Keysight N5991C25A CCIX Test Automation Software Platform

User Guide

KEYSIGHT TECHNOLOGIES

Notices

Manual Part Number

N5991-91301

Edition

Edition 2.0, March 2021

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

Technology Licenses

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

U.S. Government Rights

The Software is “commercial computer software,” as defined by Federal Acquisition Regulation (“FAR”) 2.101. Pursuant to FAR 12.212 and 27.405-3 and Department of Defense FAR Supplement

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

Warranty

THE MATERIAL CONTAINED IN THIS DOCUMENT IS PROVIDED "AS IS," AND IS SUBJECT TO BEING CHANGED, WITHOUT NOTICE, IN FUTURE EDITIONS. FURTHER, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, KEYSIGHT DISCLAIMS ALL WARRANTIES, EITHER EXPRESS OR IMPLIED WITH REGARD TO THIS MANUAL AND ANY INFORMATION CONTAINED HEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. KEYSIGHT SHALL NOT BE LIABLE FOR ERRORS OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE FURNISHING, USE, OR PERFORMANCE OF THIS DOCUMENT OR ANY INFORMATION CONTAINED HEREIN. SHOULD KEYSIGHT AND THE USER HAVE A SEPARATE WRITTEN AGREEMENT WITH WARRANTY TERMS COVERING THE MATERIAL IN THIS DOCUMENT THAT CONFLICT WITH THESE TERMS, THE WARRANTY TERMS IN THE SEPARATE AGREEMENT WILL CONTROL.

Safety Notices

CAUTION

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

WARNING

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

Contents

Keysight N5991C25A CCIX Test Automation Software Platform

User Guide

1 Introduction

KEYSIGHT TECHNOLOGIES

Overview

This guide provides a detailed description of the Keysight N5991C25A CCIX Test Automation Software Platform.

The BitifEye “ValiFrame” Test Automation software is globally marketed and supported by Keysight Technologies as N5991. This document describes the calibrations and test procedures conducted by N5991 ValiFrame for CCIX (Cache Coherent Interconnect for Accelerators) in detail.

The N5991 software calibrates the stress conditions and controls all test electronic equipment for automated receiver tolerance tests. The receiver tests described in this document are developed to determine if a product conforms to specifications defined in the *CCIX Base Specification*. Specifically, this software is focused on the testing of the Extended Data Rate (EDR) PHY type for ESM data rates. Additionally, ValiFrame offers some custom characterization tests to provide more details on DUT behavior beyond the limits.

The N5991 CCIX Receiver tests support the Keysight Technologies J-BERT M8040A high-performance serial BERT (Bit Error Ratio Tester). An Infiniium Oscilloscope is always required.

The software runs on a standard Windows-PC and controls the hardware test resources through appropriate interfaces, such as LAN (Local AREA Network).

Document History

First Edition (March 2020)

The first edition of this user guide describes functionality of software version N5991C25A ValiFrame CCIX_1.0.0 based on the *CCIX Base* specification.

Second Edition (March 2021)

The second edition of this user guide describes functionality of software version N5991C25A ValiFrame CCIX_1.2.0 based on the *CCIX Base* specification.

2 ValiFrame CCIX Station

After the software has been installed, two icons are added to the desktop as shown in Figure 1 and Figure 6. One is for the Station Configuration and the other icon pertains to ValiFrame CCIX.

ValiFrame CCIX Station Configuration

Test Station Selection

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

The ValiFrame CCIX Station Configuration must be started prior to launching ValiFrame. It allows you to select the required set of instruments. Double-click the icon (see Figure 1) to launch the software. Alternatively, to access the ValiFrame Station Configuration on a Windows-based PC:

Click **Start** > **BitifEye CCIX N5991** > **CCIX Station Configurator (N5991)**.

Figure 1 Icon for CCIX Station Configurator

When the ValiFrame CCIX Station Configuration is launched, the “Station Configurator’ window appears as shown in Figure 2.

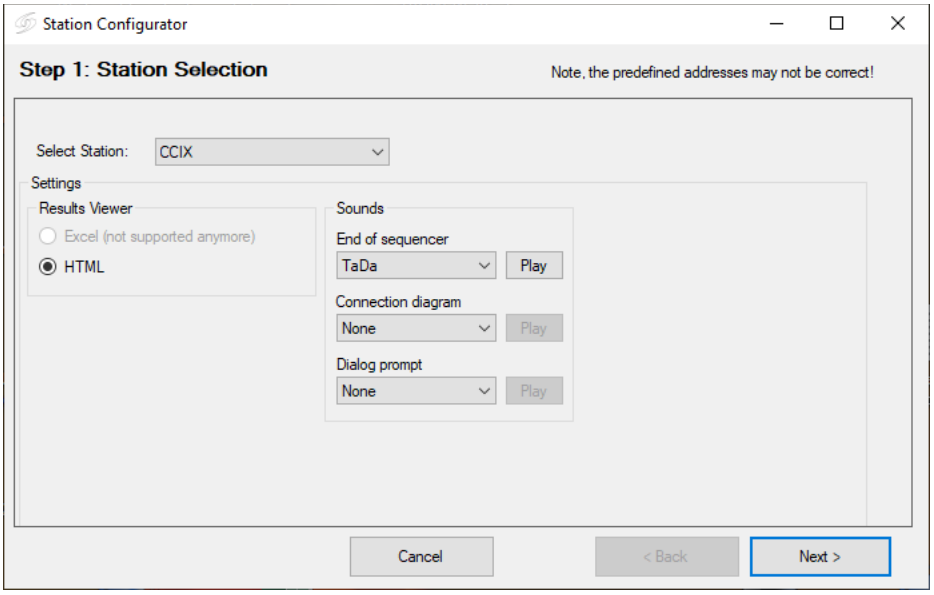


Figure 2 Station selection window

HTML is the default viewer for the test results.

Next, you may optionally assign sounds that would mark the attainment of different states of the program.

1 End of Sequencer plays the selected sound at the end of a sequence.

2 Connection diagram plays the selected sound every time a connection diagram pops up.

3 Dialog Prompt plays the selected sound at each dialog prompt.

Select a sound tone from the following options available in the drop-down options. The option 'None' disables the sound for the respective action.

- Car brake
- Feep Feep
- Ringing
- TaDa
- Tut

Click "Play" to test a sound before assigning it to a specific action.

Test Station Configuration

After selecting **Test Station** as **CCIX Station**, click **Next** to continue. The Station Configuration stage of the Station Configurator is displayed as shown in Figure 3. It shows the various options for instruments that can be used for CCIX testing. It contains such options as:

- Data Generator
- Main Power Control
- Use ext. 100MHz Reference Clock Source

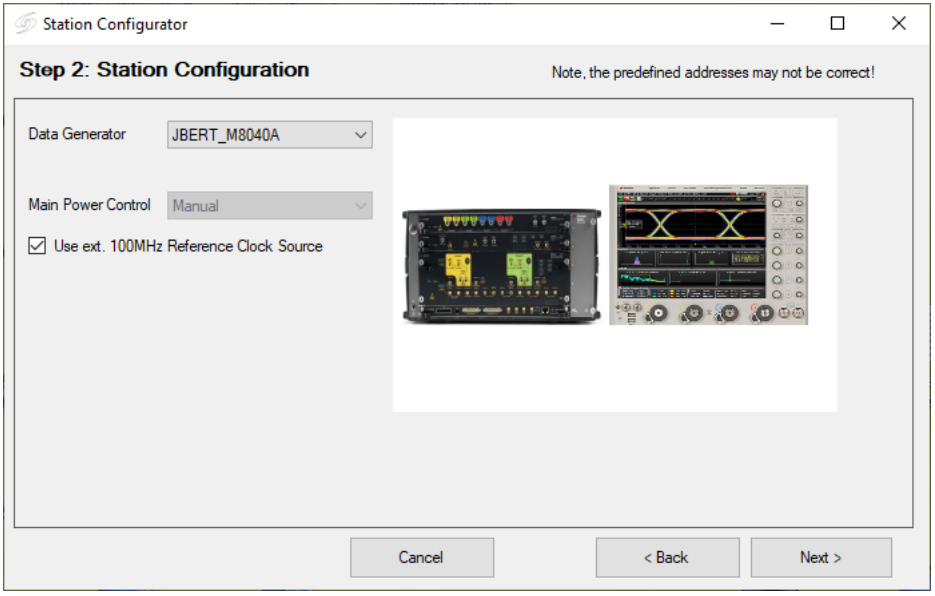


Figure 3 Station configuration window

Data Generator

The 'Data Generator' is used to create patterns with specified stress parameters. Available options are:

- JBERT M8040A (Keysight M8040A 64 Gbaud High-performance BERT)

Main Power Control

The options to select in the drop-down list for 'Main Power Control' are:

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

Use ext. 100MHz Reference Clock Source

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

Test Instrument Configuration

Once the CCIX station is configured, the instrument addresses must be set. An example for instrument configuration is set as shown in Figure 4.

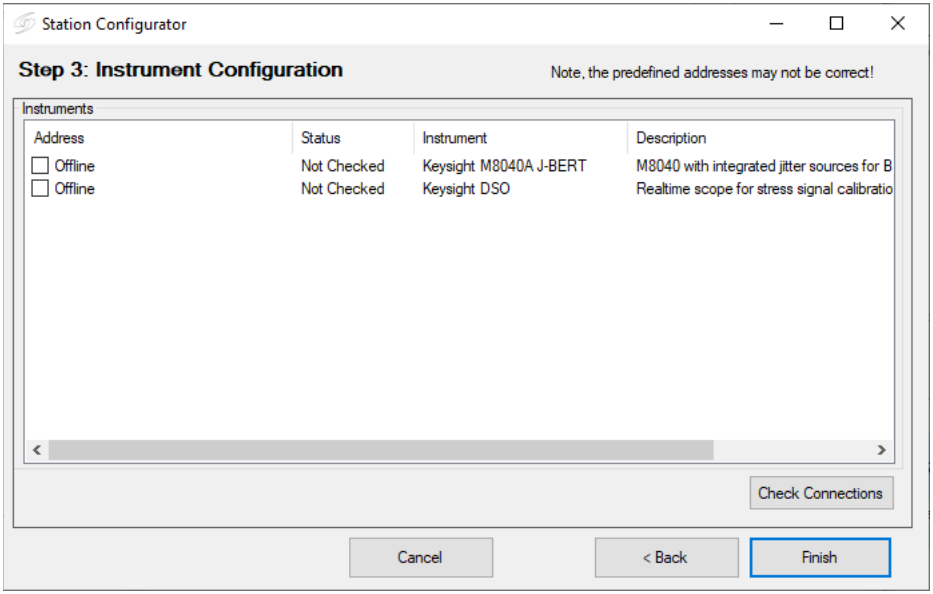


Figure 4 Instrument configuration window

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

After the installation process, all instruments are configured by default in “Offline” mode. In the simulation mode, the hardware need not necessarily be physically connected to the test controller PC. The ValiFrame software cannot connect to any instrument in this mode. In order to control the instruments that are connected to the PC, the instrument address must be entered. The address depends on the bus type used for the connection, for example, GPIB (General Purpose Interface BUS) or LAN (Local Area Network). Most of the instruments used in the CCIX station require a VISA (Virtual Instrument System Architecture) connection. To determine the VISA address, run the “Connection Expert” (right-click the Keysight IO Control icon in the task bar and select the first entry “Connection Expert”). Copy the address string for each instrument from the Connection Expert entries and paste it as the instrument address in the ‘Station Configurator’. After the address strings have been entered, select the “Offline” check box to configure the instruments in offline mode and click **Check Connections** to verify that the connections for the instruments are established properly. If an erroneous instrument address configuration is performed, the station Configurator displays a prompt to indicate so.

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 only.

Using Keysight IO VISA Connection Expert

Introduction

The Keysight Connection Expert is recommended to setup new connections or verify existing connections. Start the Connection Expert by right-clicking on the Keysight IO Libraries Suite icon in the task bar and selecting “Connection Expert”. A window similar to the one shown in Figure 5 is displayed.

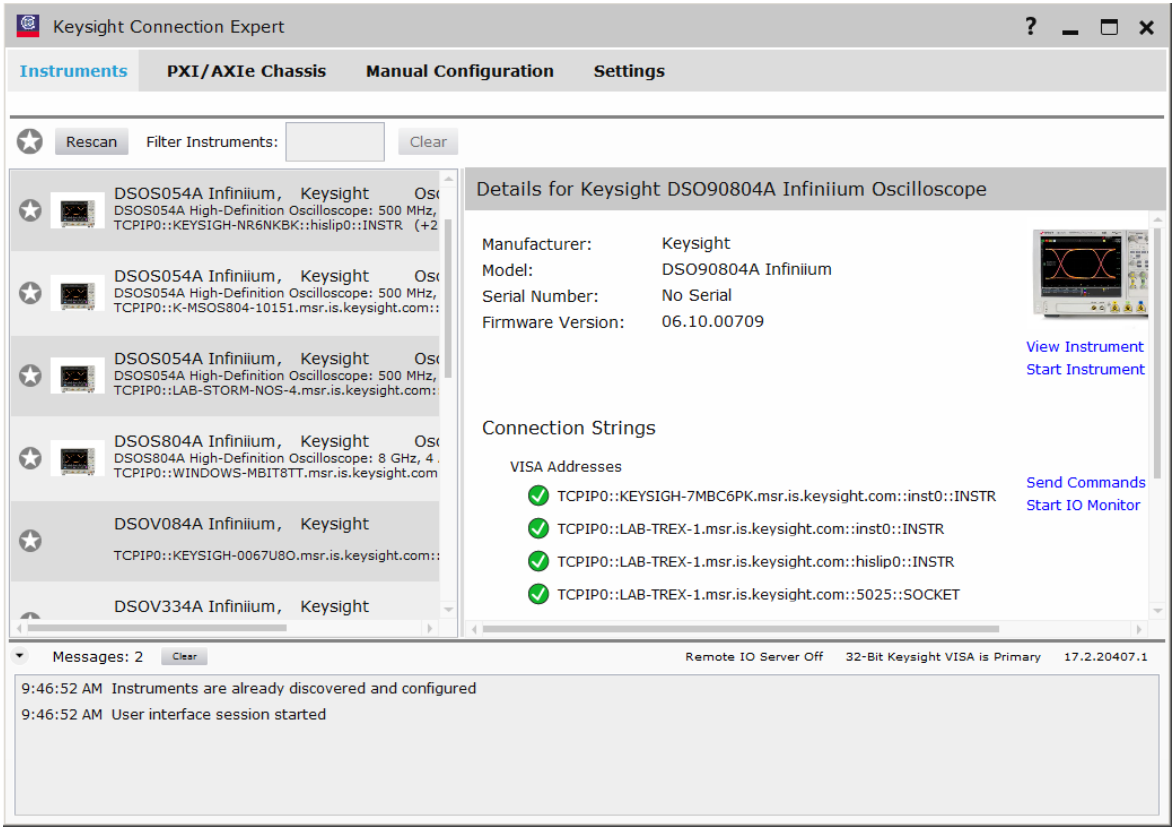


Figure 5 Keysight Connection Expert

Under “Instruments”, click **Rescan**.

For each instrument that must be connected, verify that the corresponding information is listed on the menu to the left and that the VISA Address for each instrument shows a green tick.

Once all the instruments to be used are listed properly, their address strings can be entered in the Instrument Configuration stage of the Wizard (see Figure 4). The recommended way of doing this is to copy and paste each instrument address as follows:

Click the “VISA Address” field next to an instrument in the Connection Expert and copy the address. Highlight the corresponding entry of that instrument in the Test Station Connection window, paste the address in the “Instrument Address” text field and click “Apply Address”. Repeat this procedure for all the instruments being used, except standard specific applications running on the oscilloscope.

The applications running on the oscilloscope use a different technology to provide remote access to ValiFrame, called *.NET Remoting Communication*. The remote access is only possible using a LAN connection to the oscilloscope; therefore, only an IP address is used to connect to such an instrument.

Once all the instruments are set with the appropriate addresses, tick the check boxes for all such instruments, which shall be used by the Test Automation Software. This will set the instrument mode to “Online”. Click “Check Connections” to verify that the instrument addresses are valid.

Click “Finish” to save the changes and close the ValiFrame Configuration Wizard.

Starting the CCIX Station

Start the ValiFrame CCIX Test Station by double-clicking “CCIX Valiframe (N5991)” icon on the desktop as shown in Figure 6. Alternatively, click **Start** > **BitifEye CCIX N5991** > **ValiFrame (N5991)**.

Figure 6 ValiFrame CCIX Test Station icon

Clicking the ValiFrame CCIX icon launches the CCIX N5991 Valiframe window as shown in Figure 7.

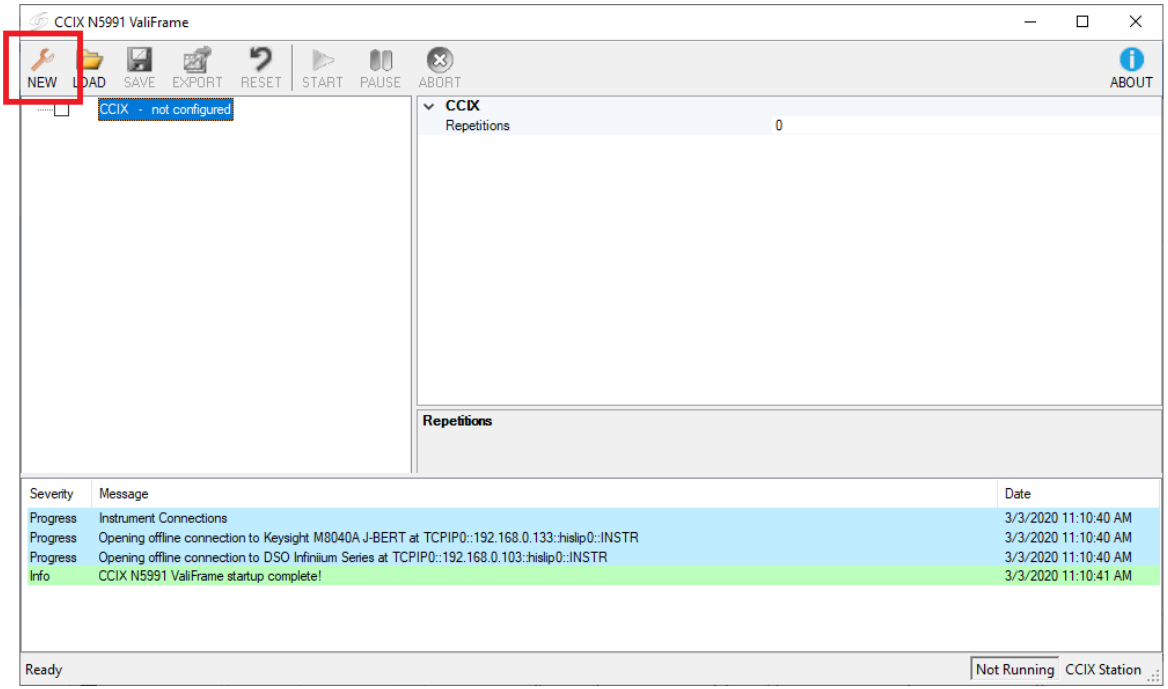


Figure 7 ValiFrame CCIX user interface

The test parameters must be configured before running any test or calibration procedure. Click the “NEW” button to open the Configure DUT window (Figure 8).

Configuring DUT

The Configure DUT window allows you to select the DUT parameters, such as DUT Type, Spec Version, Compliance Mode or Expert Mode and also test parameters, which are related to the receiver test configuration. These parameters shall be used later in several calibrations and test procedures.

