N5991MM6A MIPI M-PHY® Receiver Conformance Test Automation Software

KEYSIGHT

USER'S GUIDE

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1 Introduction

Overview

This guide provides a detailed description of the Keysight N5991MM6A MIPI M-PHY® RX Conformance Test Automation Software. It describes the calibrations and test procedures conducted by N5991MM6A 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 expected requirements of the *MIPI Alliance Specification for M-PHY® v6.0*.

The N5991MM6A receiver tests support Keysight's M8040A BERT. A Keysight Infiniium UXR oscilloscope is always required.

NOTE The definitions of the acronyms and abbreviations used throughout this user's guide are given in Appendix C: Acronyms and Abbreviations.

Document History

First Edition (December 2025)

The first edition of this user's guide describes the functionality of software version MPhyG6_ValiFrame_N5991_1.0.0 based on the *MIPI Alliance Specification for M-PHY® v6.0*.

Support and Troubleshooting

If you encounter problems when running the software, check the log list at the bottom of the main window. The log file can be viewed by right-clicking within the log list section and selecting “Show Log File” (see red frame in Figure 1-1).

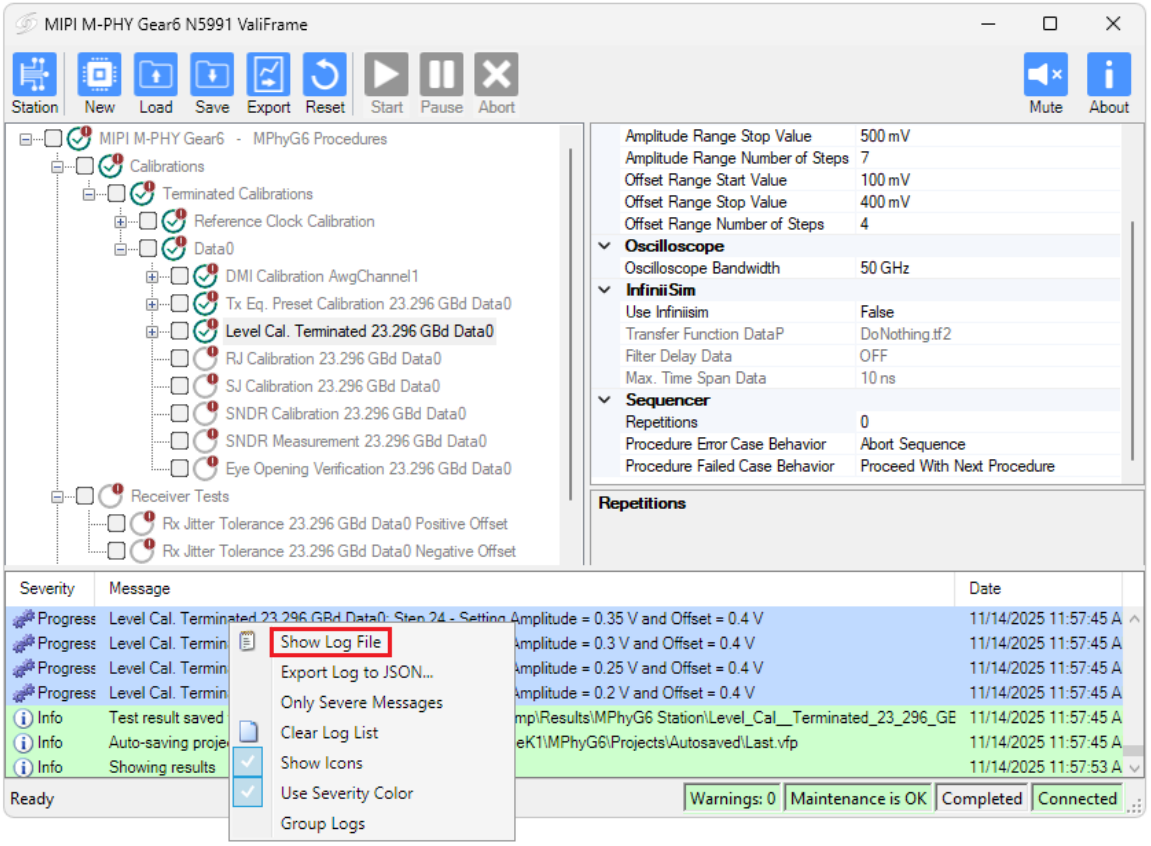

Figure 1-1 Accessing the log file

If a problem with the application persists, click About (in the main window, Figure 1-2), create an issue report file (in the About window, Figure 1-3) and send this zip file (BitifEye_IssueReportFile.zip, which will be saved to your desktop) to your Keysight support contact.

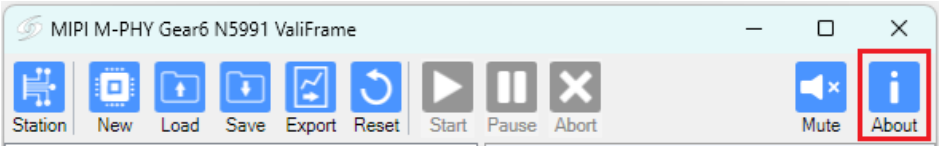

Figure 1-2 About button

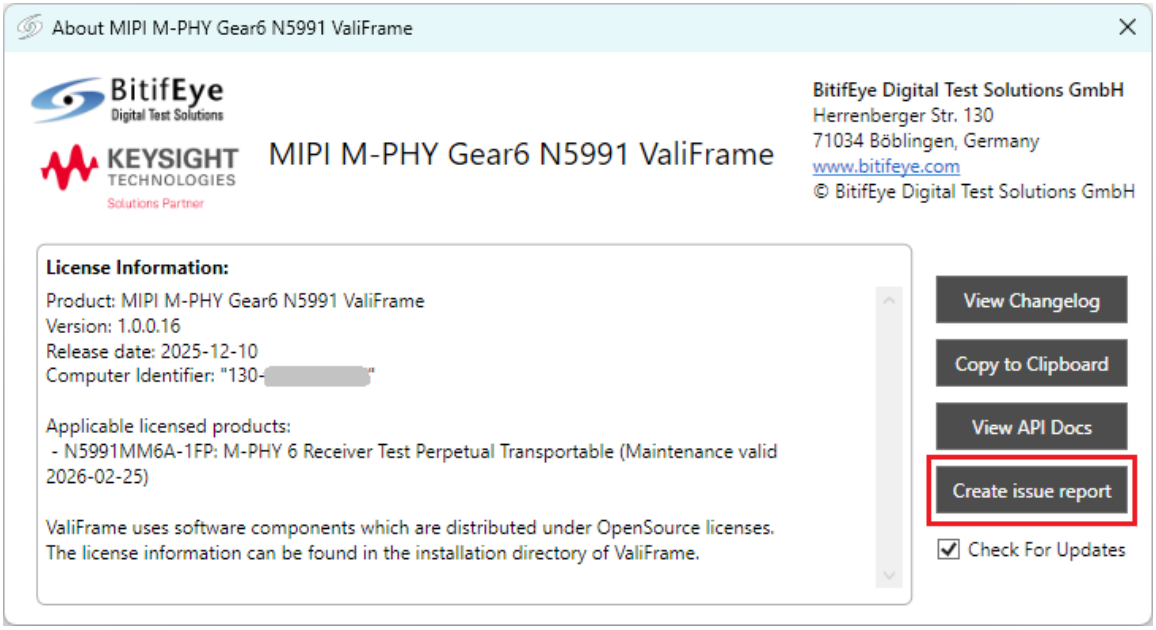

Figure 1-3 Creating an issue report file

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

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

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2 Preparing to Take Measurements

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 N5991MM6A Test Station.

Overview

The set of test instruments that are used for N5991MM6A MIPI M-PHY test automation are referred to in the following as the “Test Station” or simply “Station”. The test station is controlled by a suitable PC and the N5991MM6A MIPI M-PHY RX Conformance Test Automation Software.

Downloading and Installing the N5991MM6A Software

First download and install the N5991MM6A software. Further details about this and the licenses required can be found in the N5991 Getting Started Guide.

Normal Workflow

After the N5991MM6A software has been installed, the normal procedure when testing a DUT is as listed below. More details about each step are provided in the following sections.

- **Start the N5991MM6A app**

  (see Starting the N5991MM6A Software on page 20)

- **Configure the Station**

  (see Configuring the Test Station on page 21)

  - Station configuration
  - Instrument configuration

- **Configure the DUT**

  (see Configuring the DUT and Test Parameters on page 25)

- **Calibrate the system**

  - Select calibration procedure(s) (see Selecting Procedures on page 35)
  - Modify parameters (see Modifying Parameters on page 36).
    Note: Modifying parameters might break the conformance status.
  - View connection diagram and connect setup (see Connection Diagrams on page 38)
  - Run calibration procedure(s) (see Running Procedures on page 37)
  - Save/export calibration results (see Exporting Results on page 43)

- **Run test procedures**

  - Select test procedures (see Selecting Procedures on page 35)
  - Modify parameters (see Modifying Parameters on page 36)
  - View connection diagram and connect setup (see Connection Diagrams on page 38)
  - Run test procedure(s) (see Running Procedures on page 37)
  - Save/export test results (see Exporting Results on page 43)

Starting the N5991MM6A Software

Double-click the M-PHY G6 ValiFrame (N5991) icon on the desktop (see Figure 2-1) to launch the N5991MM6A app. Alternatively, to access the N5991MM6A app on a Windows 11-based PC, search for M-PHY G6 ValiFrame (N5991).

Figure 2-1 M-PHY G6 ValiFrame (N5991) desktop icon for N5991MM6A

Configuring the Test Station

When the N5991MM6A app is launched, the main window appears, as shown in Figure 2-2.

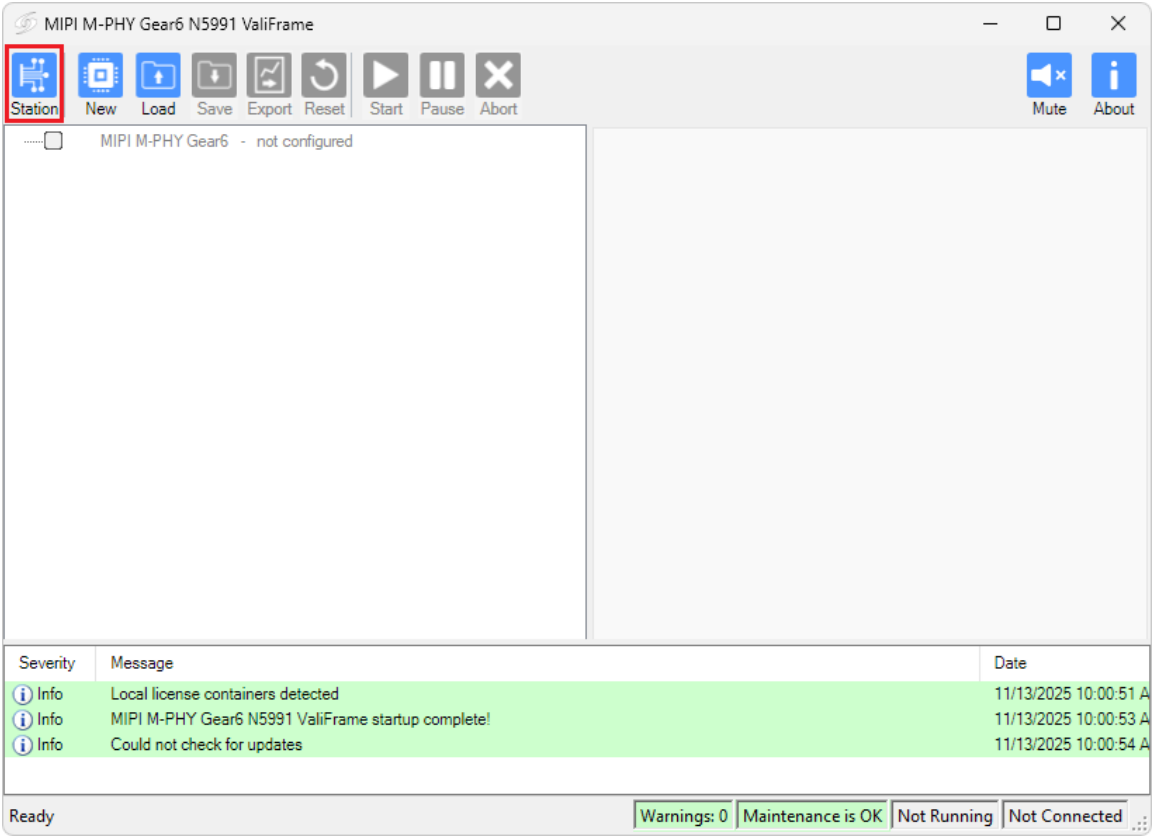

Figure 2-2 N5991MM6A user interface main window

Click **Station** (red frame in the figure) to open the Station Configuration window (Figure 2-3).

Station Configuration

The Station Configuration window (Figure 2-3) displays the currently available options for MIPI M-PHY G6 testing.

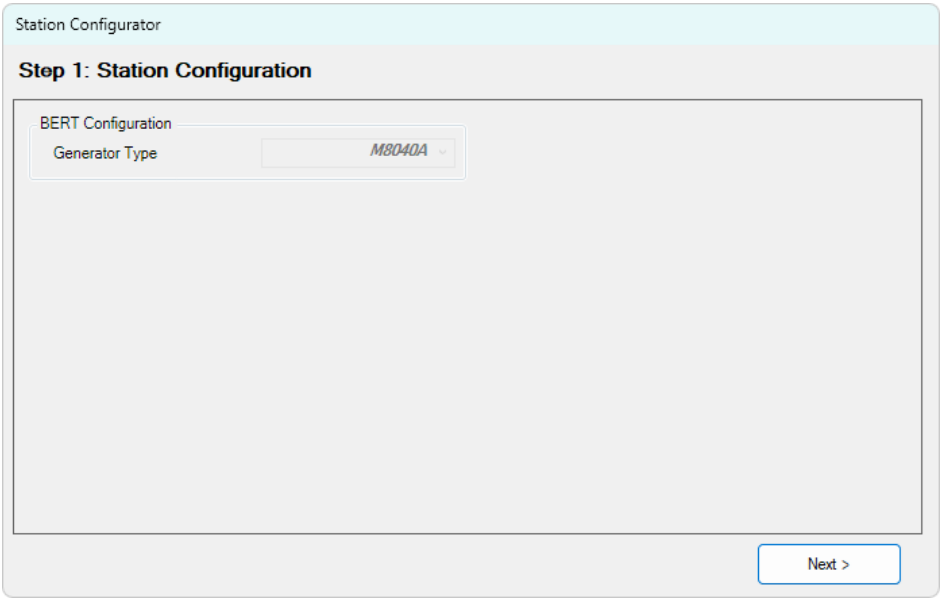

Figure 2-3 Station Configuration window

BERT Configuration

The signal generator is M8040A.

Click **Next**.

Instrument Configuration

Next, the instrument addresses must be set. An example of instrument configuration is shown in Figure 2-4.

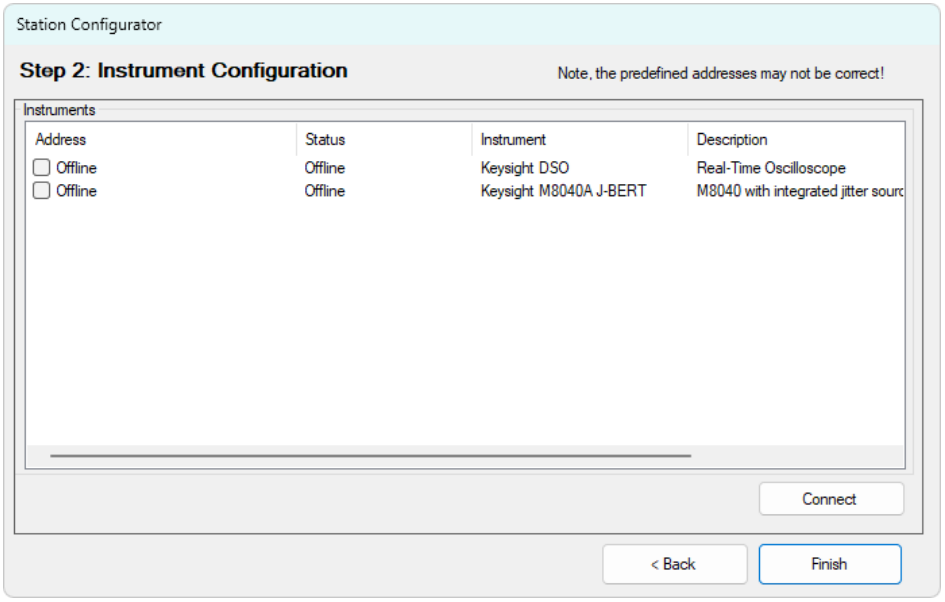

Figure 2-4 Instrument configuration window

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, hardware does not need to be physically connected to the test controller PC. The N5991MM6A 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, LAN or USB.

Most of the instruments listed in the Instrument Configuration window require a VISA connection. To determine the VISA address, run the “Keysight Connection Expert”, which is part of the Keysight IO Libraries Suite. For each instrument, copy the address string from the Connection Expert entries and paste it as the instrument address in the N5991MM6A Instrument Configuration window.

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

Some applications running on the oscilloscope use a different technology to provide remote access to the N5991MM6A app, called ‘.NET Remoting’. Remote access is only possible using a LAN connection to the oscilloscope; therefore, an IP address is used to connect to such an instrument.

After the address strings have been entered in the Instrument Configuration window of N5991MM6A, click **Connect** to verify that the connections for the instruments are established properly. The software checks for the best kind of connection, and displays a message if you have entered one that is not optimal. For the data generator and the real-time oscilloscope, the use of a HiSLIP connection string is recommended.

Click **Finish** to save the selected instruments and connections.

NOTE

When starting a specific test station configuration for the first time, all instruments are set to the “Offline” mode. In this mode the test automation software does not connect to any instrument. This mode can be used for demonstrations or checks only. No valid data is produced.

You will need to repeat the station and instrument configuration whenever you change the instruments that you are using or their connections.

Configuring the DUT and Test Parameters

Once the Test Station has been configured, the next step is to configure the DUT and test parameters.

