D9010CPHC MIPI® C-PHY℠ Compliance Test Application - Methods of Implementation

KEYSIGHT

METHODS OF IMPLEMENTATION

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MIPI C-PHY Compliance Test Application — At A Glance

The Keysight D9010CPHC MIPI C-PHY Compliance Test Application allows the testing of all MIPI devices with the Keysight Infiniium oscilloscope based on the MIPI Alliance Standard for C-PHY v1.0, v1.1, and v2.0 specifications. MIPI stands for Mobile Industry Processor Interface. The MIPI alliance is a collaboration of mobile industry leader with the objective to define and promote open standards for interfaces to mobile application processors.

The MIPI C-PHY Compliance Test Application:

- Lets you select individual or multiple tests to run.
- Lets you identify the device being tested and its configuration.
- Shows you how to make oscilloscope connections to the device under test.
- Automatically checks for proper oscilloscope configuration.
- Automatically sets up the oscilloscope for each test.
- Provides detailed information for each test that has been run, and lets you specify the thresholds at which marginal or critical warnings appear.
- Creates a printable HTML report of the tests that have been run.

NOTE **The tests performed by the MIPI C-PHY Compliance Test Application are intended to provide a quick check of the electrical health of the DUT. This testing is not a replacement for an exhaustive test validation plan.**

Required Equipment and Software

In order to run the MIPI C-PHY Compliance Test Application, you need the following equipment and software:

- Oscilloscope should have a bandwidth of 6GHz or higher. Use one of the following oscilloscope models:
  - Keysight 9000A, S-series, 90000A, X-series, V-series and Z-series Infiniium Oscilloscopes
  - Keysight UXR Oscilloscopes (13GHz – 33GHz)
  - Keysight MXR Real-Time Oscilloscopes (4 channels with channels 1-3 and 2-4 pairing support, up to 6GHz bandwidth, and sampling rate upto 16GSa/s)
- The minimum version of Infiniium oscilloscope software (see the D9010CPHC Compliance Test Application release notes).
- D9010CPHC MIPI C-PHY Compliance Test Application software.
- MX0020/21/22/23/24/25A: InfiniiMax Ultra Probe, bandwidth 10/13/16/25/20/25 GHz, qty = 3.
- MX0109A: InfiniiMax III GHz Extreme Temperature Solder-in Head, 26 GHz (Recommended head for Ultra-series probes above), qty = 3.
- 1132B/1134B/1168B/1169B: InfiniiMax Probe, bandwidth 5/7/10/13 GHz, qty = 3.
  Note: 1132B/1134B/1168B/1169B are alternate option to Ultra-series probes. Preferred probe for MXR scopes (no adapter required).
- E2669B: Differential probe connectivity kit (includes 4x E2677B 12GHz solder-in heads, 2x E2678B 12GHz socketed heads, and 1x E2675B browser head). Recommended head for 113xB/116xB probes, qty = 1.
- 15443A: Matched cable pair (2 x SMA(m) to SMA(m) cable included), qty = 2.
- N7010A: 30GHz Active Termination Adapter for Continuous mode test, qty = 3.
- Keyboard, qty = 1, (provided with the Keysight Infiniium oscilloscope).
- Mouse, qty = 1, (provided with the Keysight Infiniium oscilloscope).
- Keysight also recommends using a second monitor to view the automated test application.

For the list of licenses required to run this application, refer to the Data Sheet for this application.

In This Book

This manual describes the tests that are performed by the MIPI C-PHY Compliance Test Application in more detail.

- Chapter 1, “Installing the MIPI C-PHY Compliance Test Application” describes how to install and license the automated test application software (if it was purchased separately).
- Chapter 2, “Preparing to Take Measurements” describes how to start the MIPI C-PHY Compliance Test Application and gives a brief overview of how it is used.
- Chapter 3, “TX Electrical Signaling and Timing Tests” contains an overview on the signaling and timing electrical tests for high-speed transmitters and low-power transmitters.
- Chapter 4, “MIPI C-PHY 1.0 High-Speed Transmitter (HS-TX) Electrical Tests” contains an overview on the MIPI C-PHY 1.0 electrical tests for high-speed transmitters (HS-TX).
- Chapter 5, “MIPI C-PHY 1.0 Low Power Transmitter (LP-TX) Electrical Tests” describes the MIPI C-PHY 1.0 electrical tests for low-power transmitters (LP-TX).
- Chapter 6, “MIPI C-PHY 1.0 Global Timing Tests” describes the MIPI C-PHY 1.0 global timing tests.
- Chapter 7, “Informative Tests” describes the informative tests.
- Chapter 8, “MIPI C-PHY 1.1 High-Speed Transmitter (HS-TX) Electrical Tests” contains an overview on the MIPI C-PHY 1.1 electrical tests for high-speed transmitters (HS-TX).
- Chapter 9, “MIPI C-PHY 1.1 Low Power Transmitter (LP-TX) Electrical Tests” describes the MIPI C-PHY 1.1 electrical tests for low-power transmitters (LP-TX).
- Chapter 10, “MIPI C-PHY 1.1 Global Timing Tests” describes the MIPI C-PHY 1.1 global timing tests.
- Chapter 11, “Informative Tests” describes the informative tests.
- Chapter 12, “MIPI C-PHY 2.0 High-Speed Transmitter (HS-TX) Electrical Tests” contains an overview on the MIPI C-PHY 2.0 electrical tests for high-speed transmitters (HS-TX).
- Chapter 13, “MIPI C-PHY 2.0 Low Power Transmitter (LP-TX) Electrical Tests” describes the MIPI C-PHY 2.0 electrical tests for low-power transmitters (LP-TX).
- Chapter 14, “MIPI C-PHY 2.0 Global Timing Tests” describes the MIPI C-PHY 2.0 global timing tests.
- Chapter 15, “MIPI C-PHY 2.0 High Speed Calibration Preamble Tests” describes the MIPI C-PHY 2.0 high speed calibration preamble tests.
- Chapter 16, “Informative Tests” describes the informative tests.
- Chapter 17, “Calibrating the Infiniium Oscilloscope” describes how to calibrate the oscilloscope in preparation for running the MIPI C-PHY automated tests.
- Chapter 18, “InfiniiMax Probing” describes the probe amplifier and probe head recommendations for MIPI C-PHY conformance testing.

