N5991SA4A/3A SAS Test Automation Software Platform - User Guide

KEYSIGHT

USER GUIDE

Notices

Manual Part Number

N5991-91100

Edition

Edition 4.0, July 2023

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WARNING

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Keysight N5991SA4A/3A SAS Test Automation Software Platform

User Guide

1 Introduction

KEYSIGHT TECHNOLOGIES

Overview

This User Guide provides a detailed description of the Keysight N5991SA4A/3A SAS 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 SAS (Serial Attached SCSI) 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 implemented according to the requirements of the *SAS 12G Receiver (Rx) Test Keysight J-BERT High-Performance BERT Systems* document. These tests are designed to determine if a product conforms to specifications defined in the *Working Draft Project American National T10/BSR INCITS 534 Standard*. Additionally, ValiFrame offers some custom characterization tests to provide more details on DUT behavior beyond the limits.

The N5991 SAS Receiver tests support the Keysight Technologies J-BERT M8020A and M8040A high-performance serial BERTs. An Infiniium oscilloscope is always required.

NOTE The definitions of the acronyms and abbreviations used throughout this User Guide are given in Chapter 7: Acronyms and Abbreviations.

Document History

First Edition (September 2019)

The first edition of this user guide describes the functionality of software version N5991 ValiFrame SAS_1.00 based on the *Working Draft Project American National T10/BSR INCITS 534 Standard* specification.

Second Edition (October 2020)

The second edition of this user guide describes the functionality of software version N5991 ValiFrame SAS_1.11.0 based on the *Working Draft Project American National T10/BSR INCITS 534 Standard* specification.

Third Edition (November 2021)

The third edition of this user guide describes the functionality of software version N5991 ValiFrame SAS_1.11.1 based on the *Working Draft Project American National T10/BSR INCITS 534 Standard* specification.

Fourth Edition (July 2023)

The fourth edition of this user guide describes the functionality of software version N5991 ValiFrame SAS_1.12.0 based on the *Working Draft Project American National T10/BSR INCITS 534 Standard* specification.

Support and Troubleshooting

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

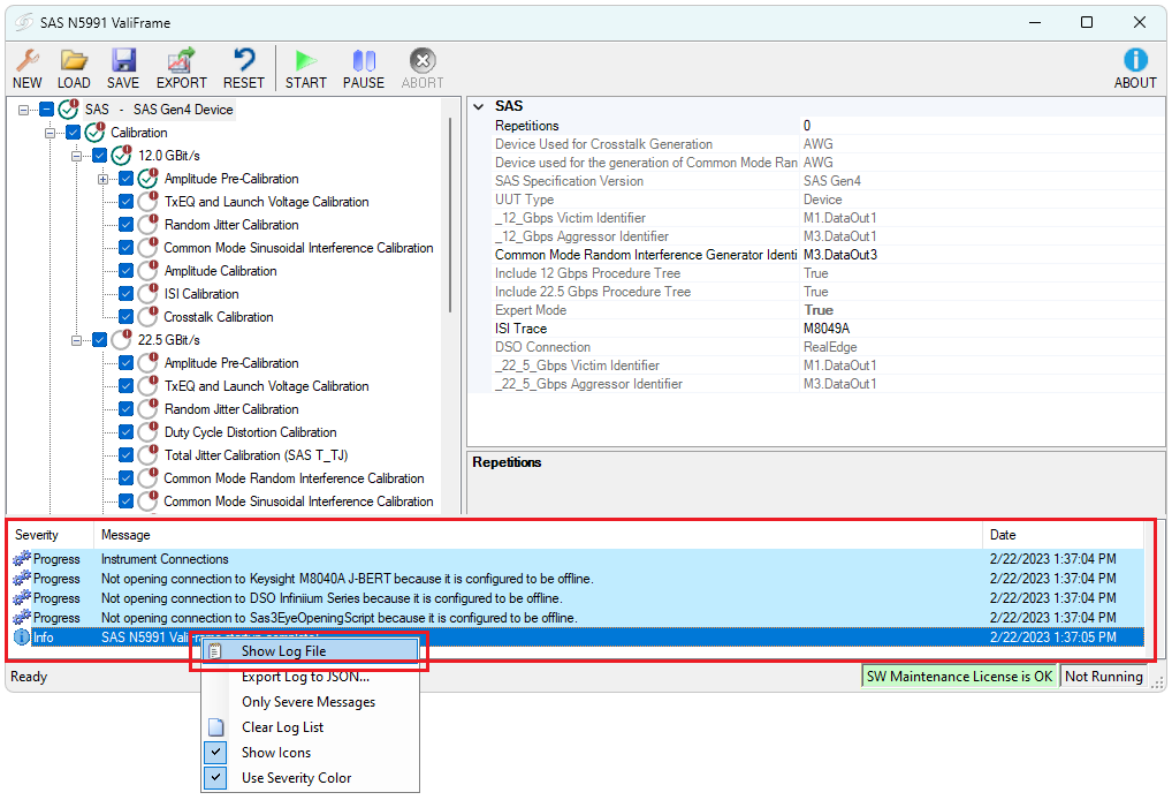


Figure 1 Accessing the log file

If a problem with an application persists, send the log file with the problem to Keysight support. For support options, visit www.keysight.com/find/contactus.

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

2 ValiFrame SAS Test Station

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

ValiFrame SAS Station Configuration

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

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

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

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

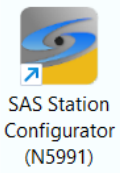


Figure 2 Icon for SAS Station Configurator (N5991)

Test Station Configuration

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

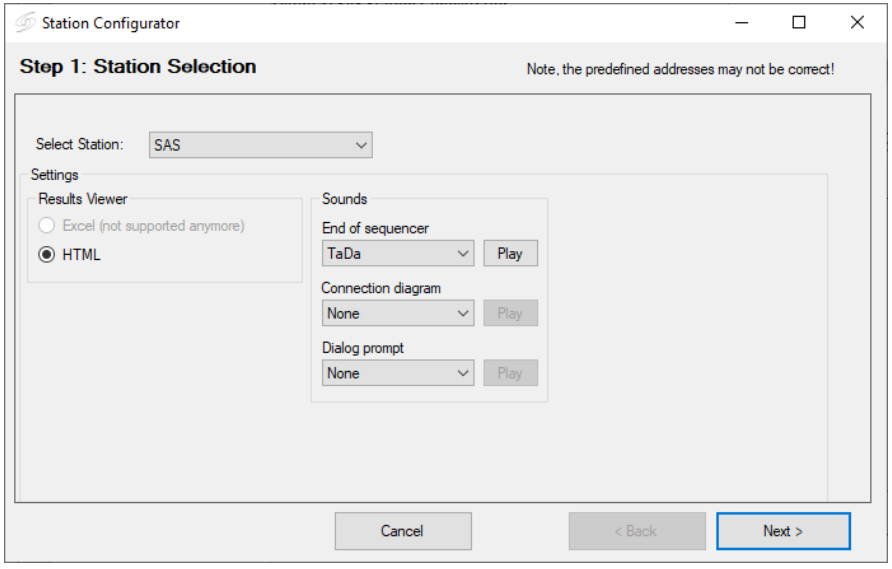


Figure 3 Station selection window

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

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

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

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

In the Station Configuration stage of the Configurator, you can select the **Data Generator** that is used to create patterns with specified stress parameters. The supported options are:

- JBERT M8020A (Keysight M8020A High-Performance BERT)
- JBERT M8040A (Keysight M8040A High-Performance BERT)

NOTE **JBERT M8020A supports only the 12 Gbps data rate. For the higher data rate of 22.5 Gbps you need to use the JBERT M8040A.**

If you select JBERT M8040A, a check box will appear labeled “Use TTC”. Check this box if you wish to use **Transition Time Converters**. Using TTCs slows down the M8040A’s edge rates and reduces the required bandwidth of the oscilloscope. Therefore, adding TTCs to the setup allows low-bandwidth inputs to be used for all calibrations, thus avoiding re-connections on the oscilloscope.

Test Instrument Configuration

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

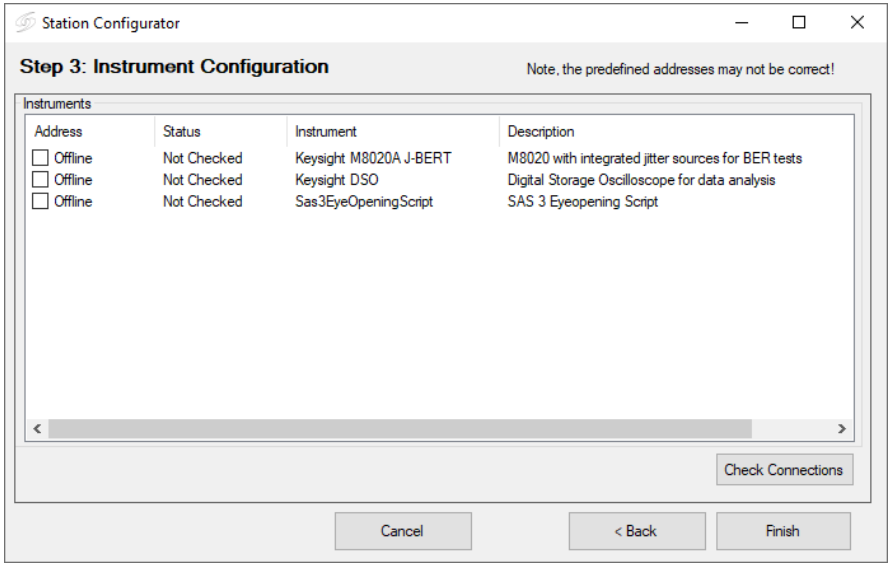


Figure 4 Instrument configuration window

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

After the installation process, all instruments are configured by default in “Offline” mode. In this simulation mode, the hardware need not necessarily be physically connected to the test controller PC. The ValiFrame software cannot connect to any instrument in this mode. In order to control the instruments that are connected to the PC, the instrument address must be entered. The address depends on the bus type used for the connection, for example, USB or LAN.

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

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

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

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

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

BitifEye Remote Instruments Server

In order to run the SAS3 Amplitude and ISI Calibrations a connection to the Sas3EyeOpeningScript needs to be established. This tool can be downloaded from the BitifEye Website, where it is called the Remote Instruments Server. It has to be installed on the oscilloscope. It contains the MATLAB script that is required to calculate the eye parameters from waveform data.

NOTE

When using a UXR Oscilloscope, the MATLAB Compiler Runtime version 7.15, 32-bit, needs to be installed before installing the Sas3EyeOpeningScript. MATLAB Compiler Runtime 7.15, 32-bit, can be found on Keysight.com.

Starting the SAS Station

Start the ValiFrame SAS Test Station by double-clicking “SAS Valiframe (N5991)” icon on the desktop as shown in Figure 5. Alternatively, click **Start** > **BitifEye SAS N5991** > **SAS ValiFrame (N5991)**.

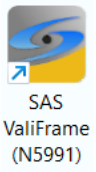


Figure 5 SAS Valiframe Test Station icon

Clicking the ValiFrame SAS icon launches the SAS N5991 ValiFrame main window as shown in Figure 6.

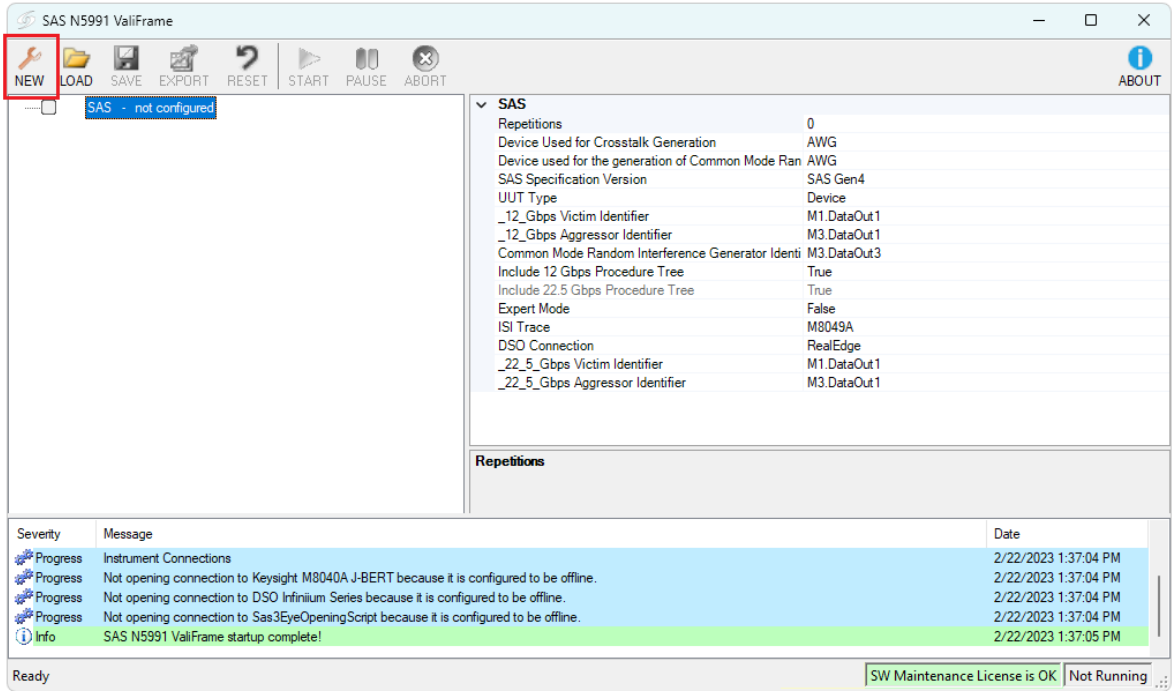


Figure 6 SAS N5991 ValiFrame user interface main window

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

Configure DUT Dialog Box

The Configure DUT dialog box (Figure 7) 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 will be used later in several calibrations and test procedures.

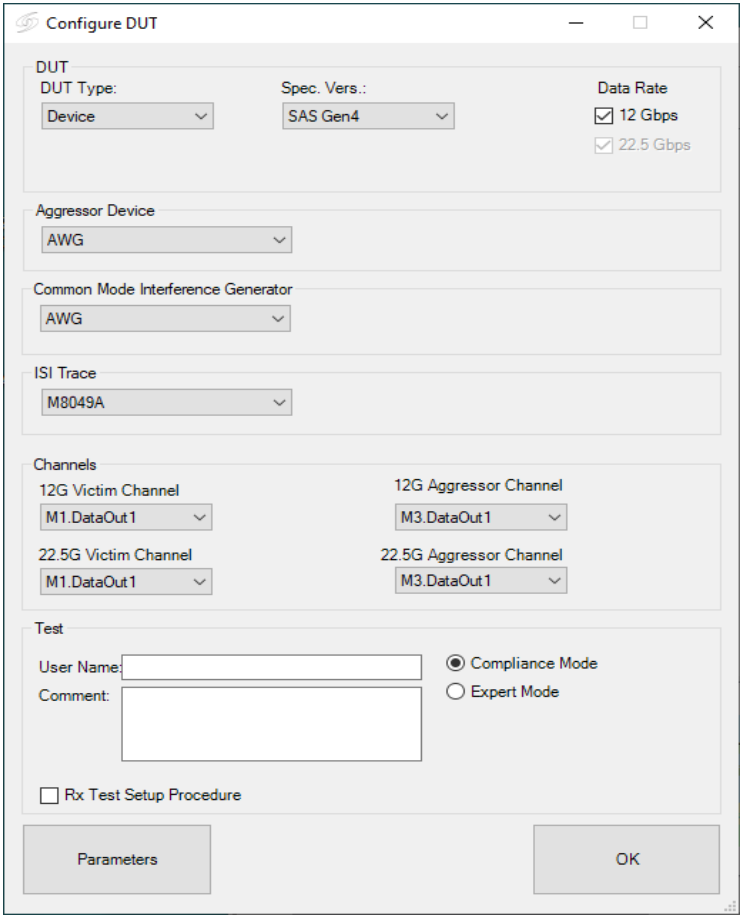


Figure 7 Configure DUT dialog box

Configuration Parameters

The parameters that appear in the Configure DUT dialog box are listed and described in Table 1.

