Keysight N5991MC2E MIPI® C-PHY Frame Generator

User Guide

KEYSIGHT TECHNOLOGIES

Notices

Trademarks

MIPI® C-PHY™ is a registered trademark of the MIPI Alliance.

Manual Part Number

N5991-91701

Edition

Edition 1.0, June 2020

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

Technology Licenses

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

U.S. Government Rights

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

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

Warranty

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

Safety Notices

CAUTION

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

WARNING

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

Contents

Keysight N5991MC2E MIPI® C-PHY Frame Generator

User Guide

1 Introduction

KEYSIGHT TECHNOLOGIES

Overview

The MIPI® (Mobile Industry Processor Interface) C-PHY Frame Generator software (also called as “Frame Generator” or “software”, in short) is a stand-alone software utility. It provides semi-automatic control of the C-PHY Signal Generator for physical layer tests, which is based on the Keysight Technologies M8195A AWG (Arbitrary Waveform Generator).

The Frame Generator is a flexible tool for trouble-shooting and debugging. It complements the full MIPI® C-PHY Test Automation Software, which provides automated physical layer compliance tests and device characterization. The Frame Generator generates the data sequences and allows pattern changes as well as control of signal levels, data rate, and timing parameters. The software runs on a standard Windows PC and controls the hardware test resources through appropriate interfaces such as LAN (Local Area Network).

Document History

First Edition (June 2020)

The first edition of this user guide describes functionality of software version N5991 MIPI® C-PHY_1.00 Frame Generator based on the *MIPI® C-PHY Base* specification.

2 Test Instrument Setup

KEYSIGHT TECHNOLOGIES

Keysight recommends that prior to using the MIPI® C-PHY Frame Generator software for connecting instruments, you must set up the test instruments and establish the required connections.

- Connect the instruments to the controller PC by USB or LAN (AWG and other instruments such as, signal and waveform generators).
- Establish all required cable connections between the instruments and the DUT (device under test).
- Switch on the PC and instruments.
- Start Keysight "IO (Input Output) VISA (Virtual Instrument Software Architecture) Connection Expert" and check the connections for the instruments.
- Set the correct IP address for each instrument.

The software uses M8195A AWG modules for C-PHY output. For more than one AWG module, the M8197A synchronizes the M8195A modules. It supports up to three data lanes.

The AWG Setup can be used in two different modes:

- Four Channel mode
- Dual Channel mode

M8195A Four Channel Mode

This setup uses four channels on each AWG module to generate MIPI® C-PHY signal. With this configuration, up to three data lanes can be tested.

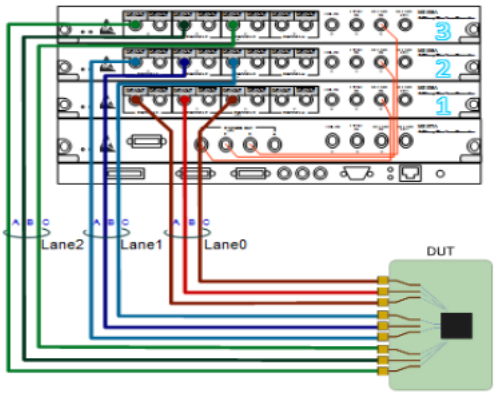

Figure 1 Connection diagram for M8195A 4 Channel mode (3 lanes)

M8195A Dual Channel Mode

This setup uses two channels on each AWG module to generate MIPI® C-PHY signal. With this configuration, up to two data lanes can be tested.

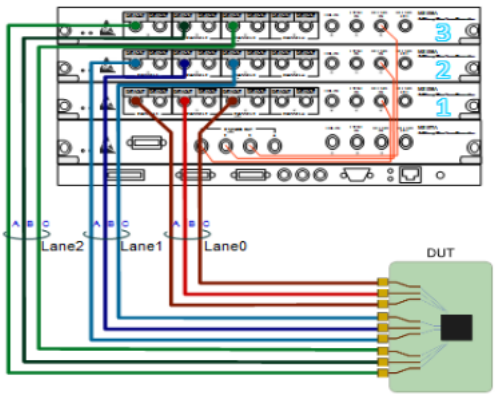

Figure 2 Connection diagram for M8195A 4 Channel mode (3 lanes)

NOTE Dual Channel mode is available only if you install the add-on license '*C-PHY 2.0 Debug Tools 32G Sample Waveform Generation Add-on*'.

3 Using the Software

KEYSIGHT TECHNOLOGIES

Connecting to the Instruments

Once you launch the MIPI® C-PHY Frame Generator, the software is in “offline” mode. This indicates that user inputs have no effect until the software has been connected to the instruments.

The **CONNECTION** section is displayed by default (see Figure 3). In this section of the interface, you can enter all parameters that are necessary to establish connections to the signal generator and the complementary instruments, such as power supplies.