See Also

- The MIPI C-PHY Compliance Test Application’s Online Help, which describes:
  - Starting the MIPI C-PHY Compliance Test Application.
  - Creating or opening a test project.
  - Setting up the MIPI C-PHY test environment.
  - Selecting tests.
  - Configuring selected tests.
  - Defining compliance limits.
  - Connecting the oscilloscope to the DUT.
  - Running tests.
  - Automating the application.
  - Viewing test results.
  - Viewing/exporting/printing the HTML test report.

    - Saving test projects.
    - Installing/removing add-ins.
    - Controlling the application via a remote PC.
    - Using a second monitor.
- The MIPI C-PHY standard specifications are available in C-PHY Physical Layer Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016), C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016) and C-PHY Specification draft v2.0r03 (29Dec2018).

Contents

1 Installing the MIPI C-PHY Compliance Test Application

If you purchased the D9010CPHC MIPI C-PHY Compliance Test Application separately, you must install the software and license key.

Installing the Software

1. Make sure you have the minimum version of Infiniium Oscilloscope software (see the D9010CPHC test application release notes) by choosing **Help>About Infiniium**... from the main menu.
2. To obtain the MIPI C-PHY Compliance Test Application, go to Keysight Web site: http://www.keysight.com/en/pc-1152185/oscilloscope-software.
3. Navigate to the D9010CPHC MIPI C-PHY Compliance Test Application software download.
4. Follow the instructions to download and install the application software.

Installing the License Key

For the list of licenses required to run this application, refer to the Data Sheet for this application. To procure a license, you require the Host ID information that is displayed in the Keysight License Manager application installed on the same machine where you wish to install the license.

Using Keysight License Manager 5

To view and copy the Host ID from Keysight License Manager 5:

1 Launch Keysight License Manager on your machine, where you wish to run the Test Application and its features.

2 Copy the Host ID that appears on the top pane of the application. Note that x indicates numeric values.

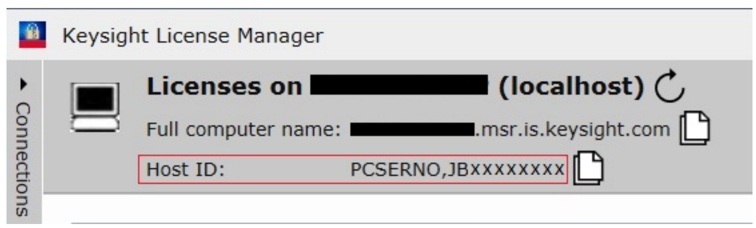


Figure 1 Viewing the Host ID information in Keysight License Manager 5

To install one of the procured licenses using Keysight License Manager 5 application,

1 Save the license files on the machine, where you wish to run the Test Application and its features.

2 Launch Keysight License Manager.

3 From the configuration menu, use one of the options to install each license file.

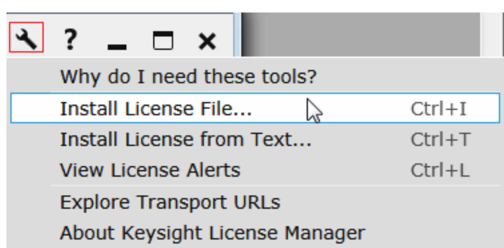


Figure 2 Configuration menu options to install licenses on Keysight License Manager 5

For more information regarding installation of procured licenses on Keysight License Manager 5, refer to Keysight License Manager 5 Supporting Documentation.

Using Keysight License Manager 6

To view and copy the Host ID from Keysight License Manager 6:

1 Launch Keysight License Manager 6 on your machine, where you wish to run the Test Application and its features.

2 Copy the Host ID, which is the first set of alphanumeric value (as highlighted in Figure 3) that appears in the Environment tab of the application. Note that x indicates numeric values.