Table 1 List of Configuration Parameters and their description

Parameter name	Description
DUT Parameters	
DUT Type	The DUT type can be chosen as: ▪ Device ▪ Host
Spec Vers.	The available versions for SAS specification are: ▪ Gen3 ▪ Gen4
Data Rate	The available data rates to test are 12 and 22.5 Gbps. ▪ For Gen3, only 12 Gbps is available and the corresponding box is automatically checked (it is read-only). ▪ For Gen4, and provided the connected data generator supports that data rate, both data rates are available. The 22.5 Gbps box is read-only but you can choose whether to select (and test at) 12 Gbps as well.
Aggressor Parameter	
Aggressor Device	Select the source that is being used to generate the crosstalk aggressor signal. The available options are: ▪ M8000 (only for Gen3 and M8020 setup) ▪ AWG ▪ Custom Device ▪ No Device
Common Mode Interference Parameter	
Common Mode Interference Generator	Select the source that is being used to generate the CM random interference signal. The available options are: ▪ AWG ▪ Custom Device ▪ No Device
ISI Parameter	
ISI Trace	Select the source that is being used to generate inter-symbol interference. The available options are: ▪ M8048A (only for M8020A setup) ▪ M8049A
Channel Parameters	
Channels	Here you can select the signal generator channels to be used as the Data (Victim) and Aggressor channels for 12 Gpbs and 22.5 Gbps data rates.
Test Parameters	
User Name	User name text field.

Parameter name	Description
Comment	Text field for user comments.
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 constraints of the CTS and the DUT. The parameters that are shown in the calibrations and test procedures can be modified by the user.
Rx Test Setup Procedure	Select this check box to add Rx test procedure tests. These tests are used to configure the data generator with the required Rx test setup without performing any BER measurements.

SAS Station Configuration Parameters

In the Configure DUT window, click the “Parameters” button. The “Parameters” dialog box is displayed, as shown in Figure 8.

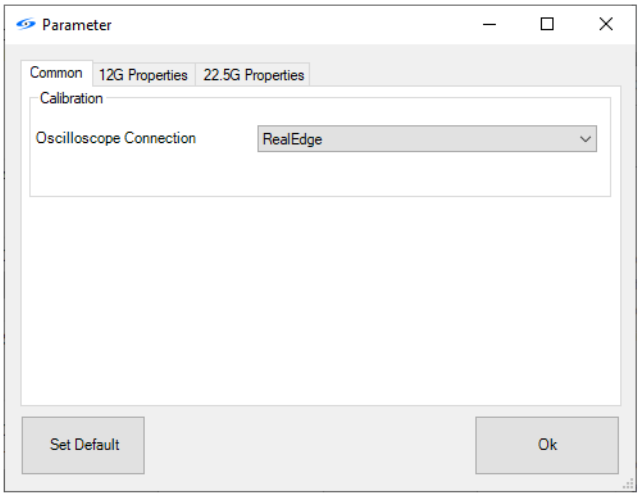


Figure 8 SAS Parameters dialog box

The parameters that appear in the various tabs of the Parameter dialog box (Figure 8, Figure 9 and Figure 10) are listed and described in Table 2.

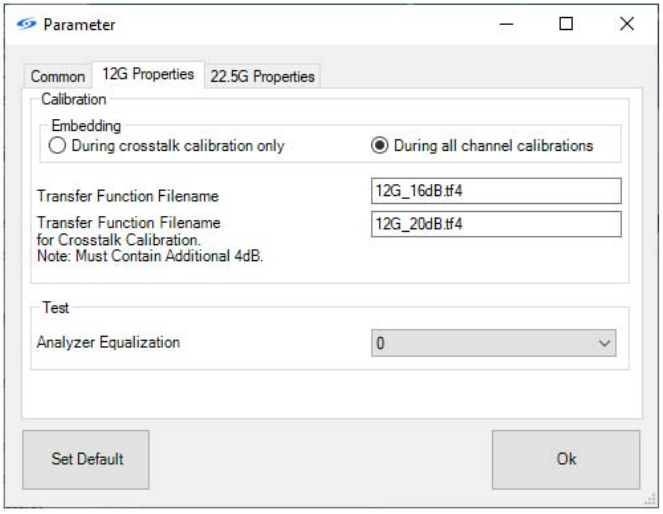


Figure 9 SAS parameter configuration tab for 12G

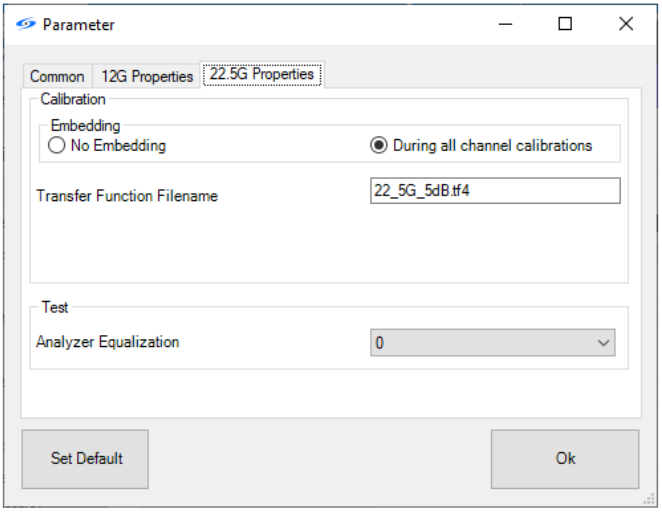


Figure 10 SAS parameter configuration tab for 22.5G

Table 2 List of SAS Station Configuration Parameters and their description

Parameter name	Description
Oscilloscope Connection	Tab: Common Select one of the options for the connection to the oscilloscope: ▪ Channel 1 3 Direct Connect ▪ Channel 2 4 Direct Connect ▪ RealEdge. Note that the available options depend on the connected oscilloscope, that is, for Z-Series oscilloscopes, only RealEdge is available; for other oscilloscope types, Channels 1&3 and 2&4 are available.
Embedding	Tab: 12G Properties. Choose between embedding being carried out during crosstalk calibration only or during all channel calibrations. Tab: 22.5G Properties. Choose between embedding being carried out not at all or during all channel calibrations.
Transfer Function Filename	Tab: 12G Properties. If embedding is to be performed during all channel calibrations, a different transfer function file must be used for the Crosstalk Calibration than for the other calibrations because the Sas3EyeOpeningScript is used for the Amplitude Calibration and ISI Calibration but not for the Crosstalk Calibration, which means that 4 dB more loss has to be embedded for the Crosstalk Calibration. Tab: 22.5G Properties. If embedding is to be performed, the transfer function filename will be displayed. The Sas3EyeOpeningScript is not used at 22.5G, which means that just one transfer function is required for all calibrations.

Analyzer Equalization	Tabs: 12G Properties and 22.5G Properties.
	For Rx tests, the signal can be equalized in the analyzer.
	▪ For M8040A, the equalizer is set to Off by default, but can be configured from 0 to 120.
	▪ For M8020A, the equalizer is set to Off by default, but can be configured to
	  ▪ –6, –9 or –12 dB for 12G Data Rate
	  ▪ low, medium or high for 22.5G Data Rate

3 Using the Software

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

Introduction

Once the DUT has been configured, click **OK** in the Configure DUT Dialog Box. All calibration and test procedures are now included in the left-hand pane of the SAS main window (Figure 11) in the respective groups in a manner similar to how they are organized in the specification.

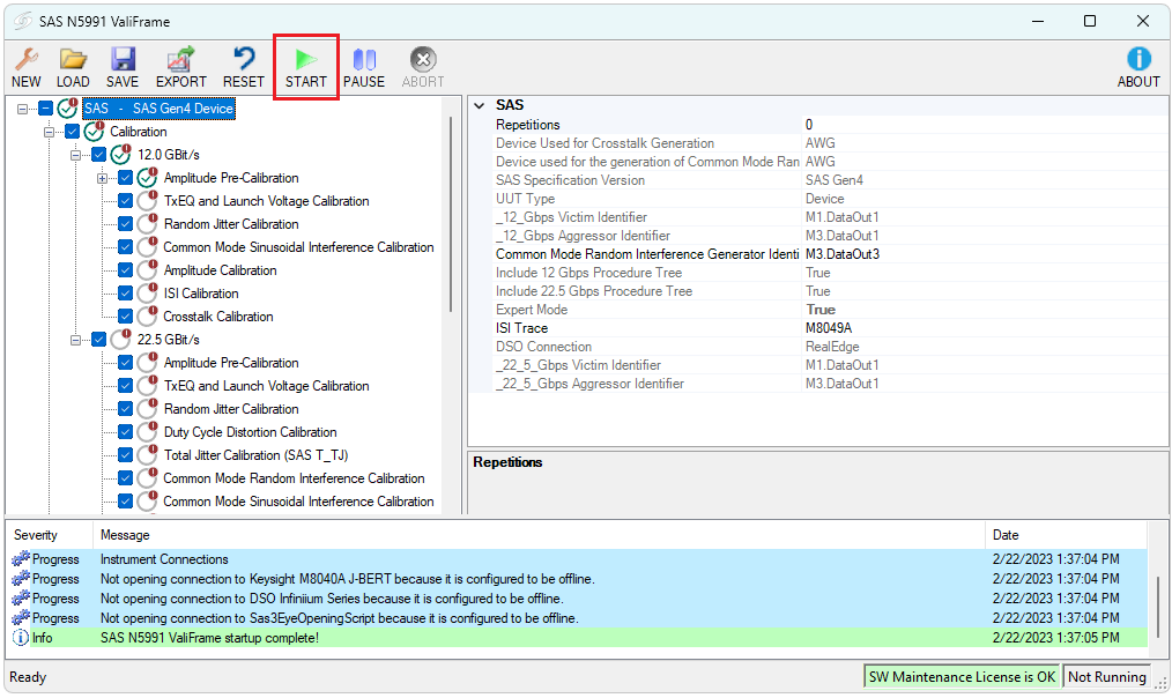


Figure 11 SAS main window

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

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).

The **status bar** at the very bottom provides information about how many warnings have been sent, the software license and if ValiFrame is running.

To start one or more procedures, select the corresponding check box(es). Then the Start button is enabled and turns green (outlined in red in Figure 11). Click **Start** to run the selected procedures.

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

NOTE

A warning message may appear when you try to use an old configuration file. This is because changes made in the transfer functions (TFs) used for embedding mean that old configuration files could potentially now be incorrect. This concerns Amplitude Calibration, ISI Calibration and Crosstalk Calibration at 12G data rate. It is recommended that you re-check the TF embedding settings after loading such a configuration.

CAUTION

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

For SAS Gen3 calibrations, in addition to the instruments, it is necessary to verify that the *Sas3EyeOpeningScript* has been installed on the oscilloscope and connected correctly.

Selecting, Modifying & Running Tests

Selecting Procedures

The calibration, Rx test setup (expert mode only), and Rx tests procedure groups can be selected globally by selecting the check box next to the group name. Alternatively, an individual test procedure can be selected by checking the corresponding check box. Click Start to run the selected test procedures.

Modifying Parameters

Most calibration and test procedures, as well as the groups containing them, have parameters that control the details of how the procedures are run. In compliance mode, most of these parameters are read-only. In expert mode, more of 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 corresponding 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 values of the test parameters are listed in the procedure results.

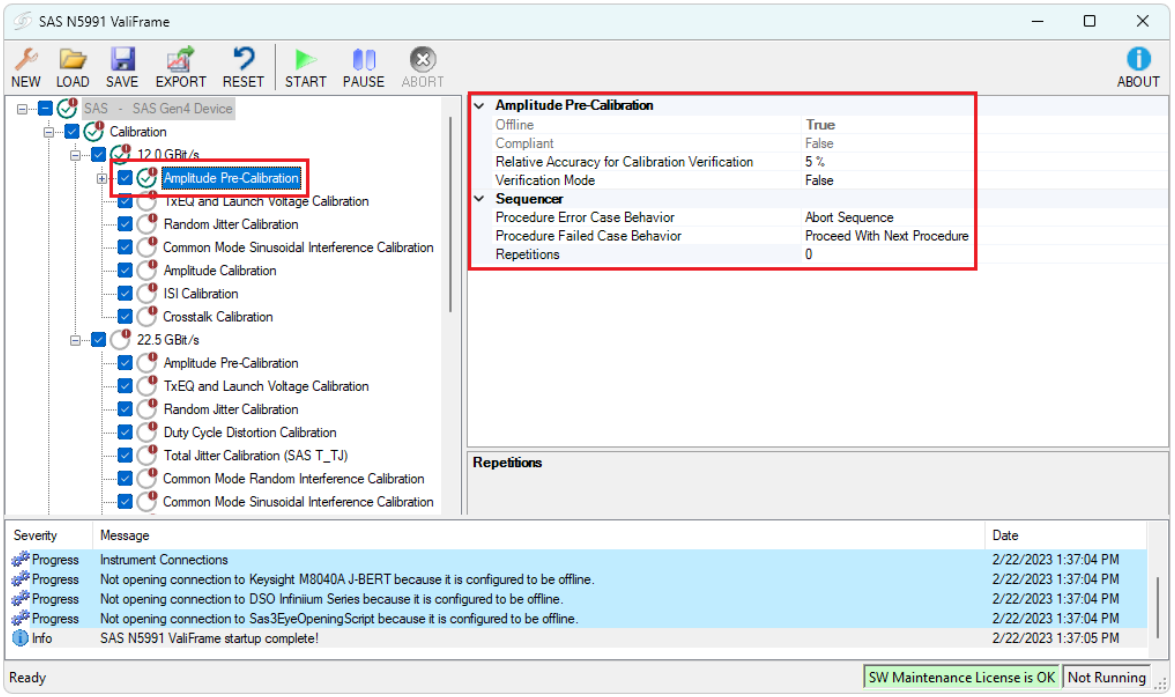


Figure 12 Modifying parameters

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 before the calibration/test procedures are run. To view the appropriate 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 results viewer window, which opens automatically for each individual procedure.

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

Exporting Results

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

NOTE

As a safety feature, all calibration and test results are saved by default to the N5991 "Tmp" directory (*C:\ProgramData\BitifEye\ValiFrameK1\Tmp*). The sub-folder "Results/SAS Station" contains the HTML files of the results measured at each calibration and test procedure.

In addition to the calibration data worksheets, calibration data files are generated, which are saved as .txt files by default to the SAS N5991 calibrations folder (*C:\ProgramData\BitifEye\ValiFrameK1\SAS\Calibrations*). 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 and saved manually in any folder before rerunning the calibrations.

SAS Parameters

The SAS parameters are of three types:

- Sequencer Parameters
- Common Parameters
- Procedure Parameters

NOTE Some parameters that are read-only in the user interface main window (names shown in gray instead of black) can be changed in the Station Configurator and others can be changed when you configure the DUT.

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

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 available only for procedures. Like all other parameters, the sequencer parameters are shown on the right side of the ValiFrame user interface, as illustrated in Figure 13, and you may manually change them.