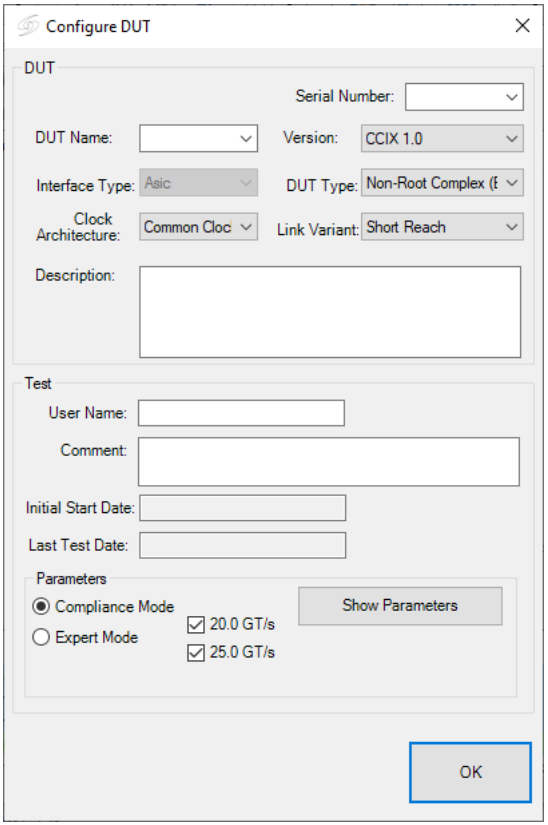


Figure 8 Configure DUT panel

Configuration Parameters

The description for parameters that appear in the Configure DUT window are listed in Table 1.

Table 1 List of Configuration Parameters and their description

Parameter name	Description
DUT Parameters	
Version	The current version is 'CCIX 1.0'.
Interface Type	The default interface type is 'ASIC'.
DUT Type	The DUT type can be chosen as: ▪ Non-Root Complex (End Point) ▪ Root Complex
Clock Architecture	Select the option: ▪ Common Clock: The default clock architecture where all parts of the system use the same clock.
Link Variant	There are two different electrical variants that are supported and can be tested: ▪ Short Reach ▪ Long Reach
Test Parameters	
User Name	User name text field.
Comment	Text field for user comments.
Initial Start Date	Time stamp of the start of the current session.
Last Test Date	Time stamp of the last test conducted in the current session.
Compliance Mode	Test are conducted as mandated by the CTS. The parameters that are shown in the calibrations and test procedures cannot be modified by the user.
Expert Mode	Calibration and tests can be conducted beyond the limits and constrains of the DUT. The parameters that are shown in the calibrations and test procedures can be modified by the user.
Data Rate	The tests are available for the two ESM data rates: ▪ 20GT/s ▪ 25GT/s

CCIX Parameters

On the Configure DUT window, click the “Show Parameters” button. The “PCIe End Point Parameters” (for CCIX) default window is displayed in Figure 9; whereas Figure 10 shows the parameters that appear by default under the “Rx” tab of this window.

The description for parameters that appear under the “Rx All Data Rates” tab of this window are listed in Table 2, whereas the parameters that appear under the “Rx” tab are listed in Table 3.

Figure 9 CCIX End Point Parameters under Rx All Data Rates tab

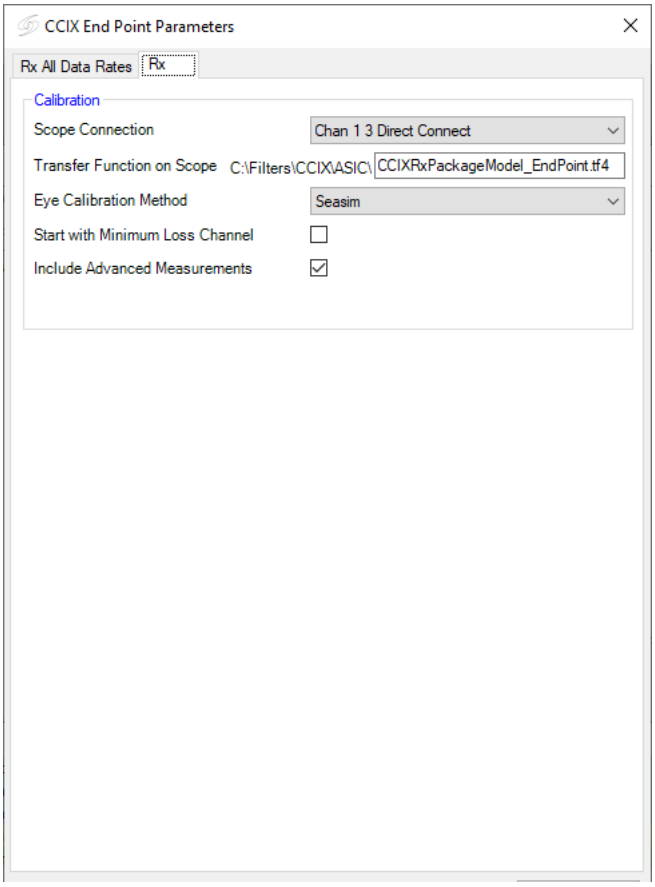


Figure 10 CCIX End Point Parameters under Rx tab

Table 2 List of CCIX Parameters for "Rx All Data Rates"

Parameter name	Description
Generator SSC	This parameter can be enabled only when the SRIS architecture is selected. If such is the case, you may set the following parameters: ▪ SSC Frequency ▪ Sin SSC Deviation
Power Switch Automation	If a Power Switch is used, the DUT will be powered on/off automatically by the software and the loopback training runs without user intervention. The "Use Power Switch Automation" check box is automatically selected, if you select a switch from the "Main Power Control" options of the "Station Configurator". When "Use Power Switch Automation" is checked, you may set the following parameter settings: ▪ Channel: Sets the channel number of the power switch channel, which is connected to the DUT. ▪ Off-On Duration: The duration between powering off the DUT and powering it back on again. ▪ Settling Time: The Waiting time after the DUT is powered on and before the test continues with loopback training. ▪ Max. retries for LB training: Maximum number of tries that Valiframe attempts to train the DUT into loopback mode. If the DUT training is not possible within the specified number of attempts, the test is aborted automatically. If the "Use Power Switch Automation" check box is not selected, Valiframe prompts the user to retry each time loopback fails.

External Reference Clock	This option is available only for "Common Clock architecture".
	▪ For End Point DUT type, you may select one of the following options:
	  ▪ Use External 100MHz Reference Clock Source: If this option is selected, an external source provides the clock to the DUT and the data generator. If this option is not selected, the clock output of the data generator is connected directly to the DUT.
	  ▪ Reference Clock Multiplier: Specifies the way to connect the external clock to the data generator. The available option is:
	  Internal–Connects the external clock to the data generator directly and the data generator uses its internal PLL.
	▪ For RootComplex DUT type, the External Reference Clock is not required, the clock is provided by the DUT.
	  ▪ Reference Clock Multiplier: The clock is directly connected to the data generator and is multiplied internally.

BER Reader	The error measurement can be performed using the JBERT Analyzer, with an Offline BER reader or with a Customized BerReader assembly written in C#, which implements the Common iBerReader interface.
Receiver Setup Procedures	Include Rx Setup Procedures–Select this option to add the receiver setup procedures to the test tree. In these procedures, the data generator is set up for the calibrated compliance conditions, but the BER test is not performed.

Table 3 List of CCIX Parameters for "Rx"

Parameter name	Description
Calibration	▪ Scope Connection: Choose the scope connection type either as 'Chan 1&3 Direct Connect' or as 'Chan 2&4 Direct Connect'. If a 2-channel UXR is used, only channel 1&2 can be selected. ▪ Transfer function on Scope: Shows the path of the transfer function file for the package model. Note that these transfer function files are located on the Oscilloscope and must be copied from the ValiFrame-PC to the scope, if needed. ▪ Eye Calibration Method: Select the tool used for the stressed eye calibration. Each software uses a different methodology for jitter and eye measurements. Currently, Seasim is the only tool available. ▪ Seasim: It is a processing tool that uses the standard method. A step pattern with 256 ones and zeros are applied at the input of the calibration channel and the step response is captured at the output of the replica channel. The oscilloscope averages the step response, which minimizes the noise. The Step response defines the complete electrical behavior of the channel. Seasim calculates a statistical eye out of this step response and also simulates different impairments. ▪ SigTest: Currently, this tool is not used with Valiframe CCIX. ▪ Start with Minimum Loss Channel: If not selected, the "Initial Equalization Preset Optimization Calibration" starts with a maximum appropriate channel length. Then, the "Channel Calibration" decreases channel loss in 0.5dB steps until Eye Height and Width is above the spec value (and the ratio is similar to the nominal value) or until the channel loss reaches the minimum allowed value. If selected, the "Initial Equalization Preset Optimization Calibration" starts with the minimum allowed loss (depending on the channel type). Then, the "Channel Calibration" increases channel loss in -0.5dB steps until Eye Height and Width is slightly below the spec value (and the ratio is close to the ratio of the nominal eye) or until the channel loss reaches the allowed maximum. In both cases, the following calibration procedures use the estimated optimal channel. ▪ Include Advanced Measurements: This option is unchecked by default. Select this option to add to the calibration tree some procedures that are used for debugging purposes.

3 Using the Software

KEYSIGHT TECHNOLOGIES

Introduction

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

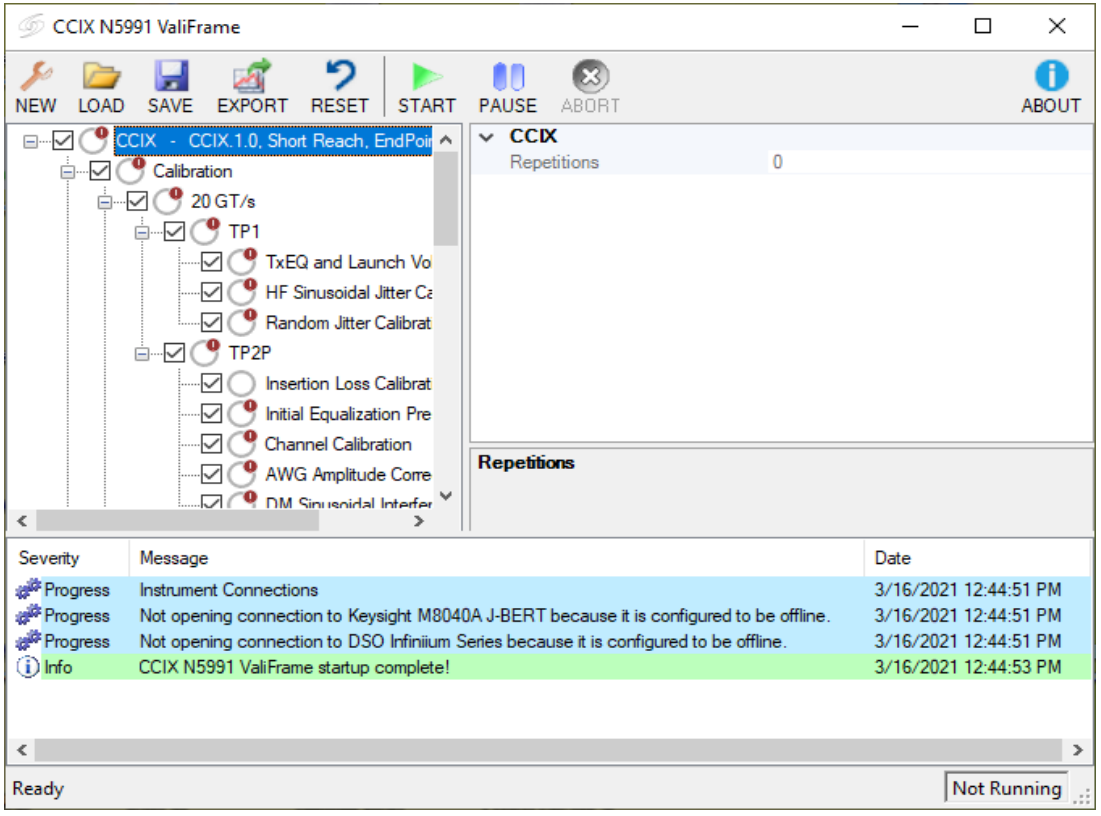


Figure 11 CCIX main window

The parameter grid on the right side of the window shows the parameters which are related to the selected procedures.

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).

To start one or more procedures, select the corresponding check box. The Start button is enabled and turns green in color. Click ‘Start’ to run the selected procedures.

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

CAUTION

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

Selecting, Modifying, & Running Tests

Selecting Procedures

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

Modifying Parameters

Most calibration and test procedures, as well as the groups containing them, have parameters that control the details of how the procedures are run. In compliance mode, most of these parameters are read-only. In expert mode, almost all the parameters can be modified. First, select a specific calibration or test procedure or one of the groups contained in the N5991 procedure tree, as shown in Figure 12. The parameters are displayed in a property list on the right side of the window. These parameters can be configured only before the selected procedure subgroup or procedure is started. All selected test parameters are listed in the MS Excel/HTML test results worksheets.

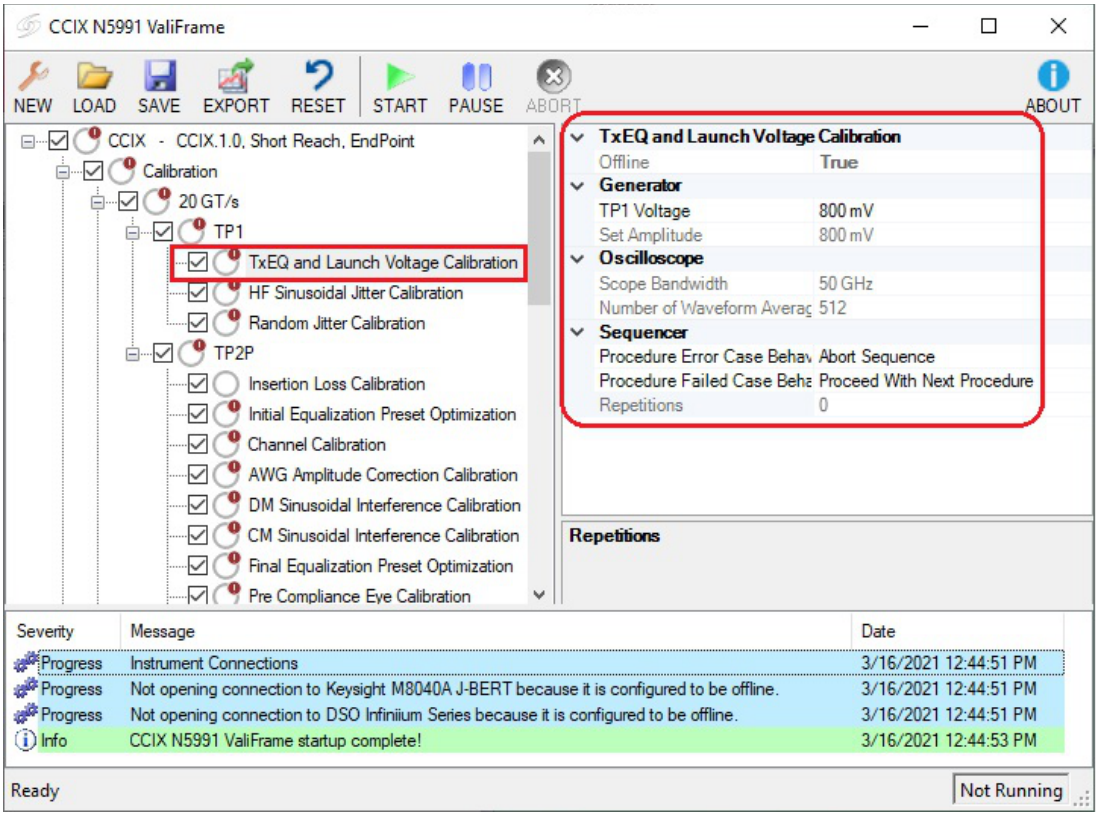


Figure 12 Modifying parameters

Running Procedures

To run the selected procedures, click the “Start” icon on the toolbar (see Figure 11). The procedures are run sequentially in the order shown in the procedure selection tree. Some procedures may require user intervention, such as changing cable connections or entering DUT parameters. The required action is prompted in pop-up dialog boxes prior to running the calibration/test procedures. To view the connection diagram, right-click the desired test or calibration. From the right-click menu, select “Show Connection”.

Results

Runtime Data Display

Most procedures generate data output. While the procedure is running, the data is displayed in a temporary MS Excel worksheet or HTML document (depending on the selected viewer in the Station configuration), which opens automatically for each individual procedure.

Any MS-Excel worksheet or HTML documents, which are open during the procedure runs are closed automatically once the specific procedure is finished. As long as the N5991 Software is running, each result file (MS Excel worksheet or HTML Page) can be reopened by double-clicking the respective procedure. However, the individual files are lost when the N5991 main window is closed, unless you save the individual files or a collection of them.

Results Workbook

By default, all individual results are summarized in an MS Excel workbook or HTML document at the end of the test run. All calibration and test data worksheets can be saved in a workbook by clicking the “Export” button on the toolbar of the CCIX N5991 Test Automation window. Keysight recommends performing this action at least once at the end of each N5991 procedure runs to avoid any data loss. If the calibration and test procedures are conducted several times during the same N5991 run, the resulting worksheets are combined in 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.

NOTE

As a safety feature, all calibration and test results are saved by default to the N5991 “Tmp” directory (*C:\ProgramData\BitifEye\ValiframeK1\Tmp*). The sub-folder “Results/CCIX Station” contains the final results measured at each calibration and test procedure. In addition to the calibration data worksheets, calibration data files are generated. These files are saved by default to the N5991 calibrations folder. If these calibrations are run again, the data file is overwritten. To save the calibration data files at each configuration, the files must be copied from the directory: ‘*C:\ ProgramData\BitifEye\ValiframeK1\CCIX\Calibrations*’ and saved manually in any folder before rerunning the calibrations.

Icon Representation

Once the selected procedures are run successfully, the icons that appear for individual procedures indicates the result (Pass / Fail / Incomplete) as described in Table 4.

Table 4 Icon Result description

Smiley	Description
	Indicates that the procedures have not run yet.
	Indicates that the procedures are running.
	Indicates that the selected procedures passed successfully in the previous run and the results are available.
	Indicates that the selected procedures were passed in offline mode and the results are available.
	Indicates that the procedure was not run completely in the previous run.
	Indicates that the procedure could not be run in the present run. Most likely, the DUT failed during initialization, so no test was conducted.
	Indicates that the procedure failed in the previous run.
	Indicates that the procedure failed in the current run.

CCIX Parameters

The CCIX parameters are of three types:

- Sequencer Parameters
- Common Parameters
- Procedure Parameters Sufficient to use

Sequencer Parameters

The sequencer parameters control the flow of the test sequencer, not the behavior of individual procedures. They are identical across all versions of ValiFrame. 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 right side of the ValiFrame user interface and you may manually change them, as illustrated in Figure 13.

