Gen4 ISI Adjustment	Emulated ISI
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	False
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
ISI from M8020A Start Value	0 dB
ISI from M8020A Stop Value	-5 dB
Save Calibration Data	True
Skip Generator Reset	False

Frequency [GHz]	Insertion Loss (0 dB ISI) [dB]	Insertion Loss (-0.5 dB ISI) [dB]
1.00	-4.88	-4.89
1.10	-5.30	-5.32
1.20	-5.67	-5.69
1.30	-6.00	-6.03
1.40	-6.33	-6.36
1.50	-6.64	-6.67
1.60	-7.13	-7.17
1.70	-7.44	-7.49
1.80	-7.78	-7.83
1.90	-8.13	-8.19
2.00	-8.29	-8.36
2.10	-8.73	-8.80
2.20	-9.02	-9.09
2.30	-9.23	-9.31

Figure 97 Result Description of ISI Adjustment Calibration

- Column 1:
  - Frequency [GHz]: It is the frequency at which the insertion loss is measured.
- Column 2:
  - Insertion Loss (X dB ISI) [dB]: insertion loss measured when the M8020A internal ISI is set to X.

16G Initial Equalization Preset Optimization

Purpose and Method

This procedure measures the Eye-Height and Eye-Width for each Tx equalization preset.

When the “Start with minimum loss channel” option is not selected in the Configure DUT dialog, the measurement is done with a channel loss of -30dB. When the “Start with minimum loss channel” option is selected, the measurement is done with a channel loss o -27dB.

It will be used in the Channel calibration to set the preset that gets the largest eye.

Depending on the Eye Cal Method selected the eye measurement is done with Seasim or SigTest software.

With Seasim a step 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 noise. With the step response the complete electrical behavior of the channel is defined. With this data a statistical eye can by calculated. The different impairments are simulated by Seasim.

With SigTest a compliance pattern is applied and the different impairments like random jitter, sinusoidal jitter and differential and common mode sinusoidal inference are added to the signal.

The calibration data is stored in a caltable (Pci4_ Asic_<DUT Type>_<FixtureType>_EyeHeightInitialPreset, Pci4_ Asic_<DUT Type>_<FixtureType>_EyeWidthInitialPreset). This cal data is used to evaluate the preset that gets the largest Eye.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Initial Equalization Preset Optimization

Same as Connection Setup for Insertion Loss Calibration on page 208. With the hardware trace 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).

Parameters in Expert Mode

- Initial Equalization Preset Range

    - Equalization Preset Range: The set of preset values that are calibrated.
- Generator
    - Generator Voltage
    - DMSI
    - CMSI
    - Random Jitter
    - Sinusoidal Jitter
    - Sinusoidal Jitter Frequency
- Oscilloscope
    - Scope Bandwidth
    - Number of Averages
    - Number of Waveform Averages
- Channel
    - Trace Number
    - Total Channel Loss
    - ISI from M8020A

Used Calibrations

- TxEq and Launch Voltage Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration

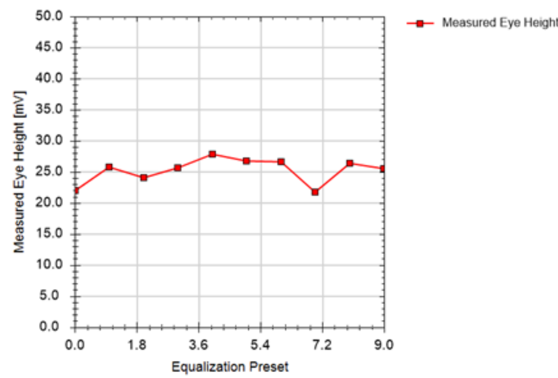
For details, refer to Table 5 on page 74.

Procedure Report

Examples of HTML worksheet for Initial Equalization Preset Optimization procedure are shown in Figure 98 and Figure 99.

L0_Cal_16GTps_IniPres_EH

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Trace Number	2
Total Channel Loss	-26.49 dB
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Equalization Preset Range	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
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
Skip Generator Reset	False

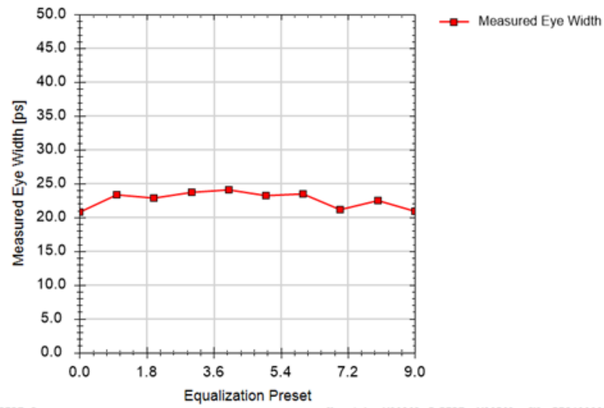
Set Equalization Preset []	Measured Eye Height [mV]
0.00	22.0
1.00	25.8
2.00	24.0
3.00	25.7
4.00	27.8
5.00	26.7
6.00	26.6
7.00	21.8
8.00	26.4

Figure 98 Result Description of Initial Equalization Preset Optimization

- Column 1:
  - Set Equalization Preset: The equalization preset selected.
- Column 2:
  - Measured Eye Height [mV]: The measured Eye-Height for each preset.

L0_Cal_16GTps_IniPres_EW

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Trace Number	2
Total Channel Loss	-26.49 dB
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Equalization Preset Range	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
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
Skip Generator Reset	False

Set Equalization Preset []	Measured Eye Width [ps]
0.00	20.7
1.00	23.4
2.00	22.8
3.00	23.7
4.00	24.1
5.00	23.2
6.00	23.5
7.00	21.1
8.00	22.5
9.00	20.9

Figure 99 Result Description of Initial Equalization Preset Optimization

- Column 1:
  - Set Equalization Preset: The equalization preset selected.
- Column 2:
  - Measured Eye Width [ps]: The measured Eye-Width for each preset.

16G Channel Calibration

Purpose and Method

This procedure searches for the calibration channel loss that gets 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 get -30dB at 8GHz and the Tx EQ preset to the value that gets the largest eye. Then at each step the channel loss is decreased by 0.5dB and the eye measured until the eye width and the eye height is over the target, or until the insertion loss at 8GHz reaches the minimum of -27dB.

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

If the emulated ISI option is selected, the channel loss is increased by changing the internal M8020A ISI traces. If not, the procedure increases the hardware ISI trace number.

The calibration data is stored in a caltable (Pci4_ Asic_<DUT Type>_<FixtureType>_EyeHeightChannel, Pci4_ Asic_<DUT Type>_<FixtureType>_EyeWidthChannel). This cal data is used to evaluate the optimum ISI trace for the Rx tests.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Channel Calibration

Same as Connection Setup for Insertion Loss Calibration on page 208.with the hardware trace 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). Note that for each step it will be required to change the hardware trace until the optimum channel is found.

Parameters in Expert Mode

- Channel Calibration
  - ISI form M8020A Start Value: The minimum trace number that is calibrated.

- ISI form M8020A Stop Value: The maximum trace number that is calibrated.
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Launch Voltage
  - DMSI
  - CMSI
  - Random Jitter
  - Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of Waveform Averages

For details, refer to Table 5 on page 74.

Used Calibrations

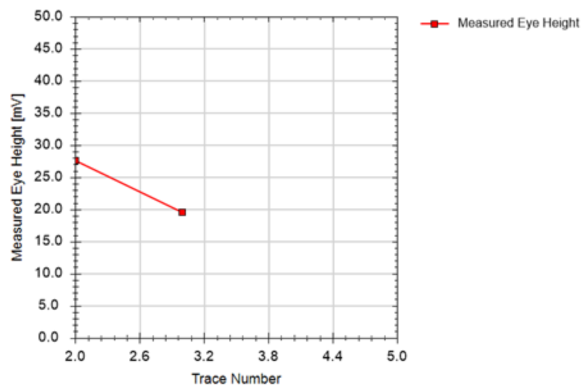
- TxEq and Launch Voltage Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- Initial Equalization Preset Optimization

Procedure Report

Examples of HTML worksheet for Random Jitter Calibration procedure are shown in Figure and Figure 101.

L0_Cal_16GTps_Chan_EH

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Pre-Shoot	0 dB
De-Emphasis	0 dB
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Trace Number Start Value	2
Trace Number Stop Value	5
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
Skip Generator Reset	False

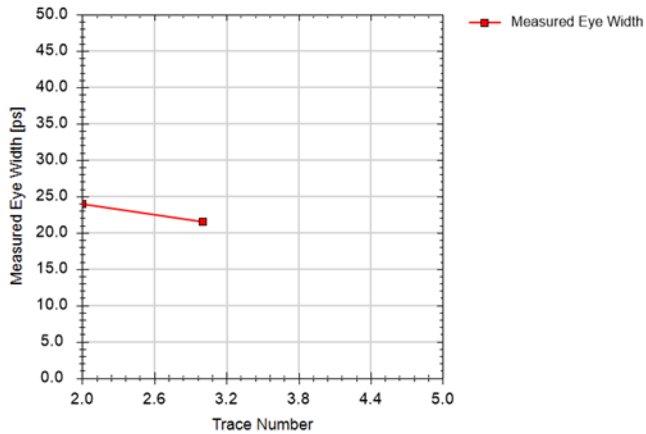
Set Trace Number []	Measured Eye Height [mV]
2.00	27.6
3.00	19.6

Figure 100 Result Description of Channel Calibration

- Column 1:
  - Set Trace Number: The trace number selected.
- Column 2:
  - Measured Eye Height [mV]: Measured eye height for each trace.

L0_Cal_16GTps_Chan_EW

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Pre-Shoot	0 dB
De-Emphasis	0 dB
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Trace Number Start Value	2
Trace Number Stop Value	5
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
Skip Generator Reset	False

Set Trace Number []	Measured Eye Width [ps]
2.00	23.9
3.00	21.4

Figure 101 Result Description of Channel Calibration

- Column 1:
  - Set Trace Number: The trace number selected.
- Column 2:
  - Measured Eye Width [ps]: Measured eye width for each trace.

16G DM SI Calibration

Purpose and Method

The Differential Mode Sinusoidal Interference (DMSI) is generated internally with the M8020A. The resulting amplitude at the input of the Rx is attenuated and needs to be calibrated.

The DMSI is calibrated for a defined range of values from 0 to 50 mV. At each step the actual DMSI is measured with a real time oscilloscope.

The calibration data is stored in a caltable (Pci4_ Asic_<DUT Type>_<FixtureType>_DmInterference.txt). For the measurements these calibration tables will be used to adjust the DMSI amplitude to the desired value in the RX input.

Available for the following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for DM Sinusoidal Interference Calibration

Same as Connection Setup for Insertion Loss Calibration on page 208. With the hardware trace set to the optimal number according the Channel Calibration

Parameters in Expert Mode

- DM Sinusoidal Interference Calibration
  - Verification Mode
- Oscilloscope
  - Scope Bandwidth
  - Number of Waveform Averages
- Channel
  - Trace Number
  - Total Channel Loss
  - ISI from M8020A

For details, refer to Table 5 on page 74.

Used Calibrations

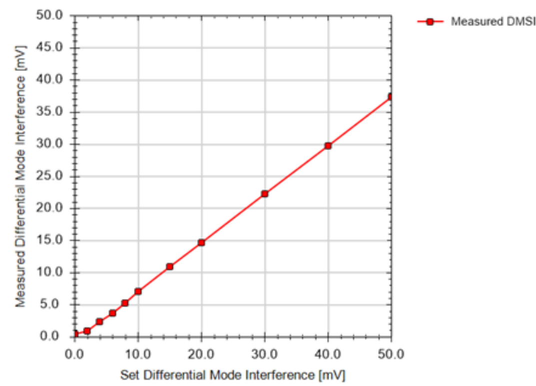
- Insertion Loss Calibration
- ISI Adjustment Calibration

Procedure Report

An example of HTML worksheet for DM SI Calibration procedure is shown in Figure 102.

L0_Cal_16GTps_DMSI

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Trace Number	13
Total Channel Loss	-29.72 dB
ISI from M8020A	0 dB
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	Generic
Gen4 ISI Adjustment	Emulated ISI
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	False
Scope Bandwidth	25 GHz
Number of Waveform Averages	128
Verification Mode	False
Skip Generator Reset	False

Set DMSI [mV]	Measured DMSI [mV]
0.00	0.34
2.00	0.92
4.00	2.35
6.00	3.62
8.00	5.18
10.00	7.01
15.00	10.89
20.00	14.68
30.00	22.24
40.00	29.74
50.00	37.32

Figure 102 Result Description of DM Sinusoidal Interference Calibration

- Column 1:
  - Set DM SI Amplitude [mV]: The jitter amplitude set in the instrument.
- Column 2:

- Measured DM SI Amplitude [mV]: The measured DM SI amplitude.

16G CM SI Calibration

Purpose and Method

The Common Mode Sinusoidal Interference (CMSI) is generated internally by the M8020A. The resulting amplitude at the input of the Rx is attenuated by the channel and needs to be calibrated.

The CMSI is calibrated for a defined set of values from 0 to the maximum value of CMSI, that the instrument can generate. In every step, the actual CMSI value is measured with a DSO.

The calibration data is stored in a caltable (Pci4_ Asic_<DUT Type>_<FixtureType>__CmInterference.txt). For the measurements these calibration tables will be used to adjust the amplitude of the function generator to the desired output CMSI.

Available for following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for CM Sinusoidal Interference Calibration

Same as Connection Setup for Insertion Loss Calibration on page 208. With the hardware trace set to the optimal number according the Channel Calibration.

Parameters in Expert Mode

- CM Sinusoidal Interference Calibration
  - Verification Mode
- Oscilloscope
  - Scope Bandwidth
  - Number of Waveform Averages
- Channel
  - Trace Number:
  - Total Channel Loss
  - ISI from M8020A

For details, refer to Table 5 on page 74.

Used Calibrations

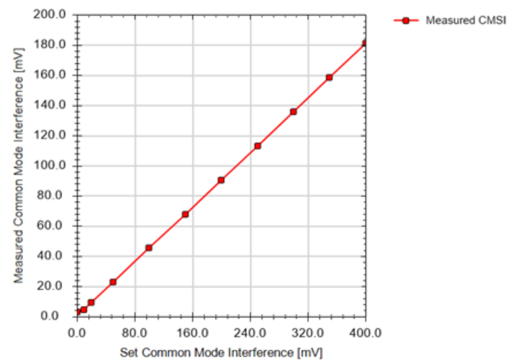
- Insertion Loss Calibration
- ISI Adjustment Calibration

Procedure Report

- An example of HTML worksheet for CM SI Calibration procedure is shown in Figure 103.

L0_Cal_16GTps_CMSI

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Trace Number	3
Total Channel Loss	-28.14 dB
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True
Scope Bandwidth	25 GHz
Number of Waveform Averages	128
Verification Mode	False
Skip Generator Reset	False

Set CMSI [mV]	Measured CMSI [mV]
0.00	2.90
10.00	4.59
20.00	9.15
50.00	22.75
100.00	45.30
150.00	67.69
200.00	90.27
250.00	112.87
300.00	135.54
350.00	158.26
400.00	180.89

Figure 103 Result Description of CM Sinusoidal Interference Calibration

- Column 1:
  - Set CM SI Amplitude [mV]: It is the CM SI set at the 81150A.
- Column 2:
  - Measured CM SI Amplitude [mV]: The measured CM SI amplitude.

16G Final Equalization Preset Optimization

Purpose and Method

This procedure measures the Eye-Height and Eye-Width for each Tx equalization preset when the channel loss have been adjusted to the optimum value.

Depending on the Eye Cal Method selected the eye measurement is done with Seasim or SigTest software.

The calibration data is stored in a caltable (Pci4_ Asic_<DUT Type>_<FixtureType>_EyeHeightFinalPreset, Pci4_ Asic_<DUT Type>_<FixtureType>_EyeWidthFinalPreset). This cal data is used to evaluate the optimum preset to get the desired Eye.

Available for following hardware configurations

Data Generator: _-BERT M8020A

Connection Setup for Final Equalization Preset Optimization

Same as Connection Setup for Insertion Loss Calibration on page 208. With the hardware trace set to the optimal number according the Channel Calibration.

Parameters in Expert Mode

- Final Equalization Preset Range
  - Equalization Preset Range: The set of preset values that are calibrated.
- Generator
  - Generator Launch Voltage
  - DMSI
  - CMSI
  - Random Jitter
  - Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of Waveform Averages
- Channel
  - Trace Number

- ISI from M8020A
- Total Channel Loss

For details, refer to Table 5 on page 74.

Used Calibrations

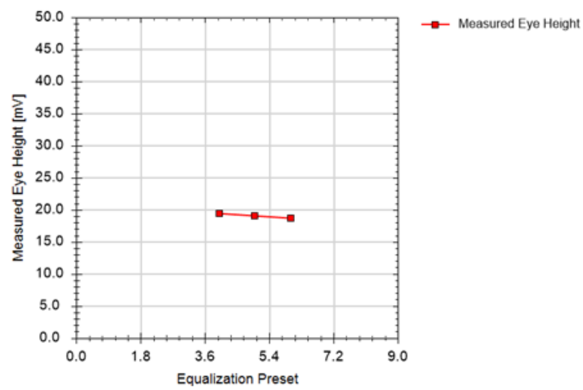
- Launch Voltage Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference

Procedure Report

Examples of HTML worksheet for Random Jitter Calibration procedure are shown in Figure 104 and Figure 105.

L0_Cal_16GTps_FinPres_EH

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Trace Number	3
Total Channel Loss	-28.14 dB
Equalization Preset Range	P4;P5;P6
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
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True

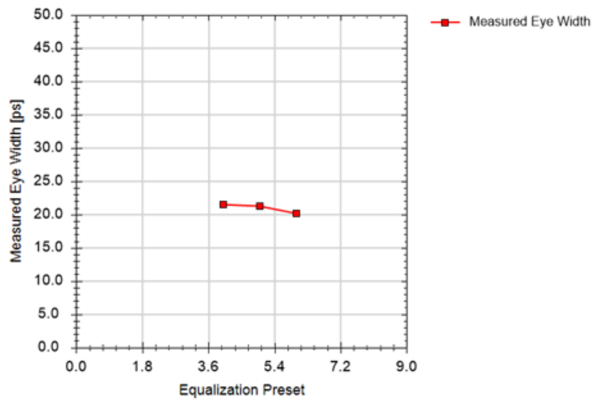
Set Equalization Preset []	Measured Eye Height [mV]
4.00	19.4
5.00	19.0
6.00	18.7

Figure 104 Result Description of Final Equalization Preset Optimization

- Column 1:
  - Set Equalization Preset: It is the selected equalization preset.
- Column 2:
  - Measured Eye Height [mV]: The measured Eye-Height for each preset.

L0_Cal_16GTps_FinPres_EW

for PCIe 4.0 EndPoint ASIC



BERT System	Keysight M8020A J-BERT, M8070A, SN: DE54300024
Offline	False
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Trace Number	3
Total Channel Loss	-28.14 dB
Equalization Preset Range	P4;P5;P6
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
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True

Set Equalization Preset []	Measured Eye Width [ps]
4.00	21.5
5.00	21.2
6.00	20.2

Figure 105 Result Description of Final Equalization Preset Optimization

- Column 1:
  - Set Equalization Preset: It is the selected equalization preset.
- Column 2:
  - Measured Eye Width [ps]: The measured Eye-Width for each preset.

16G Pre Compliance Eye Calibration

Purpose and Method

This procedure measures how affects to the Eye-Height and Eye-Width the individual change of each impairment (SJ, DMSI and Launch Voltage).

The calibration measures the eye in four situations: 1) all the impairments are set to the nominal values; 2) the DMSI is set to the maximum value allowed by the specifications; 3) the SJ is set to the maximum spec amplitude; 4) the differential voltage is set to the minimum spec level.

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

The calibration data is stored in a caltable (Pci4_ Asic_<DUT Type>_<FixtureType>_PreCompEye). This cal data is used in the Compliance Eye Calibration to calculate DMSI, SJ and Vdiff adjustment to meet the target eye.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Pre Compliance Eye Calibration

Same as Connection Setup for Insertion Loss Calibration on page 208. With the hardware trace set to the optimal number according the Channel Calibration.

Parameters in Expert Mode

- Generator
  - Pre-Shoot
  - De-Emphasis
  - CMSI
  - Random Jitter
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of Waveform Averages
- Channel
  - Trace Number
  - ISI from M8020A
  - Total Channel Loss

For details, refer to Table 5 on page 74.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- DM Sinusoidal Interference
- CM Sinusoidal Interference

Procedure Report

An example of HTML worksheet for Pre Compliance Eye Calibration procedure is shown in Figure 106.

L0_Cal_16GTps_PreComp

for PCIe 4.0 EndPoint ASIC

BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Scope Bandwidth	25 GHz
Number of Averages	21
Number of Waveform Averages	1024
Trace Number	3
Total Channel Loss	-28.14 dB
Pre-Shoot	0 dB
De-Emphasis	0 dB
Common Mode Interference	0 V
Random Jitter	1 ps
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True

DMSI [mV]	SJ [ps]	Vdiff [mV]	Eye Height [mV]	Eye Width [ps]
14.0	6.25	800	19.34	21.30
25.0	6.25	800	11.22	15.34
14.0	10.00	800	17.79	17.64
14.0	6.25	720	15.83	20.29

Figure 106 Result Description of Pre Compliance Eye Calibration

- Column 1:
  - DMSI[mV]: The DMSI amplitude added to the signal.
- Column 2:
  - SJ: The SJ amplitude added to the signal.
- Column 3:
  - Vdiff [mV]:The differential voltage amplitude added to the signal.
- Column 4:
  - Eye Height [mV]: The measured Eye- Height for each impairment combination.
- Column 5:
  - Eye Width [ps]: The measured Eye- Width for each impairment combination.

16G Compliance Eye Calibration

Purpose and Method

This calibration searches for the optimum combination of DMSI, SJ and Launch Voltage values to generate a close as possible to the Compliance Eye-Height and Eye-Width.

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 is repeated until the eye is in the middle of the specs or until the Max number of Search Steps is reached.

If the best combination of impairments, that the algorithm is able to find, generates an eye out of specs (EH between 14 and 16 mV and EW between 18.5 and 19ps), it is possible to do a manual search by manually setting the SJ, DMSI and Vdiff values.

Available for following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for Compliance Eye Calibration

Same as Connection Setup for Insertion Loss Calibration on page 208. With the hardware trace set to the optimal number according the Channel Calibration.

Parameters in Expert Mode

- Compliance Eye Calibration
  - Verification Mode
  - Max Number of Search Steps
  - Use nominal EH/EW results from Pre Comp Cal: If is set to true, the measurement in the first step is skipped and the eye result is directly copied from the Pre Comp Cal.
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Sinusoidal Jitter Frequency
  - CMSI
  - Random Jitter
- Oscilloscope
  - Scope Bandwidth

  - Number of Averages
  - Number of Waveform Averages

- Channel
  - Trace Number
  - ISI from M8020A
  - Total Channel Loss

For details, refer to Table 5 on page 74.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- DM Sinusoidal Interference
- CM Sinusoidal Interference
- Pre Compliance Calibration

Procedure Report

An example of HTML worksheet for Compliance Eye Calibration procedure is shown in Figure 107.

L0_Cal_16GTps_CompEye

for PCIe 4.0 EndPoint ASIC

BERT System	Keysight M8020A J-BERT, M8070A, SN: DE5430002
Offline	False
Scope Bandwidth	25 GHz
Number of Averages	21
Number of Waveform Averages	1024
Trace Number	3
Total Channel Loss	-28.14 dB
Pre-Shoot	0 dB
De-Emphasis	0 dB
Max Number of Search Steps	7
Use nominal EH/EW results from Pre Comp Cal	True
Sinusoidal Jitter Frequency	100 MHz
Common Mode Interference	0 V
Random Jitter	1 ps
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True

DMSI [mV]	SJ [ps]	Vdiff [mV]	Eye Height [mV]	Eye Width [ps]
20.6	5.20	800	15.13	18.85

Figure 107 Result Description Compliance Eye Calibration

- Column 1:
  - DMSI [mV]: The DMSI amplitude added to the signal.
- Column 2:
  - SJ [ps]: The SJ amplitude added to the signal.
- Column 3:
  - Vdiff [mV]: The differential voltage amplitude added to the signal.
- Column 4:
  - Eye Height [mV]: The measured Eye- Height for each impairment combination.
- Column 5:
  - Eye Width [ps]: The measured Eye- Width for each impairment combination.

Procedure Report (for Verification Mode)

An example of HTML worksheet for Compliance Eye Verification procedure is shown in Figure 108.

L0_Ver_16GTps_CompEye

for PCIe 4.0 EndPoint ASIC

BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Scope Bandwidth	25 GHz
Number of Averages	21
Number of Waveform Averages	1024
Trace Number	3
Total Channel Loss	-28.14 dB
Pre-Shoot	0 dB
De-Emphasis	0 dB
Differential Mode Interference	20.6 mV
Generator Launch Voltage	800 mV
Sinusoidal Jitter	5.2 ps
Common Mode Interference	0 V
Random Jitter	1 ps
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True

Eye Height [mV]	Eye Width [ps]
15.0	18.8

Figure 108 Result Description of Compliance Eye Verification

- Column 1:
  - Eye Height [mV]: It is the measured Eye Height.
- Column 2:
  - Eye-Width [ps]: It is the measured Eye Width.

16G Eye Height and Width Measurement

Purpose and Method

This procedure measures the Eye-Height and Eye-Width for the selected signal impairments.

The Differential Voltage, Pre-Shoot, De-Emphasis, DMSI, Random and Sinusoidal jitter values can be defined. The eye is measured each time a new impairment combination is selected.

It is only available for **Expert Mode** when the **Include Advanced Measurement** option is selected. For setting the option, refer to section For Rx 16GT/s on page 49 of Chapter 2, N5990A PCIe Station.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Eye Height and Width Measurement

Same as Connection Setup for Insertion Loss Calibration on page 208.

Parameters in Expert Mode

- Generator
  - Pre-Shoot
  - De-Emphasis
  - Differential Mode Interference
  - Generator Launch Voltage
  - Sinusoidal Jitter
  - Random Jitter
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of Waveform Averages
- Channel
  - Trace Number
  - ISI from M8020A
  - Total Channel Loss

For more details, refer to Table 5 on page 74.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- DM Sinusoidal Interference
- CM Sinusoidal Interference

Procedure Report

An example of HTML worksheet for Eye Height and Width Measurement procedure is shown in Figure 109.

L0_Meas_16GTps_EHEW

for PCIe 4.0 EndPoint ASIC

BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Optimize CTLE	True
CTLE	-8 dB
Trace Number	3
Pre-Shoot	1.9 dB
De-Emphasis	0 dB
Differential Voltage	800 mV
Differential Mode Interference	14 mV
Random Jitter	1 ps
Sinusoidal Jitter	6.25 ps
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4
Skip Generator Reset	False
Scope Connection for Calibration	Chan 1 3 Direct Connect
Gen4 ASIC Fixture	BIT CEM Connector + M8048A
Gen4 ISI Adjustment	Hardware Traces
Gen4 Eye Calibration Method	Seasim
Gen4 Do Channel Calibration	True

Set Pre-Shoot [dB]	Set De-Emphasis [dB]	Set Differential Voltage [V]	Set Differential Mode Interference [mV]	Set Random Jitter [ps]	Set Sinusoidal Jitter [ps]	Measured Eye Height [mV]	Measured Eye Width [ps]
1.90	0.00	0.80	14.00	1.00	6.25	15.00	18.75
1.90	0.00	0.90	16.00	1.00	6.25	15.00	18.75

Figure 109 Result Description of Eye Height and Width Measurement

- Column 1:
  - Set Pre-Shoot [dB]: The Pre-Shoot added to the signal.
- Column 2:
  - Set De-Emphasis [dB]: The De-Emphasis added to the signal.
- Column 3:
  - Set Differential Voltage [V]: The differential voltage amplitude added to the signal.
- Column 4:
  - Set Differential Mode Interference [mV]: The DMSI amplitude added to the signal.
- Column 5:
  - Set Random Jitter [ps]: The random jitter amplitude added to the signal.
- Column 6:
  - Set Sinusoidal Jitter [ps]: The SJ amplitude added to the signal.
- Column 7:
  - Measured Eye Height [mV]: The measured Eye- Height for each impairment combination.
- Column 8:
  - Measured Eye Width [ps]: The measured Eye- Width for each impairment combination.

16G Eye Height and Width Scan

Purpose and Method

This procedure measures the Eye-Height and Eye-Width for a scan of one or more impairments.

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

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Eye Height and Width Scan

Same as Connection Setup for Insertion Loss Calibration on page 208.

Parameters in Expert Mode

- Eye Height and Width Scan
  - Loop Levels: It is the number of impairments to scan
  - Equalization Mode: If is set to Presets, it will be possible to choose the equalization presets to scan. If is set to Custom Values, it will be possible to choose the Pre-Shoot and De-Emphasis values to scan.
- Loop
  - Scan Parameter: The impairment to scan. It can be selected as:
    - Equalization Preset
    - Generator Launch Voltage
    - Differential Mode Sinusoidal Interference
    - Common Mode Sinusoidal Interference
    - Random Jitter
    - Sinusoidal Jitter
    - Sinusoidal Jitter Frequency
    - CTLE
    - ISI
  - <Parameter> Start Value: the start value for the scan of the selected impairment.
  - <Parameter> Stop Value: the stop value for the scan of the selected impairment.

- <Parameter> Scale Type: The scale type of the scan.
- <Parameter> Number of Steps: The number of steps for the scan of the selected impairment.

- Fixed Parameters
  - <Parameter>: For all the parameters that are not scanned, set the fixed value used in all the steps.
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of Waveform Averages

For details, refer to Table 5 on page 74.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- DM Sinusoidal Interference
- CM Sinusoidal Interference

Procedure Report

An example of HTML worksheet for Eye Height and Width Scan procedure is shown in Figure 110.

L0_Scan_16GTps_EHEW

for PCIe 4.0 EndPoint ASIC

BERT System	Keysight M8020A J-BERT, M8020A J-BERT, SN: Unknown
Generator Channel Channel	M1.DataOut1
Offline	True
Scope Bandwidth	25 GHz
Number of Averages	7
Number of Waveform Averages	1024
Loop Levels	3
Equalization Mode	Presets
Optimize CTLE	True
Scan Parameter (Loop 1)	EqualizationPreset
Scan Parameter (Loop 2)	GeneratorLaunchVoltage
Scan Parameter (Loop 3)	DifferentialModeSinusoidalInterference
Equalization Preset Range	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
Generator Launch Voltage Start Value	700 mV
Generator Launch Voltage Stop Value	800 mV
Generator Launch Voltage Scale Type	Linear
Generator Launch Voltage Number of Steps	2
DMSI Start Value	10 mV
DMSI Stop Value	20 mV
DMSI Scale Type	Linear
DMSI Number of Steps	2
CMSI	0 V
Random Jitter	1 ps
Sinusoidal Jitter	6.25 ps
Sinusoidal Jitter Frequency	100 MHz
CTLE	-8 dB
Trace Number	3
Transfer Function File for Package Model on Scope	PCIe4RxPackageModel_EndPoint.tf4

Set Equalization Preset	Set Generator Launch Voltage [mV]	Set DMSI [mV]	Measured Eye Height [mV]	Measured Eye Width [ps]
P0	700.00	10.00	15.00	18.75
P0	700.00	20.00	15.00	18.75
P0	800.00	10.00	15.00	18.75
P0	800.00	20.00	15.00	18.75
P1	700.00	10.00	15.00	18.75
P1	700.00	20.00	15.00	18.75
P1	800.00	10.00	15.00	18.75
P1	800.00	20.00	15.00	18.75
P2	700.00	10.00	15.00	18.75
P2	700.00	20.00	15.00	18.75
P2	800.00	10.00	15.00	18.75
P2	800.00	20.00	15.00	18.75
P3	700.00	10.00	15.00	18.75

Figure 110 Result Description of Eye Height and Width Scan

- Column1:
  - Set Equalization Preset: The equalization preset set at each step.
- Column2:
  - Set Generator Launch Voltage: The differential amplitude of the signal.