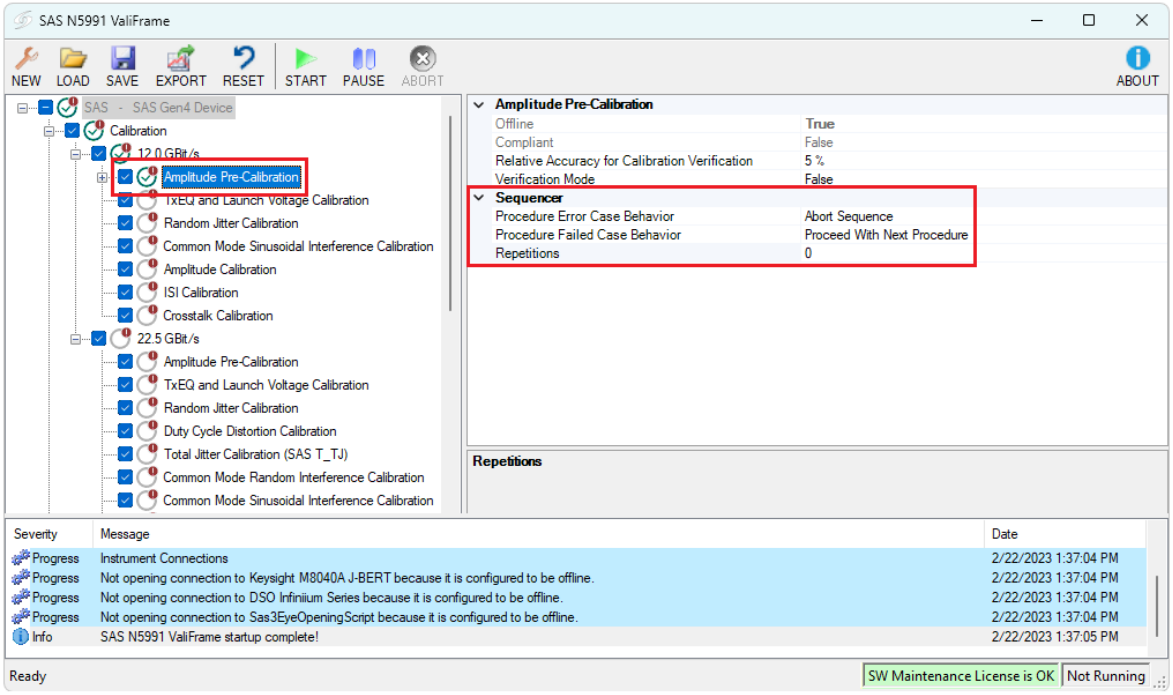


Figure 13 SAS Sequencer Parameters

All sequencer parameters are listed in alphabetical order in Table 3.

Table 3 SAS 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 of procedures is going to be repeated. If the value is '0', it runs only once.

Common Parameters

Common parameters are used for several related calibration or test procedures. They are shown on the right side of the ValiFrame user interface when the selected entry of the procedure tree on the left is a group instead of an individual procedure.

The SAS Receiver Test Software has some common parameters (in addition to “Repetitions”) on the top-level entry of the SAS tree. These are common to all ValiFrame calibration and Rx Test Setup and Rx Test procedures (see Table 4). Additionally, the data rates have some common parameters (but not for calibrations).

Table 4 SAS Common Parameters

Parameter Name	Parameter Description
Common Parameters at the Top Level	
Device Used for Crosstalk Generation	The source used to generate the crosstalk aggressor signal (read only). Select it in the Configure DUT dialog.
Device used for the generation of Common Mode Random Interference	The source used to generate the CM random interference signal (read only). Select it in the Configure DUT dialog.
SAS Specification Version	The SAS specification version used for the current set of tests (read only). Select it in the Configure DUT dialog.
UUT Type	The current UUT type: Device or Host. Select it in the Configure DUT dialog.
_12_Gbps Victim Identifier	The M8000 channel used for the victim signal at 12 Gbps (read only). Select it in the Configure DUT dialog.
_22_5_Gbps Victim Identifier	The M8000 channel used for the victim signal at 22.5 Gbps (read only). Select it in the Configure DUT dialog.
_12_Gbps Aggressor Identifier	The M8000 channel used for the aggressor signal at 12 Gbps (read only). Select it in the Configure DUT dialog.
_22_5_Gbps Aggressor Identifier	The M8000 channel used for the aggressor signal at 22.5 Gbps (read only). Select it in the Configure DUT dialog.
Common Mode Random Interference Generator Identifier	The M8000 channel used for the common mode random interference. Select it in the Configure DUT dialog.
Include 12 Gbps (22.5 Gbps) Procedure Tree	This is True if the test tree includes the procedures for 12Gbps (22.5 Gbps). For that, the 12 Gbps (22.5 Gbps) data rate option must be selected in the Configure DUT dialog.
Expert Mode	Specifies whether ValiFrame is working in Expert Mode. Select Expert or Compliance mode in the Configure DUT dialog.
ISI Trace	This allows the source used to generate inter-symbol interference to be selected. It can be selected as: ▪ M8048A ISI Channels (only for M8020A setup) ▪ M8049A ISI Channels
DSO Connection	Connection for the DSO (read only). Select it in the Configure DUT dialog.

Parameter Name	Parameter Description
Common Receiver Parameters – At Data Rate Level	
Analyzer Equalization 12 Gbps (22.5 Gbps)	Analyzer equalization used at 12 Gbps (22.5 Gbps) (read only). Select it in the Configure DUT dialog.
Redriver	
Boost	Boost value applied at the redriver, accessible in the M8070B GUI. Determine the value manually before using ValiFrame.
Eye Expander	Eye Expander value applied at the redriver, accessible in the M8070B GUI. Determine the value manually before using ValiFrame.
DC Gain	DC Gain value applied at the redriver, accessible in the M8070B GUI. Determine the value manually before using ValiFrame.
Driver Gain	Driver Gain value applied at the redriver, accessible in the M8070B GUI. Determine the value manually before using ValiFrame.
SSC	
12G (22.5G) Use SSC	Set to True to enable spread spectrum clocking (SSC).
12G (22.5G) SSC Type	Select the SSC type as Centerspread or Downspread. (Available only if Use SSC is set to True.)
12G (22.5G) SSC Pk-Pk Deviation	The SSC modulation depth in relation to the data rate. (Available only if Use SSC is set to True.)
12G (22.5G) SSC Frequency	The frequency of the SSC added to the signal. (Available only if Use SSC is set to True.)
12G (22.5G) CDR Expected Data Rate	Specifies the expected data rate that the UUT has. (Available only if Use SSC is set to True.)

Procedure Parameters

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

Table 5 shows a list of SAS Calibration parameters that are available in Expert Mode for individual calibration procedures.

Table 5 SAS Calibration Parameters

Heading or Parameter Name	Description
No Heading	
Offline	▪ If True, the test automation software is not connected to any instrument. This mode should be used for demonstrations and checks only. It is not valid for calibrations or measurements. ▪ If False, the software is connected to instruments and produces valid data. It is read-only in the parameter grid and can be altered by enabling/disabling instruments in the Instrument Configuration step of the Station Configurator. All individual procedures.
Compliant	Read-only in the parameter grid. True indicates ▪ you are working in Compliance mode, or ▪ you are working in Expert mode but none of the relevant parameters have been changed from their compliance values. (Compliance or Expert mode can be selected in the Configure DUT panel.) All the calibrations used in the procedure must also be compliant in order for the procedure to be compliant. Working offline is not compliant. All individual procedures.
Relative/Absolute Accuracy for Calibration Verification	The maximum permissible margin to pass the verification test. ▪ Amplitude Pre-Calibration ▪ TxEQ and Launch Voltage Calibration ▪ Random Jitter Calibration ▪ Duty Cycle Distortion Calibration ▪ Total Jitter Calibration ▪ Common Mode Random Interference Calibration ▪ Common Mode Sinusoidal Interference Calibration ▪ Amplitude Calibration ▪ Select Target ISI ▪ ISI Calibration ▪ Crosstalk Calibration

Heading or 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. ▪ Amplitude Pre-Calibration ▪ TxEQ and Launch Voltage Calibration ▪ Random Jitter Calibration ▪ Duty Cycle Distortion Calibration ▪ Total Jitter Calibration ▪ Common Mode Random Interference Calibration ▪ Common Mode Sinusoidal Interference Calibration ▪ Amplitude Calibration ▪ ISI Calibration ▪ Crosstalk Calibration
Measure All Generator Voltages	Only available for M8040A. Set to 'False' to speed up the TxEQ Calibration. Then only one measurement is made for each unique combination of the signs of the equalization cursors. ▪ TxEQ and Launch Voltage Calibration
Select Measurement Algorithm	Only available for M8040A. Select either 'Measure All Coefficients' or 'Speed Optimized Measurement'. ▪ TxEQ and Launch Voltage Calibration
12G/22.5G Embedding Mode	A read-only property specifying the calibrations for which the embedding mode will be used at 12/22.5 Gbps. It must be selected in the Configure DUT dialog. ▪ Amplitude Calibration ▪ ISI Calibration ▪ Crosstalk Calibration
12G/22.5G Transfer Function File on Scope for Crosstalk Calibration	A read-only property specifying the transfer function file used on the oscilloscope at 12/22.5 Gbps. It must be selected in the Configure DUT dialog. ▪ Crosstalk Calibration
Stop Voltage	In Crosstalk Calibration, the final value of voltage at which the calibration measurements should stop. Default value is 200 mV. ▪ Crosstalk Calibration
Step Size	In Crosstalk Calibration, the amount by which the voltage is increased at each step. Default value is 50 mV. ▪ Crosstalk Calibration
Generator	
TP1 Voltage	Output voltage of the generator at TP1. ▪ TxEQ and Launch Voltage Calibration
Oscilloscope	
Number of Waveform Averages	Number of waveforms that are averaged during oscilloscope acquisition. This reduces the noise floor. ▪ TxEQ and Launch Voltage Calibration

Table 6 shows a list of SAS Receiver parameters that are available in Expert Mode for individual Rx Test and Rx Test Setup procedures.

Table 6 SAS Receiver Parameters

Parameter Name	Description
No Heading	
Offline	▪ If True, the test automation software is not connected to any instrument. This mode should be used for demonstrations and checks only. It is not valid for calibrations or measurements. ▪ If False, the software is connected to instruments and produces valid data. It is read-only in the parameter grid and can be altered by enabling/disabling instruments in the Instrument Configuration step of the Station Configurator. All individual Rx Test and Rx Test Setup procedures.
Compliant	Read-only in the parameter grid. True indicates ▪ you are working in Compliance mode, or ▪ you are working in Expert mode but none of the relevant parameters have been changed from their compliance values. (Compliance or Expert mode can be selected in the Configure DUT panel.) All the calibrations used in the procedure must also be compliant in order for the procedure to be compliant. Working offline is not compliant. All individual Rx Test and Rx Test Setup procedures.
Use Analyzer Equalization	Set to True to enable the equalization on the analyzer. ▪ Compliance Test ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Use Clock Recovery	Set to True to enable the clock recovery on the analyzer. ▪ Compliance Test ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Use Calibrated Values	If set to False, the uncalibrated values are set on the instrument. ▪ Compliance Test ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Do Align Filtering	Align symbols are “filler” symbols defined in the SAS specification to align the clock. When this parameter is set to ‘True’, it enables the align filtering on the analyzer / error detector to avoid these being wrongly identified as bit errors. The analyzer will ignore incoming align symbols. ▪ Compliance Test (only 12G) ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test

Parameter Name	Description
BER Measurement	
BER Method	The BER measurement can be run either for a fixed time (FixedDuration) or until a target BER is achieved. ▪ Compliance Test (not Setup) ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Target BER	Only if BER Method is TargetBER. The target BER for the BER measurement. ▪ Compliance Test (not Setup) ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Datarate	Read only. Only visible if BER Method is TargetBER. ▪ Compliance Test (not Setup) ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Fixed Duration	The duration of the BER measurement when BER Method is FixedDuration. ▪ Compliance Test (not Setup) ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Allowed Errors	Only if BER Method is FixedDuration. The maximum allowed number of bit errors during the fixed duration BER measurement in order to still pass the test. ▪ Compliance Test (not Setup) ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Use IBERReader	Set to True to use the IBERReader for error detection. ▪ Compliance Test (not Setup) ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
IBERReader Address	Only if IBERReader is True. The IP address of the IBERReader. ▪ Compliance Test (not Setup) ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Jitter Points / CMSI Points	
Frequency Mode	Specifies the distribution of the frequency points to be tested. Select from ▪ Compliance Frequencies: The frequencies defined in the specification for compliance testing. ▪ Equally Spaced Frequencies ▪ User Defined Frequencies ▪ Single Frequency. The other parameters that are visible under the heading “Jitter Points” depend on the frequency mode chosen and apply for both the tests listed here: ▪ Jitter Tolerance Test ▪ Common Mode tolerance Test
Jitter Frequencies/Frequency	For ‘Compliance Frequencies’, ‘User Defined Frequencies’, ‘Single Frequency’. In Compliance Mode, this list is ‘read-only’. In Expert Mode the frequencies can be edited.

Parameter Name	Description
Start Frequency Value	For 'Equally Spaced Frequencies'. The minimum value of jitter frequency to be tested.
Stop Frequency Value	For 'Equally Spaced Frequencies'. The minimum value of jitter frequency to be tested.
Number of Frequency Steps	For 'Equally Spaced Frequencies'. 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.
Frequency Sweep Scale	For 'Equally Spaced Frequencies'. Choose either Linear or Logarithmic.
Start Jitter Amplitude(s)	For all frequency modes. The initial value of the SJ amplitude tested in the search algorithm.
Use Fixed Number of Steps	For all frequency modes. The range of jitter amplitudes that must be tested at each frequency starts with the defined "Start jitter amplitude" and ends with the jitter capability of the data generator. If this parameter is True, the range is divided into a fixed number of steps. If it is False, the steps are defined by the step size.
Number of Jitter Steps	For all frequency modes, but only if 'Use Fixed Number of Steps' is True. The number of jitter points used in the search algorithm.
Jitter Step Size(s) or Factor(s)	For all frequency modes, but only if 'Use Fixed Number of Steps' is False. The value by which the jitter value is increased at each step of the search algorithm.
Show Min Failed Points	For all frequency modes. If True, the result shows the first SJ amplitude that did not pass the BER test at each frequency.
Link Training Method	
Link Training Method	Two different link training methods are available: ▪ "Vendor Specific": If selected, it is the responsibility of the user to manually perform DUT training into loopback mode. ▪ "Plugin" (only M8020A): If selected, the link training process is automated using a M8020A plugin. ▪ Compliance Test ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
PreShoot	The amount of pre-shoot added to the signal. ▪ Compliance Test ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
DeEmphasis	The amount of de-emphasis added to the signal. ▪ Compliance Test ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Script Source for Link Negotiation Script	Set this property to "ValiFrameSequence" to use the default link negotiation script. To use an alternative sequence, choose the script source as "CustomFile". ▪ Compliance Test ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test
Custom script file path for Link Negotiation Script	Only if "Script Source for Link Negotiation Script" is set to "CustomFile". Use this property to select the custom Link Negotiation Script ▪ Compliance Test ▪ Jitter Tolerance Test ▪ Common Mode Tolerance Test

4 SAS Calibrations

Before any receiver test procedure can be run, the SAS receiver test setup has to be calibrated.

Calibrations Overview

The ValiFrame calibration plane is given by the DUT input ports. The receiver test signal characteristics such as the SAS 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 TTCs 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 SAS 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-configurations of the hardware connections.

Parameters in Expert Mode for Individual Calibrations

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

Details of SAS Calibration Parameters for individual procedures can be found in Table 5 on page 33.

Connection Diagrams

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

Descriptions of Calibrations

Amplitude Pre-Calibration

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

This procedure is used to calibrate the amplitude of the signal generators before the ISI channel.

The victim signal and the aggressor signal are connected through a power divider to the oscilloscope with direct SMA connection.

The victim channel sends an equalization pattern whereas the aggressor channel sends a Static Zero pattern. In the victim channel, the signal generator sets the differential voltage amplitude to 850 mV. Then the actual value of the differential voltage amplitude is measured by the oscilloscope and the amplification factor is calculated and stored.

For this calibration, no crosstalk, SSC or jitter are added to the signal.

Connection Diagram

Refer to Figure 14 or Figure 15 (at 12G) and Figure 16 (at 22.5G).