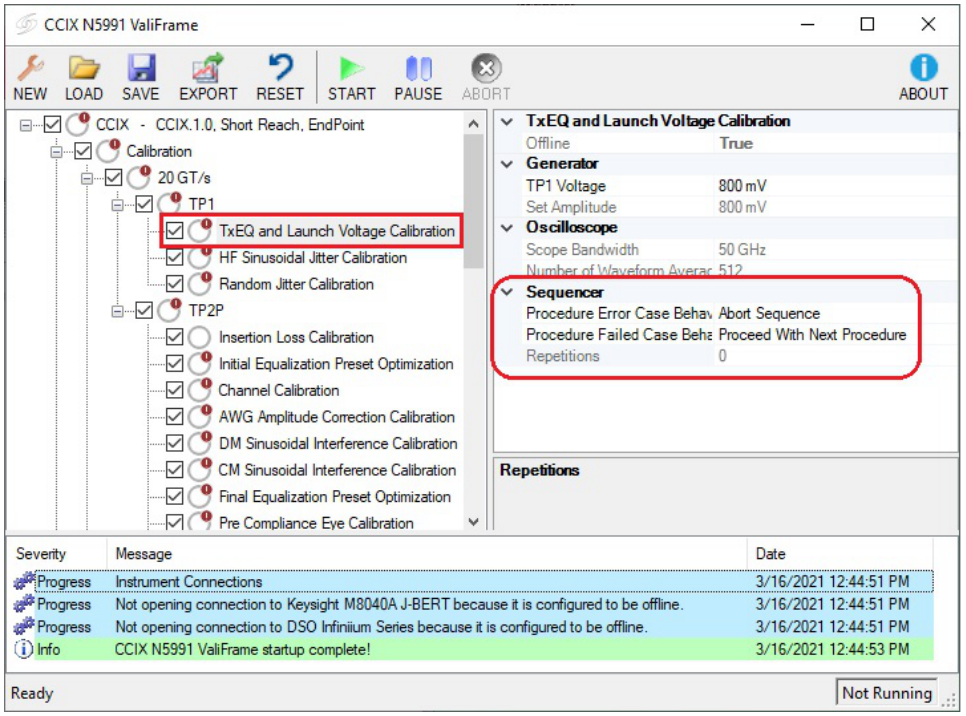


Figure 13 CCIX Sequencer Parameters

All sequencer parameters are listed in alphabetical order in Table 5.

Table 5 CCIX 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 further running 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 further running 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.

The CCIX Receiver Test Software has some group parameters (in addition to "Repetitions") on the top-level entry of the CCIX tree. These are common for all Valiframe calibration and receiver procedures respectively.

All common parameters are listed in alphabetical order in Table 6.

Table 6 CCIX Common and Receiver Parameters

Parameter Name	Parameter Description
Common Parameters	
CCIX ASIC Eye Calibration Method	Read-only parameters are always set to "SeaSim". The selected software is used for jitter and eye measurements.
Scope Connection for Calibration	All calibrations can be done with a single-ended direct connection to Channels 1&3 or to Channels 2&4.
Transfer Function File for Package Model on Scope	Shows the path for the transfer function file for the package model. Note that these transfer function files must be located on the Oscilloscope and if needed, you must copy them from the ValiFrame-PC to the Oscilloscope.
Package Model Loss at DMSI Frequency	The loss of the package model on the Oscilloscope for the DMSI frequency point.

Receiver Parameters	
Reference Clock	The frequency of the reference clock.
Error Detector	
CDR Loop Bandwidth	The loop bandwidth of the JBERT error detector CDR in MHz.
Peaking	Select the CDR Peaking in dB (from 0 to 1dB).
Analyzer Equalizatiion	Select the Analyzer Equalization. The available values depend on the Analyzer used.
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.

Procedure Parameters

The Procedure Parameters are all such parameters that are not part of any of the previously described categories. They are shown on the right side of the ValiFrame user interface when the selected entry of the procedure tree on the left is an individual procedure. Their purpose is to modify the behavior of that single procedure. Procedures often have parameters with the same name, but pre-configured settings always apply on the selected procedure, while their meaning may be slightly different.

Table 7 shows a list of CCIX Calibration parameters that are used in several calibration procedures repeatedly.

Table 7 CCIX Calibration Parameters

Parameter Name	Description
Verification Mode	If set to 'False', the procedure behaves as a normal calibration and the results are saved as usual. If set to 'True', the procedure uses a previous calibration to set the calibrated parameter. In this case, the purpose of the procedures is to certify that the available calibration is valid and the desired values can be achieved.
Generator	
TP1 Voltage, Differential Voltage, Set Amplitude	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	Amount of RJ added to the signal.
Sinusoidal Jitter	Amount for SJ added to the signal.
Sinusoidal Jitter Frequency	Frequency of the sinusoidal jitter.
Oscilloscope	
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.
Number of Waveforms Averages	Number of waveform that are averaged during the scope acquisition. This will reduce the noise floor.
Capture	

Capture Mode	Select one of the options: ▪ Do only local measurements ▪ Only save waveform on the oscilloscope ▪ Do local eye measurements and save waveform on the oscilloscope
File Path of BaseFile	The path of the base file. The “PX” will be replaced by Preset Value.
Channel	
Trace Length [inch]	Hardware trace number used for ASIC.
Total Channel Loss	Total insertion loss of the calibration channel.
SeaSim	
Optimize CTLE	Set to ‘True’ to apply the optimal CTLE with the SeaSim software.
Insertion Loss	
Measurement Method	If ‘Step response’ is selected, the test automation measures the insertion loss for different traces. If ‘VNA’ is selected, the test automation does not perform any measurement and the trace must be measured manually using a VNA.
Automatic Trace Selection	If ‘True’, the Trace Number Start Value and Trace Number Stop Value are internally calculated. They are calculated to achieve as close to the target ISI of 16GHz as possible.
Trace Loss Increment	It is the expected insertion loss variation between each trace number.
Trace Number Start	The minimum trace number that is calibrated.
Trace Number Stop	The maximum trace number that is calibrated.
Save Calibration Data	Set to ‘True’ to save the results in a calibration table.

Table 8 shows a list of CCIX Receiver parameters that are used in several test procedures repeatedly.

Table 8 CCIX Receiver Parameters

Parameter Name	Description
Generator	
Pre-Shoot	The amount of pre-shoot value added to the signal.
De-Emphasis	The amount of de-emphasis value added to the signal.
Differential Voltage	The differential voltage amplitude set to the signal.
Common Mode Interference	The amount of CMSI added to the signal.
Differential Mode Interference	The amount of DMSI added to the signal.
Random Jitter	The amount of RJ added to the signal.
Initial Sinusoidal Jitter	The amount of SJ added to the signal.
Initial Sinusoidal Jitter Frequency	The frequency of the sinusoidal jitter.
Additional Sinusoidal Jitter	Used to fine-adjust the Eye Height and Eye Width.
Additional Sinusoidal Jitter Frequency	The frequency of the SJ second tone.
Residual SSC	Amplitude of the SSC signal.
RJ Low Pass Jitter Frequency	1000MHz low pass filter frequency is spec compliant but reduces the total amount of SJ for high jitter frequencies. In order to have full amount of SJ switch to 500MHz
BER Measurement	

BER Mode	The BER measurement can either be run for a fixed time or until a target BER is achieved.
BER Measurement Duration	The duration of the BER measurement when mode is set to 'FixedTime'.
Allowed Bit Error	The allowed number of bit errors to pass the test during the BER measurement, when mode is 'FixedTime'.
Target BER	The target BER for the BER measurement used in the test.
Confidence Level	The confidence level value when BER mode is 'TargetBER'.
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, the manual set up of the pre-shoot and de-emphasis values that must be used for the following tests.
Loopback Training	
Force retraining at each BER measurement	Force training at each BER measurement for different PS/DE combinations.
Pre-shoot used for LB Training	The pre-shoot value used during loopback training (not during the BER test).
De-emphasis used for LB Training	The de-emphasis value used during loopback training (not during the BER test).
Coefficient Matrix Scan	
Coefficient Divider	The coefficient divider for C-1 and C+1.
Maximum Boost	Coefficient C+1 is increased until the Boost Level is exceeded.
Start Pre-Shoot	It is the Start Pre-shoot value in dB.

Start De-Emphasis	It is the Start De-Emphasis value in dB.
Jitter Tolerance	
Frequency Mode	Select one of the following options: ▪ Compliance Frequencies ▪ Equally Spaced Frequencies ▪ User Defined Frequencies ▪ Single Frequency
Jitter frequencies	List of frequencies to be tested. In compliance mode, this list is 'read-only', otherwise they can be edited.
Start frequency value	It is the minimum value of jitter frequency that must be tested (for 'Equally Spaced Frequencies' mode).
Stop frequency value	It is the maximum value of jitter frequency that must be tested (for 'Equally Spaced Frequencies' mode).
Number of Frequency Steps	The number of different jitter frequencies that are tested. The distribution of frequencies between minimum and maximum is equidistant on a logarithmic or linear scale (for 'Equally Spaced Frequencies' mode).
Frequency sweep scale	Can be chosen as Linear or Logarithmic scale (for 'Equally Spaced Frequencies' mode).
Start Jitter Values	The initial value of the SJ amplitude tested in the search algorithm.
Use fixed number of steps	If set to "True", the range from the start amplitude to the jitter capability at each frequency is divided in a fixed number of steps. If set to "False", the jitter steps are calculated depending on the scale selected.
Number of jitter steps	Step interval, in which the range from the start amplitude to the jitter capability is divided.
Jitter Linear Step Size	It is the jitter value to be increased at each step of the search algorithm.
Show Min Failed Points	If set to 'True', the result shows the first SJ amplitude that didn't pass the BER test at each frequency.

Keysight N5991C25A CCIX Test Automation Software Platform

User Guide

4 CCIX Calibrations

KEYSIGHT TECHNOLOGIES

Calibrations Overview

Before any receiver test procedure can be run, the CCIX receiver test system must be calibrated.

The ValiFrame calibration plane is given by the DUT input ports. The receiver test signal characteristics such as the CCIX signal generator output voltage level and jitter parameters are typically affected by the signal transmission between the generator output ports and the DUT input ports. The transmission elements such as cables, power dividers, splitters, and so on, impact the signal generator's output signal, for example, by reducing signal levels as a result of losses and slowing down transition times. Thus, for any signal output parameter that you select (set value), the jitter and the signal received at the DUT input ports (actual value) deviate from the set value. Additional deviations can be caused by effects such as offset errors, hysteresis, and nonlinear behavior of the signal generator. The ValiFrame calibration procedures compensate for the deviations of the relevant signal output parameter actual values from the set values over the required parameter range.

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

All calibrations are performed for the 20GT/s and 25GT/s as well as for long and short reach links.

Common Parameters for Calibrations

Data Rate specific

- CCIX ASIC Eye Calibration Method
- Scope Connection for Calibration

TP2P (Test Point 2 Post Processing) specific

- Transfer Function File for Package Model on Scope
- Package Model Loss at DMSI Frequency

Refer to Table 6 for description of the aforementioned parameters.

NOTE TP2 is the signal at the input of an Oscilloscope, whereas TP2P is the signal after it has been processed in the Oscilloscope.

Calibration Procedures

TxEQ and Launch Voltage Calibration

Purpose and Method

This procedure calibrates the De-Emphasis, Pre-shoot and Differential Voltage amplitude at TP1.

The pattern generator sends an equalization pattern to the oscilloscope and performs a sweep of the entire equalization range.

First, the pre-cursor is set to the initial value (-0.28dB). For this value, the post cursor is swept from -0.28 to 0.02dB with linear steps of 0.02dB. At each post-cursor value, the de-emphasis, pre-shoot and differential voltage are measured with the oscilloscope. Then, the pre-cursor is increased with a step size of 0.02dB and the process is repeated until 0.02dB. The Launch Voltage is always fixed to 800mV.

As result, three calibration data tables are generated. Then, in further procedures these calibrations will be used to set equalization values that provides the desired de-emphasis, pre-shoot and voltage in the test point.

Connection Diagram

The connection diagram for calibrations at point TP1 are shown in Figure 14.

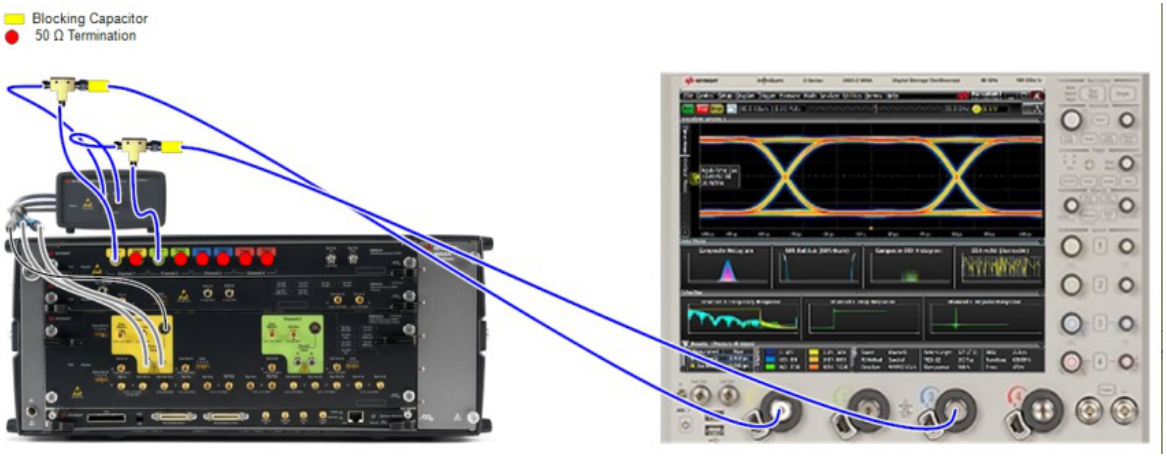


Figure 14 Connection diagram for ASIC calibration at TP1 (M8040A)

Parameters in Expert Mode

- Verification Mode

Generator

- TP1 Amplitude
- Set Amplitude

Oscilloscope

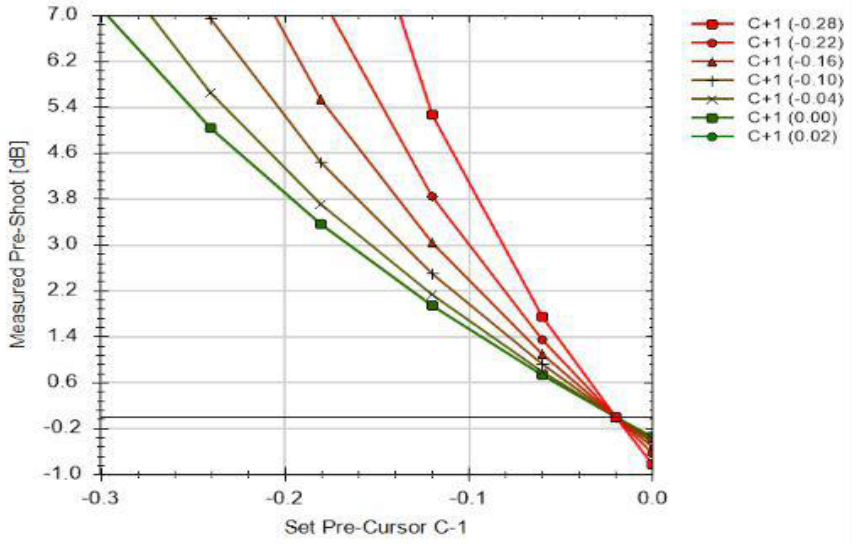
- Scope Bandwidth
- Number of Waveform Averages

For detailed information regarding these parameters, refer to Table 7.

Result Description

Cal_20G_PS

for CCIX EndPoint ASIC



----General----	
Offline	True
BERT System	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
----Oscilloscope----	
Scope Bandwidth	50 GHz
Number of Waveform Averages	512
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Generator----	
TP1 Voltage	800 mV
Set Amplitude	800 mV

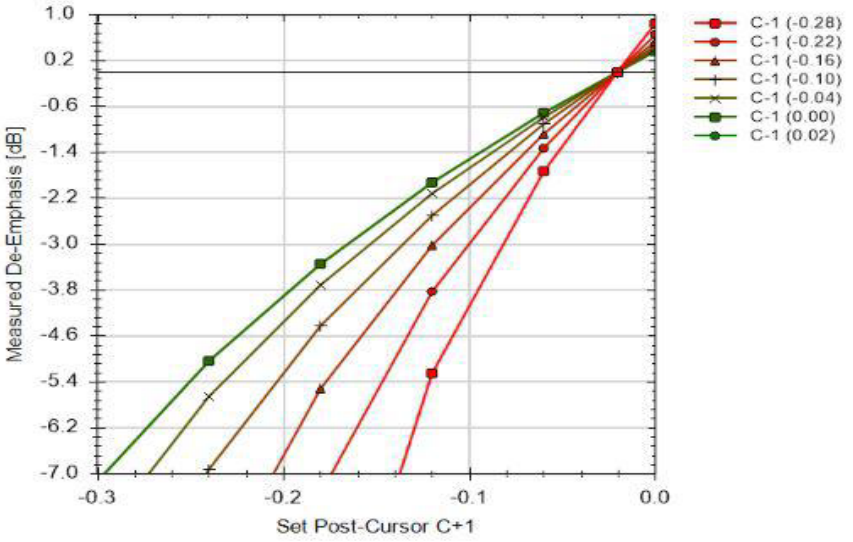
Set Pre-Cursor C-1 []	C+1 (-0.28) [dB]	C+1 (-0.22) [dB]	C+1 (-0.16) [dB]	C+1 (-0.10) [dB]	C+1 (-0.04) [dB]	C+1 (0.00) [dB]	C+1 (0.02) [dB]
-0.28	NaN	NaN	15.07	10.46	8.15	7.13	7.13
-0.22	NaN	13.38	9.05	6.94	5.65	5.04	5.04
-0.16	11.29	7.36	5.52	4.44	3.71	3.35	3.35
-0.10	5.26	3.84	3.03	2.50	2.13	1.94	1.94
-0.04	1.74	1.34	1.09	0.92	0.79	0.72	0.72
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.02	-0.83	-0.64	-0.53	-0.45	-0.39	-0.35	-0.35

Figure 15 Result for ASIC Tx EQ and launch voltage calibration (pre-shoot)

- Set Pre-Cursor: The pre-cursor value set in the data generator.
- C+1(x dB): The pre-shoot measured for the combination of post-cursor (x dB) and pre-cursor values set on the data generator.

Cal_20G_DE

for CCIX EndPoint ASIC



----General----	
Offline	True
BERT System	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
----Oscilloscope----	
Scope Bandwidth	50 GHz
Number of Waveform Averages	512
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Generator----	
TP1 Voltage	800 mV
Set Amplitude	800 mV

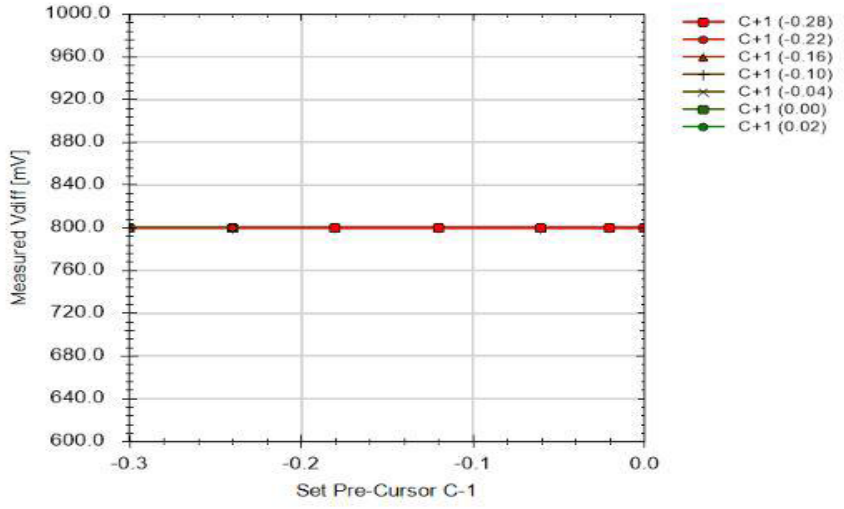
Set Post-Cursor C+1 []	C-1 (-0.28) [dB]	C-1 (-0.22) [dB]	C-1 (-0.16) [dB]	C-1 (-0.10) [dB]	C-1 (-0.04) [dB]	C-1 (0.00) [dB]	C-1 (0.02) [dB]
-0.28	NaN	NaN	-15.07	-10.46	-8.15	-7.13	-7.13
-0.22	NaN	-13.38	-9.05	-6.94	-5.65	-5.04	-5.04
-0.16	-11.29	-7.36	-5.52	-4.44	-3.71	-3.35	-3.35
-0.10	-5.26	-3.84	-3.03	-2.50	-2.13	-1.94	-1.94
-0.04	-1.74	-1.34	-1.09	-0.92	-0.79	-0.72	-0.72
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.02	0.83	0.64	0.53	0.45	0.39	0.35	0.35

Figure 16 Result for ASIC Tx EQ and launch voltage calibration (de-emphasis)

- Set Post-Cursor: The post-cursor value set in the data generator.
- C-1(x dB): The De-Emphasis measured for the combination of post-cursor and pre-cursor values set on the data generator.