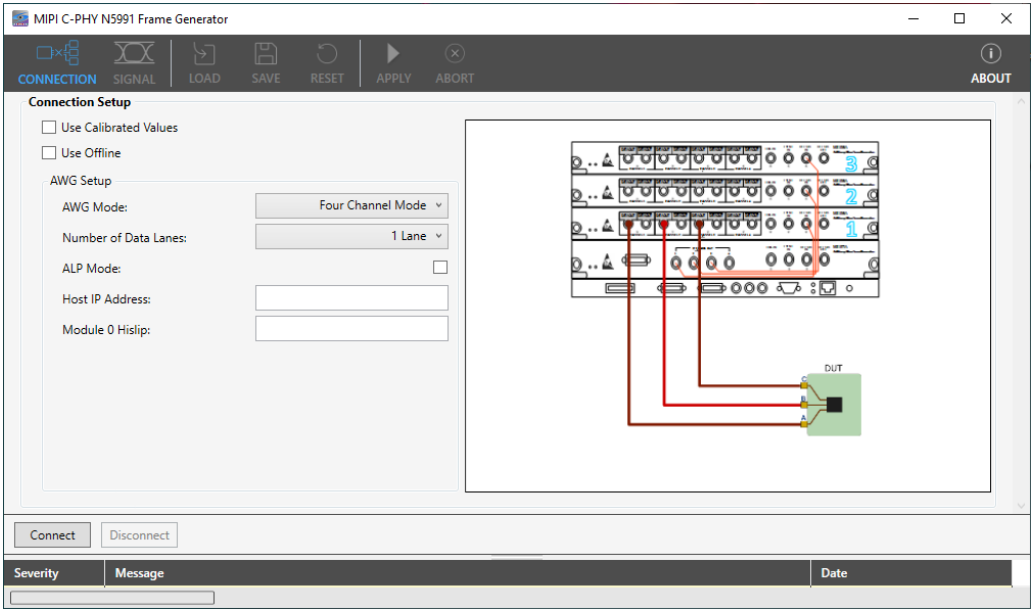

Figure 3 MIPI® C-PHY Frame Generator Connection Setup

NOTE

Ensure that suitable cable connections between the PC and the instruments are established, such as LAN or USB-to-GPIB connections. The specific connection is reflected in the name-string of the corresponding instrument. For details on naming conventions, refer to the *Keysight IO Libraries Suite Help*.

In the **CONNECTION** section:

1 Select **Use Calibrated Values** to apply existing calibrations to settings for various impairments. These existing calibrations should have been generated using the ValiFrame MIPI® C-PHY software.

   If "Use Calibrated Values" is selected, following calibrations are applied:

   - Skew Calibration (inter and intra module)
   - Amplifier Calibration
   - LP Level Calibration
   - HS Level Calibration

2 Enable **Use Offline** to work in “offline” mode.

3 In the **AWG Setup** area,

   a From the drop-down options for **AWG Mode**, select:

   - **Four Channel Mode** to use all four channels on each AWG module. This will allow you to select up to three lanes. The maximum Data Rate for this configuration is 4.5G.
   - **Dual Channel Mode** to use two channels on each AWG module. This will allow you to select up to two lanes. The maximum Data Rate for this configuration is 9.0G.

NOTE Dual Channel mode is available only if you install the add-on license ‘*C-PHY 2.0 Debug Tools 32G Sample Waveform Generation Add-on*’.

   b From the drop-down options for **Number of Data Lanes**, select the number of data lanes to be tested, depending on the AWG Mode selected.

   c Select the check box to enable **ALP Mode** if you want to generate the MIPI® C-PHY waveforms in ALP (Alternate Low-Power) operating mode.

   d In the **Host IP Address** field, specify the IP address of the AWG Host PC.

This is the PC, which is connected to the hardware and runs the AWG firmware. The entry “localhost” is valid if the MIPI® C-PHY Frame Generator software resides on the same controller PC of the AWG system.

e In the following fields, specify the IP address for each generator and the synchronization module, as they appear: **Sync Hislip**, **Module 0 Hislip**, **Module 1 Hislip** and **Module 2 Hislip**.

4 After setting the desired configuration, click **Connect**.

When you click **Connect**, the MIPI® C-PHY Frame Generator software checks the desired connections and, if available, establishes them.

Click **Disconnect** to disconnect to the current instruments and to define a new configuration.

After the instrument connections are established successfully, the SIGNAL section becomes available. See Figure 4.

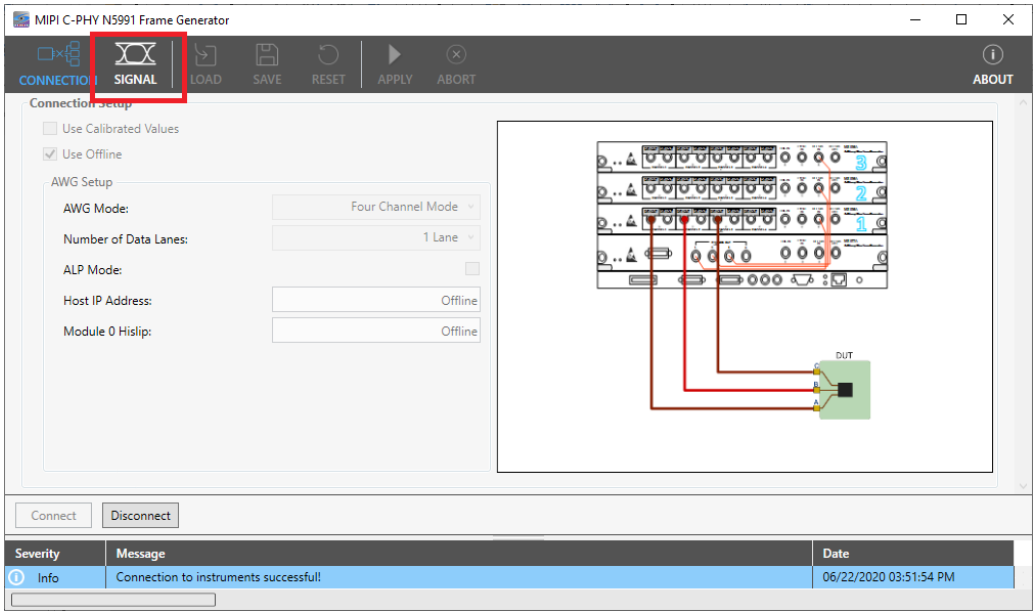

Figure 4 MIPI® C-PHY Frame Generator Instruments connected

Signal settings on main window

After the connection to the instruments has been established, the SIGNAL section is available, as shown in Figure 5. It offers basic functionality as well as access to top-level test parameters and status information.