NOTE

Figure 14 shows the connection diagram when the aggressor device is selected as AWG. If M8000 is selected (only for SAS3 and M8020A), right-click the appropriate procedure in the procedure tree of the main window of the user interface and select “Show Connection...” to view the exact connection diagram.

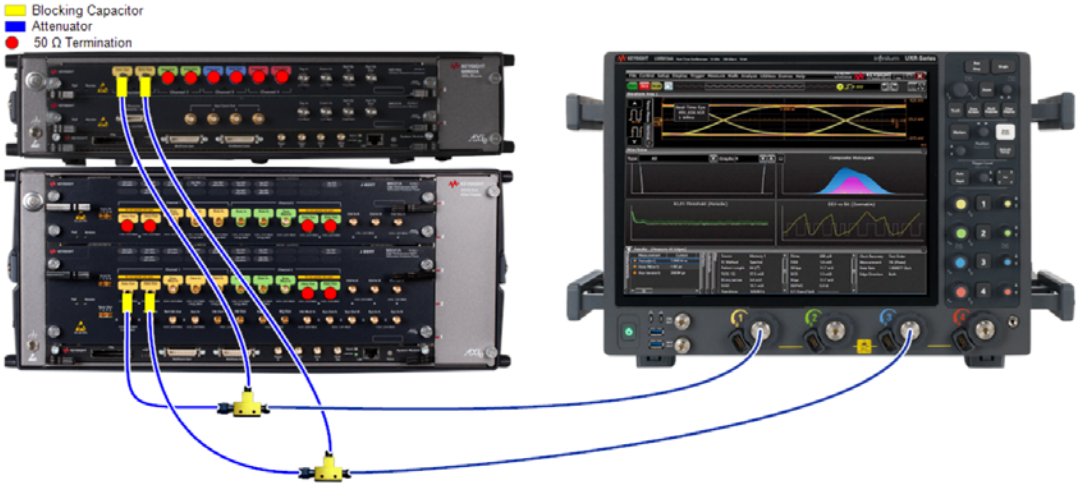


Figure 14 Example Connection Diagram for 12G calibrations without an ISI channel (M8020A; Chan 1 3 Direct Connect DSO connection)

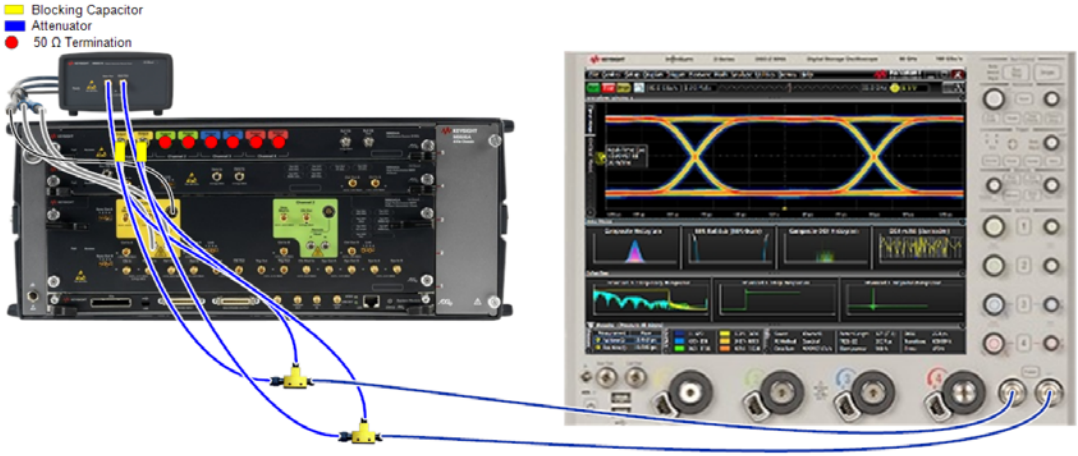


Figure 15 Example Connection Diagram for 12G calibrations without an ISI channel (M8040A; RealEdge DSO connection)

Figure 16 Connection Diagram for 22.5G calibrations (M8040A)

Result Description

SAS_225G_M1DO1_PreCal_Amp

for Gen4 _22_5_Gbps

----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Amplification Factor []
1.00

Figure 17 Example result for 22.5G Amplitude Pre-Calibration

- Amplification Factor

TxEQ and Launch Voltage Calibration

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

This procedure calibrates the De-Emphasis, Pre-Shoot and Differential Voltage amplitude at TP1, that is, before the ISI channel.

The victim signal is connected to the oscilloscope with direct SMA connection.

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

For the **M8040A setup**, the pre-cursor is swept from –0.28 to 0.02 in linear steps of 0.02. For each pre-cursor value, the post-cursor is swept from 0.28 to 0.02 in linear steps of 0.02. For each combination, the de-emphasis, pre-shoot and differential voltage are measured with the oscilloscope. The Launch Voltage is held fixed at 850 mV.

For the **M8020A setup**, the procedure is very similar but the sweep is not performed over the pre-cursor and post-cursor values. Here, the sweep is performed directly for the de-emphasis (from –6 dB to 0 dB) and pre-shoot (from 6 dB to 0 dB).

As a result, three calibration data tables are generated.

For this calibration, no jitter sources are added to the signal.

Prerequisite Calibration

- Amplitude Pre-Calibration on page 42

Connection Diagram

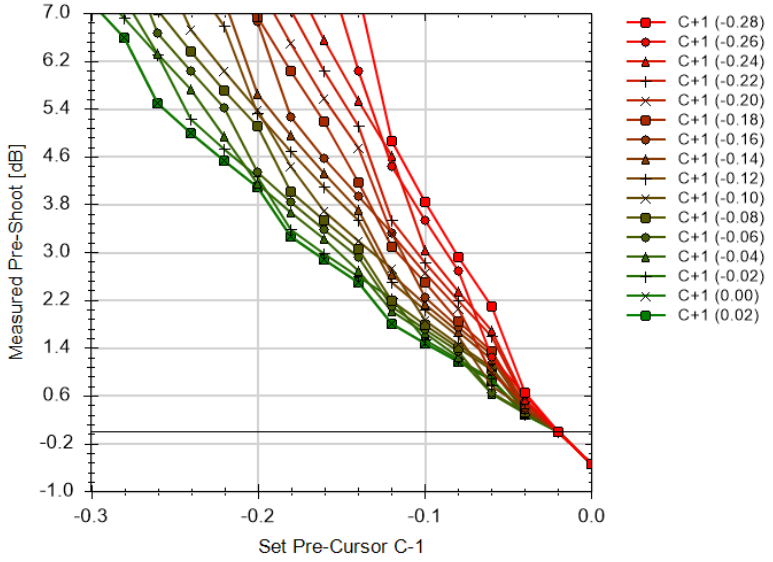
Refer to Figure 14 or Figure 15 on page 43 (at 12G) and Figure 16 on page 44 (at 22.5G).

Result Description

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

SAS_225G_M1DO1_Cal_PsDe_Ps

for Gen4 _22_5_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Measure all Generator voltages	False
Select Measurement Algorithm	Measure All Coefficients
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument
----Oscilloscope----	
Number of Waveform Averages	256
----Generator----	
Set Amplitude	800 mV
TP1 Voltage	850 mV

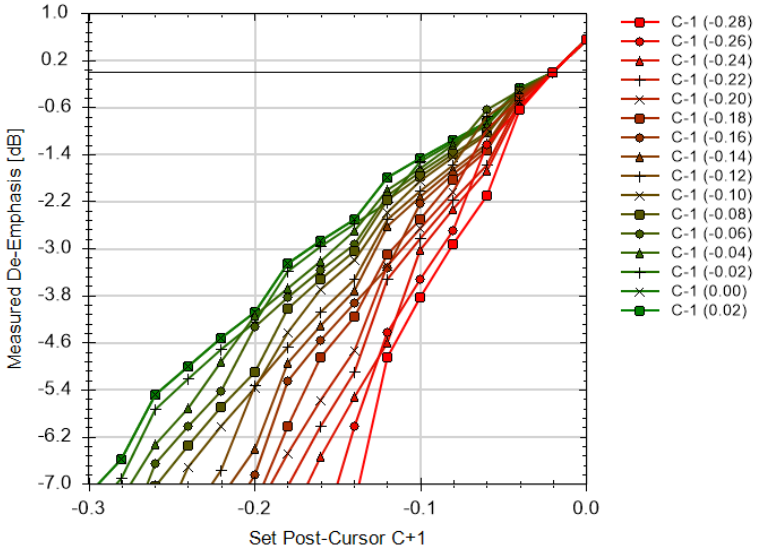
Set Pre-Cursor C-1 []	C+1 (-0.28) [dB]	C+1 (-0.26) [dB]	C+1 (-0.24) [dB]	C+1 (-0.22) [dB]	C+1 (-0.20) [dB]	C+1 (-0.18) [dB]	C+1 (-0.16) [dB]	C+1 (-0.14) [dB]	C+1 (-0.12) [dB]	C+1 (-0.10) [dB]	C+1 (-0.08) [dB]	C+1 (-0.06) [dB]	C+1 (-0.04) [dB]	C+1 (-0.02) [dB]	C+1 (0.00) [dB]	C+1 (0.02) [dB]
-0.28	N/A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

Figure 18 Example result for 22.5G Tx EQ and Launch Voltage Calibration – Pre-Shoot (M8040A)

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

SAS_225G_M1DO1_Cal_PsDe_DeEmp

for Gen4 _22_5_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Measure all Generator voltages	False
Select Measurement Algorithm	Measure All Coefficients
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument
----Oscilloscope----	
Number of Waveform Averages	256
----Generator----	
Set Amplitude	800 mV
TP1 Voltage	850 mV

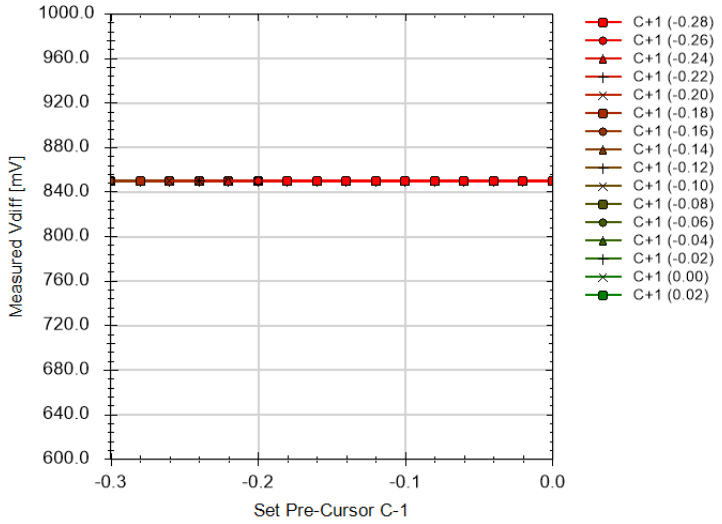
Set Post-Cursor C+1 []	C-1 (-0.28) [dB]	C-1 (-0.26) [dB]	C-1 (-0.24) [dB]	C-1 (-0.22) [dB]	C-1 (-0.20) [dB]	C-1 (-0.18) [dB]	C-1 (-0.16) [dB]	C-1 (-0.14) [dB]	C-1 (-0.12) [dB]	C-1 (-0.10) [dB]	C-1 (-0.08) [dB]	C-1 (-0.06) [dB]	C-1 (-0.04) [dB]	C-1 (-0.02) [dB]	C-1 (0.00) [dB]	C-1 (0.02) [dB]
-0.28	N/A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

Figure 19 Example result for 22.5G Tx EQ and Launch Voltage Calibration – De-Emphasis (M8040A)

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

SAS_225G_M1DO1_Cal_PsDe_Vdiff

for Gen4 _22_5_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Measure all Generator voltages	False
Select Measurement Algorithm	Measure All Coefficients
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument
----Oscilloscope----	
Number of Waveform Averages	256
----Generator----	
Set Amplitude	800 mV
TP1 Voltage	850 mV

Set Pre-Cursor C-1 []	C+1 (-0.28) [mV]	C+1 (-0.26) [mV]	C+1 (-0.24) [mV]	C+1 (-0.22) [mV]	C+1 (-0.20) [mV]	C+1 (-0.18) [mV]	C+1 (-0.16) [mV]	C+1 (-0.14) [mV]	C+1 (-0.12) [mV]	C+1 (-0.10) [mV]	C+1 (-0.08) [mV]	C+1 (-0.06) [mV]	C+1 (-0.04) [mV]	C+1 (-0.02) [mV]	C+1 (0.00) [mV]	C+1 (0.02) [mV]
-0.28	N/A	N/A	N/A	N/A	N/A	N/A	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.26	N/A	N/A	N/A	N/A	N/A	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.24	N/A	N/A	N/A	N/A	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.22	N/A	N/A	N/A	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.20	N/A	N/A	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.18	N/A	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.16	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.14	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.12	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.10	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.08	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.06	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.04	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
-0.02	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
0.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00
0.02	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00	850.00

Figure 20 Example result for 22.5G Tx EQ and Launch Voltage Calibration – Differential Voltage (M8040A)

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

Random Jitter Calibration

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

In the 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 has to be calibrated.

The victim signal and the aggressor signal are connected through a power divider to the oscilloscope with direct SMA connection.

The victim channel sends a PRBS15 pattern (22.5G data rate) or CLK/4 pattern (12G data rate) whereas the aggressor channel sends a Static Zero pattern. In the victim channel, the signal generator performs a sweep of the random jitter amplitude from 28 mUI to 238 mUI. For each step, the actual random jitter amplitude is measured with the oscilloscope using the RJ/DJ-separation software EZJIT; thereafter, the set and measured values are stored.

For this calibration, no crosstalk, SSC or sinusoidal jitter are added to the signal.

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42
- TxEQ and Launch Voltage Calibration on page 46

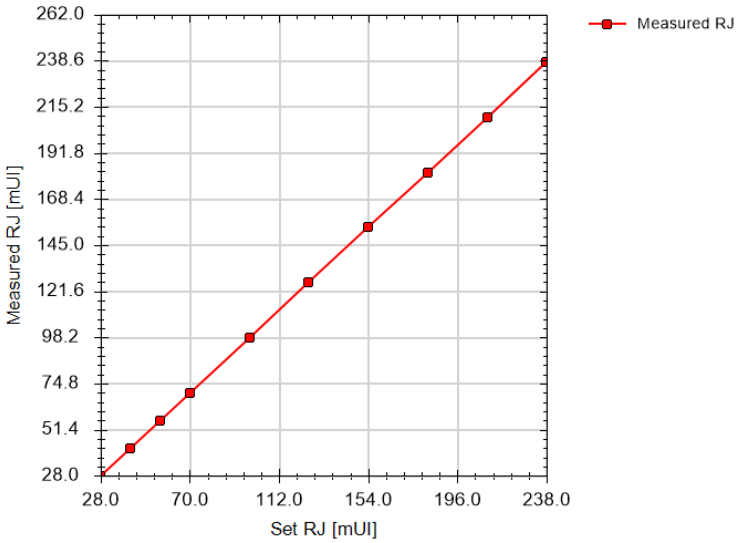
Connection Diagram

Refer to Figure 14 or Figure 15 on page 43 (at 12G) and Figure 16 on page 44 (at 22.5G).

Result Description

SAS_225G_M1DO1_Cal_RJ

for Gen4 _22_5_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set RJ [mUI]	Measured RJ [mUI]
28	28
42	42
56	56
70	70
98	98
126	126
154	154
182	182
210	210
238	238

Figure 21 Example result for 22.5G Random Jitter Calibration

- Set RJ [mUI]: The jitter amplitude set on the generator.
- Measured RJ [mUI]: The values of RJ measured at the oscilloscope when “Set RJ” values are applied.

Duty Cycle Distortion Calibration

Availability

Spec version:	SAS4
Data Generator:	M8040A
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	22.5G

Purpose and Method

This procedure is used to calibrate the duty cycle distortion of the signal generator.

The victim signal is connected to the oscilloscope with direct SMA connection.