Cal_20G_Vdiff

for CCIX EndPoint ASIC



----General----	
Offline	True
BERT System	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
----Oscilloscope----	
Scope Bandwidth	50 GHz
Number of Waveform Averages	512
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Generator----	
TP1 Voltage	800 mV
Set Amplitude	800 mV

Set Pre-Cursor C-1 []	C+1 (-0.28) [mV]	C+1 (-0.22) [mV]	C+1 (-0.16) [mV]	C+1 (-0.10) [mV]	C+1 (-0.04) [mV]	C+1 (0.00) [mV]	C+1 (0.02) [mV]
-0.28	NaN	NaN	800.00	800.00	800.00	800.00	800.00
-0.22	NaN	800.00	800.00	800.00	800.00	800.00	800.00
-0.16	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.10	800.00	800.00	800.00	800.00	800.00	800.00	800.00
-0.04	800.00	800.00	800.00	800.00	800.00	800.00	800.00
0.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
0.02	800.00	800.00	800.00	800.00	800.00	800.00	800.00

Figure 17 Result for ASIC Tx EQ and Launch Voltage Calibration (Launch Voltage)

- Set Post-Cursor: The post-cursor value set in the data generator.
- C-1(x dB): The Differential Voltage Amplitude measured for the combination of post-cursor and pre-cursor values set on the data generator.

HF Sinusoidal Jitter Calibration

Purpose and Method

This procedure calibrates the sinusoidal jitter amplitude for a set of high frequencies (5 MHz, 10 MHz and 100 MHz).

The test automation starts with a small SJ amplitude and increases its value with several steps over a defined range. For each step, the procedure measures the actual sinusoidal jitter for all the frequencies. For measurements, the EZJIT application running on the real-time scope is used.

The calibration data is stored in a caltable. For measurements, this calibration table is used to adjust the SJ amplitude to the desired output SJ amplitudes.

Connection Diagram

The connection diagram for calibrations at point TP1 are shown in Figure 18.

Figure 18 Connection Diagram for ASIC Calibration at TP1 (M8040A)

Parameters in Expert Mode

- Verification Mode

Generator

- TP1 Amplitude

Oscilloscope

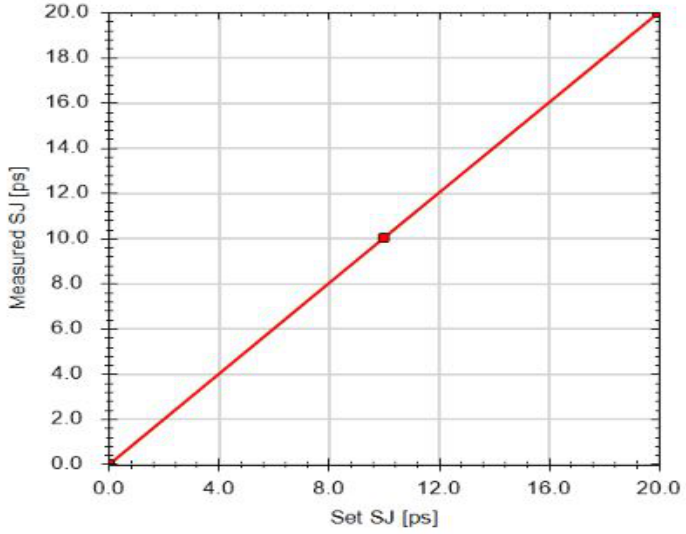
- Scope Bandwidth
- Number of Averages
- Number of UIs

For detailed information regarding these parameters, refer to Table 7.

Result Description

Cal_20G_HFSJ

for CCIX EndPoint ASIC



----General----	
Offline	True
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	3
Number of UIs	2 MUI
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Generator----	
TP1 Voltage	800 mV
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Set SJ [ps]	SJ (5 MHz) [ps]	SJ (20 MHz) [ps]	SJ (100 MHz) [ps]
0.00	0.00	0.00	0.00
10.00	10.00	10.00	10.00
20.00	20.00	20.00	20.00

Figure 19 Result for ASIC HF SJ Calibration

- Set SJ: The SJ jitter amplitude set in the instrument.
- SJ (x frequency): The measured sinusoidal jitter amplitude for the set SJ amplitude and frequency.

Random Jitter Calibration

Purpose and Method

In Rx tests, the input signal is 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 amplitude and increases its value with several steps over a defined range. For each step, the procedure measures the actual random jitter.

The generator sends a clock pattern during this calibration procedure.

The measurement is done on a real-time oscilloscope using the RJ/DJ-separation software EZJIT.

The calibration data is stored in a caltable. For measurements, this calibration table is 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 Diagram

The connection diagrams for calibrations at point TP1 are shown in Figure 20.

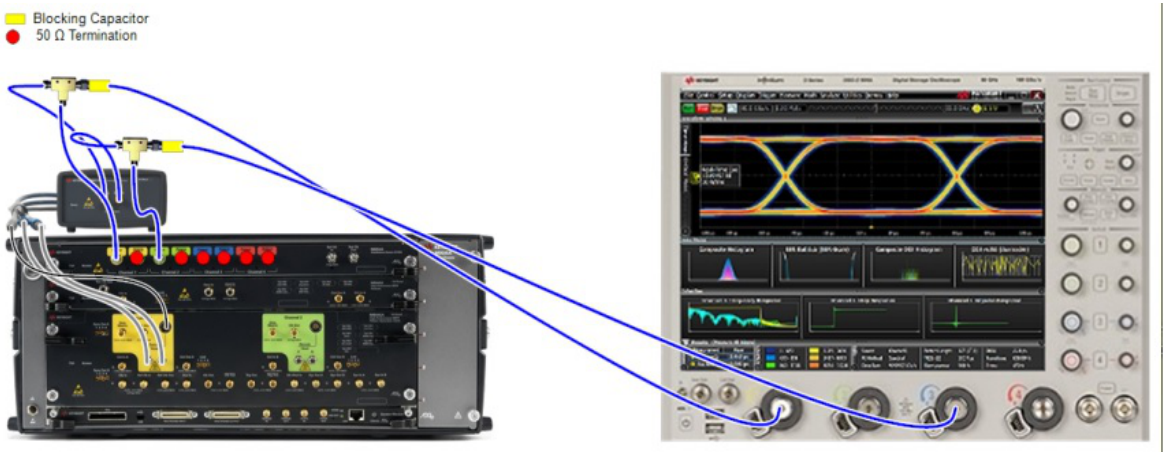


Figure 20 Connection Diagram for ASIC Calibration at TP1 (M8040A)

Parameters in Expert Mode

- Verification Mode

Generator

- TP1 Amplitude

Oscilloscope

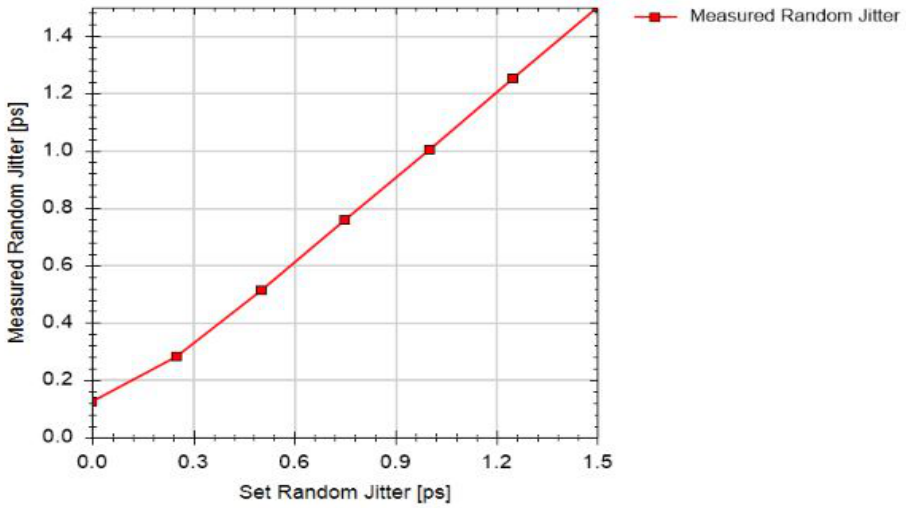
- Scope Bandwidth
- Number of Averages
- Number of UIs

For detailed information regarding these parameters, refer to Table 7.

Result Description

Cal_20G_RJ

for CCIX EndPoint ASIC



----General----	
Offline	True
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	3
Number of UIs	2 MUI
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Generator----	
TP1 Voltage	800 mV
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Set Random Jitter [ps]	Measured Random Jitter [ps]
0.00	0.13
0.25	0.28
0.50	0.51
0.75	0.76
1.00	1.01
1.25	1.25
1.50	1.50

Figure 21 Result for Random Jitter Calibration

- Set Random Jitter: The jitter amplitude set in the instrument.
- Measured Random Jitter: The measured jitter amplitude.

TxEQ and Launch Voltage Measurement

Purpose and Method

This procedure sets the calibrated Differential Voltage, Pre-Shoot and De-Emphasis values at TP1 and remeasures them. 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.

This measurement is available only in Expert Mode, when the “Include Advanced Measurement” option is selected. To know how to configure this option, refer to CCIX Parameters on page 20.

Connection Diagram

The connection diagrams for calibrations at point TP1 are shown in Figure 22.

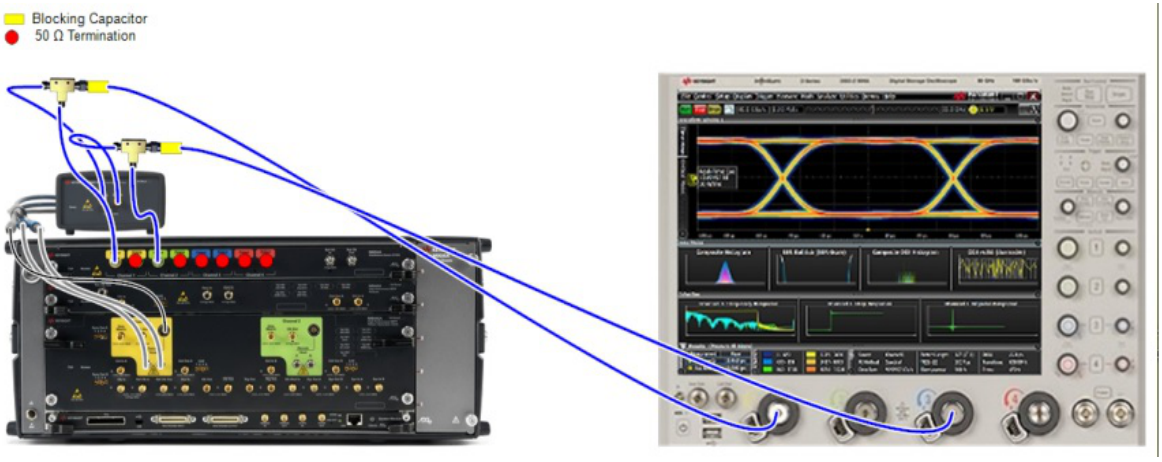


Figure 22 Connection Diagram for ASIC Calibration at TP1 (M8040A)

Parameters in Expert Mode

Generator

- TP1 Voltage

Oscilloscope

- Scope Bandwidth
- Number of Averages

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisites)

- TxEQ and Launch Voltage Calibration on page 43.

Result Description

Cal_20G_EQ_Vdiff

for CCIX EndPoint ASIC

----General----	
Offline	True
Number of Waveform Averages	256
----Oscilloscope----	
Scope Bandwidth	50 GHz
Number of Averages	5
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Generator----	
TP1 Voltage	800 mV
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Pre-Shoot [dB]	De-Emphasis [dB]	TP1 Voltage [mV]	Measured Pre-Shoot [dB]	Measured De-Emphasis [dB]	Measured Differential Voltage [mV]
3.50	0.00	800	3.50	0.00	800
3.50	0.00	800	3.50	0.00	800
3.50	0.00	800	3.50	0.00	800

Figure 23 Result for ASIC Tx EQ and Launch Voltage Measurement

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

Insertion Loss Calibration

Purpose and Method

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

The “Measurement Method” parameter is set to VNA (manual) by default. The procedure does not perform any measurement. In the beginning of the calibration, it is necessary to specify the variable ISI pair numbers that generate a channel loss of the minimum, nominal and maximum values (-16, -20 and -24dB for short reach; -26, -30 and -34dB for long reach). In this case, the variable ISI pair number for certain channels must be determined manually by a VNA. The package loss must be added to the VNA IL value. With these values, the procedure calculates the insertion loss from 1GHz to 10GHz with steps of 100MHz for each ISI trace. This is the default and recommended method.

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

Connection Diagram

If the “VNA Method” is configured, no connections are required.

Parameters in Expert Mode

- Measurement Method
- Trace Loss Increment
- Save Calibration Data

Oscilloscope

- Scope Bandwidth
- Number of Averages
- Number of Waveform Averages

Variable ISI Pairs

- Pseudo Package Loss
- Trace Length for -16dB, Trace Length for -20dB and Trace Length for -24dB

For detailed information regarding these parameters, refer to Table 7.

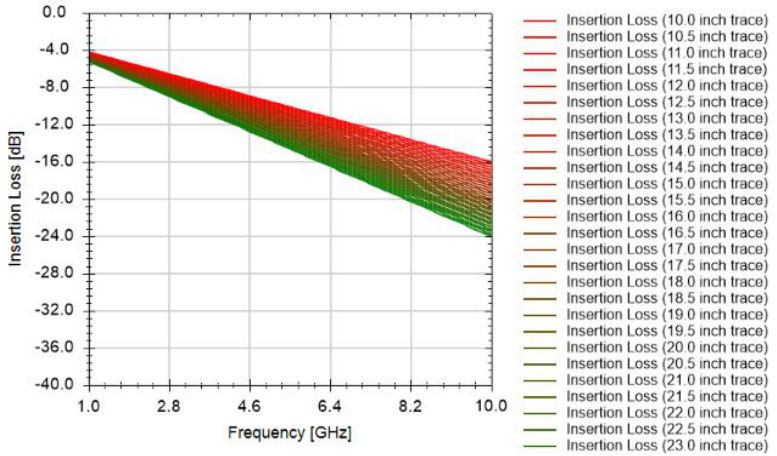
Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Calibration on page 43.

Result Description

Cal_20G_SR_IL

for CCIX EndPoint ASIC



----General----	
Offline	False
Measurement Method	VNA (manual)
Trace Loss Increment	-0.5 dB
Save Calibration Data	True
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	5
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Variable ISI traces----	
Pseudo Package Loss@20 GT/s	-2 dB
Trace length [inch] for -16dB	10
Trace length [inch] for -20dB	17
Trace length [inch] for -24dB	25

Frequency [GHz]	Insertion Loss (10.0 inch trace) [dB]	Insertion Loss (10.5 inch trace) [dB]	Insertion Loss (11.0 inch trace) [dB]	Insertion Loss (11.5 inch trace) [dB]	Insertion Loss (12.0 inch trace) [dB]	Insertion Loss (12.5 inch trace) [dB]	Insertion Loss (13.0 inch trace) [dB]	Insertion Loss (13.5 inch trace) [dB]	Insertion Loss (14.0 inch trace) [dB]	Insertion Loss (14.5 inch trace) [dB]	Insertion Loss (15.0 inch trace) [dB]	Insertion Loss (15.5 inch trace) [dB]	Insertion Loss (16.0 inch trace) [dB]
1.00	-4.20	-4.24	-4.27	-4.31	-4.34	-4.38	-4.41	-4.45	-4.49	-4.52	-4.56	-4.59	-4.63
1.10	-4.33	-4.37	-4.41	-4.45	-4.49	-4.52	-4.56	-4.60	-4.64	-4.68	-4.72	-4.75	-4.79
1.20	-4.46	-4.50	-4.54	-4.59	-4.63	-4.67	-4.71	-4.75	-4.79	-4.83	-4.87	-4.92	-4.96
1.30	-4.59	-4.64	-4.68	-4.73	-4.77	-4.81	-4.86	-4.90	-4.95	-4.99	-5.03	-5.08	-5.12
1.40	-4.72	-4.77	-4.82	-4.86	-4.91	-4.96	-5.01	-5.05	-5.10	-5.15	-5.19	-5.24	-5.29
1.50	-4.86	-4.91	-4.95	-5.00	-5.05	-5.10	-5.15	-5.20	-5.25	-5.30	-5.35	-5.40	-5.45
1.60	-4.99	-5.04	-5.09	-5.14	-5.20	-5.25	-5.30	-5.35	-5.41	-5.46	-5.51	-5.56	-5.62
1.70	-5.12	-5.17	-5.23	-5.28	-5.34	-5.39	-5.45	-5.50	-5.56	-5.61	-5.67	-5.72	-5.78
1.80	-5.25	-5.31	-5.36	-5.42	-5.48	-5.54	-5.60	-5.65	-5.71	-5.77	-5.83	-5.89	-5.94
1.90	-5.38	-5.44	-5.50	-5.56	-5.62	-5.68	-5.74	-5.81	-5.87	-5.93	-5.99	-6.05	-6.11
2.00	-5.51	-5.57	-5.64	-5.70	-5.77	-5.83	-5.89	-5.96	-6.02	-6.08	-6.15	-6.21	-6.27
2.10	-5.64	-5.71	-5.77	-5.84	-5.91	-5.97	-6.04	-6.11	-6.17	-6.24	-6.30	-6.37	-6.44

Figure 24 Result for ASIC - Insertion Loss Calibration

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

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 -24dB for short reach and -34dB for long reach. When the “Start with minimum loss channel” option is selected, the measurement is done with a channel loss of -16dB for short reach and -26dB for long reach.

The eye measurement is done with the Seasim 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. Within the step response, the complete electrical behavior of the channel is defined. With this data, a statistical eye can by calculated. The impairments are simulated by Seasim.

The calibration data is stored in a caltable. This cal data is used in the Channel calibration to configure the preset that results in the largest eye.

Connection Diagram

The setup corresponds to test point TP2 (refer to Figure 25) with the hardware trace set either to 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).