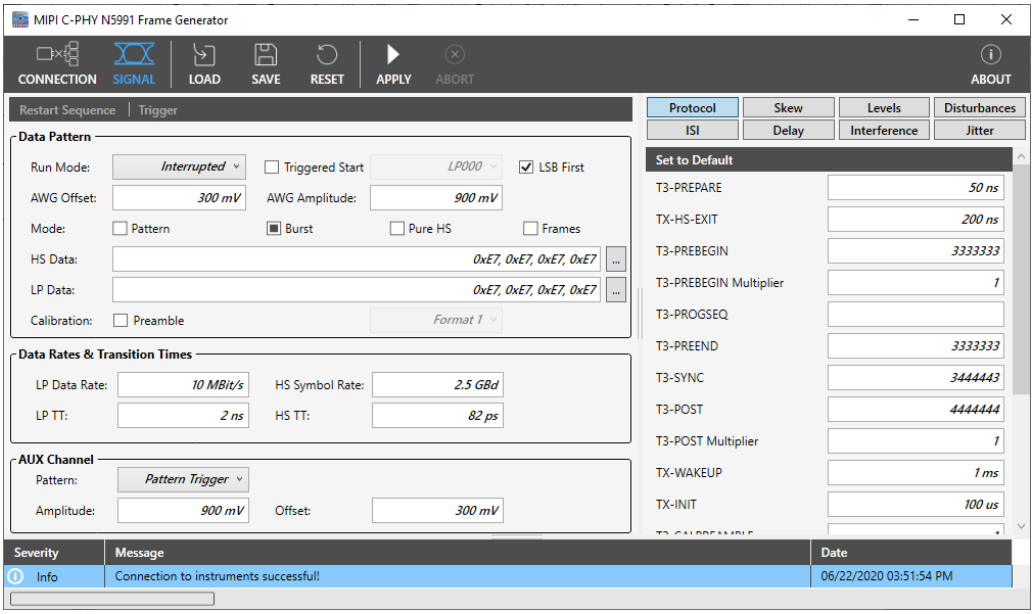

Figure 5 MIPI® C-PHY Frame Generator main window

The parameters for the MIPI® C-PHY signal configuration are divided in the following sections:

- Data Pattern
- Data Rates & Transition Times
- AUX Channel
- Protocol
- Skew
- Levels
- Disturbances
- ISI
- Delay

- Interference
- Jitter

After you select the required parameters, you may follow the steps in the **SIGNAL** section, as described below.

- Click **SAVE** to save current settings of the Frame Generator to a .cpdts file.
- Click **LOAD** to load the saved file back into the Frame Generator so that the saved settings are restored.

NOTE

The use of the .cpdts file is dependent on the connection settings. If the AWG Mode or ALP Mode is different between settings file and current configuration, loading of the saved file will not be possible. If Number of Data Lanes is different, a warning will be shown in the Log.

- Click **RESET** to set all the parameters to their default values.
- Click **APPLY** to send the setup information to one or more instruments.

  Once this information is received by the instruments, the transmission of the MIPI® C-PHY signal is started. The signal is transmitted continuously until a new setting is applied.

NOTE

When the MIPI® C-PHY parameters appear in italics and bold font style on the interface, it indicates that they have not been applied to the instruments yet. When you click APPLY, the font appearance for all such parameters becomes normal.

- After the MIPI® C-PHY signal generation starts, the **ABORT** button becomes available. Click **ABORT** to stop C-PHY signaling.
- Below the SIGNAL tab:
  - The Restart Sequence button stops and start the AWG. It does not reprogram any waveform on the AWG. It is available only if a waveform is applied on the AWG.
  - The Trigger button enables a jump from the initial loop block to the next block. This option is available only if a pattern with the option “triggered startup” was programmed into the AWG.
- A Logs panel is displayed at the bottom of the main window, which shows description of errors, warnings and information messages along with their time stamps.

Data Pattern

Run mode

You may toggle between **Continuous** and **Interrupted** mode.

- In **Continuous** mode, if waveform calculation has already been performed, when you click **APPLY** for the new settings, the AWGs are not stopped. The AWG outputs waveforms for the previous settings. After the new waveform is calculated, the new waveforms are generated without stopping the AWGs.
- In the **Interrupted** mode, the functionality varies in a manner that applying a new waveform always triggers the AWGs to stop.

NOTE For some combinations of the parameter settings, it is imperative that the AWGs are always stopped (such as, change in HS Symbol Range and so on).

Triggered Start

Configure a trigger sequence.

- Select the **Triggered Start** check box.
- Select the Low Power (LP) state from the drop-down options that must be used in the initial looped block.

  The data is looped until you send a trigger that breaks the data from the loop. After the initial loop is broken, the second loop, which contains the data, is initiated. Enabling the “Triggered Start” feature is especially important for such DUTs that require special initialization to properly receive data.

LSB First

Select this check box to transmit the Least Significant Bit (instead of the Most Significant Bit) first in the Data Pattern.

AWG Offset

This is the offset voltage that is set on the AWG output amplifiers when the AWGs are in ‘Stop’ state.

AWG Amplitude

This is the amplitude voltage set on the AWG output amplifiers.