The data generator sends a CLK/2 pattern and performs a sweep of the duty cycle distortion from 0.5 ps to 3 ps with a step size of 0.5 ps. At each step, the actual duty cycle distortion is measured with the oscilloscope using the RJ/DJ-separation software EZJIT; thereafter, the set and measured values are stored.

For this calibration, neither SSC nor jitter sources are added to the signal.

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42

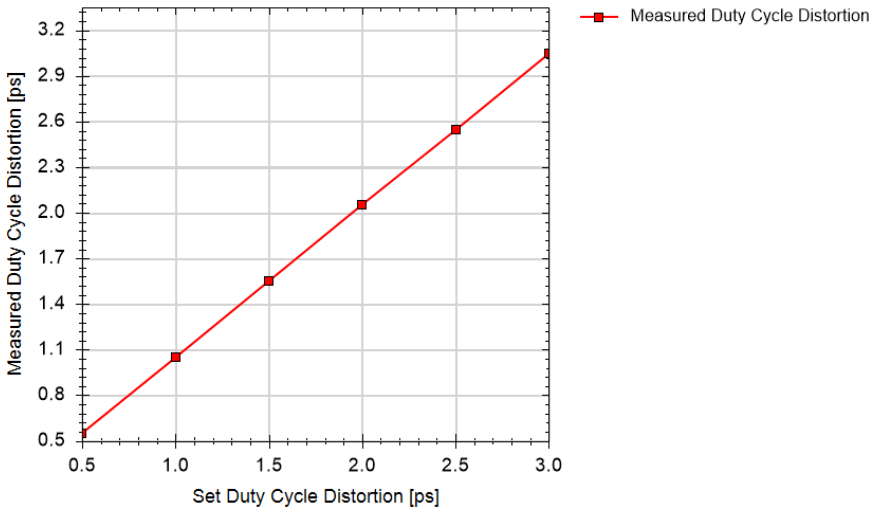
Connection Diagram

Refer to Figure 16 on page 44.

Result Description

SAS_225G_M1DO1_Cal_DCD

for Gen4 _22_5_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set Duty Cycle Distortion [ps]	Measured Duty Cycle Distortion [ps]
0.50	0.50
1.00	1.00
1.50	1.50
2.00	2.00
2.50	2.50
3.00	3.00

Figure 22 Example result for Duty Cycle Distortion Calibration

- Set Duty Cycle Distortion [ps]: The duty cycle value set on the instrument.
- Measured Duty Cycle Distortion [ps]: The values of duty cycle distortion measured at the oscilloscope when the “Set Duty Cycle Distortion” values are applied.

Total Jitter Calibration

Availability

Spec version:	SAS4
Data Generator:	M8040A
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	22.5G

Purpose and Method

This procedure is used to calibrate the jitter sources so the total jitter budget is met.

The victim signal is connected to the oscilloscope with direct SMA connection.

The data generator sends a PRBS15 pattern and performs a sweep of the duty cycle distortion from 0.5 ps to 1.7 ps with a step size of 0.4 ps. The other impairments are set to the nominal specification values:

- The differential voltage is set to 850 mV;
- The random jitter is set to 150 mUI;
- The sinusoidal jitter is set to 100 mUI.

At each step, the total jitter amplitude is measured with the oscilloscope using the RJ/DJ-separation software EZJIT and the resulting values are stored.

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42
- TxEQ and Launch Voltage Calibration on page 46
- Random Jitter Calibration on page 53
- Duty Cycle Distortion Calibration on page 56

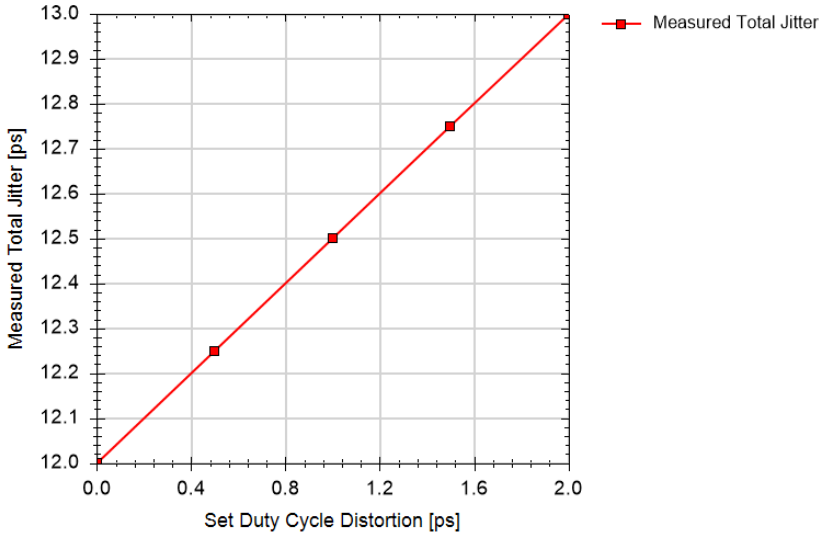
Connection Diagram

Refer to Figure 16 on page 44.

Result Description

SAS_225G_M1DO1_Cal_TJ

for Gen4 _22_5_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set Duty Cycle Distortion [ps]	Measured Total Jitter [ps]
0.00	12.00
0.50	12.25
1.00	12.50
1.50	12.75
2.00	13.00

Figure 23 Example result for Total Jitter Calibration

- Set Duty Cycle Distortion [ps]: The calibrated duty cycle distortion value set without an ISI channel.
- Measured Total Jitter [ps]: The values of total jitter amplitude measured at the oscilloscope when the “Set Duty Cycle Distortion” values are applied.

Common Mode Random Interference Calibration

Availability

Spec version:	SAS4
Data Generator:	M8040A
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	22.5G

Purpose and Method

This procedure is used to calibrate the Common Mode Random Interference amplitude of the setup.

The data and the common mode interference channels are connected through a power divider to the oscilloscope with direct SMA connection.

The victim channel sends the Static Zero pattern. The AWG does a sweep of the common mode random interference amplitude from 100 mV to 900 mV. For each step, the actual CMRI amplitude is measured with the oscilloscope; the set and measured values are stored.

For this calibration, no crosstalk, SSC or sinusoidal jitter are added to the signal.

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42

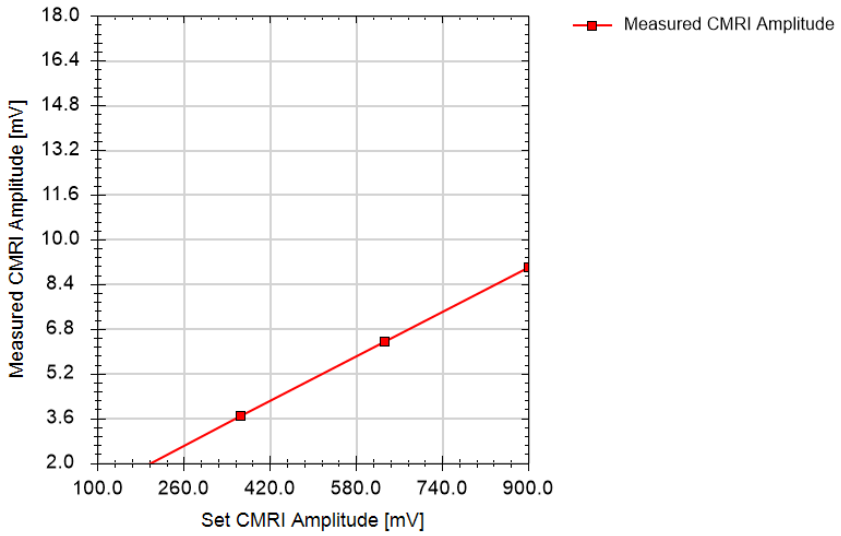
Connection Diagram

Refer to Figure 16 on page 44.

Result Description

SAS_225G_M1DO1_Cal_CMRI

for Gen4 _22_5_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set CMRI Amplitude [mV]	Measured CMRI Amplitude [mV]
100	1
367	4
633	6
900	9

Figure 24 Example result for Common Mode Random Interference Calibration

- Set CMRI Amplitude [mV]: The CMRI amplitude set on the instrument.
- Measured CMRI Amplitude [mV]: The value of CMRI measured at the oscilloscope while applying the “Set CMRI Amplitude”.

Common Mode Sinusoidal Interference Calibration

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

This procedure is used to calibrate the Common Mode Sinusoidal Interference amplitude of the setup.

The data and the common mode interference channels are connected through a power divider to the oscilloscope with direct SMA connection.

The victim channel sends the Static Zero pattern. The AWG does a sweep of the common mode sinusoidal interference amplitude from 300 mV to 900 mV. For each step, the actual CMSI amplitude is measured at different frequencies with the oscilloscope; then the set and measured values are stored.

For this calibration, no crosstalk, SSC and random jitter are added to the signal.

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42
- TxEQ and Launch Voltage Calibration on page 46

Connection Diagram

Refer to Figure 25 or Figure 26 on page 66 (at 12G) and Figure 16 on page 44 (at 22.5G).

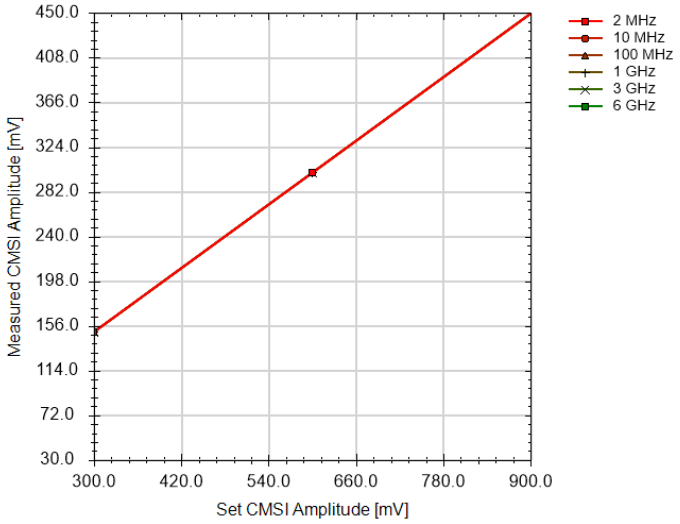
Figure 25 Connection Diagram for 12G CMSI Calibration (M8020A)

Figure 26 Connection Diagram for 12G CMSI Calibration (M8040A)

Result Description

SAS_12G_M1DO1_Cal_CMSI

for Gen4 _12_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set CMSI Amplitude [mV]	2 MHz [mV]	10 MHz [mV]	100 MHz [mV]	1 GHz [mV]	3 GHz [mV]	6 GHz [mV]
300.00	150.00	150.00	150.00	150.00	150.00	150.00
600.00	300.00	300.00	300.00	300.00	300.00	300.00
900.00	450.00	450.00	450.00	450.00	450.00	450.00

Figure 27 Result for 12G Common Mode Sinusoidal Interference Calibration

- Set CMSI Amplitude [mV]: The CMSI amplitude set on the instrument.

- x MHz [mV]: The values in this column are the measured values of CMSI in mV when the “Set CMSI Amplitude” is applied at the frequency x in MHz or GHz as noted.

Amplitude Calibration

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A, M8020A
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	12G

Purpose and Method

This procedure is used to calibrate the differential voltage amplitude after the ISI channel.

The ISI channel is connected to the oscilloscope with direct SMA connection.

The victim channel sends an Idle pattern whereas the aggressor channel sends a Static Zero pattern. In the victim channel, the signal generator performs a sweep of the differential voltage amplitude from 800 mV to 900 mV using the Amplitude Pre-Calibration. At each step, the actual voltage amplitude is measured with the oscilloscope and then the set and measured values are stored. For this measurement, the oscilloscope uses a MATLAB script (the eye opening script).

All jitter sources and SSC are activated but set to zero amplitude / deviation. Crosstalk impairments are disabled (set to Off).

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42

Connection Diagram

Refer to Figure 28 or Figure 29 on page 70.

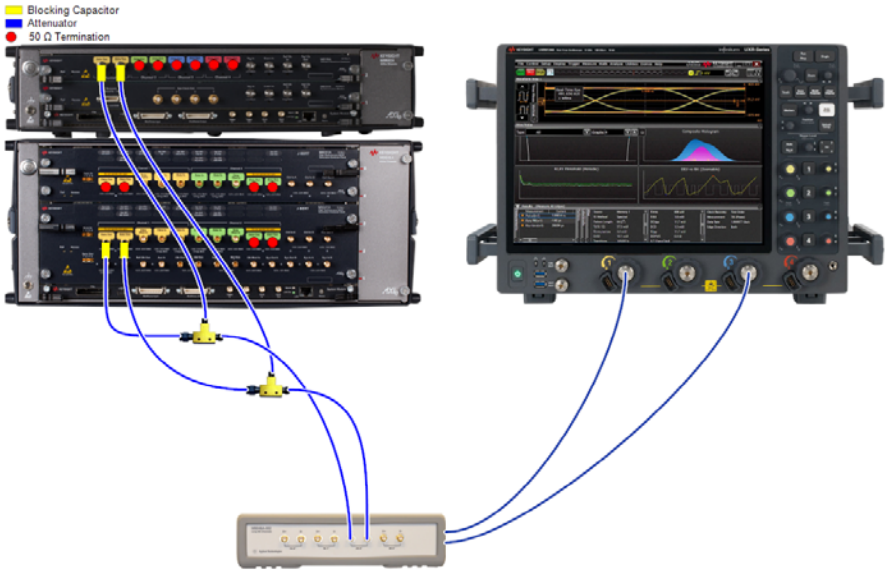


Figure 28 Connection Diagram for 12G calibrations with an ISI channel (M8020A)

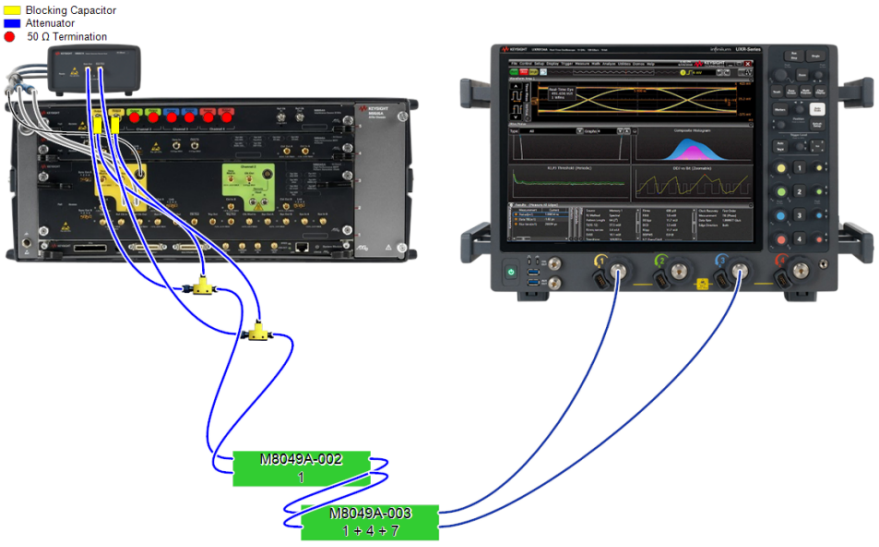
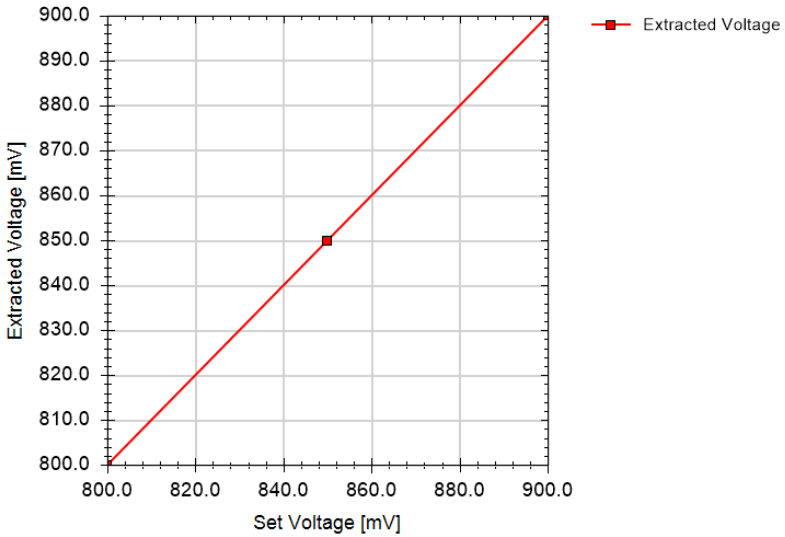


Figure 29 Connection Diagram for 12G calibrations with an ISI channel (M8040A)

Result Description

SAS_12G_D_M1DO1_Cal_Amp

for Gen4 _12_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
ISI Trace	M8049A
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set Voltage [mV]	Extracted Voltage [mV]
800	800
850	850
900	900

Figure 30 Example result for Amplitude Calibration

- Set Voltage [mV]: The voltage amplitude set before the ISI channel using the Amplitude Pre-Calibration.
- Extracted Voltage [mV]: The differential voltage measured at the oscilloscope, after the ISI channel, when the “Set Voltage” value is applied.