- Column3
  - Set DMSI: The amount of differential mode sinusoidal interference added to the signal.
- Column4
  - Measured Eye Height: The eye height measured at each step.
- Column5
  - Measured Eye Width: The eye width measured at each step.

Receiver

Common Receiver Parameters

Receiver Specific

- Reference Clock

Data Rate Specific

1. Loopback Training
   - Link Training Mode:
   - Link Training Mode
   - Link Training Suite Settings File,
   - Default Link Training Lane Number for every Lane
   - Suppress Loopback Training Messages
   - Use Gen3 EIEOS
   - Use Custom Training Voltage
2. Interactive Link Training
   - Training Through
   - Generator Start Preset
   - DUT Initial Preset
   - DUT Target Preset
   - Generator Start Preset Gen4
   - DUT Initial Preset Gen4
   - DUT Target Preset Gen4
   - Drop Link Method
3. Error Detector
   - Use CDR
   - CDR Loop Bandwidth
   - Peaking
   - Analyzer Equalization
   - Sensitivity Mode
   - Capture and Compare Mode
   - Pause before Auto-Align
   - Polarity
4. BER Measurement
   - Relax Time

Channel Specific

- Pre Shoot
- De Emphasis

Lane Specific

- Link Training Lane Number

For details, refer to Table 4 on page 72.

16G Rx Coefficient Matrix Scan

Purpose and Method

Same as for 8.0GT/s ASIC. Refer to 8G Rx Coefficient Matrix Scan on page 149.

Connection Setup for EQ Coefficient Matrix Scan

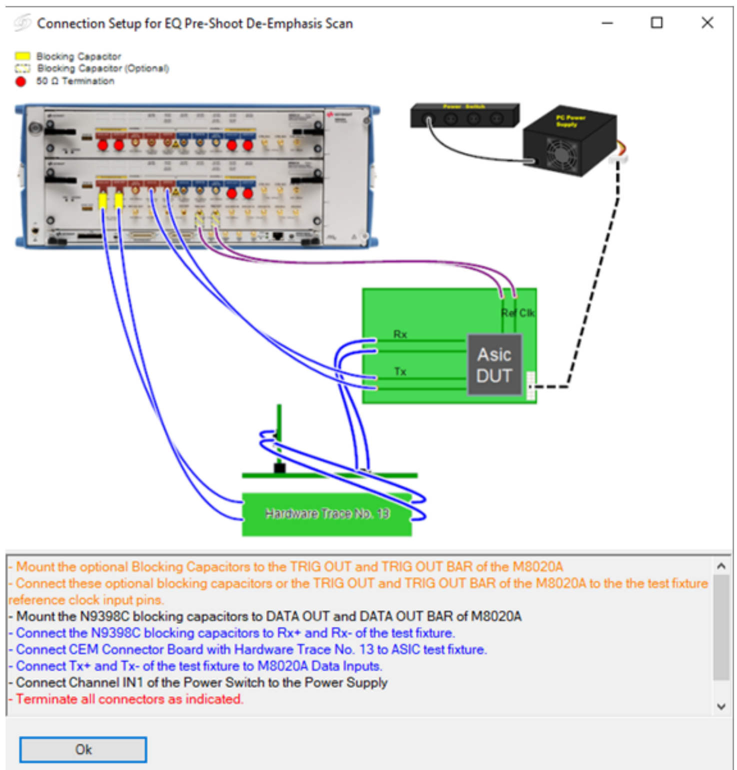


Figure 111 Connection Setup using JBERT_M8020A for Common Clock Architecture and no external ref clock

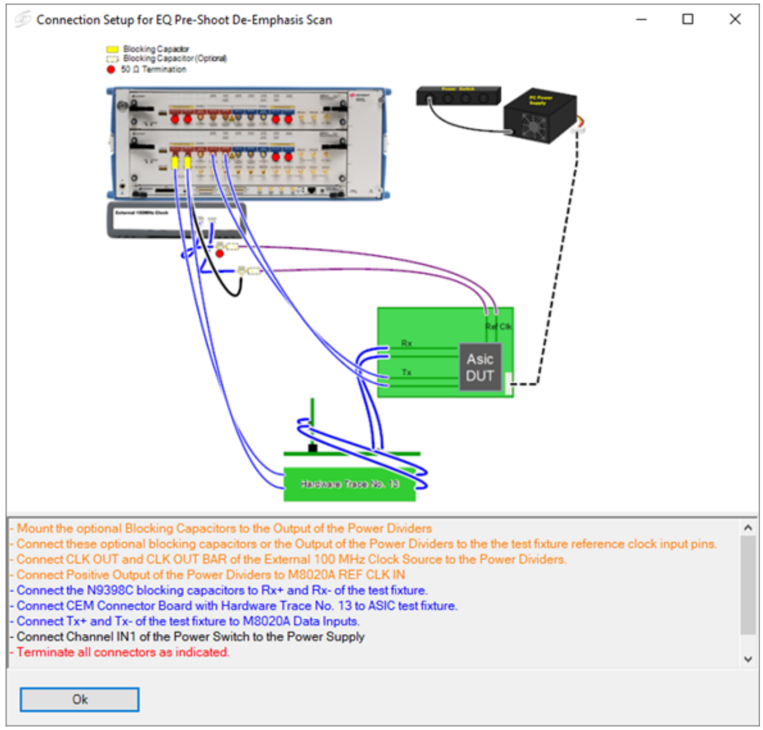


Figure 112 Connection Setup using JBERT_M8020A for Common Clock Architecture and external ref clock

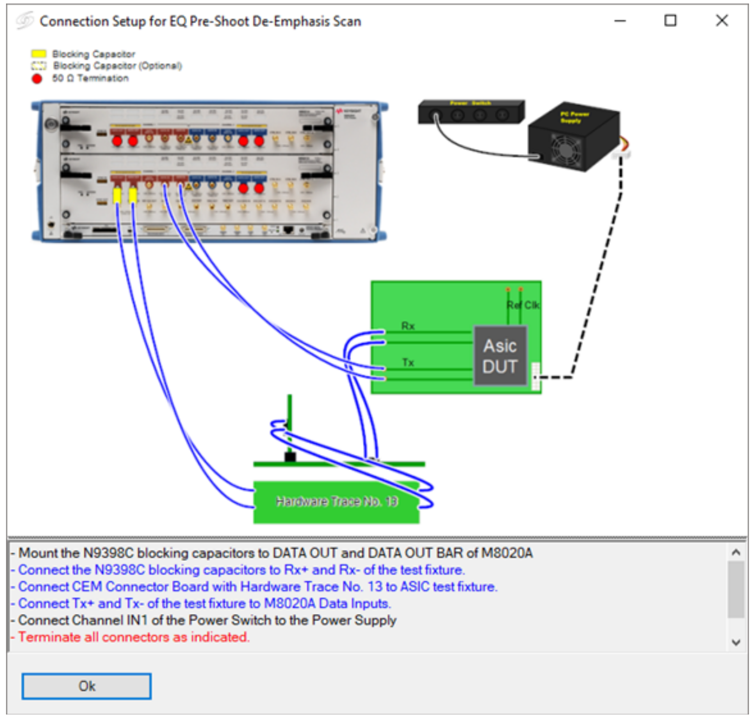


Figure 113 Connection Setup using JBERT_M8020A for Separated Clock Architecture

Parameters in Expert Mode

1. EQ Coefficient Matrix Scan
   - Residual SSC
2. Loopback Training
   - Force training at each BER measurement
   - Coefficient Variation
   - Coefficient Divider
   - Maximum Boost
   - Start Pre-Shoot
   - Start De-Emphasis

3 BER Measurement
- BER Mode
- Target BER
- Confidence Level

4 Impairments
- Random Jitter
- Sinusoidal Jitter
- 2nd Tone Sinusoidal Jitter
- Sinusoidal Jitter Frequency
- Common Mode Sinusoidal Interference
- Differential Mode Sinusoidal Interference
- Generator Launch Voltage

5 Channel
- Trace Number
- Total Channel Loss
- ISI from M8020A

6 Equalization for remaining Rx Tests
- Allow user to enter optimum equalization for remaining Rx tests: Controls, if a window appears at the end of the test to let the user set the pre-shoot and de-emphasis values to use for the following tests.

For details, refer to Table 6 on page 76.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- DM Sinusoidal Interference
- CM Sinusoidal Interference
- Compliance Calibration

Procedure Report

The HTML worksheet for EQ Coefficient Matrix Scan procedure is similar to Figure 81 on page -155.

16G Rx Pre-Shoot De-Emphasis Scan

Purpose and Method

Same as for 8.0GT/s ASIC. Refer to 8G Rx Pre-Shoot De-Emphasis Scan on page 156.

Connection Setup for EQ Pre-Shoot De-Emphasis Scan

Same as Connection Setup for EQ Pre-Shoot De-Emphasis Scan on page 255.

Parameters in Expert Mode

- EQ Pre-Shoot De-Emphasis Scan
  - Residual SSC

1. Pre-Shoot Variation
   - Start Pre Shoot: Start amplitude for the pre-shoot scan.
   - Stop Pre Shoot: Stop amplitude for the pre-shoot scan.
   - De Pre Shoot Size: Step size for the pre-shoot scan.
2. De-Emphasis Variation
   - Start De Emphasis: Start amplitude for the de-emphasis scan.
   - Stop De Emphasis: Stop amplitude for the de-emphasis scan.
   - De Emphasis Step Size: Step size for the de-emphasis scan.
3. Parameter
   - Scan Order: Select if De-Emphasis or Pre-Shoot is tested first.
   - Initial De Emphasis: The initial de-emphasis used for BER adjustment and pre-shoot scan.
   - Initial Pre Shoot: The initial pre-shoot used for BER adjustment and de-emphasis scan.
   - Force training at each Preset: If true, every time the de-emphasis or the pre-shoot is changed the DUT is trained into loopback again.
   - Common Mode Sinusoidal Interference: Common Mode Sinusoidal Interference amplitude.
4. BER Measurement
   - BER Mode
   - Target BER
   - Confidence Level
   - BER Measurement Duration
   - Allowed Bit Error

- Impairments
  - Random Jitter
  - Sinusoidal Jitter
  - 2nd Tone Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
  - Common Mode Sinusoidal Interference
  - Differential Mode Sinusoidal Interference
  - Generator Launch Voltage
- Channel
  - Trace Number
  - ISI from M8020A
  - Total Channel Loss
- Equalization for remaining Rx Tests
  - Allow user to enter optimum equalization for remaining Rx tests.

For details, refer to Table 6, “Procedure Parameters for Receivers,”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height Calibration
- Eye Width Calibration

Procedure Report

The HTML worksheets for EQ Pre-Shoot De-Emphasis Scan procedure are shown in Figure 82 and Figure 83.

16G Rx Stressed Jitter Eye Test

Purpose and Method

This test verifies that the DUT properly functions in 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.

Available for following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for Stressed Jitter Eye Test

Same as Connection Setup for EQ Coefficient Matrix Scan on page 250.

Parameters in Expert Mode

- Compliance Rx test
  - Residual SSC
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error
- Impairments
  - Random Jitter
  - 2nd Tone Sinusoidal Jitter:
  - Common Mode Interference
  - Differential Mode Interference
  - Generator Launch Voltage
- Channel
  - Trace Number:
  - Total Channel Loss
  - ISI from M8020A
- Link Training
  - Enable Impairment for Loopback Training.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- DM Sinusoidal Interference
- CM Sinusoidal Interference
- Compliance Calibration

For details, refer to Table 6, “Procedure Parameters for Receivers,”.

Procedure Report

An example of HTML worksheet for Compliance Test procedure is shown in Figure 114.

L0_Rx_16GTps_Comp_Test

for PCIe 4.0 EndPoint ASIC

Random Jitter	1 ps
Sinusoidal Jitter	6.25 ps
Differential Mode Sinusoidal Interference	14 mV
Generator Launch Voltage	800 mV
Offline	True
Trace Number	13
ISI from M8020A	0 dB
Total Channel Loss	-29.72 dB
Residual SSC	500 ps
2nd Tone Sinusoidal Jitter	0 s
Common Mode Sinusoidal Interference	150 mV
Enable Impairments for Loopback Training	True
BER Mode	FixedTime
BER Measurement Duration	187.5 s
Allowed Bit Error	1
Pre-Shoot	1.9 dB
De-Emphasis	0 dB
Link Training Mode	JBERT Interactive Link Training
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrame\Settings\
Suppress Loopback Training Messages	False
Use Gen3 EIEOS	False
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P4
Generator Start Preset Gen4	P5
DUT Initial Preset Gen4	P5
DUT Target Preset Gen4	P5
Drop Link Method	JBERT LTSSM
Use CDR	True
CDR Loop Bandwidth	20 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Sensitivity	Normal
Polarity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Relax Time	1 s
Use Power Switch Automation	False

Result	Allowed Bit Errors []	Measured Bit Errors []
pass	1	0

Figure 114 Result Description of Compliance Test

- Column 1:
  - Result: The number of errors should be smaller than "Allowed Bit Error".
- Column 2:
  - Allowed Bit Error: Number of bits received during the test.
- Column 3:
  - Measured Bit Errors: It is the number of errors.

16G Rx Jitter Tolerance Test

Purpose and Method

Same as for 2.5GT/s ASIC procedure. For details refer to J2.5G/5G Rx Jitter Tolerance Test on page 100.

Connection Setup for Jitter Tolerance Test

Same as Connection Setup for EQ Coefficient Matrix Scan on page 250.

Parameters in Expert Mode

- Jitter Tolerance Test
  - Residual SSC
- Sinusoidal Jitter Variation
  - Frequency Mode
  - Frequency Scale
  - Start Frequency
  - Stop Frequency
  - Frequency Steps
  - Frequency Points
  - Search algorithm
  - Jitter Step Size
  - Jitter Step Factor
  - Jitter Start Value
  - Show Min Failed Points
- Parameter
  - Force retraining on each frequency
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error
- Impairments
  - Jitter Eye Adjustment Mode:
    - ASIC: Either a 2nd SJ or RJ reduction is used to adjust the target EH and EW. SJ pass/fail limit is nominal SJ.

    - CEM: The 1st tone SJ is used to adjust to the target EH and EW. RJ stays at nominal and 2nd SJ tone is off. SJ pass/fail limit is the SJ level from the compliance eye calibration.
  - Random Jitter
  - 2nd Tone Sinusoidal Jitter:
  - Common Mode Interference
  - Differential Mode Interference
  - Generator Launch Voltage
- Channel
  - Trace Number:
  - Total Channel Loss
  - ISI from M8020A

For details, refer to Table 6, “Procedure Parameters for Receivers,”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- DM Sinusoidal Interference
- CM Sinusoidal Interference
- Compliance Calibration

Procedure Report

The HTML worksheet for Jitter Tolerance Test procedure is similar to Figure 57 on page -103.

Link Equalization Receiver Tests

In order to have access to the link equalization tests, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Rx Test Parameters

Data Rate Specific

1 Loopback Training
  - Interactive Training Script File
  - Suppress Loopback Training Messages
  - Use Gen3 EIEOS
  - Use Custom Training Voltage

2 Interactive Link Training
  - Generator Start Preset
  - DUT Initial Preset
  - DUT Target Preset
  - Generator Start Preset Gen4
  - DUT Initial Preset Gen4
  - DUT Target Preset Gen4
  - Drop Link Method

3 Error Detector
  - Use CDR
  - CDR Loop Bandwidth
  - Peaking
  - Analyzer Equalization
  - Sensitivity Mode
  - Capture and Compare Mode
  - Pause before Auto-Align
  - Polarity

4 BER Measurement
  - Relax Time

For details, refer to Table 4, “Common Parameters for Receiver groups,”

16G LEQ Rx Stressed Jitter Eye Test

Purpose and Method

This tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Rx Stressed Jitter Eye Test. For more details, refer to 16G Rx Stressed Jitter Eye Test on page 257.

16G LEQ Rx Jitter Tolerance Test

Purpose and Method

This tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Receiver Jitter Tolerance. For more details, refer to 16G Rx Jitter Tolerance Test on page 260.

Link Equalization Transmitter Tests

In order to have access to the link equalization tests, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Tx Test Parameters

Link Equalization Tx

- Generator Output Voltage Compensation
- Scope Connection for Link EQ Tx Tests
- Skip BER Check

Data Rate Specific

1. Loopback Training
   - Interactive Training Script File
   - Generator Start Preset
2. Error Detector
   - Use Gen3 EIEOS

For details, refer to Table 4, “Common Parameters for Receiver groups,”

NOTE

Lane 0 is the only available lane for Link Equalization Tests.

16G LEQ Tx Initial Preset Compliance Test

Purpose and Method

Same as for 8.0 GT/s. Refer to 8G LEQ Tx Initial Preset Compliance Test on page 180.

Connection Setup for Initial Preset Test

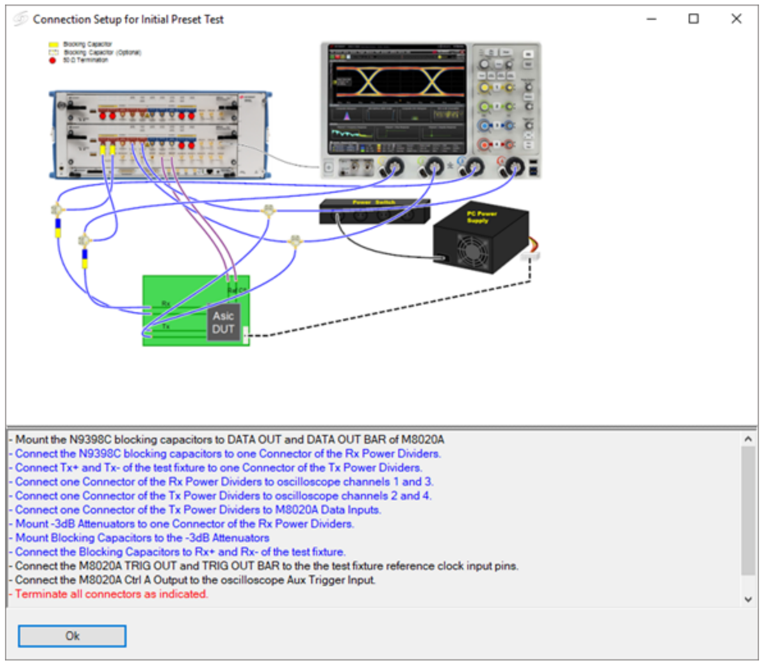


Figure 115 Connection Setup for Initial Preset Test

Used Calibrations

- None

Procedure Report

The HTML worksheet for Initial Preset Test procedure is similar to Figure 87 on page -182.

16G LEQ Tx Response Time Compliance Test

Purpose and Method

Same as for 8.0GT/s. Refer to 8G LEQ Tx Response Time Compliance Test on page 184.

Connection Setup for Response Time Test

Same as Connection Setup for Initial Preset Test on page 265.

Parameters in Expert Mode

- Scope visible range: Waveform range which will be used at the moment when the link equalization phase is performed.
- Use CTLE: Set to true to use the CTLE in the oscilloscope.
- CTLE DC Gain: The selected value is equivalent to a negative decibel quantity.

Used Calibrations

- None

Procedure Report

The HTML worksheet for Response Time Test procedure is similar to Figure 88 on page -185.

Receiver Setup (Only for Debugging)

16G Rx Stressed Jitter Eye Setup

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Rx Stressed Jitter Eye test using the calibration data saved on the PC where ValiFrame is running. The method begins like Rx Stressed Jitter Eye test but then the test will not run, it only leaves the setup prepared. The set parameters are the differential amplitude, random jitter, swept sinusoidal jitter and the common and differential mode sinusoidal interference.

Connection Setup for Rx Stressed Jitter Eye Setup

Same as Connection Setup for EQ Coefficient Matrix Scan on page 250.

Parameters in Expert Mode

- Impairments
  - Random Jitter
  - 2nd Tone Sinusoidal Jitter
  - Common Mode Interference
  - Differential Mode Interference
  - Generator Launch Voltage
- Channel
  - Trace Number
  - Total Channel Loss
  - ISI from M8020A

For details, refer to Table 6, “Procedure Parameters for Receivers,”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- DM Sinusoidal Interference
- CM Sinusoidal Interference
- Compliance Calibration

Result Description

- None

7 2.5 GT/s & 5.0 GT/s CEM Tests

Calibration

Common Calibration Parameters

- Data Rate Specific
  - Scope Connection for Calibration

For details, refer to Table 3, "Common Parameters for Calibration groups".

2.5G/5G RJ Calibration

Purpose and Method

Same as for 2.5GT/s ASIC interface, for more details refer to 2.5G/5G RJ Calibration on page 84

The calibration data is stored in a caltable (Pcie<generation>_<DutType>_RandomJitter.txt). The calibration must be done for generation 1 and 2 for add-in-cards and system. For the measurements these calibration tables will be used to calculate the RJ amplitude that needs to be set on the generator to get the desired RJ amplitude at the test point.

Connection Setup for Random Jitter Calibration

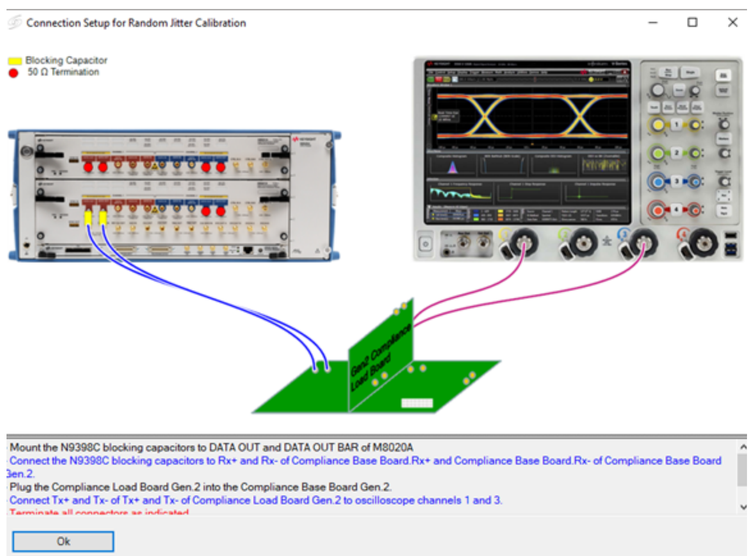


Figure 116   Connection Setup using JBERT_M8020A for AddInCard

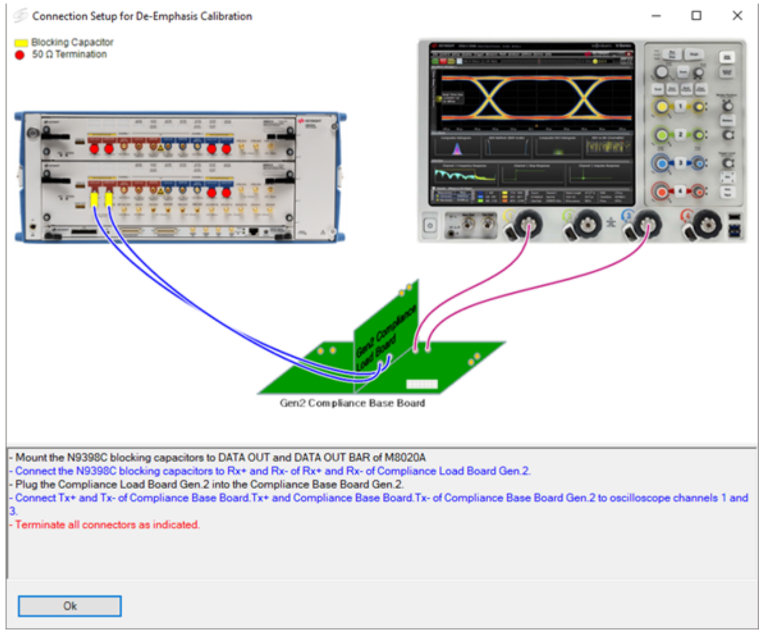


Figure 117 Connection Setup using JBERT_M8020A for System

Parameters in Expert Mode

- None

Used Calibrations

- None

Procedure Report

The HTML worksheet for Random Jitter Calibration procedure is similar to Figure 48 on page -86.

2.5G/5G De-Emphasis Calibration

Purpose and Method

This procedure calibrates the de-emphasis. The test automation starts with -6 dB of de-emphasis (by default), increases it with a step size of 0.5 dB and measures for every set value the corresponding de-emphasis. The calibration ends when the set de-emphasis is 0 or the measured de-emphasis is greater than 0 dB.

The calibration data is stored in a caltable (Pcie<generation>_<DutType>__DeEmphasis.txt). The calibration must be done for generation 1 and 2 for add-in-cards and systems. For the measurements these calibration tables will be used to calculate the de-emphasis level that needs to be set on the generator to get the desired de-emphasis level at the test point.

Connection Setup for De-Emphasis Calibration

Same as Connection Setup for Random Jitter Calibration on page 271.

Parameters in Expert Mode

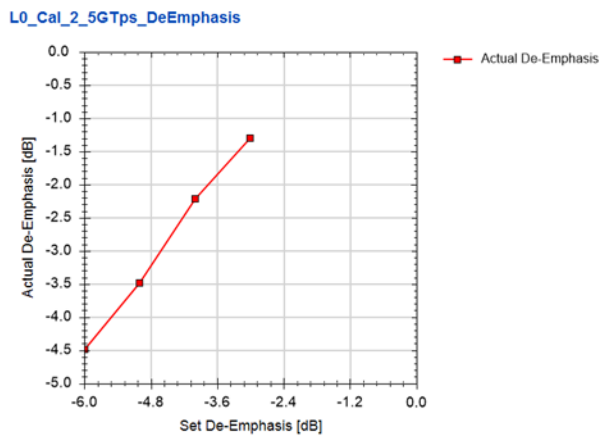
- Eye-Height: The eye height used in this procedure.
- Start De-Emphasis: The minimum de-emphasis that is calibrated.

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for De-Emphasis Calibration procedure is shown in Figure 118.



BERT System	Agilent M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Eye Height	238 mV
Start De-Emphasis	-6 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
Jitter Unit	Time

Set De-Emphasis [dB]	Actual De-Emphasis [dB]
-6.0	-4.492
-5.0	-3.482
-4.0	-2.215
-3.0	-1.300

Figure 118 Result Description of De-Emphasis Calibration

- Column 1
  - Set De-Emphasis [dB]: The de-emphasis set in the instrument.
- Column 2
  - Actual De-Emphasis [dB]: The measured de-emphasis.

2.5G/5G Eye Height Calibration

Purpose and Method

Same as for 2.5GT/s ASIC interface, but for CEM test Common Mode Sinusoidal Interference is not added to the stressed signal. For more details, refer to 2.5G/5G Eye Height Calibration on page 92.

The calibration data is stored in a caltable (Pcie<generation>_<DutType>__EyeHeight.txt). The calibration must be done for generation 1 and 2 for add-in-cards and systems. For the measurements these calibration tables will be used to adjust the differential voltage amplitude to the desired eye height.

Connection Setup for Eye Height Calibration

Same as Connection Setup for Random Jitter Calibration on page 271.

Parameters in Expert Mode

- None

Used Calibrations

- Random Jitter Calibration
- De-Emphasis Calibration

Procedure Report

The HTML worksheet for Eye Height Calibration procedure is similar to Figure 52 on page -93.

Receiver

Common Receiver Parameters

Receiver Specific

- Use External Reference Clock
- Ref Clock Multiplier

Data Rate Specific

1. Loopback Training
   - Link Training Mode
   - Link Training Suite Settings File,
   - Default Link Training Lane Number for every Lane
   - Suppress Loopback Training Messages
   - Use Custom Training Voltage
2. Error Detector
   - Use CDR
   - CDR Loop Bandwidth
   - CDR Use SSC
   - Filter Gen1/Gen2 SKPOs for BER test
   - Peaking
   - Analyzer Equalization
   - Sensitivity Mode
   - Polarity
3. BER Measurement
   - Relax Time

Lane Specific

- Link Training Lane Number

For details, refer to Table 4, “Common Parameters for Receiver groups”.

2.5G/5G Rx Compliance Test

Purpose and Method

Same as for 2.5GT/s ASIC interface. Refer to 2.5G/5G Rx Compliance Test on page 96.