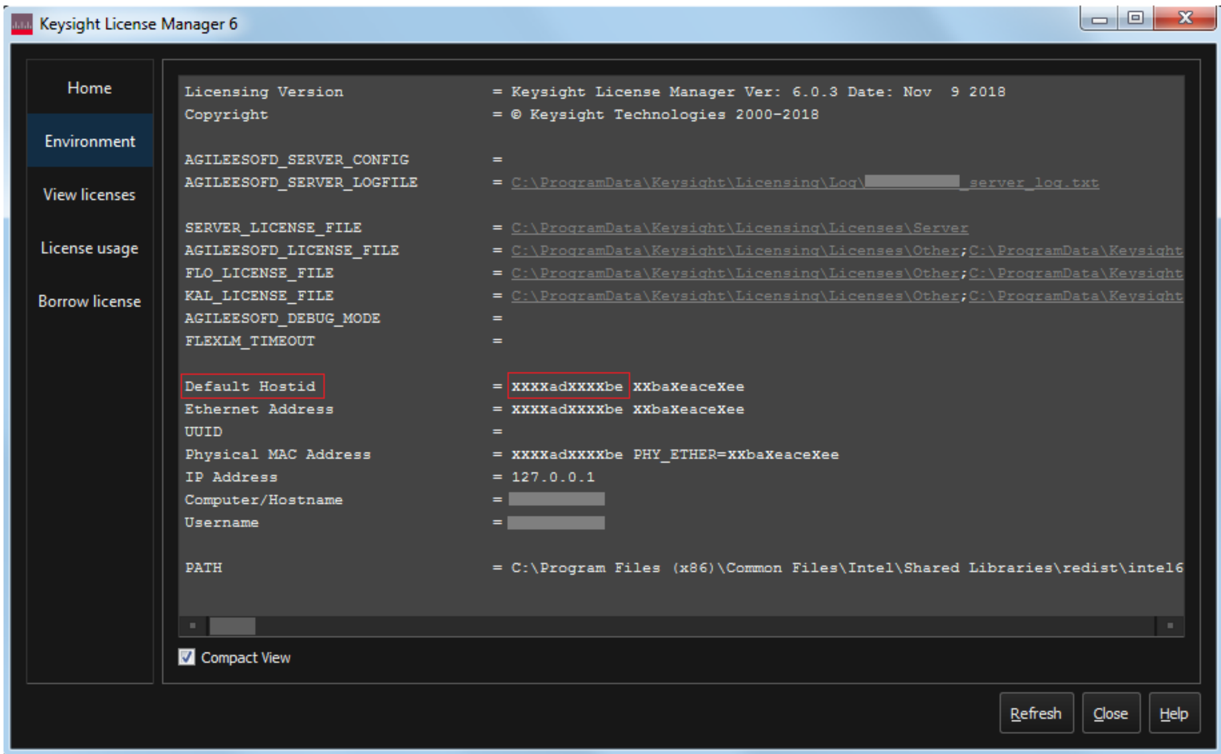


Figure 3 Viewing the Host ID information in Keysight License Manager 6

To install one of the procured licenses using Keysight License Manager 6 application,

1 Save the license files on the machine, where you wish to run the Test Application and its features.
2 Launch Keysight License Manager 6.
3 From the Home tab, use one of the options to install each license file.