Select Target ISI

Availability

Spec version:	SAS4
Data Generator:	M8040A, M8020A
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	22.5G

Purpose and Method

This procedure is used to select the target ISI value to be used in the ISI Calibration at 22.5G on page 81 at the 22.5G data rate.

When you run this procedure, a dialog box opens where you can insert the required value of the target ISI. The results simply record the selected value, the setup configuration and the instruments used.

Prerequisite Calibrations

None

Connection Diagram

None

Result Description

SAS_225G_D_M1DO1_Cal_TargetIsi

for Gen4 _22_5_Gbps

----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

TargetISI [dB]
-20.0

Figure 31 Example result for Select Target ISI

- Target ISI [dB]: Value of the selected target ISI.

ISI Calibration at 12G

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A, M8020A
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	12G

Purpose and Method

This procedure is used to calibrate the Inter-Symbol Interference amplitude of the setup.

The victim channel sends an Idle pattern whereas the aggressor channel sends a Static Zero pattern. In the victim channel, a sweep of the ISI value is performed. At each step, a MATLAB script (the eye opening script) is run on the oscilloscope, which returns the Reference Cursor, Maximum DFE and the Vertical Eye Opening as results. These resulting values along with the set ISI values are stored in three separate calibration tables.

For the **M8040A** generator, the ISI is set externally with the M8049A ISI board. Each step requires the trace number in the connection setup to be changed manually.

For the **M8020A**, the ISI is set internally and the sweep is performed automatically from -3.5 dB to -0.50 dB.

For this calibration, the differential amplitude is set to 850 mV by using the Amplitude Calibration. All jitter sources and SSC are activated but set to zero amplitude / deviation. Crosstalk impairments are disabled (set to Off).

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42
- TxEQ and Launch Voltage Calibration on page 46
- Amplitude Calibration on page 69 (only for 12G)

Connection Diagram

Refer to Figure 28 or Figure 29 on page 70.

NOTE The numbers of the traces to be used are given in the Connection Setup window, which either pops up when you click Start to begin the run or opens when you (i) right-click the name of the procedure in the procedure tree and then (ii) click “Show Connection...”.

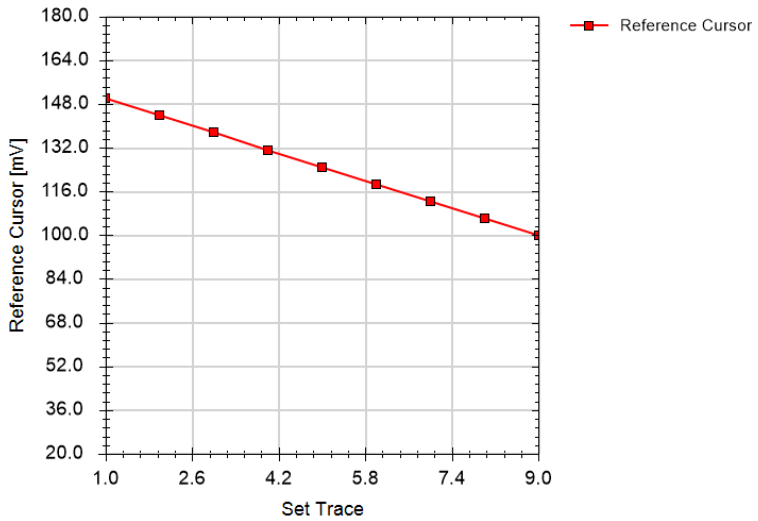
Result Description

The Reference Cursor, Vertical Eye Opening and Maximum DFE are reported separately.

Reference Cursor

SAS_12G_D_M1DO1_Cal_ExIsi_RC

for Gen4 _12_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
ISI Trace	M8049A
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument

Victim Channel

M1.DataOut1

Keysight DSO

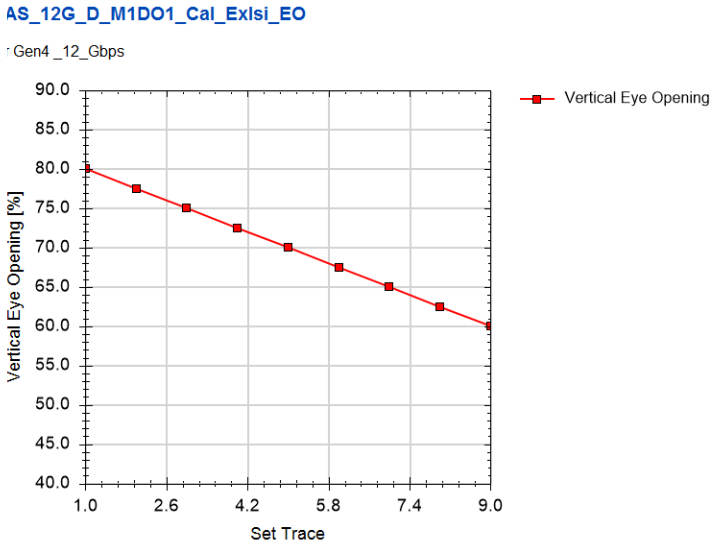
Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set Trace []	Reference Cursor [mV]
9.00	100.00
8.00	106.25
7.00	112.50
6.00	118.75
5.00	125.00
4.00	131.25
3.00	137.50
2.00	143.75
1.00	150.00

Figure 32 Example result for 12G ISI Calibration – Reference Cursor (M8040A)

- Set ISI [dB]: (M8020A) The internal ISI set at the data generator.
- Set Trace: (M8040A) The number of the trace used.
- Reference Cursor [mV]: The value of the Reference Cursor when the “Set ISI” value (M8020A) or the “Set Trace” value (M8040A) is applied.

Vertical Eye Opening



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
ISI Trace	M8049A
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set Trace []	Vertical Eye Opening [%]
9.00	60.00
8.00	62.50
7.00	65.00
6.00	67.50
5.00	70.00
4.00	72.50
3.00	75.00
2.00	77.50
1.00	80.00

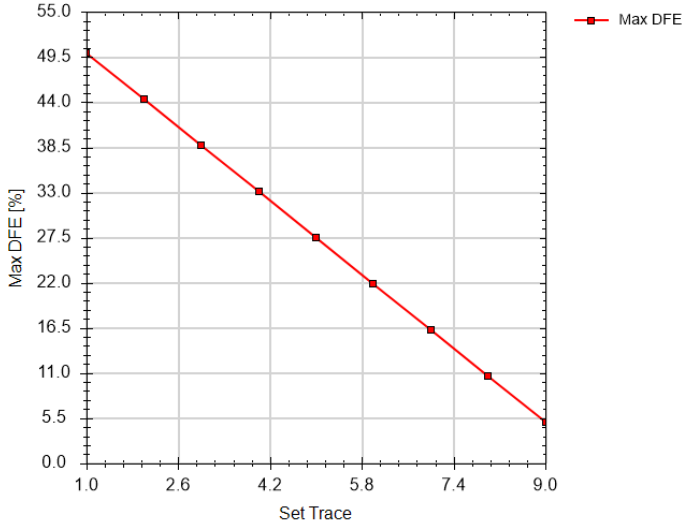
Figure 33 Example Result for 12G ISI Calibration – Vertical Eye Opening

- Set ISI [dB]: (M8020A) The internal ISI set at the data generator.
- Set Trace: (M8040A) The number of the trace used.
- Vertical Eye Opening [%]: The Vertical Eye Opening value in % measured when applying the “Set ISI” (M8020A) or “Set Trace” (M8040A) value.

Maximum DFE

SAS_12G_D_M1DO1_Cal_ExIsi_MD

for Gen4 _12_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
ISI Trace	M8049A
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument

Set Trace []	Max DFE [%]
9.00	5.00
8.00	10.63
7.00	16.25
6.00	21.88
5.00	27.50
4.00	33.13
3.00	38.75
2.00	44.38
1.00	50.00

Figure 34 Example result for 12G ISI Calibration – Max DFE

- Set ISI [dB]: (M8020A) The internal ISI set at the data generator.
- Set Trace: (M8040A) The number of the trace used.
- Max DFE [%]: This is the maximum DFE value in % measured while applying the “Set ISI” (M8020A) or “Set Trace” (M8040A) value.

ISI Calibration at 22.5G

Availability

Spec version:	SAS4
Data Generator:	M8040A
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	22.5G

Purpose and Method

This procedure is used to calibrate the channel to meet the loss requirements.

The victim signal is connected to the oscilloscope with direct SMA connection.

The pattern generator sends a step pattern.

The ISI is added with the M8049A ISI channel board. In the first step, the trace number is set to 1 and the insertion loss is measured with the oscilloscope and the resulting values are stored. Then, the trace number is incremented and the process is repeated until the target loss is reached or until the maximum trace number is measured. The target loss is the value selected in Select Target ISI on page 73.

For this calibration, no other jitter sources are added to the signal.

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42
- TxEQ and Launch Voltage Calibration on page 46
- Select Target ISI on page 73

Connection Diagram

Refer to Figure 16 on page 44.

Note that the required trace number of the ISI board will be changed during the calibration. See Purpose and Method.

The setup may differ depending on the selections made in the Configure DUT panel. After configuring the DUT, right-click the name of the procedure in the main window and select “Show Connection...” to display the exact setup.

Result Description

SAS_225G_D_M1DO1_Cal_ExIsi_FFT

for Gen4 _22_5_Gbps

----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
ISI Trace	M8049A
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument
Target Channel Loss	-20
Custom Channel Name	Combination 2

Trace Number []	Measured Insertion Loss [dB]
1	-18.00
2	-19.00
3	-20.00

Figure 35 Example result for ISI Calibration at 22.5G with target ISI selected as –20 dB

- Trace Number: The number of the trace used on the ISI board.
- Measured Insertion Loss (dB): The value of insertion loss measured using the oscilloscope.

Crosstalk Calibration

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

This procedure is used to calibrate the crosstalk of the aggressor channel.

The victim signal and the aggressor signal are connected through a power divider to the ISI channel. Then the ISI channel is connected to the oscilloscope with direct SMA connection.

The victim channel sends a Static Zero pattern whereas the aggressor channel sends a PRBS23 pattern. In the aggressor channel, the signal generator performs a sweep of the differential voltage amplitude from 0 V to 200 mV at 12G data rate and from 0 V to 60 mV at 22.5G data rate. For each step, the actual voltage amplitude is measured with the oscilloscope. The set and measured values are stored.

For this calibration, neither SSC nor jitter are added to the signal.

Prerequisite Calibrations

- Amplitude Pre-Calibration on page 42
- TxEQ and Launch Voltage Calibration on page 46
- Amplitude Calibration on page 69 (only 12G)
- ISI Calibration at 12G on page 75 and/or
  ISI Calibration at 22.5G on page 81

Connection Diagram

Refer to Figure 28 or Figure 29 on page 70 (at 12G) and Figure 36 on page 84 (at 22.5G).

NOTE

The numbers of the traces to be used are given in the Connection Setup window, which either pops up when you click Start to begin the run or opens when you (i) right-click the name of the procedure in the procedure tree and then (ii) click “Show Connection...”.

At 22.5G, the connection diagram will be similar to that in Figure 36, but the required trace number of the ISI board will be the one that is the target channel according to the ISI Calibration at 22.5G on page 81.

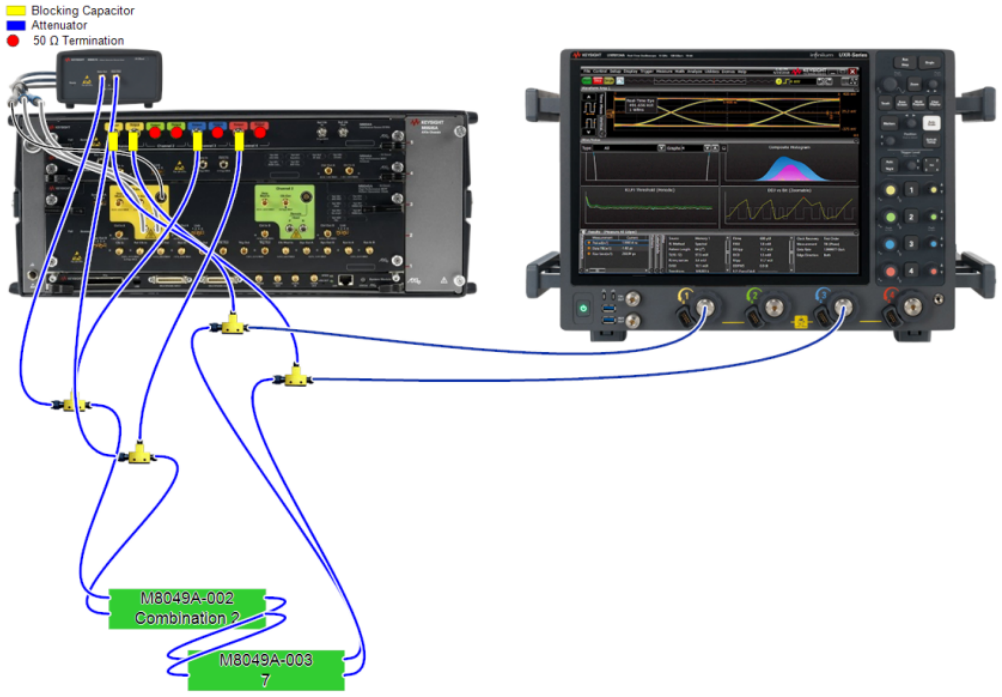
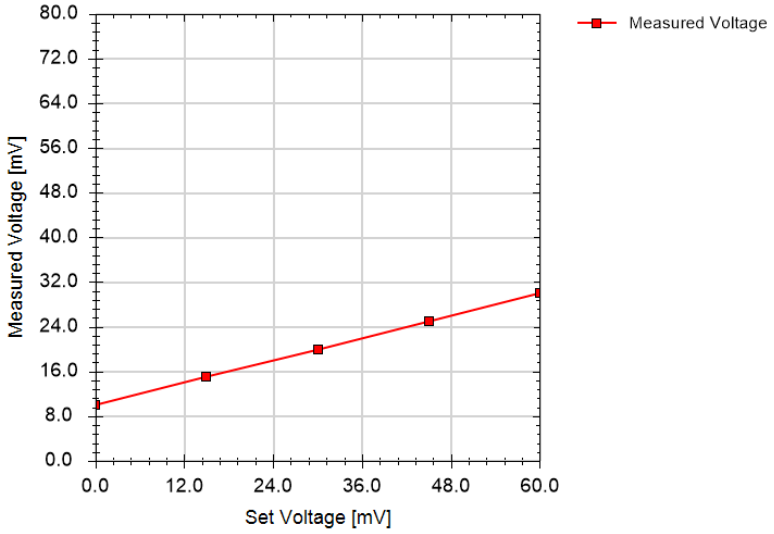


Figure 36 Example Connection Diagram for Crosstalk Calibration at 22.5G (M8040A)

Result Description

SAS_225G_D_M1DO1_Cal_Crosstalk

for Gen4 _22_5_Gbps



----General----	
Offline	True
Compliant	False
Relative Accuracy for Calibration Verification	5 %
Verification Mode	False
Device Used for Crosstalk Generation	AWG
Device used for the generation of Common Mode Random Interference	AWG
Common Mode Random Interference Generator Identifier	M3.DataOut3
ISI Trace	M8049A
DSO Connection	Chan_1_3_Direct_Connect
Keysight M8040A J-BERT	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Model: Keysight M8040A J-BERT ; SN: Unknown ; FW rev.: Unknown ; Description: M8040 with integrated jitter sources for BER tests ; Calibrated Instrument
Victim Channel	M1.DataOut1
Keysight DSO	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Digital Storage Oscilloscope for data analysis ; Measurement Instrument
Intersymbol Interference	2
Target Channel Loss	-20

Set Voltage [mV]	Measured Voltage [mV]
0	10
15	15
30	20
45	25
60	30

Figure 37 Result for 22.5G Crosstalk Calibration

- Set Voltage (mV): The voltage set at the generator output in the aggressor channel.
- Measured Voltage (mV): The voltage amplitude in the victim channel measured at the oscilloscope.