Connection Setup for Compliance Test

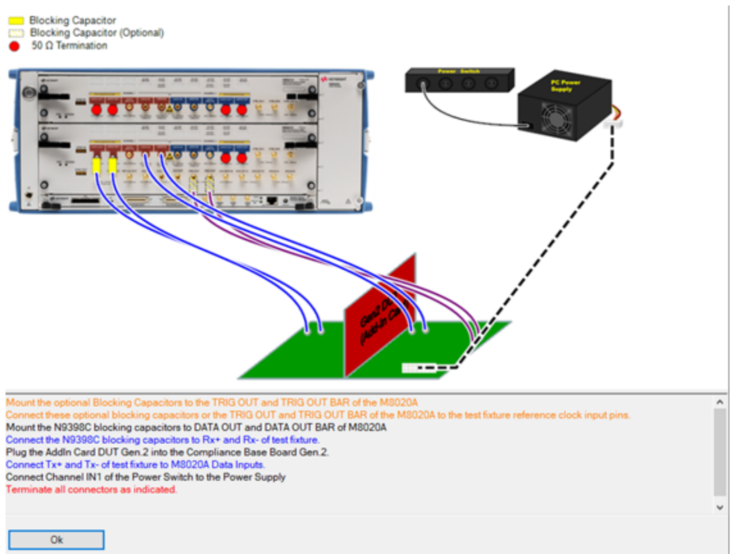


Figure 119 Connection Setup using JBERT_M8020A for AddInCard, Common Clock Architecture and no external ref clock

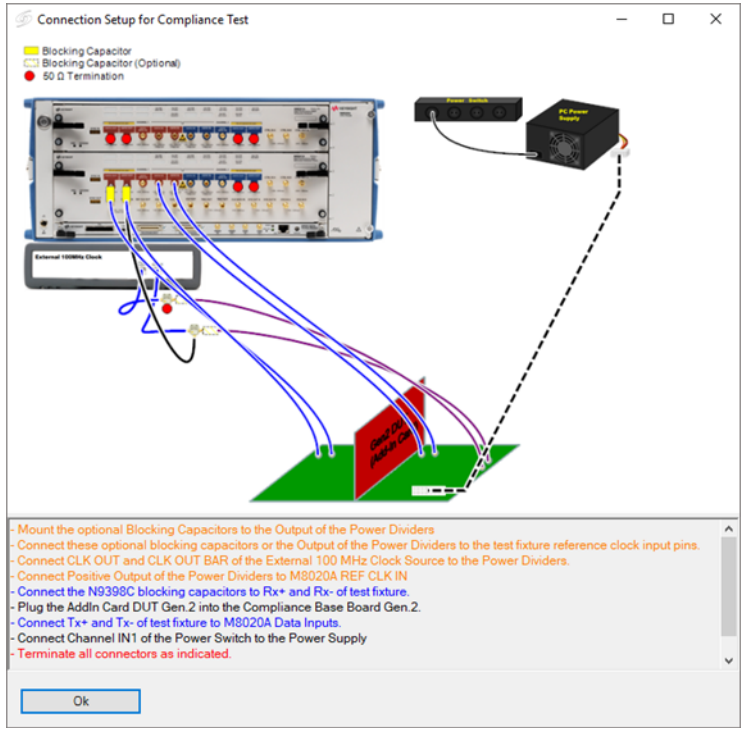


Figure 120 Connection Setup using JBERT_M8020A for AddInCard, Common Clock Architecture and external ref clock

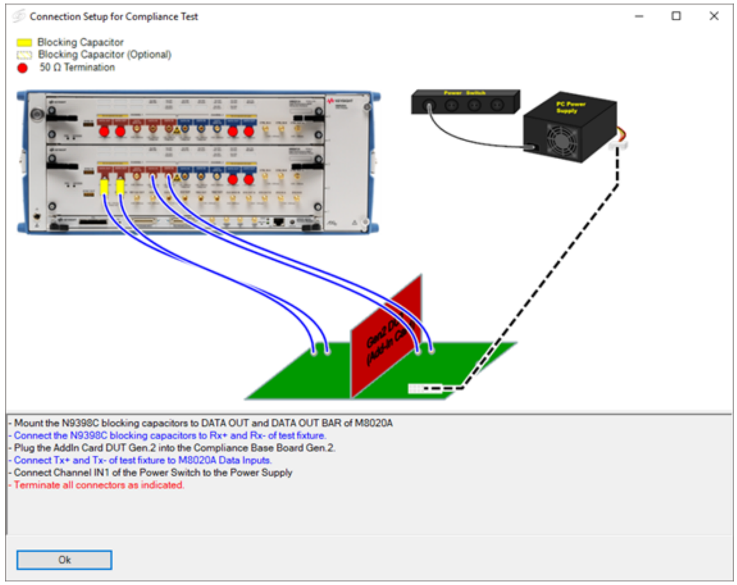


Figure 121   Connection Setup using JBERT_M8020A for AddInCard separate clock architecture

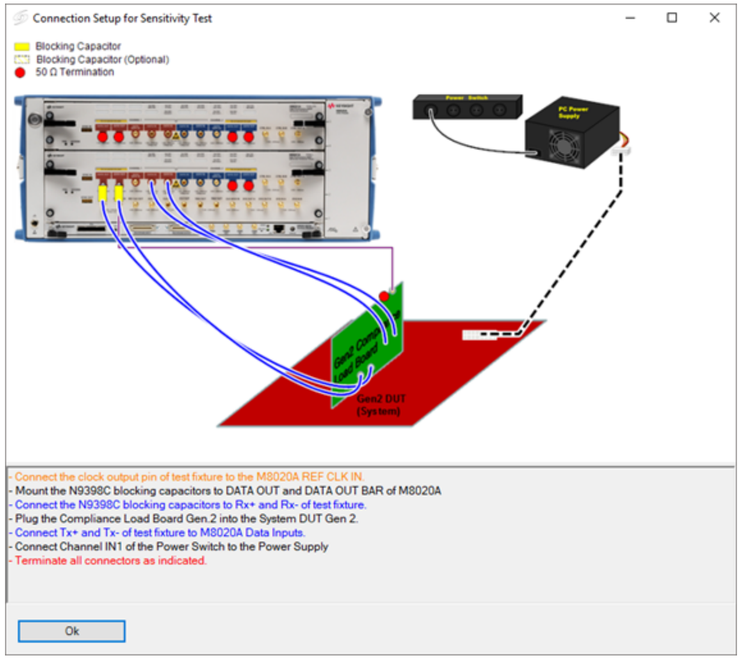


Figure 122 Connection Setup using JBERT_M8020A for System, Common Clock Architecture

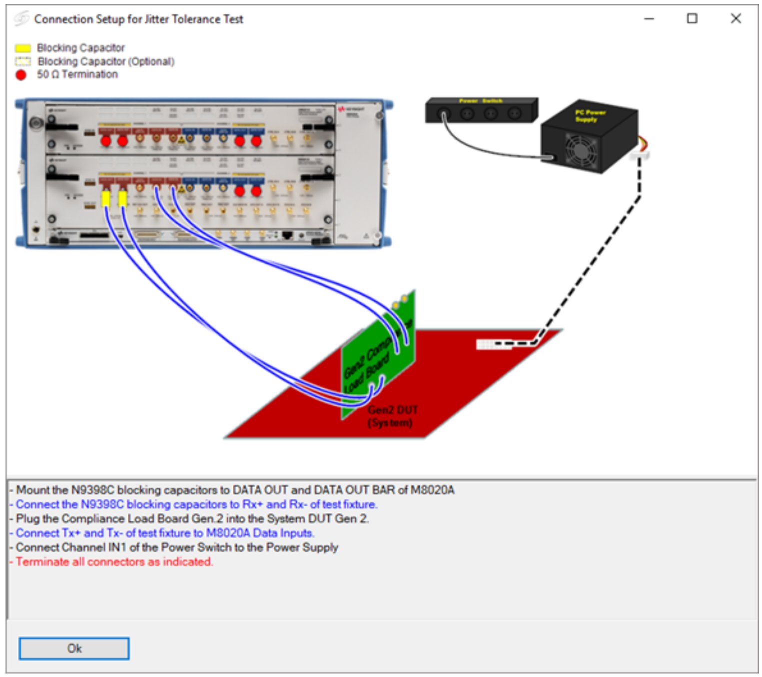


Figure 123   Connection Setup using JBERT_M8020A for System, Separate Clock Architecture

Parameters in Expert Mode

- Generator Jitter
  - Random Jitter
  - Swept sinusoidal Jitter
  - HF Sinusoidal Jitter (only for 5.0Gbit/s)
  - HF Sinusoidal Jitter Frequency (only for 5.0Gbit/s)
  - SSC Residual (only for 5.0Gbit/s)
- Eye Height
  - Eye Height
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level

- BER Measurement Duration
- Allowed Bit Error

For details, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Random Jitter Calibration
- De-Emphasis Calibration
- Eye Height Calibration

Procedure Report

The HTML worksheet for Compliance Test procedure is similar to Figure 56.

2.5G/5G Rx Jitter Tolerance Test

Purpose and Method

Same as for 2.5GT/a ASIC tests. For details refer to 2.5G/5G Rx Jitter Tolerance Test on page 100.

Connection Setup for Jitter Tolerance Test

Same as Connection Setup for Compliance Test on page 277.

Parameters in Expert Mode

- Sinusoidal Jitter Variation
  - Frequency Mode
  - Frequency Scale
  - Start Frequency
  - Stop Frequency
  - Frequency Steps
  - Frequency Points
  - Search algorithm
  - Jitter Step Size
  - Jitter Step Factor
  - Jitter Start Value
  - Show Min Failed Points
- Parameter
  - Force retraining on each frequency
- Generator Jitter
  - Random Jitter
  - HF Sinusoidal Jitter (only for 5.0Gbit/s)
  - HF Sinusoidal Jitter Frequency (only for 5.0Gbit/s)
  - SSC Residual (only for 5.0Gbit/s)
- Eye Height
  - Eye Height: The eye height used in this procedure.
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration

- Allowed Bit Error

For details, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Random Jitter Calibration
- De-Emphasis Calibration
- Eye Height Calibration

Procedure Report

The HTML worksheet for Jitter Tolerance Test procedure is similar to Figure 57 on page -103.

2.5G/5G Rx Sensitivity Test

Purpose and Method

Same as for 2.5GT/s ASIC interface. Refer to 2.5G/5G Rx Sensitivity Test on page 105.

Connection Setup for Sensitivity Test

Same as Connection Setup for Compliance Test on page 277.

Parameters in Expert Mode

- Generator Jitter
  - Use Jitter
  - Random Jitter
  - Swept sinusoidal Jitter
  - HF Sinusoidal Jitter (only for 5.0Gbit/s
  - HF Sinusoidal Jitter Frequency (only for 5.0Gbit/s)
  - SSC Residual (only for 5.0Gbit/s)
- Eye Height
  - Loopback Training Eye Height: The eye height used for loopback training.
  - Start Eye Height: The eye height (transitions bits) where the test starts.
  - Stop Eye Height: The eye height (transitions bits) where the test stops.
  - Step Size: The amount the eye height is decreased each step to search the “Min Passed Eye Height”.
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error

For details, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Random Jitter Calibration
- De-Emphasis Calibration

- Eye Height Calibration

Procedure Report

The HTML worksheet for Sensitivity Test procedure is similar to Figure 58 on page -107.

Receiver Setup (Only for Debugging)

2.5G/5G Rx Compliance Setup

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Compliance Rx test using the calibration data saved on the PC where N5990A software is running. The method begins like Compliance test but then the test will not run, it only leaves the setup prepared. The set parameters are the eye height, random jitter, swept sinusoidal jitter and HF sinusoidal jitter (only for 5.0GT/s).

Connection Setup for Sensitivity Test

Same as Connection Setup for 2.5G/5G Rx Compliance Test on page 277.

Parameters in Expert Mode

- Generator Jitter
- Random Jitter:
- Swept sinusoidal Jitter
- HF Sinusoidal Jitter (only for 5.0Gbit/s)
- HF Sinusoidal Jitter Frequency (only for 5.0Gbit/s)
- SSC Residual (only for 5.0Gbit/s)
- Eye Height
- Eye Height

For details, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Random Jitter Calibration
- De-Emphasis Calibration
- Eye Height Calibration

Procedure Report

- None

8 8.0 GT/s CEM Tests

Calibration

Common Calibration Parameters

- Data Rate Specific
  - Scope Connection for Calibration
  - UXR Calibration Mode
  - Sampling Rate
  - Range to Signal Ratio

For details, refer to Table 3, “Common Parameters for Calibration groups”.

8G TxEQ and Launch Voltage Calibration

Purpose and Method

The PCIe3 Base Specification defines several combinations of pre-shoots and de-emphasis values. In this calibration the De-emphasis, Pre-shoot and DC amplitude are calibrated at the end of the cables which are later plugged into the SMP connectors of Rx lane 1 of the compliance board riser card or the compliance base board. The procedure is the same as for 8.0GT/s ASIC interface. For more details, refer to 8G TxEq and Launch Voltage Calibration on page 113.

Connection Setup for TxEQ and Launch Voltage Calibration

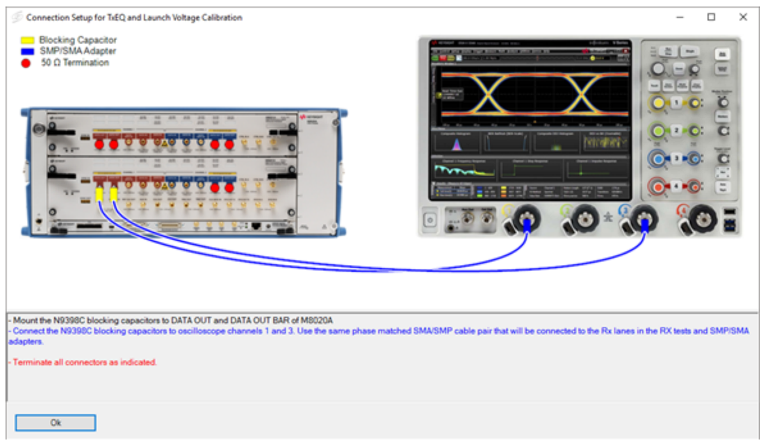


Figure 124 Connection Setup using JBERT_M8020A

Parameters in Expert Mode

- EQ Calibration Pattern
- Verification Mode
- Generator
  - Set Amplitude
- Oscilloscope
  - Scope Bandwidth
  - Number of Waveform Averages

For details, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- None

Procedure Report

Examples of HTML worksheet for TxEQ and Launch Voltage Calibration procedure are shown in Figure 60, Figure 61 and Figure 62 on page -118.

8G RJ Calibration

Purpose and Method

Same as for 8.0GT/s ASIC interface. For more details, refer to 8G RJ Calibration on page 120.

Connection Setup for Random Jitter Calibration

Same as Connection Setup for TxEQ and Launch Voltage Calibration on page 291.

Parameters in Expert Mode

- Verification Mode
- Number of averages for jitter measurement
- Stop Random Jitter: The maximum jitter that is calibrated.
- Random Jitter Step Size: The amount the random jitter is increased in each step.

For details, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- None

Procedure Report

The HTML worksheet for Random Jitter Calibration procedure is similar to Figure 63 on page -121.

8G SJ Calibration

Purpose and Method

This procedure calibrates the sinusoidal jitter amplitude at two different frequencies (5 MHz and 100 MHz). The test automation starts with 0 ps of SJ and increases that value in linear steps. For each step the procedure measures the actual amplitude for both frequencies.

The calibration data is stored in a caltable (Pcie3Cem_<channel>_SinusoidalJitter.txt). For the measurements these calibration tables will be used to adjust the SJ amplitude to the desired output SJ amplitudes.

Available for following hardware configurations

- All

Connection Setup for Sinusoidal Jitter Calibration

Same as Connection Setup for TxEQ and Launch Voltage Calibration on page 291.

Parameters in Expert Mode

- Verification Mode
- CDR loop-bandwidth.
- Number of averages for jitter measurement

Used Calibrations

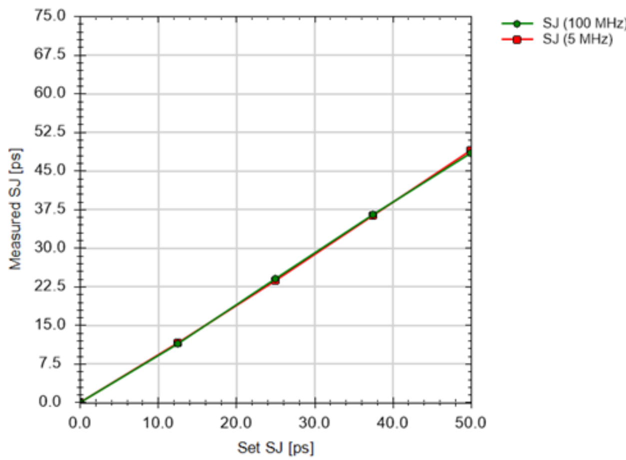
- None

Procedure Report

An example of HTML worksheet for Sinusoidal Jitter Calibration procedure is shown in Figure 125.

L0_Cal_8GTps_SJ

for PCIe 3.0 AddInCard



SigTest Version	3.1.63
BERT System	Agilent M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
CDR loop-bandwidth	50 kHz
Number of averages for jitter measurement	1
Scope Connection for Calibration	Chan 1 3 Direct Connect
Jitter Unit	Time

Set SJ [ps]	SJ (5 MHz) [ps]	SJ (100 MHz) [ps]
0.00	0.00	0.00
12.50	11.58	11.45
25.00	23.58	24.06
37.50	36.32	36.47
50.00	48.87	48.42

Figure 125 Result Description of Sinusoidal Jitter Calibration

- Column 1:
  - Set Jitter [ps]: The jitter amplitude set in the instrument.
- Column 2:
  - SJ (x frequency) [ps]: The measured jitter amplitude at x frequency.

8G DM SI Calibration

Purpose and Method

The procedure is similar as for ASIC interface but for CEM, CMSI is not added to the signal. For more details, refer to 8G DM SI Calibration on page 130.

Connection Setup for DM Sinusoidal Interference Calibration

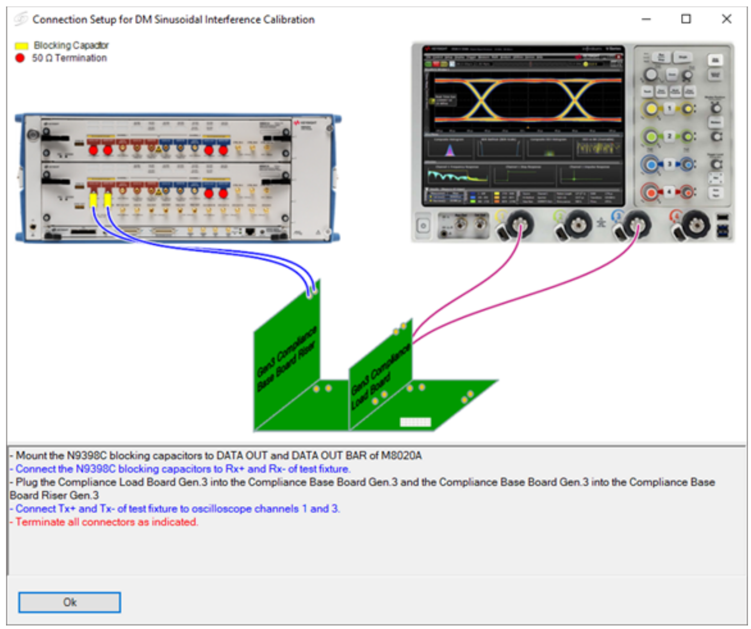


Figure 126 Connection Setup using JBERT_M8020A

Parameters in Expert Mode

- None

Used Calibrations

- None

Procedure Report

The HTML worksheet for DM Sinusoidal Interference Calibration procedure is similar to Figure 68 on page -131.

8G Eye Height and Width Calibration

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 now repeated for all remaining DMSI amplitudes.

The eye is measured by using the SigTest software.

The calibration data is stored in a caltable (Pcie3Cem_<channel>_ _Cbb3_EyeHeight and Pcie3Cem_<channel>_ _Cbb3_EyeWidth). This cal data is used to evaluate the optimum amount of DMSI and Random Jitter to get the desired Eye Height and Width.

Available for following hardware configurations

- All

Connection Setups for Eye Height and Width Calibration

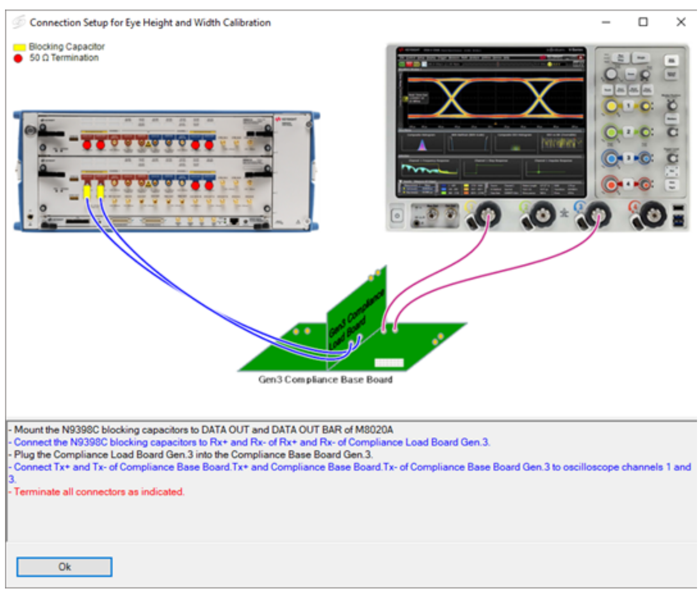


Figure 127 Connection Setup using JBERT_M8020A with System

Parameters in Expert Mode

- Eye Height and Width Calibration
  - Optimize CTLE: Select if CTLE optimization is used. Default is false.
  - RJ for CTLE optimization: Random jitter set if CTLE optimization is used.
  - DMSI for CTLE optimization: DMSI set if CTLE optimization is used.
  - CTLE Index: CTLE index if CTLE optimization is not used.
  - Start DMSI: The first set DMSI value.
  - Stop DMSI: The last set DMSI value.
  - Number of DMSI Steps: The number of DMSI steps.
  - Start RJ: The first set RJ value.
  - Stop RJ: The last set RJ value.
  - Number of RJ Steps: The number of RJ steps.
  - Number of Averages

For details, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

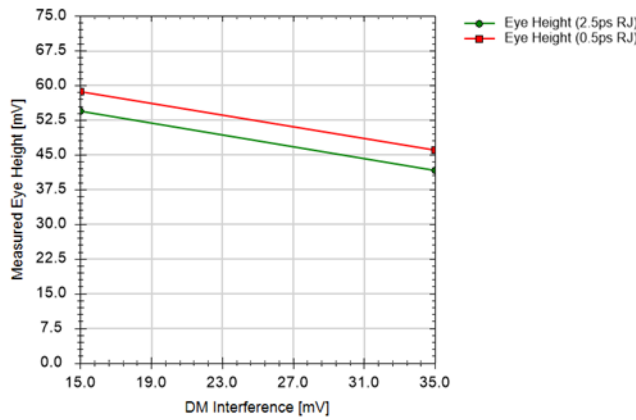
- Equalization Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration

Procedure Report

Examples of HTML worksheet for Eye Height and Width Calibration procedure are shown in Figure 128 and Figure 129.

L0_Cal_8GTps_CBB3_Eye_Height

for PCIe 3.0 AddInCard

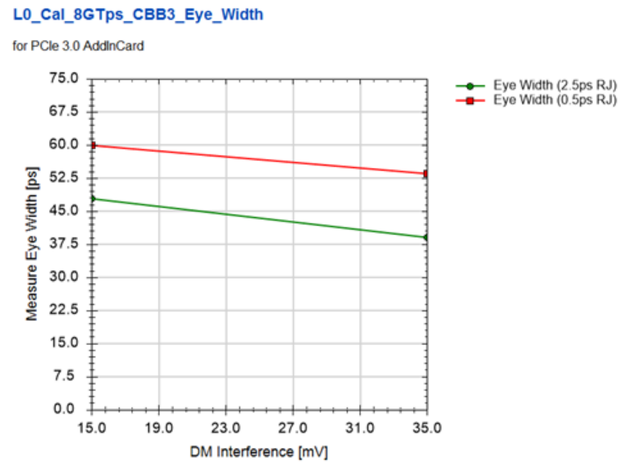


BERT System	Agilent M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Optimize CTLE	False
CTLE Index	7
Start DMSI	15 mV
Stop DMSI	35 mV
Start RJ	500 fs
Stop RJ	2.5 ps
Number of Averages	3
Scope Connection for Calibration	Chan 1 3 Direct Connect
Jitter Unit	Time

Set DM Interference [mV]	Eye Height (0.5ps RJ) [mV]	Eye Height (2.5ps RJ) [mV]
15	58.7	54.4
35	45.9	41.6

Figure 128 Result Description of Eye Height and Width Calibration

- Column 1:
  - Set DM Interference [mV]: The DMSI set in the instrument.
- Column x+1:
  - Eye Height (x RJ) [mV]: The measured eye height for x RJ.



SigTest Version	3.1.63
BERT System	Agilent M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Optimize CTLE	False
CTLE Index	7
Start DMSI	15 mV
Stop DMSI	35 mV
Start RJ	500 fs
Stop RJ	2.5 ps
Number of Averages	3
Scope Connection for Calibration	Chan 1 3 Direct Connect
Jitter Unit	Time

Set DM Interference [mV]	Eye Width (0.5ps RJ) [ps]	Eye Width (2.5ps RJ) [ps]
15	59.9	47.9
35	53.4	39.1

Figure 129 Result Description of Eye Height and Width Calibration

- Column 1:
  - Set DM Interference [mV]: The DMSI set in the instrument.
- Column x + 1:
  - Eye Width (x RJ) [ps]: The measured eye width for x RJ.

8G Compliance Eye Calibration

Purpose and Method

This procedure checks if it is possible to generate an eye-height and an eye- width that meet the specification by adding Random Jitter and Differential Mode Sinusoidal Interference. The method starts with default 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 found or until the “Max Number of Search Steps” is reached. If the “Max Number of Search Steps” is reached it checks if the optimum combination of RJ and DMSI tested meets the specification.

The calibration data is stored in a caltable (Pcie3Cem_<channel>_ _Cbb3_CompEye). This cal data is used to get the combination of DMSI and Random Jitter that generates the eye closest to the compliance

Connection Setups for Compliance Eye Calibration

Same as Connection Setups for Eye Height and Width Calibration on page 297.

Parameters in Expert Mode

- Verification Mode
- Target Eye-Height: Read-only. Max spec value - 1mV.
- Target Eye-Width: Read-only. Max spec value - 5ps.
- Max Number of Search Steps: Max number of times that the RJ and DMSI can be recalculated to get the target values.
- Number of Averages

For details, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- Equalization Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

L0_Cal_8GTps_CBB3_Comp_Eye

for PCIe 3.0 AddInCard

SigTest Version	3.1.63
BERT System	Agilent M8020A J-BERT, M8070A, SN: DE53C00025
Offline	False
Max Number of Search Steps	4
Number of Averages	3
Scope Connection for Calibration	Chan 1 3 Direct Connect
Jitter Unit	Time

DMSI [mV]	RJ [ps]	Eye Height [mV]	Eye Width [ps]
29.3	2.63	44.4	40.5

Figure 130 Result Description of Compliance Eye Calibration

- Column 1:
  - DMSI [mV]: Optimum DMSI added to the signal.
- Column 2:
  - RJ [ps]: Optimum RJ added to the signal.
- Column 3:
  - Eye Width [mV]: Eye width measured.
- Column 4:
  - Eye Height [ps]: Eye height measured.

Procedure Report (Verification Mode)

L0_Ver_8GTps_CBB3_Comp_Eye

for PCIe 3.0 AddInCard

Offline	True
Compliance Mode	True
Number of Averages	21
Scope Connection for Calibration	Chan 1 3 Direct Connect
Jitter Unit	Time

Eye Height [mV]	Eye Width [ps]
44.5	40.50

Figure 131 Result Description of Compliance Eye Verification

- Column 1:
  - Eye-Height [mV]: Simulated Eye Height
- Column 2:
  - Eye-Width [ps]: Simulated Eye Height

Receiver Tests

Common Rx Tests Parameters

Receiver Specific

1. Use External Reference Clock
2. Ref Clock Multiplier

Data Rate Specific

1. Loopback Training
   - Link Training Mode
   - Link Training Suite Settings File,
   - Default Link Training Lane Number for every Lane
   - Suppress Loopback Training Messages
   - Use Custom Training Voltage
2. Interactive Link Training
   - Training Through
   - Generator Start Preset
   - DUT Initial Preset
   - DUT Target Preset
   - Drop Link Method
3. Error Detector
   - Use CDR
   - CDR Loop Bandwidth
   - CDR Use SSC
   - Filter Gen3 SKPOs for BER test
   - Peaking
   - Analyzer Equalization
   - Sensitivity Mode
   - Capture and Compare Mode
   - Pause before Auto-Align
   - Polarity
4. BER Measurement
   - Relax Time

5 Lane Specific
- Link Training Lane Number
- Use Preset
- Generator Preset
- Pre-Shoot
- De-Emphasis

8G Rx Coefficient Matrix Scan

Purpose and Method

Same as for 8.0GT/s ASIC interface. Refer to 8G Rx Coefficient Matrix Scan on page 149.

Connection Setups for EQ Coefficient Matrix Scan

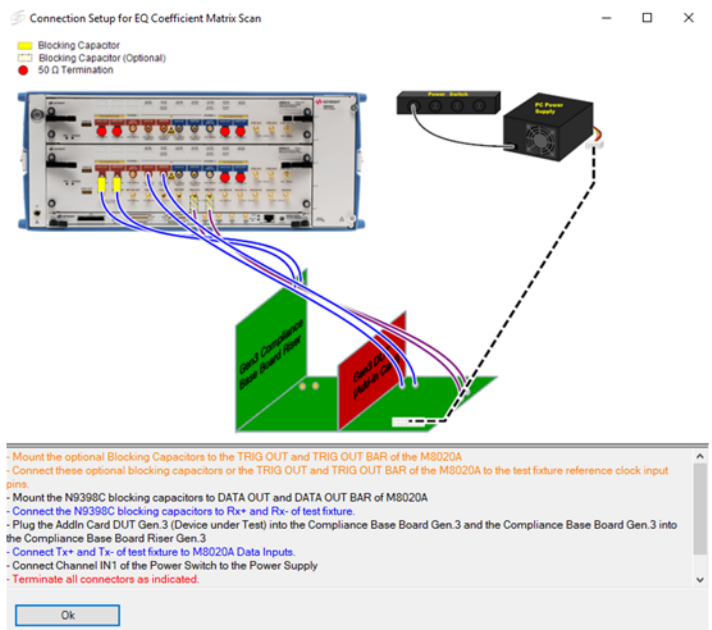


Figure 132 Connection Setup using JBERT_M8020A with AddInCard Common Clock Architecture and no external ref clock

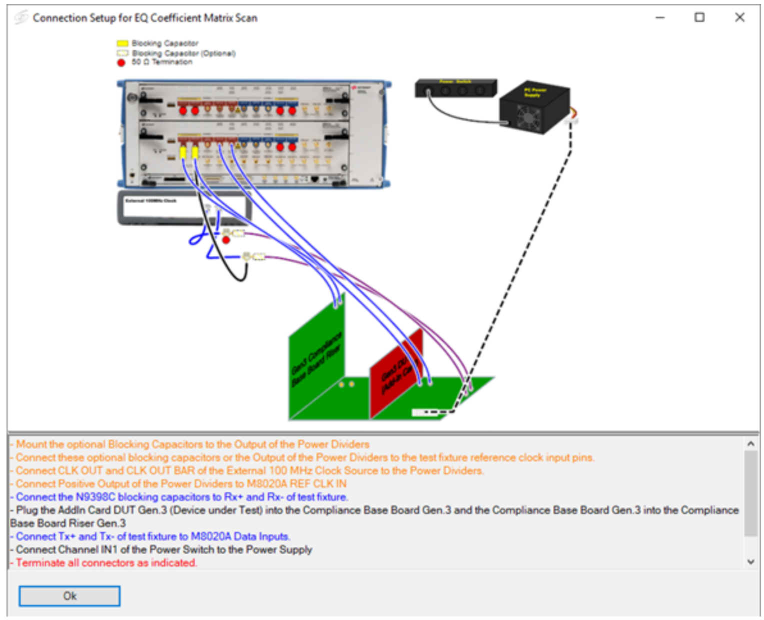


Figure 133 Connection Setup using JBERT_M8020A with AddInCard Common Clock Architecture and external ref clock internal clock multiplier

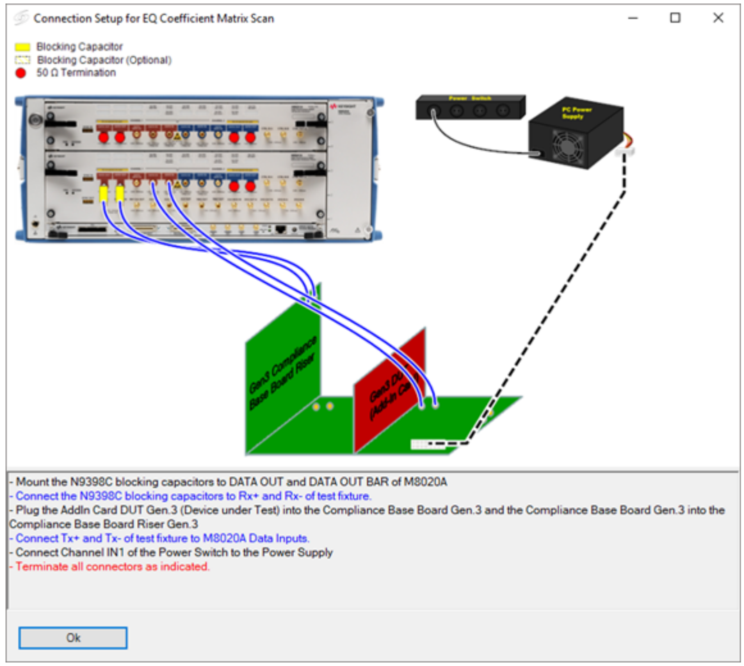


Figure 134 Connection Setup using JBERT_M8020A with AddInCard Separate Clock Architecture

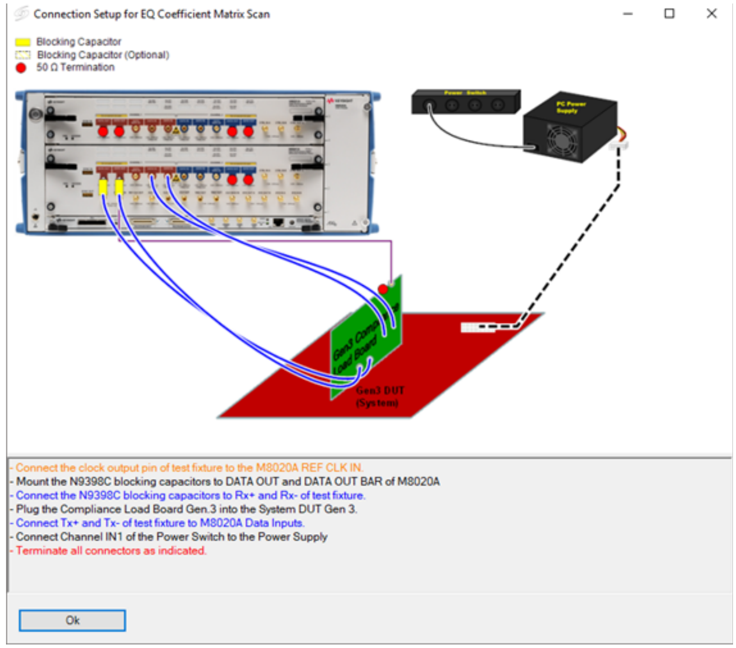


Figure 135 Connection Setup using JBERT_M8020A with System Common Clock Architecture

Parameters in Expert Mode

1 Loopback Training
   - Force Retraining at each BER measurement
2 Eye Parameter
   - Eye-Height
   - Eye-Width
   - Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to the signal to achieve the desired eye-height and eye width in combination with the RJ.
   - Random Jitter: The amount of RJ which needs to be added to the signal to achieve the desired eye-height and eye-width in combination with the DMSI.
   - Sinusoidal Jitter: 12.5 ps of SJ has to be added for this procedure.
   - Sinusoidal Jitter Frequency: The frequency of the sinusoidal jitter component.
3 Coefficient Variation

- Test Presets only
- Coefficient Divider
- Maximum Boost
- Start Pre-Shoot
- Start De-Emphasis

4 BER Measurement

- BER Mode
- Target BER
- Confidence Level

5 Equalization for remaining Rx Tests

- Allow user to enter optimum equalization for remaining Rx tests.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

The HTML worksheet for EQ Coefficient Matrix Scan procedure is similar to Figure 81 on page -155.