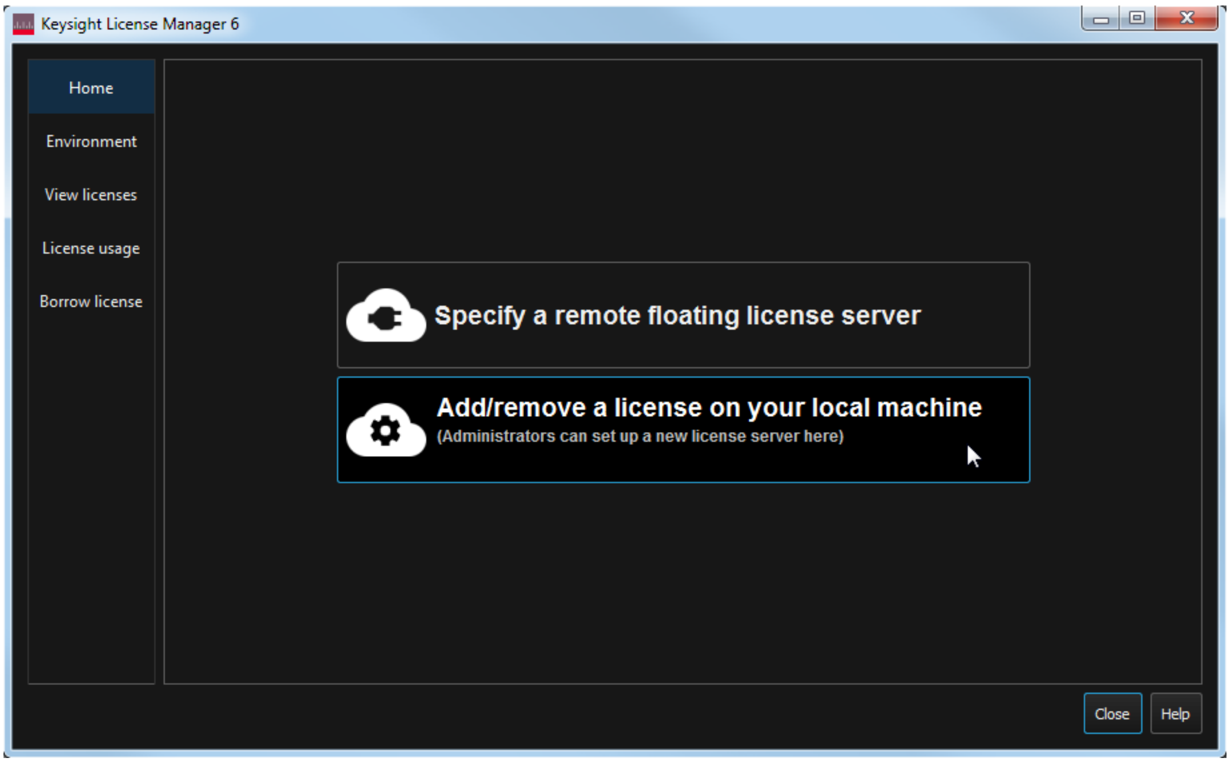


Figure 4 Home menu options to install licenses on Keysight License Manager 6

For more information regarding installation of procured licenses on Keysight License Manager 6, refer to Keysight License Manager 6 Supporting Documentation.

2 Preparing to Take Measurements

Before running the MIPI C-PHY automated tests, you must calibrate the oscilloscope and probe. After the oscilloscope and probe have been calibrated, you are ready to start the MIPI C-PHY Compliance Test Application and perform the measurements.

Calibrating the Oscilloscope

- If you have not already calibrated the oscilloscope and probe, see Chapter 17, “Calibrating the Infiniium Oscilloscope.

NOTE If the ambient temperature changes more than 5 degrees Celsius from the calibration temperature, internal calibration should be performed again. The delta between the calibration temperature and the present operating temperature is shown in the **Utilities>Calibration** menu.

NOTE If you switch cables between channels or other oscilloscopes, it is necessary to perform cable and probe calibration again. Keysight recommends that, once calibration is performed, you label the cables with the channel on which they were calibrated.

Starting the MIPI C-PHY Compliance Test Application

1 From the Infiniium Oscilloscope's main menu, choose **Analyze>Automated Test Apps>D9010CPHC MIPI C-PHY Test App.**

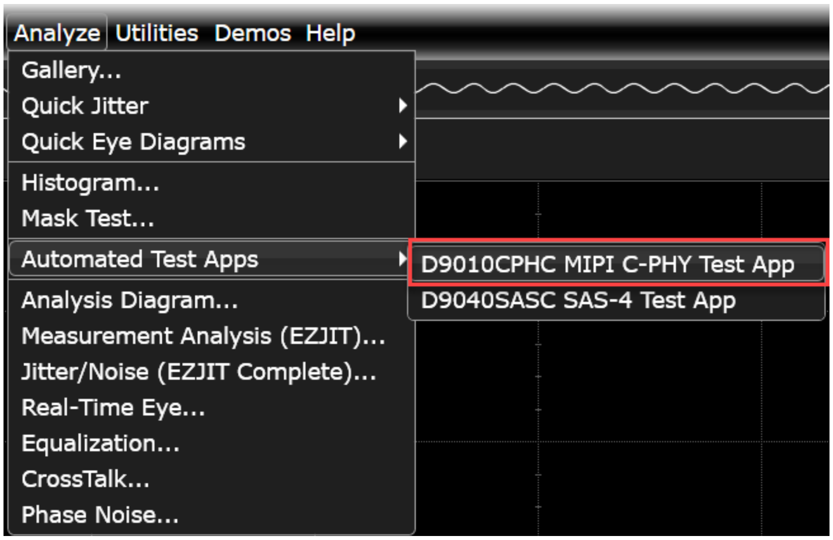


Figure 5 Starting the MIPI C-PHY Compliance Test Application

NOTE

If the D9010CPHC MIPI C-PHY Test App does not appear in the **Automated Test Apps** menu, the MIPI C-PHY Compliance Test Application has not been installed (see Chapter 1, "Installing the MIPI C-PHY Compliance Test Application").