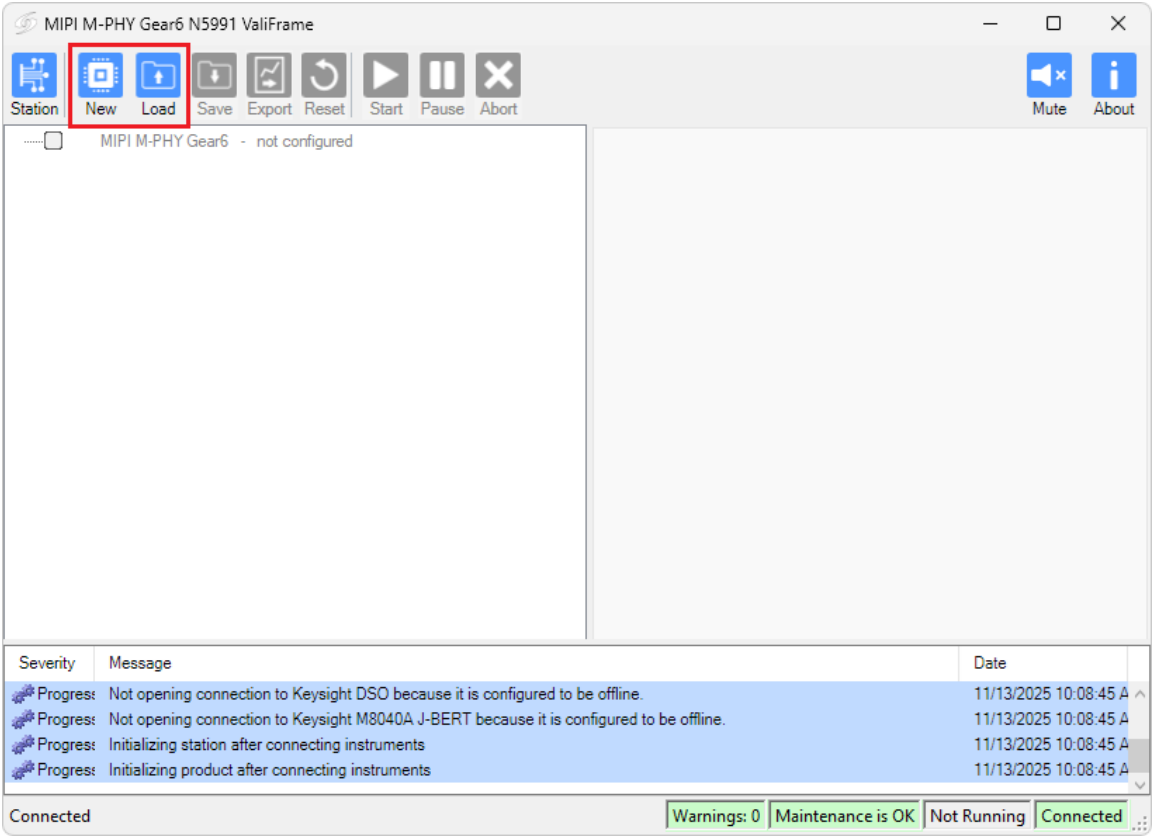

Figure 2-5 New and Load buttons in the main window

Opening a Previously Saved Project

If you have already configured the N5991MM6A software and saved the settings as a configuration or project file, you can click **Load** (Figure 2-5) to use the same station, product and test parameters again, which can save time.

Beginning a New Project

To begin a new project, click **New** (Figure 2-5), which opens the N5991MM6A Configure Product window (Figure 2-6).

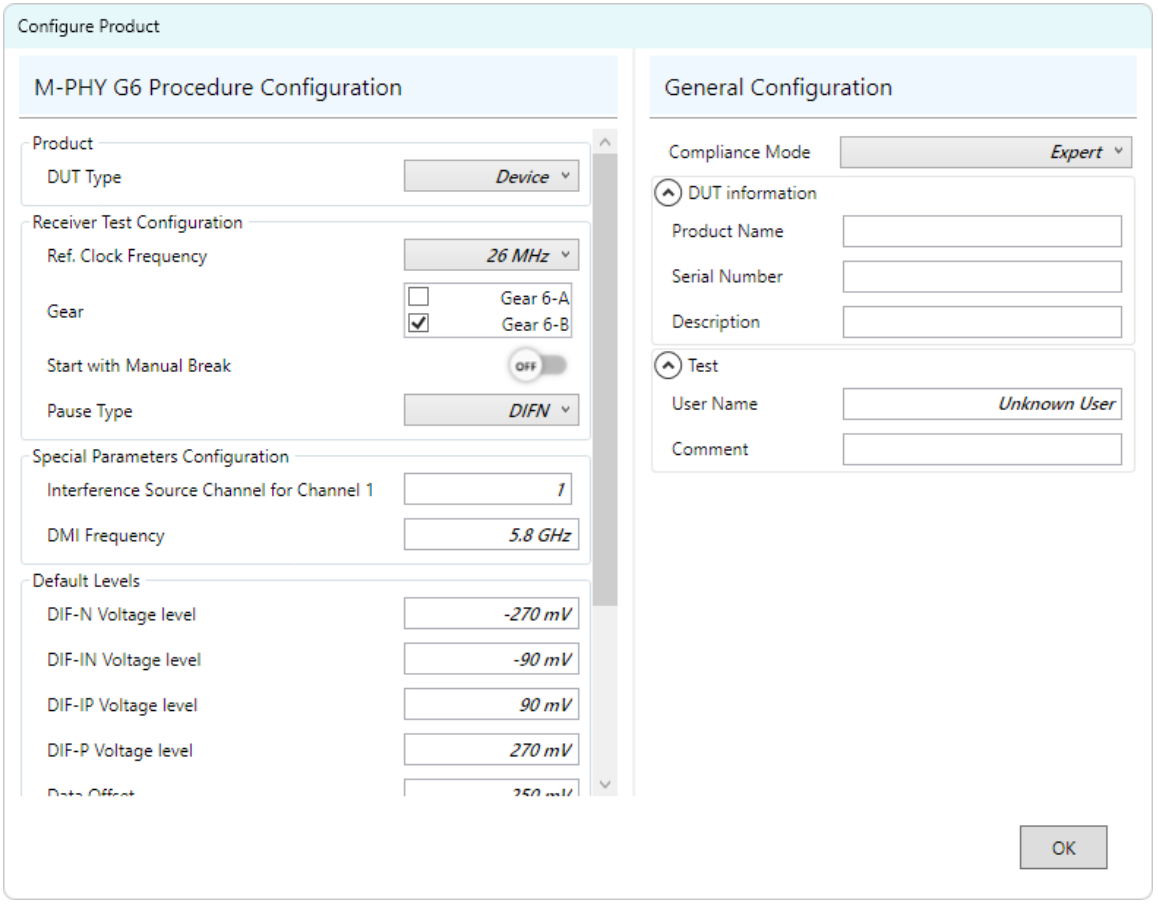

Figure 2-6 N5991MM6A Configure Product window

The N5991MM6A Configure Product window allows you to select product and test parameters (Table 2-1).

Table 2-1 Parameters for N5991MM6A Procedure Configuration

Parameter / Category Name	Description
Product	
DUT Type	Select either Device or Host.
Receiver Test Configuration	
Ref. Clock Frequency	Choose from 19.2 MHz, 26 MHz, 38.4 MHz, 52 MHz, 76.8 MHz, 104 MHz.
Gear	Check either Gear 6-A or Gear 6-B or both.
Start with Manual Break	Toggle this button to insert a manual break at the beginning of each sequence. When a manual break is added, the application will pause before the BER measurement is started, a pop-up dialog will ask you to prepare the DUT, and when you confirm that this has been done, the sequence will continue.
Pause Type	This property defines the type of block that is added to the sequence when 'Start with Manual Break' is enabled. Selecting DIFN will create a block of zeros, while DIFZ will add a block with the idle signal.
Special Parameters Configuration	
Interference Source Channel for Channel 1	Specify here the physical channel of the Interference Source that is going to be combined with Channel 1 of the BERT to generate the stressed signal.
DMI Frequency	Frequency of the differential mode interference that is applied.
Default Levels	
DIF-N Voltage Level	Differential amplitude of the PAM4 Symbol0.
DIF-IN Voltage Level	Differential amplitude of the PAM4 Symbol1.
DIF-IP Voltage Level	Differential amplitude of the PAM4 Symbol2.
DIF-P Voltage Level	Differential amplitude of the PAM4 Symbol3.
Data Offset	Offset of the data signal.
Ref Clk Amplitude	Amplitude of the reference clock signal.
Ref Clk Offset	Offset of the reference clock signal.
Bit Error Rate Settings	
BER Reader	Select the BER reader to be used as either Offline or BERT Analyzer. See BER Reader on page 28.
Target BER	The target BER can be chosen between 1E-6 and 1E-12.

Table 2-2 Parameters for N5991MM6A General Configuration

Parameter / Category Name	Description
No Category Name	
Compliance Mode	Preselected as 'Expert'. The selection 'Compliance' is not available in the current version because the MIPI M-PHY G6 CTS has not been finalized yet.
DUT Information	
Product Name	Text field for the name of the product (DUT).
Serial Number	Text field for the serial number of the product (DUT).
Description	Text field for a description of the product (DUT).
Test	
User Name	User name text field.
Comment	Text field for user comments.

BER Reader

For automated receiver testing, it is necessary to determine whether the DUT is receiving the data properly. This can be achieved by reading pass/fail information from the device. The Bit Error Ratio (BER) is measured and read. N5991MM6A supports the following BER Reader implementations.

– *BERT Analyzer*

  The DUT must be configured to Loopback Mode manually, enabled by sideband control, so that it loops back the received test pattern. The Error Detector (ED) then compares the pattern returned by the DUT with the pattern loaded on the analyzer module to detect bit errors and compute the BER.

  The pattern must match and be in phase. The same pattern is loaded to the generators and the ED. When the received bits are not synchronized with the pattern of the ED, the computed BER will be very high. In this case, the synchronization algorithm in the ED, which aligns the sampling delay and decision threshold voltage to the received data, is restarted.

– *Offline BER Reader*

  For each step of the test procedure, N5991MM6A shows pop-up dialogs asking you to reset and initialize the DUT and decide whether the DUT is

working properly. It is also possible to connect the DUT to the oscilloscope and verify if the output data is valid with the help of the oscilloscope's serial decoder. Using an offline BER reader can result in a semi-automated test, because at each test point you have to enter the pass/fail information. However, an offline BER reader can be used to advantage when paired with the API and sideband control.

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3 Using the Software

This chapter describes how to select the calibrations and test procedures that are to be run and how you can modify the parameters.

Introduction to Using the Software

Once the DUT has been configured, click ‘OK’ in the N5991MM6A Configure DUT panel. The MIPI M-PHY G6 N5991MM6A main window will appear (Figure 3-1).

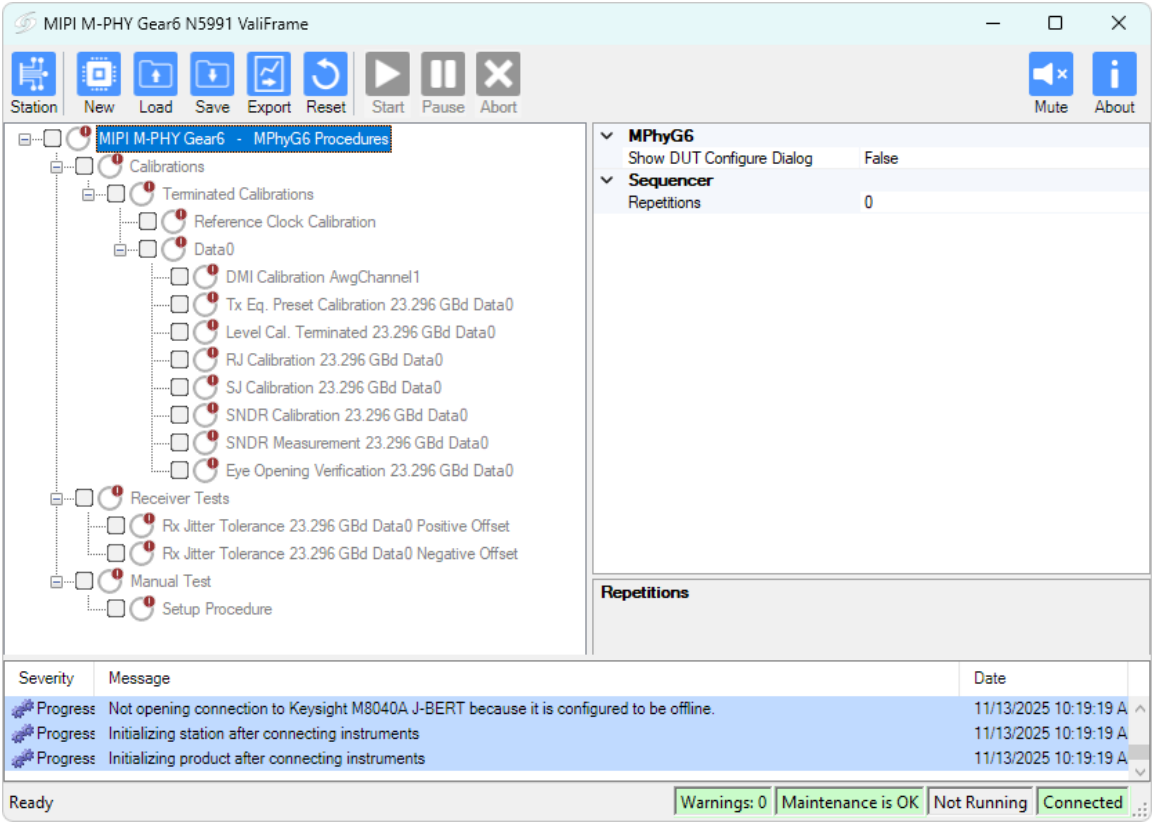

Figure 3-1 N5991MM6A main window with procedure tree

N5991MM6A Toolbar

Use the **Station** button to configure the Test Station. See Configuring the Test Station.

Use **New** to open the N5991MM6A Configure DUT window. This allows you to configure a new DUT or change the DUT and test parameters. See Configuring the DUT and Test Parameters.

If you have already configured the N5991MM6A software for a particular product and saved the settings as a configuration file, you can click **Load** to use the same station, product and test parameters again, which can save time.

The **Save** button is used to save settings for a particular project. You can save the settings as either a ValiFrame configuration file (.vfc; this contains the changed parameters and the selected procedures) or a ValiFrame project file (.vfp; contains the same as the configuration file and in addition the results of the current run). See the N5991 Getting Started Guide for more details.

Use the **Export** button to save results of measurements. See Exporting Results for details.

Reset sets ALL parameters to their default values.

To start one or more procedures, select the corresponding check box(es). Then the **Start** button is enabled and turns blue. Click Start to run the selected procedure(s).

Pause interrupts the current run at the end of the current step. When the test is paused, the Start button is relabeled **Step**.

You have two options when a procedure is paused.

- Click ‘Step’ to continue the procedure and pause at the next step.
- Click ‘Pause’ again to toggle the state of the Start/Step button and continue running the test until the end of the procedure.

The Step feature is useful for debugging purposes, for example to analyze the signal on the oscilloscope at each step. When a procedure is paused, a message in the bottom-left corner of the main window indicates which step has been reached.

Abort stops the current run and closes the procedure window.

The N5991MM6A app produces a sound to indicate when a different state of the program has been reached. You can turn this off (and on again) using the **Mute** button.

The **About** button opens a window that provides details of the software, such as the version of N5991MM6A that is being run, the Container ID of the computer and when the software maintenance will expire. The window can also be used to send a report to Support if you encounter persistent problems. For more details see the N5991 Getting Started Guide.

Parts of the Main Window

All the relevant calibration and test procedures are listed in groups in a **procedure tree** (left side of the N5991MM6A main window, Figure 3-1), similarly to how they are organized in the CTS.

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

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

The **status bar** at the very bottom provides information about how many critical errors have occurred, how many warnings have been sent, the status of the software maintenance license, whether a procedure is running, which step has been reached and whether the instruments were successfully connected.

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

Selecting, Modifying and Running Procedures

Selecting Procedures

The calibration and test procedure groups can be globally selected to run by clicking the check box next to the group name. Alternatively, one or more individual procedures can be selected by clicking the check boxes next to the individual procedure names. Click 'Start' (Figure 3-2) to run the selected procedures.

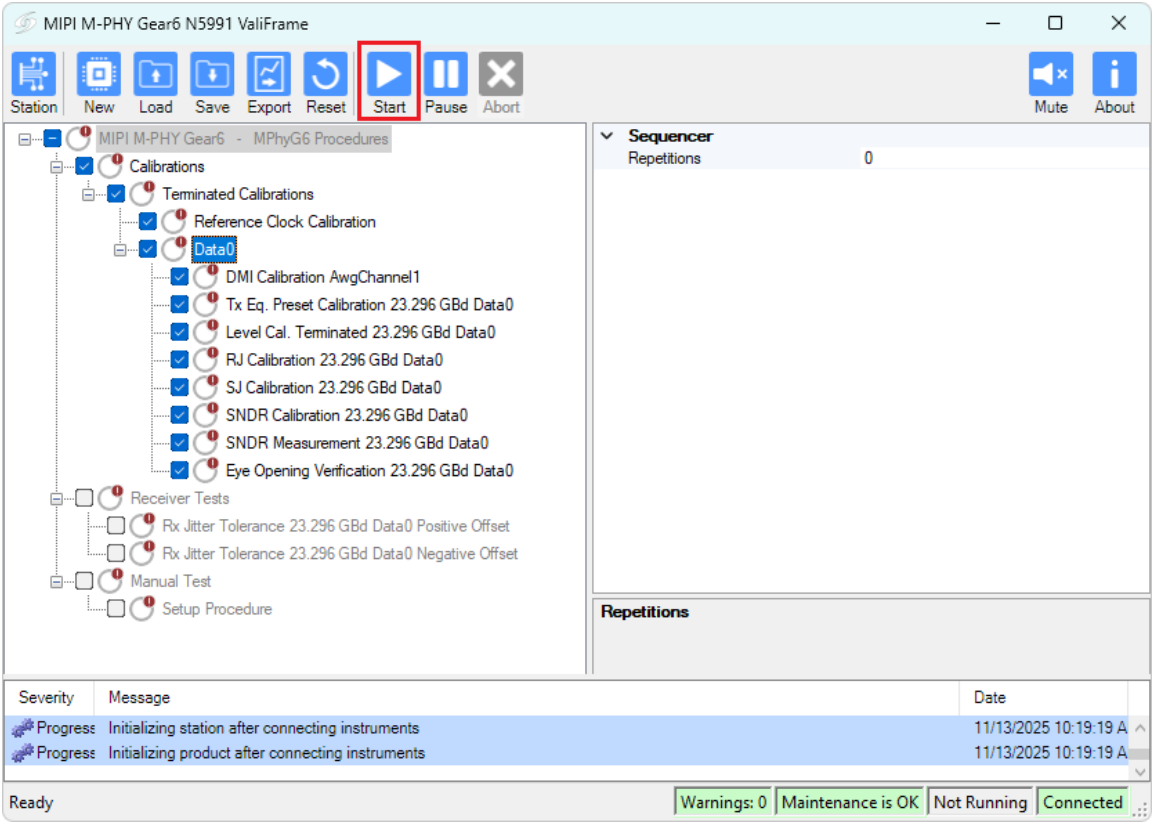

Figure 3-2 Selecting and starting procedures

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, most of the parameters can be modified. To modify a parameter, first select a specific calibration or test procedure in the procedure tree, as shown in the left half of Figure 3-3. The corresponding parameters are displayed in a property list (parameter grid) in the right pane. These parameters can be configured only before the selected procedure is started. All of the selected test parameters are listed in the test results.