Mode

The MIPI® C-PHY Frame Generator software supports four modes:

- **Pattern**—In this mode, you can load pattern files with the extension '*.*ptrn*', which is written in terms of line states. A *.*ptrn* file contains LP and/or HS data definitions.
- **Burst**—In this mode, a block of data is repeated infinitely. This block contains either LP data, HS data or both, which can be typed directly on the user interface or you may load the burst block using data files with the extension '*.*dat*'. The data must be formatted in hexadecimal bytes separated by commas.
- **Pure HS**—This mode is similar to Burst mode expect that no LP111 transitions are included and the entire LP data is neglected.
- **Frames**—In this mode, a complex sequence file can be loaded (*.*seq*). In this sequence file, the blocks contain data, which can be specified and the sequence behavior can also be specified.

  If you select **APL Mode** (under **CONNECTION**), only **Frames** mode can be used.

  With **Mode** selected as **Frames**, the DSI protocol has two version options (either *V1.0* or *V1.1*) to choose from.

Calibration Preamble

When the **Preamble** check box is selected, it enables the calibration preamble in the sequence. From the drop-down options, you may also choose one of the three possible formats (**Format 1**, **Format 2** or **Format 3**) for the calibration preamble as defined in the MIPI® C-PHY specification.

Data Rates & Transition Times

LP Data Rate

Set the Low Power data rate.

HS Symbol Rate

Set the High Speed data rate. Note that this value depends on the **AWG Mode** selected.

- For **Four Channels**, you may set an HS data rate of up to 4.5 Gbps.
- For **Two Channels**, you may set an HS data rate of up to 9.0 Gbps.

LP TT

Set the transition time (that is, rise and fall times) for the Low Power mode.

HS TT

Set the transition time (that is, rise and fall times) for the High Speed mode.

AUX Channel

Normally, the 4th channel of the M8195A AWG does not generate any data. However, it becomes useful at times to have some data generated on the unused Channel for the purposes of debugging or for any miscellaneous functions. Considering this point, the software has the AUX Channel setting for the unused channel of the M8195A AWG.

Pattern

- Pattern Trigger—Select this option to generate a stable triggered pattern on the Oscilloscope. Note that the trigger is synchronous with the infinite loop generated. As a result, the Oscilloscope displays the same part of the pattern within the loop.
- Clock Pattern—Select this option to initiate eye trigger on high speed data.
- Mirror Line A / B / C—Select the desired option to mirror the data from one of the lines to either Line A, B or C.
- Off—Select this option to disable the Auxiliary Channel.

Amplitude & Offset

Use the **Amplitude** and **Offset** settings to change the amplitude and offset, respectively, on the signal output from the 4th channel of the AWGs, as this channel is not normally used to generate C-PHY signals. These settings are available only when the **Pattern** is set to either **Pattern Trigger** or **Clock Pattern**.

Parameter groups

On the right side of the main window, several MIPI® C-PHY signal parameters and impairments can be modified. They are organized in groups, which are **Protocol**, **Skew**, **Level**, **Disturbances**, **ISI**, **Delay**, **Interference** and **Jitter**. By selecting a specific group, the corresponding parameters of the group appear in the respective panel.

Changing the value of any parameter on the user interface does not perform waveform recalculation automatically anymore. After modifying one or more parameters, you must explicitly request for a waveform recalculation by clicking the **APPLY** button on the user interface.

Protocol

To change the protocol settings, click **Protocol** on the right panel to view the corresponding settings (See Figure 6).

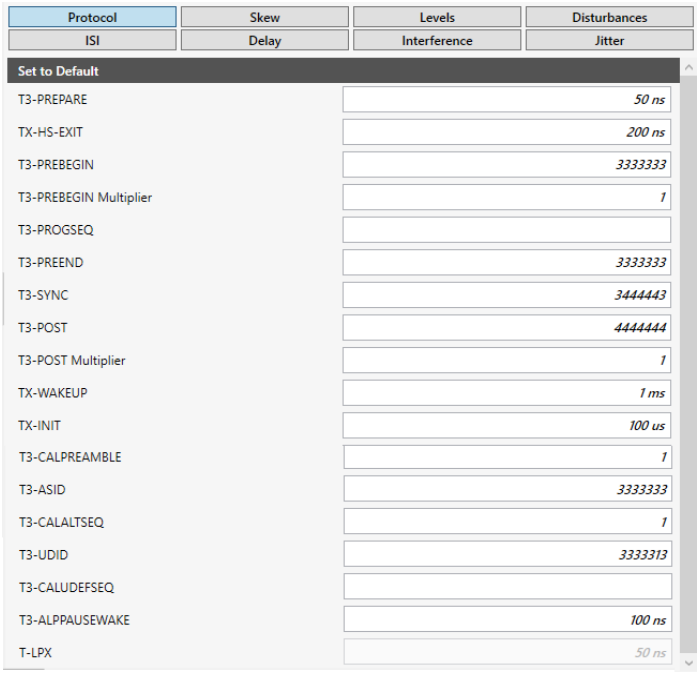

Figure 6 MIPI® C-PHY Parameters - Protocol Group

The parameters in this group are:

T3-PREPARE

Sets the time that the transmitter drives a LP-000 state immediately before the start of high speed transmission.

TX-HS-EXIT

Sets the length of LP-111 state following a high-speed burst.

T3-PREBEGIN

Sets the T3-PREBEGIN pattern in high-speed MIPI® C-PHY pattern format. It should be a multiple of 7 UI from a minimum of 7UI to 448 UI.

T3-PREBEGIN Multiplier

Define a multiplier value between 1 and 64 to set the required HS pattern length from 7UI to 448UI. By default, the multiplier is set to 1, which indicates that a T3-PREBEGIN pattern length of (1 x 7UI) 7UI is defined. You may modify the multiplier value up to 64 to achieve the maximum T3-PREBEGIN pattern length of up to 448UI.