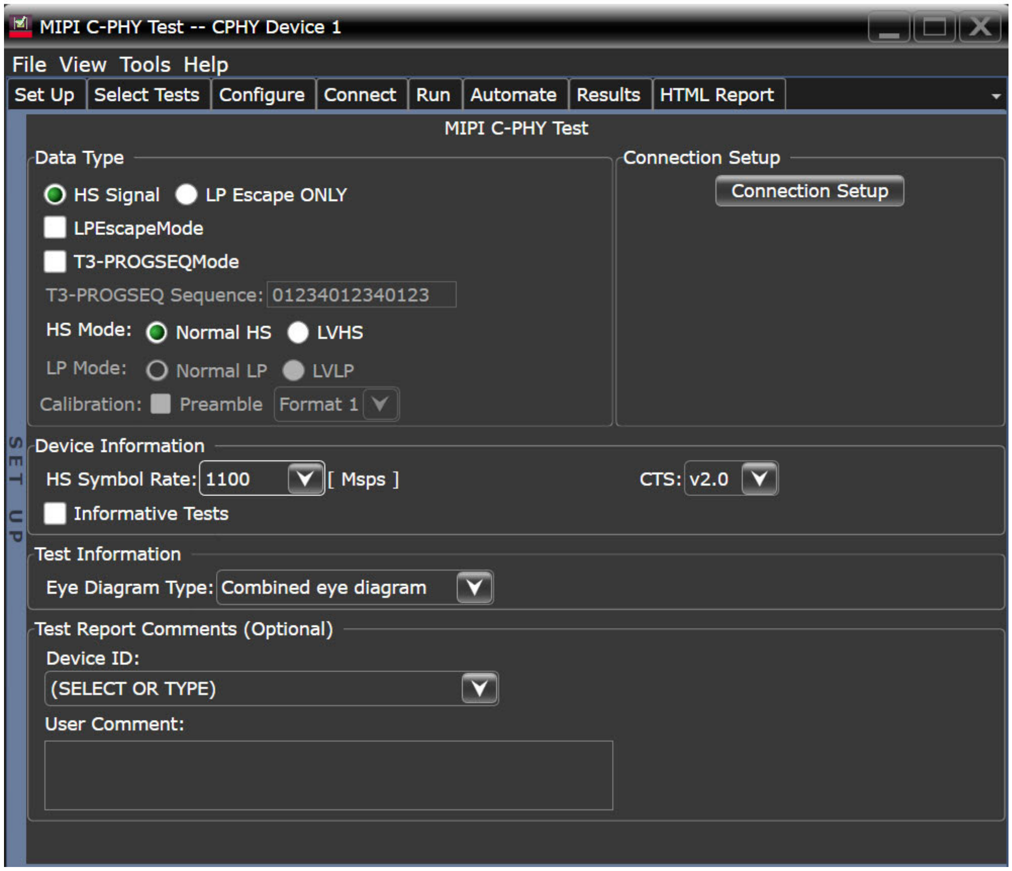


Figure 6 The MIPI C-PHY Compliance Test Application's default window

Figure 5 shows the procedure to launch the MIPI C-PHY Compliance Test Application and Figure 6 shows the MIPI C-PHY Compliance Test Application default window. The tabs in the main pane show the steps you take in running the automated tests:

Tab	Description
Set Up	Lets you identify and set up the test environment, including information about the device under test.
Select Tests	Lets you select the tests you want to run. The tests are organized hierarchically so you can select all tests in a group. After tests are run, status indicators show which tests have passed, failed, or not been run, and there are indicators for the test groups.
Configure	Lets you configure test parameters. This information appears in the HTML report.
Connect	Shows you how to connect the oscilloscope to the device under test for the tests to be run.
Run Tests	Starts the automated tests. If the connections to the device under test need to be changed while multiple tests are running, the tests pause, show you how to change the connection, and wait for you to confirm that the connections have been changed before continuing.
Automation	Lets you construct scripts of commands that drive execution of the application.
Results	Contains more detailed information about the tests that have been run. You can change the thresholds at which marginal or critical warnings appear.
HTML Report	Shows a compliance test report that can be printed.

NOTE

The configuration options shown under the **Set Up** tab of the MIPI C-PHY Compliance Test Application main window dictate the availability of various tests. You may have to select more than one configuration option to make some tests available, else they appear unavailable/disabled. To know more about the configurable options under the **Set Up** tab that must be selected for each test, refer to the section, “Test Availability” under the method of implementation for each test in this document.

Online Help Topics

For information on using the MIPI C-PHY Compliance Test Application, see its Online Help (which you can access by choosing **Help>Contents**... from the application's main menu).

The MIPI C-PHY Compliance Test Application's Online Help describes:

- Starting the MIPI C-PHY Compliance Test Application.
- Creating or opening a test project.
- Setting up the MIPI C-PHY test environment.
- Selecting tests.
- Configuring selected tests.
- Defining compliance limits.
- Connecting the oscilloscope to the device under test (DUT).
- Running tests.
- Automating the application.
- Viewing test results.
- Viewing/exporting/printing the HTML test report.
- Saving test projects.
- Installing/removing add-ins.
- Controlling the application via a remote PC.
- Using a second monitor.

3 TX Electrical Signaling and Timing Tests

The Keysight D9010CPHC MIPI C-PHY Compliance Test Application enables compliance testing of the High-Speed Transmitter (HS-TX) and Low-Power Transmitter (LP-TX), in adherence to the MIPI C-PHY specifications.

Overview

The group of tests specified in this Methods of Implementation document pertains to the MIPI C-PHY specifications. The tests within these test groups are developed to cater for High-Speed Transmitter and Low-Power Transmitter testing.

Figure 7 and Figure 8 show the circuit diagram of a C-PHY Transceiver and the associated C-PHY signaling levels, respectively.