For more details about parameters, see N5991MM6A Parameters on page 47.

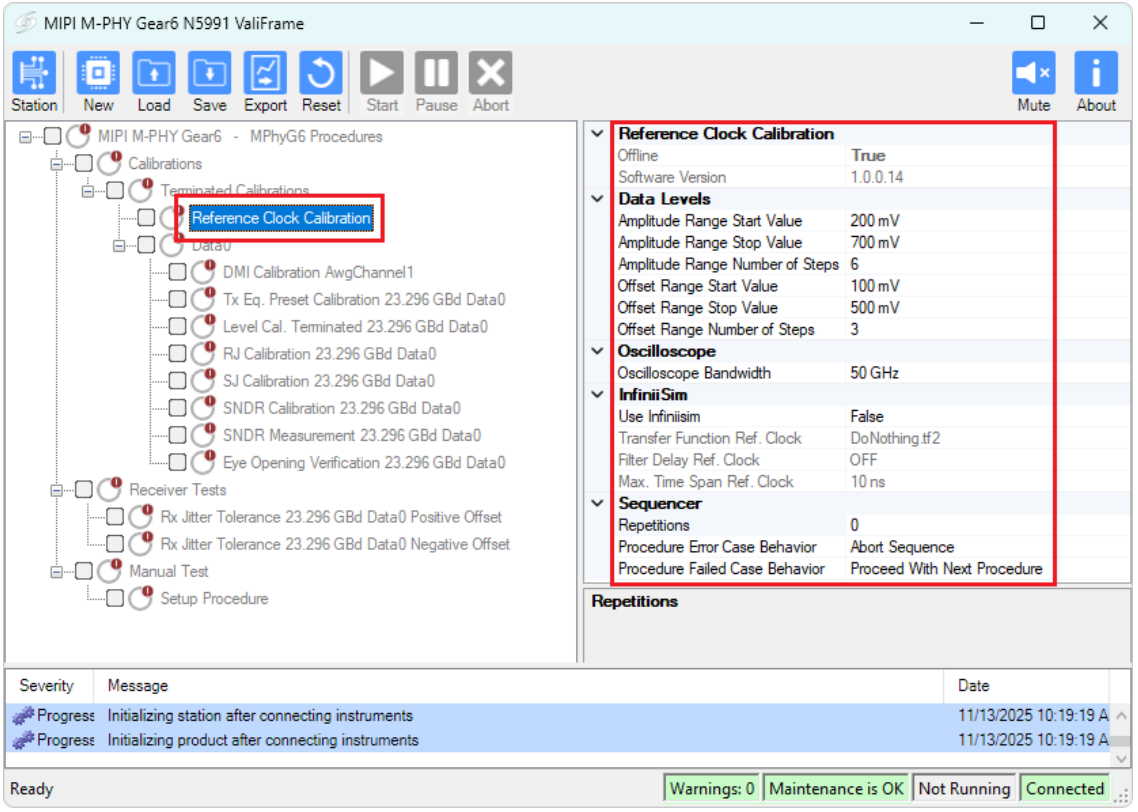

Figure 3-3 Modifying parameters

Running Procedures

To run the selected procedure, click the Start icon on the toolbar (see Figure 3-2). 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 actions are prompted in pop-up dialog boxes.

To view the appropriate connection diagram, right-click the desired test or calibration and select 'Show Connection...'. See also Connection Diagrams on page 38.

State Icons

Once the selected procedures have been run, the state icon next to a group or an individual procedure indicates the result (pass / fail / incomplete) and provides further information. For an explanation of the icon beside a particular procedure, right-click the procedure name and select 'Show State Details...' (Figure 3-4). For more information about all state icons, refer to the N5991 Getting Started Guide.

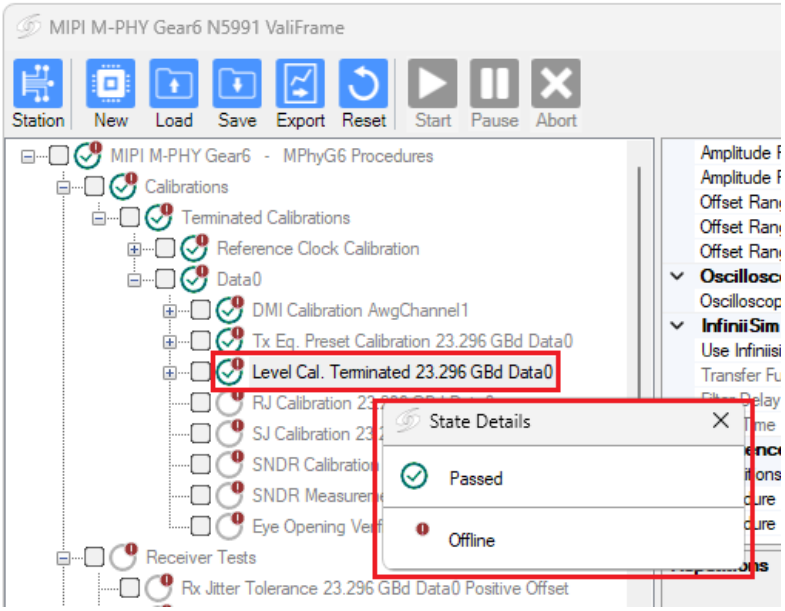

Figure 3-4 Icon representation

Connection Diagrams

To view the connection diagram for a particular procedure and set of instruments, right-click the desired test or calibration in the procedure tree. From the context menu select 'Show Connection...'.

The window that opens consists of a connection diagram in the left pane and a list of connections instructions in the right pane. There are five buttons, which are outlined in red and numbered in Figure 3-5.

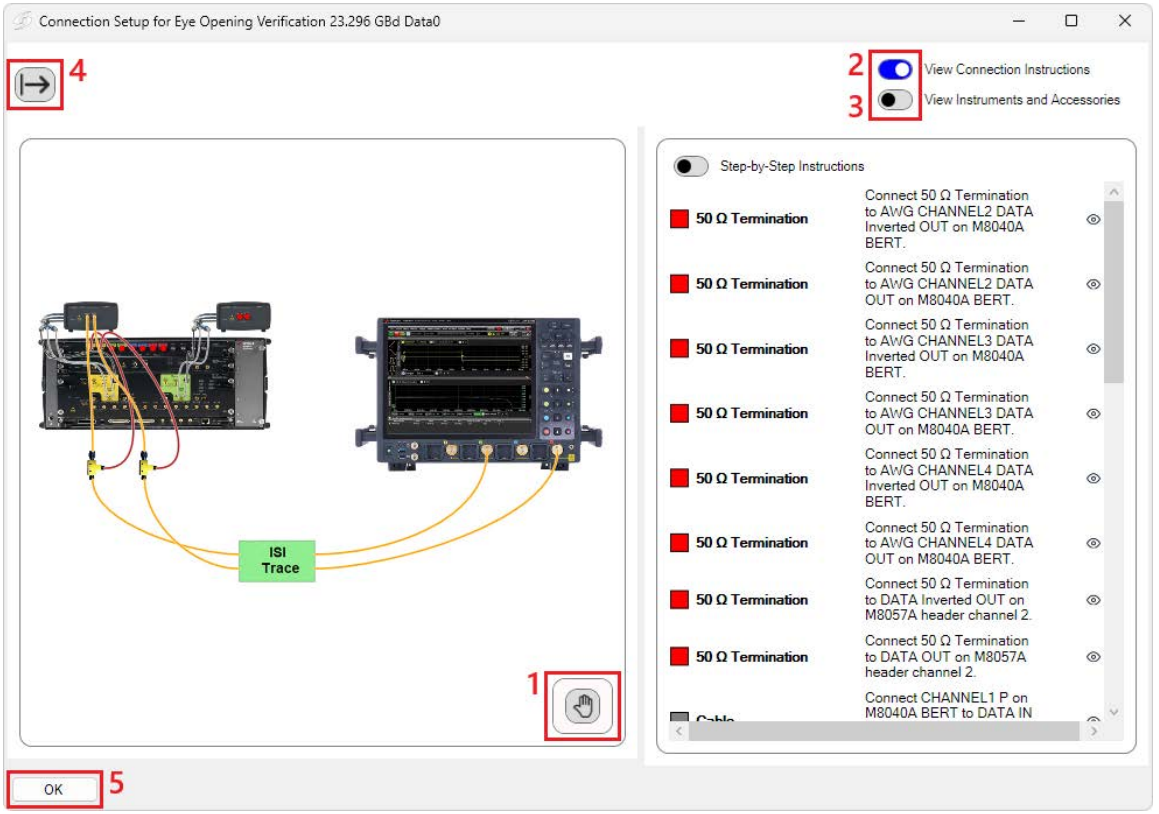

Figure 3-5 Connection diagram window – default view

1 **Export Mode**: Click here to change the positions of the individual instruments and cables in the connection diagram before exporting it. This is intended to increase the clarity of the connections. You can increase the size of the diagram by toggling button 2 to off. The diagram then fills the whole window.

2 **Connection Instructions**: In the default view, the connection instructions and further information are visible. It is possible to open step-by-step instructions, where the connection currently being made is highlighted (Figure 3-6).

3 **Instruments and Accessories**: Toggle to 'on' to view the list of required instruments and accessories (Figure 3-6).

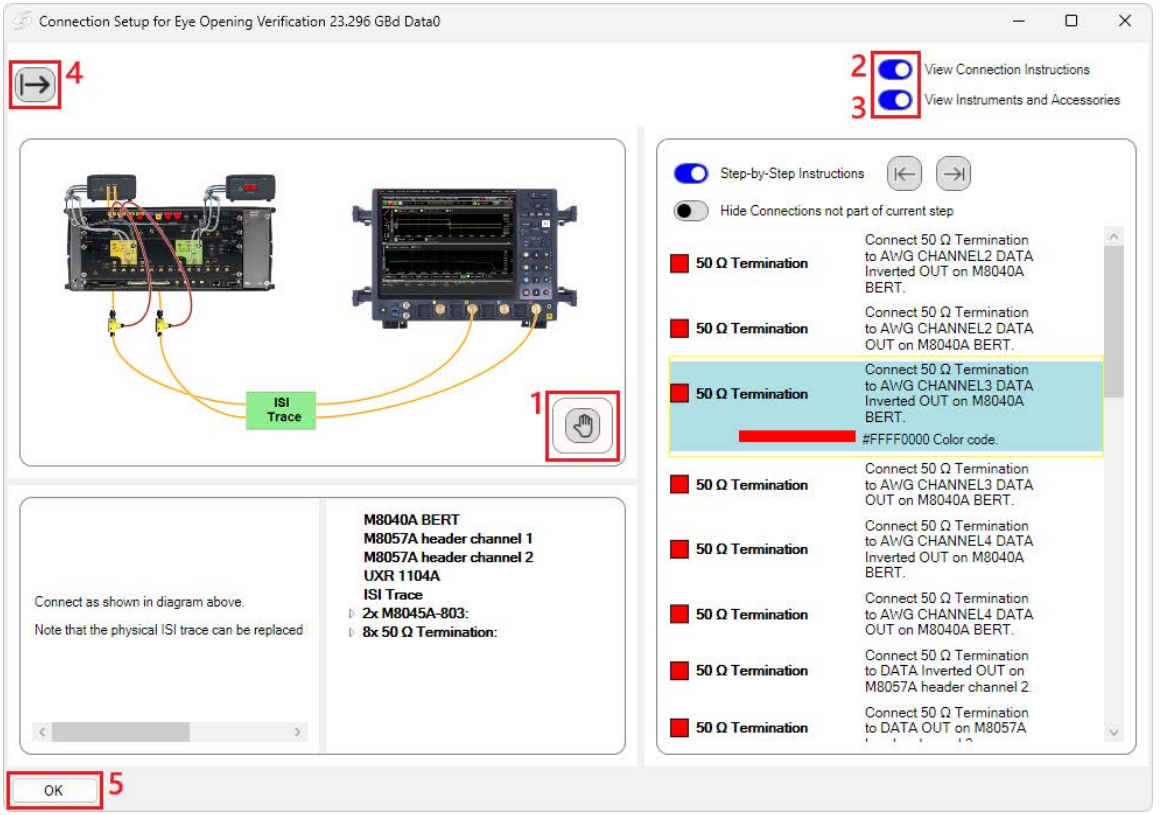

Figure 3-6 Connection diagram window with step-by-step instructions and list of instruments

4 **Export**: Export the diagram as an HTML file. If the list of instruments and accessories is expanded, that will be included in the HTML report as well.

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

For more details, see the N5991 Getting Started Guide.

Required Calibration Data

Some of the calibration procedures and most of the test procedures require calibration data that has been measured previously. You can see the calibration data required by a particular procedure by right-clicking its name in the procedure tree and selecting 'Required Calibration Data...'. A list of the prerequisite calibrations pops up (Figure 3-7).

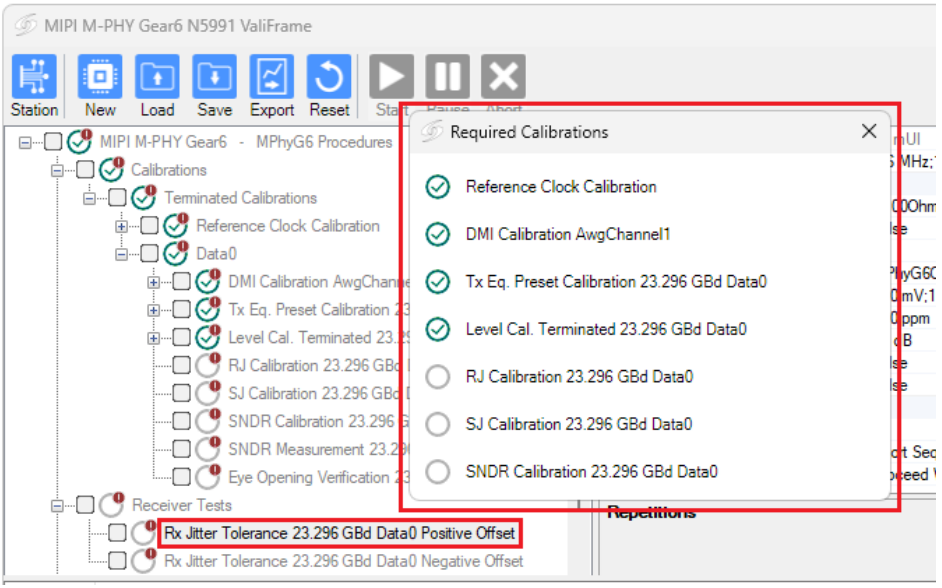

Figure 3-7 Example list of required calibrations

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

N5991MM6A Data Structure

All the N5991MM6A internal data is saved on the PC's local disk in the application data folder ProgramData\BitifEye\ValiFrameK1\MPhyG6.

NOTE **Windows hides the system folders by default. To make the application data folder visible, check 'Hidden items' in the Windows file explorer > View > Show.**

Calibrations

The calibration data is saved in the Calibrations folder. For each calibration procedure run, at least one calibration file is saved.

CalibrationsOffline

If the calibration was run in offline (simulation/demonstration) mode, the calibration data is saved in the CalibrationsOffline folder. Offline calibrations are for demonstration purposes only. They do not yield valid data.

Data

N5991MM6A does not save any files in the Data folder.

Pattern

In the Pattern folder, N5991MM6A saves sequence (.seq) and data (.dat) files.

Projects

The Projects folder is the default folder for ValiFrame project (.vfp) and configuration (.vfc) files. These can be saved by clicking the Save icon in the N5991MM6A main window. The latest project run is saved in the *Autosaved* subfolder, but always overwritten during the next run.

Settings

The Settings folder contains settings files. These will include the instrument connection setup, the Station Configuration setup and settings for the last configured DUT, for example.

SParameter

S-parameter and transfer function files are stored in the SParameter folder.

Results

Run-Time 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 viewer windows that are open during the procedure runs are closed automatically once the specific procedure is finished. As long as the N5991MM6A software is running, each test result file (HTML page) can be reopened by double-clicking the respective procedure. However, the individual files are lost when the N5991MM6A application is closed, unless you save the individual files or a collection of them.

Description of Results

In this user's guide, the descriptions of the calibration and test procedures include example descriptions of the results. In addition to a graph and a table, there is a text in each set of results that records the conditions under which the procedure was carried out, including a list of the instruments used and their associated firmware.

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 anytime in a workbook by clicking the Export button on the toolbar of the N5991MM6A main window. More details can be found in the N5991 Getting Started Guide.

Keysight recommends exporting results at least at the end of each N5991MM6A run to avoid any data loss. If several calibration and test procedures are conducted during the same N5991MM6A 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 a "Tmp" directory (*C:\ProgramData\BitifEye\ValiFrameK1\Tmp*). The sub-folder *Results\MPhyG6 Station* contains the HTML files of the most-recent results measured for each calibration and test procedure.

In addition to the calibration data HTML files, calibration data files are generated. These files are saved by default to the calibrations folder *C:\ ProgramData\BitifEye\ValiFrameK1\MPhyG6\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 this folder and saved manually in a different folder before the calibrations are rerun.

An exported workbook includes a summary of the procedures performed in that run (Figure 3-8) and a summary of the instruments used (Figure 3-9).

Procedure result summary

Shows the procedure results as an overview

Product Number: MPhyG6
Serial Number:
Description:
User Name: Unknown User
User's Comment:
Software Version:
MIPI M-PHY Gear6 N5991 ValiFrame 1.0.0.14

Procedure name	Timestamp	Result	Instruments	Software Version	Spec Deviations	Comments
Reference Clock CalibrationO	11/14/2025 11:22:49 AM	Passed	Offline	1.0.0.14		
Reference Clock CalibrationA	11/14/2025 11:22:49 AM	Passed	Offline	1.0.0.14		
DMI Cal. AwgChannel1	11/14/2025 11:39:52 AM	Passed	Offline	1.0.0.14		
TxEq Cal. 23296MBdData0	11/14/2025 11:45:12 AM	Passed	Offline	1.0.0.14		
Level Cal. Term. 23296MBdData0O	11/14/2025 11:57:45 AM	Passed	Offline	1.0.0.14		
Level Cal. Term. 23296MBdData0A	11/14/2025 11:57:45 AM	Passed	Offline	1.0.0.14		
RJ Cal. 23296MBdData0	11/14/2025 2:16:15 PM	Passed	Offline	1.0.0.14		
SJ Cal. 23296MBdData0	11/14/2025 2:25:03 PM	Passed	Offline	1.0.0.14		
SNDR Cal. 23296MBd Data0	11/14/2025 2:31:24 PM	Passed	Offline	1.0.0.14		
SNDR Meas. 23296MBd Data0	11/14/2025 2:37:27 PM	Passed	Offline	1.0.0.14		
Eye Ver. 23296MBd Data0	11/14/2025 2:41:31 PM	Passed	Offline	1.0.0.14		
JTol 23296MBd Data0 P. Offset	11/14/2025 3:26:14 PM	Passed	Offline	1.0.0.14		

Figure 3-8 Example Procedure Result Summary of an N5991MM6A workbook

- **Procedure Name**: Abbreviated name of the procedure (test or calibration).
- **Timestamp**: the date and time at which the procedure ended.
- **Result**: Whether the procedure was passed or failed.
- **Instruments**: Either 'Connected' or 'Offline' (simulation mode).
- **Software Version**: The version of the N5991MM6A software used to perform the procedure (calibration or test).
- **Spec Deviations**: The parameters that deviate from their default values.
- **Comments**

Instrument Summary

This table lists the instruments used to run these procedures.