T3-PROGSEQ

Sets the optional T3-PROGSEQ pattern on a high-speed MIPI® C-PHY pattern format.

T3-PREEND

Sets the T3-PREEND pattern on a high-speed MIPI® C-PHY pattern format. By default, this pattern contains a total of 7 symbols of type 3.

T3-SYNC

Sets the T3-SYNC, which is sent immediately before starting the high-speed transmission. By default, the pattern is '3444443'.

T3-POST

Sets the T3-POST pattern, which is sent immediately after starting high-speed transmission.

T3-POST Multiplier

Define a multiplier value between 1 and 32 to set the required T3-POST pattern length from 7UI to 224 UI. By default, the multiplier is set to 1, which indicates that a T3-POST pattern length of (1 x 7UI) 7UI is defined. You may modify the multiplier value up to 32 to achieve the maximum T3-POST pattern length of up to 224 UI.

TX-WAKEUP

Time that the transmitter drives a Mark-1 state prior to a Stop state in order to initiate an exit from ULPS.

TX-INIT

Time that the transmitter drives a Stop State (LP-111).

T3-CALPREAMBLE

The length of preamble symbol sequence consisting of a sequence of “1” symbols. It is adjustable in the transmitter in increments of seven unit intervals (UI) with a range from a minimum of one group of seven UI, to a maximum of 256 groups of seven UI.

T3-ASID

Alternate sequence identifier. A sequence of seven “3” symbols. The purpose of this field is to inform the Receiver that the Alternate Sequence field follows. The length of this field shall be fixed at 7 UI.

T3-CALALTSEQ

Alternate Sequence field consisting of mapped and encoded PRBS9 data. The length of this field is adjustable in the transmitter in increments of seven unit intervals (UI) with a range from a minimum of one group of seven UI, to a maximum of 2048 groups of seven UI.

T3-UDID

User-defined sequence identifier. A unique sequence of seven symbols, 3333313. The length of this field shall be fixed at 7 UI.

T3-CALUDEFSEQ

User-defined sequence field consisting of a user-defined sequence of symbols. The length of this field shall be adjustable in the transmitter in increments of seven unit intervals (UI) with a range from a minimum of one group of seven UI, to a maximum of 2048 groups of seven UI.

T3-ALPAUSEWAKE

Duration that the Transmitter asserts the ALP-Pause Wake pulse from the ALP-Pause Stop state in 90ns as minimum. It is also the duration that the Transmitter asserts the ALP-Pause Wake pulse from the ALP-Pause ULPS state in 1ms as minimum.

T-LPX

It is the transmitted length of the Low Power state. The length of this field shall be fixed at 50 ns.

Skew

To change the skew settings, click **Skew** on the right panel to view the corresponding settings. The parameters in this group are self-explanatory and are shown in Figure 7.

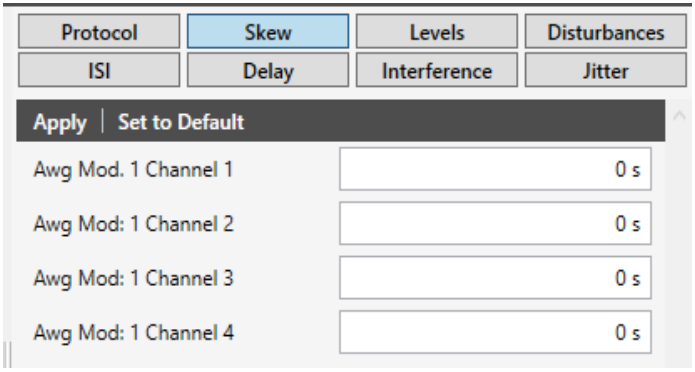

Figure 7 MIPI® C-PHY Parameters - Skew Group

The **Skew** group parameter gives the ability to change the skew (in seconds) on one or more specific AWG Channels. This feature is useful to de-skew the influences on cables. Depending on the configured setup, some of the parameters do not apply and are disabled.

The **Skew** section also consists of an **Apply** button, which is present locally in this panel. This button is enabled after the settings have been applied to the instruments using the global **APPLY** button (present on the main menu). You may modify the skew parameters only after the signal is generated.

Levels

To change the voltage levels on the signal, click **Levels** on the right panel to view the corresponding settings (See Figure 8).

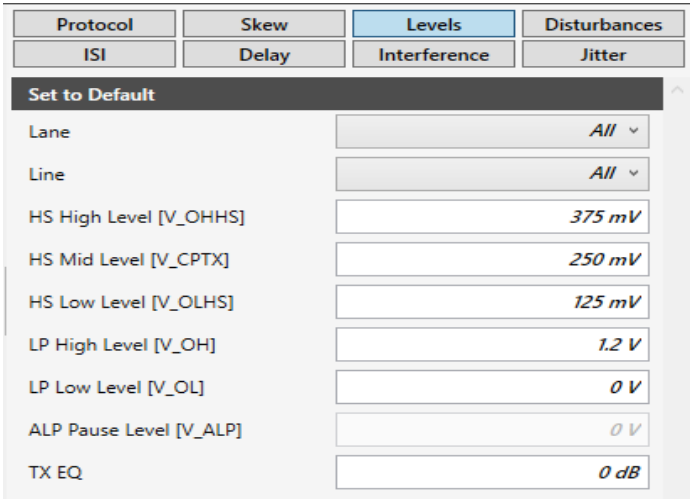

Figure 8 MIPI® C-PHY Parameters - Levels Group

You may modify the voltage level for specific lanes, lines or both while keeping the signal levels unchanged for the rest of the data lanes and lines. This feature is helpful especially when you run compliance tests on the DUT for the M8195A configuration, where you may want to understand the impact of different voltage levels on specific data lanes or wires.