8G Rx PreShoot De-Emphasis Scan

Purpose and Method

Same as for 8.0GT/s ASIC interface. Refer to 8G Rx Pre-Shoot De-Emphasis Scan on page 156.

Connection Setups for EQ PreShoot De-Emphasis Scan

Same as Connection Setups for EQ Coefficient Matrix Scan on page 306.

Parameters in Expert Mode

1 Parameter
- Scan Order: Select if de-emphasis or pre-shoot is tested first.
- Initial De Emphasis: The initial de-emphasis used for BER adjustment and pre-shoot scan.
- Initial Pre Shoot: The initial pre-shoot used for BER adjustment and de-emphasis scan.
- Force training at each Preset: If true, every time the de-emphasis or the pre-shoot is changed the DUT is trained into loopback again.

2 De-Emphasis Variation
- Start De Emphasis: Start amplitude for the de-emphasis scan.
- Stop De Emphasis: Stop amplitude for the de-emphasis scan.
- De Emphasis Step Size: Step size for the de-emphasis scan.

3 Pre-Shoot Variation
- Start Pre Shoot: Start amplitude for the pre-shoot scan.
- Stop Pre Shoot: Stop amplitude for the pre-shoot scan.
- De Pre Shoot Size: Step size for the pre-shoot scan.

4 BER Measurement
- BER Mode
- Target BER
- Confidence Level
- BER Measurement Duration
- Allowed Bit Error

5 Equalization for remaining Rx Tests
- Allow user to enter optimum equalization for remaining Rx tests.

For detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

Examples of HTML worksheet for EQ PreShoot De-Emphasis Scan procedure are similar to Figure 82 and Figure 83 on page -159.

8G Rx Preset Compliance

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 adding the adequate amount of random jitter and DMSI. The procedure measure the number of errors during “BER Measurement duration” and checks if the “Target BER” is satisfied. In this procedure presets P7 and P8 are tested.

Connection Setups for Preset Compliance Test

Same as Connection Setups for EQ Coefficient Matrix Scan on page 306.

Parameters in Expert Mode

- Loopback Training
  - Enable Impairments for Loopback Training
- Parameter
  - Eye Height
  - Eye Width
  - Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the desired eye height and eye width in combination with RJ.
  - Random Jitter: The amount of RJ which needs to be added to achieve the desired eye height and eye width in combination with DMSI.
  - Sinusoidal Jitter: 12.5ps of SJ has to be added for this test.
  - Sinusoidal Jitter Frequency
- BER Measurement
  - BER Measurement Duration
  - Target BER

For detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

An example of HTML worksheet for Preset Compliance Test procedure is shown in Figure 136.

L0_Rx_8GTps_CBB3_PreComp

for PCIe 3.0 AddInCard

Differential Mode Sinusoidal Interference	35.1 mV
Random Jitter	1.9 ps
Sinusoidal Jitter	12.5 ps
Offline	False
Enable Impairments for Link Training	True
Eye Height	44.5 mV
Eye Width	40.5 ps
Sinusoidal Jitter Frequency	100 MHz
BER Measurement Duration	12.5 s
Target BER	100E-6
Use Preset	False
Pre-Shoot	2.4 dB
De-Emphasis	-1 dB
Link Training Lane Number	0
Data Rate Deviation	0 ppm
Use CDR	True
CDR Loop Bandwidth	12 MHz
CDR Use SSC	False
Filter Gen3 SKPOS for BER test	False
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	1 s
Link Training Mode	JBERT Link Training
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrame\Settings\PCIe\Tr
Default Link Training Lane Number for every Lane	Auto
Suppress Loopback Training Messages	False
Jitter Unit	Time
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

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

Figure 136 Result Description of Preset Compliance Test

- Column1:
  - Result: The BER measured should be smaller than the Target BER.
- Column 2:
  - Preset: Preset tested.
- Column 3:
  - Target BER: Max BER allowed to pass the test.
- Column4:
  - Measured BER.

8G Rx Preset Pre Compliance Test

This procedure is only available if Gen4 spec is selected.

The procedure behaves the same as the 8G Rx Preset Compliance on page 313.

8G Rx Compliance Tests

Purpose and Method

This procedure is only available if Gen3 spec is selected.The test is nearly the same as the Preset Compliance Test, but only for preset P7.

Connection Setups for Compliance Tests

Same as Connection Setups for EQ Coefficient Matrix Scan on page 306.

Parameters in Expert Mode

- Loopback Training
  - Enable Impairments for Loopback Training
- Parameter
  - Eye Height
  - Eye Width
  - Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the desired eye height and eye width in combination with RJ.
  - Random Jitter: The amount of RJ which needs to be added to achieve the desired eye height and eye width in combination with DMSI.
  - Sinusoidal Jitter: 12.5 ps of SJ has to be added for this test.
  - Sinusoidal Jitter Frequency
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error

For detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

An example of HTML worksheet for Compliance Tests procedure is shown in Figure 137.

L0_Rx_8GTps_CBB3_Comp

for PCIe 3.0 AddInCard

Differential Mode Sinusoidal Interference	15 mV
Random Jitter	1.5 ps
Sinusoidal Jitter	12.5 ps
Offline	True
Eye Height	44.5 mV
Eye Width	40.5 ps
Sinusoidal Jitter Frequency	100 MHz
Enable Impairments for Link Training	True
BER Mode	FixedTime
BER Measurement Duration	125 s
Allowed Bit Error	1
Use Preset	True
Generator Preset	P7
Pre-Shoot	3.5 dB
De-Emphasis	-6 dB
Data Rate Deviation	0 ppm
Link Training Mode	Interactive
Training through	L0-Recovery
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Drop Link Method	LTSSM
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK0\PCIe\Setti
Suppress Loopback Training Messages	False
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	-6 dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	3 s
Use External 100MHz Reference Clock Source	False
Ref Clock Multiplier	N4880A

Result	Allowed Bit Errors []	Measured Bit Errors []
pass	1	0

Figure 137 Result Description of Compliance Tests

- Column1:
  - Result: The BER measured should be smaller than the Target BER.
- Column 2:
  - Allowed Bit Errors: The allowed number of bit errors with the BER measurement.
- Column 3:
  - Measured Bit Errors: Number of received error bits during BER measurement.

8G Rx Pre Compliance Test

This procedure is only available if Gen4 spec is selected.

The procedure behaves the same as the 8G Rx Compliance Tests on page 316.

8G Rx Jitter Tolerance Test

Purpose and Method

Same as for 2.5GT/s ASIC interface. For details refer to 2.5G/5G Rx Jitter Tolerance Test on page 100.

Connection Setups for Jitter Tolerance Test

Same as Connection Setups for EQ Coefficient Matrix Scan on page 306.

Parameters in Expert Mode

1. Sinusoidal Jitter Variation
   - Frequency Mode
   - Frequency Scale
   - Start Frequency
   - Stop Frequency
   - Frequency Steps
   - Frequency Points
   - Search algorithm
   - Jitter Step Size
   - Jitter Step Factor
   - Jitter Start Value
   - Show Min Failed Points
2. Parameter
   - Use Compliance RJ and DMSI Values: 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.
   - Random Jitter: The amount of RJ which needs to be added to achieve the compliance eye height and eye width in combination with DMSI.
   - Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the compliance eye height and eye width in combination with RJ.
   - Force Retraining on Each Frequency
3. BER Measurement
   - Ber Mode
   - Target BER
   - Confidence Level

- BER Measurement Duration
- Allowed Bit Error

For detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration

Procedure Report

The example of HTML worksheet for Jitter Tolerance Test procedure is similar to Figure 57 on page -103.

8G Rx Sensitivity Test

Purpose and Method

This test searches the minimum eye height at which the DUT passes the BER test. The method starts with “Start Eye Height” and decreases with steps of “Step Size”. The minimum passed value is the last test point that did not return an error. Eye height is generated changing the Differential Mode Sinusoidal Interference, the random jitter is fixed to the compliance value.

Connection Setups for Sensitivity Test

Same as Connection Setups for EQ Coefficient Matrix Scan on page 306.

Parameters in Expert Mode

1 Sensitivity Variation
   - Start Eye Height: It is the first and also the largest Eye Height attained in the Eye Diagram.
   - Stop Eye Height: It is the last and also the smallest Eye Height attained in the Eye Diagram unless the DUT already fails at a higher eye-height.
   - Eye-Height Step Size: The amount of the eye height, which is decreased at each step, to search the “Min Passed Eye Height”.

2 Parameter
   - Random Jitter: The amount of RJ which needs to be added to achieve the compliance eye height and eye width in combination with DMSI.
   - Sinusoidal Jitter: 12.5 ps of SJ has to be added for this test.
   - Sinusoidal Jitter Frequency: Frequency of the sinusoidal jitter component.

- BER Measurement
   - BER Mode
   - Target BER
   - Confidence Level
   - BER Measurement Duration
   - Allowed Bit Error

For detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height Calibration

Procedure Report

The example of HTML worksheet for Sensitivity Test procedure is shown in

L0_Rx_8GTps_CBB3_Sensitivity

for PCIe 4.0 AddInCard

Offline	False
Start Eye Height	58 mV
Eye Height Step Size	1 mV
Sinusoidal Jitter Frequency	100 MHz
BER Mode	TargetBer
Target BER	1E-9
Confidence Level	95 %
Use Preset	False
Pre-Shoot	3.5 dB
De-Emphasis	-6 dB
Data Rate Deviation	0 ppm
Link Training Mode	Interactive
Training through	L0-Recovery
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Drop Link Method	LTSSM
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK0\PCIe\Settings\
Suppress Loopback Training Messages	False
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	-6 dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	3 s

Result	Min Passed Eye Height [mV]	Spec Limit [mV]	Margin [%]
pass	1.0	46.0	97.8

Figure 138 Result Description of Sensitivity Test

- "Result: Pass if the main passed eye height is lower than the spec limit
- "Mix Passed Eye Height: This is the miximum value of eye-height that the DUT can tolerate.

- "Spec Limit: This is the minimum value of eye-height that the DUT should tolerate according to the specs.
- "Margin: Ratio between the min eye height tolerated and the minimum defined in the specs.

Link Equalization Receiver Tests

In order to have access to the link equalization tests, ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Rx Test Parameters

Data Rate Specific

1. Loopback Training
   - Interactive Training Script File
   - Suppress Loopback Training Messages
   - Use Custom Training Voltage
2. Interactive Link Training
   - Generator Start Preset
   - DUT Initial Preset
   - DUT Target Preset
   - Drop Link Method
3. Error Detector
   - Use CDR
   - CDR Loop Bandwidth
   - CDR Use SSC
   - Filter Gen3 SKPOs for BER test
   - Peaking
   - Analyzer Equalization
   - Sensitivity Mode
   - Capture and Compare Mode
   - Pause before Auto-Align
   - Polarity
4. BER Measurement
   - Relax Time

For detail, refer to Table 4, “Common Parameters for Receiver groups”.

NOTE

Lane 0 is the only available lane for Link Equalization Tests.

8G LEQ Rx Compliance Tests

Purpose and Method

These tests use the interactive link training feature of the M8020A J-BERT to let the DUT negotiate the generator transmitter preset that will be used.

The Compliance Test for Add-in Cards can be divided in two phases. In the first phase, the CBB rev.3 is used and the starting generator transmitter presets are P7 and P8. In the second phase, the CBB rev.2 is used and the starting generator transmitter presets are P1, P7 and P8.

The Compliance Test for System Boards consists of one phase, using the CLB rev.3.

Connection Setup for Compliance Tests

Same as Connection Setups for EQ Coefficient Matrix Scan on page 306, depending on the DUT and the CLB/CBB rev. required.

Parameters in Expert Mode

- Loopback Training
  - Enable Impairments for Loopback Training
  - Parameter
  - Eye Height
  - Eye Width
  - Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the desired eye height and eye width in combination with RJ.
  - Random Jitter: The amount of RJ which needs to be added to achieve the desired eye height and eye width in combination with DMSI.
  - Sinusoidal Jitter: 12.5 ps of SJ has to be added for this test.
  - Sinusoidal Jitter Frequency
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error

For detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

An example of HTML worksheet for Compliance Tests procedures is shown in Figure 139.

L0_EqRx_8GTps_CBB3_Comp

for PCIe 3.0 AddInCard

Differential Mode Sinusoidal Interference	15 mV
Random Jitter	1.5 ps
Sinusoidal Jitter	12.5 ps
Offline	True
Enable Impairments for Link Training	True
Eye Height	44.5 mV
Eye Width	40.5 ps
Sinusoidal Jitter Frequency	100 MHz
BER Mode	FixedTime
BER Measurement Duration	125 s
Allowed Bit Error	1
Data Rate Deviation	0 ppm
Interactive Training Script File	C:\ProgramData\BitifEye\ValiFrameK0\PCIe
Suppress Loopback Training Messages	False
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Drop Link Method	LTSSM
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	-6 dB
Capture and Compare Mode	False
Pause before Auto-Align	False
Sensitivity	Normal
Polarity	Normal
Relax Time	3 s

Result	Initial Generator Preset	Final Generator Preset	Final Generator Pre-shoot [dB]	Final Generator De-emphasis [dB]	Allowed Bit Errors []	Measured Bit Errors []
pass	P7	P0	0.00	-6.00	1	0
pass	P8	P0	0.00	-6.00	1	0

Figure 139 Result Description of Compliance Tests

- Column1:
  - Result: The BER measured should be smaller than the Target BER.
- Column 2:
  - Initial Generator Preset: Initial Generator Preset (used for Add-in Card only).
- Column 3:
  - Final Generator Preset: Final Generator Preset (requested by the DUT).

- Column 4:
  - Final Generator Pre-Shoot [dB]: The pre-shoot sent by the generator
  - after the negotiation.
- Column 5:
  - Final Generator De-Emphasis [dB]: The de-emphasis sent by the generator after the negotiation.
- Column 6:
  - Allowed Bit Errors: Number of allowed bit errors to pass the test.
- Column 7:
  - Measured Bit Errors: Number of measured bit errors after the BER test.

8G LEQ Rx Jitter Tolerance Test

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 M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used. Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Receiver 8G Rx Jitter Tolerance Test on page 319.

8G LEQ Rx Sensitivity Test

Purpose and Method

This test searches the minimum eye height at which the DUT passes the BER test. It uses the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Receiver Sensitivity Test. For more details see receiver 8G Rx Sensitivity Test on page 321.

Link Equalization Transmitter Tests

To access to the link equalization tests, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Tx Test Parameters

Data Rate Specific

- Generator Output Voltage Compensation
- Scope Connection for Link EQ Tx Tests
- Skip BER Check

Data Rate Specific

- Loopback Training
    - Link EQ Tx Test Script File
    - Generator Start Preset
- Error Detector
    - Sensitivity Mode

For detail, refer to Table 6, “Procedure Parameters for Receivers”.

NOTE **Lane 0 is the only available lane for Link Equalization Tests.**

8G LEQ Tx Initial Preset Compliance Test

This procedure is only available if Gen3 spec is selected.

Purpose and Method

The procedure behaves the same as the Initial Preset for 8.0GT/s ASIC interface. Refer to 8G LEQ Tx Initial Preset Compliance Test on page 180.

Connection Setup for Compliance Test

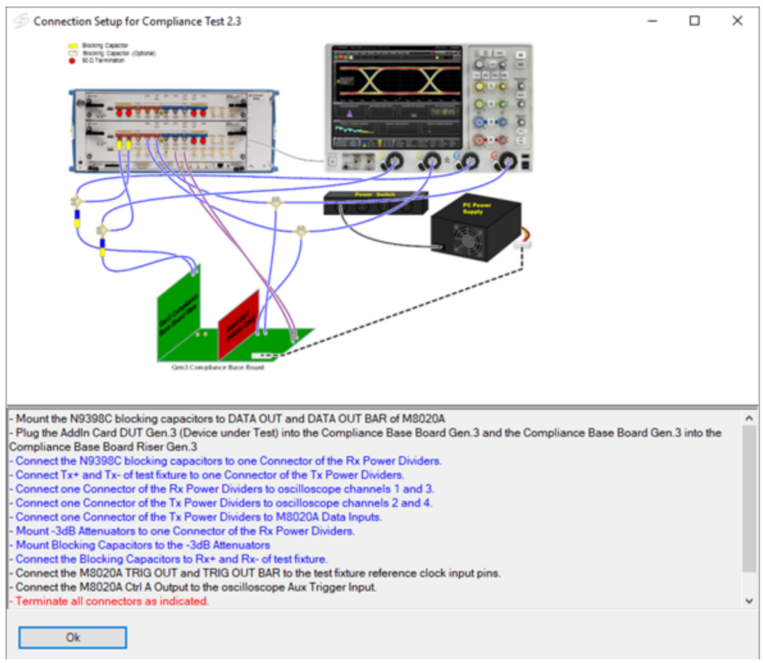


Figure 140 Connection Setup for Compliance Test

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Compliance Test procedure is similar to Figure 87 on page -182.

8G LEQ Tx Response Time Compliance Test

This procedure is only available if Gen3 spec is selected.

Purpose and Method

The procedure behaves the same as the Response Time for 8.0GT/s ASIC interface. Refer to 8G LEQ Tx Response Time Compliance Test on page 184.

Connection Diagram Compliance Tests

It is same as for Connection Setup for Compliance Test on page 331. For the Compliance Test 2.7, the Add-in Card, CBB and Riser Card are replaced with the System Board and the CLB. The reference clock connection is similar to the previously described connection setups involving a System Board.

Parameters in Expert Mode

- Max Number of Retries: in case the acquired data cannot be decoded, the link training can be repeated in order to get new data.
- Scope visible range: Waveform range which will be used at the moment when the link equalization phase is performed.
- Use CTLE: Apply a CTLE filter as defined in the PCI-Express specification to the DUT's waveform. If true, several DC gains can be selected.

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Compliance Test procedure is similar to Figure 88 on page -185.

.

Receiver Setup (Only for Debugging)

8G Rx Compliance Setup

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Preset Compliance Rx test using the calibration data saved on the PC where N5990A software is running. The method begins like Compliance test but then the test will not run, it only leaves the setup prepared. The set parameters are the eye height and the eye width.

Connection Setups for Preset Compliance

Same as Connection Setups for EQ Coefficient Matrix Scan on page 408.

Parameters in Expert Mode

- Eye Height
- Eye Width
- Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the desired eye height and eye width in combination with RJ.
- Random Jitter: The amount of RJ which needs to be added to achieve the desired eye height and eye width in combination with DMSI.
- Sinusoidal Jitter: 12.5ps of SJ has to be added for this test.
- Sinusoidal Jitter Frequency

For detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

- None

8G Rx Pre Compliance Setup

This procedure is only available if Gen4 spec is selected.

The procedure behaves the same as the 8G Rx Compliance Tests on page 316.

9 16.0 GT/s CEM Tests

KEYSIGHT TECHNOLOGIES

Calibration

Common Calibration Parameters

- Data Rate Specific
  - Scope Connection
  - Gen4 Do Channel Calibration
  - UXR Calibration Mode
  - Sampling Rate
  - Range to Signal Ratio

16G TxEq and Launch Voltage Calibration

Purpose and Method

The procedure is the same as for 8.0GT/s ASIC interface. For more details refer to ¡Error! No se encuentra el origen de la referencia..

Available for the following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for TxEq and Launch Voltage Calibration

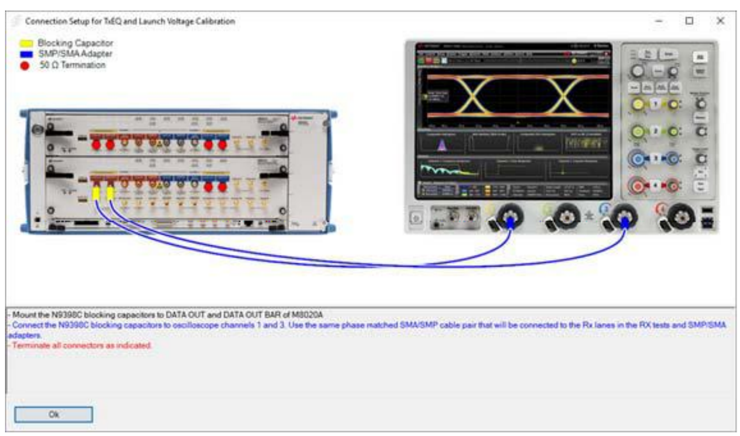


Figure 141 Connection setup with JBERT_M8020A Without Channel

Parameters in Expert Mode

- TXEQ and Launch Voltage Calibration
  - Number of Waveform Average
  - Verification Mode
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages:

For more details, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- None

Procedure Report

Examples of HTML worksheet for TxEq and Launch Voltage Calibration procedure are shown in Figure 60, Figure 61, Figure 62 on page 118.

16G RJ Calibration

Purpose and Method

Same as for 16.0GT/s ASIC interface. For details refer to "16G RJ Calibration" on page 197.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Random Jitter Calibration

Same as "Connection Setup for TxEq and Launch Voltage Calibration" on page 336, see Figure 141 on page 336

Parameters in Expert Mode

- Random Jitter Calibration
  - Verification Mode
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Average
  - Number of UIs

For more details, refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

None

Procedure Report

The example of HTML worksheet for Random Jitter Calibration procedure is similar to Random Jitter Calibration of 8.0GT/s ASIC see Figure 63 on page 121.

16G LF SJCalibration

Purpose and Method

Same as for 16.0GT/s ASIC interface. For details refer to LF Sinusoidal Jitter Calibration.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for LF Sinusoidal Jitter Calibration

Same as "Connection Setup for TxEq and Launch Voltage Calibration" on page 336.

Parameters in Expert Mode

- LF Sinusoidal Jitter Calibration
- Verification Mode
- Generator
- Pre-Shoot
- De-Emphasi
- Generator Voltage
- Oscilloscope
- Scope Bandwidth
- Number of Averages
- Number of UIs

For more detail, refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

- None

Procedure Report

The example of HTML worksheet for LF Sinusoidal Jitter Calibration procedure is similar to LF Sinusoidal Jitter Calibration 8.0GT/s Figure 125 on page 295.

16G HF SJ Calibration

Purpose and Method

Same as for 16.0GT/s ASIC interface. For details refer to HF Sinusoidal Jitter Calibration.

The calibration data is stored in a caltable

(Pci4_<calMethod>_HfSinusoidalJitter.txt). For the measurements these calibration tables will be used to adjust the SJ amplitude to the desired output SJ amplitudes.

Available for following hardware configurations:

Data Generator: JBERT_M8020A

Connection Setup for HF Sinusoidal Jitter Calibration

Same as "Connection Setup for TxEq and Launch Voltage Calibration" on page 336.

Parameters in Expert Mode

- HF Sinusoidal Jitter Calibration
  - Verification Mode
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs

For more detail, refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for HF Sinusoidal Jitter Calibration procedure is similar to 16.0 GT/s ASIC HF Sinusoidal Jitter Calibration, see Figure 91 on page -202.

16G Unit Interval Calibration

Purpose and Method

Same as for ASIC 16.0GT/s interface. For details refer to Unit Interval Calibration.

The calibration data is stored in a caltable (Pci4_UnitInteval.txt). This calibration table will be used to help measuring eye height and eye width with SigTest.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Unit Interval Calibration

Same as "Connection Setup for TxEq and Launch Voltage Calibration" on page 336.

Parameters in Expert Mode

- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs

For more detail, refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

- None

Procedure Report

The example of HTML worksheet for Unit Interval Calibration procedure is similar to 16.0 GT/s ASIC Unit Interval Calibration procedure, see Figure 92 on page -204

16G TxEq and Launch Voltage Measurement

Purpose and Method

Same as for 16.0GT/s ASIC interface. For details refer to "16G TxEq and Launch Voltage Calibration" on page 195.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Diagram

Same as Connection Setup for "16G TxEq and Launch Voltage Calibration" on page 336.

Parameters in Expert Mode

- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Voltage
- Oscilloscope
  - Scope Bandwidth:
  - Number of Averages

For more detail, refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

- None

Procedure Report

The example of HTML worksheet for TxEq and Launch Voltage Measurement procedure is similar to 16.0GT/s ASIC TxEq and Launch Voltage Measurement procedure, see Figure 93 on page 206

16G Insertion Loss Calibration

Purpose and Method

This procedure calibrates the Insertion Loss for the different variable ISI traces. The procedure is the same as for 16.0GT/s ASIC interface, refer to Insertion Loss Calibration.

The calibration data is stored in a caltable (Pcie4_CEM_<DUT

Type>_<FixtureType>_InsertionLoss). This cal data is used to evaluate the optimum var ISI pair number for the Rx tests.

Available for following hardware configurations

- Data Generator: JBERT_M8020A

Connection Setup for Insertion Loss Calibration

Figure 149Connection Setup for Insertion Loss Calibration

Parameters in Expert Mode

- Insertion Loss Calibration
  - Measurement Method
  - Save Calibration Data
  - Automatic Trace Selection
  - Generator Cable Loss
  - Trace Loss Increment
  - Trace Number Start Value
  - Trace Number Stop Value
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of Wavefrom Average
- Variable ISI pairs
  - CLB var. ISI pair: The variable ISI pair number for the CLB:
  - CBB var. ISI pair -27 dB Channel: The variable ISI pair number for the -27 dB Channel.
  - CBB var. ISI pair -28 dB Channel: The variable ISI pair number for the -28 dB Channel.
  - CBB var. ISI pair -30 dB Channel: The variable ISI pair number for the -30 dB Channel.

For more detail, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

No calibrations are required.

Procedure Report

The example of HTML worksheet for Insertion Loss Calibration procedure is similar to 16.0 GT/s ASIC Insertion Loss Calibration procedure see Figure 96 on page -211.

16G Initial Equalization Preset Optimization

Purpose and Method

Same as for 16.0GT/S ASIC interface. The eye measurement is done with SigTest method.

For more details see “16G Initial Equalization Preset Optimization” on page 216.

The calibration data is stored in a caltable (Pci4_ CEM_<DUT Type>_<FixtureType>_EyeHeightInitialPreset, Pci4_ CEM _<DUT Type>_<FixtureType>_EyeWidthInitialPreset). This cal data is used to evaluate the preset that gets the largest Eye.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Initial Equalization Preset Optimization

Same as for “Connection Setup for Initial Equalization Preset Optimization” on page 216.

Parameters in Expert Mode

  - Initial Equalization Preset Range
  - Equalization Preset Range: The set of preset values that are calibrated.
  - CTLE Start Value: The start value for the sweep of the CTLE in the SigTest
  - CTLE Stop Value: : The stop value for the sweep of the CTLE in the SigTest.
- Generator
  - Generator Voltage
  - DMSI
  - Random Jitter
  - Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs
- Channel

- CBB var. ISI pair
- CLB var. ISI pair
- Total Channel Loss

For more detail, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Insertion Loss Calibration

Procedure Report

Examples of HTML worksheet for Initial Equalization Preset Optimization procedure are similar to 16.0 GT/s ASIC see Figure 98 and Figure 99 on page -219.

16G Channel Calibration

Purpose and Method

Same as for 16.0GT/s ASIC interface. For more details see "16G Channel Calibration" on page 220.

The calibration data is stored in a caltable (Pci4_ CEM_<DUT

Type>_<FixtureType>_EyeHeightChannel, Pci4_ CEM_<DUT

Type>_<FixtureType>_EyeWidthChannel). This cal data is used to evaluate

the optimum ISI trace for the Rx tests.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Channel Calibration

Same as for "Connection Setup for Insertion Loss Calibration" on page 343.

Parameters in Expert Mode

- Channel Calibration
  - Trace Number Start Value: The minimum trace number that is calibrated.
  - Trace Number Stop Value: The maximum trace number that is calibrated.
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Generator Launch Voltage
- DMSI
  - Random Jitter
  - Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
- Oscilloscope
  - Scope Bandwidth:
  - Number of Averages
  - Number of UIs

- Channel
  - CLB var. ISI pair

For more detail, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Insertion Loss Calibration
- ISI Adjustment Calibration
- Initial Equalization Preset Optimization

Procedure Report

Examples of HTML worksheet for Channel Calibration procedure are similar to 16.0 GT/s ASIC Figure 100 and Figure 101 on page -223.

16G DM SI Calibration

Purpose and Method

Same as for 16GT/s ASIC interface. For more details refer to “16G DM SI Calibration” on page 224.

Available for the following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for DM Sinusoidal Interference Calibration

Same as for “Connection Setup for Insertion Loss Calibration” on page 343.

Parameters in Expert Mode

- DM Sinusoidal Interference Calibration
  - Verification Mode
- Oscilloscope
  - Scope Bandwidth
- Channel
  - CBB var. ISI pair
  - CLB var. ISI pair
  - Total Channel Loss

For more detail, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- Insertion Loss Calibration

Procedure Report

The example of HTML worksheet for DM Sinusoidal Interference Calibration procedure is similar to 16.0 GT/s ASIC DM Sinusoidal Interference Calibration procedure, see Figure 102 on page -225.