Company	Instrument Name	Serial	Instrument Revision	Description
Keysight Technologies	Keysight M8040A J-BERT	Unknown	Unknown	M8040 with integrated jitter sources for BER tests
Keysight Technologies	DSO Infiniium Series	Unknown	Unknown	Real-Time Oscilloscope

Figure 3-9 Example Instrument Summary table from an N5991MM6A workbook

- **Company**: The manufacturer of the instrument.
- **Instrument Name**: The model number or name of the instrument.
- **Serial**: The serial number of the instrument.
- **Instrument Revision**: The revision number or version of the software running on the instrument.
- **Description**: The type of instrument, e.g., Real-Time Oscilloscope.

N5991MM6A Parameters

Sequencer Parameters

The sequencer parameters control the flow of the test sequencer only, not the behavior of individual procedures. One of them, Repetitions, is available for all groups and all individual procedures in the procedure tree. The others are only available for individual procedures. Like all other parameters, the sequencer parameters are shown in the right half of the N5991MM6A user interface, as illustrated in Figure 3-10, and you may manually change them. The sequencer parameters are described in Table B-1 on page 97.

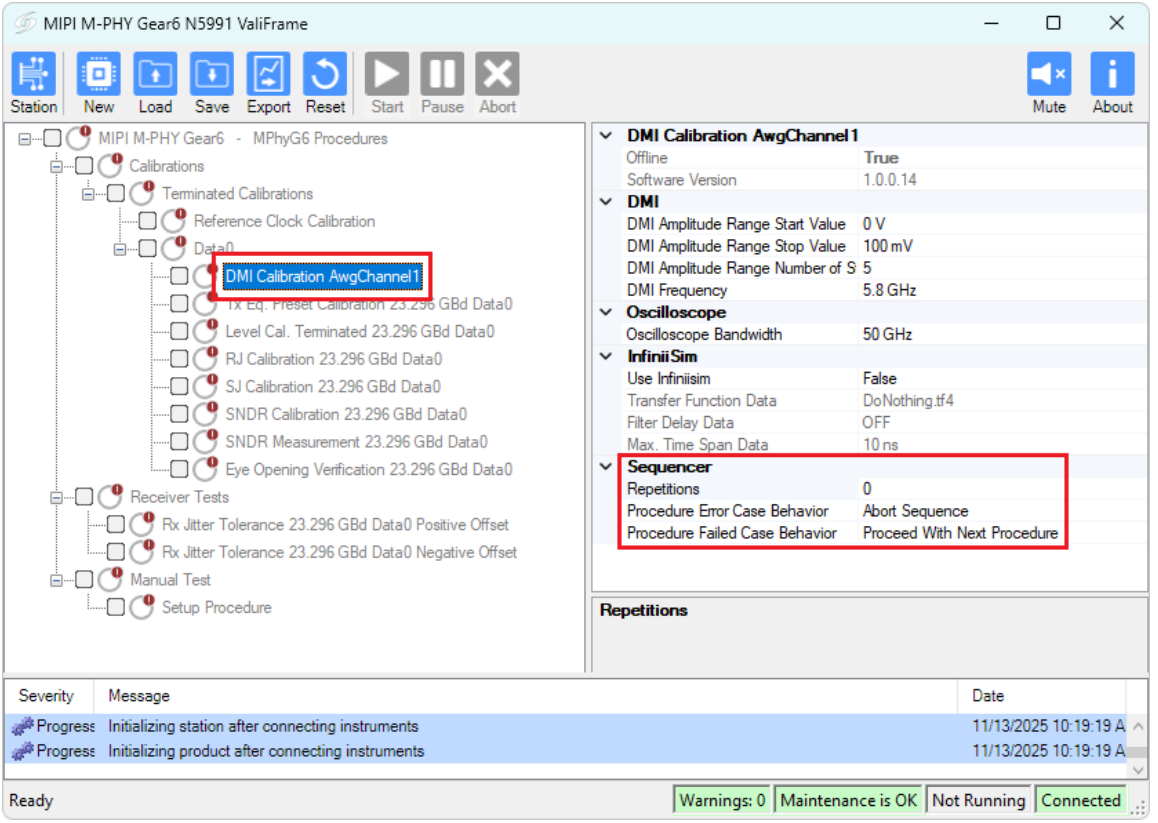

Figure 3-10 N5991MM6A sequencer parameters

Common Parameters

Common parameters are used for several related calibration or test procedures. They are shown on the right side of the N5991MM6A user interface when the selected entry of the procedure tree on the left is a group instead of an individual procedure.

The common parameters used in the N5991MM6A app are listed in Table B-2 on page 98.

Procedure Parameters

The procedure parameters are all those parameters that are not part of either of the previously described categories. They are shown on the right-hand side of the N5991MM6A 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 configured settings always apply to the selected procedure. The meanings of parameters with identical names may differ slightly between procedures.

- The N5991MM6A **calibration** parameters used in individual procedures are listed in Table B-3.
- The N5991MM6A **receiver test and manual test** parameters used in individual procedures are listed in Table B-4.

NOTE Some parameters that are read-only in the user interface main window can be changed when you configure the station 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.

Application Programming Interface

The Test Automation Software Platform application programming interface (ValiFrameAPI) may be of use when an extra level of automation is required above that supplied by the Keysight N5991 Test Automation Software, for example, if a set of tests is to be repeated several times at different temperatures or with other different parameters.

For more details about the API, see the Application Programming Interface for the ValiFrame Test Automation Software Platform User's Guide.

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4 MIPI M-PHY G6 Calibrations for RX Tests

Before any receiver test procedures can be run, the MIPI M-PHY G6 test system must be calibrated.

MIPI M-PHY G6 Calibration Overview

The MIPI M-PHY G6 receiver test system has to be calibrated before any receiver test procedure can be run.

The receiver test signal characteristics, such as the signal generator output voltage level and jitter parameters, are typically affected by the signal transmission between the generator output ports and the DUT input ports. Thus, for any signal output parameter that you may select (referred to as the 'set value'), the jitter and the signal received at the DUT input ports (referred to as the '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 N5991MM6A calibration procedures compensate the actual value deviations of the relevant signal output parameter from the set values over the required parameter range.

All calibration procedures required for MIPI M-PHY G6 receiver testing are included in the N5991MM6A software. The N5991MM6A 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 reconfigurations of the hardware connections.

The results of each calibration are stored in the N5991MM6A 'Calibrations' folder (*C:\ProgramData\BitifEye\ValiFrameK1\MPhyG6\Calibrations*), so that they can be used for another calibration or test, as required.

Prerequisite Calibrations

Prerequisite calibrations are not listed explicitly for each procedure in this user's guide. However, they can be found directly in the application (see Required Calibration Data for details).

N5991MM6A Parameters

The N5991MM6A **common parameters for calibrations** 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. There are only very few common parameters.

Details of N5991MM6A Common Parameters can be found in Table B-2 on page 98.

N5991MM6A **parameters for individual procedures** that can be changed in expert mode are not listed in this user's guide explicitly. They are displayed in the parameter grid (right pane) of the main window of the user interface when you click on the corresponding entry in the procedure tree in the left pane of the main window.

Details of N5991MM6A Calibration Parameters for individual procedures can be found in the section N5991MM6A Parameters for Individual Calibrations on page 99.

Example Connection Diagrams

In this user's 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...".

Calibration Procedures

Example Connection Diagrams

In this user's 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...".

Figure 4-1 Example connection diagram for a terminated calibration procedure without an ISI trace (M8040A, 4-channel scope)

Figure 4-2 Example connection diagram for a terminated calibration procedure without an ISI trace (M8040A, 2-channel scope)

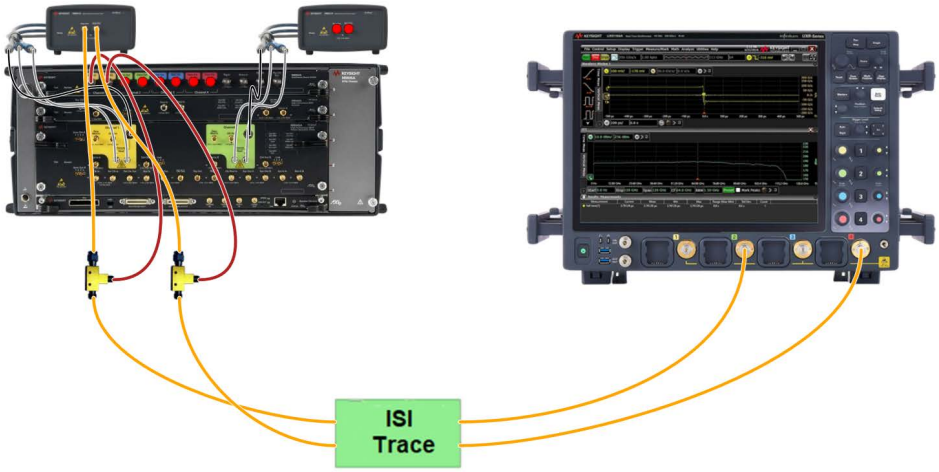


Figure 4-3 Example connection diagram for a Terminated Calibration Procedure with an ISI trace (M8040A, 4-channel scope)

Reference Clock Calibration

Availability

Only for DUT Type Device. When the DUT Type is Host, the clock is generated by the DUT.

Purpose and Method

The purpose of this procedure is to calibrate the output levels (amplitude and offset) of the reference clock.

The output used to generate the reference clock is connected to the oscilloscope. The data generator sweeps the offset according to the range defined by the Offset Range parameters. For each offset value, a sweep of the voltage amplitude is also performed according to the range defined by the Amplitude Range parameters. Then, for each offset–amplitude pair set in the data generator, the actual values of offset and differential voltage amplitude are measured by the oscilloscope and stored.

The results are saved in two separate calibration data files, one for the offset and one for the amplitude.

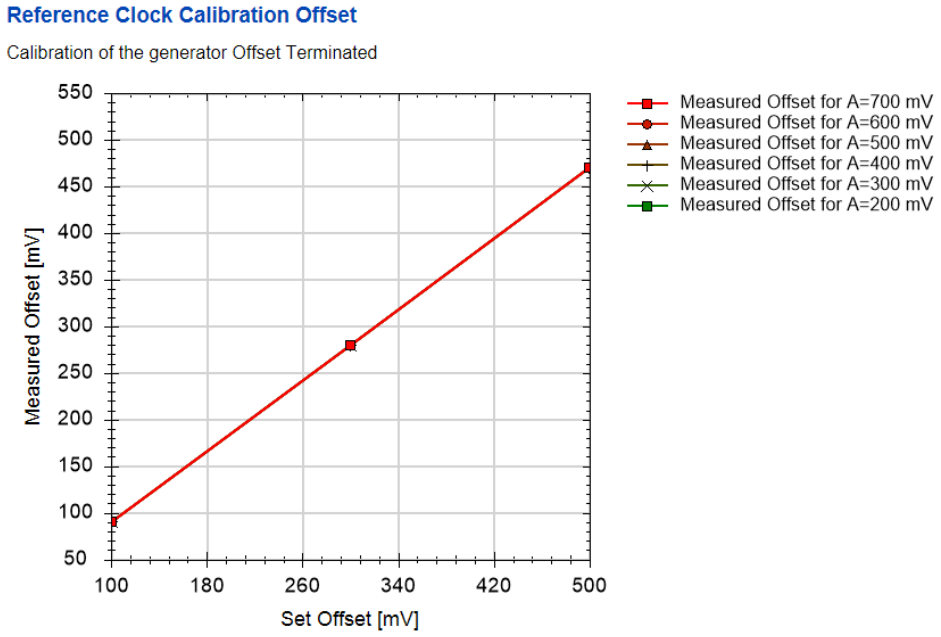
Connection Diagram

Figure 4-4 Example connection diagram for Reference Clock Calibration (M8040A)

Result Description

The Reference Clock Calibration produces two sets of results: one for the offset (Figure 4-5) and one for the amplitude (Figure 4-6).

Offset



----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Data Levels----	
Amplitude Range Start Value	200 mV
Amplitude Range Stop Value	700 mV
Amplitude Range Number of Steps	6
Offset Range Start Value	100 mV
Offset Range Stop Value	500 mV
Offset Range Number of Steps	3
----Oscilloscope----	
Oscilloscope Bandwidth	50 GHz

```
----InfiniiSim----
Use Infiniisim                  False
----Instruments----
Calibrated Instrument 1         Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Mode
Measurement Instrument 1        Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Inf
```

Result	Set Offset [mV]	Measured Offset for A=700 mV [mV]	Measured Offset for A=600 mV [mV]	Measured Offset for A=500 mV [mV]	Measured Offset for A=400 mV [mV]	Measured Offset for A=300 mV [mV]	Measured Offset for A=200 mV [mV]
pass	100	90	90	90	90	90	90
pass	300	280	280	280	280	280	280
pass	500	470	470	470	470	470	470

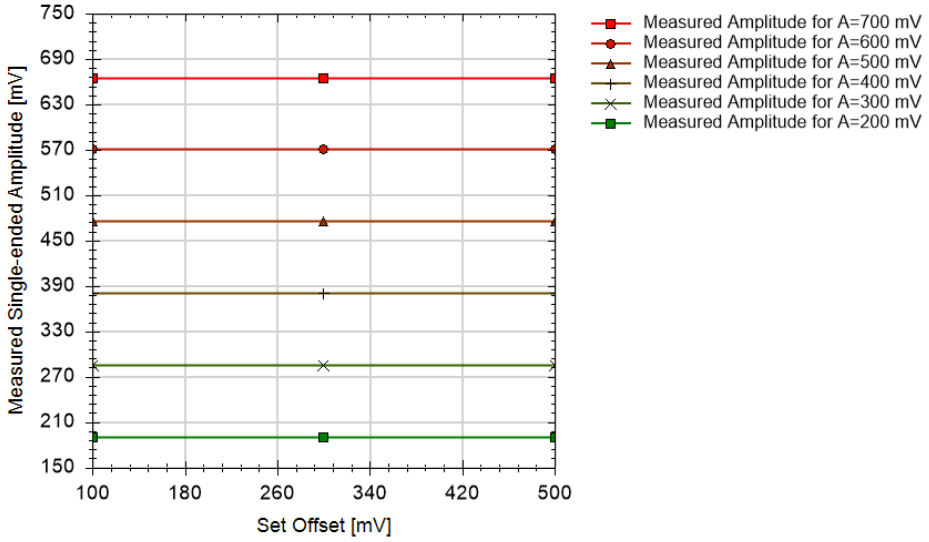
Figure 4-5 Example result for Reference Clock Calibration – Offset

- Result: Pass/Fail — For a Pass, the data for the measured offset values must be monotonic.
- Set Offset [mV]: The offset value set on the generator.
- Measured Offset for A = X mV [mV]: The effective offset value as measured with the oscilloscope using the histogram technique for a generator set amplitude value of X mV.

Amplitude

Reference Clock Calibration Amplitude

Calibration of the Generator Amplitude Terminated



----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Data Levels----	
Amplitude Range Start Value	200 mV
Amplitude Range Stop Value	700 mV
Amplitude Range Number of Steps	6
Offset Range Start Value	100 mV
Offset Range Stop Value	500 mV
Offset Range Number of Steps	3
----Oscilloscope----	
Oscilloscope Bandwidth	50 GHz
----InfiniiSim----	
Use Infiniisim	False
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Mode
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Inf

Result	Set Offset [mV]	Measured Amplitude for A=700 mV [mV]	Measured Amplitude for A=600 mV [mV]	Measured Amplitude for A=500 mV [mV]	Measured Amplitude for A=400 mV [mV]	Measured Amplitude for A=300 mV [mV]	Measured Amplitude for A=200 mV [mV]
pass	100	665	570	475	380	285	190
pass	300	665	570	475	380	285	190
pass	500	665	570	475	380	285	190

Figure 4-6 Example result for Reference Clock Calibration – Amplitude

- Result: Pass/Fail — For a Pass, the data for the measured amplitude values must be monotonic.
- Set Offset [mV]: The offset value set on the generator.
- Measured Amplitude for A = X mV [mV]: The effective amplitude value as measured with the oscilloscope using the histogram technique for a generator set amplitude value of X mV.

DMI Calibration

Purpose and Method

The purpose of this procedure is to calibrate the Differential Mode Interference amplitude. This interference is added for the purpose of adjusting the SNDR.

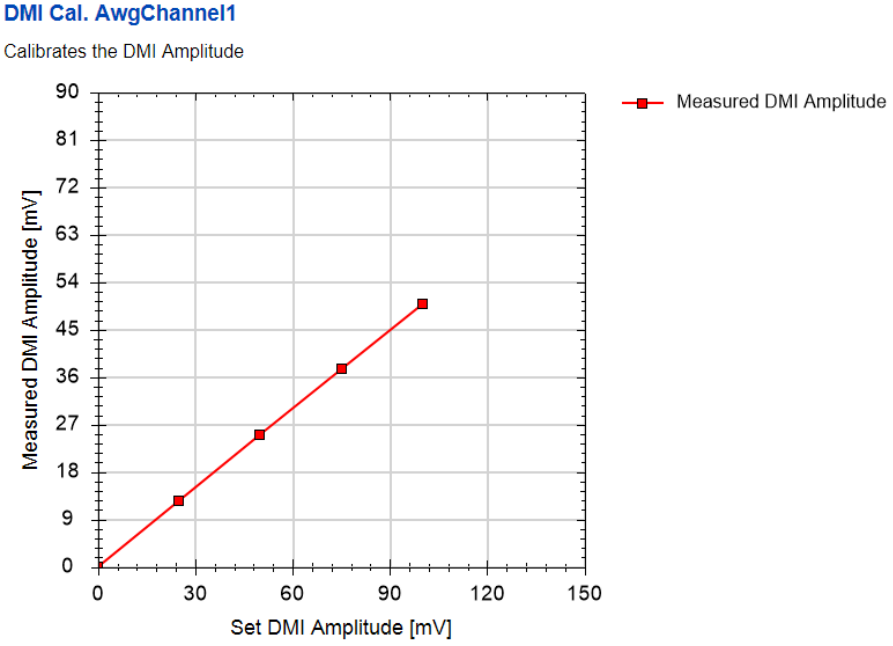
The interference source is combined with the data generator output and connected to the oscilloscope. The interference source generator sweeps the amplitude according to the range defined by the DMI Amplitude Range parameters. The data generator outputs the idle signal. For each DMI amplitude, the actual differential voltage amplitude is measured by the oscilloscope and stored.