By default, with the **Lane** and **Line** set to **All**, the values set for the signal level settings (V_OHHS, V_CPTX, V_OLHS, V_OH, V_OL) are the same for each data lane and line. However, you can modify the voltage levels for specific Lanes, Lines, or both without impacting the voltage levels on other Lanes or Lines. The software stores all such values for voltage levels, which you may have modified for a certain combination of Lane and Line and does not change them automatically. However, if you perform a waveform calculation in the same instance of the Frame Generator for the **All** option in **Lane**, **Line** or both; the modified values for specific lanes or lines are reset to the voltage level values set for the **All** option in **Lane**, **Line** or both.

The parameters in this group are:

Lane

Select the lane where the voltage levels must be applied.

Line

Select the line where the voltage levels must be applied.

HS High Level [V_OHHS]

High Speed Mode high voltage level.

HS Mid Level [V_CPTX]

High Speed Mode mid voltage level.

HS Low Level [V_OLHS]

High Speed Mode low voltage level.

LP High Level [V_OH]

Low Power Mode high voltage level.

LP Low Level [V_OL]

Low Power Mode low voltage level.

ALP Pause Level [V_ALP]

Voltage level applied for the **ALP Pause** mode. This parameter is available only when **ALP** mode is selected in the **CONNECTION** section.

TX EQ

Displays the Transmitter Equalization.

Disturbances

To change the disturbance settings, click **Disturbances** on the right panel to view the corresponding settings (See Figure 9).

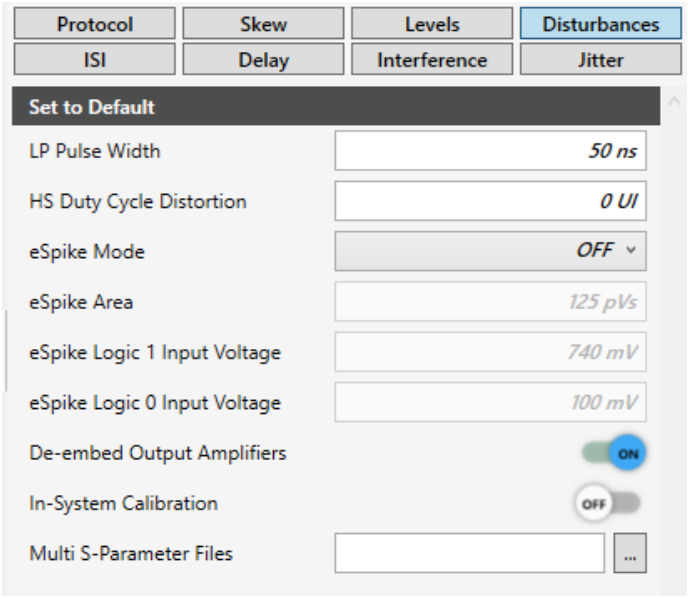

Figure 9 MIPI® C-PHY Parameters - Disturbances Group

The parameters in the **Disturbances** Group allow you to insert an eSpike in the middle of a symbol that has an editable area and input voltages of logic 1(or 0). Also, these parameters allow you to modify the LP Pulse Width and the pattern disturbances on the high-speed entry and exit sequences of a burst.

The parameters in this group are:

LP Pulse Width

Set the pulse width for the Low Power mode within the defined ranges.

Changing the value of **LP Pulse Width** does not affect the data rate. The data rate remains constant because increasing the pulse width by this option applies to LP High state, which changes the duty cycle and simultaneously, decreases the width of the LP low state.

HS Duty Cycle Distortion

Set the Duty Cycle on the HS signal.

eSpike Mode

Set to **ON** or **OFF** to enable/disable eSpike generation on the high levels or on the low levels of the pulse.

This parameter tests the ability of the LP receiver to reject any input signal smaller than the eSpike.

eSpike Area

Defines the area covered by the eSpike. The area can be calculated in the following manner:

Area calculation: With eSpike in high levels, the glitch goes from LP high level to LP low level. The area calculation begins below the selected “Logic 1 Input Voltage” to the “peak of the glitch”. The width of the eSpike increases when you increase the value of “Logic 1 Input Voltage”, which simultaneously increases the area. “Logic 0 Input Voltage” has no effect on high level eSpike. Similarly, you can calculate the area of eSpike in low levels.

eSpike Logic 1 Input Voltage

Specifies the lower receiver detection threshold level for a logic 1. It is the voltage level just below the LP high level voltage and is represented by VIH.

eSpike Logical 0 Input Voltage

Specifies the upper receiver detection threshold level for a logic 0. It is the voltage level just above the LP low level voltage and is represented by VIL.

De-embed Output Amplifiers

If set to **ON**, this parameter applies a software filter to compensate impairments of the AWG output amplifier, thereby, improving the MIPI® C-PHY signal quality. It also enables the parameter to enable/disable the *In-System AWG Calibration*.

In-System Calibration

If set to **ON**, this parameter enables the *In-System AWG Calibration* data. If not, the factory calibration data from the AWG are used.

Multi S-Parameter

Together with the **In-System Calibration** parameter, the S-Parameters can also be used to de-embed the system.

ISI

To change the InterSymbol Interference settings, click **ISI** on the right panel to view the corresponding settings (See Figure 10).