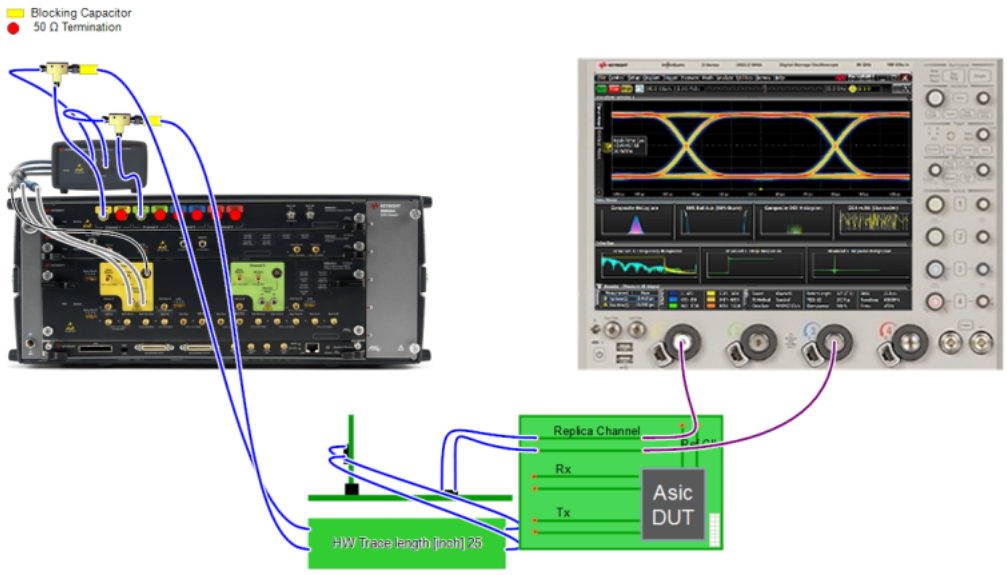


Figure 25 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

- Equalization Preset Range: The set of preset values that are calibrated.

Generator

- Differential Voltage
- DMSI
- CMSI
- Random Jitter
- Sinusoidal Jitter (in UI)
- Sinusoidal Jitter (in seconds)
- Sinusoidal Jitter Frequency

Oscilloscope

- Scope Bandwidth
- Number of Averages
- Number of Waveform Averages

Capture

- Capture Mode

- File Path of Base File

Channel

- Trace Length [inch]
- Total Channel Loss

Seasim

- Optimize CTLE

For detailed information regarding these parameters, refer to Table 7.

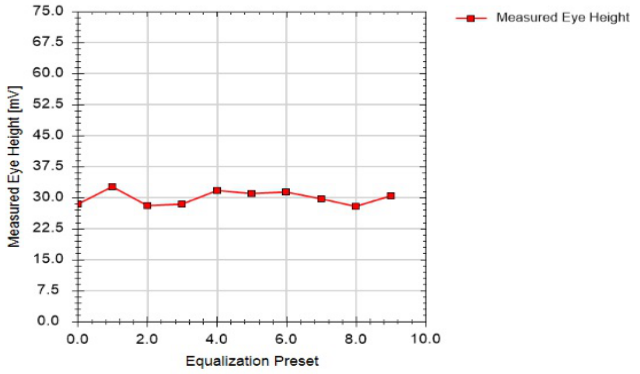
Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Calibration on page 43.
- Insertion Loss Calibration on page 62.

Result Description

L0_Cal_20G_SR_IniPres_EH

for CCIX EndPoint ASIC



----General----	
Offline	True
Equalization Preset Range	P0,P1,P2,P3,P4,P5,P6,P7,P8,P9
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	5
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Optimize CTLE	True
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Generator----	
Differential Voltage	800 mV
DMSI	14 mV
CMSI	0 V
Random Jitter	750 fs
Sinusoidal Jitter in UI	100 mUI
Sinusoidal Jitter	5 ps
Sinusoidal Jitter Frequency	100 MHz
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

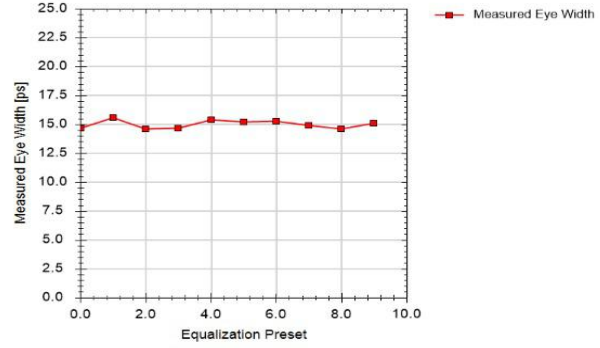
Set Equalization Preset []	Measured Eye Height [mV]
0.00	28.35
1.00	32.62
2.00	28.02
3.00	28.44
4.00	31.72
5.00	30.97
6.00	31.39
7.00	29.65
8.00	27.92
9.00	30.49

Figure 26 Result for ASIC - Initial Equalization Preset Optimization (Eye Height)

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

L0_Cal_20G_SR_IniPres_EW

for CCIX EndPoint ASIC



----General----	
Offline	True
Equalization Preset Range	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	5
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Optimize CTLE	True
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Generator----	
Differential Voltage	800 mV
DMSI	14 mV
CMSI	0 V
Random Jitter	750 fs
Sinusoidal Jitter in UI	100 mUI
Sinusoidal Jitter	5 ps
Sinusoidal Jitter Frequency	100 MHz
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Set Equalization Preset []	Measured Eye Width [ps]
0.00	14.66
1.00	15.54
2.00	14.59
3.00	14.67
4.00	15.36
5.00	15.20
6.00	15.29
7.00	14.93
8.00	14.57
9.00	15.10

Figure 27 Result for ASIC - Initial Equalization Preset Optimization (Eye Width)

- Set Equalization Preset: The equalization preset selected.
- Measured Eye Width [mV]: The measured Eye-Width for each preset.

Channel Calibration

Purpose and Method

This procedure searches for the calibration channel loss that can achieve an eye, which is closest to the target.

When the “Start with Minimum Loss Channel” option is not selected in the “Configure DUT” dialog, the hardware trace is set to achieve the value -24 dB/-34 dB (short/long reach, respectively) at 10/12.5 GHz and the Tx EQ preset is set to the value that can achieve the largest eye. Then, at each step, the channel loss is decreased by 0.5 dB and the eye is measured until the eye width and the eye height exceeds the target, or until the insertion loss at 10/12.5 GHz reaches the minimum of -16 dB/-26 dB (short/long reach).

When the “Start with Minimum Loss Channel” option is selected, the hardware trace is set to achieve the value -16 dB/-26 dB (short/long reach) at 10/12.5 GHz and the Tx EQ preset is set to the value that can achieve the largest eye. Then, at each step, the channel loss is increased and the eye is measured until either the eye width or the eye height have fallen below the target, or until the insertion loss at 10/12.5 GHz reaches the -24 dB/-34 dB (short/long reach).

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

Connection Diagram

The initial setup corresponds to ISI (refer to Figure 28) with the hardware trace set either to 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 it is required to change the hardware trace for each step, until the optimum channel is found.

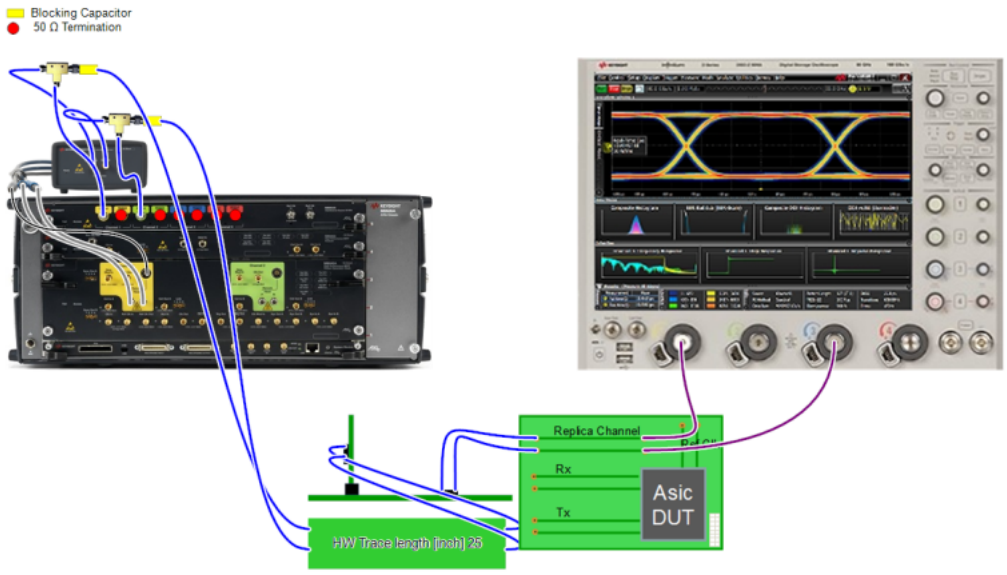


Figure 28 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

- Equalization Preset Range: The set of preset values that are calibrated.
- Trace Length Start Value
- Trace Length Stop Value

Generator

- Pre-shoot
- De-Emphasis
- DMSI
- CMSI
- Random Jitter
- Sinusoidal Jitter (in UI)
- Sinusoidal Jitter (in seconds)
- Sinusoidal Jitter Frequency

Oscilloscope

- Scope Bandwidth
- Number of Averages

- Number of Waveform Averages

Capture

- Capture Mode
- File Path of Base File

Seasim

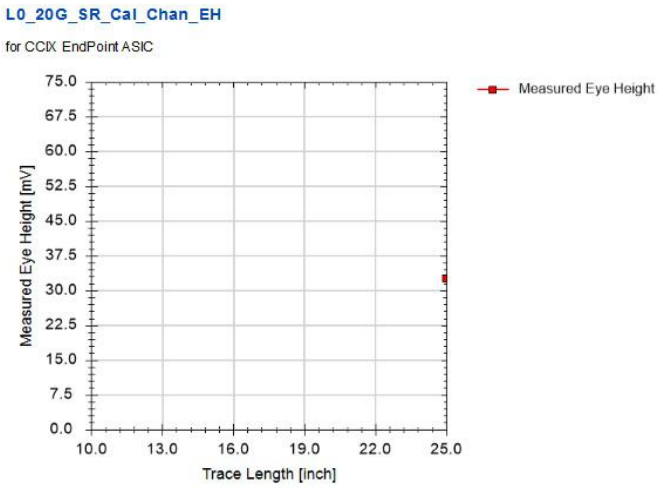
- Optimize CTLE

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Calibration on page 43.
- Insertion Loss Calibration on page 62.
- Initial Equalization Preset Optimization on page 65.

Result Description



----General----	
Offline	True
Use Caldata from Initial Equalization Preset Optimization	True
Trace Length [inch] Start Value	25
Trace Length [inch] Stop Value	10
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	5
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Optimize CTLE	True
----Generator----	
Pre-Shoot	0 dB
De-Emphasis	-3.5 dB
Differential Voltage	800 mV
DMSI	14 mV
CMSI	0 V
Random Jitter	750 fs
Sinusoidal Jitter in UI	100 mUI
Sinusoidal Jitter	5 ps
Sinusoidal Jitter Frequency	100 MHz
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8045A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

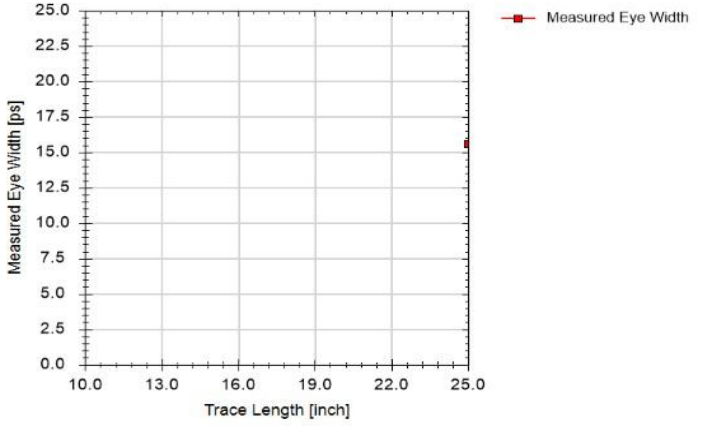
Set Trace Length [inch] []	Measured Eye Height [mV]
25.00	32.62

Figure 29 Result for ASIC - Channel Calibration (Eye Height)

- Set Trace Number: The tested Trace Number.
- Measured Eye Height: The measured Eye-Height for each trace number.

L0_20G_SR_Cal_Chan_EW

for CCIX EndPoint ASIC



----General----	
Offline	True
Use Caldata from Initial Equalization Preset Optimization	True
Trace Length [inch] Start Value	25
Trace Length [inch] Stop Value	10
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	5
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Optimize CTLE	True
----Generator----	
Pre-Shoot	0 dB
De-Emphasis	-3.5 dB
Differential Voltage	800 mV
DMSI	14 mV
CMSI	0 V
Random Jitter	750 fs
Sinusoidal Jitter in UI	100 mUI
Sinusoidal Jitter	5 ps
Sinusoidal Jitter Frequency	100 MHz
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Set Trace Length [inch] []	Measured Eye Width [ps]
25.00	15.54

Figure 30 Result for ASIC - Channel Calibration (Eye Width)

- Set Trace Number: The tested Trace Number.
- Measured Eye Width: The measured Eye-Width value for each Trace Number.

AWG Amplitude Correction Calibration

Purpose and Method

This procedure calibrates the correction factor of the AWG.

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

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 31) with the hardware trace set to the optimal number, according to the Channel Calibration.

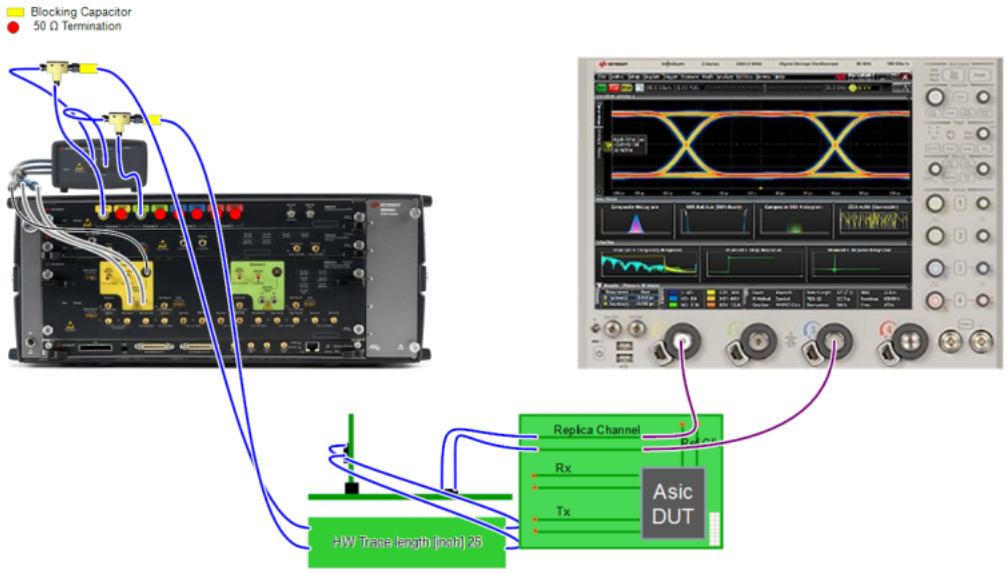


Figure 31 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

Oscilloscope

- Scope Bandwidth
- Number of Averages
- Number of Waveform Averages

Channel

- Trace Length [inch]
- Total Channel Loss

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Calibration on page 43.
- Insertion Loss Calibration on page 62.
- Channel Calibration on page 71.

Result Description

Cal_20G_SR_AWG_Correction

for CCIX EndPoint ASIC

----General----	
Offline	True
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	5 GHz
Number of Averages	5
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Amplitude Correction Factor [x/x]
1.000

Figure 32 Result for ASIC - AWG Amplitude Correction Calibrations

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

DM Sinusoidal Jitter Calibration

Purpose and Method

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

The test automation starts with small DMSI amplitude and increases that value with several steps over a defined range. For each step, the procedure measures the actual DMSI with a real-time oscilloscope.

The calibration data is stored in a caltable For measurements, this calibration table is used to adjust the DMSI amplitude to the desired value in the Rx input.

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 33) with the hardware trace set to the optimal number, according to the Channel Calibration.

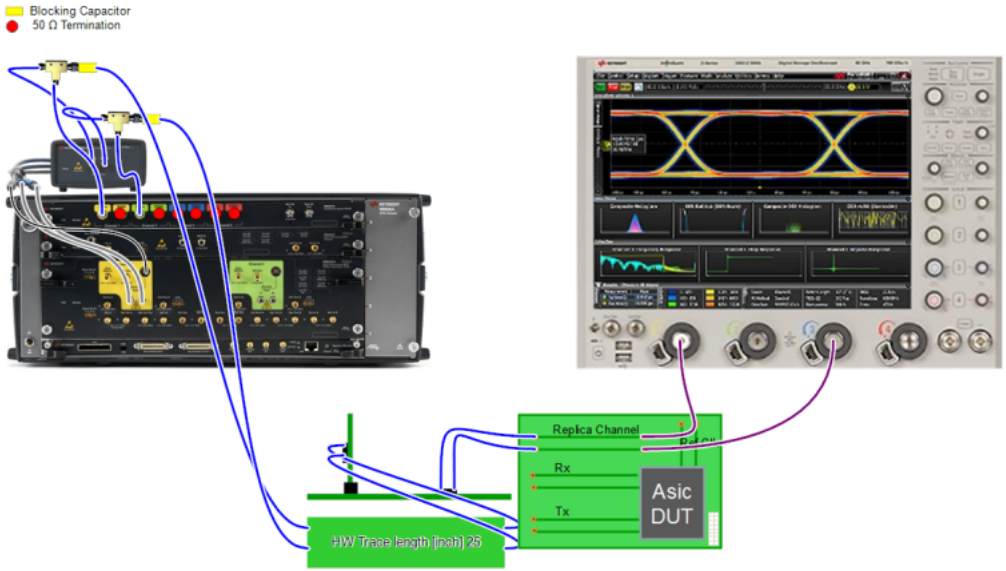


Figure 33 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

- Verification Mode

Oscilloscope

- Scope Bandwidth
- Number of Waveform Averages

Channel

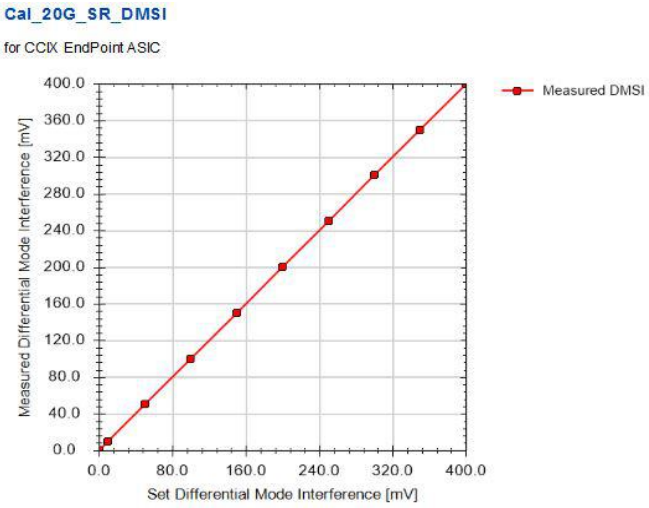
- Trace Length
- Total Channel Loss

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisite)

- Insertion Loss Calibration on page 62.

Result Description



----General----	
Offline	True
Verification Mode	False
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	5 GHz
Number of Waveform Averages	0
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Set DMSI [mV]	Measured DMSI [mV]
0.00	0.20
10.00	10.05
50.00	50.02
100.00	100.01
150.00	150.01
200.00	200.01
250.00	250.00
300.00	300.00
350.00	350.00
400.00	400.00

Figure 34 Result for ASIC - DMSI Calibration

- Set DM Interference: The amount of DMSI set in the data generator.