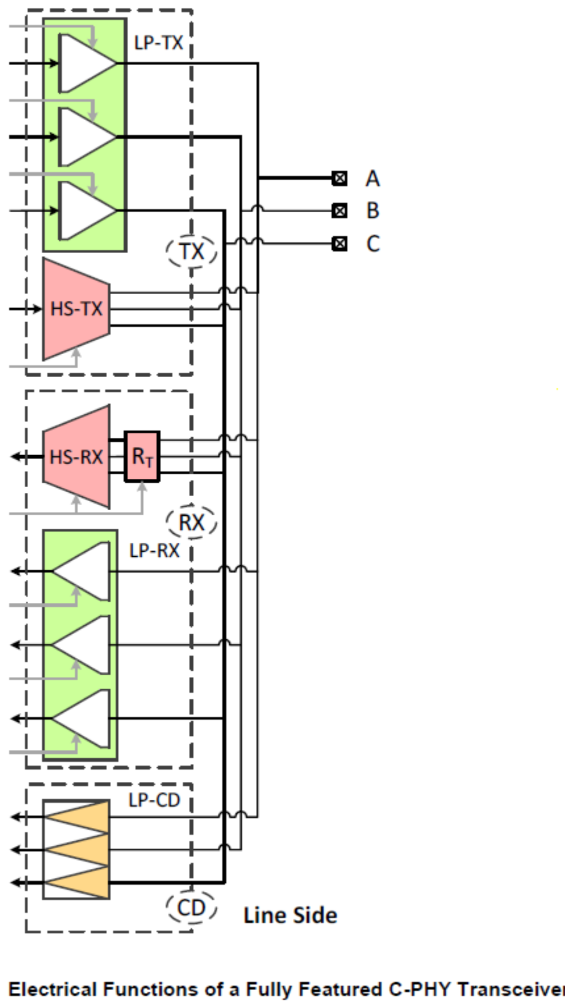


Figure 7 Circuit Diagram of a C-PHY Transceiver

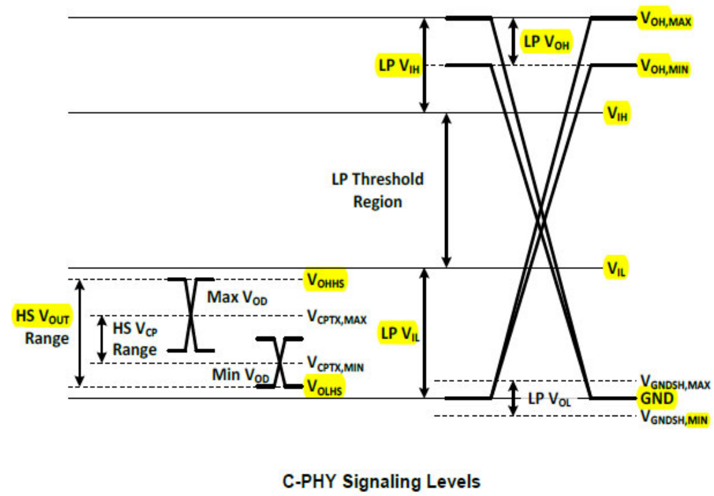


Figure 8 C-PHY Signaling Levels

Notice that the signal levels for the Differential High-Speed mode differ from that for the single-ended Low-Power mode. The High-Speed signaling levels are below the low level input threshold for the Low-Power mode such that the Low Power receiver always detects low on HS signals.

The actual maximum bit rate for the High-Speed mode is not specified in the MIPI C-PHY specifications. However, the specification document is primarily intended to define a solution for a bit range from 80 Mbps to 3 Gbps (or above) per Lane.

For the Low-Power mode, the maximum data rate specified in the MIPI C-PHY specifications is 10Mbps.

Test Availability in the C-PHY Compliance Test Application

The C-PHY Compliance Test Application consists of some options in the **Set Up** tab that dictate the availability of certain tests. The test settings could be affected by one or more configuration options. For such tests, if one of the option is disabled, the test is unavailable. The options in the **Set Up** tab, as shown in Figure 9, which primarily affect the availability of tests are:

1. HS Signal — LPEscapeMode
2. LP Escape ONLY
3. T3-PROGSEQMode
4. HS Mode
5. LP Mode
6. Calibration
7. Preamble
8. HS Symbol Rate
9. CTS
10. Informative Tests
11. Eye Diagram Type
12. Probing Method