5 Receiver Test Setup Procedures

Receiver Setup Procedures can be used to set up the data generator as for a Receiver Compliance Test but without doing a BER test.

Rx Test Setup Procedures Overview

Receiver Test Setup Procedures can be run in either Compliance Mode or Expert Mode but only if “Rx Test Setup Procedure” is checked in the Configure DUT panel. See Figure 7 on page 18 and Table 1.

SAS Common Receiver Test Setup Parameters

The SAS Common Parameters are listed in the parameter grid (right pane) of the main window of the user interface when you click the corresponding group in the procedure tree in the left half of the main window. SAS Common Rx Test Setup Parameters exist only for data rates. When you select a Rx test setup data rate, the corresponding common parameters are listed.

Details of SAS Common Receiver Test Setup Parameters can be found in Table 4 on page 31.

Parameters in Expert Mode for Individual Tests

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

Details of SAS Receiver Test Setup Parameters for individual procedures can be found in Table 6 on page 35.

Connection Diagrams

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

Description of Rx Test Setup Procedure

Compliance Test

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

The purpose of this procedure is to configure the data generator with the parameters needed in the Rx Compliance test, using the calibration data saved on the PC where the N5991 software is running.

The method initiates in the same manner as the Rx Compliance Test but it does not proceed any further after the setup has been prepared.

Prerequisite Calibrations

- TxEQ and Launch Voltage Calibration on page 46
- Random Jitter Calibration on page 53
- Duty Cycle Distortion Calibration on page 56 (for 22.5G)
- Total Jitter Calibration on page 59 (for 22.5G)
- Amplitude Calibration on page 69 (for 12G)
- ISI Calibration at 12G on page 75 and/or ISI Calibration at 22.5G on page 81
- Crosstalk Calibration on page 83

Connection Diagram

Refer to Figure 39 on page 96 or Figure 40 on page 97 (for 12G) and Figure 41 on page 97 (for 25.5G).

Result Description

None

6 SAS Receiver Tests

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

Receiver Tests Overview

The basic principle of all SAS receiver tests is:

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

Most of the Rx tests 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 calibration data is missing, a warning message pops up. If you explicitly ignore the warning messages, you can run tests without calibration data.

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

SAS Common Receiver Parameters

The SAS Common Rx Parameters are listed in the parameter grid (right half) of the main window of the user interface when you click the corresponding group in the procedure tree in the left half of the main window. SAS Common Rx Parameters exist only for data rates. When you select a Rx test data rate, the corresponding common parameters are listed on the right side.

Details of SAS Common Receiver Parameters can be found in Table 4 on page 31.

Parameters in Expert Mode for Individual Tests

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

Details of SAS Receiver Parameters for individual procedures can be found in Table 6 on page 35.

Connection Diagrams

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

Redrivers

NOTE

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

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

The redriver for the BERT error detector is optional. If an M8047 Redriver is connected, it will be automatically detected by the ValiFrame software and included in the Connection Diagrams for the individual procedures where necessary. Figure 38 shows an example.

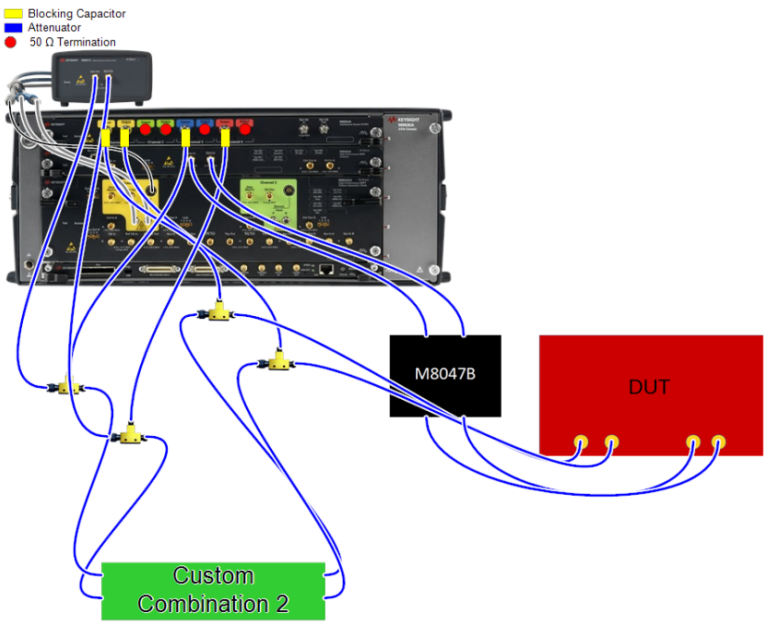


Figure 38 Example connection diagram for Compliance Test at 22.5G with a M8047B Redriver (M8040A)

When a redriver is connected, extra parameters appear in the parameter grid at the data rate level for Rx Tests. See Table 4 on page 31. You need to determine the values of the parameters for the DUT beforehand and enter them in the parameter grid. They will be applied by ValiFrame during testing.

When testing multiple lanes, ensure that you use just one type of redriver (either M8047B or M8047A). If A and B are mixed together, only the M8047B will be used.

Order of Descriptions of Receiver Tests

The receiver test descriptions are arranged in this chapter in the order in which they are listed and performed in the procedure tree of the N5991 main window.

Descriptions of Receiver Tests

Compliance Test

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

This procedure is used to determine if the DUT is compliant according to the specification.

The victim signal is connected to the ISI channel. The ISI channel is connected to the DUT.

The data generator is configured to comply with the characteristics defined in the specification:

For 12G:

- The differential amplitude is set to 850 mV,
- The random jitter is set to 150 mUI and the crosstalk to 18 mV,
- The ISI is also adjusted to get the worse case of the specified channel.

For 22.5G:

- The differential amplitude is set to 850 mV,
- The common mode amplitude is set to 12 mV.
- The random jitter is set to 150 mUI and the duty cycle distortion is adjusted to get the total jitter budget (12.4 ps),
- The ISI is also adjusted to get the worse case of the specified channel.

The DUT is trained into loopback mode either using the vendor-specific method or using the M8000 plug-in. After the link negotiation, the pre-shoot and the de-emphasis are set accordingly.

With this setup, the BER is measured at three different sinusoidal jitter points: 0.24 MHz, 3.60 MHz and 15 MHz.

The final result is Pass if in all cases the BER test is passed.

Prerequisite Calibrations

- TxEQ and Launch Voltage Calibration on page 46
- Random Jitter Calibration on page 53
- Duty Cycle Distortion Calibration on page 56 (for 22.5G)
- Total Jitter Calibration on page 59 (for 22.5G)
- Amplitude Calibration on page 69 (for 12G)
- ISI Calibration at 12G on page 75 and/or ISI Calibration at 22.5G on page 81
- Crosstalk Calibration on page 83.

Connection Diagram

Refer to Figure 39 or Figure 40 (for 12G) and Figure 41 (for 22.5G).

NOTE The Trace Number for M8049A-002 in Figure 40 and Figure 41 might change, depending on the ISI Calibration.

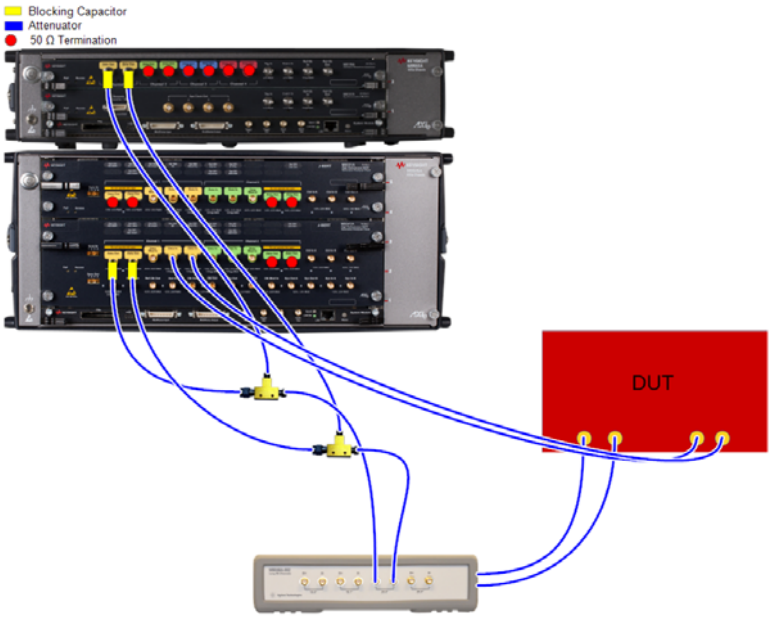


Figure 39 Example Connection Diagram for Compliance Test at 12G (M8020A)

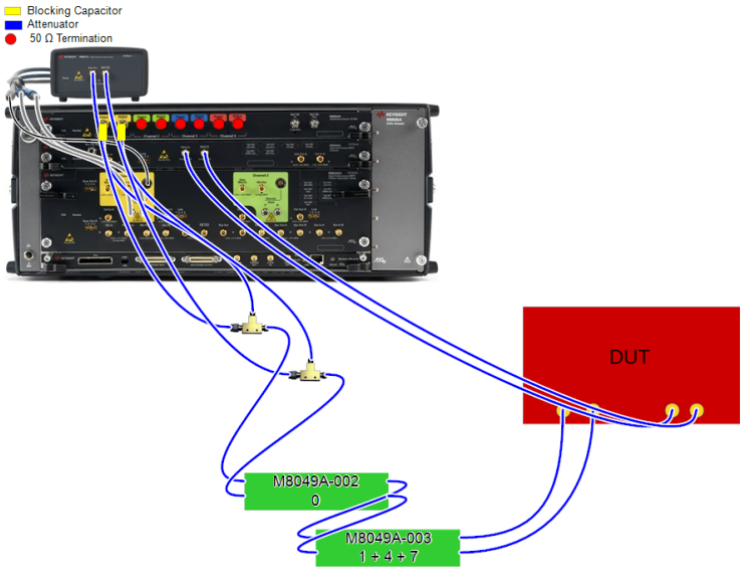


Figure 40 Example Connection Diagram for Compliance Test at 12G (M8040A)

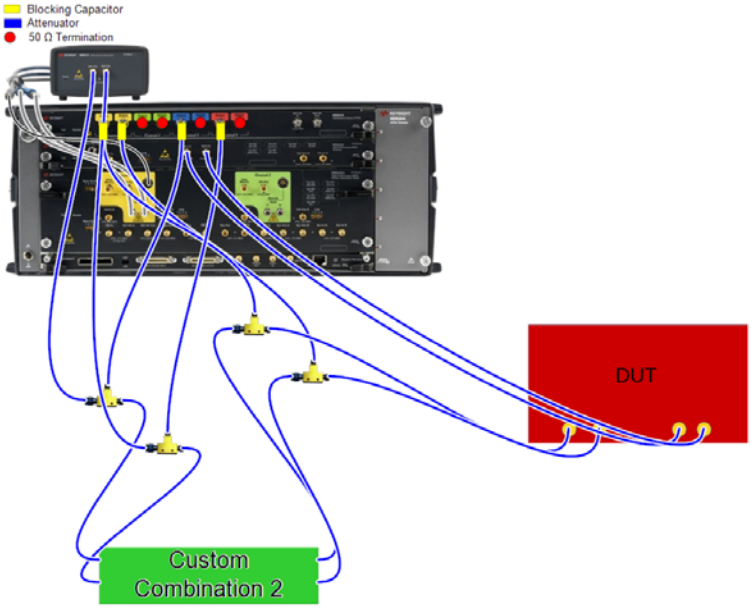
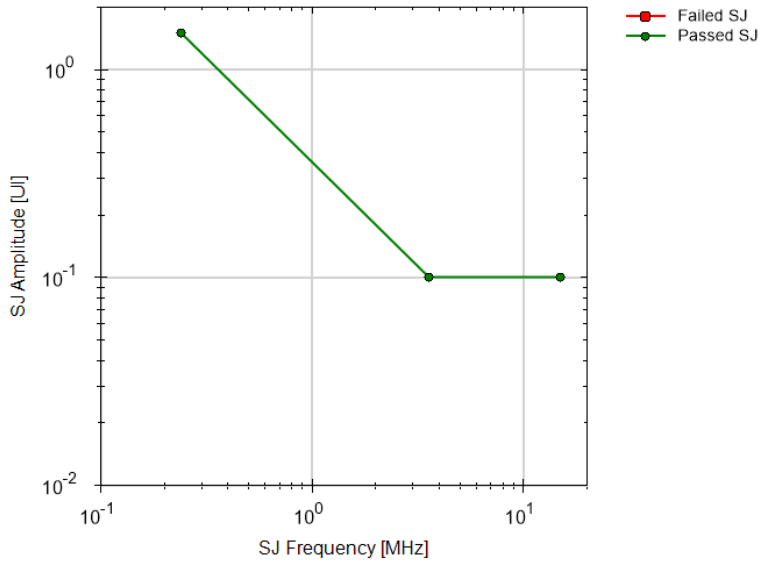


Figure 41 Example Connection Diagram for Compliance Test at 22.5G (M8040A)

Result Description

22.5 G Compliance Test

for Device



----General----	
Offline	True
Compliant	False
Use Analyzer Equalization	True
Use Clock Recovery	True
Analyzer Equalization 22.5 Gbps	0
Amplitude	852.5 mV
Intersymbol Interference	-3 dB
Random Jitter	150 mUI
Common Mode Random Interference	28.38375 mV
Crosstalk Amplitude	27.9315 mV
----Link Training Method----	
Link Training Method	VendorSpecific
PreShoot	0 dB
DeEmphasis	0 dB
Script Source for Link Negotiation Script	ValiframeSequence
----BER Measurement----	
BER Method	TargetBer
Target BER	1E-9
Datarate	22.5 GBit/s
Use IBERReader	False

----SSC----
22.5G Use SSC False

Result	SJ Frequency [MHz]	Failed SJ [UI]	Passed SJ [UI]	Received Bits	Received Errors
pass	0.24		1.50	NaN	NaN
pass	3.60		0.10	NaN	NaN
pass	15.00		0.10	NaN	NaN

Figure 42 Example result for 22.5G Compliance Test

- Result: (pass/FAIL) Pass if the BER Test passes.
- SJ Frequency: The sinusoidal jitter frequency of the signal.
- Failed SJ (UI): The SJ amplitude that did not pass the BER test at the frequency tested.
- Passed SJ (UI): The SJ amplitude that passed the BER test at the frequency tested.
- Received Bits: The number of received bits.
- Received Errors: The number of received errors.