- Measured DMSI Amplitude: The actual DMSI measured with the oscilloscope.

CM Sinusoidal Jitter Calibration

Purpose and Method

The Common Mode Sinusoidal Interference (CMSI) is generated internally with the data generator. The resulting amplitude at the input of the Rx is attenuated and must be calibrated.

The test automation starts with small CMSI amplitude and increases that value with several steps over a defined range. The minimum amplitude is 0mV and the maximum value corresponds to the maximum amplitude that the data generator can generate.

For each step, the procedure measures the actual CMSI with a real-time oscilloscope.

The calibration data is stored in a caltable For measurements, this calibration table is used to adjust the voltage amplitude to the desired output CMSI.

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 35) with the hardware trace set to the optimal number, according to the Channel Calibration.

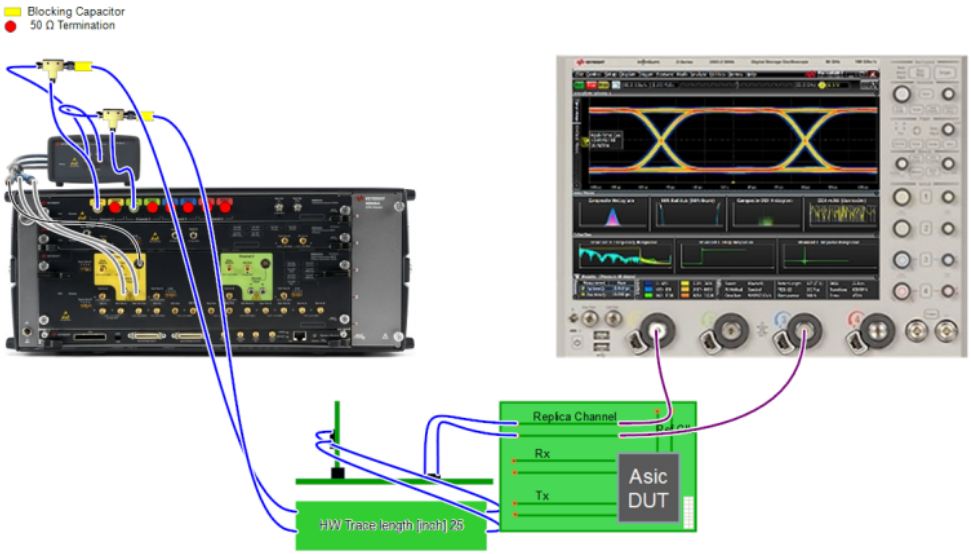


Figure 35 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

- Verification Mode

Oscilloscope

- Scope Bandwidth
- Number of Waveform Averages

Channel

- Trace Length
- Total Channel Loss

For detailed information regarding these parameters, refer to Table 7.

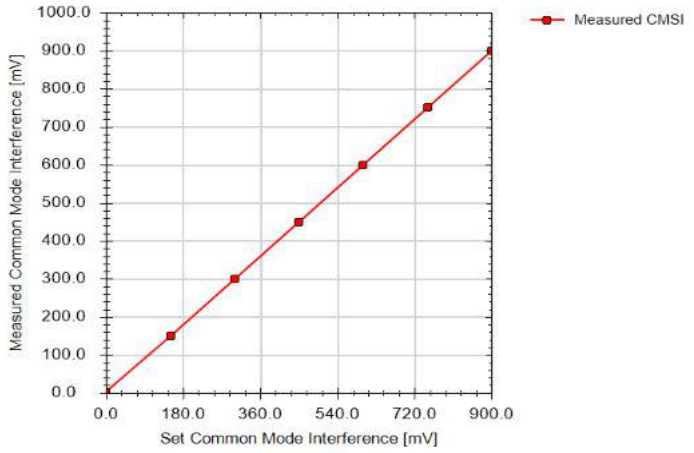
Used Calibrations (Prerequisite)

- Insertion Loss Calibration on page 62.

Result Description

Cal_20G_SR_CMSI

for CCIX EndPoint ASIC



----General----	
Offline	True
Verification Mode	False
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	5 GHz
Number of Waveform Averages	128
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Set CMSI [mV]	Measured CMSI [mV]
0.00	2.00
150.00	150.13
300.00	300.04
450.00	450.02
600.00	600.01
750.00	750.01
900.00	900.01

Figure 36 Result for ASIC - CMSI Calibration

- Set CMSI: The amount of CMSI set in the data generator.
- Measured CMSI: The actual CMSI measured with the oscilloscope.

Final Equalization Preset

Purpose and Method

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

The eye measurement is performed with the Seasim software.

The procedures that are run hereafter, shall use this calibration data to configure the preset that achieves the largest eye.

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 37) with the hardware trace set to the optimal number, according to the Channel Calibration.

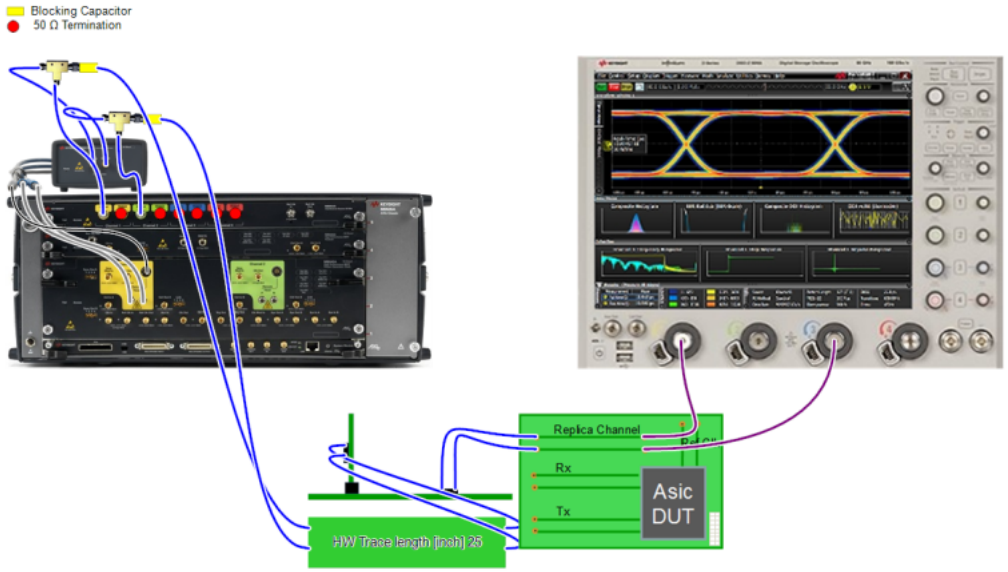


Figure 37 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

- Use Cal data from Initial Equalization Preset Optimization.
- Equalization Preset Range: The set of preset values that are calibrated.

Generator

- Differential Voltage
- DMSI
- CMSI
- Random Jitter
- Sinusoidal Jitter (in UI)
- Sinusoidal Jitter (in seconds)
- Sinusoidal Jitter Frequency

Oscilloscope

- Scope Bandwidth
- Number of Averages
- Number of Waveform Averages

Capture

- Capture Mode
- File Path of Base File

Channel

- Trace Length
- Total Channel Loss
- Seasim
- Optimize CTLE

For detailed information regarding these parameters, refer to Table 7.

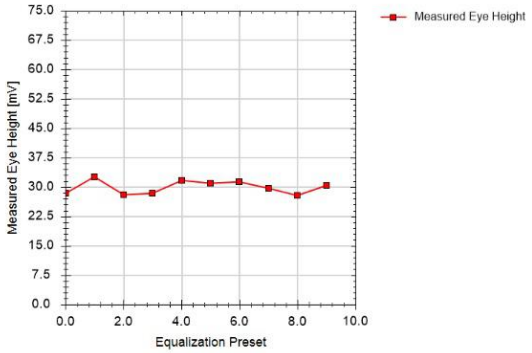
Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Calibration on page 43.
- Insertion Loss Calibration on page 62.
- DM Sinusoidal Jitter Calibration on page 81.

Result Description

L0_Cal_20G_SR_FinPres_EH

for CCIX EndPoint ASIC



----General----	
Offline	True
Use Caldata from Initial Equalization Preset Optimization	True
Equalization Preset Range	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	5
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Optimize CTLE	True
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Generator----	
Differential Voltage	800 mV
DMSI	14 mV
CMSI	0 V
Random Jitter	750 fs
Sinusoidal Jitter in UI	100 mUI
Sinusoidal Jitter	5 ps
Sinusoidal Jitter Frequency	100 MHz
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT , Company: Keysight Technologies , Model: Keysight M8040A J-BERT , SN: Unknown , FW rev.: Unknown , Description: M8043A with integrated jitter sources for BER tests , Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO , Company: Keysight Technologies , Model: DSO Infiniium Series , SN: Unknown , FW rev.: Unknown , Description: Realtime scope for stress signal calibration , Measurement Instrument

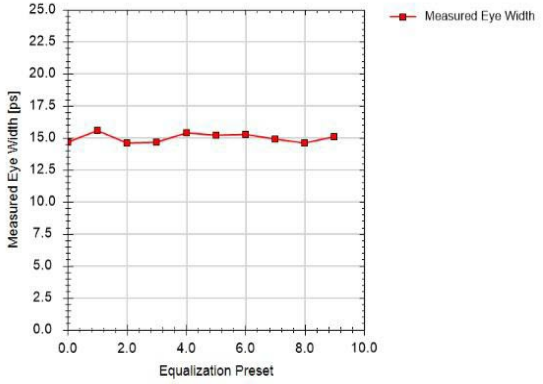
Set Equalization Preset []	Measured Eye Height [mV]
0.00	28.35
1.00	32.62
2.00	28.02
3.00	28.44
4.00	31.72
5.00	30.97
6.00	31.39
7.00	29.65
8.00	27.92
9.00	30.49

Figure 38 Result for ASIC - Final Equalization Preset (Eye Height)

- Set Equalization Preset: The equalization preset value configured in the instrument.
- Measured Eye Height: The measured Eye-Height value for each step.

L0_Cal_20G_SR_FinPres_EW

for CCIX EndPoint ASIC



----General----	
Offline	True
Use Caldata from Initial Equalization Preset Optimization	True
Equalization Preset Range	P0;P1;P2;P3;P4;P5;P6;P7;P8;P9
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	5
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Sassim----	
Optimize CTLE	True
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Generator----	
Differential Voltage	800 mV
DMSI	14 mV
CMSI	0 V
Random Jitter	750 fs
Sinusoidal Jitter in UI	100 mUI
Sinusoidal Jitter	5 ps
Sinusoidal Jitter Frequency	100 MHz
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress signal calibration ; Measurement Instrument

Set Equalization Preset []	Measured Eye Width [ps]
0.00	14.66
1.00	15.54
2.00	14.59
3.00	14.67
4.00	15.36
5.00	15.20
6.00	15.29
7.00	14.93
8.00	14.57
9.00	15.10

Figure 39 Result for ASIC - Final Equalization Preset (Eye Width)

- Set Equalization Preset: The equalization preset value configured in the instrument.
- Measured Eye Width: The measured Eye-Width value for each step.

Pre-Compliance Eye Calibration

Purpose and Method

This procedure measures how the Eye-Height and Eye-Width is affected by the variation of the impairments (SJ, DMSI and Launch Voltage).

The calibration measures the eye in four situations:

- all the impairments are set to the nominal values,
- the DMSI is set to the maximum value allowed by the specifications,
- the SJ is set to the maximum spec amplitude,
- the differential voltage is set to the minimum specification level.

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

The calibration data are stored in a caltable. They are used in the Compliance Eye Calibration to calculate DMSI, SJ and Vdiff adjustment to meet the target eye.

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 40) with the hardware trace set to the optimal number, according to the Channel Calibration.

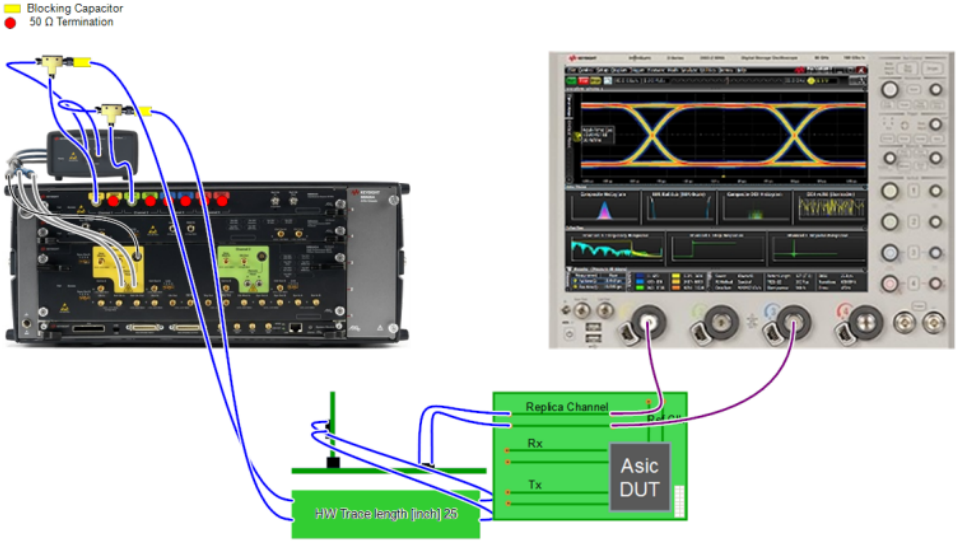


Figure 40 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

Generator

- Pre-shoot
- De-Emphasis
- CMSI
- Random Jitter

Oscilloscope

- Scope Bandwidth
- Number of Averages
- Number of Waveform Averages

Capture

- Capture Mode
- File Path of Base File

Channel

- Trace Length
- Total Channel Loss

Seasim

- Optimize CTLE

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Measurement on page 59.
- Random Jitter Calibration on page 55.
- HF Sinusoidal Jitter Calibration on page 51.
- Insertion Loss Calibration on page 62.
- DM Sinusoidal Jitter Calibration on page 81.
- CM Sinusoidal Jitter Calibration on page 85.

Result Description

Cal_20G_SR_PreComp

for CCIX EndPoint ASIC

----General----	
Offline	True
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	10
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Optimize CTLE	True
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Generator----	
Pre-Shoot	0 dB
De-Emphasis	-3.5 dB
Common Mode Interference	0 V
Random Jitter	750 fs
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with inte sources for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infini Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress sig calibration ; Measurement Instrument

DMSI [mV]	SJ [ps]	Vdiff [mV]	Eye Height [mV]	Eye Width [ps]
14.0	5.00	800	30.00	15.00
25.0	5.00	800	28.00	14.40
14.0	8.00	800	27.00	13.60
14.0	5.00	720	26.00	14.50

Figure 41 Result for ASIC - Pre-Compliance Calibration

- DMSI: The amount of DMSI set using the calibrations.

- SJ: The amount of SJ set using the calibrations.
- Vdiff: The amount of differential voltage set using the calibrations.
- Eye Height: The measured eye height.
- Eye Width: The measured eye width.

Compliance Eye Calibration

Purpose and Method

This calibration searches for the optimum combination of DMSI, SJ and Launch Voltage values to generate an eye as close as possible to the compliance eye.

In the first step, the eye is measured when the impairments are set to the nominal values. Then, a search algorithm is used to re-calculate the optimum amount of SJ, DMSI and Vdiff. This process is repeated until the eye is in the middle of the specification levels or until the max. number of Search Steps are attained.

If the automatic search is unable to find a suitable combination of impairments to generate an eye within the specs (EH between 27 and 33 mV and EW between 287.5 and 312.5 mUI), it is possible to perform a manual search by manually setting the SJ, DMSI and Vdiff values.

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 42) with the hardware trace set to the optimal number, according to the Channel Calibration.

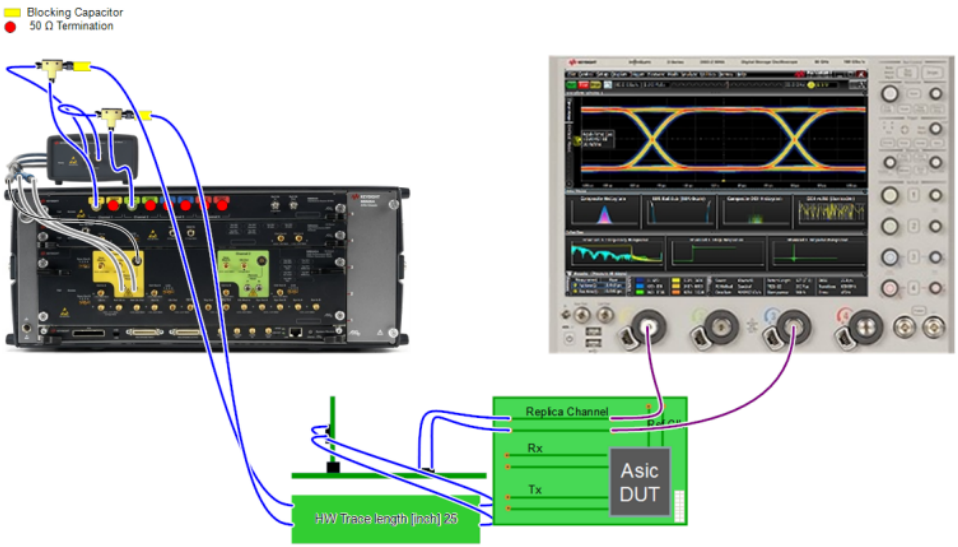


Figure 42 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

Generator

- Pre-shoot
- De-Emphasis
- Sinusoidal Jitter Frequency
- CMSI
- Random Jitter

Oscilloscope

- Scope Bandwidth
- Number of Averages
- Number of Waveform Averages

Capture

- Capture Mode
- File Path of Base File

Channel

- Trace Length
- Total Channel Loss

Seasim

- Optimize CTLE

Search Algorithm

- Minimum Vdiff
- Maximum DMSI
- Maximum SJ
- Max. Number of Search: Maximum number of times the optimal eye is searched automatically.
- Use nominal EH/EW results from Pre-Compliance Cal: If set to 'True', the measurement in the first step is skipped and the eye result is directly copied from the Pre-Compliance Eye Calibration.

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Measurement on page 59.
- Random Jitter Calibration on page 55.
- HF Sinusoidal Jitter Calibration on page 51.
- Insertion Loss Calibration on page 62.
- DM Sinusoidal Jitter Calibration on page 81.
- CM Sinusoidal Jitter Calibration on page 85.

Result Description

Cal_20G_SR_CompEye

for CCIX EndPoint ASIC

----General----	
Offline	True
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	10
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Optimize CTLE	True
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Generator----	
Pre-Shoot	0 dB
De-Emphasis	-3.5 dB
Sinusoidal Jitter in UI	100 mUI
Sinusoidal Jitter Frequency	100 MHz
Common Mode Interference	0 V
Random Jitter	750 fs
----Search Algorithm----	
Minimum Vdiff	720 mV
Maximum DMSI	25 mV
Maximum SJ	10 ps
Max Number of Search Steps	7
Use nominal EH/EW results from Pre Comp Cal	True
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integ for BER tests ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infin Unknown ; FW rev.: Unknown ; Description: Realtime scope for stress si Measurement Instrument

DMSI [mV]	SJ [ps]	Vdiff [mV]	Eye Height [mV]	Eye Width [ps]
14.0	5.00	800	30.0	15.00

Figure 43 Result for ASIC - Compliance Eye Calibration

- DMSI: The amount of DMSI set using the calibrations.
- SJ: The amount of SJ set using the calibrations.
- Vdiff: The amount of differential voltage set using the calibrations.
- Eye Height: The measured eye height.
- Eye Width: The measured eye width.