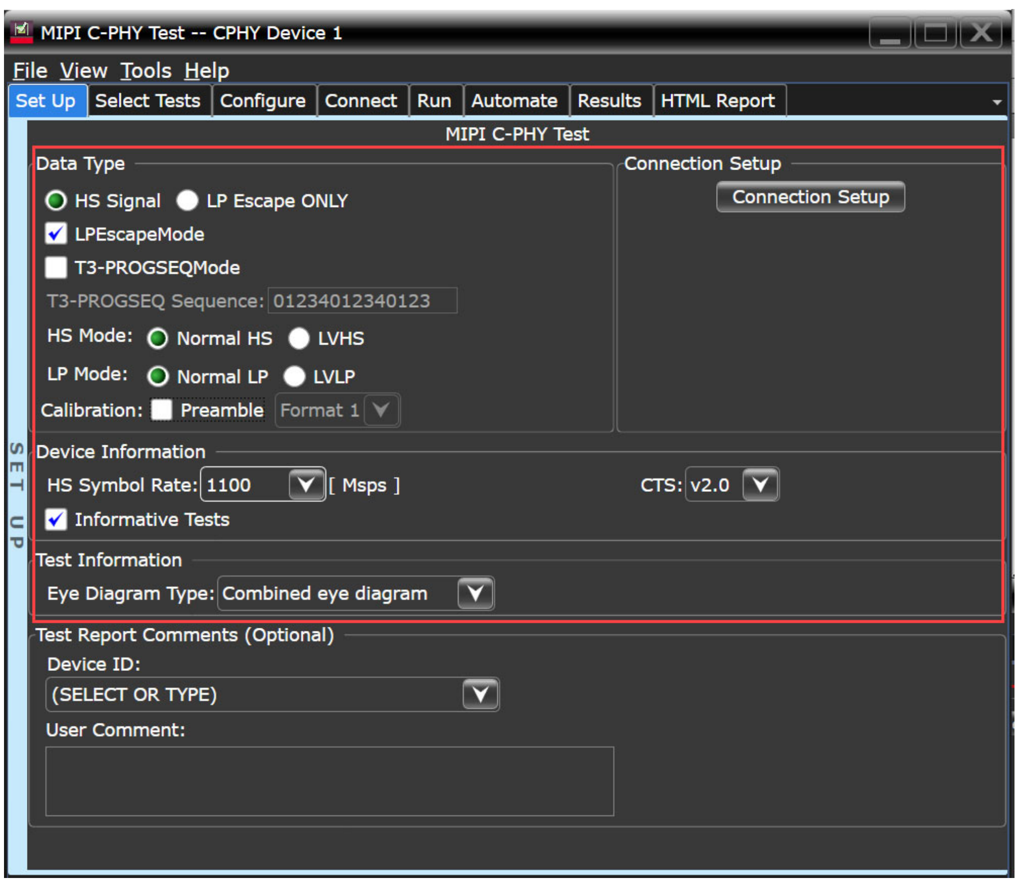


Figure 9 C-PHY Configuration Options in the **Set Up** tab

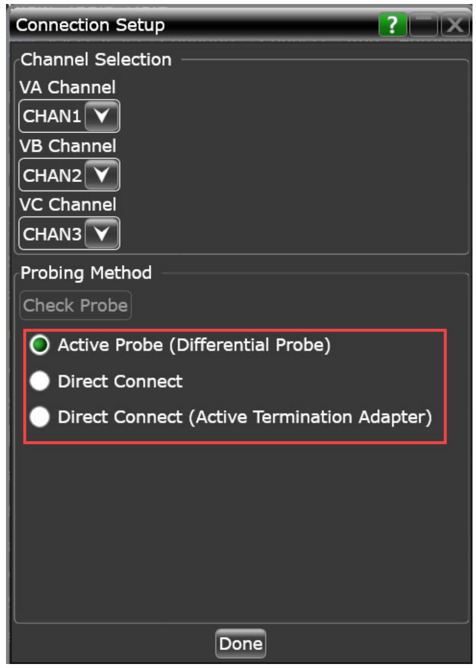


Figure 10 CPHY Configuration options – Probing Method

To check for the configuration options that impact the availability of each of the tests described in this document, refer to the “Test Availability” section for each test.

Broadly, the test groups are categorized as:

1 HS Electrical Tests
2 LP Tests
3 Global Timing Tests
4 HS Calibration Preamble Tests

4 MIPI C-PHY 1.0 High-Speed Transmitter (HS-TX) Electrical Tests

This section provides the Methods of Implementation (MOIs) for the electrical tests for high-speed transmitters (HS-TX) using an Keysight Infiniium oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

Probing for High-Speed Transmitter Electrical Tests

When performing the HS Electrical tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the HS Electrical tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **Reference Termination Board** and configure the DUT to output **Burst signal** prior to running the HS Electrical Tests.

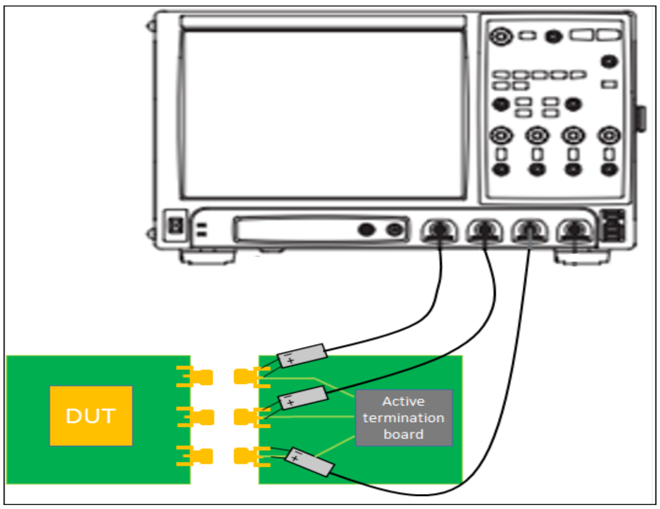


Figure 11 Sample connection diagram for HS Electrical Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 11 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, "InfiniiMax Probing," starting on page 249.

Test Procedure

1 Start the automated test application as described in "Starting the MIPI C-PHY Compliance Test Application" on page 29.
2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3 Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v1.0**.
4 Click **Connection Setup** to configure the channel selection and probing method.
5 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