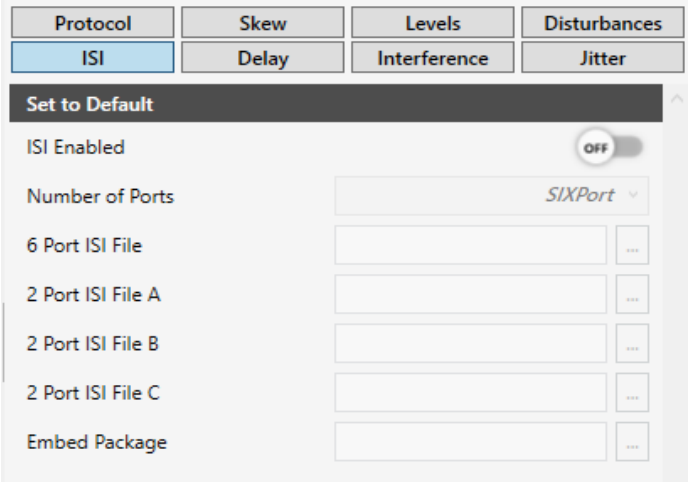

Figure 10 MIPI® C-PHY Parameters - ISI Group

InterSymbol Interference can also be generated by the software by using an S-Parameter file that modulates the targeted physical Channel. After selecting an S-Parameter file, you may make some additional changes.

The parameters in this group are:

ISI Enabled

Enables or disables the InterSymbol Interference parameter.

Number of Ports

Load an S-parameter file corresponding to either 2-Ports or 6-Ports. The software needs just one parameter to modify ISI because in an S-parameter file, a model of a fixed trace is given. Internally, it is converted into a time domain filter and applied to the waveform. By this factor, the time domain filter is stretched or compressed in time domain, which emulates a longer or shorter trace than the original. It can be used to tune the resulting ISI.

6 Port ISI File

S-Parameter file that emulates the target ISI channel. It is considered only when **SIXPort** is selected from the **Number of Ports** drop-down options.

2 Port ISI File A / B / C

Defines the ISI 2 Port S-Parameter file. These files are considered only when **TWOPort** is selected from the **Number of Ports** drop-down options.

Embed Package

Select the package file to de-embed the system.

Delay

To change the Delay settings, click **Delay** on the right panel to view the corresponding settings (See Figure 11).

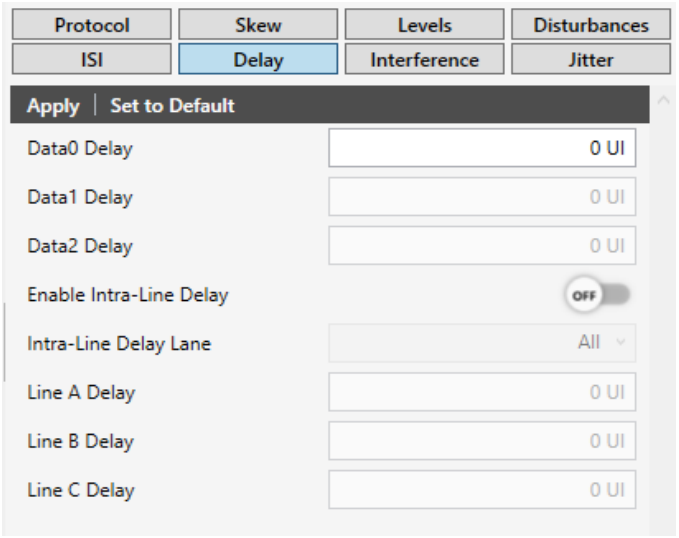

Figure 11 MIPI® C-PHY Parameters - Delay Group

The parameters in the **Delay** Group allow you to change the delays among the lanes. If the **Enable Intra-Line Delay** parameter is activated, it is also possible to apply delays among the lines.

The **Delay** section also consists of an **Apply** button, which is present locally in this panel. This button is enabled after the settings have been applied to the instruments using the global **APPLY** button (present on the main menu). When you click the **Apply** button within the **Delay** section, the software tries to use the hardware resources to generate delays. If the hardware resources are not enough, the delays must be embedded in the pattern; therefore, the waveform must be recalculated.

Interference

To change the signal interference settings, click **Interference** on the right panel to view the corresponding settings (See Figure 12).

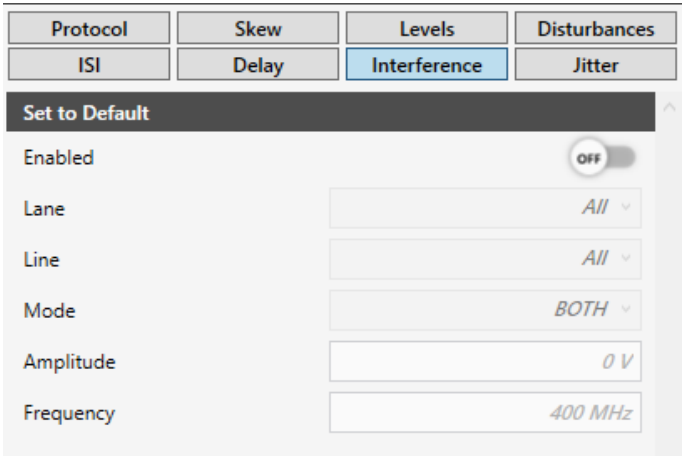

Figure 12 MIPI® C-PHY Parameters - Interference Group

The signal Interference settings indicate the lanes, lines, mode of the interference that must be introduced along with the amplitude and frequency of the interfering signal.

By default, the signal Interference settings are disabled. You must enable it only when the waveform generation has to be performed along with an available interfering signal.

The parameters in the signal **Interference** group generate signal interference that is super-imposed on the MIPI® C-PHY waveform. This is particularly useful to emulate external interferences on the MIPI® C-PHY devices.