Compliance Eye Verification

Purpose and Method

For the Rx Compliance test, the eye-width and eye-height at the Rx inputs must be within the limits allowed for the specifications. This procedure verifies the possibility for compliance with the calibrated setup.

The procedure leverages the results from the Compliance Eye Calibration to set the optimum combination of launch voltage, DMSI and sinusoidal jitter. Then, the eye is measured with a real-time oscilloscope.

If the resulting eye is within the compliance limits, the verification is considered as Pass and, the setup is identified as valid for the Rx Compliance test.

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 44) with the hardware trace set to the optimal number, according to the Channel Calibration.

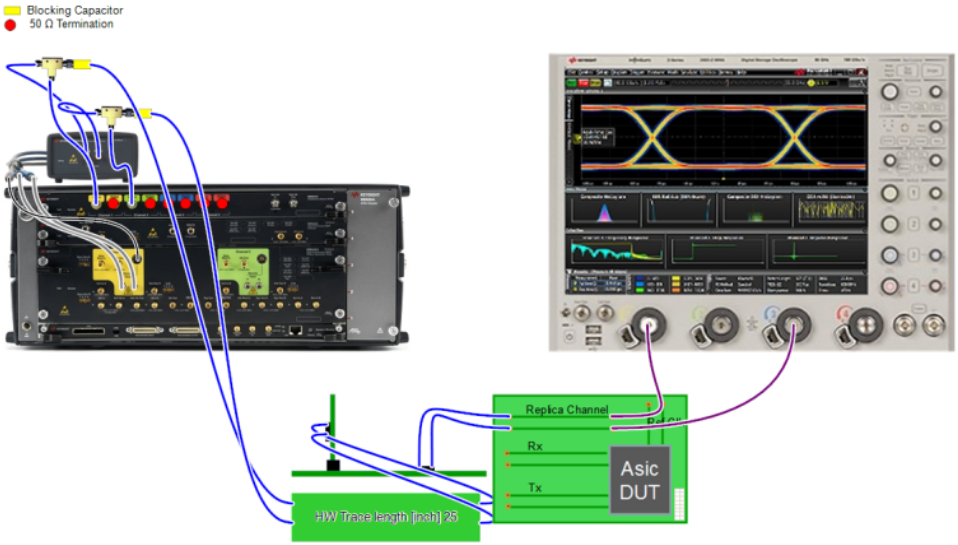


Figure 44 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

- CTLE DC Gain

Generator

- Pre-shoot
- De-Emphasis
- Differential Mode Interference
- Differential Voltage
- Sinusoidal Jitter (in UI)
- Sinusoidal Jitter (in seconds)
- Random Jitter

Oscilloscope

- Scope Bandwidth
- Number of Averages
- Number of Waveform Averages

Capture

- Capture Mode
- File Path of Base File

Channel

- Trace Length
- Total Channel Loss

Seasim

- Optimize CTLE

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Measurement on page 59.
- Random Jitter Calibration on page 55.
- HF Sinusoidal Jitter Calibration on page 51.
- Insertion Loss Calibration on page 62.
- DM Sinusoidal Jitter Calibration on page 81.
- CM Sinusoidal Jitter Calibration on page 85.

Result Description

Ver_20G_SR_CompEye

for CCIX EndPoint ASIC

----General----	
Offline	True
Generator Channel Channel	M1.DataOut1
----Oscilloscope----	
Scope Bandwidth	33 GHz
Number of Averages	10
Number of Waveform Averages	1024
Transfer Function File for Package Model on Scope	CCIXRxPackageModel_EndPoint.tf4
Package Model Loss at the DMSI frequency (2.1GHz)	-0.906 dB
Scope Connection for Calibration	Chan 1 3 Direct Connect
----Seasim----	
Optimize CTLE	True
----Channel----	
Trace Length [inch]	25
Total Channel Loss	-24 dB
----Generator----	
Pre-Shoot	0 dB
De-Emphasis	-3.5 dB
Differential Mode Interference	14 mV
Differential Voltage	800 mV
Sinusoidal Jitter in UI	100 mUI
Sinusoidal Jitter	5 ps
Common Mode Interference	0 V
Random Jitter	750 fs
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitt Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infi rev.: Unknown ; Description: Realtime scope for stress signal calibr

Eye Height [mV]	Eye Width [mUI]
27.0	290.4

Figure 45 Result for ASIC - Compliance Eye Calibration

- Eye Height: The measured eye height.
- Eye Width: The measured eye width.

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.

This calibration is only available in “Expert Mode” when the option “Include Advanced Measurement” is selected. To configure this option, refer to CCIX Parameters on page 20.

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 46) with the hardware trace set to the optimal number, according to the Channel Calibration.

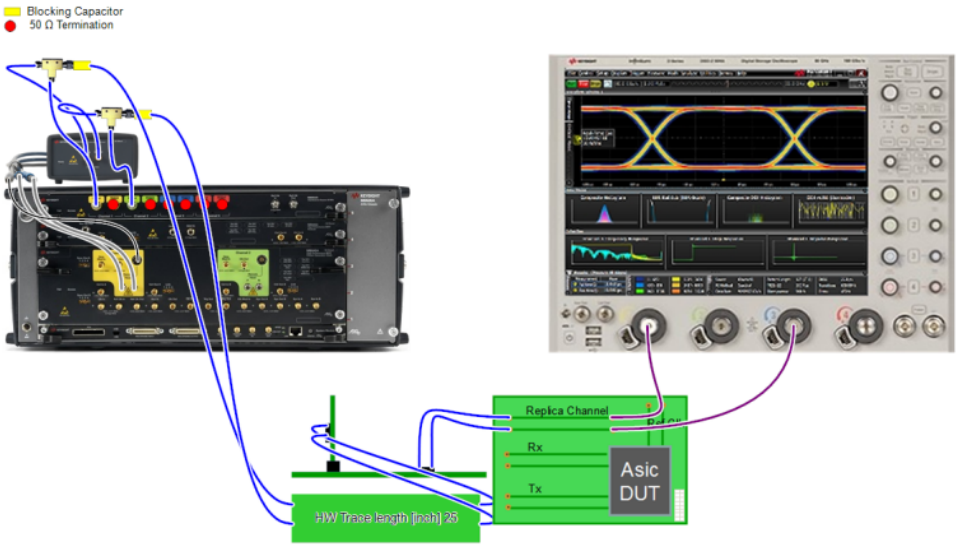


Figure 46 Connection Diagram for ASIC Calibration at TP2 (M8040A)

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 Waveform Averages

Capture

- Capture Mode
- File Path of Base File

Channel

- Trace Length
- Total Channel Loss

Seasim

- Optimize CTLE

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Measurement on page 59.
- Random Jitter Calibration on page 55.
- HF Sinusoidal Jitter Calibration on page 51.
- Insertion Loss Calibration on page 62.
- DM Sinusoidal Jitter Calibration on page 81.
- CM Sinusoidal Jitter Calibration on page 85.

Eye-Height and Width Scan

Purpose and Method

This procedure measures the Eye-Height and Eye-Width generated with any combination of impairments.

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

This calibration is only available in “Expert Mode” when the option “Include Advanced Measurement” is selected. To configure this option, refer to CCIX Parameters on page 20.

Connection Diagram

The setup corresponds to the test point TP2 (refer to Figure 47) with the hardware trace set to the optimal number, according to the Channel Calibration.

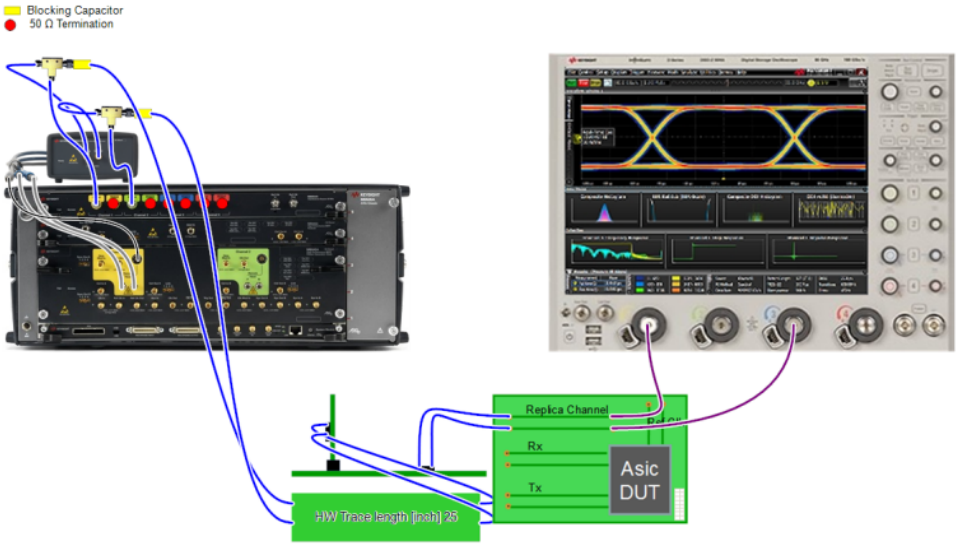


Figure 47 Connection Diagram for ASIC Calibration at TP2 (M8040A)

Parameters in Expert Mode

- Loop Levels: The number of impairments to scan.
- Show Plots
- Equalization Mode: If it is set to “Presets”, you may choose the equalization presets to scan. If it is set to “Custom Values”, you may choose the Pre-Shoot and De-Emphasis values to scan.

Loop

- Scan Parameter: This is the impairment to scan, which can be selected from one of the options:
  - 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 such parameters that are not scanned, set the fixed value that shall be used in all steps.

Oscilloscope

- Scope Bandwidth
- Number of Averages
- Number of Waveform Averages

Capture

- Capture Mode
- File Path of Base File

Channel

- Trace Length
- Total Channel Loss

Seasim

- Optimize CTLE

For detailed information regarding these parameters, refer to Table 7.

Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Measurement on page 59.
- Random Jitter Calibration on page 55.
- HF Sinusoidal Jitter Calibration on page 51.
- Insertion Loss Calibration on page 62.
- DM Sinusoidal Jitter Calibration on page 81.
- CM Sinusoidal Jitter Calibration on page 85.

5 Receiver Setup Tests

Rx Setup Test Procedures

Rx Impairments Setup

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Rx Pre-Compliance test using the calibration data saved on the PC where ValiFrame is running.

The method starts running in the beginning like the Rx Pre-Compliance test but the test does not run entirely, it only leaves the setup prepared.

Connection Diagram

The connection diagram for ASIC endpoints for M8040A is shown in Figure 48, respectively. Note that the setup can differ depending on the ISI channel, clock architecture and external reference clock selection.

For ASIC RootComplex DUTs, the setup differs in the reference clock connection.

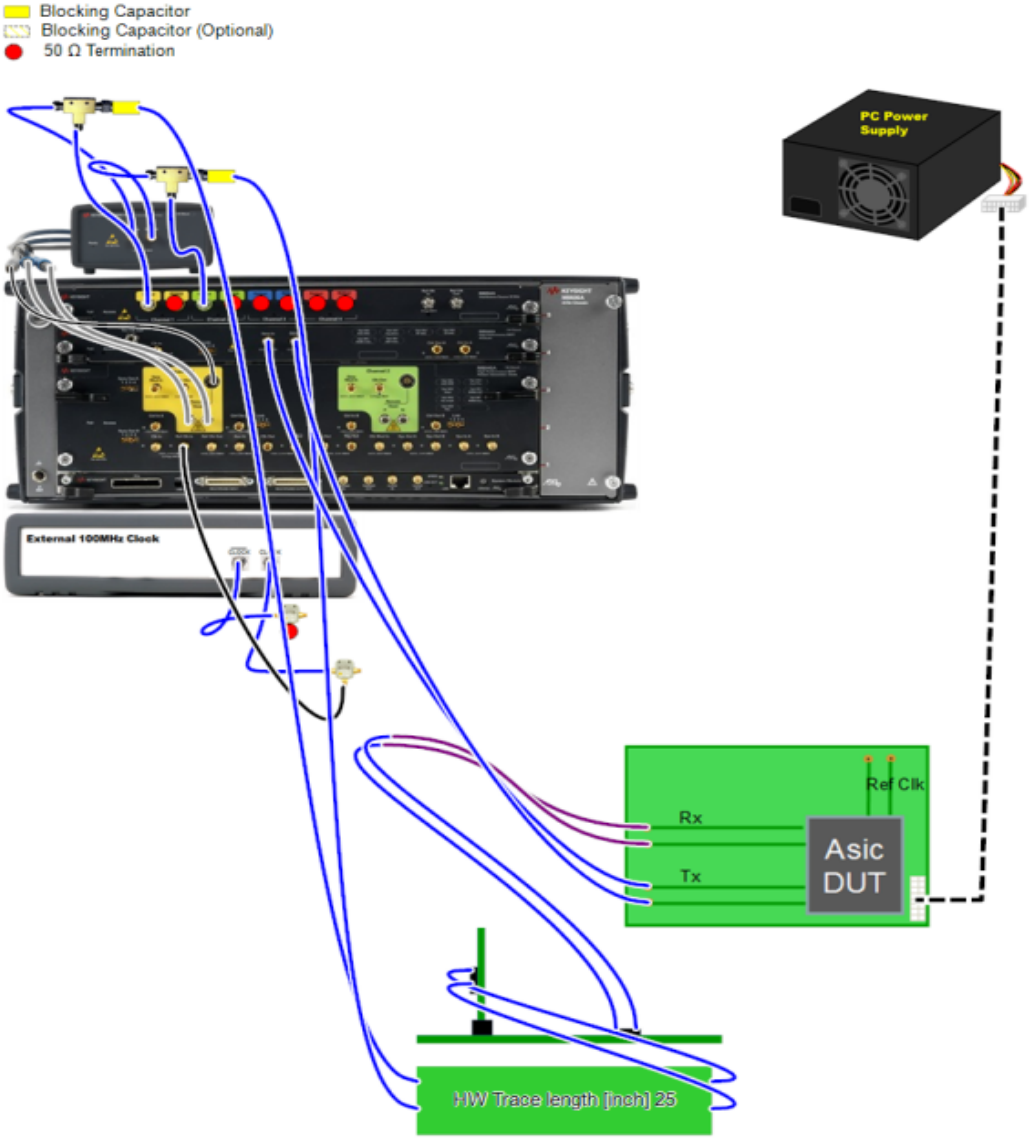


Figure 48 Connection Diagram for 20 GT/s ASIC Receiver Setup Tests (M8040A)

Parameters in Expert Mode

Generator

- Pre-shoot
- De-Emphasis
- Differential Voltage
- Common Mode Interference
- Differential Mode Interference
- Random Jitter
- Sinusoidal Jitter
- Sinusoidal Jitter Frequency
- 2nd Tone Sinusoidal Jitter
- 2nd Tone Sinusoidal Jitter Frequency

For detailed information regarding these parameters, refer to Table 8.

Used Calibrations (Prerequisite)

- TxEQ and Launch Voltage Calibration on page 43.
- Random Jitter Calibration on page 55.
- HF Sinusoidal Jitter Calibration on page 51.
- Insertion Loss Calibration on page 62.
- Channel Calibration on page 71.
- AWG Amplitude Correction Calibration on page 78.
- DM Sinusoidal Jitter Calibration on page 81.
- CM Sinusoidal Jitter Calibration on page 85.
- Compliance Eye Calibration on page 99.

6 Receiver Tests

The basic principle of all CCIX receiver tests is:

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

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

All tests can be performed for the 20 GT/s and 25 GT/s rates.

NOTE For Rx tests, you do not require a real-time oscilloscope.

Rx Test Procedures

EQ 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 green in color, the entry values are valid and they can be used for testing. The values that approach red in color are invalid for testing.

If the parameter “Allow user to enter optimum equalization” for remaining tests is set to ‘True’, a window appears, where you may manually select the values of pre-shoot and de-emphasis from the result graph.

Connection Diagram

The connection diagram for ASIC endpoints for M8040A are shown in Figure 49, respectively. Note that the setup can differ depending on the ISI channel, clock architecture and external reference clock selection.

For ASIC RootComplex DUTs, the setup differs in the reference clock connection.

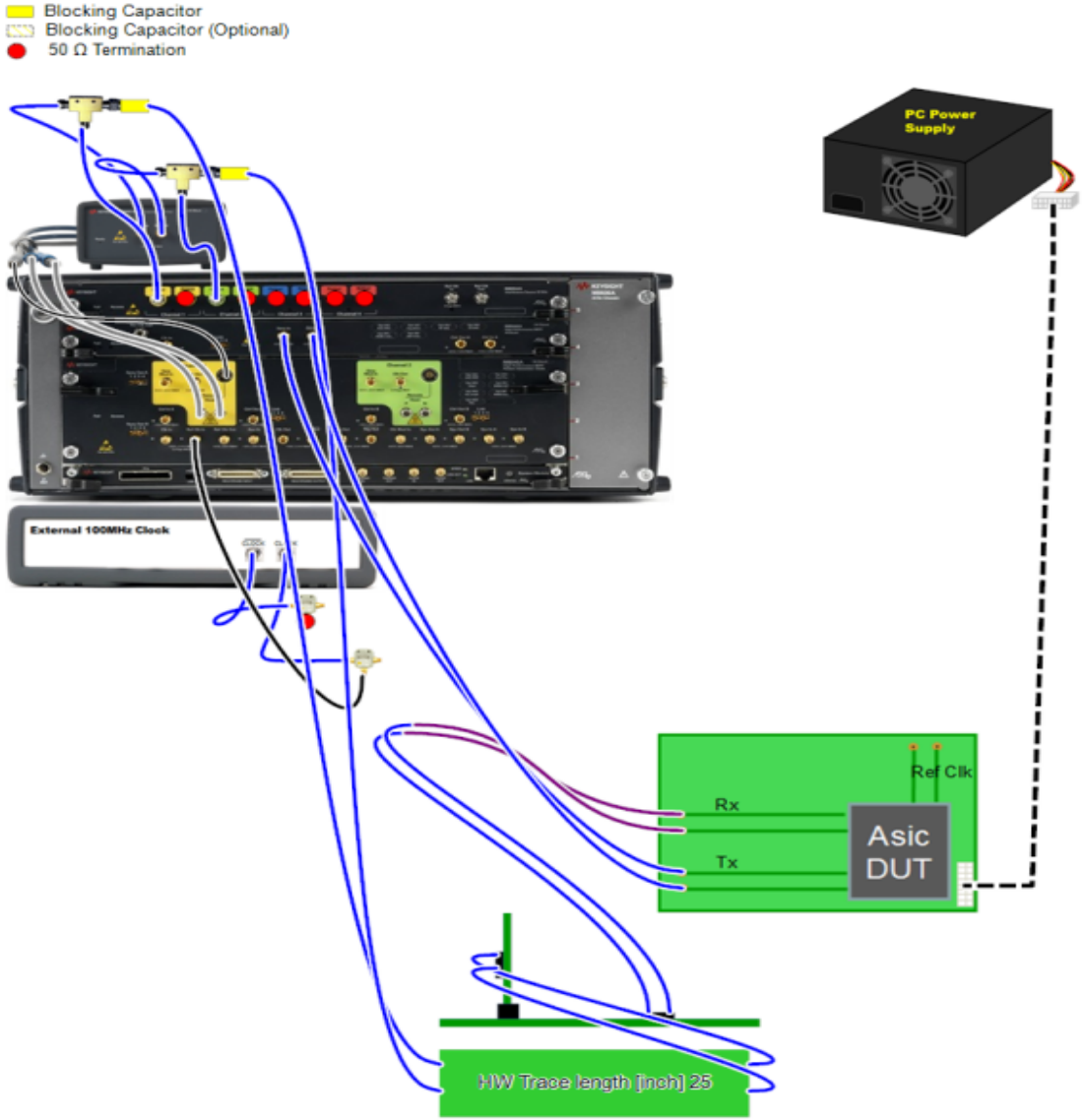


Figure 49 Connection Diagram for 20GT/s ASIC Receiver Tests (M8040A)

Parameters in Expert Mode

Coefficient Variation

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

BER Measurement

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

Equalization for remaining Rx tests

- Allow user to enter optimum equalization for remaining Rx tests

Generator

- Differential Voltage
- Common Mode Sinusoidal Interference
- Differential Mode Sinusoidal Interference
- Random Jitter
- Sinusoidal Jitter (in seconds)
- Sinusoidal Jitter Frequency
- Additional Sinusoidal Jitter (in seconds)
- Additional Sinusoidal Jitter Frequency
- Residual SSC

For detailed information regarding these parameters, refer to Table 8.