16G CM SI Calibration

Purpose and Method

Same as for 16.0GT/s ASIC interface. For more details see "16G CM SI Calibration" on page 227.

The calibration data is stored in a caltable (Pci4_ Cem_<DUT

Type>_<FixtureType>__CmInterference.txt). For the measurements these calibration tables will be used to adjust the amplitude of the function generator to the desired output CMSI.

Available for following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for CM Sinusoidal Interference Calibration

Same as for "Connection Setup for Insertion Loss Calibration" on page 343.

Parameters in Expert Mode

- CM Sinusoidal Interference Calibration
  - Verification Mode
- Oscilloscope
  - Scope Bandwidth
- Channel

CBB var. ISI pair

  - Total Channel Loss

For more detail, refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

Insertion Loss Calibration

Procedure Report

The example of HTML worksheet for CM Sinusoidal Interference Calibration procedure is similar to 16.0 GT/s ASIC CM Sinusoidal Interference Calibration procedure, see Figure 103 on page -228.

16G Final Equalization Preset Optimization

Purpose and Method

Same as for 16.0GT/s ASIC interface. The eye is measured with the SigTest software.

For more details see "16G Final Equalization Preset Optimization" on page 229.

The calibration data is stored in a caltable (Pci4_ CEM_<DUT Type>_<FixtureType>_EyeHeightFinalPreset, Pci4_ CEM_<DUT Type>_<FixtureType>_EyeWidthFinalPreset). This cal data is used to evaluate the optimum preset to get the desired Eye.

Available for following hardware configurations

Data Generator: _-BERT M8020A

Connection Setup for Final Equalization Preset Optimization

Same as for Insertion Loss Calibration.

Parameters in Expert Mode

- Final Equalization Preset Range
  - Equalization Preset Range
  - CTLE Start Value
  - CTLE Stop Value
- Generator
  - Generator Launch Voltage
  - DMSI
  - Random Jitter
  - Sinusoidal Jitter:
  - Sinusoidal Jitter Frequency
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs
- Channel
  - CBB var. ISI pair
  - CLB var. ISI pair
  - Total Channel Loss

For more detail, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- Launch Voltage Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference

Procedure Report

Examples of HTML worksheet for Final Equalization Preset Optimization are similar to 16.0 GT/s ASIC Random JFinal Equalization Preset Optimization, see Figure 104 and Figure 105 on page -232.

16G Pre Compliance Eye Calibration

Purpose and Method

Same as for 16.0GT/s ASIC interface. The eye is measured with the SigTest software.

For more details see "16G Pre Compliance Eye Calibration" on page 233.

The calibration data is stored in a caltable (Pci4_CEM_<DUT Type>_<FixtureType>_PreCompEye). This cal data is used in the Compliance Eye Calibration to calculate DMSI, SJ and Vdiff adjustment to meet the target eye.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Pre Compliance Eye Calibration

Same as for Insertion Loss Calibration

Parameters in Expert Mode

- Generator
  - Pre-Shoot
  - De-Emphasis
  - Random Jitter
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs
- Channel
  - CBB var. ISI pair:
  - CLB var. ISI pair
  - Total Channel Loss

For more detail, refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration

- ISI Adjustment Calibration
- DM Sinusoidal Interference

Procedure Report

The example of HTML worksheet for Pre Compliance Eye Calibration is similar to 16.0 GT/s ASIC Pre Compliance Eye Calibration, see "Result Description of Pre Compliance Eye Calibration" on page 235.

16G Compliance Eye Calibration

Purpose and Method

Same as for 16.0T/s ASIC interface. The eye is measured with the SigTest software.

For more details see “16G Compliance Eye Calibration” on page 237.

Available for following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for Compliance Eye Calibration

Same as for “Connection Setup for Insertion Loss Calibration” on page 343.

Parameters in Expert Mode

- Compliance Eye Calibration
  - Max Number of Search Steps
  - Use nominal EH/EW results from Pre Comp Cal: If is set to true, the measurement in the first step is skipped and the eye result is directly copied from the Pre Comp Cal.
  - CTLE: The gain of the CTLE filter.
- Generator
  - Pre-Shoot
  - De-Emphasis
  - Sinusoidal Jitter Frequency
  - Random Jitter
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs
- Channel
  - CBB var. ISI pair
  - CLB var. ISI pair
  - Total Channel Loss

For more detail, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference
- Pre Compliance Calibration

Procedure Report

The example of HTML worksheet for Compliance Eye Calibration procedure is similar to 16.0GT/s ASIC Compliance Eye Calibration procedure, see Figure 107 on page -239.

16G Eye Height and Width Measurement

Purpose and Method

Same as for 16.0GT/s ASIC interface. The eye is measured with the SigTest software.

For more details see “16G Eye Height and Width Measurement” on page 241.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Eye Height and Width Measurement

Same as for “Connection Setup for Insertion Loss Calibration” on page 343.

Parameters in Expert Mode

- Generator
  - Pre-Shoot
  - De-Emphasis
  - Differential Voltage
  - Differential Mode Interference
  - Random Jitter
  - Sinusoidal Jitter
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs
  - SigTest Template for EH/EW Measurement: It is the file that contains the template with the parameters used in the SigTest measurement.
  - Add SigTest Result Details: Set to true to add to the test result additional information.
  - CTLE: The gain of the CTLE filter.
- Channel
  - CBB var. ISI pair
  - Total Channel Loss.

For more detail, refer to Table 3, “Common Parameters for Calibration groups”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference

Procedure Report

An example of HTML worksheet for Eye Height and Width Measurement procedure is similar to 16.0GT/s ASIC Eye Height and Width Measurement procedure, see Figure 109 on page -242.

16G Eye Height and Width Scan

Purpose and Method

Same as for 16.0GT/s ASIC interface. The eye is measured with the SigTest software.

For more details see "16G Eye Height and Width Scan" on page 244.

Available for following hardware configurations

Data Generator: JBERT_M8020A

Connection Setup for Eye Height and Width Scan

Same as for "Connection Setup for Insertion Loss Calibration" on page 343.

Parameters in Expert Mode

- Eye Height and Width Scan
  - Loop Levels: It is the number of impairments to scan
  - Equalization Mode: If is set to Presets, it will be possible to choose the equalization presets to scan. If is set to Custom Values, it will be possible to choose the Pre-Shoot and De-Emphasis values to scan.
- Loop
  - Scan Parameter: The impairment to scan. It can be selected as:
  - Equalization Preset
  - Generator Launch Voltage
  - Differential Mode Sinusoidal Interference
  - Common Mode Sinusoidal Interference
  - Random Jitter
  - Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
  - CTLE
  - Trace
  - <Parameter> Start Value: the start value for the scan of the selected impairment.
  - <Parameter> Stop Value: the stop value for the scan of the selected impairment.
  - Parameter> Scale Type: The scale type of the scan.
  - <Parameter> Number of Steps: The number of steps for the scan of the selected impairment.

- Fixed Parameters
  - <Parameter>: For all the parameters that are not scanned, set the fixed value used in all the steps.
- Oscilloscope
  - Scope Bandwidth
  - Number of Averages
  - Number of UIs
  - SigTest Template for EH/EW Measurement: It is the file that contains the template with the parameters used in the the SigTest measurement
  - Add SigTest Result Details: Set to true to add to the test result additional information.

For more detail, refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference

Procedure Report

An example of HTML worksheet for Eye Height and Width Scan procedure is similar to 16.0 GT/s ASIC Eye Height and Width Scan procedure, see Figure 109 on page -242.

Receiver

All the tests described in this section are no longer required for the official Compliance Testing Only the EQ Tx and Rx tests are required.

Common Receiver Parameters

- Receiver Specific
  - Reference Clock
- Data Rate Specific
  - Data Rate Deviation
- Loopback Training
  - Link Training Mode
  - Link Training Suite Settings File,
  - Default Link Training Lane Number for every Lane
  - Suppress Loopback Training Messages
  - Use Gen3 EIEOS
  - Use Custom Training Voltage
- Interactive Link Training
  - Training Through
  - Generator Start Preset
  - DUT Initial Preset
  - DUT Target Preset
  - Generator Start Preset Gen4
  - DUT Initial Preset Gen4
  - DUT Target Preset Gen4
  - Drop Link Method
- Error Detector
  - Use CDR
  - CDR Loop Bandwidth
  - Peaking
  - Analyzer Equalization
  - Sensitivity Mode
  - Capture and Compare Mode
  - Pause before Auto-Align
  - Polarity
- BER Measurement

  - Relax Time
- Lane Specific
  - User Preset
  - Generator Preset
  - Pre-shoot
  - De Emphasis

For more detail, refer to Table 4, “Common Parameters for Receiver groups”.

  - DUT Initial Preset Gen4: It is the preset which the DUT should use at the start of the equalization training for Gen4.
  - DUT Target Preset Gen4: It is the preset which the DUT should use to send out data after the Link Training for Gen4.
  - Drop Link Method: It selects the method to drop the link during the link training.
- Error Detector
  - Use CDR: If true, CDR is used to generate a clock signal for the JBERT error detector. If false, the clock is supplied by the JBERT data generator. With CDR the JBERT error detector performance is better.
  - CDR Loop Bandwidth: The loop bandwidth of the JBERT error detector CDR.
  - Peaking: Select the CDR Peaking in dB (between 0-1dB). It is available only for JBERT_M8020A.
  - Analyzer Equalization: Select the equalization to Off, 6, 9 or 12dB. It is available only for JBERT_M8020A.
  - Sensitivity Mode: Set to Normal or High. It is available only for JBERT_M8020A.
  - Polarity: Set to Normal or Inverted.
- BER Measurement
  - Relax Time: It is the time span between the points from where the stress signal is changed and the BER measurement begins.
- Channel Specific
  - Pre Shoot: Pre shoot used for receiver tests.
  - De Emphasis: De Emphasis used for receiver tests.

16G Rx EQ Coefficient Matrix Scan

Purpose and Method

Same as for 8.0GT/s ASIC interface. Refer to "8G Rx Coefficient Matrix Scan" on page 149.

Connection Setup for EQ Coefficient Matrix Scan

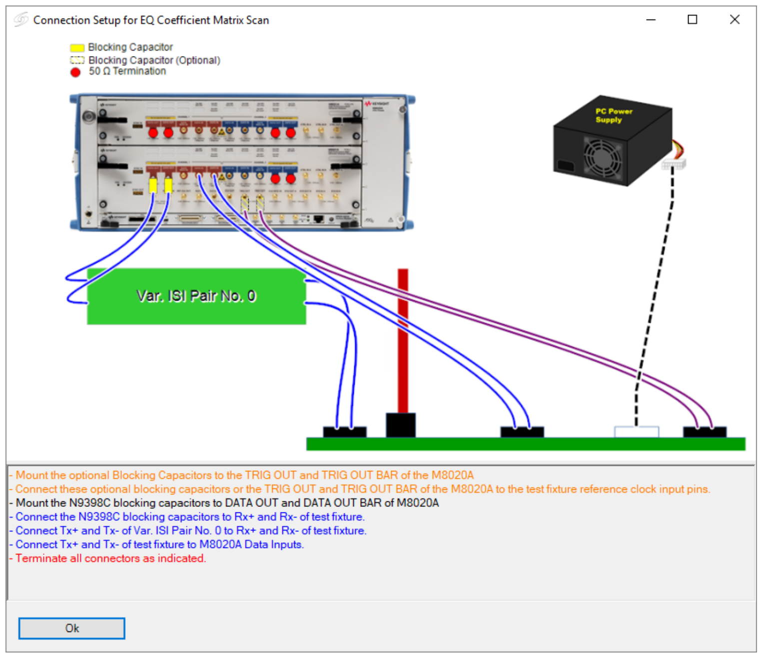


Figure 142 Connection Setup using JBERT_M8020A for Common Clock Architecture and no external ref clock

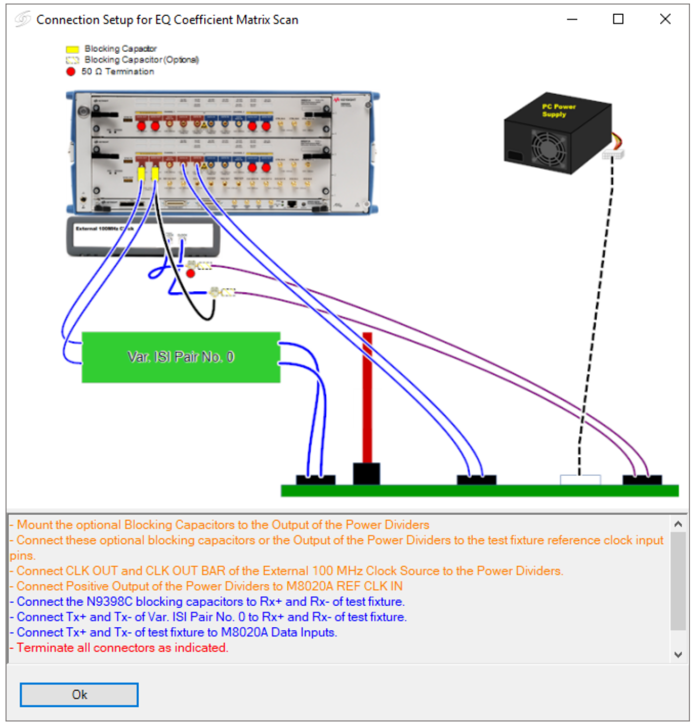


Figure 143 Connection Setup using JBERT_M8020A for Common Clock Architecture and external ref clock

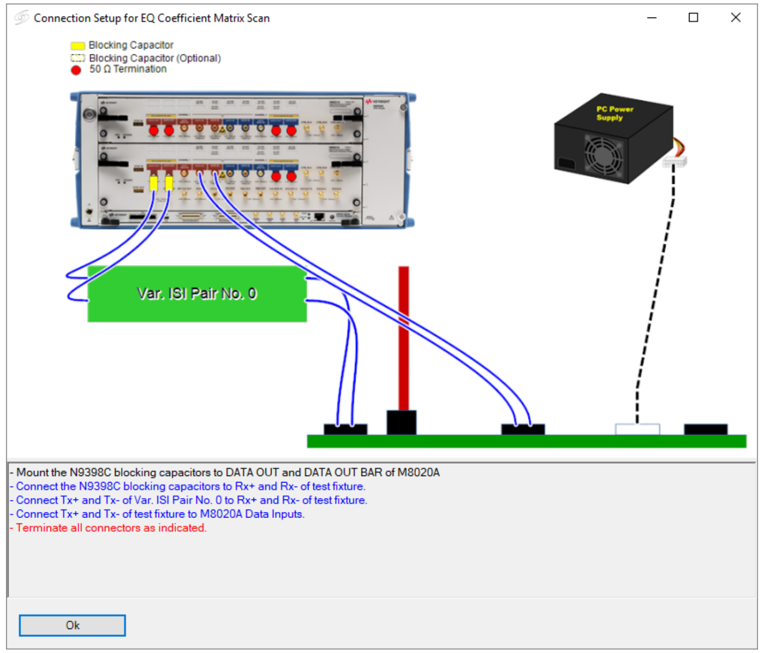


Figure 144 Connection Setup using JBERT_M8020A for Separated Clock Architecture

Parameters in Expert Mode

- Loopback Training
  - Force training at each BER measurement
  - Coefficient Variation
- Coefficient Divider
  - Maximum Boost
  - Start Pre-Shoot
  - Start De-Emphasis
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
- Impairments
  - Random Jitter
  - Sinusoidal Jitter

  - Sinusoidal Jitter Frequency
  - Common Mode Sinusoidal Interference
  - Differential Mode Sinusoidal Interference
  - Generator Launch Voltage
- Channel
  - CBB var. ISI pair
  - Total Channel Loss
- Equalization for remaining Rx Tests
  - Allow user to enter optimum equalization for remaining Rx tests

For more detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference
- Compliance Calibration

Procedure Report

An example of HTML worksheet for EQ Coefficient Matrix Scan procedure is simiar to 8.0 GT/s ASIC EQ Pre-Shoot De-Emphasis Scan, see Figure 82 on page -158.

16G Rx Pre-Shoot De-Emphasis Scan

Purpose and Method

Same as for 8.0GT/s ASIC interface. Refer to “8G Rx Pre-Shoot De-Emphasis Scan” on page 156.

Connection Setup for EQ Pre-Shoot De-Emphasis Scan

Same as “Connection Setup for EQ Coefficient Matrix Scan” on page 363.

Parameters in Expert Mode

- Pre-Shoot Variation
  - Start Pre Shoot: Start amplitude for the pre-shoot scan.
  - Stop Pre Shoot: Stop amplitude for the pre-shoot scan.
  - De Pre Shoot Size: Step size for the pre-shoot scan.
- De-Emphasis Variation
  - Start De Emphasis: Start amplitude for the de-emphasis scan.
  - Stop De Emphasis: Stop amplitude for the de-emphasis scan.
  - De Emphasis Step Size: Step size for the de-emphasis scan.
- Parameter
  - Scan Order: Select if De-Emphasis or Pre-Shoot is tested first.
  - Initial De Emphasis: The initial de-emphasis used for BER adjustment and pre-shoot scan.
  - Initial Pre Shoot: The initial pre-shoot used for BER adjustment and de-emphasis scan.
  - Force training at each Preset: If true, every time the de-emphasis or the pre-shoot is changed the DUT is trained into loopback again.
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error
- Impairments
  - Random Jitter
  - Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
  - Differential Mode Sinusoidal Interference

    - Generator Launch Voltage
- Channel
    - CBB var. ISI pair
    - Total Channel Loss
- Equalization for remaining Rx Tests
    - Allow user to enter optimum equalization for remaining Rx tests.

For more detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height Calibration
- Eye Width Calibration

Procedure Report

Examples of HTML worksheet for EQ Pre-Shoot De-Emphasis Scan procedure are similar to 8.0 GT/s ASIC EQ Pre-Shoot De-Emphasis Scan procedure, see Figure 82 on page -158.

16G Rx Pre Compliance Test

Purpose and Method

Same as for 16GT/s ASIC. Refer to Compliance Test.

Available for following hardware configurations

Data Generator: JBERT M8020A

Connection Setup for Compliance Test

Same as "Connection Setup for EQ Coefficient Matrix Scan" on page 363.

Parameters in Expert Mode

- Compliance Rx test
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error
- Impairments
  - Random Jitter
  - Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
  - Differential Mode Interference
  - Generator Launch Voltage
- Channel
  - CBB var. ISI pair
  - Total Channel Loss
- Link Training
  - Enable Impairment for Loopback Training.

For more detail, refer to Table 6, "Procedure Parameters for Receivers".

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration

- DM Sinusoidal Interference
- Compliance Calibration

Procedure Report

An example of HTML worksheet for Compliance Test procedure is similar to 2.5 GT/s ASIC Jitter Tolerance Test, see Figure 57 on page -103.

16G Rx Jitter Tolerance Test

Purpose and Method

Same as for 2.5GT/s ASIC interface. For details refer to "2.5G/5G Rx Jitter Tolerance Test" on page 100.

Connection Setup for Jitter Tolerance Test

Same as "Connection Setup for EQ Coefficient Matrix Scan" on page 363.

Parameters in Expert Mode

- Sinusoidal Jitter Variation
  - Frequency Mode
  - Frequency Scale
  - Start Frequency
  - Stop Frequency
  - Frequency Steps
  - Frequency Points
  - Search algorithm
  - Jitter Step Size
  - Jitter Step Factor
  - Jitter Start Value
  - Show Min Failed Points
- Parameter
  - Force retraining on each frequency
- BER Measurement
  - BER Mode
  - Target BER
  - Confidence Level
  - BER Measurement Duration
  - Allowed Bit Error
- Impairments
  - Jitter Eye Adjustment Mode
    - ASIC: Either a 2nd SJ or RJ reduction is used to adjust the target EH and EW. SJ pass/fail limit is nominal SJ.
    - CEM: The 1st tone SJ is used to adjust to the target EH and EW. RJ stays at nominal and 2nd SJ tone is off. SJ pass/fail limit is the SJ level from the compliance eye calibration.

    - Random Jitter
    - 2nd Tone Sinusoidal Jitter:
    - Common Mode Interference
    - Differential Mode Interference
    - Generator Launch Voltage
- Channel
    - CBB var. ISI pair
    - Total Channel Loss

For more detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference
- Compliance Calibration

Procedure Report

An example of HTML worksheet for Jitter Tolerance Test procedure is similar to 2.5 GT/s Jitter Tolerance Test, see Figure 57 on page -103.

Link Equalization Receiver Tests

In order to have access to the link equalization tests, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Rx Test Parameters

- Data Rate Specific
  - Data Rate Deviation
- Loopback Training
  - Interactive Training Script File
  - Suppress Loopback Training Messages
  - Use Gen3 EIEOS
  - Use Custom Training Voltage
- Interactive Link Training
  - Generator Start Preset
  - DUT Initial Preset
  - DUT Target Preset
  - Generator Start Preset Gen4
  - DUT Initial Preset Gen4
  - DUT Target Preset Gen4
  - Drop Link Method
- Error Detector
  - Use CDR
  - CDR Loop Bandwidth
  - Peaking
  - Analyzer Equalization
  - Sensitivity Mode
  - Capture and Compare Mode
  - Pause before Auto-Align
  - Polarity
- BER Measurement
  - Relax Time

For more detail, refer to Table 4, “Common Parameters for Receiver groups”.

16G LEQ Rx Compliance Test

Purpose and Method

This tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Pre Compliance Rx Test. For more details, see "16G Rx Pre Compliance Test" on page 369.

16G LEQ Rx Jitter Tolerance Test

Purpose and Method

This tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

Once the equalization training is finished and the DUT is in loopback mode, the test behaves the same as Receiver Jitter Tolerance. For more details see "16G LEQ Rx Jitter Tolerance Test" on page 374.

Link Equalization Transmitter Tests

In order to have access to the link equalization tests, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Tx Test Parameters

Link Equalization Tx

- Generator Output Voltage Compensation
- Scope Connection for Link EQ Tx Tests
- Skip BER Check

Data Rate Specific

- Loopback Training
  - Interactive Training Script File
  - Generator Start Preset
- Error Detector
  - Use Gen3 EIOS
  - Sensitivity Mode

For more detail, refer to Table 4, “Common Parameters for Receiver groups”.

16G LEQ Tx Initial Preset Compliance Test

Purpose and Method

The procedure behaves the same as the Initial Preset for 8.0GT/s ASIC interface. Refer to "8G LEQ Tx Initial Preset Compliance Test" on page 180.

Connection Setup for Initial Preset Compliance Test

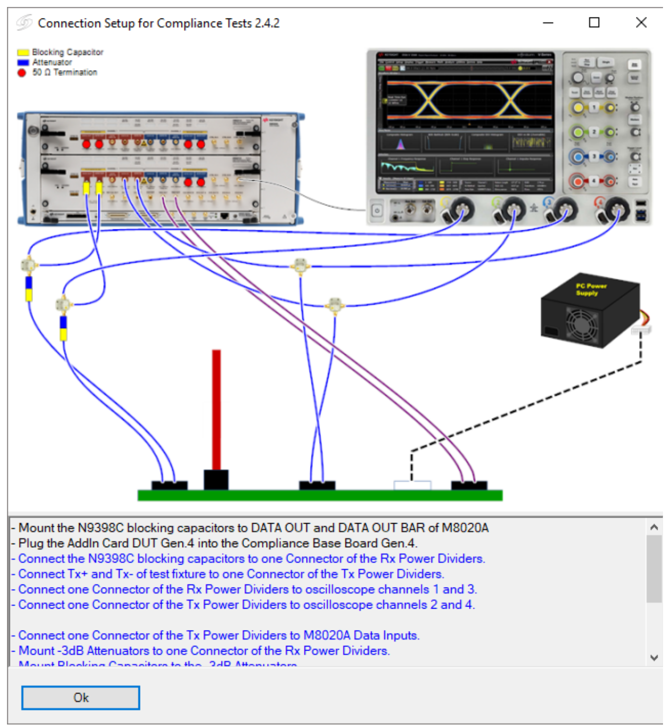


Figure 145 Connection Setup for Compliance Test

Used Calibrations

- None

Procedure Report

The example of HTML worksheet for Compliance Test procedure is similar to 8.0 GT/s ASIC Initial Preset Test Procedure, Figure 87 on page -182.

16G LEQ Tx Response Time Test

Purpose and Method

The procedure behaves the same as the Respose Time for 8.0GT/s ASIC interface. Refer to "8G LEQ Tx Response Time Compliance Test" on page 184.

Connection Setup for Response Time Test

Same as "**Connection Setup for Initial Preset Test**" on page 181.

Parameters in Expert Mode

- Scope visible range: Waveform range which will be used at the moment when the link equalization phase is performed.
- Use CTLE: Set to true to use the CTLE in the oscilloscope.
- CTLE DC Gain: The selected value is equivalent to a negative decibel quantity.

Used Calibrations

None

Procedure Report

The example of HTML worksheet for Response Time Test is similar to Response Time Test procedure, see Figure 88 on page -185.

Receiver Setup (Only for Debugging)

16G Rx Pre Compliance Setup

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Pre Compliance Rx test using the calibration data saved on the PC where ValiFrame is running. The method begins like Pre Compliance test but then the test will not run, it only leaves the setup prepared. The set parameters are the differential amplitude, random jitter, swept sinusoidal jitter and the common and differential mode sinusoidal interference.

Connection Setup for Compliance Setup

Same as "Connection Setup for EQ Coefficient Matrix Scan" on page 363 .

Parameters in Expert Mode

- Impairments
  - Random Jitter
  - Sinusoidal Jitter
  - Sinusoidal Jitter Frequency
  - Differential Mode Interference
  - Generator Launch Voltage
- Channel
  - CBB var. ISI pair
  - Total Channel Loss

For details refer to Table 6, "Procedure Parameters for Receivers".

Used Calibrations

- TxEq and Launch Voltage Calibration
- Random Jitter Calibration
- HF Sinusoidal Jitter Calibration
- Insertion Loss Calibration
- DM Sinusoidal Interference
- Compliance Calibration

Result Description

- None

10 8.0 GT/s U2 Tests

To test the U2 DUT type, the ValiFrame option 111 (PCI Express u.2 Receiver Test Add-On) is required.

Calibration

Common Calibration Parameters

- Calibration Specific
- Data Rate Specific
    - Scope Connection
    - UXR Calibration Mode
    - Sampling Rate
    - Range to Signal Ratio

For details refer to Table 3, “Common Parameters for Calibration groups”.

8G TxEQ and Launch Voltage Calibration

Purpose and Method

The procedure is the same as for 8.0GT/s ASIC interface. For more details, refer to 8G TxEq and Launch Voltage Calibration on page 113.

Connection Setups for TxEQ and Launch Voltage Calibration

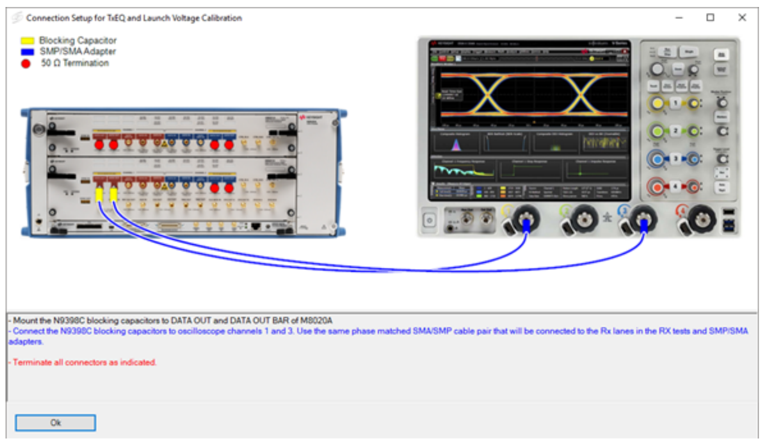


Figure 146 Connection Setup for JBERT_M8020A

Parameters in Expert Mode

- TXEQ and Launch Voltage Calibration
  - Verification Mode
  - Number of Averages for Jitter Measurement
  - Stop Random Jitter
  - Random Jitter Step Size

For details refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- None

Procedure Report

The examples of HTML worksheet for TxEQ and Launch Voltage Calibration procedure are similar to 8.0 GT/s ASIC TxEQ and Launch Voltage Calibration procedure, see Figure 60, Figure 61, Figure 62 on page -118.

8G RJ Calibration

Purpose and Method

Same as for 8.0GT/s ASIC interface. For more details, refer to 8G RJ Calibration on page 120.

Connection Setups for Random Jitter Calibration

Same as Connection Setups for TxEQ and Launch Voltage Calibration on page 383.

Parameters in Expert Mode

- Verification Mode
- Number of averages for jitter measurement
- Stop Random Jitter
- Random Jitter Step Size: The amount the random jitter is increased in each step.

For details refer to Table 5, "Procedure Parameters for Calibrations".

Used Calibrations

- None

Procedure Report

The example of HTML worksheet for Random Jitter Calibration procedure is similar to 8.0 GT/s ASIC, Random Jitter Calibration procedure see figure Figure 63 on page -121.

8G SJ Calibration

Purpose and Method

The procedure is the same as for 8.0GT/s CEM interface. For more details, refer to 8G SJ Calibration on page 294.

Available for following hardware configurations

- All

Connection Setups for

Same as Connection Setups for TxEQ and Launch Voltage Calibration on page 383.

Parameters in Expert Mode

- Verification Mode
- CDR loop-bandwidth.
- Number of averages for jitter measurement.

For details refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Sinusoidal Jitter Calibration procedure is similar to 8.0 GT/s CEM Sinusoidal Jitter Calibration procedure, see Figure 125 on page -295.

8G DM SI Calibration

Purpose and Method

The procedure is similar as for 8.0G/s ASIC interface but for U.2 CMSI is not added to the signal. For more detail, refer to 8G DM SI Calibration on page 296.

Connection Setups for DM Sinusoidal Interference Calibration

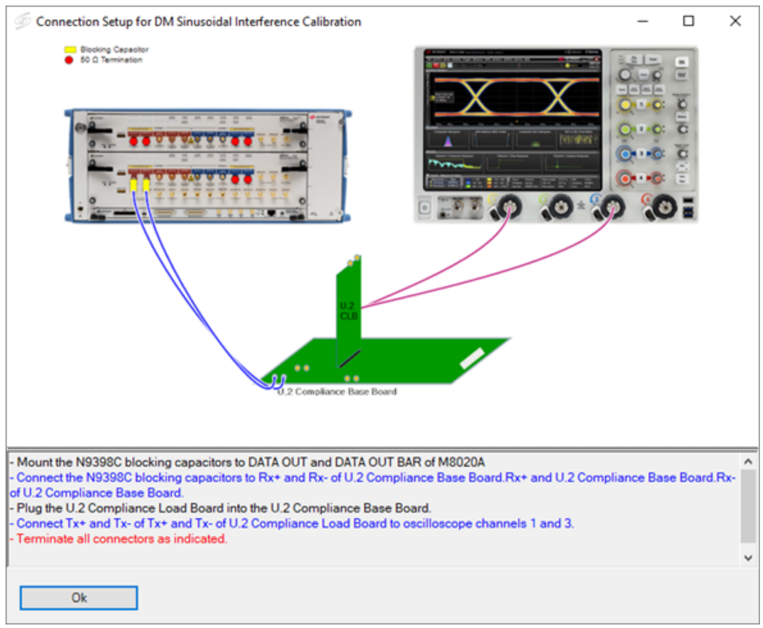


Figure 147 Connection Setup for JBERT_M8020A

Parameters in Expert Mode

- Verification Mode

Used Calibrations

- None

Procedure Report

The example of HTML worksheet for DM Sinusoidal Interference Calibration procedure is similar to 8.0GT/s ASIC DM Sinusoidal Interference Calibration procedure, see Figure 68 on page -131.