The results are saved in one calibration data file.

Connection Diagram

Refer to Figure 4-1 and Figure 4-2.

Result Description



----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----DMI----	
DMI Amplitude Range Start Value	0 V
DMI Amplitude Range Stop Value	100 mV
DMI Amplitude Range Number of Steps	5
DMI Frequency	5.8 GHz
----Oscilloscope----	
Oscilloscope Bandwidth	50 GHz
----InfiniiSim----	
Use Infiniisim	False
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ;
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO

Result	Set DMI Amplitude [mV]	Measured DMI Amplitude [mV]
pass	100	50
pass	75	38
pass	50	25
pass	25	13
pass	0	0

Figure 4-7 Example result for DMI Calibration

- Result: Pass/Fail — Monotonicity is required for a Pass.
- Set DMI Amplitude [mV]: DMI amplitude set on the interference source.
- Measured DMI Amplitude [mV]: DMI amplitude measured using the oscilloscope.

TX Equalization Preset Calibration

Purpose and Method

This procedure calibrates the de-emphasis and pre-shoot by sweeping equalization settings and analyzing the resulting waveform levels.

The pattern generator sends a pattern composed of 16 PAM4 Symbol0 followed by 16 PAM Symbol3 to the oscilloscope and performs a sweep of the equalization range according to the Equalization Setting Method selected in the user interface.

- If Set Pre-Shoot/De-Emphasis is selected as the method, the data generator sweeps according to the range defined by the Pre-Shoot Range and De-Emphasis Range parameters.
- If Set Coefficients is selected, the data generator sweeps according to the range defined by the Pre-Cursor Range and Post-Cursor Range parameters.

At each combination of values, the de-emphasis and pre-shoot are measured with the oscilloscope.

De-emphasis and pre-shoot are calculated using the formulas defined in the specification:

De-emphasis = $-20\log(V_b/V_a)$

Pre-shoot = $20\log(V_c/V_b)$

The waveform levels V_a, V_b and V_c are calculated as the differential value between the amplitude measured on the positive transition and the amplitude measured on the negative transition.

For those measurements, the histogram on the oscilloscope has a width of 0.5 UI. This width allows the correct maximum to be measured in the de-emphasis or pre-shoot zones without including a full UI, which could mix pre-shoot and de-emphasis contributions.

As a result, a single calibration-data table is generated. In subsequent procedures, this calibration data is used to set equalization values that provide the desired de-emphasis and pre-shoot.

Connection Diagram

Refer to Figure 4-1 and Figure 4-2.

Result Description

TxEq Cal. 23296MBdData0

Calibrates the Tx Equalization Presets

----General----	
Offline	True
Software Version	1.0.0.20
Spec Deviations	
Comments	
Ref Clock Frequency	26 MHz
Show DUT Configure Dialog	False
----Transmitter Equalization----	
Equalization Setting Method	Set Pre-Shoot/De-Emphasis
Set Pre-Shoot Range Start Value	0 dB
Set Pre-Shoot Range Stop Value	2.5 dB
Set Pre-Shoot Range Number of Steps	11
Set De-Emphasis Range Start Value	0 dB
Set De-Emphasis Range Stop Value	2.5 dB
Set De-Emphasis Range Number of Steps	11
----Oscilloscope----	
Oscilloscope Bandwidth (Brick Wall)	50 GHz
----InfiniiSim----	
Use Infiniisim	False
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Techn Supported: False ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; I

Set Pre-Cursor []	Set Post-Cursor []	Set Pre-Shoot [dB]	Set De-Emphasis [dB]	Measured Pre-Shoot [dB]	Measured De-Emphasis [dB]
-0.100	-0.100	2.50	2.50	2.70	2.70
-0.091	-0.102	2.25	2.49	2.45	2.69
-0.081	-0.105	1.99	2.51	2.19	2.71
-0.072	-0.107	1.76	2.50	1.96	2.70
-0.062	-0.110	1.50	2.51	1.70	2.71
-0.052	-0.112	1.25	2.50	1.45	2.70
-0.042	-0.115	1.00	2.51	1.20	2.71
-0.032	-0.117	0.76	2.50	0.96	2.70
-0.021	-0.120	0.49	2.50	0.69	2.70
-0.011	-0.122	0.26	2.49	0.46	2.69
0.000	-0.125	0.00	2.50	0.20	2.70
-0.102	-0.091	2.49	2.25	2.69	2.45
-0.093	-0.093	2.25	2.25	2.45	2.45

(...)

-0.122	-0.011	2.49	0.26	2.69	0.46
-0.112	-0.011	2.26	0.25	2.46	0.45
-0.101	-0.011	2.01	0.24	2.21	0.44
-0.089	-0.012	1.75	0.26	1.95	0.46
-0.077	-0.012	1.49	0.25	1.69	0.45
-0.065	-0.012	1.24	0.24	1.44	0.44
-0.053	-0.013	1.00	0.26	1.20	0.46
-0.040	-0.013	0.74	0.25	0.94	0.45
-0.027	-0.013	0.50	0.24	0.70	0.44
-0.014	-0.014	0.25	0.25	0.45	0.45
0.000	-0.014	0.00	0.25	0.20	0.45
-0.125	0.000	2.50	0.00	2.70	0.20
-0.114	0.000	2.25	0.00	2.45	0.20
-0.103	0.000	2.00	0.00	2.20	0.20
-0.091	0.000	1.74	0.00	1.94	0.20
-0.079	0.000	1.49	0.00	1.69	0.20
-0.067	0.000	1.25	0.00	1.45	0.20
-0.054	0.000	0.99	0.00	1.19	0.20
-0.041	0.000	0.74	0.00	0.94	0.20
-0.028	0.000	0.50	0.00	0.70	0.20
-0.014	0.000	0.25	0.00	0.45	0.20
0.000	0.000	0.00	0.00	0.20	0.20

Figure 4-8 Example result for TX Equalization Preset Calibration

- Set Pre-Cursor: Set value of the pre-cursor.
- Set Post-Cursor: Set value of the post-cursor.
- Set Pre-Shoot [dB]: Set value of the pre-shoot.
- Set De-Emphasis [dB]: Set value of the de-emphasis.
- Measured Pre-Shoot [dB]: Value of the pre-shoot measured with the oscilloscope.
- Measured De-Emphasis [dB]: Value of the de-emphasis measured with the oscilloscope.

Level Calibration Terminated

Purpose and Method

The purpose of this procedure is to calibrate the amplitude and offset of the signal generators.

The normal and the complement output signals of the data generator are connected to the oscilloscope channels by direct SMA connection.

The data generator sends a particular clock pattern (Clock Div 160: 80 ones followed by 80 zeros). The offset is swept according to the range defined by the Offset Range parameters. For each offset value, a sweep of the voltage amplitude is also performed according to the range defined by the Amplitude Range parameters. Then, for each offset–amplitude pair set on the data generator, the actual values of offset and differential voltage amplitude are measured by the oscilloscope and stored.

NOTE **The clock pattern is NRZ. Only the total amplitude is calibrated, not each PAM4 level individually. The PAM4 levels will be adjusted in subsequent procedures, calculating according to the Symbol percentage.**

The results are saved in two separate calibration data files, one for the offset and one for the amplitude values.

This calibration is run once at each selected HS data rate.

Connection Diagram

Refer to Figure 4-1 and Figure 4-2.

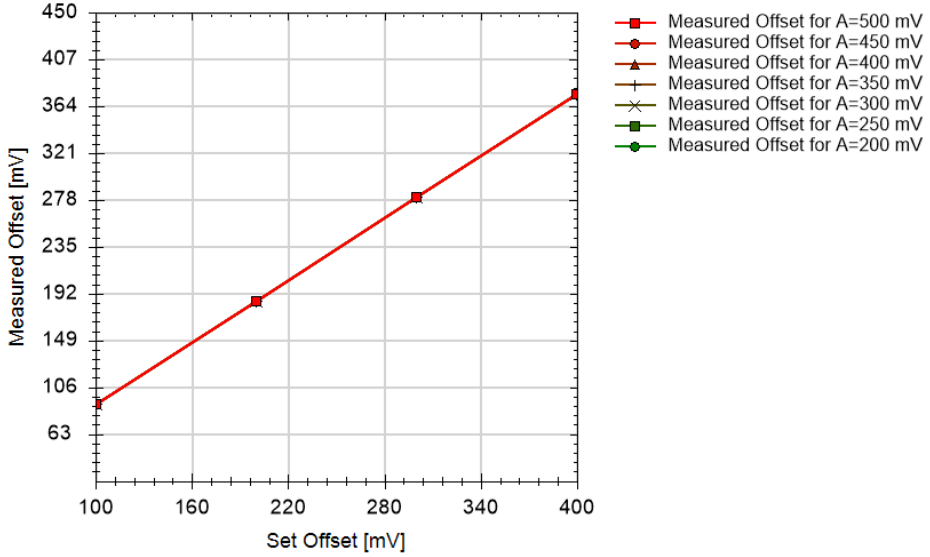
Result Description

The Level Calibration produces two sets of results: one for the offset (Figure 4-9) and one for the amplitude (Figure 4-10).

Offset

Level Cal. Term. 23296MBdData0 Offset

Calibration of the generator Offset Terminated



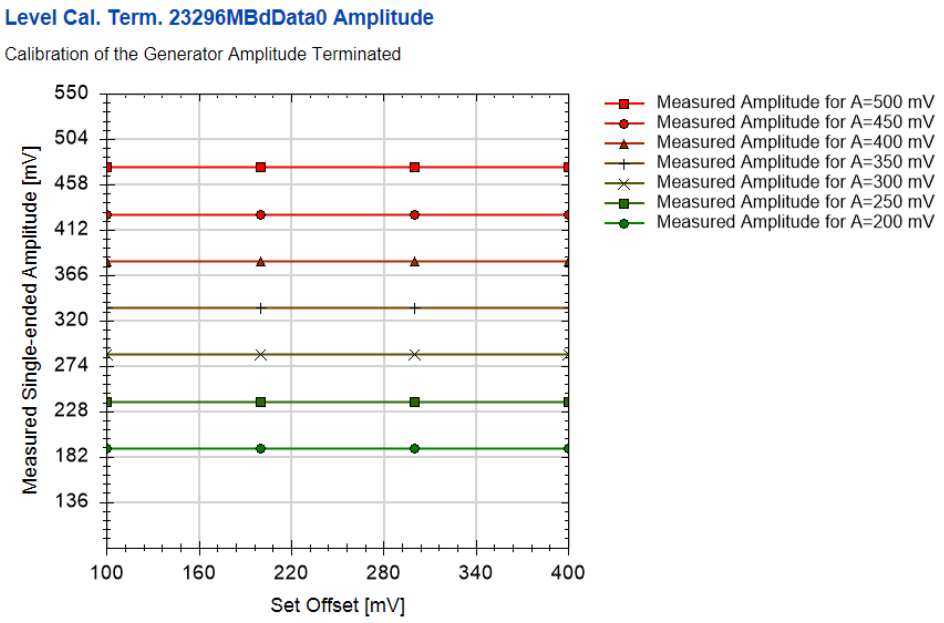
----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Data Levels----	
Amplitude Range Start Value	200 mV
Amplitude Range Stop Value	500 mV
Amplitude Range Number of Steps	7
Offset Range Start Value	100 mV
Offset Range Stop Value	400 mV
Offset Range Number of Steps	4
----Oscilloscope----	
Oscilloscope Bandwidth	50 GHz
----InfiniiSim----	
Use Infiniisim	False
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Mode
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Inf

Result	Set Offset [mV]	Measured Offset for A=500 mV [mV]	Measured Offset for A=450 mV [mV]	Measured Offset for A=400 mV [mV]	Measured Offset for A=350 mV [mV]	Measured Offset for A=300 mV [mV]	Measured Offset for A=250 mV [mV]	Measured Offset for A=200 mV [mV]
pass	100	90	90	90	90	90	90	90
pass	200	185	185	185	185	185	185	185
pass	300	280	280	280	280	280	280	280
pass	400	375	375	375	375	375	375	375

Figure 4-9 Example result for Level Calibration Terminated – Offset

- Result: Pass/Fail — Monotonicity is required for a Pass.
- Set Offset [mV]: The offset value set on the generator.
- Measured Offset for A = X mV [mV]: The effective offset value as measured with an oscilloscope using the histogram technique for a generator set amplitude value of X mV.

Amplitude



----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Data Levels----	
Amplitude Range Start Value	200 mV
Amplitude Range Stop Value	500 mV
Amplitude Range Number of Steps	7
Offset Range Start Value	100 mV
Offset Range Stop Value	400 mV
Offset Range Number of Steps	4
----Oscilloscope----	
Oscilloscope Bandwidth	50 GHz
----InfiniiSim----	
Use Infiniisim	False
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Mode
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Inf

Result	Set Offset [mV]	Measured Amplitude for A=500 mV [mV]	Measured Amplitude for A=450 mV [mV]	Measured Amplitude for A=400 mV [mV]	Measured Amplitude for A=350 mV [mV]	Measured Amplitude for A=300 mV [mV]	Measured Amplitude for A=250 mV [mV]	Measured Amplitude for A=200 mV [mV]
pass	100	475	428	380	333	285	238	190
pass	200	475	428	380	333	285	238	190
pass	300	475	428	380	333	285	238	190
pass	400	475	428	380	333	285	238	190

Figure 4-10 Example result for Level Calibration Terminated – Amplitude

- Result: Pass/Fail — Monotonicity is required for a Pass.
- Set Offset [mV]: The offset value set on the generator.
- Measured Amplitude for A = X mV [mV]: The effective amplitude value as measured with the oscilloscope using the histogram technique for a generator set amplitude value of X mV.

RJ Calibration

Purpose and Method

The purpose of this procedure is to calibrate the random jitter that is generated internally by the BERT.

The data generator sends a clock pattern and sweeps the RJ amplitude according to the range defined by the RJ Amplitude (RMS) Range parameters. At each step, the values of random jitter are measured, and both set and measured random jitter values are saved.

This calibration should be run once at each selected HS data rate.

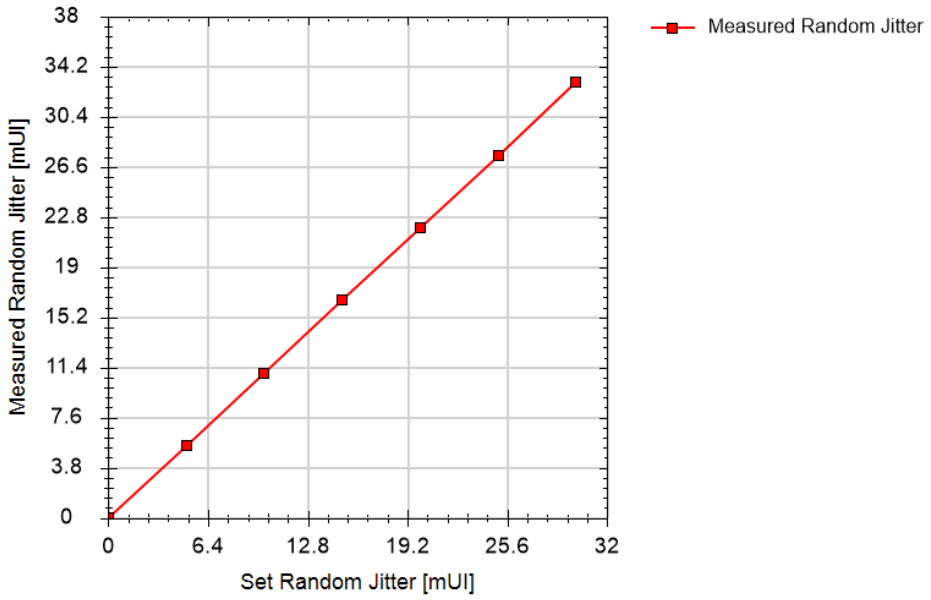
Connection Diagram

Refer to Figure 4-1 and Figure 4-2.

Result Description

RJ Cal. 23296MBdData0

Calibrates the Random Jitter Amplitude



----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Jitter----	
RJ Amplitude (RMS) Range Start Value	0 UI
RJ Amplitude (RMS) Range Stop Value	30 mUI
RJ Amplitude (RMS) Range Number of Steps	7
----Calibration----	
Calibration transition count	500000
----Oscilloscope----	
Oscilloscope Bandwidth	50 GHz
----Clock Data Recovery----	
CDR Loop Bandwidth	1.6 MHz
CDR Damping Factor	0.707
----InfiniiSim----	
Use Infiniisim	False
----Equalization----	
Enable Equalization	False
First Zero Frequency	6.4 GHz
DFE Tap1 Voltage Level	0 V
DFE Tap2 Voltage Level	0 V
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologi Instrument
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model

Result	Set Random Jitter [mUI]	Measured Random Jitter [mUI]	Measured Jitter (Time) [ps]
pass	0.00	0.00	0.000
pass	5.00	5.50	0.236
pass	10.00	11.00	0.472
pass	15.00	16.50	0.708
pass	20.00	22.00	0.944
pass	25.00	27.50	1.180
pass	30.00	33.00	1.417

Figure 4-11 Example result for RJ Calibration

- Result: Pass/Fail — The calibration will fail if the measured values are non-monotonic.
- Set Random Jitter [mUI]: The jitter value set on the generator (in UI RMS).
- Measured Random Jitter [mUI]: The value of jitter measured on the oscilloscope in terms of unit intervals (UI RMS).
- Measured Jitter (Time) [ps]: The value of jitter measured on the oscilloscope in units of picoseconds.

SJ Calibration

Purpose and Method

This procedure calibrates the sinusoidal jitter that is added to the generated signal.

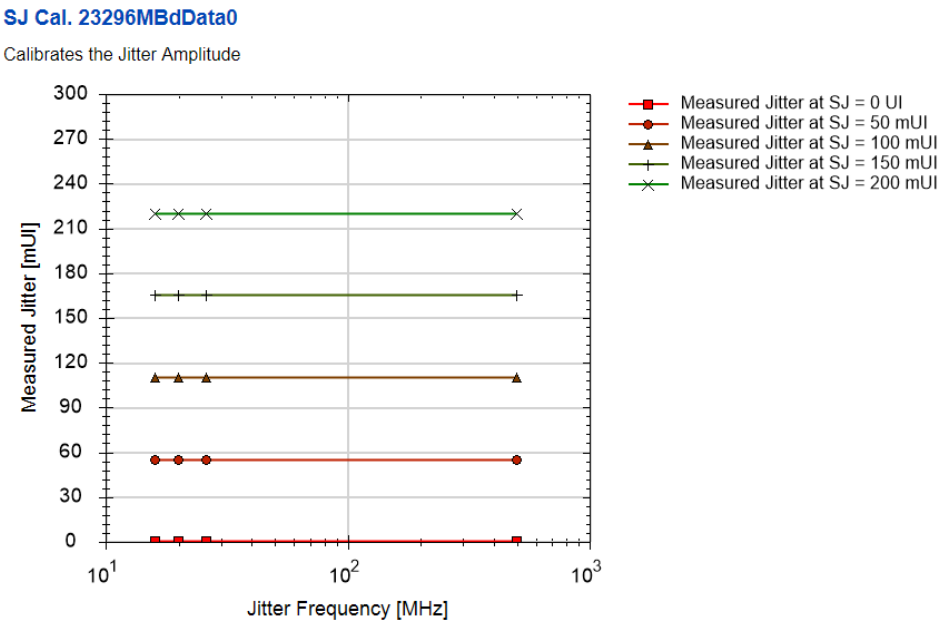
The data generator sends a clock pattern and sweeps the SJ amplitude according to the range defined by the SJ Amplitude Range parameters. Each jitter value is calibrated for several frequency points (given by the SJ Frequencies parameter). At each step, the actual value of jitter amplitude, measured with the oscilloscope, and the set value are saved.