Jitter Tolerance Test

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

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

The victim signal is connected to the ISI channel. Then the ISI channel is connected to the DUT.

With the DUT in loopback mode, the data generator performs a linear sweep of the sinusoidal jitter amplitude from the “Start Jitter” value until the BER test fails, or until the jitter capability is reached. This is repeated over a defined range of jitter frequencies. The result is a curve that shows the maximum jitter that the DUT can tolerate as a function of the SJ frequency.

For this test, all the impairments are set to the compliance values according to the specifications.

Prerequisite Calibrations

- TxEQ and Launch Voltage Calibration on page 46
- Random Jitter Calibration on page 53
- Duty Cycle Distortion Calibration on page 56 (for 22.5G)
- Total Jitter Calibration on page 59 (for 22.5G)
- Amplitude Calibration on page 69 (for 12G)
- ISI Calibration at 12G on page 75 and/or ISI Calibration at 22.5G on page 81
- Crosstalk Calibration on page 83

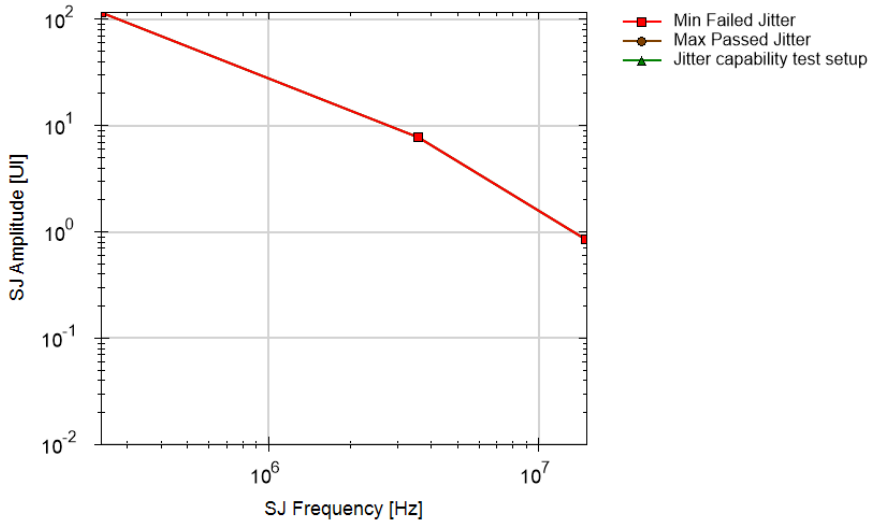
Connection Diagram

Refer to Figure 39 on page 96 or Figure 40 on page 97 (for 12G) and Figure 41 on page 97 (for 25.5G).

Result Description

22.5 G Jitter Tolerance Test

for Device



----General----	
Offline	True
Compliant	False
Use Analyzer Equalization	True
Use Clock Recovery	True
Analyzer Equalization 22.5 Gbps	0
Amplitude	852.5 mV
Random Jitter	150 mUI
Common Mode Random Interference	28.38375 mV
Crosstalk Amplitude	27.9315 mV
----Link Training Method----	
Link Training Method	VendorSpecific
PreShoot	0 dB
DeEmphasis	0 dB
Script Source for Link Negotiation Script	ValiframeSequence
----BER Measurement----	
BER Method	TargetBer
Target BER	1E-9
Datarate	22.5 GBit/s
Use IBERReader	False
----Jitter Points----	
Frequency mode	Compliance Frequencies
Use fixed number of steps	False
Show min failed points	True

----SSC----
22.5G Use SSC False

Result	SJ Frequency [Hz]	Min Failed Jitter [UI]	Max Passed Jitter [UI]	Jitter capability test setup [UI]
pass	240000.00	115.78	115.78	115.78
pass	3600000.00	7.72	7.72	7.72
pass	15000000.00	0.85	0.85	0.85

Figure 43 Result for 22.5G Jitter Tolerance Test

- Result: (pass/FAIL) Pass if the BER Test passes.
- SJ Frequency [Hz]: The sinusoidal jitter frequency of the signal.
- Min Failed Jitter [UI]: The minimum SJ amplitude at which the BER test failed.
- Max Passed Jitter [UI]: The maximum SJ amplitude that the DUT can tolerate.
- Jitter capability test setup: The maximum SJ amplitude that can be generated with the setup.

Common Mode Tolerance Test

Availability

Spec version:	SAS4, SAS3
Data Generator:	M8040A (12G and 22.5G) M8020A (only 12G)
DUT Type:	Device, Host
Modes:	Compliance, Expert
Data Rates:	SAS4: 12G, 22.5G SAS3: 12G

Purpose and Method

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

The data and the common mode interference channels are connected through a power divider to the ISI channel. Then the ISI channel is connected to the DUT.

With the DUT in loopback mode, the data generator does a linear sweep of the CMSI amplitude form 0 mV until the BER test fails, or until the jitter capability is reached. This is repeated over a defined range of CMSI frequencies. The result is a curve that shows the maximum jitter that the DUT can tolerate as a function of the CMSI frequency.

For this test, all the impairments are set to the compliance values according to the specification.

Prerequisite Calibrations

- TxEQ and Launch Voltage Calibration on page 46
- Random Jitter Calibration on page 53
- Common Mode Sinusoidal Interference Calibration on page 65
- Amplitude Calibration on page 69
- ISI Calibration at 12G on page 75 and/or
ISI Calibration at 22.5G on page 81
- Crosstalk Calibration on page 83

Connection Diagram

Refer to Figure 44 or Figure 45 on page 105 (for 12G) and Figure 46 on page 106 (for 22.5G).

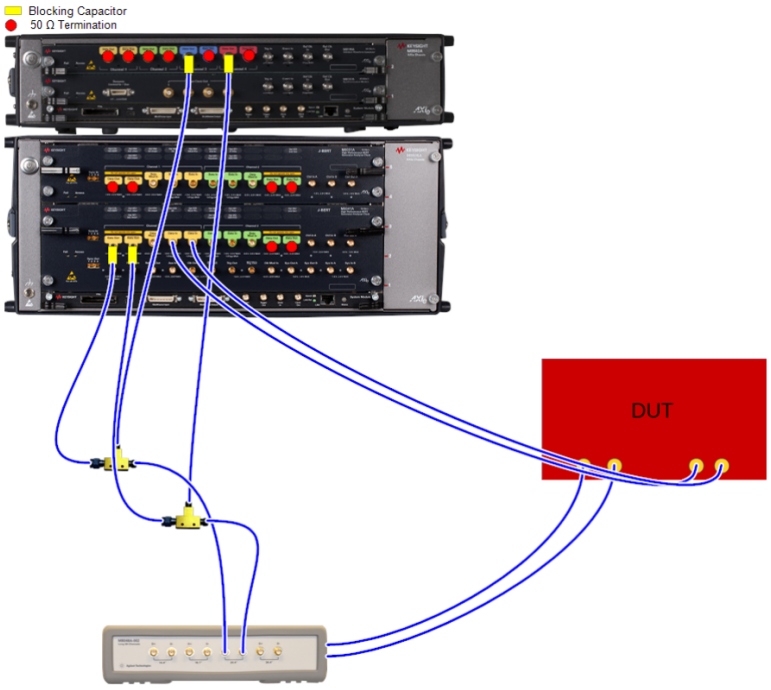


Figure 44 Example connection Diagram for Common Mode Tolerance Test at 12G (M8020A)

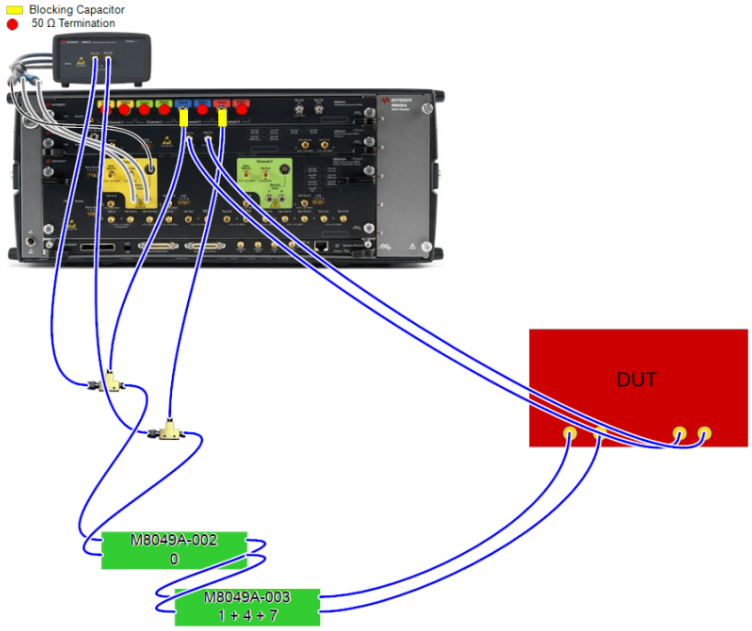


Figure 45 Example connection Diagram for Common Mode Tolerance Test at 12G (M8040A)

NOTE Trace Number for M8049A-002 might change due to the ISI calibration.

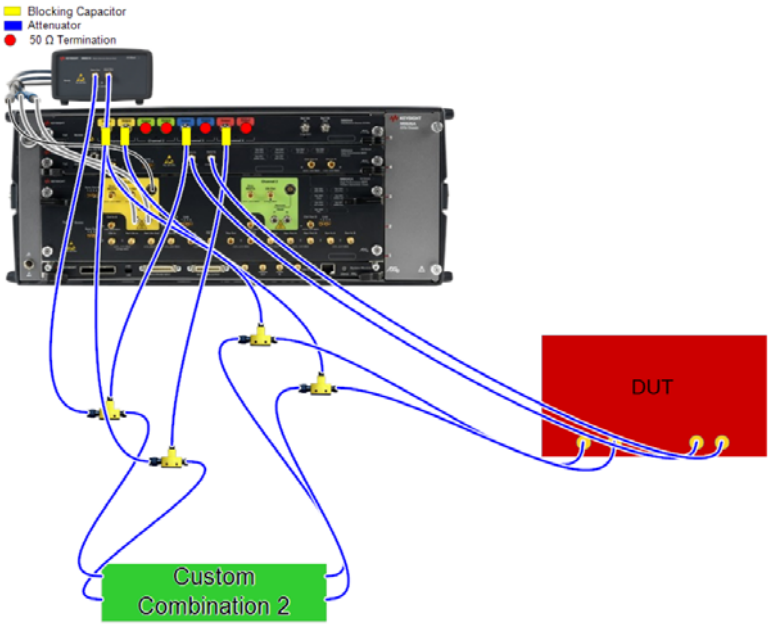
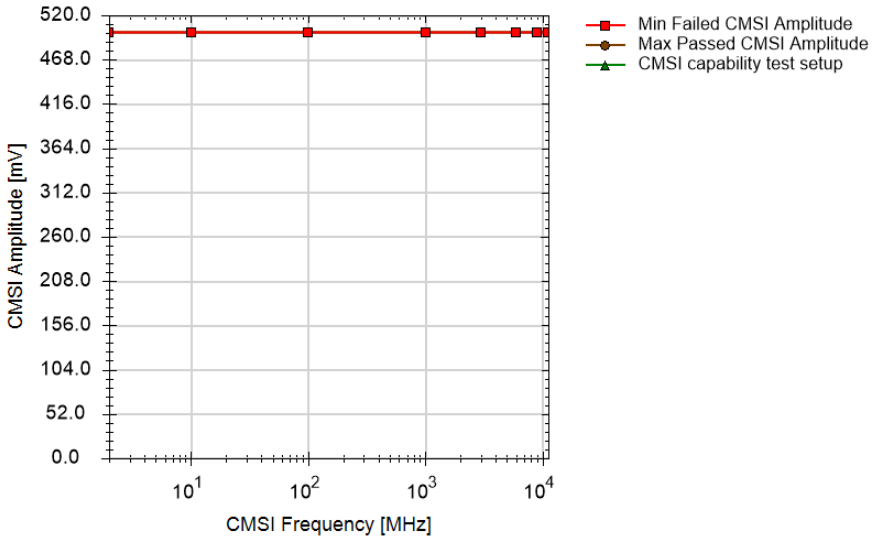


Figure 46 Example Connection Diagram for Common Mode Tolerance Test at 22.5G (M8040A)

Result Description

22.5 G CMI Tolerance Test

for Device



----General----	
Offline	True
Compliant	False
Use Analyzer Equalization	True
Use Clock Recovery	True
Analyzer Equalization 22.5 Gbps	0
Amplitude	852.5 mV
----Link Training Method----	
Link Training Method	VendorSpecific
PreShoot	0 dB
DeEmphasis	0 dB
Script Source for Link Negotiation Script	ValiframeSequence
----BER Measurement----	
BER Method	TargetBer
Target BER	1E-9
Datarate	22.5 GBit/s
Use IBERReader	False
----CMSI Points----	
Frequency mode	Compliance Frequencies
Use fixed number of steps	False
Show min failed points	True
----SSC----	
22.5G Use SSC	False

Result	CMSI Frequency [MHz]	Min Failed CMSI Amplitude [mV]	Max Passed CMSI Amplitude [mV]	CMSI capability test setup [mV]
pass	2.00	500.00	500.00	500.00
pass	10.00	500.00	500.00	500.00
pass	100.00	500.00	500.00	500.00
pass	1000.00	500.00	500.00	500.00
pass	3000.00	500.00	500.00	500.00
pass	6000.00	500.00	500.00	500.00
pass	9000.00	500.00	500.00	500.00
pass	11250.00	500.00	500.00	500.00

Figure 47 Example result for Common Mode Tolerance Test

- Result: (pass/FAIL) Pass if the BER test passes, otherwise fail.
- CMSI Frequency [MHz]: The CMSI frequency set at each step.
- Min Failed CMSI Amplitude [mV]: The minimum CMSI amplitude at which the BER test failed.
- Max Passed CMSI Amplitude [mV]: The maximum CMSI amplitude that the DUT can tolerate.
- CMSI capability test setup [mV]: The maximum CMSI amplitude that can be generated with the setup.

Keysight N5991SA4A/3A SAS Test Automation Software Platform

User Guide

7 Appendix: Acronyms and Abbreviations

This Appendix contains a list of acronyms and abbreviations used in the Keysight N5991 SAS4A/3A Test Automation Software Platform User Guide.

KEYSIGHT TECHNOLOGIES

Acronyms and Abbreviations

Acronym	Definition
AWG	Arbitrary Waveform Generator
BER	Bit Error Ratio
BERT	Bit Error Ratio Tester
BSR	Board of Standards Review
BW	Bandwidth
CDR	Clock and Data Recovery
CM	Common Mode
CMRI	Common Mode Random Interference
CMSI	Common Mode Sinusoidal Interference
CTS	Compliance Test Specification
DFE	Decision Feedback Equalization
DJ	Deterministic Jitter
DSO	Digital Storage Oscilloscope
DUT	Device Under Test
EQ	Equalization
Gbps	Gigabits per second
GPIB	General Purpose Interface BUS
GUI	Graphical User Interface
HTML	HyperText Markup Language
INCITS	International Committee for Information Technology Standards
IO	Interface
IP	Internet Protocol
ISI	Inter-Symbol Interference
LAN	Local Area Network
N/A	Not Applicable

Acronym	Definition
NaN	Not a Number
PC	Personal Computer
Pk-Pk	Peak to Peak
RJ	Random Jitter
Rx	Receiver
SAS	Serial Attached SCSI
SCSI	Small Computer System Interface
SJ	Sinusoidal Jitter
SMA	SunMiniature version A (connector)
SSC	Spread Spectrum Clocking
TF	Transfer Function
TP	Test Point
TTC	Transition Time Converter
Tx	Transmitter
UI	Unit Interval
USB	Universal Serial Bus
UUT	Unit Under Test
VISA	Virtual Instrument System Architecture

Edition 4.0, July 2023

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