8G Eye Height and Width Calibration

Purpose and Method

The procedure is similar as for 8.0GT/s CEM interface. For more details, refer to 8G Eye Height and Width Calibration on page 297.

Available for following hardware configurations

- All

Connection setups for Eye Height and Width Calibration

The same as for “DM Sinusoidal Interference Calibration”

Parameters in Expert Mode

- Optimize CTLE: Select if CTLE optimization is used. Default is false.
- RJ for CTLE optimization: Random jitter set if CTLE optimization is used.
- DMSI for CTLE optimization: DMSI set if CTLE optimization is used.
- CTLE Index: CTLE index if CTLE optimization is not used.
- Start DMSI: The first set DMSI value.
- Stop DMSI: The last set DMSI value.
- Number of DMSI Steps: The number of DMSI steps.
- Start RJ: The first set RJ value.
- Stop RJ: The last set RJ value.
- Number of RJ Steps: The number of RJ steps.
- Number of Averages

For details refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- Equalization Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration

Procedure Report

The example of HTML worksheet for Eye Height and Width Calibration procedure are similar to Figure 128 and Figure 129 on page -300.

8G Compliance Eye Calibration

Purpose and Method

The procedure is similar as for 8.0GT/s CEM interface. For more details, refer to 8G Compliance Eye Calibration on page 301.

Connection Setups for Compliance Eye Calibration.

Same as Connection setups for Eye Height and Width Calibration on page 387.

Parameters in Expert Mode

- Verification Mode
- Target Eye-Height
- Target Eye-Width
- Max Number of Search Steps: Max number of times that the RJ and DMSI can be recalculated to get the target values.
- Number of Averages

For details refer to Table 5, “Procedure Parameters for Calibrations”.

Used Calibrations

- Equalization Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

The example of HTML worksheet for Compliance Eye Calibration procedure is similar to 8.0 GT/s CEM Compliance Eye Calibration procedure, see Figure 130 on page -302.

Receiver Tests

Common Rx Tests Parameters

Receiver Specific

- Use External 100MHz Reference Clock

Data Rate Specific

1. Loopback Training
   - Link Training Mode:
   - Link Training Suite Settings File,
   - Default Link Training Lane Number for every Lane
   - Suppress Loopback Training Messages
   - Use Custom Training Voltage
2. Interactive Link Training
   - Training Through
   - Generator Start Preset
   - DUT Initial Preset
   - DUT Target Preset
   - Drop Link Method
3. Error Detector
   - Use CDR
   - CDR Loop Bandwidth
   - CDR Use SSC
   - Filter Gen3 SKPOs for BER test
   - Peaking
   - Analyzer Equalization
   - Sensitivity Mode
   - Capture and Compare Mode
   - Pause before Auto-Align
   - Polarity
4. BER Measurement
   - Relax Time

Lane Specific

- User Preset
- Generator Preset
- Pre-shoot
- De-Emphasis

For details refer to Table 4, "Common Parameters for Receiver groups".

8G Rx Coefficient Matrix Scan

Purpose and Method

Same as for 8.0GT/s ASIC interface. Refer to 8G Rx Coefficient Matrix Scan on page 149.

Connection Setup Coefficient Matrix Scan

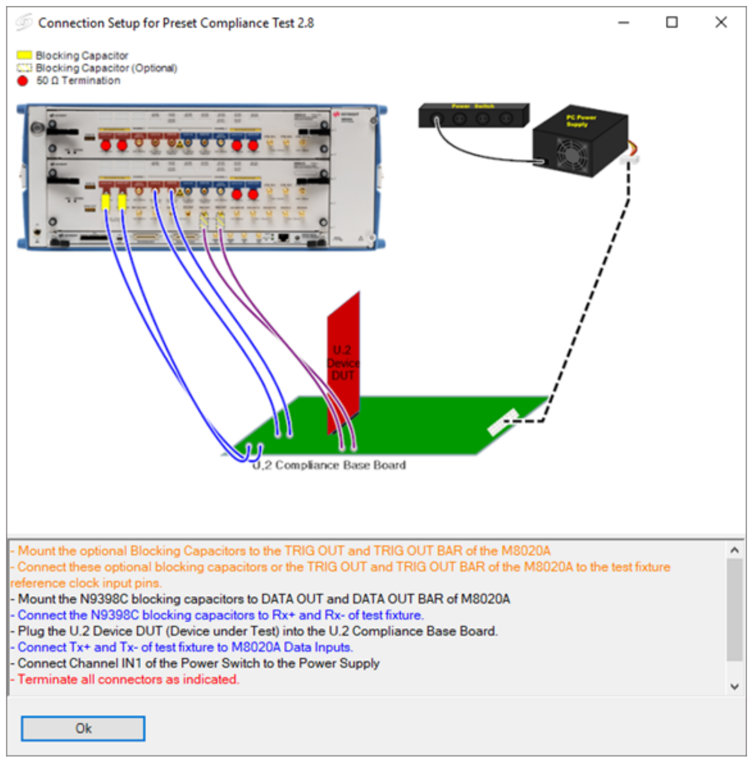


Figure 148 Connection Setup using JBERT_M8020A with AddInCard Common clock Architecture and no external ref clock

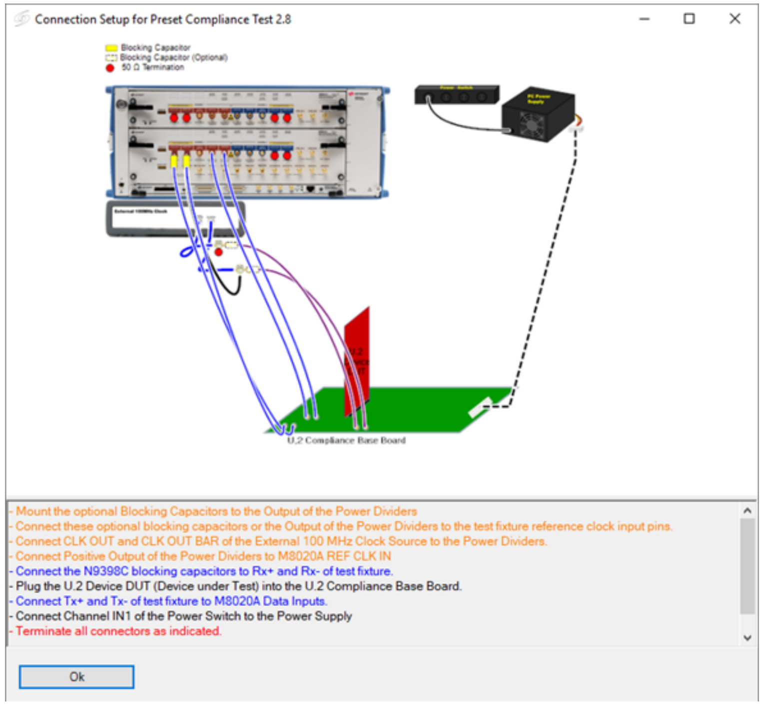


Figure 149 Connection Setup using JBERT_M8020A with U2 Common Clock Architecture and external ref clock- internal clock multiplier

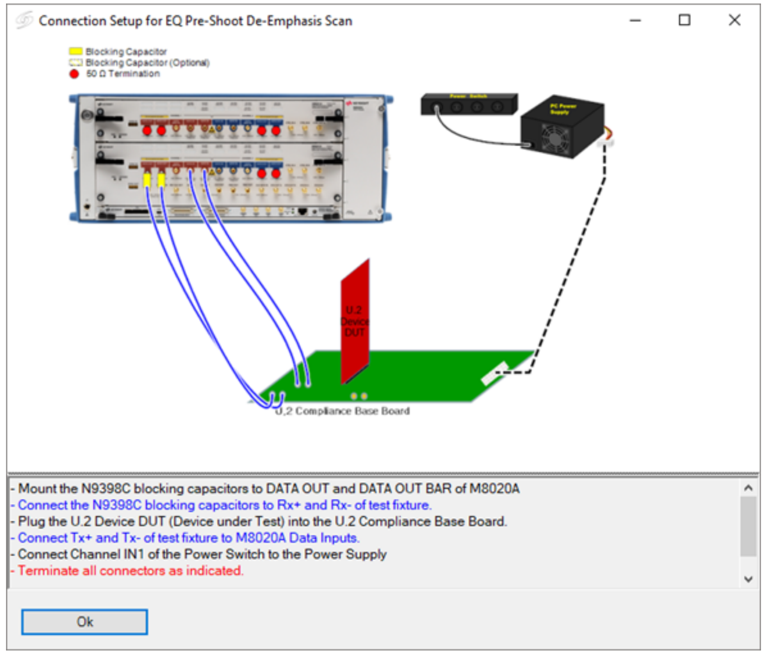


Figure 150 Connection Setup using JBERT_M8020A with AddInCard Separate Clock Architecture

Parameters in Expert Mode

1 Loopback Training
   - Force Retraining at each BER measurement
2 Eye Parameter
   - Eye-Height:
   - Eye-Width
   - Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to the signal to achieve the desired eye-height and eye width in combination with the RJ.
   - Random Jitter: The amount of RJ which needs to be added to the signal to achieve the desired eye-height and eye-width in combination with the DMSI.
   - Sinusoidal Jitter: 12.5 ps of SJ has to be added for this procedure.
   - Sinusoidal Jitter Frequency:
3 Coefficient Variation

- Test Calibrated Presets only
- Coefficient Divider
- Maximum Boost
- Start Pre-Shoot
- Start De-Emphasis

4 BER Measurement

- BER Mode
- Target BER
- Confidence Level

5 Equalization for remaining Rx Tests

- Allow user to enter optimum equalization for remaining Rx tests.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

The example of HTML worksheet for Coefficient Matrix Scan procedure is similar to 8.0 GT/s ASIC Coefficient Matrix Scan procedure, see Figure 81 on page -155.

8G Rx Pre-Shoot De-Emphasis Scan

Purpose and Method

Same as for 8.0GT/s ASIC interference. Refer to 8G Rx Pre-Shoot De-Emphasis Scan on page 156.

Connection Setups for Pre-Shoot De-Emphasis Scan

Same as Connection Setup Coefficient Matrix Scan on page 391.

Parameters in Expert Mode

1. Parameter
   - Scan Order
   - Initial Pre Shoot
   - Force training at each Prese
2. De-Emphasis Variation
   - Start De Emphasis
   - Stop De Emphasis
   - De Emphasis Step Size
3. Pre-Shoot Variation
   - Start Pre Shoot
   - Stop Pre Shoot
   - De Pre Shoot Size
4. BER Measurement
   - BER Mode
   - Target BER
   - Confidence Level
   - BER Measurement Duration
   - Allowed Bit Error
5. Equalization for remaining Rx Tests
   - Allow user to enter optimum equalization for remaining Rx tests.

For details refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration

- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

The Examples of HTML worksheet for Pre-Shoot De-Emphasis Scan procedure are similar to 8.0GT/s ASIC Pre-Shoot De-Emphasis Scan procedure, see Figure 81, Figure 82 and Figure 83 on page -159.

8G Rx Preset Compliance Test

Purpose and Method

The procedure behaves the same as the 8G Rx Preset Compliance on page 313, for 8.0GT/s CEM DUTs.

Connection Setups for Preset Compliance Test

Same as Connection Setup Coefficient Matrix Scan on page 391.

Parameters in Expert Mode

- Enable Impairments for Loopback Training.
- Parameter
  - Eye Height
  - Eye Width
  - Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the desired eye height and eye width in combination with RJ.
  - Random Jitter: The amount of RJ which needs to be added to achieve the desired eye height and eye width in combination with DMSI.
  - Sinusoidal Jitter: 12.5ps of SJ has to be added for this test.
  - Sinusoidal Jitter Frequency
- BER Measurement
  - BER Measurement Duration
  - Target BER

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

For details refer to Table 6, “Procedure Parameters for Receivers”.

Procedure Report

The example of HTML worksheet for Preset Compliance Test is similar to 8G Rx Preset Compliance on page 313 see Figure 136 on page -314.

L0_Rx_8GTps_CBB3_PresComp

for PCIe 3.0 U.2 Device

Differential Mode Sinusoidal Interference	15 mV
Random Jitter	1.5 ps
Sinusoidal Jitter	12.5 ps
Offline	True
Enable Impairments for Link Training	True
Eye Height	44.5 mV
Eye Width	40.5 ps
Sinusoidal Jitter Frequency	100 MHz
BER Measurement Duration	12.5 s
Target BER	100E-6
Use Preset	True
Generator Preset	P7
Pre-Shoot	3.5 dB
De-Emphasis	-6 dB
Link Training Mode	Interactive
Training through	L0-Recovery
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Drop Link Method	LTSSM
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK0\PCIe\Settings\
Suppress Loopback Training Messages	False
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	-6 dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	3 s
Use External 100MHz Reference Clock Source	True

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

Figure 151 Result Description of Preset Compliance Test 2.8

- Column1:
  - Result: The BER measured should be smaller than the Target BER.
- Column 2:
  - Preset: Preset tested.
- Column 3:
  - Target BER: Max BER allowed to pass the test.

- Column4:
  - Measured BER

8G Rx Compliance Tests

Purpose and Method

The test is nearly the same as the Preset Compliance Test but only for preset P7. The Compliance Test 2.8 corresponds to Add-in Cards and the Compliance Test 2.9 corresponds to System Boards.

Connection Setups for Compliance Tests 2.8 and 2.9

Same as Connection Setup Coefficient Matrix Scan on page 391.

Parameters in Expert Mode

- Enable Impairments for Loopback Training: Jitter and DMSI are enabled or disabled during loopback training.
- Eye Height: Eye height for the compliance test.
- Eye Width: Eye width for the compliance test.
- Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the desired eye height and eye width in combination with RJ.
- Random Jitter: The amount of RJ which needs to be added to achieve the desired eye height and eye width in combination with DMSI.
- Sinusoidal Jitter: 12.5 ps of SJ has to be added for this test.
- Sinusoidal Jitter Frequency: Frequency of the sinusoidal jitter component.
- BER Mode: The BER measurement can be executed for a fixed time or until a target BER is achieved.
- Target BER: The Target BER for the BER measurement used in the test.
- Confidence Level: The confidence level value when BER mode is TargetBer.
- BER Measurement Duration: The duration of the BER measurement when mode is FixedTime.
- Allowed Bit Error: The allowed number of bit errors during the BER measurement when mode is FixedTime.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

An example of HTML worksheet for Compliance Tests 2.8 and 2.9 procedure is shown in Figure 152.

L0_Rx_8GTps_CBB3_Comp

for PCIe 3.0 U.2 Device

Differential Mode Sinusoidal Interference	15 mV
Random Jitter	1.5 ps
Sinusoidal Jitter	12.5 ps
Offline	True
Eye Height	44.5 mV
Eye Width	40.5 ps
Sinusoidal Jitter Frequency	100 MHz
Enable Impairments for Link Training	True
BER Mode	FixedTime
BER Measurement Duration	125 s
Allowed Bit Error	1
Use Preset	True
Generator Preset	P7
Pre-Shoot	3.5 dB
De-Emphasis	-6 dB
Link Training Mode	Interactive
Training through	L0-Recovery
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Drop Link Method	LTSSM
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrameK0\PCIe\Settings\
Suppress Loopback Training Messages	False
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	-6 dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	3 s
Use External 100MHz Reference Clock Source	True

Result	Allowed Bit Errors []	Measured Bit Errors []
pass	1	0

Figure 152 Result Description of Compliance Tests 2.8 and 2.9

- Column1:
  - Result: The BER measured should be smaller than the Target BER.
- Column 2:

  - Allowed Bit Errors: The allowed number of bit errors with the BER measurement.
- Column3:
  - Measured Bit Errors

8G Rx Jitter Tolerance Test

Purpose and Method

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

There are different methods to find the jitter tolerance limits. It can be selected with “search algorithm” parameter as: Binary, Linear, Linear with two sizes, Linear with Hysteresis or Logarithmic.

- If Binary is selected, the binary search algorithm is used. At first, the jitter amplitude is set to the middle of the tested range. When the BER test passes it goes forward and when the test fails it goes down, At each step, the step size is reduced until the target resolution is reached.
- If Linear is selected, the test uses the defined step size to go linearly from “Start Jitter” up until the BER test fails.
- If Linear with two step size is selected, the test first uses relatively large steps to go linearly from “Start Jitter” up. When BER test fails it goes back to the last passed point and steps up again with small steps until an error is found again.
- If Linear with Hysteresis is selected, the test first uses relatively large steps to go linearly from “Start Jitter” up. When BER test fails it goes back down with mid-sized steps until it passes again. From there it 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 with a logarithmic scale from “Start Jitter” up until the BER test fails.

The maximum passed value is the last test point that did not return an error. All of this happens separately for each frequency.

Connection Setups for Jitter Tolerance Test

Same as Connection Setup Coefficient Matrix Scan on page 391.

Parameters in Expert Mode

1. Sinusoidal Jitter Variation
   - Frequency Mode: It specifies the distribution of the frequency points to test. Following are the possible distributions:
     - Compliance Frequencies: The frequencies defined in the specification for compliance testing.
     - Equally Spaced Frequencies
     - User Defined Frequencies

    - Single Frequency
- Frequency Scale: The results can be represented in logarithmic or linear scaling. For “Equally Spaced Frequencies” the frequency points depends on the chosen frequency scale.
- Start Frequency: Start frequency for “Equally Spaced Frequencies”.
- Stop Frequency: Stop frequency for “Equally Spaced Frequencies”.
- Number of Frequency Steps: Number of frequency points for “Equally Spaced Frequencies”.
- Search Algorithm (HyteresisUp or Binary): The Binary search is not recommended for devices with a long recovery time.
- Frequency Points: Frequency points for “User Defined Frequencies”.
- Start Jitter Points: Start jitter amplitudes for “User Defined Frequencies”. In the other frequency modes start jitter amplitude is always 0.
- Jitter Frequency: Single frequency point for “Single Frequency”.
- Jitter Step Size: The size of the smallest sinusoidal jitter amplitude step used to search the “Max passed jitter” at each frequency.
- Show Min Failed Points: The results graph can show the minimum jitter failed jitter in addition to the maximum passed jitter for each tested frequency.

2 Parameter
   - Use Compliance RJ and DMSI Values: 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.
   - Random Jitter: The amount of RJ, which needs to be added to achieve the compliance eye height and eye width in combination with DMSI.
   - Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the compliance eye height and eye width in combination with RJ.
   - Force Retraining on Each Frequency: Re-train the DUT at each tested jitter frequency

3 BER Measurement
   - BER Mode: The BER measurement can be executed for a fixed time or until a target BER is achieved.
   - Target BER: The Target BER for the BER measurement used in the test.
   - Confidence Level: The confidence level value when BER mode is TargetBer.

- BER Measurement Duration: The duration of the BER measurement, when mode is FixedTime.
- Allowed Bit Error: The allowed number of bit errors, during the BER measurement, when mode is FixedTime.

Used Calibrations

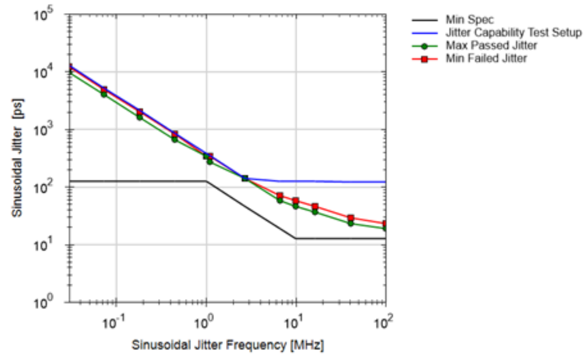
- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration

Procedure Report

An example of HTML worksheet for Jitter Tolerance Test procedure is shown in Figure 153.

L0_Rx_8GTps_CBB3_JitTol

for PCIe 3.0 U.2 Device



Polarity	Normal
Relax Time	1 s
Link Training Mode	JBERT Link Training
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrame\Setting
Default Link Training Lane Number for every Lane	Auto
Suppress Loopback Training Messages	False
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P4
Drop Link Method	JBERT LTSSM
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
Use External 100MHz Reference Clock Source	True

Result	Sinusoidal Jitter Frequency [MHz]	Min Failed Jitter [ps]	Max Passed Jitter [ps]	Jitter Capability Test Setup [ps]	Min Spec [ps]	Margin [%]
pass	0.030	12037.0	9629.6	12869.1	125.0	7603.7
pass	0.074	4930.4	3944.3	5224.4	125.0	3055.4
pass	0.182	2019.5	1615.6	2120.3	125.0	1192.5
pass	0.448	827.2	661.7	860.0	125.0	429.4
pass	1.000	338.8	338.8	384.5	125.0	171.0
pass	1.104	338.8	271.1	348.2	113.3	139.3
pass	2.718	140.4	140.4	140.4	46.0	205.3
pass	6.694	71.1	56.8	123.7	18.7	204.4
pass	10.000	56.8	45.5	123.5	12.5	263.8
pass	16.487	45.5	36.4	123.2	12.5	191.0
pass	40.604	29.1	23.3	122.2	12.5	86.3
pass	100.000	23.3	18.6	119.7	12.5	49.0

Figure 153 Result Description of Jitter Tolerance Test

- Column1:
  - Result: Max passed Jitter should be bigger than Min Spec.
- Column 2:
  - Sinusoidal Jitter Frequency [MHz]: Test frequency points.
- Column 3:

- Max Passed Jitter [ps]: Max jitter that passed the Target BER.
- Column 4:
- Jitter Capability Test Setup [ps]: Max jitter that the hardware can generate.
- Column 5:
    - Min Spec [ps]: Min jitter that has to pass the test to meet the specification.
- Column 6:
    - Margin[%]: Margin between the max passed jitter and the specification.

8G Rx Sensitivity Test

Purpose and Method

This test searches the minimum eye height at which the DUT passes the BER test. The method starts with “Start Eye Height” and decreases with steps of “Step Size”. The minimum passed value is the last test point that did not return an error. Eye height is generated changing the Differential Mode Sinusoidal Interference, the random jitter is fixed to the compliance value.

Connection Setups for Sensitivity Test

Same as Connection Setup Coefficient Matrix Scan on page 391.

Parameters in Expert Mode

1 Sensitivity Variation
   - Start Eye Height: It is the first and also the largest Eye Height attained in the Eye Diagram.
   - Stop Eye Height: It is the last and also the smallest Eye Height attained in the Eye Diagram unless the DUT already fails at a higher eye-height.
   - Eye-Height Step Size: The amount of the eye height, which is decreased at each step, to search the “Min Passed Eye Height”.

2 Parameter
   - Random Jitter: The amount of RJ, which needs to be added to achieve the compliance eye height and eye width in combination with DMSI.
   - Sinusoidal Jitter: 12.5 ps of SJ has to be added for this test.
   - Sinusoidal Jitter Frequency: Frequency of the sinusoidal jitter component.
   - BER Mode: The BER measurement can be executed for a fixed time or until a target BER is achieved.
   - Target BER: The Target BER for the BER measurement used in the test.
   - Confidence Level: The confidence level value, when BER mode is TargetBer.
   - BER Measurement Duration: The duration of the BER measurement, when mode is FixedTime.
   - Allowed Bit Error: The allowed number of bit errors, during the BER measurement, when mode is FixedTime.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height Calibration

Procedure Report

An example of HTML worksheet for Sensitivity Test procedure is shown in Figure 154.

L0_Rx_8GTps_CBB3_Sensitivity

for PCIe 3.0 U.2 Device

Offline	True
Start Eye Height	63 mV
Eye Height Step Size	1 mV
Sinusoidal Jitter Frequency	100 MHz
BER Mode	TargetBer
Target BER	1E-9
Confidence Level	95 %
Use Preset	False
Pre-Shoot	3.5 dB
De-Emphasis	-6 dB
Link Training Lane Number	0
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	1 s
Link Training Mode	JBERT Link Training
Link Training Suite Settings File	C:\ProgramData\BitifEye\ValiFrame\Settings
Default Link Training Lane Number for every Lane	Auto
Suppress Loopback Training Messages	False
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P4
Drop Link Method	JBERT LTSSM
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
Use External 100MHz Reference Clock Source	True

Result	Min Passed Eye Height [mV]	Spec Limit [mV]	Margin [%]
pass	40.0	46.0	13.0

Figure 154 Result Description of Sensitivity Test

- Column1:
  - Result: The Min Passed Eye Height measured should be smaller than the Min Spec.
- Column 2:
  - Min Passed Eye Height [mV]: The minimum eye height at which the DUT passes the BER test.
- Column 3:
  - Spec Limit [mV]: The minimum eye height at which the DUT has to pass the BER test to meet the specification.
- Column 4:
  - Margin [%]: It is the margin between the min eye height passed and the minimum spec value.

Link Equalization Receiver Tests

In order to have access to the link equalization tests, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Rx Test Parameters

Data Rate Specific

1 Loopback Training
   - Interactive Training Suite Setting File: The Link Training Suite settings file (script file) which will be used for loopback training.
   - Suppress Loopback Training Messages: All loopback related message boxes, e.g. “Please power cycle DUT” are not displayed. The user has to assure that the DUT is in loopback when starting Rx tests.
   - Use Custom Training Voltage: Set to true, to use a specific differential voltage during the loopback training. Then select the voltage level in the “Custom Voltage” property.

2 Interactive Link Training
   - Generator Start Preset: The generator will use this preset in link equalization phase 1. Note that this setting will be applied in the Jitter Tolerance and Sensitivity test only.
   - DUT Initial Preset: The DUT Tx will use this preset in link equalization phase 0.
   - DUT Target Preset: The generator (downstream port) will request this preset in link equalization phase 3.
   - Drop Link Method: It selects the method to drop the link during link training.

3 Error Detector
   - Use CDR: If true, CDR is used to generate a clock signal for the JBERT error detector. If false, the clock is supplied by the JBERT data generator. With CDR the JBERT error detector performance is better.
   - CRD Loop Bandwidth: The loop bandwidth of the JBERT error detector CDR.
   - Peaking: CDR peaking.It is available only for JBERT_M8020A.
   - Analyzer Equalization: Apply PCI-Express Equalization settings to the received signal. It is available only for JBERT_M8020A.

- Sensitivity Mode: Set to Normal or High. It is available only for JBERT_M8020A.
- Capture and Compare Mode: If enabled, the received data is captured and saved in a pattern. A new analyzer sequence is generated with a single block containing the captured pattern. This mode is only available with a common reference clock architecture.
- Pause before Auto-Align: Pause before the BER measurement so that the user can perform manual optimization of the DUT receiver.
- Polarity: Set to Normal or Inverted.

4 BER Measurement

- Relax Time: Time span between the point the stress signal is changed and the BER measurement begins.

NOTE Lane 0 is the only available lane for Link Equalization Tests.

8G LEQ Rx Compliance Tests

This procedure is available only if Gen3 spec is selected.

Purpose and Method

These tests use the interactive link training feature of the M8020A JBERT to let the DUT negotiate the generator transmitter preset that will be used.

The Compliance Test for Devices can be divided in two phases. In the first phase, the CBB rev.3 is used and the starting generator transmitter presets are P7 and P8. In the second phase, the CBB rev.2 is used and the starting generator transmitter presets are P1, P7 and P8.

The Compliance Test for Hosts consists of one phase, using the CLB rev.3.

Connection Setups for Compliance Tests

Same as Connection Setup Coefficient Matrix Scan on page 391, depending on the DUT and the CLB/CBB rev. required.

Parameters in Expert Mode

- Enable Impairments for Loopback Training: Jitter and DMSI are enabled or disabled during loopback training.
- Eye Height: Eye height for the compliance test.
- Eye Width: Eye width for the compliance test.
- Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the desired eye height and eye width in combination with RJ.
- Random Jitter: The amount of RJ which needs to be added to achieve the desired eye height and eye width in combination with DMSI.
- Sinusoidal Jitter: 12.5 ps of SJ has to be added for this test.
- Sinusoidal Jitter Frequency: Frequency of the sinusoidal jitter component.
- BER Mode: The BER measurement can be executed for a fixed time or until a target BER is achieved.
- Target BER: The Target BER for the BER measurement used in the test.
- Confidence Level: The confidence level value when BER mode is TargetBer.
- BER Measurement Duration: The duration of the BER measurement when mode is FixedTime.
- Allowed Bit Error: The allowed number of bit errors during the BER measurement when mode is FixedTime.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

An example of HTML worksheet for Compliance Tests procedure is shown in Figure 155.

L0_EqRx_8GTps_CBB3_Comp

for PCIe 3.0 U.2 Device

Differential Mode Sinusoidal Interference	15 mV
Random Jitter	1.5 ps
Sinusoidal Jitter	12.5 ps
Offline	True
Enable Impairments for Link Training	True
Eye Height	44.5 mV
Eye Width	40.5 ps
Sinusoidal Jitter Frequency	100 MHz
BER Mode	FixedTime
BER Measurement Duration	125 s
Allowed Bit Error	1
Interactive Training Script File	C:\ProgramData\BitifEye\ValiFrameK0\PCIe\Settings\TrainingScri
Suppress Loopback Training Messages	False
Generator Full Swing	24
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P5
Drop Link Method	LTSSM
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	-6 dB
Capture and Compare Mode	False
Pause before Auto-Align	False
Sensitivity	Normal
Polarity	Normal
Relax Time	3 s

Result	Initial Generator Preset	Final Generator Preset	Final Generator Pre-shoot [dB]	Final Generator De-emphasis [dB]	Allowed Bit Errors []	Measured Bit Errors []
pass	P7	P0	0.00	-6.00	1	0

Figure 155 Result Description of Compliance Tests

- Column1:
  - Result: The BER measured should be smaller than the Target BER.
- Column 2:
  - Initial Generator Preset (used for Add-in Card only): The preset sent by the generator at the beginning of the test.
- Column 3:
  - Final Generator Preset (requested by the DUT): The preset sent by the generator after the link negotiation.
- Column 4:
  - Final Generator Pre-Shoot [dB]: The pre-shoot sent by the generator after the negotiation.
- Column 5:
  - Final Generator De-Emphasis [dB]: The de-emphasis sent by the generator after the negotiation.
- Column 6:
  - Allowed Bit Errors: Number of allowed bit errors to pass the test.
- Column 7:
  - Measured Bit Errors: Number of measured bit errors after the BER test.

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8G LEQ Rx Jitter Tolerance Test

Purpose and Method

This test characterizes how much jitter a DUT can tolerate at different frequencies of sinusoidal jitter. After training the DUT into loopback mode, using the M8020A JBERT interactive link training feature, a BER test is performed. Starting with the “Min Frequency” the jitter is increased with equally spaced steps until the BER test fails. The BER test fails when the number of error bits is bigger than 0. This procedure is repeated for all SJ frequencies.

Connection Setups for Jitter Tolerance Test

Same as Connection Setup Coefficient Matrix Scan on page 391, depending on the DUT and the CLB/CBB revision required

Parameters in Expert Mode

1 Sinusoidal Jitter Variation

- Frequency Mode: It specifies the distribution of the frequency points to be test.ed. Following are the possible distributions:
    - Compliance Frequencies: The frequencies defined in the specification for compliance testing.
    - Equally Spaced Frequencies
    - User Defined Frequencies
    - Single Frequency
- Frequency Scale: The results can be represented in logarithmic or linear scaling. For “Equally Spaced Frequencies” the frequency points depends on the chosen frequency scale.
- Start Frequency: Start frequency for “Equally Spaced Frequencies”.
- Stop Frequency: Stop frequency for “Equally Spaced Frequencies”.
- Number of Frequency Steps: Number of frequency points for “Equally Spaced Frequencies”.
- Search Algorithm (HyteresisUp or Binary):
- The Binary search is not recommended for devices with a long recovery time.
- Frequency Points: Frequency points for “User Defined Frequencies”.
- Start Jitter Points: Start jitter amplitudes for “User Defined Frequencies”. In the other frequency modes start jitter amplitude is always 0.
- Jitter Frequency: Single frequency point for “Single Frequency”.