This calibration is run once at each selected HS data rate.

Connection Diagram

Refer to Figure 4-1 and Figure 4-2.

Result Description



----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Jitter----	
SJ Frequencies	16 MHz;20 MHz;26 MHz;500 MHz
SJ Amplitude Range Start Value	0 UI
SJ Amplitude Range Stop Value	200 mUI
SJ Amplitude Range Number of Steps	5
----Calibration----	
Calibration transition count	14000
----Oscilloscope----	
Oscilloscope Bandwidth	50 GHz
----Clock Data Recovery----	
CDR Loop Bandwidth	1.6 MHz
CDR Damping Factor	0.707
----InfiniiSim----	
Use Infiniisim	False
----Equalization----	
Enable Equalization	False
First Zero Frequency	6.4 GHz
DFE Tap1 Voltage Level	0 V
DFE Tap2 Voltage Level	0 V
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; M
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO

Result	Jitter Frequency [MHz]	Measured Jitter at SJ = 0 UI [mUI]	Measured Jitter at SJ = 50 mUI [mUI]	Measured Jitter at SJ = 100 mUI [mUI]	Measured Jitter at SJ = 150 mUI [mUI]	Measured Jitter at SJ = 200 mUI [mUI]
pass	16.00	0.0	55.0	110.0	165.0	220.0
pass	20.00	0.0	55.0	110.0	165.0	220.0
pass	26.00	0.0	55.0	110.0	165.0	220.0
pass	500.00	0.0	55.0	110.0	165.0	220.0

Figure 4-12 Example result for SJ Calibration

- Result: Pass/Fail — The result is fail if the results are not monotonic.
- Jitter Frequency [MHz]: The frequency of the jitter that is being calibrated.
- Measured Jitter at SJ = X mUI [mUI]: The measured amplitude value of the sinusoidal jitter for the set SJ amplitude value X mUI.

SNDR Calibration

Purpose and Method

This procedure calibrates the ratio of signal to noise and distortion of the generator (SNDR: signal-to-(noise and distortion) ratio) by adjusting the DMI.

The data generator sends the PRBS13Q pattern, and the interference source sweeps the DMI amplitude in the range defined by the DMI Amplitude Range parameters. The SJ and RJ sources are set to the target values for the jitter tolerance test. The DMI frequency that was used in the DMI Calibration will be set in this calibration as default. At each step, the SNDR is measured with the oscilloscope using the Infiniium software.

This calibration requires the oscilloscope RJ and noise to be calibrated (among other things). This can be done two ways. By default, the parameter Disconnect for Noise Calibration is 'false,' and the calibration is done without reconnections. To do the calibration exactly as described on the oscilloscope, set Disconnect for Noise Calibration to 'true' and follow the instructions.

The measured SNDR values and the set DMI are saved in the calibration data.

The voltage level used for the PAM4 symbols will affect the result of this calibration. Therefore, in further calibrations or tests where calibrated SNDR is applied, the voltage level will be set to the same value as used in the SNDR calibration.

Also, the PAM4 voltage levels are set in the Configure Product dialog (under Default Levels), and the SNDR calibration will be valid only if it is run with the same voltage level values as there. If other voltage levels are used, when the procedure tree is reloaded (by clicking New or reloading the app), it will be shown as incomplete. In later procedures that require the SNDR calibration, a dialog pops up to inform the user that they ran the SNDR calibration previously with values different from the default and to ask them if they wish to continue with the procedure.

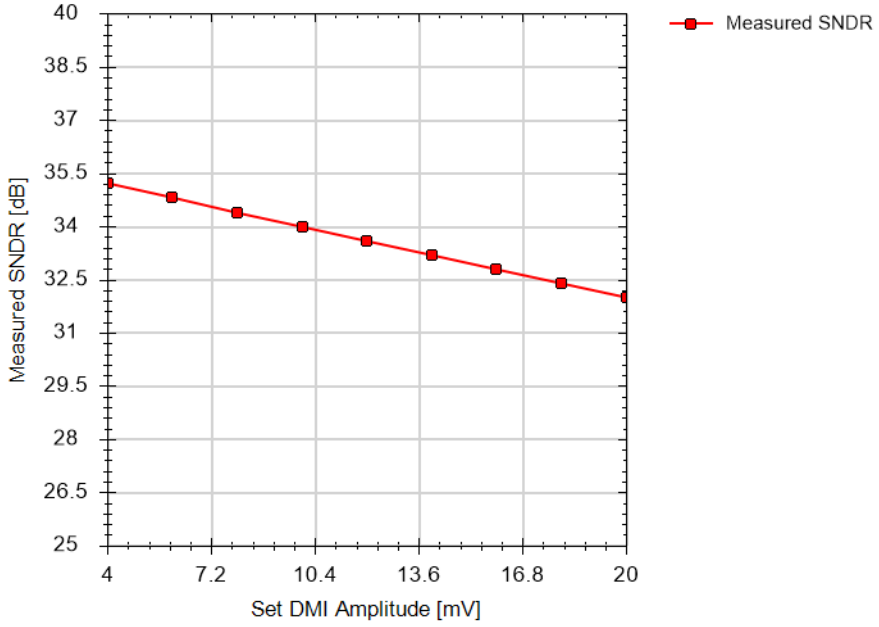
Connection Diagram

Refer to Figure 4-1 and Figure 4-2.

Result Description

SNDR Cal. 23296MBd Data0

Measure the SNDR



----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Data Levels----	
DIF-N Voltage level	-270 mV
DIF-IN Voltage level	-90 mV
DIF-IP Voltage level	90 mV
DIF-P Voltage level	270 mV
Data Offset	0 V
----DMI----	
DMI Amplitude Range Start Value	4 mV
DMI Amplitude Range Stop Value	20 mV
DMI Amplitude Range Number of Steps	9
DMI Frequency	5.8 GHz

----Jitter----	
SJ Amplitude	80 mUI
SJ Frequency	16 MHz
RJ (RMS) Amplitude	12.1 mUI
----Calibration----	
Frequency Deviation	0 ppm
Sequence	MPhyG6CalPRBS13Q.seq
Number of UIs to acquire	3500000
Disconnect For Noise Calibration	False
----Oscilloscope----	
Oscilloscope Bandwidth	30 GHz
----Clock Data Recovery----	
CDR Loop Bandwidth	1.6 MHz
CDR Damping Factor	0.707
----InfiniiSim----	
Use Infiniisim	False
----Equalization----	
Enable Equalization	False
First Zero Frequency	2.54789 GHz
DFE Tap1 Voltage Level	0 V
DFE Tap2 Voltage Level	0 V
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ;
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO

Result	Set DMI Amplitude [mV]	Measured SNDR [dB]
pass	20	32.00
pass	18	32.40
pass	16	32.80
pass	14	33.20
pass	12	33.60
pass	10	34.00
pass	8	34.40
pass	6	34.80
pass	4	35.20

Figure 4-13 Example result for SNDR Calibration

- Result: Pass/Fail — Monotonicity is required for a Pass.
- Set DMI Amplitude [mV]: The amplitude of the DMI set on the interference source.
- Measured SNDR [dB]: The value of SNDR measured using the oscilloscope.

SNDR Measurement

Purpose and Method

This procedure makes a single SNDR measurement for the impairments defined by the parameters. It can be used to verify that the correct target SNDR is saved.

This procedure consists of a single step that sets all the parameters in the data generator (levels, RJ, SJ, DMI). The default DMI frequency is the one that was used in the DMI Calibration. The default value of the DMI amplitude parameter is the one that generates the target SNDR according to the SNDR calibration. The SNDR Measurement will only apply the DMI amplitude that corresponds to the target SNDR of 33 if the loaded DMI calibration and SNDR calibration were both executed with the same DMI frequency.

The DMI value is set on the interference source while the data generator sends the PRBS13Q pattern. The SNDR is measured with the same method as for the calibration.

Besides the measured SNDR, also Pmax, SigmaN, SigmaE and RLM are reported and saved.

Connection Diagram

Refer to Figure 4-1 and Figure 4-2.

Result Description

SNDR Meas. 23296MBd Data0

Measure the SNDR

----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Data Levels----	
DIF-N Voltage level	-270 mV
DIF-IN Voltage level	-90 mV
DIF-IP Voltage level	90 mV
DIF-P Voltage level	270 mV
Data Offset	0 V

----DMI----	
DMI Amplitude	15 mV
DMI Frequency	5.8 GHz
----Jitter----	
SJ Amplitude	80 mUI
SJ Frequency	16 MHz
RJ (RMS) Amplitude	12.1 mUI
----Calibration----	
Frequency Deviation	0 ppm
Sequence	MPhyG6CalPRBS13Q.seq
Number of UIs to acquire	3500000
Disconnect For Noise Calibration	False
----Oscilloscope----	
Oscilloscope Bandwidth	30 GHz
----Clock Data Recovery----	
CDR Loop Bandwidth	1.6 MHz
CDR Damping Factor	0.707
----InfiniiSim----	
Use Infiniisim	False
----Equalization----	
Enable Equalization	False
First Zero Frequency	2.54789 GHz
DFE Tap1 Voltage Level	0 V
DFE Tap2 Voltage Level	0 V
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies ; Mod
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO In

Result	Measured SNDR [dB]	Measured Pmax [mV]	Measured SigmaN [mV]	Measured SigmaE [mV]	Measured RLM [x/x]
pass	33.000	270.000	2.000	3.000	0.950

Figure 4-14 Example result for SNDR Measurement

- Result: Pass/Fail – The result is Fail if any of the parameters measured on the oscilloscope are not a number (NaN).
- Measured SNDR [dB]: Value of SNDR measured on the oscilloscope.
- Measured Pmax [mV]: Value of Pmax measured on the oscilloscope.
- Measured SigmaN [mV]: Value of SigmaN measured on the oscilloscope.
- Measured SigmaE [mV]: Value of SigmaE measured on the oscilloscope.
- Measured RLM [x/x]: Measured level separation mismatch ratio.

Eye Opening Verification

Purpose and Method

The purpose of this procedure is to measure the eye and verify that it is within the specification values.

The pattern generator sends the PRQS10 pattern by default. The selected TX Equalization and levels are applied to the signal; RJ and SJ amplitudes are set to spec values and the DMI source is adjusted to give the target SNDR. The upper eye is measured on the oscilloscope, and it will be considered as a pass if EW > 240 mUI and EH > 25 mV. The measurement is repeated for each SJ frequency defined in the 'SJ Frequency' parameter.

If 'Sweep over TX Equalization Presets' is set to True, the eye measurement will be done for each preset listed under 'Equalization Presets to Test'.

If 'Sweep over CTLE AC Gain' is set to true, the eye measurement will be repeated for each CTLE listed under 'CTLE Presets'.

In this procedure, the test point to be calibrated should include:

- the channel with an insertion loss of –10.55 dB (including ISI Conformance Channel, Replica Trace and cables)
- Receiver Package + Die Model (of the IC in the DUT)
- CDR, CTLE and DFE

The ISI channel and replica trace can be either added physically to the setup or included in the transfer function that is embedded using the InfiniiSim feature of the oscilloscope.

The N5991MM6A app includes two transfer functions that can be used:

- M-PHY_6-Reference_Package-Die_Model.tf4.
  This one can be used when the channel is added physically to the setup.
- M-PHY_6-Channel_Model_CH1d0_Compliance-Reference_Package-Die_Model.tf4.
  This one does not require a channel to be added to the setup.

The overall result will be a pass if for at least one of the equalization combinations the eye passes for all of the SJ frequencies.

Connection Diagram

Refer to Figure 4-3.

Result Description

Eye Ver. 23296MBd Data0

Measure Eye Opening

----General----	
Offline	True
Software Version	1.0.0.19
Spec Deviations	
Comments	
Ref Clock Frequency	26 MHz
Show DUT Configure Dialog	False
----Transmitter Equalization----	
Tx Equalization Preset	P4
De-Emphasis Level	0 dB
Pre-Shoot Level	1.6 dB
----Data Levels----	
DIF-N Voltage level	-270 mV
DIF-IN Voltage level	-90 mV
DIF-IP Voltage level	90 mV
DIF-P Voltage level	270 mV
Data Offset	250 mV
----Jitter----	
SJ Frequencies	16 MHz;20 MHz;26 MHz;500 MHz
SJ Amplitude	80 mUI
RJ (RMS) Amplitude	12.1 mUI
----Calibration----	
Frequency Deviation	0 ppm
Sequence	MPhyG6CalPRQS10.seq
Target SNDR	33 dB
Number of UIs to acquire	10000000
Calculate Center of Middle Eye	True
Run Mask Test	True
Sweep over Tx Equalization Presets	False
Sweep over CTLE AC Gain	False
----Oscilloscope----	
Oscilloscope Bandwidth (Bessel)	30 GHz
----Clock Data Recovery----	
CDR Loop Bandwidth	16 MHz
CDR Damping Factor	0.707
----InfiniiSim----	
Use Infiniisim	True
Transfer Function Data	M-PHY_6-Reference_Package-Die_Model.tf4
Filter Delay Data	OFF
Max. Time Span Data	10 ns

----Receiver Equalization----	
Enable Equalization	True
AC Gain	10 dB
DC Gain	0 dB
First Zero Frequency	2.02386 GHz
Second Zero Frequency	9 GHz
Pole 1 Frequency	6.4 GHz
Pole 2 Frequency	12.6 GHz
Pole 3 Frequency	26 GHz
DFE enabled	True
Auto set DFE taps	True
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technolo
Measurement Instrument 1	Name: Keysight DSO ; Company: Keysight Technologies ; Mod

Result	Set SJ Frequency [MHz]	Set AC Gain [dB]	Set DFE Tap1 [mV]	Set DFE Tap2 [mV]	Set Tx Equalization Preset []	Measured Eye Width [mUI]	Target Eye Width [mUI]	Measured Eye Height [mV]	Target Eye Height [mV]	Top Eye Mask Violations []	Middle Eye Mask Violations []	Bottom Eye Mask Violations []
pass	16	10	0.0	0.0	4	279.6	240.0	30.0	25.0	0	0	0
pass	20	10	0.0	0.0	4	279.6	240.0	30.0	25.0	0	0	0
pass	26	10	0.0	0.0	4	279.6	240.0	30.0	25.0	0	0	0
pass	500	10	0.0	0.0	4	279.6	240.0	30.0	25.0	0	0	0

Figure 4-15 Example result for Eye Opening Calibration

- Result: Pass/Fail – The result is Fail if it is not possible to reach the target eye width and height for all SJ frequencies. When a sweep over either TX Equalization Presets or CTLE Gain is performed (see method), the procedure will pass if for at least one equalization combination the eye is within the specification range for all the SJ frequencies.
- Set SJ Frequency [MHz]: Value of set SJ frequency.
- Set AC Gain [dB]: Value of set AC gain.
- Set DFE Tap1 [mV]: Value of set DFE Tap1.
- Set DFE Tap2 [mV]: Value of set DFE Tap2.
- Set TX Equalization Preset: The equalization preset that was used.
- Measured Eye Width [mUI]: The value of the upper eye width measured on the oscilloscope.
- Target Eye Width [mUI]: Target eye width according to the specification.
- Measured Eye Height [mV]: The value of the upper eye height measured on the oscilloscope.
- Target Eye Height [mV]: Target eye height according to the specification.

- Top Eye Mask Violations: Number of times the top-eye mask was violated.
- Middle Eye Mask Violations: Number of times the middle-eye mask was violated.
- Bottom Eye Mask Violations: Number of times the bottom-eye mask was violated.

5 MIPI M-PHY G6 Receiver Tests

Once the MIPI M-PHY G6 Test Station has been calibrated, MIPI M-PHY G6 receiver test procedures can be run.

MIPI M-PHY G6 Receiver Test Overview

Prerequisite Calibrations

Prerequisite calibrations are not listed explicitly for each procedure in this user's guide. However, they can be found directly in the application (see Required Calibration Data for details).

N5991MM6A Parameters

Apart from 'Repetitions', N5991MM6A has no **common parameters** for Receiver Tests.

The N5991MM6A **parameters for individual procedures** that can be changed in expert mode are not listed in this user's guide explicitly. They are displayed in the parameter grid (right pane) 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 N5991MM6A Receiver Test Parameters for individual procedures can be found in Table B-4 on page 110.

Connection Diagrams

In this user's guide, only example connection diagrams are given at the beginning of each chapter. 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...".

Receiver Tests

Example Connection Diagram

In this user's guide, only an example connection diagram is 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...".

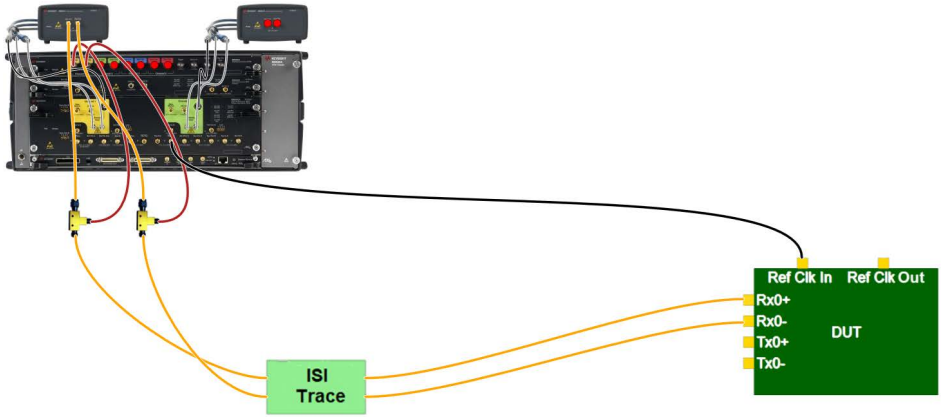


Figure 5-1 Example connection diagram for receiver tests

RX Jitter Tolerance

Purpose and Method

This procedure verifies that the M-RX receives the data successfully with a test scenario where the jitter conforms with the specification.