Used Calibrations (Prerequisite)

- "TxEQ and Launch Voltage Calibration" on page 43.
- "Random Jitter Calibration" on page 55.
- "HF Sinusoidal Jitter Calibration" on page 51.
- "Insertion Loss Calibration" on page 62.
- "Channel Calibration" on page 71.
- "AWG Amplitude Correction Calibration" on page 78.
- "DM Sinusoidal Jitter Calibration" on page 81.
- "CM Sinusoidal Jitter Calibration" on page 85.
- "Compliance Eye Calibration" on page 99.

Result Description

Rx_20G_SR_EQtable

for CCIX EndPoint ASIC

----General----	
Offline	True
----Generator----	
Differential Voltage	800 mV
Common Mode Interference	150 mV
Differential Mode Interference	14 mV
Random Jitter	750 fs
Sinusoidal Jitter	5 ps
Sinusoidal Jitter Frequency	100 MHz
Additional Sinusoidal Jitter in seconds	0 s
Additional Sinusoidal Jitter Frequency	210 MHz
Residual SSC	500 ps
----Loopback Training----	
Enable Impaiments during Loopbacktraining	True
Force Retraining at each BER measurement	False
Pre-Shoot used for LB Training	1.9 dB
De-Emphasis used for LB Training	0 dB
----BER Measurement----	
BER Mode	FixedTime
BER Measurement Duration	15 s
Allowed Bit Error	0
----Coefficient Variation----	
Coefficient Divider	24
Maximum Boost	9.5 dB
Start Pre-Shoot	0 dB
Start De-Emphasis	0 dB
----Equalization for remaining Rx tests----	
Allow user to enter optimum equalization for remaining Rx tests	True
----BER Measurement----	
Relax Time	3 s
----Error Detector----	
CDR Loop Bandwidth	20 MHz
Peaking	1 dB
Analyzer Equalization	80
Polarity	Normal
----Instruments----	
Measurement Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Measurement Instrument

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: 3.6dB 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	BER: 0 Errors PS: 6.8dB DE: -1.6dB	BER: 0 Errors PS: 8.0dB DE: -3.5dB						

Figure 50 Result for EQ Coefficient Matrix Scan

- C-1/C+1: Result of the BER Measurement for the specific combination of the coefficient matrix.

Jitter Tolerance Test

Purpose and Method

This procedure is used to determine how much jitter a DUT can tolerate at different SJ frequencies.

The test procedure applies a search algorithm that is sequentially used over a range of jitter frequencies. The range of frequencies to be tested is defined with the “Frequency Mode” property. At each jitter frequency value, the maximum passed jitter amplitude is reported. The result "Pass" indicates that the DUT produced only the allowed number of Bit Errors or less. The result is a curve showing the maximum passed jitter as a function of the SJ frequency.

To search the maximum passed jitter amplitude, different algorithms can be used. The linear algorithm is defined by the “Start Jitter Amplitudes” and “Jitter Linear Step Sizes” parameters.

Connection Diagram

The connection diagrams for ASIC endpoints for M8040A is shown in Figure 51. Note that the setup can differ depending on the ISI channel, clock architecture and external reference clock selection.

For ASIC RootComplex DUTs, the setup differs in the reference clock connection.

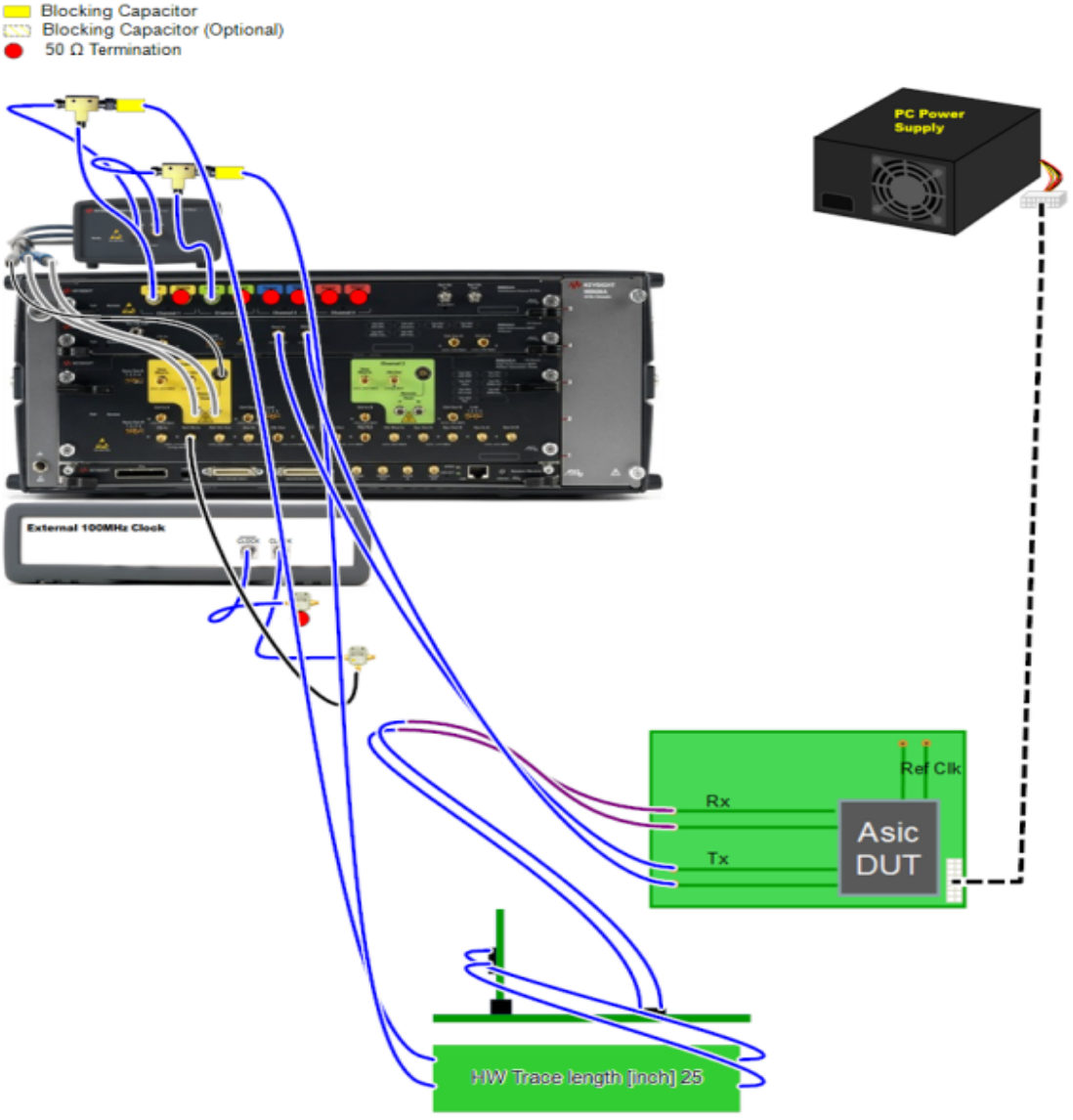


Figure 51 Connection Diagram for 20GT/s ASIC Receiver Tests (M8040A)

Parameters in Expert Mode

Jitter Tolerance

- Frequency Mode

If either Compliance Frequencies, User Defined Frequencies or Single Frequency are selected as the Frequency Mode, the parameter used is:

  - Jitter Frequencies

If Equally Spaced Frequencies is selected as the Frequency Mode, the parameter used are:

  - Start frequency value
  - Stop frequency value
  - Number of Frequency Steps
  - Frequency sweep scale

- Start jitter amplitude
- Use fixed number of steps
  - Number of jitter steps
  - Jitter linear step size
- Show Min Failed Points

Loopback Training

- Enable Impairments during Loopback Training

Generator

- Pre-shoot
- De-Emphasis
- Differential Voltage
- Common Mode Sinusoidal Interference
- Differential Mode Sinusoidal Interference
- Random Jitter
- Additional Sinusoidal Jitter (in seconds)
- Additional Sinusoidal Jitter Frequency
- Residual SSC
- RJ Low Pass Filter Frequency

BER Measurement

- BER Mode
- BER Measurement Duration
- Allowed Bit Error

- Target BER
- Confidence Level

For detailed information regarding these parameters, refer to Table 8.

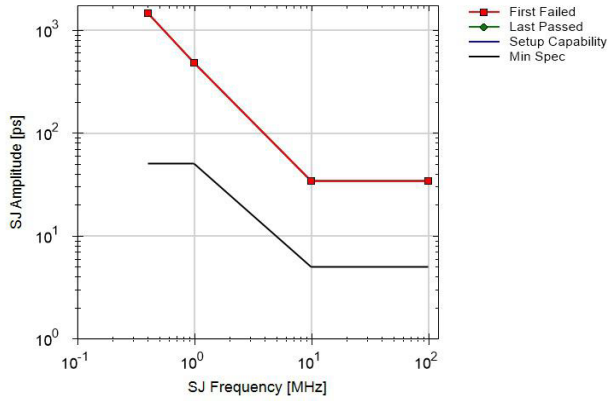
Used Calibrations (Prerequisite)

- "TxEQ and Launch Voltage Calibration" on page 43.
- "Random Jitter Calibration" on page 55.
- "HF Sinusoidal Jitter Calibration" on page 51.
- "Insertion Loss Calibration" on page 62.
- "Channel Calibration" on page 71.
- "AWG Amplitude Correction Calibration" on page 78.
- "DM Sinusoidal Jitter Calibration" on page 81.
- "CM Sinusoidal Jitter Calibration" on page 85.
- "Compliance Eye Calibration" on page 99.

Result Description

Rx_20G_SR_JTol

for CCIX EndPoint ASIC



----General----	
Offline	True
Frequency mode	Compliance Frequencies
Use fixed number of steps	False
Show min failed points	True
----Generator----	
Pre-Shoot	1.9 dB
De-Emphasis	0 dB
Differential Voltage	800 mV
Common Mode Interference	150 mV
Differential Mode Interference	14 mV
Random Jitter	750 fs
Additional Sinusoidal Jitter in seconds	0 s
Additional Sinusoidal Jitter Frequency	210 MHz
Residual SSC	500 ps
RJ Low Pass Filter Frequency	500 MHz
----Loopback Training----	
Enable Impairments during Loopbacktraining	True
----BER Measurement----	
BER Mode	FixedTime
BER Measurement Duration	1.5 s
Allowed Bit Error	5
----BER Measurement----	
Relax Time	3 s
----Error Detector----	
CDR Loop Bandwidth	20 MHz
Peaking	1 dB
Analyzer Equalization	80
Polarity	Normal
----Instruments----	
Measurement Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040A with integrated jitter sources for BER tests ; Measurement Instrument

Result	SJ Frequency [MHz]	First Failed [ps]	Last Passed [ps]	Setup Capability [ps]	Min Spec [ps]	Margin [%]
pass	0.40	1453.60	1453.60	1454	50.00	2807.2
pass	1.00	484.10	484.10	484	50.00	868.2
pass	10.00	34.20	34.20	34	5.00	584.0
pass	100.00	34.20	34.20	34	5.00	584.0

Figure 52 Result for Jitter Tolerance Test

- Result: PASS/FAIL; True if the BER Test passes.
- SJ Frequency: The sinusoidal jitter frequency applied to the test signal.
- First Failed: This is the first value of SJ amplitude where the DUT didn't pass the BER Test at a specific frequency.
- Last Passed: This is the maximum value of SJ that the DUT can tolerate at a specific SJ frequency.
- Setup Capability: This is the maximum value of jitter that the test setup can generate at a specific SJ frequency.

Compliance Test

Purpose and Method

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

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

Connection Diagram

The connection diagram for ASIC endpoints for M8040A is shown in Figure 53, respectively. Note that the setup can differ depending on the ISI channel, clock architecture and external reference clock selection.

For ASIC RootComplex DUTs, the setup differs in the reference clock connection.

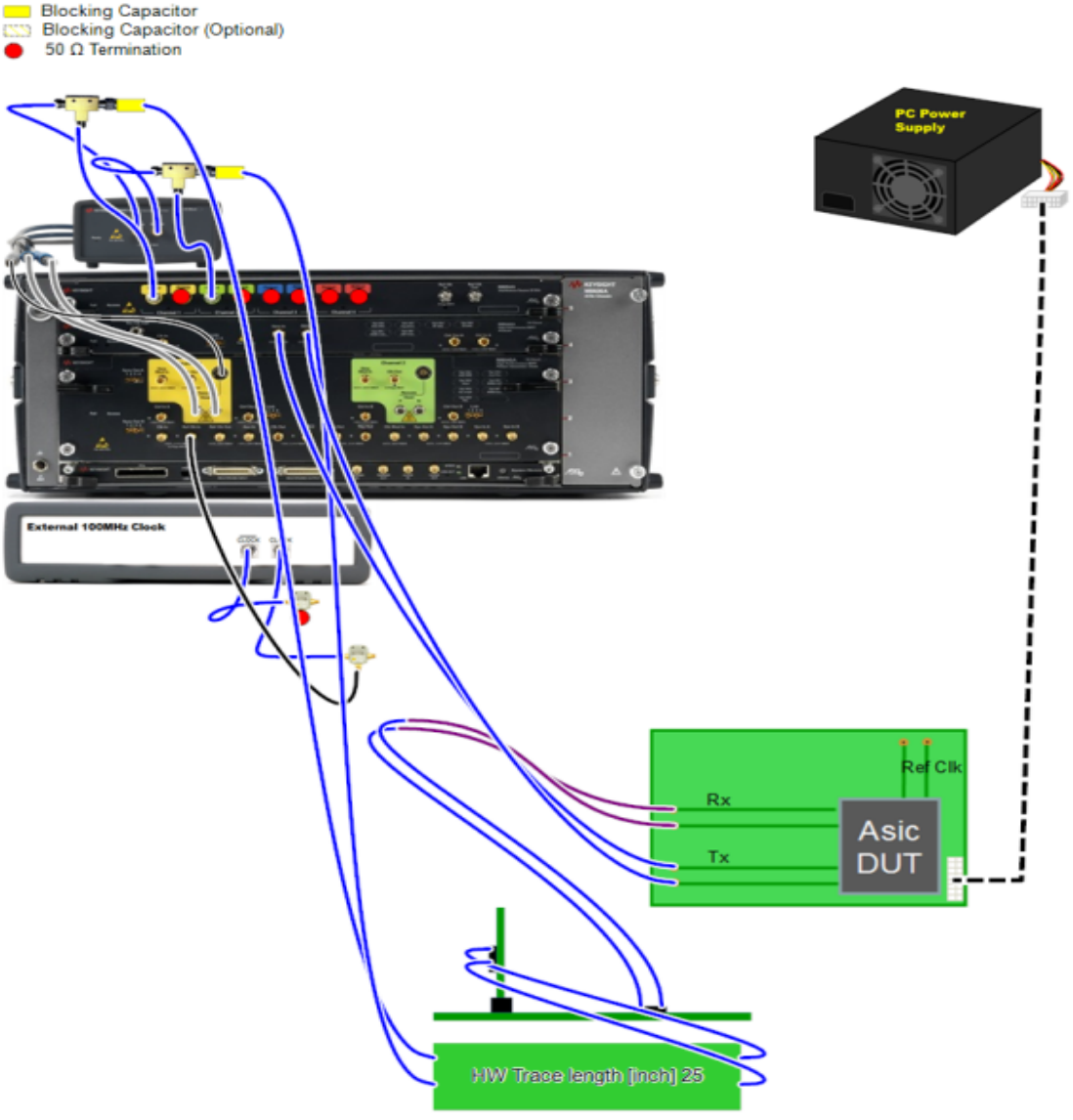


Figure 53 Connection Diagram for 20GT/s ASIC Receiver Tests (M8040A)

Parameters in Expert Mode

Loopback Training

- Sinusoidal Jitter
- Sinusoidal Jitter Frequency
- Enable Impairments during Loopback Training

BER Measurement

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

Generator

- Pre-shoot
- De-Emphasis
- Differential Voltage—By default, it is set to the value that gets the desired eye.
- Common Mode Sinusoidal Interference—By default, it is set to the nominal value (150mV).
- Differential Mode Sinusoidal Interference—By default. it is set to the value that gets the desired eye.
- Random Jitter—By default, it is set to the nominal value (0.5ps).
- Additional Sinusoidal Jitter
- Additional Sinusoidal Jitter Frequency
- Residual SSC

For detailed information regarding these parameters, refer to Table 8.

Used Calibrations (Prerequisite)

- "TxEQ and Launch Voltage Calibration" on page 43.
- "Random Jitter Calibration" on page 55.
- "HF Sinusoidal Jitter Calibration" on page 51.
- "Insertion Loss Calibration" on page 62.
- "Channel Calibration" on page 71.
- "AWG Amplitude Correction Calibration" on page 78.
- "DM Sinusoidal Jitter Calibration" on page 81.
- "CM Sinusoidal Jitter Calibration" on page 85.

- “Compliance Eye Calibration” on page 99.

Result Description

Rx_20G_SR_Comp

for CCIX EndPoint ASIC

Offline	True
Pre-Shoot	1.9 dB
De-Emphasis	0 dB
Differential Voltage	800 mV
Common Mode Interference	150 mV
Differential Mode Interference	14 mV
Random Jitter	750 fs
Sinusoidal Jitter	5 ps
Sinusoidal Jitter Frequency	100 MHz
Additional Sinusoidal Jitter in seconds	0 s
Additional Sinusoidal Jitter Frequency	210 MHz
Residual SSC	500 ps
Enable Impaiments during Loopbacktraining	True
BER Mode	TargetBer
Target BER	1E-12
Confidence Level	95 %
Relax Time	3 s
CDR Loop Bandwidth	20 MHz
Peaking	1 dB
Analyzer Equalization	80
Polarity	Normal

Result	SJ Frequency [MHz]	SJ Amplitude [ps]	Target BER [ ]	Measured BER [ ]
pass	0.40	50.000	1.000E+000	1.000E+000
pass	1.00	50.000	1.000E+000	1.000E+000
pass	10.00	5.000	1.000E+000	1.000E+000
pass	100.00	5.000	1.000E+000	1.000E+000

Figure 54 Result for Pre-Compliance Test

- Result: Pass/Fail; If the BER Test passes at a specific frequency, the value is “Pass”, else “Fail”.
- SJ Frequency: The SJ frequency of the signal tested at each step.
- SJ Amplitude: The SJ amplitude of the signal tested at each step.
- Target BER: The maximum BER to consider the BER test as a Pass.
- Measured BER: The number of bit errors that occurred during the test.

Edition 2.0, March 2021

www.keysight.com

KEYSIGHT
TECHNOLOGIES