- Jitter Step Size: The size of the smallest sinusoidal jitter amplitude step used to search the “Max passed jitter” at each frequency.
- Show Min Failed Points: The results graph can show the minimum jitter failed jitter in addition to the maximum passed jitter for each tested frequency.

2 Parameter

- Use Compliance RJ and DMSI Values: 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.
- Random Jitter: The amount of RJ, which needs to be added to achieve the compliance eye height and eye width in combination with DMSI.
- Differential Mode Sinusoidal Interference: The amount of DMSI, which needs to be added to achieve the compliance eye height and eye width in combination with RJ.
- Force Retraining on Each Frequency: Re-train the DUT at each tested jitter frequency.

3 BER Measurement

- BER Mode: The BER measurement can be executed for a fixed time or until a target BER is achieved.
- Target BER: The Target BER for the BER measurement used in the test.
- Confidence Level: The confidence level value, when BER mode is TargetBer.
- BER Measurement Duration: The duration of the BER measurement, when mode is FixedTime.
- Allowed Bit Error: The allowed number of bit errors, during the BER measurement, when mode is FixedTime.

Used Calibrations

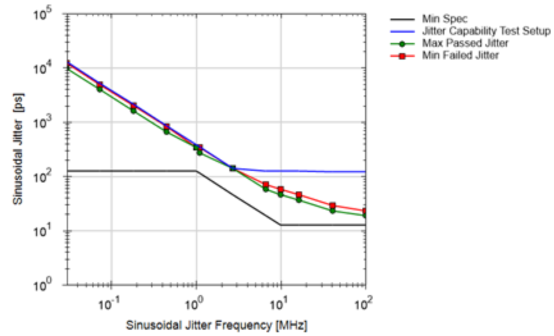
- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration

Procedure Report

An example of HTML worksheet for Jitter Tolerance Test procedure is shown in Figure 156.

L0_EqRx_8GTps_CBB3_JitTol

for PCIe 3.0 U.2 Device



Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P4
Drop Link Method	JBERT LTSSM
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	1 s
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

Result	Sinusoidal Jitter Frequency [MHz]	Min Failed Jitter [ps]	Max Passed Jitter [ps]	Jitter Capability Test Setup [ps]	Min Spec [ps]	Margin [%]
pass	0.030	12037.0	9629.6	12869.1	125.0	7603.7
pass	0.074	4930.4	3944.3	5224.4	125.0	3055.4
pass	0.182	2019.5	1615.6	2120.3	125.0	1192.5
pass	0.448	827.2	661.7	860.0	125.0	429.4
pass	1.000	338.8	338.8	384.5	125.0	171.0
pass	1.104	338.8	271.1	348.2	113.3	139.3
pass	2.718	140.4	140.4	140.4	46.0	205.3
pass	6.694	71.1	56.8	123.7	18.7	204.4
pass	10.000	56.8	45.5	123.5	12.5	263.8
pass	16.487	45.5	36.4	123.2	12.5	191.0
pass	40.604	29.1	23.3	122.2	12.5	86.3
pass	100.000	23.3	18.6	119.7	12.5	49.0

Figure 156 Result Description Jitter Tolerance Test

- Column1:
  - Result: Max passed Jitter should be bigger than Min Spec.
- Column 2:
  - Sinusoidal Jitter Frequency [MHz]: Test frequency points.
- Column 2:
  - Sinusoidal Jitter Frequency [MHz]: Test frequency points.
- Column 3:
  - Min Failed Jitter [ps]: Min jitter that failed the Target BER.
- Column 4:
  - Max Passed Jitter [ps]: Max jitter that passed the Target BER.
- Column 5:
  - Jitter Capability Test Setup [ps]: Max jitter that the hardware can generate.
- Column 6:
  - Min Spec [ps]: Min jitter that has to pass the test to meet the specification.
- Column 7:
  - Margin [%]: Margin between the max passed jitter and the specification.

8G LEQ Rx Sensitivity Test

Purpose and Method

This test searches the minimum eye height at which the DUT passes the BER test. The DUT is trained into loopback mode using the M8020A JBERT interactive link training feature and a BER measurement is performed, starting with an eye height of “Start Eye Height” and decreases with steps of “Step Size”. The minimum passed value is the last test point that did not return an error. Eye height is generated changing the Differential Mode Sinusoidal Interference, the random jitter is fixed to the compliance value.

Connection Setups for Sensitivity Test

Same as Connection Setup Coefficient Matrix Scan on page 391, depending on the DUT and the CLB/CBB revision required.

Parameters in Expert Mode

1. Sensitivity Variation
   - Start Eye Height: It is the first and also the largest Eye Height attained in the Eye Diagram.
   - Stop Eye Height: It is the last and also the smallest Eye Height attained in the Eye Diagram unless the DUT already fails at a higher eye-height.
   - Eye-Height Step Size: The amount of the eye height, which is decreased at each step, to search the “Min Passed Eye Height”.
2. Parameter
   - Random Jitter: The amount of RJ which needs to be added to achieve the compliance eye height and eye width in combination with DMSI.
   - Sinusoidal Jitter: 12.5 ps of SJ has to be added for this test.
   - Sinusoidal Jitter Frequency: Frequency of the sinusoidal jitter component.
   - BER Mode: The BER measurement can be executed for a fixed time or until a target BER is achieved.
   - Target BER: The Target BER for the BER measurement used in the test.
   - Confidence Level: The confidence level value when BER mode is TargetBer.
   - BER Measurement Duration: The duration of the BER measurement when mode is FixedTime.

- Allowed Bit Error: The allowed number of bit errors during the BER measurement when mode is FixedTime.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height Calibration

Procedure Report

An example of HTML worksheet for Sensitivity Test procedure is shown in . Figure 157.

L0_EqRx_8GTps_CBB3_Sens

for PCIe 3.0 U.2 Device

Offline	True
Start Eye Height	63 mV
Eye Height Step Size	1 mV
Sinusoidal Jitter Frequency	100 MHz
BER Mode	TargetBer
Target BER	1E-9
Confidence Level	95 %
Generator final preset	P0
Generator final pre-shoot	0 dB
Generator final de-emphasis	-6 dB
Interactive Training Script File	C:\ProgramData\BitifEye\ValiFrame\Settings\
Suppress Loopback Training Messages	False
Generator Start Preset	P5
DUT Initial Preset	P5
DUT Target Preset	P4
Drop Link Method	JBERT LTSSM
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	6dB
Sensitivity	Normal
Capture and Compare Mode	False
Pause before Auto-Align	False
Polarity	Normal
Relax Time	1 s
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

Result	Min Passed Eye Height [mV]	Spec Limit [mV]	Margin [%]
pass	40.0	46.0	13.0

Figure 157 Result Description of Sensitivity Test

- Column1:
  - Result: The Min Passed Eye Height measured should be smaller than the Min Spec.
- Column 2:
  - Min Passed Eye Height [mV]: The minimum eye height at which the DUT passes the BER test.
- Column 3:
  - Spec Limit [mV]: The minimum eye height at which the DUT has to pass the BER test to meet the specification.
- Column 4:
  - Margin [%]: It is the margin between the min eye height passed and the minimum spec value.

Link Equalization Transmitter Tests

To access to the link equalization test, the ValiFrame option 501 (PCI Express Link Equalization Tests) is required.

Common Link Equalization Tx Test Parameters

Link Equalization Tx

- Generator Output Voltage Compensation
- Oscilloscope channels for Link EQ Tx Tests
- Skip BER Check

Data Rate Specific

1. Parameter
   - EQ Preset Measurement: The user can select to run the preset measurement of the captured waveforms locally using SigTest or the N5393C PCI-Express scope application if a connection to it is available.
2. Loopback Training
   - Link EQ Transmitter Test Script File: The Link Training Suite settings file (script file) which will be used for loopback training.
   - Suppress Loopback Training Messages: All loopback related message boxes, e.g. “Please power cycle DUT” are not displayed. The user has to assure that the DUT is in loopback when starting Rx tests.
3. Error Detector
   - Use CDR: If true, CDR is used to generate a clock signal for the JBERT error detector. If false, the clock is supplied by the JBERT data generator. With CDR the JBERT error detector performance is better.
   - CDR Loop Bandwidth: The loop bandwidth of the JBERT error detector CDR.
   - Peaking: CDR peaking.It is available only for JBERT_M8020A.
   - Analyzer Equalization: Apply PCI-Express Equalization settings to the received signal. t is available only for JBERT_M8020A.
   - Capture and Compare Mode: If enabled, the received data is captured and saved in a pattern. A new analyzer sequence is generated with a single block containing the captured pattern. This mode is only available with a common reference clock architecture.

- Pause before Auto-Align: Pause before the BER measurement so that the user can perform manual optimization of the DUT receiver.
- Sensitivity Mode: Set to Normal or High. t is available only for JBERT_M8020A.
- Polarity: Set to Normal or Inverted.

Please refer to Table 4, “Common Parameters for Receiver groups”

NOTE

Lane 0 is the only available lane for Link Equalization Tests.

8G LEQ Tx Initial Preset Compliance Test

This procedure is available only if Gen3 spec is selected.

Purpose and Method

This test, for Devices only, uses the interactive link training feature of the M8020A JBERT. The M8020A JBERT 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 M8020A JBERT or not.

Connection Setup for Compliance Test

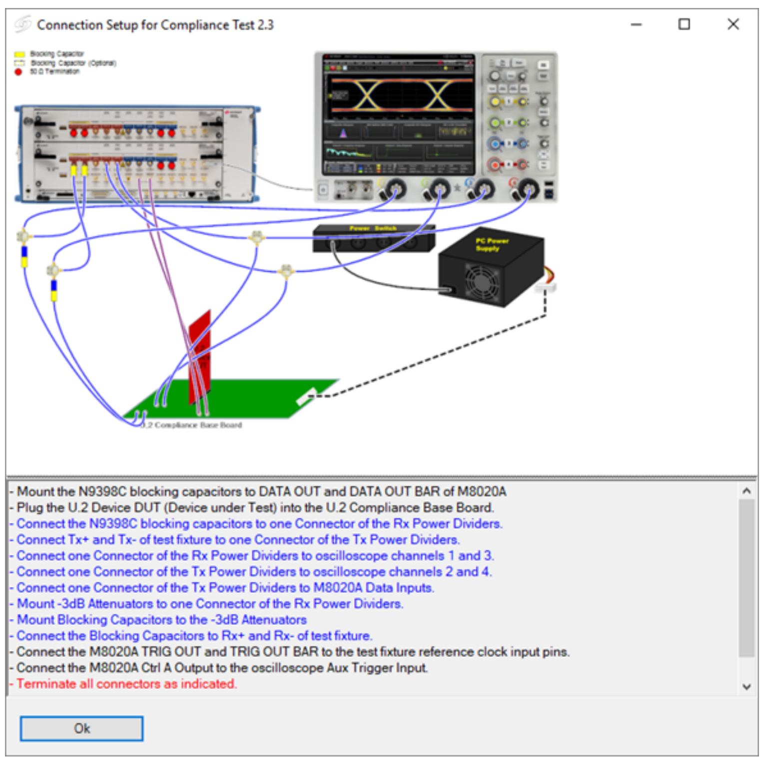


Figure 158 Connection Setup for Compliance Test

Used Calibrations

- None.

Procedure Report

An example of HTML worksheet for Compliance Test procedure is shown in Figure 159.

L0_EqTx_8GTps_IniPreset

for PCIe 3.0 U.2 Device

Offline	True
Link EQ Tx Test Script File	C:\ProgramData\BitifEye\ValiFrameK0 \PCIe\Settings\TrainingScripts\Pcie3_8G_M8020A_EqTx_Loopback.txt
Generator Start Preset	P5
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	-6 dB
Sensitivity	High
Polarity	Normal
Scope Connection for Link EQ Tx Tests	Chan 1 2 3 4 Direct Connect
Generator Output Voltage Compensation	9 dB
Skip BER Check	True

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	0.00	0.00	0.00	-6.00	-7.50	-4.50	
pass	P1	0.00	0.00	0.00	-3.50	-4.50	-2.50	
pass	P2	0.00	0.00	0.00	-4.40	-5.90	-2.90	
pass	P3	0.00	0.00	0.00	-2.50	-3.50	-1.50	
pass	P4	0.00	0.00	0.00	0.00	0.00	0.00	
pass	P5	1.90	0.90	2.90	0.00	0.00	0.00	
pass	P6	2.50	1.50	3.50	0.00	0.00	0.00	
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	0.00	0.00	0.00	

Figure 159 Result Description of Compliance Test

- Column1:
  - Result: The measured Pre-Shoot and De-Emphasis must be within the specification limits.
- Column 2:
  - DUT Initial Preset: Initial DUT transmitter preset (set by the M8020A JBERT).
- Column 3:
  - Pre-Shoot [dB]: Measured Pre-Shoot on the DUT waveform.
- Column 4:

    - Min Spec [ps]: Pre-Shoot lower specification limit.
- Column 5:
    - MaxSpec [ps]: Pre-Shoot upper specification limit.
- Column 6:
    - De-Emphasis [dB]: Measured De-Emphasis on the DUT waveform.
- Column 7:
    - Min Spec DE [dB]: De-Emphasis lower specification limit.

- Column 8:
  - Max Spec DE [dB]: De-Emphasis upper specification limit.
- Column 9:
  - Comment: A comment is added to each test step if fails, explaining the reason.

8G LEQ Tx Response Time Compliance Test

This procedure is available only if Gen3 spec is selected.

Purpose and Method

These tests use the interactive link training feature of the M8020A JBERT 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 rises an event which is used to capture the waveforms of the M8020A JBERT and the DUT. At that moment, the captured waveform from the M8020A JBERT contains the preset change request and the waveform from the DUT contains the acknowledgement of that request plus the physical transition from the initial transmitter preset to the requested preset.

The captured data is decoded and two timespans are calculated: one between the request and the acknowledgement, and other between the request and the electrical transition.

Finally, once the DUT is in loopback mode, a similar preset measurement as for the Compliance Test is performed. The test is divided in two parts. In the first part, the M8020A-JBERT requests transmitter presets. In the second part, the M8020A-JBERT requests the pre-cursor, cursor and post-cursor reported by the DUT.

In the Compliance Test for Devices, the initial transmitter preset is set by the M8020A JBERT. In the Compliance Test 2.7 (for Hosts), the user has to manually set the DUT initial transmitter preset.

Connection Setup for Compliance Tests

Same as 8G LEQ Tx Initial Preset Compliance Test on page 426.

Parameters in Expert Mode

- Max Number of Retries: in case the acquired data cannot be decoded, the link training can be repeated in order to get new data.
- Scope visible range: Waveform range which will be used at the moment when the link equalization phase is performed.
- Use CTLE: Apply a CTLE filter as defined in the PCI-Express specification to the DUT’s waveform. If true, several DC gains can be selected.

Used Calibrations

- None

Procedure Report

An example of HTML worksheet for Compliance Tests procedure is shown in Figure 160.

L0_EqTx_8GTps_RespTime

for PCIe 3.0 U.2 Device

Offline	True
Skip response time measurments	False
Ignore protocol response times for pass/fail	False
Max Number of Retries	1
Scope Horizontal Range	10 us
Scope Request Vertical Range	2.4 V
Scope Response Vertical Range	400 mV
Link EQ Tx Test Script File	C:\ProgramData\BitifEye\ValiFrameK0 \PCIe\Settings\TrainingScripts\Pcie3_8G_M8020A_EqTx_Loopback.txt
Generator Start Preset	P5
Use CDR	True
CDR Loop Bandwidth	12 MHz
Peaking	1 dB
Analyzer Equalization	-6 dB
Sensitivity	High
Polarity	Normal
Scope Connection for Link EQ Tx Tests	Chan 1 2 3 4 Direct Connect
Generator Output Voltage Compensation	9 dB
Skip BER Check	True

Result	DUT Target Preset	Electrical response time [ns]	Protocol 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	176.00	0.00	0.00	0.00	-6.00	-7.50	-4.50	DUT reported cursors: (0, 0, 0)
pass	P1	100.00	176.00	0.00	0.00	0.00	-3.50	-4.50	-2.50	DUT reported cursors: (0, 0, 0)
pass	P2	100.00	176.00	0.00	0.00	0.00	-4.40	-5.90	-2.90	DUT reported cursors: (0, 0, 0)
pass	P3	100.00	176.00	0.00	0.00	0.00	-2.50	-3.50	-1.50	DUT reported cursors: (0, 0, 0)
pass	P4	100.00	176.00	0.00	0.00	0.00	0.00	0.00	0.00	DUT reported cursors: (0, 0, 0)
pass	P5	100.00	176.00	1.90	0.90	2.90	0.00	0.00	0.00	DUT reported cursors: (0, 0, 0)
pass	P6	100.00	176.00	2.50	1.50	3.50	0.00	0.00	0.00	DUT reported cursors: (0, 0, 0)
pass	P7	100.00	176.00	3.50	2.50	4.50	-6.00	-7.50	-4.50	DUT reported cursors: (0, 0, 0)
pass	P8	100.00	176.00	3.50	2.50	4.50	-3.50	-4.50	-2.50	DUT reported cursors: (0, 0, 0)
pass	P9	100.00	176.00	3.50	2.50	4.50	0.00	0.00	0.00	DUT reported cursors: (0, 0, 0)
pass	P0' (0, 0, 0)	100.00	176.00	0.00	0.00	0.00	-6.00	-7.50	-4.50	
pass	P1' (0, 0, 0)	100.00	176.00	0.00	0.00	0.00	-3.50	-4.50	-2.50	
pass	P2' (0, 0, 0)	100.00	176.00	0.00	0.00	0.00	-4.40	-5.90	-2.90	
pass	P3' (0, 0, 0)	100.00	176.00	0.00	0.00	0.00	-2.50	-3.50	-1.50	
pass	P4' (0, 0, 0)	100.00	176.00	0.00	0.00	0.00	0.00	0.00	0.00	
pass	P5' (0, 0, 0)	100.00	176.00	1.90	0.90	2.90	0.00	0.00	0.00	
pass	P6' (0, 0, 0)	100.00	176.00	2.50	1.50	3.50	0.00	0.00	0.00	
pass	P7' (0, 0, 0)	100.00	176.00	3.50	2.50	4.50	-6.00	-7.50	-4.50	
pass	P8' (0, 0, 0)	100.00	176.00	3.50	2.50	4.50	-3.50	-4.50	-2.50	
pass	P9' (0, 0, 0)	100.00	176.00	3.50	2.50	4.50	0.00	0.00	0.00	
pass	Overall Result	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Figure 160 Result Description of Compliance Tests

- Column1:
  - Result: Max passed Jitter should be bigger than Min Spec.
- Column 2:
  - DUT Target Preset: It is the transmitter preset the M8020A-JBERT requests the DUT to use.
- Column 3:

- Electrical response time [ns]: It is calculated timespan between the request from the M8020A JBERT and the physical preset transition on the DUT waveform.
- Column 4:
  - Protocol response time [ns]: It is calculated timespan between the request from the M8020A JBERT and the acknowledgment.
- Column 5:
  - Pre-Shoot [dB]: Measured Pre-Shoot on the DUT waveform.
- Column 6:
  - Min Spec [ps]: Pre-Shoot lower specification limit.
- Column 7:
  - Max Spec [ps]: Pre-Shoot upper specification limit.
- Column 8:
  - Measured De-Emphasis on the DUT waveform.
- Column 9:
  - De-Emphasis [dB]: De-Emphasis lower specification limit.
- Column 10:
  - Min Spec DE [dB]: De-Emphasis upper specification limit.
- Column 11:
  - Max Spec DE [dB]: De-Emphasis lower specification limit.
- Column 12:
  - Comment: A comment is added to each test step.

Receiver Setup (Only for Debugging)

8G Rx Compliance Setup

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Preset Compliance Rx test using the calibration data saved on the PC where N5990A software is running. The method begins like Compliance test but then the test will not run, it only leaves the setup prepared. The set parameters are the eye height and the eye width.

Connection Setups for Preset Compliance Test

Same as Connection Setups for EQ Coefficient Matrix Scan on page.

Parameters in Expert Mode

- Eye Height
- Eye Width
- Differential Mode Sinusoidal Interference: The amount of DMSI which needs to be added to achieve the desired eye height and eye width in combination with RJ.
- Random Jitter: The amount of RJ which needs to be added to achieve the desired eye height and eye width in combination with DMSI.
- Sinusoidal Jitter: 12.5ps of SJ has to be added for this test.
- Sinusoidal Jitter Frequency

For more detail, refer to Table 6, “Procedure Parameters for Receivers”.

Used Calibrations

- Preset Calibration
- Random Jitter Calibration
- Sinusoidal Jitter Calibration
- DM Sinusoidal Interference Calibration
- Eye Height and Width Calibration

Procedure Report

- None

11 Rx Switch Matrix

Rx Switch Matrix

When more than one lane are needed to be tested, it is recommended to use the switch. It avoids the need to change the connections and thus saves a lot of times.

In order to use a BitifEye 2100 Series Switch System, the ValiFrame option 002 (Switch System Support, available from BitifEye as BIT-2001-0002-0) is required.

To use the switch for receiver tests, Select the **Use Switch for Rx tests** in the **Station Configuration,** to enable the **Switch Configuration** button to test more than one lane without changing the connections. Click the button **Switch Configuration** to open the **Rx Switch Configuration** dialog which allows to select the module type (SP4T, SP6T, or SP8T) and the slot position for each Rx and Tx lane.

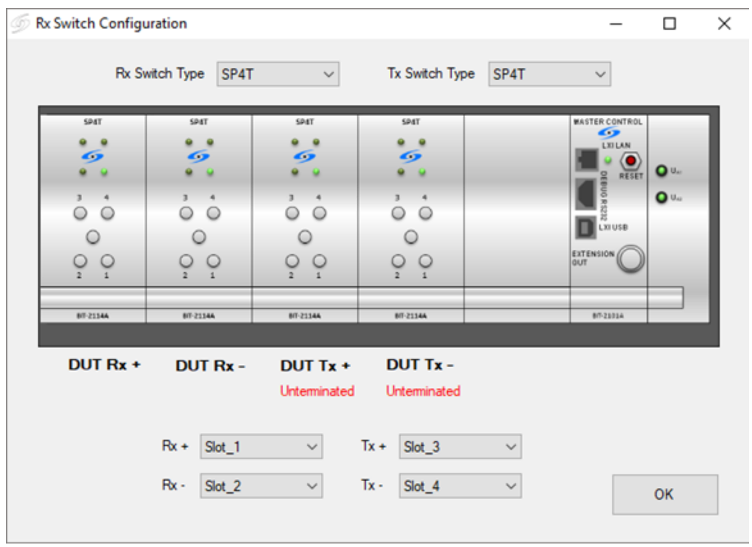


Figure 161 Rx switch configuration

The switch should not affect the test results. Therefore, when the switch is used in the receiver tests it is also included in the calibrations.

For calibrations, the switch is connected between the input signal and the calibration fixture.

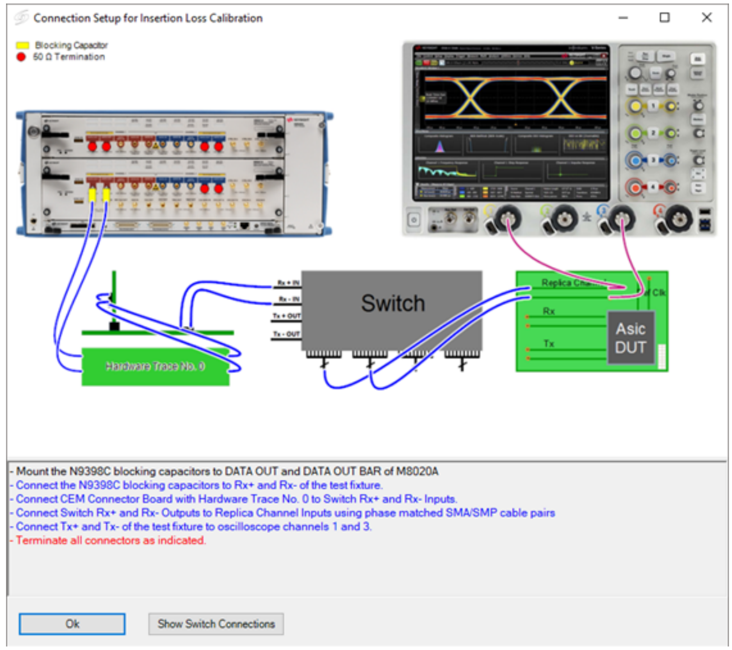


Figure 162 Connection setup for Gen4 ASIC Insertion Loss calibration

For Gen1 and Gen2 in calibrations, where the board is not included, the switch output are connected directly to the oscilloscope:

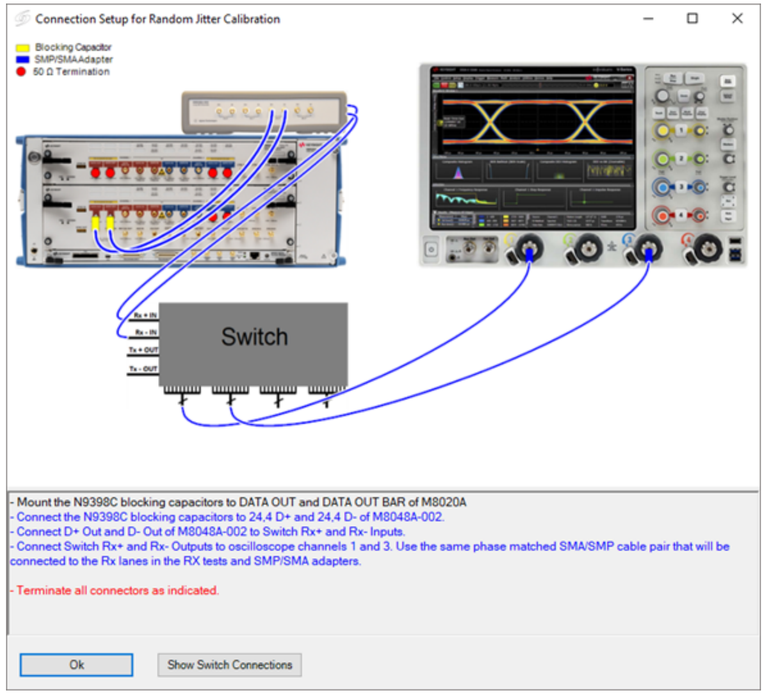


Figure 163 Connection setup for Gen1 ASIC Random Jitter Calibration

In the receiver tests, the switch is always connected between two units; one unit is the connection of input signal and the Rx lanes of the board and the other unit is the connection of Tx lanes and the error detector input.

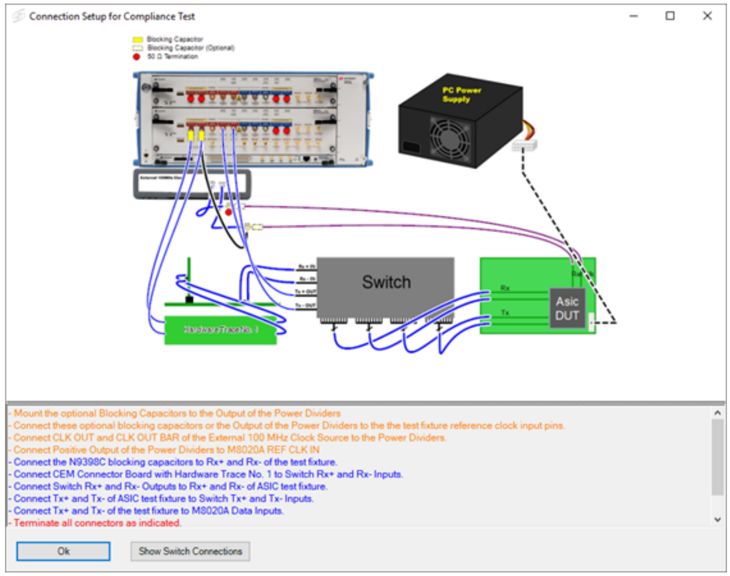


Figure 164 Connection Setup for Compliance Test

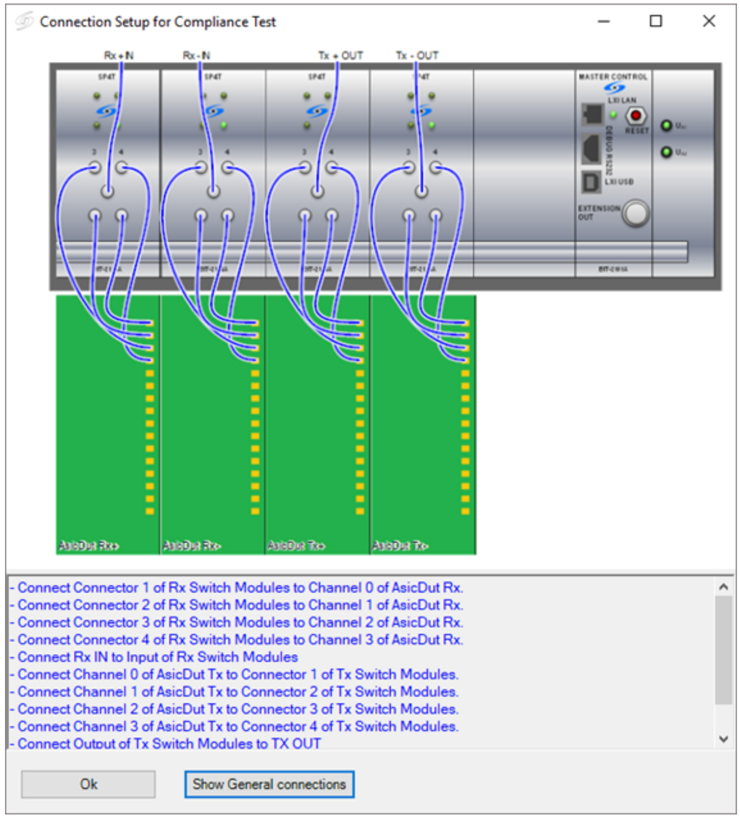


Figure 165 Detailed Connection of the switch for Compliance test

12 Appendix

Data Structure and Backup

ValiFrame Data Structure

All ValiFrame internal data is saved in the application data folder:

- For Windows XP: Documents and Settings\All Users\Application Data\BitifEye \ValiFrame”
- For Windows 7: ProgramData\BitifEye\ValiFrame

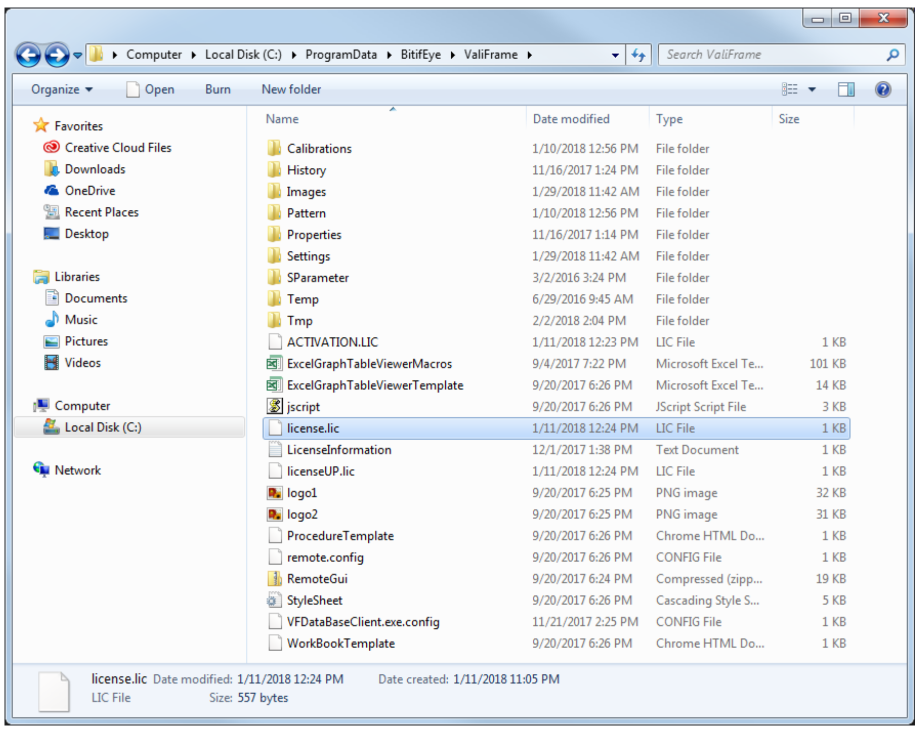


Figure 166 Valiframe Folder

NOTE

Windows hides the system folders, by default. To make the application data folder visible, the “Hidden Files and Folders” setting needs to be set to “Show hidden files and folders” in the Windows File Explorer > View Settings.