Before this test is run, TX Equalization, RJrms, SJ and SNDR should be calibrated with results verified using the Eye Opening Verification. During test-signal calibration, all components and impairments are evaluated to generate calibrated values that meet the specification.

For this test, the DUT receives a test signal that is by default a PRQS10 pattern with all previously calibrated components and impairments included. The signal is then sent through the ISI channel to meet the accumulated eye-diagram requirements for conformance.

There are two test points (measured in separate procedures), one for each frequency offset: positive offset (+150 ppm) and negative offset (–150 ppm). The Frequency Offset is with respect to the nominal bit rate.

Three separate common-mode amplitude cases are tested:

1. a nominal amplitude of 260 mV
2. the minimum RX value of 190 mV
3. the maximum RX value of 330 mV

These conformance values can be modified with the CM Voltages to Test parameter.

For each given jitter frequency, the BER is measured and compared with the Target BER of 1E-6.

If the ‘Jitter Characterization’ property is set to true, the value of SJ is increased until errors are found. The procedure performs a linear search defined by the parameters ‘SJ Test Amplitude for High Frequency Start Value’, ‘SJ Test Amplitude for High Frequency Stop Value’ and ‘SJ Test Amplitude for High Frequency Number of Steps’.

When the parameter ‘Use Eye Opening Verification Settings’ is set to True, the signal settings such as Voltage Level, TX Preset, SJ Amplitude, RJ Amplitude and Target SNDR are replaced by the values used in the available Eye Opening Verification run.

A test BER measurement will be performed with RJ and DMI enabled (set to the magnitudes from calibration), prior to the testing of each SJ tone. This provides a check of the DUT's G6 stability in a moderately stressful scenario before adding the full stress with the SJ impairment.

Connection Diagram

Refer to Figure 5-1.

Result Description

JTol 23296MBd Data0 P. Offset

----General----	
Offline	True
Software Version	1.0.0.14
Spec Deviations	
Comments	
Show DUT Configure Dialog	False
----Tx Eq----	
TxEQ Preset	P4
De-Emphasis Level	0 dB
Pre-Shoot Level	1.6 dB
----Data Levels----	
DIF-N Voltage level	-270 mV
DIF-IN Voltage level	-90 mV
DIF-IP Voltage level	90 mV
DIF-P Voltage level	270 mV
----DMI----	
DMI Amplitude	15 mV
DMI Frequency	5.8 GHz
----Jitter----	
RJ (RMS) Amplitude	12.1 mUI
SJ Amplitude	80 mUI
SJ Frequencies	1.6 MHz;16 MHz;20 MHz;26 MHz;500 MHz
----Test----	
Re-Init sequence after Reset DUT	False
Number of Retries	2
Sequence	MPhyG6Compliance.seq
CM Voltages to Test	260 mV;190 mV;330 mV
Frequency Deviation	150 ppm
Target SNDR	33 dB
Jitter Characterization	False
Use Eye Opening Verification Settings	False
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8040A J-BERT ; Company: Keysight Technologies

Result	Offset [mV]	SJ Frequency [MHz]	Max Passed SJ Amplitude [mUI]	BER Max Passed SJ [ ]
pass	260	1.6	800	0.000E+000
pass	260	16.0	80	0.000E+000
pass	260	20.0	80	0.000E+000
pass	260	26.0	80	0.000E+000
pass	260	500.0	80	0.000E+000
pass	190	1.6	800	0.000E+000
pass	190	16.0	80	0.000E+000
pass	190	20.0	80	0.000E+000
pass	190	26.0	80	0.000E+000
pass	190	500.0	80	0.000E+000
pass	330	1.6	800	0.000E+000
pass	330	16.0	80	0.000E+000
pass	330	20.0	80	0.000E+000
pass	330	26.0	80	0.000E+000
pass	330	500.0	80	0.000E+000

Figure 5-2 Example result for RX Jitter Tolerance

- Result: Pass/Fail — For the result Pass, the DUT must be able to recover data with an error below the Target BER from the pattern it receives. Otherwise the result is Fail.
- Offset [mV]: Value of the common mode voltage tested.
- SJ Frequency [MHz]: Value of SJ frequency tested.
- Max Passed SJ Amplitude [mUI]: Value of the largest SJ amplitude that passed.
- BER Max Passed SJ: Measured BER for the Max Passed SJ Amplitude.

Manual Test

Setup Procedure

Purpose and Method

This procedure allows you to set a wide range of parameters as well as to measure the BER after those parameters have been set.

If 'Check Pattern' is set to False, the sequence, level and all selected parameters are set on the generator. Then the procedure will finish. The purpose of this is to prepare the setup for manual debugging processes.

If 'Check Pattern' is set to True, instead of the procedure finishing directly after the configuration is done, it goes on to perform a BER measurement.

The Setup Procedure supports only the high-frequency jitter (HFJ) source. This will limit the frequency range and allowed amplitude of some SJ frequencies as compared to the full RX Jitter Tolerance test, where the low-frequency jitter (LFJ) source is also supported. Since there is some frequency overlap between the LFJ and HFJ sources, this can lead to differences in testing ranges and results between the Setup Procedure and RX Jitter Tolerance test.

Connection Diagram

Refer to Figure 5-1.

Result Description

– Result: When 'Check Pattern' is set to True, the BER must be below the Target BER in order to give a Pass.

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A RX Test Sequences

This appendix presents a brief summary of the RX Test sequences available for testing.

Default RX Test Sequence

The default RX Test sequence is shown in Figure A-1.

```
Blocks:
Data: 0b11s160,  8{PAM4('03030303303030300303030330303030')}, 8{PAM4('30103033233012011221030321211022')},
      PAM4('03230300100321322112303012122311'),
      "C:\ProgramData\BitifEye\ValiFrameK1\MPhyG6\Pattern\MPHY_PRQS10.txt", 0b00s64;

Sequence:
1. Data,1;
```

Figure A-1 Default RX Test pattern

Besides the Test Pattern, it contains the Prepare for Burst, Sync, and Tail of Burst elements.

- **Prepare for Burst: 0b11s160**
  By default, 160 DIF-P symbols are sent. The length of the PREPARE can be configured according to the spec definition (HS_PREPARE_LENGTH × 5 × 2(GEAR-3) SI PAM4). To use a different length replace the 160 by the desired length.
- **SYNC:**
  - **SYNC_L0_L3: 8{PAM4('03030303303030300303030330303030')}**
    By default, 8 SYNC_L0_L3 sequences are sent, which is the minimum according to the spec (2SYNC_length_L0_L3 SI PAM4). To use a different length, replace the 8 by the desired length.
  - **SYNC_L0_L1_L2_L3: 8{PAM4('30103033233012011221030321211022')}**
    By default, 8 SYNC_L0_L1_L2_L3 sequences are sent, which is the minimum according to the spec (2SYNC_length_L0_L1_L2_L3 SI PAM4). To use a different length, replace the 8 by the desired length.
  - **ALIGN: PAM4('03230300100321322112303012122311')**
    One align sequence is sent after the SYNC sequences.
- **Test Pattern: "C:\ProgramData\BitifEye\ValiFrameK1\MPhyG6\Pattern\MPHY_PRQS10.txt"**
  By default, the PRQS10 pattern is used. To use a different pattern, create a .txt file with the pattern and modify the reference accordingly.

  Under 'C:\ProgramData\BitifEye\ValiFrameK1\MPhyG6\Pattern', the following patterns are available:

  - MPHY_PRBS9Q.txt
  - MPHY_PRBS15Q.txt
  - MPHYPRBS13Q.txt
  - MPHY_PRQS10.txt
- **Tail of Burst: 0b00s64**
  By default, 64 DIF-N symbols are sent. To use a different length, replace the 64 by the desired length.

Other RX Test Sequences

Besides the default RX Test sequence, two other sequences are provided under C:\ProgramData\BitifEye\ValiFrameK1\MPhyG6\Pattern:

- **MPhyG6ConformanceContinuous.seq**
  The continuous sequence. The initialization is separated into a block that is sent at the beginning, then the sequencer loops over the Test Pattern.
- **MPhyG6ConformanceAdapt.seq**
  This sequence includes the ADAPT blocks.
  - **ADAPT_L0_L3: 1{"C:\ProgramData\BitifEye\ValiFrameK1\MPhyG6\Pattern\MPHY_PRBS9_L0_L3.txt", 0b00}**
    By default, the minimum length is sent, but it can be modified by replacing the 1 by the desired length.
  - **ADAPT_L0_L1_L2_L3: 1{"C:\ProgramData\BitifEye\ValiFrameK1\MPhyG6\Pattern\MPHY_PRBS15Q.txt", 0b00}**
    y default, the minimum length is sent, but it can be modified by replacing the 1 by the desired length.

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B N5991MM6A Parameters

This Appendix contains lists and descriptions of parameters used in the Keysight N5991MM6A MIPI M-PHY RX Conformance Test Automation Software user interface.

Overview

The parameters used in the N5991MM6A app are divided here into:

- N5991MM6A Sequencer Parameters (Table B-1)
- N5991MM6A Common Parameters (Table B-2)
- N5991MM6A Parameters for Individual Procedures
  - N5991MM6A Parameters for Individual Calibrations (Table B-3)
  - N5991MM6A Parameters for Individual Tests (Table B-4)

In the tables the parameters are listed in alphabetical order under each category heading.

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

NOTE If a parameter is read-only (gray) in the parameter grid, it can often be set when configuring the DUT.

N5991MM6A Sequencer Parameters

The parameter ‘Repetitions’ appears when you click a group node in the procedure tree or an individual procedure. The other sequencer parameters are available only for each individual procedure. They appear at the end of the parameter grid list.

Table B-1 N5991MM6A Sequencer Parameters

Parameter Name	Description
Procedure Error Case Behavior	– Proceed With Next Procedure: If an error occurs in the 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 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 that the group or procedure will be repeated. If the value is '0', it runs only once.

N5991MM6A Common Parameter

N5991 common parameters are displayed in the parameter grid when a level higher than an individual procedure is selected in the procedure tree. For N5991MM6A, there is only one (apart from Repetitions – see previous page), and this is found at the topmost level “MIPI M-PHY Gear6 – MPhyG6 Procedures”.

Table B-2 N5991MM6A Common Parameter

Category / Parameter Name	Description / Values
Show DUT Configure Dialog	If set to True, in RX tests, during the first BER measurement (which ensures that the setup is correct), a pop-up dialog will appear if the BER check fails. This will provide three options: – Retry: The measurement will be repeated. – Ignore: The setup check will be ignored and the procedure will continue to the first test step. – Abort: The procedure will be aborted.

N5991MM6A Parameters for Individual Procedures

N5991MM6A Parameters for Individual Calibrations

Within each category in the table, the parameters are listed alphabetically.

Table B-3 N5991MM6A Parameters for Individual Calibrations

Category / Parameter Name	Description / Which Procedures
No Category Name	
Offline	– If True, the test automation software is not connected to any instrument. This mode should be used for demonstrations and checks only. It is not valid for calibrations or measurements. – If False, the software is connected to instruments and produces valid data. It is read-only in the parameter grid. It can be set in the Instrument Configuration dialog during station configuration.
	All procedures
Software Version	The version of the N5991MM6A software currently being used.
	All procedures
Transmitter Equalization	
De-Emphasis Level	De-emphasis applied to the signal using the TX Equalization calibration.
	– Eye Opening Verification
Post-Cursor Range Number of Steps	The number of measurement steps in the post-cursor range between the start value and stop value. Only visible when 'Equalization Setting Method' is set to 'Set Coefficients'.
	– TX Equalization Preset Calibration
Post-Cursor Range Start Value	The first value of Post-Cursor where a measurement is made. Only visible when 'Equalization Setting Method' is set to 'Set Coefficients'.
	– TX Equalization Preset Calibration
Post-Cursor Range Stop Value	The value of Post-Cursor where measurement stops. Only visible when 'Equalization Setting Method' is set to 'Set Coefficients'.
	– TX Equalization Preset Calibration

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures
Pre-Cursor Range Number of Steps	The number of measurement steps in the pre-cursor range between the start value and stop value. Only visible when 'Equalization Setting Method' is set to 'Set Coefficients'.
	– TX Equalization Preset Calibration
Pre-Cursor Range Start Value	The first value of Pre-Cursor where a measurement is made. Only visible when 'Equalization Setting Method' is set to 'Set Coefficients'.
	– TX Equalization Preset Calibration
Pre-Cursor Range Stop Value	The value of Pre-Cursor where measurement stops. Only visible when 'Equalization Setting Method' is set to 'Set Coefficients'.
	– TX Equalization Preset Calibration
Pre-Shoot Level	Pre-shoot applied to the signal using the TX Equalization calibration.
	– Eye Opening Verification
Set De-Emphasis Range Number of Steps	The number of measurement steps in the set de-emphasis range between the start value and stop value. Only visible when 'Equalization Setting Method' is set to 'Set Pre-Shoot/ De-Emphasis'.
	– TX Equalization Preset Calibration
Set De-Emphasis Range Start Value	The first value of set de-emphasis where a measurement is made. Only visible when 'Equalization Setting Method' is set to 'Set Pre-Shoot/De-Emphasis'.
	– TX Equalization Preset Calibration
Set De-Emphasis Range Stop Value	The value of set de-emphasis where measurement stops. Only visible when 'Equalization Setting Method' is set to 'Set Pre-Shoot/De-Emphasis'.
	– TX Equalization Preset Calibration
Set Pre-Shoot Range Number of Steps	The number of measurement steps in the set pre-shoot range between the start value and stop value. Only visible when 'Equalization Setting Method' is set to 'Set Pre-Shoot/ De-Emphasis'.
	– TX Equalization Preset Calibration
Set Pre-Shoot Range Start Value	The first value of set pre-shoot where a measurement is made. Only visible when 'Equalization Setting Method' is set to 'Set Pre-Shoot/De-Emphasis'.
	– TX Equalization Preset Calibration

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures
Set Pre-Shoot Range Stop Value	The value of set pre-shoot where measurement stops. Only visible when 'Equalization Setting Method' is set to 'Set Pre-Shoot/De-Emphasis'.
	– TX Equalization Preset Calibration
TX Equalization Preset	The list of presets that the M-PHY G6 transmitter will support. If Custom is selected, instead of a predefined preset, the exact de-emphasis and pre-shoot values can be set.
	– Eye Opening Verification
Data Levels	
Amplitude Range Number of Steps	The number of measurement steps in the amplitude range between the start value and stop value.
	– Reference Clock Calibration – Level Calibration Terminated
Amplitude Range Start Value	The first value of amplitude where a measurement is made.
	– Reference Clock Calibration – Level Calibration Terminated
Amplitude Range Stop Value	The value of amplitude where measurement stops.
	– Reference Clock Calibration – Level Calibration Terminated
Data Offset	Offset voltage added to the data signal. In SNDR Calibration and SNDR Measurement, the offset is set to 0 mV by default. In Eye Opening Verification, it is set to the value selected in the Configure Product dialog.
	– SNDR Calibration – Eye Opening Verification – SNDR Measurement
DIF-IN Voltage Level	Differential amplitude of the PAM4 Symbol1. By default, it is the value selected in the Configure Product dialog.
	– SNDR Calibration – Eye Opening Verification – SNDR Measurement
DIF-IP Voltage Level	Differential amplitude of the PAM4 Symbol2. By default, it is the value selected in the Configure Product dialog.
	– SNDR Calibration – Eye Opening Verification – SNDR Measurement

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures	
DIF-N Voltage Level	Differential amplitude of the PAM4 Symbol0. By default, it is the value selected in the Configure Product dialog.	
	– SNDR Calibration – SNDR Measurement	– Eye Opening Verification
DIF-P Voltage Level	Differential amplitude of the PAM4 Symbol3. By default, it is the value selected in the Configure Product dialog.	
	– SNDR Calibration – SNDR Measurement	– Eye Opening Verification
Offset Range Number of Steps	The number of measurement steps in the offset range between the start value and stop value.	
	– Reference Clock Calibration – Level Calibration Terminated	– Eye Opening Verification
Offset Range Start Value	The first value of offset where a measurement is made.	
	– Reference Clock Calibration	– Level Calibration Terminated
Offset Range Stop Value	The value of offset where measurement stops.	
	– Reference Clock Calibration	– Level Calibration Terminated
DMI		
DMI Amplitude	The value of DMI amplitude used.	
	– SNDR Measurement	– Eye Opening Verification
DMI Amplitude Range Number of Steps	The number of measurement steps in the DMI amplitude range between the start value and stop value.	
	– DMI Calibration	– SNDR Calibration
DMI Amplitude Range Start Value	The first value of DMI amplitude where a measurement is made.	
	– DMI Calibration	– SNDR Calibration
DMI Amplitude Range Stop Value	The value of DMI amplitude where measurement stops.	
	– DMI Calibration	– SNDR Calibration

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures	
DMI Frequency	The value of DMI frequency used.	
	– DMI Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
Jitter		
RJ Amplitude (RMS) Range Number of Steps	The number of measurement steps in the RJ amplitude (RMS) range between the start value and stop value.	
	– RJ Calibration	
RJ Amplitude (RMS) Range Start Value	The first value of RJ amplitude (RMS) where a measurement is made.	
	– RJ Calibration	
RJ Amplitude (RMS) Range Stop Value	The value of RJ amplitude (RMS) where measurement stops.	
	– RJ Calibration	
RJ (RMS) Amplitude	The value of RJ amplitude (RMS) used.	
	– SNDR Calibration – SNDR Measurement	– Eye Opening Verification
SJ Amplitude	The value of SJ amplitude used.	
	– SNDR Calibration – SNDR Measurement	– Eye Opening Verification
SJ Amplitude Range Number of Steps	The number of measurement steps in the SJ amplitude range between the start value and stop value.	
	– SJ Calibration	
SJ Amplitude Range Start Value	The first value of SJ amplitude where a measurement is made.	
	– SJ Calibration	
SJ Amplitude Range Stop Value	The value of SJ Amplitude where measurement stops.	
	– SJ Calibration	
SJ Frequencies	The values of SJ frequencies used.	
	– SJ Calibration	– Eye Opening Verification

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures
SJ Frequency	The value of SJ frequency used.
	– SNDR Calibration – SNDR Measurement
Calibration	
Calculate Center of Middle Eye	If set to False, the eye diagram on the oscilloscope will be centered using the oscilloscope alignment. If set to True, the center of the middle eye will be calculated using histograms.
	– Eye Opening Verification
Calibration Transition Count	The number of transitions (0 to 1 and 1 to 0) for jitter measurements. Only applicable for EZJIT.
	– RJ Calibration – SJ Calibration
CTLE Presets	CTLE presets to be used for the calibration.
	– Eye Opening Verification
Disconnect for Noise Calibration	If set to True, the noise and RJ calibration of the oscilloscope will require physical disconnection of the cables to the oscilloscope. If set to False, the calibration is done without physical disconnection. In this case, the BERT outputs will be disabled.
	– SNDR Calibration – SNDR Measurement
Equalization Presets to Test	TX equalization presets to be used for the calibration. Visible only if Sweep over TX Equalization Presets is set to True.
	– Eye Opening Verification
Frequency Deviation	The data rate deviation that will be applied to the signal.
	– SNDR Calibration – Eye Opening Verification – SNDR Measurement
Number of UIs to acquire	Minimum number of UIs that will be acquired on the oscilloscope when folding the eye.
	– SNDR Calibration – Eye Opening Verification – SNDR Measurement
Run Mask Test	Select True or False. If True, the eye mask will be superimposed on the top, middle and bottom eyes, and the number of violations will be calculated.
	– Eye Opening Verification