The parameters in this group are:

Enabled

Enables or Disables the Sinusoidal Signal Interference generation.

Lane

Represents the target lane where the Signal Interferences are added. It allows interference on all data lanes simultaneously or on a specific data lane.

Line

Represents the target line where the Signal Interferences are added. It allows interference on all lines simultaneously or on a specific line.

Mode

Set to add interference on the High Speed signal, Low Speed signal or on both.

Amplitude

Amplitude of the generated interference.

Frequency

Frequency of the generated interference.

Jitter

To change the jitter settings, click **Jitter** on the right panel to view the corresponding settings (See Figure 13).

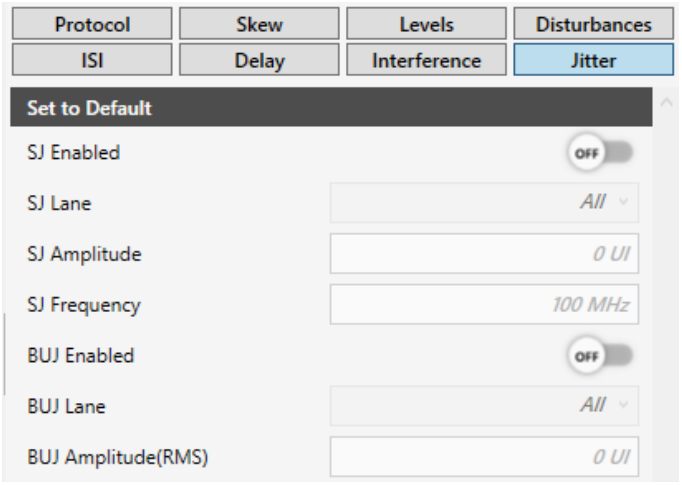

Figure 13 MIPI® C-PHY Parameters - Jitter Group

The parameters in the **Jitter** group generate Sinusoidal Jitter and Bounded Uncorrelated Jitter (Random Jitter). For both types of jitter, it is possible to select the target lane where they must be generated.

The parameters in this group are:

SJ Enabled

Enables or disables the Sinusoidal Jitter generation on all lanes.

SJ Lane

Select the lane where the Sinusoidal Jitter is applied.

It supports Sinusoidal Jitter on the Clock lane, on all Data lanes or alternatively on a specific Data lane.

SJ Amplitude

Amplitude of the Sinusoidal Jitter in peak-to-peak.

SJ Frequency

Frequency of the Sinusoidal Jitter.

BUJ Enabled

Enables or disables the Bounded Uncorrelated Jitter generation on all lanes. It emulates random jitter.

BUJ Lane

Select the lane where the Bounded Uncorrelated Jitter is applied.

It supports Bounded Uncorrelated Jitter on the Clock lane, on all Data lanes or alternatively on a specific Data lane.

BUJ Amplitude(RMS)

Root Mean Square (RMS) Amplitude of the Bounded Uncorrelated Jitter.

4 Troubleshooting

KEYSIGHT TECHNOLOGIES

Support Information

If you experience issues with the software, send an email to mipi-support@bitifeye.com. You must mention the version number, which you can find in the **About** dialog box. To access it, click **ABOUT...** from the main menu.

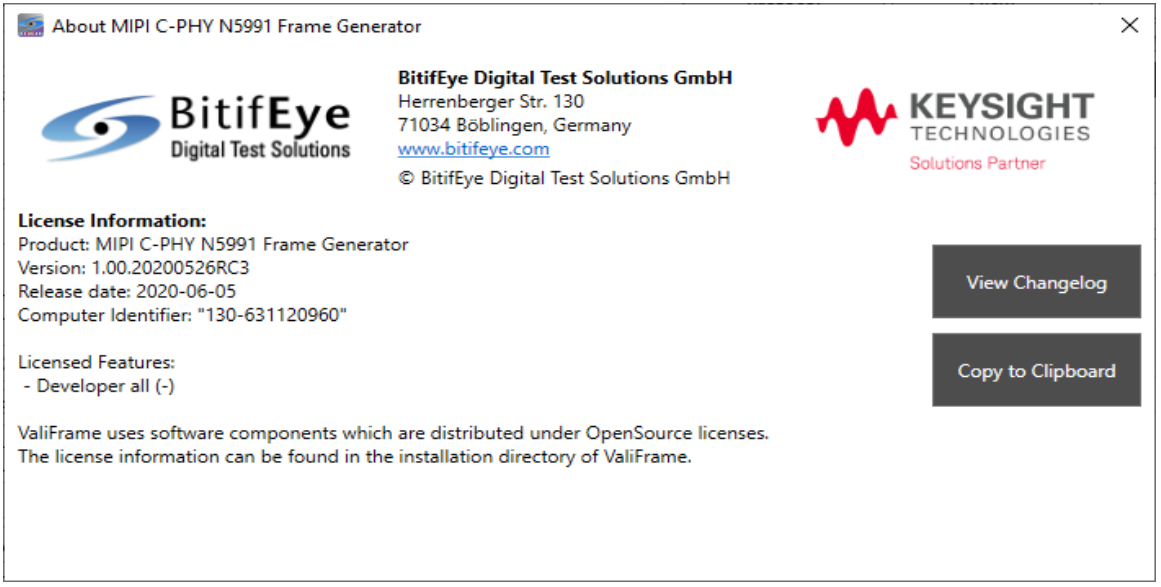

Figure 14 About the MIPI® C-PHY Frame Generator

Using Logs

Right click the **Logger** panel, select **Show Log File** to view the logs, and investigate the root cause of an issue.

Edition 1.0, June 2020

KEYSIGHT
TECHNOLOGIES

www.keysight.com