The ValiFrame application data folder contains the following folders:

- Images
- Settings
- Pattern
- Properties
- Calibrations
- Tmp

Images

The “Images” folder contains the connection diagram images.

Settings

The “Settings” folder contains the default settings file for the instrument and .vset file which contains the changes to the default registry entries. For each application, a sub folder is created and a ValiFrame.vset file is created in this sub folder as soon as any ValiFrame setting is changed from its default. The settings files contain, for example, the instrument connection setup.

Pattern

The Pattern folder contains the test pattern files. These are text files which contain the pattern in hexadecimal format.

Calibrations

The calibration data is stored in the “Calibrations” folder. For each calibration procedure at least one calibration file is stored. These files are text files and can be imported into MS Excel or displayed with the HTML viewer.

Tmp

All temporary files are created in the Tmp folder. The sub folder “Results” contains the final result of each calibration and test procedure. This is a safety feature and these files are used for recovery, in case the user forgot to save them.

ValiFrame Backup

Use the ValiFrame application data folder to save calibration data, modified test pattern or settings for backup or transfer to another PC.

The files in the folders, “Images” and “Pattern” will be generated or if they already exist, be overwritten during a ValiFrame installation. In the “Settings” folder, all instrument settings are overwritten by the installation except the .vset files. In the “Calibration” folder, all files are generated by the calibration procedures and will not be overwritten by the installation. To compare or archive the calibration data, backup the “Calibration” folder.

Remote Interface

Introduction

The N5990A ValiFrame remote interface allows ValiFrame functionality (such as test setup information, calibration, and test procedures, and results) to be accessed from external programming environments, for example MS.NET/C#, VEE, LabView, TestExec SL, or TestStand. The remote interface can thus be used to control N5990A by external software. In typical use, a top-level external test sequencer takes advantage of ValiFrame functionality.

If ValiFrame is to be used as a top-level test sequencer, the control of external software is achieved with N5990A opt. 500, User Programming.

Interface Description

The ValiFrame functionality is accessible via ValiFrameRemote.dll. It contains a class ValiFrameRemote in the BitifEye.ValiFrame.ValiFrameRemote namespace (see Figure 167). Its use is illustrated by the ValiFrameRemoteTester application. The source code and the Visual Studio solution of this example are available on the BitifEye support webpage. Using this interface requires that the ValiFrame dlls are either in the same folder or the Windows Path variable contains the folder in which these dlls are located.

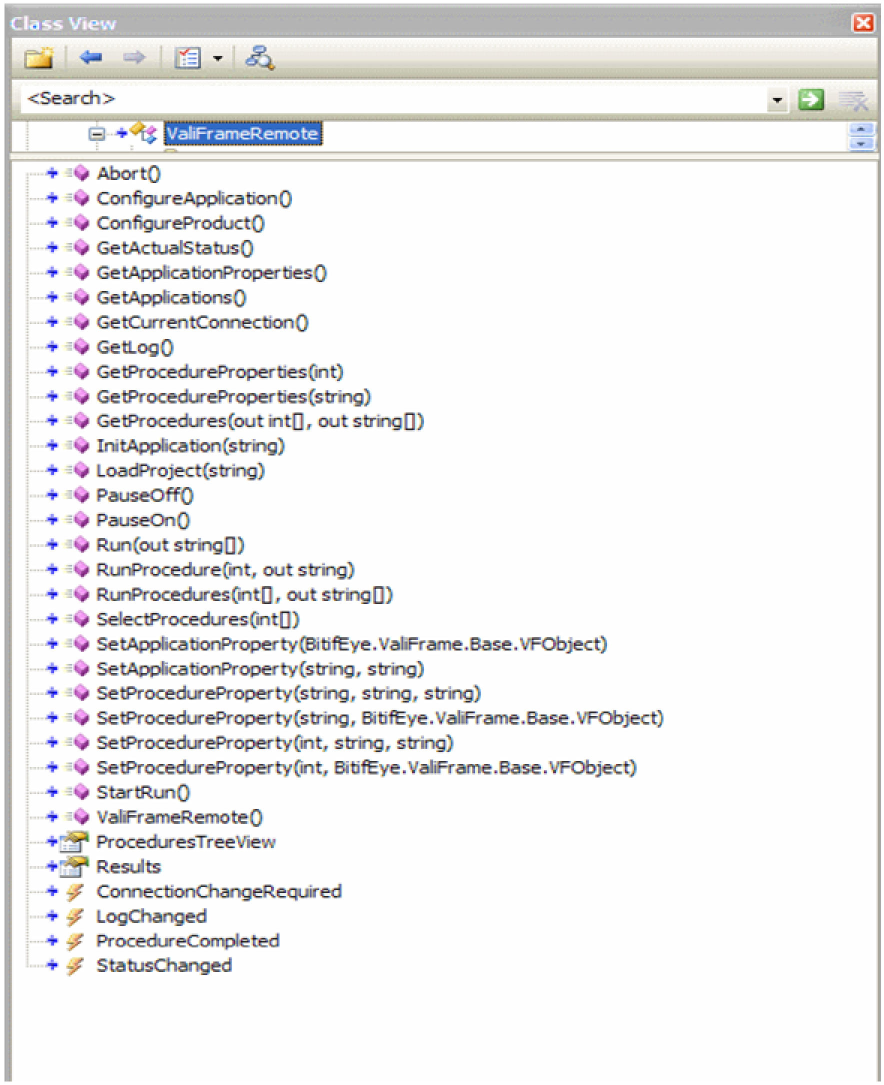


Figure 167 Members of the ValiFrameRemote class

Using the Remote Interface

1 Add the ValiFrameRemote.dll as a reference to the project.
2 Create an instance of the ValiFrameRemote class.
3 Call SetConfigurationFile(string filename), if it is needed. It is required only when the station configuration file generated by the station configurator is not to be used. This file format is same as the files generated by the station configurator, which can be found in the Valiframe Application data folder (Windows XP: C:\documents and settings\all users\application data\bitifeye\valiframe\settings\<application name>\ValiFrame.vset, or Windows 7: c:\programdata\bitifeye\valiframe\settings\<application name>\ValiFrame.vset). The station configuration files contain just the differences to the registry. Refer to Example of a station configuration file for more details.
4 By calling InitApplication(string applicationName), the instruments of the selected Test Station (see "PCIe Station Configuration" on page 20) are connected and initialized.
5 Call either ConfigureApplication() or LoadProject(string filename) to initialize the DUT properties and test procedures. The project file can be generated with the ValiFrame User Interface and it contains the DUT properties, the selected test procedures and the properties of each test procedure.
6 Calling Configure Application() prompts a dialog for setting the DUT properties

NOTE **The number and type of available test procedures can depend on the DUT properties.**

7 Get the list of available procedures with GetProcedures(out int[] procedureIds, out string[] procedureNames[]).
8 Select procedures individually with SelectProcedures(int[] procedureIds) or combined with Run(int[] procedureIds, out stringxmlResult).
9 Execute selected procedures by calling any of the Run functions given below:
10 The Run(out string[]xmlResults) executes all selected procedures. The results of all procedures executed are returned at the end of the execution of all selected procedures.
11 The RunProcedure(int id, out string xmlResult) executes a single procedure and returns the result in an xml formatted string.

12 The RunProcedures(int[] procedureIds, out string[] xmlResults) executes the list of procedures given in the procedureIds array.

13 The StartRun() function returns immediately. It is mainly used for event-driven programming. In this case the events StatusChanged() and ProcedureCompleted() can be used to determine the actual status of the ValiFrame sequencer and read the results. The ProcedureCompleted() event provides the ID and the xmlResult of the procedure completed. After the run the xmlResults are also available via the Result property

Example of a station configuration file

```
<?xml version="1.0" encoding="utf-8"
standalone="yes"?>
<Folder name="ValiFrame">
  <Folder name="Stations">
    <Folder name="PCI Express 3 Station">
      <Folder name="Instruments">
        <Folder name="Instrument2">
          <Property
name="Address">TCPIP0::192.168.0.102::inst0::INSTR</P
roperty>
          <Property name="Timeout">00:01:00</Property>
          <Property name="Description">CMSI (Common
Mode Sinusoidal Interference) Source</Property>
        </Folder>
        <Folder name="Instrument1">
          <Property name="Offline">True</Property>
          <Property
name="Address">TCPIP0::192.168.0.133::inst0::INSTR</P
roperty>
          <Property name="Timeout">00:01:00</Property>
```

```
          <Property name="Description">M8020A JBERT
with integrated jitter sources for BER
tests</Property>

          <Property
name="Dll">VFAgM8000.dll</Property>

        </Folder>

        <Folder name="Instrument3">

          <Property name="Offline">True</Property>

          <Property
name="Address">TCPIP0::192.168.0.103::inst0::INSTR</P
roperty>

          <Property name="Timeout">00:05:00</Property>

          <Property name="Description">Realtime scope
for stress signal calibration</Property>

          <Property name="Dll">VFAgDso.dll</Property>

        </Folder>

        <Folder name="Instrument4">

          <Property name="Offline">True</Property>

          <Property
name="Address">192.168.0.103</Property>

          <Property name="Timeout">00:03:00</Property>

          <Property name="Description">PciExpress Tx
application running on realtime scope</Property>

          <Property
name="Dll">VFAgN5393C.dll</Property>

        </Folder>

        <Folder name="Instrument5">

          <Property name="Offline">True</Property>

          <Property
name="Address">192.168.0.104;username;password</Prope
rty>

          <Property name="Timeout">00:01:00</Property>
```

```
          <Property name="Description">Main power
switch</Property>
          <Property
name="Dll">VFNetIo230B.dll</Property>
        </Folder>
        <Folder name="Instrument6">
          <Property name="Offline">True</Property>
          <Property
name="Address">TCPIP0::192.168.0.5::5025::SOCKET</Pro
perty>
          <Property name="Timeout">00:00:30</Property>
          <Property name="Description">Switch Matrix
for Rx Tests</Property>
          <Property
name="Dll">VFBit2100.dll</Property>
        </Folder>
      </Folder>
      <Folder name="Properties">
        <Property name="Show All
Instruments">False</Property>
        <Property name="System
Configuration">Unknown</Property>
        <Property name="Generator Type">JBERT
M8020A</Property>
        <Property name="Common Mode Interference
Source"> 81150A</Property>
        <Property name="Reference Clock
Source">None</Property>
        <Property name="Seasim
Access">Executable</Property>
        <Property name="Seasim Script Path">C:\
Seasim</Property>
        <Property name="Python 2.6 Path">C:\
Python26</Property>
```

```
        <Property name="Power Switch
Type">NetIo230B</Property>

        <Property name="Use switch for Tx
tests">False</Property>

        <Property name="Use switch for Rx
tests">True</Property>

        <Property name="Use External Reference
Clock">False</Property>

        <Property name="Switch Type for Rx Modules in
Rx tests">SP4T</Property>

        <Property name="Switch Type for Tx Modules in
Rx tests">SP4T</Property>

        <Property name="Switch Type for Modules in Tx
tests">SP4T</Property>

        <Property name="Rx + slot in the Switch">Slot
1</Property>

        <Property name="Rx - slot in the Switch">Slot
2</Property>

        <Property name="Tx + slot in the Switch">Slot
3</Property>

        <Property name="Tx - slot in the Switch">Slot
4</Property>

      </Folder>

      <Folder name="Children" />

      <Property name="Software Version">ValiFrame
1.0</Property>

    </Folder>

  </Folder>

  <Folder name="Database">

    <Folder name="Properties">

      <Property name="Offline">True</Property>

      <Property
name="ApplicationServerHostname">127.0.0.1:8082</Prop
erty>
```

```
    </Folder>
  </Folder>
</Folder>
```

If the ValiFrame sequencer is called via a .NET GUI (System.Windows.Forms.Form), the current status, the available procedures, and the procedure selection can be shown and modified by passing a TreeView control via the ProductPreTreeView property to the ValiFrame sequencer prior to the InitApplication() call. In this case, the TreeView control directly shows which procedures were selected as well as the procedure currently being processed during the run. At the end of each run, the Result is given. Refer to the ValiFrameRemoteTester source code for more details.

The log entries generated by the ValiFrame sequencer can be accessed via the LogChanged() event. Each time the sequencer generates a log entry this event will be broadcast. It is recommended that the user monitors this event and tracks the log changes to identify problems during execution.

The procedures requiring interaction with the user will pop up dialog panels. For example, each time a new connection between an instrument and the DUT is necessary, the procedure will start to display pop-up windows with the required connections. The dialog can be suppressed by attaching to the ConnectionChangeRequired() event. In some cases, internal dialogs or message boxes are also shown. For full automation without any user interaction, events must be defined and implemented such that the controlling environment can react to all dialog and message boxes without user input. Currently, how to handle these dialogs has to be decided case by case.

Results Format

Each Procedure Run will produce an xml-formatted result string, which can be accessed via the out parameters of the Run() functions or the Results property of the ValiFrameRemote class. The result string starts with a summary, which contains the procedure name, ID, result, and the time stamp of the procedure run (see Example of Result string format):

Example of Result string format


```
<?xml version="1.0" encoding="utf-16"?>
<Test Results>
  <Summary>
    <ProcedureName>Jitter Tolerance Test 2 MHz SJ RBR
Lane 0</ProcedureName>
    <ProcedureID>400008</ProcedureID>
    <Result>Passed</Result>
    <DateTime>4/30/2009 11:29:14 AM</DateTime>
  </Summary>
  <DocumentElement>
    <Parameters>
      <Name>Number of Lanes</Name>
      <Value>1</Value>
    </Parameters>
    <Parameters>
      <Name>Spec. Version</Name>
      <Value>1.1</Value>
    </Parameters>
    <Parameters>
      <Name>ISI Amplitude</Name>
      <Value>570 mUI</Value>
    </Parameters>
    <Parameters>
```

```
      <Name>Step Mode</Name>
      <Value>False</Value>
    </Parameters>
    <Parameters>
      <Name>Parade DP621 Device</Name>
      <Value>False</Value>
    </Parameters>
  </DocumentElement>
  <Data>
    <ColumnHeader>|Result|Jitter Freq.|Sin.-Jitter
Amp.|Number of Errors|Min Spec|Max
Spec|Details|</ColumnHeader>
    <Values>|pass|2000000|0.981|2|0|1000||</Values>
  </Data>
</Test Results>
```


The following part contains the list of parameters. These parameters may be changed via the project file or the remote interface. The last part contains the test data. It starts with the column header, followed by one or more data rows. The format is similar to what is obtained in the Excel output if the same procedure is run via the ValiFrame user interface. Each column name/value is separated by the pipe symbol '|'.

Controlling Loop Parameters and Looping Over Selected Tests

Often parameters such as temperatures or supply voltages need to be varied systematically. A simple example would be repeating tests over a temperature range from −10 to 30 °C to verify an operating temperature range. In this case, after the tests have been run at −10 °C, the temperature of the climate chamber is increased by the selected temperature step width, for example, 1°C. The tests are then repeated at −9 °C. After the test execution, the temperature is incremented again and the tests are rerun repeatedly until they are finally run at 30 °C. This repetitive process is called looping. In this example, the temperature within a climate chamber is the loop parameter. While the loop is executed, the test results have to be documented for each loop parameter value. In practice, multiple loop levels might be required, as shown in Figure 168.

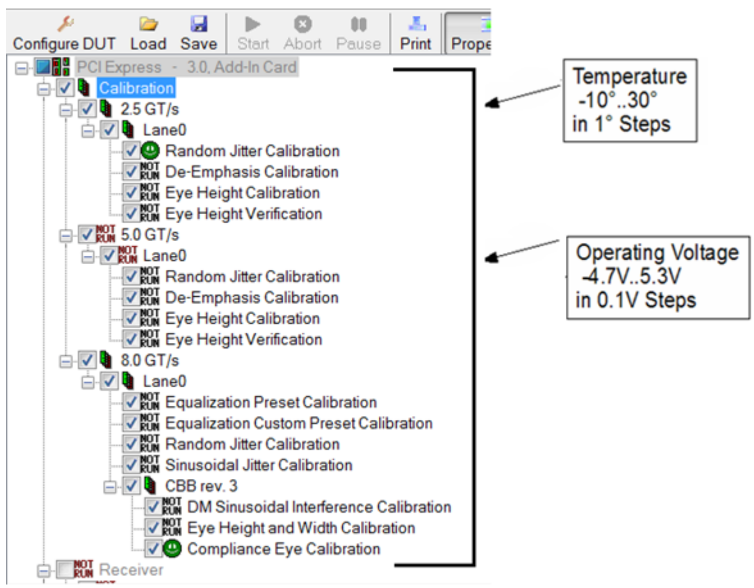


Figure 168 Temperature and voltage sweeps using N5990A sequencer

As the loop parameters are typically customer-specific, N5990A permits a list of loop parameters to be specified. N5990A supports:

1 Looping over user-specified parameters or run tests with a single parameter value.
2 Defining a set of loop parameters and for each parameter a range of test points.
3 Using custom drivers to control instruments that are not part of the ValiFrame Test Station (see section"PCIe Station Configuration" on page 20), e.g. climate chambers, ovens, and power supplies.
4 Saving the results of each test together with the actual loop parameter value independently of the results from the other runs.
5 An overview of each run after the end of the test execution.

These features are provided by an interface called IVFEnvironmentalControl.

The definition of this interface is:

```
namespace BitifEye.ValiFrame.Instruments
{
public interface IVFEnvironmentalControl
{
string UserLabel { get; }
void Connect();
void Disconnect();
string[] GetParameterList();
string[] GetParameterValues();
void Init();
bool SetNextValue();
void SetToDefault();
}
}
```

The interface has to be implemented by a class EnvironmentalControl in a .NET dll named EnvironmentalControl.dll, which then needs to be copied into the ValiFrame Program Files Folder. ValiFrame will load this dll and call the function of the Interface in the following order:

Connect()

At startup of ValiFrame allows the implementation to load the instrument drivers and connect to them.

SetToDefault()

After the Connect() call, the implementation should set all instruments with initial values to set default values. It is recommended that the sequence is stated with nominal values to ensure that the test setup is done properly. With this setting, the first run will be done and the Init() call will not overwrite the values.

Init()

The function is used to initialize the instruments with start values at the beginning of test sequence.

GetParameterList() and GetParameterValues()

These functions are used to get the parameter names and values lists and put them into the result output of each test procedure.

SetNextValue()

If this function returns true at the end of each run over the selected test procedures, ValiFrame will run the selected tests again. This function should get the next parameter set, set the controlling instruments, and return true if a new set of parameters is available.

Example

For a sweep over temperature starts at 20 °C, increasing the temperature by 2 °C at each run, and ending at 40 °C, the function should increase the temperature of the chamber and return true if 40 °C is not reached. If the next step is greater than 40 °C, this function should return false. ValiFrame will end the test sequence in this case.

Disconnect()

It is called at the closing of ValiFrame. The driver should set the instruments to default values and disconnect from the instruments. An example project is available on the BitifEye webpage.

IBerReader

ValiFrame cannot integrate all possible instruments and custom interfaces to communicate with the DUT. To overcome this problem, the customer can provide a .NET DLL which implements the IBerReader interface. This DLL is used by ValiFrame, and invoked during the test; the DLL then takes care of the instrument or DUT communication.

To use this feature in ValiFrame PCIe, go to Configure DUT > Show Parameters dialog, and change the property BER Reader to "Custom BER Reader." This option will be only be available if the dll with name PcieCustomBerReader.dll is there in its installation folder.

- PCIe specific calling conventions:
  - Connect(string): xThe string parameter is an empty string by default. It can be changed by setting the "Address" property in Confugure DUT > Show Parameters dialog.
    This is used to do general initialization or start external programs if it is required.
  - Disconnect(): This method will be called every time a test run is finished (after all selected tests are done, not after each individual test).
    It is used to clean up or shut down external programs if applicable.
  - Init (string): This will be called when the DUT needs to be put into a specific state.
    The possible values are "8000000000 T/s", "5000000000 T/s," or "2500000000 T/s" depending on the data rate.
    If Clock arquitecture is “Separate Reference Clock No Ssc” add the string “, SRNS” and if clock arquitecture is “Separate Reference Clock Independent Ssc” add “, SRIS”.

IBerReader Interface

```
using System;

using System.Collections.Generic;

using System.Text;


namespace BerReader
```

```
{
       public interface IberReader

       {
             /// <summary>
             /// This method is called to connect to
your error reader.
             /// </summary>
              /// <param name="address">The address
string can be used by your implementation
             /// to configure the connection to the
BerReader interface</param>
             void Connect(string address);


             /// <summary>
             /// This method is called to close the
connection
             /// </summary>
             void Disconnect();


             /// <summary>
             /// This method will be called prior the
individual tests to tell the device
            /// what mode is tested. This can be used
to load appropriate
            /// setups.
           /// </summary>
          /// <param name="mode"> configuration mode
in which the DUT will be tested. The possible valueas
are 8000000000 T/s, 5000000000 T/s or 2500000000 T/s.
If Clock arquitecture is Separate Ref Clock No Ssc add
```

```
            /// The automation software will compute
the BER using the following
            /// equation BER=errorCounter/bitCounter.
In the case bitCounter = 0 even when
            /// the stimulus is sending data, this is
also interpreted as fail.
            /// </summary>
            /// <param name="bitCounter"> Contains the
number of bits which are received
            /// by the DUT. If it is not possible to
count bits the value can also contain
            /// frames, or bursts. It is just a matter
of the value defined as target BER.
            /// If it is not possible to get the
number of bits/frames/bursts then the
            /// method can return a value of -1 and
the automation software can compute
            /// the number of bits from the data rate
and the runtime.</param>
            /// <param name="errorCounter"> Total
number of errors since the last start.
            /// </param>
            void GetCounter(out double bitCounter, out
double errorCounter);


            /// <summary>
            /// This method returns a Boolean value
indicating whether the device
            /// supports reading the counters while
it is running. If this method
            /// returns false, the device needs to be
stopped to read the counters.
            /// In this case the automation software
will stop data transmission
```

```
            /// before calling the GetCounter()
function, and re-start data transmission
/// again after reading the counter values.
             /// </summary>
            /// <returns> false if device needs to be
stopped before reading the counters,
             /// true if the counters can be read on
the fly.</returns>
             bool
GetReadCounterWithoutStopSupported();
             /// <summary>
             /// This property returns a number to
multiply the value delivered by the
             /// bitCounter in the GetCounter()
function.
              /// </summary>
             Double NumberOfBitsPerFrame {set; get;};


             /// This property returns the number of
payload
            /// bits in a frame used for the detection
of the BER.
             /// If i.e. the errorCounter in the
GetCounter() function is just the
            /// checksum error then this parameter is
the number of the payload.
             /// </summary>
            double NumberOfCountedBitsPerFrame {set;
get;};
}
}
```

Main Power Switch Control

Intended to power ON/OFF automatically the DUT and run the loopback training without user interaction.

The Main Power Switch Control can be selected as:

- Manual
- Netlo 230B. It is a PDU (Power Distribution Unit) that integrates one 230 V input and four 230 V outlets which allow to connect virtually any 230 V powered device)
- SynaccessNP

If it is selected as Manual, the DUT has to be power cycle manually. A dialog asking for power cycling the DUT, pops-up in the initialization of each receiver test procedure (See Figure 169).

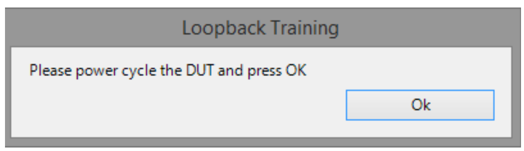


Figure 169 Manual Power Cycle Dialog

The number of user interactions for Manual option is equal to the number of times that the DUT need to be trained into loopback.

When it is selected as Netlo230B or SynaccsessNP, the DUT is power cycle automatically. A dialog asking to check the connection between the power supply and the power switch, pops-up in the first receiver test procedure executed (See Figure 170).

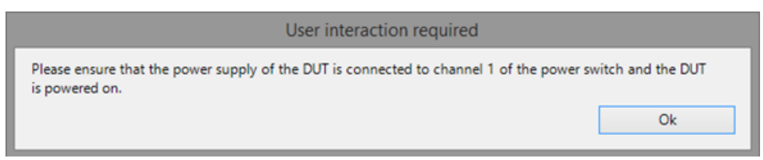


Figure 170 Automatic Power Cycle Dialog

In this case, the number of user interactions (related with the power cycle) is one, independently of the number of Rx tests and the number of times that a retraining is required.

Some properties related with the remote controllable power switch can be selected in the Parameters Dialog (See Figure 171).

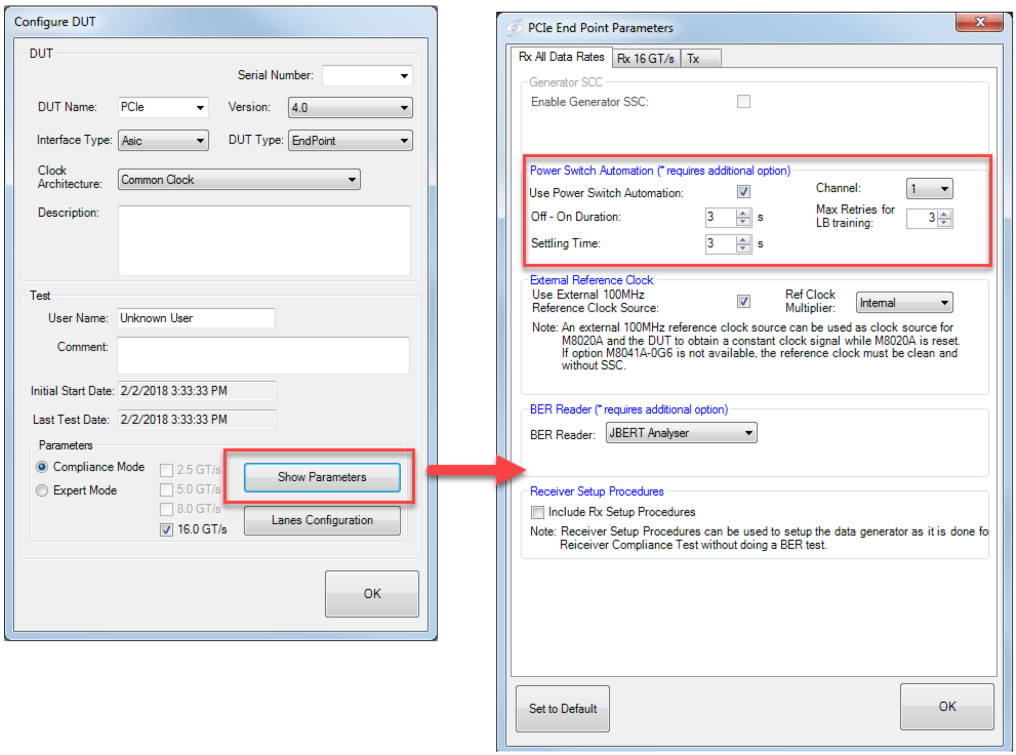


Figure 171 Power Switch Parameters

The same properties can be selected in the Parameters Panel of the Main Windows (See Figure 172).

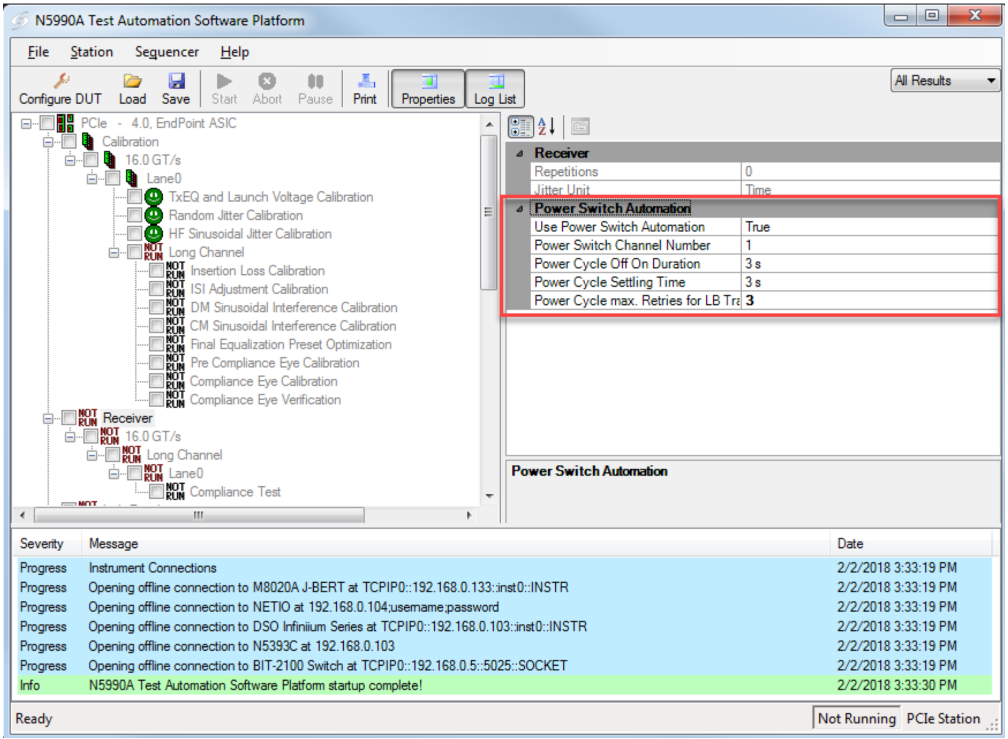


Figure 172 Power Switch Parameters

These configurable properties are:

- Channel: This sets the channel number of the power switch channel which is connected to the DUT.
- On-Off Duration: This is the duration between turning the DUT off and then turning it on again.
- Setting Time: This is the wait time after the DUT is turned on and before the test continues with loopback training.
- Max Retries for LB Training: Maximum number of times that ValiFrame will try to train the DUT into loopback mode. If it is not possible within these tries the test will be aborted automatically. When Power Switch Automation is unselected, ValiFrame asks the user to retry every time loopback fails.

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