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures
Sequence	Sequence used for calibration.
	– SNDR Calibration – SNDR Measurement – Eye Opening Verification
Sweep over CTLE AC Gain	If True, this procedure will iterate through the CTLE transfer functions, where the AC gain is modified to specified values.
	– Eye Opening Verification
Sweep over Transmitter Equalization Presets	If True, this procedure will iterate through the TX equalization presets and record the eye parameters for the specified presets.
	– Eye Opening Verification
Target SNDR	Ratio of the linear fit pulse peak (signal) to the RSS of the linear fit error and the additive noise (noise and distortion).
	– Eye Opening Verification
Oscilloscope	
Oscilloscope Bandwidth (Bessel)	This allows modification of the oscilloscope bandwidth in calibrations. As the bandwidth impacts the measured jitter, the default value is recommended.
	– Eye Opening Verification – SNDR Calibration – SNDR Measurement
Oscilloscope Bandwidth (Brick Wall)	This allows modification of the oscilloscope bandwidth in calibrations. As the bandwidth impacts the measured jitter, the default value is recommended.
	– Reference Clock Calibration – DMI Calibration – TX Equalization Preset Calibration – Level Calibration Terminated – RJ Calibration – SJ Calibration
Use EZJIT	Always True. The Keysight jitter analysis software EZJIT will be used.
	– RJ Calibration – SJ Calibration
Clock Data Recovery	
CDR Damping Factor	Damping factor applied to the CDR of the oscilloscope for the measurements.
	– RJ Calibration – SJ Calibration – SNDR Calibration – SNDR Measurement – Eye Opening Verification

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures	
CDR Loop Bandwidth	Loop bandwidth applied to the CDR of the oscilloscope for the measurements.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
InfiniiSim		
Filter Delay Data	Editable only if 'Use InfiniiSim' is enabled. Specifies the transfer function filter delay option for the data signal: – ON: Includes filter delay. – OFF: No filter delay included. – TRIG: Includes trigger-corrected delay.	
	– DMI Calibration – TX Equalization Preset Calibration – Level Calibration Terminated – RJ Calibration	– SJ Calibration – SNDR Calibration – SNDR Measurement – Eye Opening Verification
Filter Delay Ref. Clock	Editable only if 'Use InfiniiSim' is enabled. Specifies the transfer function filter delay option for the clock signal: – ON: Includes filter delay. – OFF: No filter delay included. – TRIG: Includes trigger-corrected delay.	
	– Reference Clock Calibration	
Max. Time Span Data	Editable only if 'Use InfiniiSim' is enabled. Set the maximum time span control of the InfiniiSim setup (data).	
	– DMI Calibration – TX Equalization Preset Calibration – Level Calibration Terminated – RJ Calibration	– SJ Calibration – SNDR Calibration – SNDR Measurement – Eye Opening Verification
Max. Time Span Ref. Clock	Editable only if 'Use InfiniiSim' is enabled. Set the maximum time span control of the InfiniiSim setup (clock).	
	– Reference Clock Calibration	

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures	
Transfer Function Data	The name of the transfer function used for the data lane. Editable only if 'Use InfiniiSim' is enabled.	
	– DMI Calibration – TX Equalization Preset Calibration – RJ Calibration – SJ Calibration	– SNDR Calibration – SNDR Measurement – Eye Opening Verification
Transfer Function DataP	The name of the transfer function used for the data lane when the measurement is done on the single-ended signal (Level Calibration case). Editable only if 'Use InfiniiSim' is enabled.	
	– Level Calibration Terminated	
Transfer Function Ref. Clock	The name of the transfer function used for the reference clock. Editable only if 'Use InfiniiSim' is enabled.	
	– Reference Clock Calibration	
Use InfiniiSim	Select either True or False. When it is not possible to add part of the setup path physically, the Use InfiniiSim feature is used to embed the effects of those elements by means of a transfer function. Normally the transfer function should contain the RX package and the die model (of the IC in the DUT). Also, if the Replica Trace or the ISI Channel are not available physically, they can be embedded.	
	– Reference Clock Calibration – DMI Calibration – TX Equalization Preset Calibration – Level Calibration Terminated – RJ Calibration	– SJ Calibration – SNDR Calibration – SNDR Measurement – Eye Opening Verification
Receiver Equalization		
AC Gain	AC gain value (in dB) used for the CTLE settings of the oscilloscope. Editable only if 'Enable Equalization' is set to True.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures	
Auto set DFE taps	If True, the user-defined values of 'DFE Tap1 Voltage Level' and 'DFE Tap2 Voltage Level' are ignored and the optimal values calculated by the oscilloscope are used. Visible only if 'DFE enabled' is set to True.	
	– SNDR Calibration – SNDR Measurement	– Eye Opening Verification
DC Gain	DC gain value (in dB) used for the CTLE settings of the oscilloscope. Editable only if 'Enable Equalization' is set to True.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
DFE enabled	Set to True to add DFE equalization to the signal. Normally, this is required when the channel is included in the setup.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
DFE Tap1 Voltage Level	User-defined value for the DFE Tap1 voltage on the oscilloscope for the DFE equalization configuration. If 'Auto set DFE taps' is True, this is ignored and the optimal value calculated by the oscilloscope is used. Visible only if 'DFE enabled' is set to True and 'Auto set DFE taps' is set to False.	
	– Eye Opening Verification	
DFE Tap2 Voltage Level	User-defined value for the DFE Tap2 voltage on the oscilloscope for the DFE equalization configuration. If 'Auto set DFE taps' is True, this is ignored and the optimal value calculated by the oscilloscope is used. Visible only if 'DFE enabled' is set to True and 'Auto set DFE taps' is set to False.	
	– Eye Opening Verification	
Enable Equalization	Set to True to use equalization.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification

Table B-3 N5991MM6A Parameters for Individual Calibrations (cont.)

Category / Parameter Name	Description / Which Procedures	
First Zero Frequency	First Zero Frequency value used for the CTLE settings of the oscilloscope. It is read-only and dependent on the AC Gain.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
Pole 1 Frequency	Pole 1 Frequency value used for the CTLE settings of the oscilloscope. Editable only if 'Enable Equalization' is set to True.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
Pole 2 Frequency	Pole 2 Frequency value used for the CTLE settings of the oscilloscope. Editable only if 'Enable Equalization' is set to True.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
Pole 3 Frequency	Pole 3 Frequency value used for the CTLE settings of the oscilloscope. Editable only if 'Enable Equalization' is set to True.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
Second Zero Frequency	Second Frequency value used for the CTLE settings of the oscilloscope. Editable only if 'Enable Equalization' is set to True.	
	– RJ Calibration – SJ Calibration – SNDR Calibration	– SNDR Measurement – Eye Opening Verification
Sequencer – See Table B-1.		

N5991MM6A Parameters for Individual Tests

Within each category, the parameters are listed alphabetically in the table.

Table B-4 N5991MM6A Parameters for Individual Tests

Category / Parameter Name	Description / Which Procedures
No Category Name	
Offline	– If True, the test automation software is not connected to any instrument. This mode should be used for demonstrations and checks only. It is not valid for calibrations or measurements. – If False, the software is connected to instruments and produces valid data. It is read-only in the parameter grid. It can be set in the Instrument Configuration dialog during station configuration.
	All procedures
Software Version	The version of the N5991MM6A software currently being used.
	All procedures
Transmitter Equalization	
De-Emphasis Level	De-emphasis level applied to the signal using the TX Equalization Preset Calibration.
	– RX Jitter Tolerance – Setup Procedure
Pre-Shoot Level	Pre-shoot level applied to the signal using the TX Equalization Preset Calibration.
	– RX Jitter Tolerance – Setup Procedure
TX Equalization Preset	The list of presets that the M-PHY G6 transmitter will support. If Custom is selected, instead of a predefined preset, the exact de-emphasis and pre-shoot values can be set.
	– RX Jitter Tolerance – Setup Procedure
Data Levels	
Data Offset	Offset voltage added to the data signal. By default, it is set to the value selected in the Configure Product dialog.
	– Setup Procedure
DIF-IN Voltage Level	Differential amplitude of the PAM4 Symbol1. By default, it is the value selected in the Configure Product dialog.
	– RX Jitter Tolerance – Setup Procedure

Table B-4 N5991MM6A Parameters for Individual Tests

Category / Parameter Name	Description / Which Procedures	
DIF-IP Voltage Level	Differential amplitude of the PAM4 Symbol2. By default, it is the value selected in the Configure Product dialog.	
	– RX Jitter Tolerance	– Setup Procedure
DIF-N Voltage Level	Differential amplitude of the PAM4 Symbol0. By default, it is the value selected in the Configure Product dialog.	
	– RX Jitter Tolerance	– Setup Procedure
DIF-P Voltage Level	Differential amplitude of the PAM4 Symbol3. By default, it is the value selected in the Configure Product dialog.	
	– RX Jitter Tolerance	– Setup Procedure
DMI		
DMI Amplitude	Amplitude of the differential mode interference.	
	– RX Jitter Tolerance	– Setup Procedure
DMI Frequency	Frequency of the differential mode interference.	
	– RX Jitter Tolerance	– Setup Procedure
Jitter		
RJ (RMS) Amplitude	Amplitude of the RJ (RMS).	
	– RX Jitter Tolerance	– Setup Procedure
SJ Amplitude	Amplitude of the SJ.	
	– RX Jitter Tolerance	– Setup Procedure
SJ Frequency/-ies	SJ frequency/-ies used.	
	– RX Jitter Tolerance	– Setup Procedure
SJ Test Amplitude for High Frequency Number of Steps	Number of steps between Start Value and Stop Value for the sweep of the SJ test amplitude at high frequencies. Visible only if 'Jitter Characterization' is set to True.	
	– RX Jitter Tolerance	
SJ Test Amplitude for High Frequency Start Value	Start Value for the sweep of the SJ test amplitude at high frequencies. Visible only if 'Jitter Characterization' is set to True.	
	– RX Jitter Tolerance	

Table B-4 N5991MM6A Parameters for Individual Tests

Category / Parameter Name	Description / Which Procedures
SJ Test Amplitude for High Frequency Stop Value	Stop Value for the sweep of the SJ test amplitude at high frequencies. Visible only if 'Jitter Characterization' is set to True.
	– RX Jitter Tolerance
Test	
Check Pattern	If set to False, the setup will be prepared by setting all the configured parameters on the data generator, then the procedure will stop. If set to True, the setup will be prepared by setting all the configured parameters on the data generator, then a BER test will be performed.
	– Setup Procedure
CM Voltages to Test	Common-mode voltage amplitudes to be tested.
	– RX Jitter Tolerance
Data Rate	Set the data rate (Gear 6A or Gear 6B) to be tested.
	– Setup Procedure
Frequency Deviation	Frequency deviation relative to the nominal bit rate in ppm.
	– RX Jitter Tolerance – Setup Procedure
Jitter Characterization	If True, increasing values of SJ amplitude are tested until failure. After the first failure, the next step will be carried out. If False, only the compliance amplitudes according to the Sinusoidal Tolerance Mask defined in the specification are tested.
	– RX Jitter Tolerance
Lane Under Test Termination Model	Lane under test termination. Select T50Ohm or T100Ohm: – T50Ohm: 50 ohm to ground (e.g., direct oscilloscope connection) – T100Ohm: 100 ohm differential (e.g., DUT, probe) Note: The other lanes are expected to be terminated with 100 ohm differentially.
	– RX Jitter Tolerance – Setup Procedure
Number of Retries	Number of retries for BER measurements.
	– RX Jitter Tolerance
Ref Clock Frequency	Reference clock frequency used for this procedure.
	– Setup Procedure

Table B-4 N5991MM6A Parameters for Individual Tests

Category / Parameter Name	Description / Which Procedures	
Re-Init sequence after Reset DUT	If set to True, the sequence is reset to the first block at the beginning of each BER measurement.	
	– RX Jitter Tolerance	
Sequence	Sequence used for calibration.	
	– RX Jitter Tolerance	– Setup Procedure
Target SNDR	Signal-to-Noise and distortion ratio of the linear fit pulse (signal) to the RSS of the linear fit error and the additive noise (noise and distortion).	
	– RX Jitter Tolerance	– Setup Procedure
Tested Channel	Currently, the only channel available is Channel 1.	
	– Setup Procedure	
Use Eye Opening Verification Settings	If False, the values selected for the parameters will be configured on the data generator. If True, the Level Voltage, TX Preset, SJ, RJ and SNDR values will be applied by reading values used in the available Eye Opening Verification data.	
	– RX Jitter Tolerance	
Use SNDR Calibration	If set to True: – Target SNDR can be selected – DMI Frequency and Data Voltage Levels loaded from successful SNDR Calibration will be used – DMI Amplitude of selected Target SNDR will be set from the calibrated results	
	– Setup Procedure	
Error Detector (only when BERT Analyzer is selected as the BER Reader in the Configure Product dialog)		
Analyzer Equalization	Value of the equalization level set on the error detector.	
	– RX Jitter Tolerance	– Setup Procedure
CDR Loop Bandwidth	The loop bandwidth of the BERT error detector CDR.	
	– RX Jitter Tolerance	– Setup Procedure
CDR Loop Order	The loop order selects one of the two available CDR operating modes (FIRSt, SECond). Depending on the selected mode, a different set of parameters is available as loop parameters.	
	– RX Jitter Tolerance	– Setup Procedure

Table B-4 N5991MM6A Parameters for Individual Tests

Category / Parameter Name	Description / Which Procedures	
CDR Loop Selection	The loops available depend on the value of the CDR Loop Bandwidth as follows: – Always: Loop1 – CDR Loop Bandwidth ≥ 3 MHz: Loop1, Loop2 – CDR Loop Bandwidth ≥ 5 MHz: Loop1, Loop2, Loop3 – CDR Loop Bandwidth ≥ 8 MHz: Loop1, Loop2, Loop3, Loop4	
	– RX Jitter Tolerance	– Setup Procedure
CDR Transition Density	The transition density is defined by the number of transitions in the incoming data divided by the total number of bits transmitted.	
	– RX Jitter Tolerance	– Setup Procedure
Common Mode Voltage	Offset voltage that the error detector expects in the incoming data.	
	– RX Jitter Tolerance	– Setup Procedure
Coupling	Set to AC or DC.	
	– RX Jitter Tolerance	– Setup Procedure
Follow SysClk	If True, the symbol rate automatically follows the system symbol rate. If False, the symbol rate is set manually.	
	– RX Jitter Tolerance	– Setup Procedure
Input Range	Defines the input voltage range.	
	– RX Jitter Tolerance	– Setup Procedure
Symbol Rate	Visible only if Follow SysClk is False. Symbol rate configured manually on the error detector.	
	– RX Jitter Tolerance	– Setup Procedure
Termination Configuration	Set the error detector termination as Unbalanced or Balanced.	
	– RX Jitter Tolerance	– Setup Procedure
Use Auto Analyzer Equalization	If False (default), and the equalization mode is set as Preset on the error detector, the preset value can be defined with the Analyzer Equalization parameter. If True, and the equalization mode is set as Manual on the error detector, the error detector will automatically calculate and set the optimal coefficients.	
	– RX Jitter Tolerance	– Setup Procedure

Table B-4 N5991MM6A Parameters for Individual Tests

Category / Parameter Name	Description / Which Procedures	
Use CDR	Set to True to use CDR on the error detector.	
	– RX Jitter Tolerance	– Setup Procedure
Sequencer – See Table B-1.		

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C Acronyms and Abbreviations

This Appendix contains a list of acronyms and abbreviations used in this user's guide.

List of Acronyms and Abbreviations

Acronym	Definition
A	
AC	Alternating Current
API	Application Programming Interface
AWG	Arbitrary Waveform Generator
B	
BER	Bit Error Ratio
BERT	Bit Error Ratio Tester
C	
CDR	Clock Data Recovery
Clk	Clock
CM	Common Mode
CTLE	Continuous-Time Linear Equalization
CTS	Conformance Test Suite
D	
DC	Direct Current
DFE	Decision Feedback Equalization
DIF-IN	Logical LINE state, driven by the M-TX, corresponding to a negative differential LINE voltage set between a null differential voltage and DIF-N
DIF-IP	Logical LINE state, driven by the M-TX, corresponding to a positive differential LINE voltage set between a null differential voltage and DIF-P
DIFN, DIF-N	Logical LINE state, driven by the M-TX, corresponding to a negative differential LINE voltage
DIFP, DIF-P	Logical LINE state, driven by the M-TX, corresponding to a positive differential LINE voltage
DIFZ	Logical LINE state, driven by the M-RX, corresponding to almost zero differential LINE voltage

Acronym	Definition
DMI	Differential Mode Interference
DSI	Display Serial Interface
DSO	Digital Storage Oscilloscope
DUT	Device Under Test
E	
ED	Error Detector
EH	Eye Height
Eq	Equalization
EW	Eye Width
EZJIT	Keysight jitter analysis software
G	
GUI	Graphical User Interface
H	
HFJ	High-Frequency Jitter
HiSLIP	High-Speed LAN Instrument Protocol
HS	High Speed
HTML	HyperText Markup Language
I	
IC	Integrated Circuit
ID	Identifier
IO	Input–Output, Interface
IP	Internet Protocol
ISI	Inter-Symbol Interference
L	
LAN	Local Area Network
LFJ	Low-Frequency Jitter
LS	Low Speed

Acronym	Definition
N	
N/A	Not Applicable
NaN	Not a Number
NRZ	Non-Return-to-Zero
P	
PAM4	Pulse Amplitude Modulation with 4 Levels
PC	Personal Computer
Pmax	Maximum amplitude of the linear pulse response
ppm	Parts Per Million
PRBS	Pseudorandom Binary Sequence
PRQS	Pseudorandom Quaternary Sequence
R	
RJ	Random Jitter
RLM	Level Separation Mismatch Ratio
RMS	Root Mean Squared
RSS	Received Signal Strength
RX	Receiver
S	
SigmaE	Standard deviation of the error signal
SigmaN	Standard deviation of the noise signal
SJ	Sinusoidal Jitter
SMA	SubMiniature version A (connector)
SNDR	Signal-to-(Noise and Distortion) Ratio
T	
TJ_{RX}	Total Jitter at the Receiver
TX	Transmitter

Acronym	Definition
U	
UI	Unit Interval
USB	Universal Serial Bus
V	
.vfc	ValiFrame Configuration file extension
.vfp	ValiFrame Project file extension
VISA	Virtual Instrument System Architecture

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