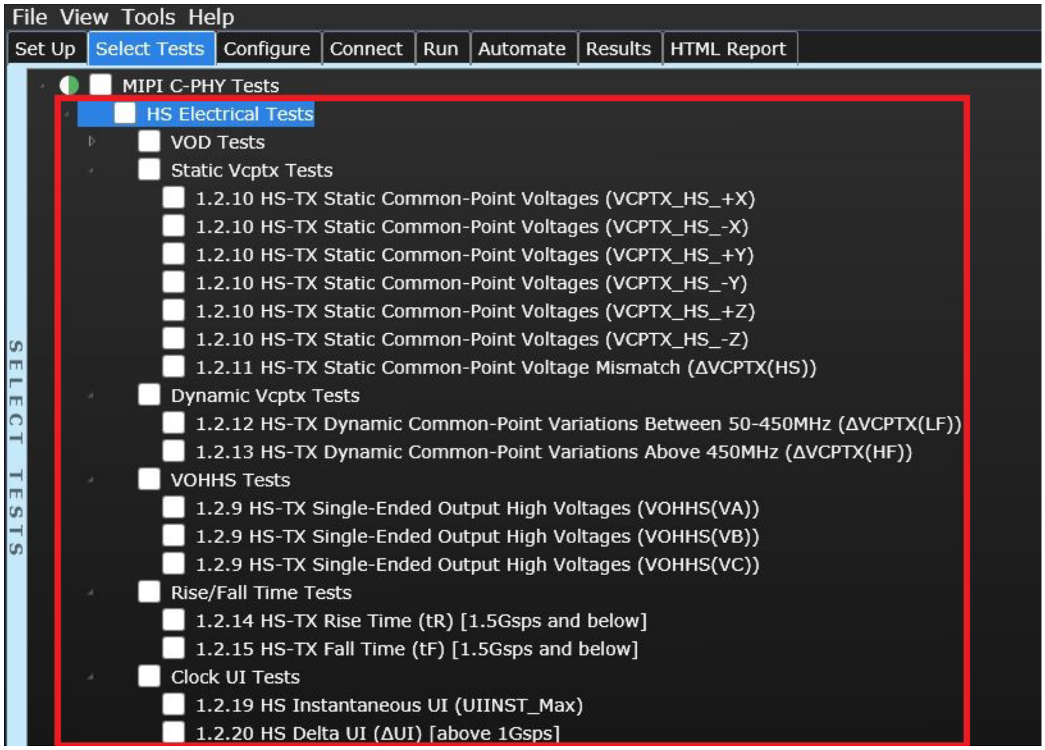


Figure 12 Selecting High-Speed Transmitter Electrical Tests

6 Follow the MIPI C-PHY Compliance Test Application's task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.2.7 HS-TX Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA})

Test Overview

The purpose of this test is to verify that the Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA}) of the HS Transmitter DUT are within the conformance limits of the MIPI C-PHY standard specification.

The single-ended output voltages are defined V_A, V_B and V_C at the A, B and C pins, respectively. The differential output voltages V_{OD_AB}, V_{OD_BC} and V_{OD_CA} are defined at the difference of the voltages:

$$V_{OD\_AB} = V_A - V_B$$

$$V_{OD\_BC} = V_B - V_C$$

$$V_{OD\_CA} = V_C - V_A$$

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 1 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA}) test.

Table 1 Configuration Options for HS-TX Differential Voltages Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.7	1700	HS-TX Differential Voltages ($V_{OD-AB-Strong1}$) [Max]	×	✓	✓	×	×
	1701	HS-TX Differential Voltages ($V_{OD-AB-Weak1}$) [Min]	×	✓	✓	×	×
	1702	HS-TX Differential Voltages ($V_{OD-AB-Weak0}$) [Max]	×	✓	✓	×	×
	1703	HS-TX Differential Voltages ($V_{OD-AB-Strong0}$) [Min]	×	✓	✓	×	×
	1710	HS-TX Differential Voltages ($V_{OD-BC-Strong1}$) [Max]	×	✓	✓	×	×
	1711	HS-TX Differential Voltages ($V_{OD-BC-Weak1}$) [Min]	×	✓	✓	×	×
	1712	HS-TX Differential Voltages ($V_{OD-BC-Weak0}$) [Max]	×	✓	✓	×	×
	1713	HS-TX Differential Voltages ($V_{OD-BC-Strong0}$) [Min]	×	✓	✓	×	×
	1720	HS-TX Differential Voltages ($V_{OD-CA-Strong1}$) [Max]	×	✓	✓	×	×
	1721	HS-TX Differential Voltages ($V_{OD-CA-Weak1}$) [Min]	×	✓	✓	×	×
	1722	HS-TX Differential Voltages ($V_{OD-CA-Weak0}$) [Max]	×	✓	✓	×	×
	1723	HS-TX Differential Voltages ($V_{OD-CA-Strong0}$) [Min]	×	✓	✓	×	×

References

See Test 1.2.7 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 1700, 1710, 1720

1 Trigger on the LP-111 to LP-001 region of an HS Burst data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Fold the required DiffData waveform to form a Data Eye.

5 Use the Histogram feature to measure the minimum and maximum values for the parameters Strong1, Weak1, Weak0 and Strong0 at a point, which is 20% of the UI width before the trigger point. Configure the Histogram window settings with the following options:
   - *a* $V_{OD(Strong1, Weak1)}$ Histogram Window [Top](V)
   - *b* $V_{OD(Strong1, Weak1)}$ Histogram Window [Bottom](V)
   - *c* $V_{OD(Strong0, Weak0)}$ Histogram Window [Top](V)
   - *d* $V_{OD(Strong0, Weak0)}$ Histogram Window [Bottom](V)
   - *e* V_{OD} Histogram Window Width (UI)

6 Report the measured values of V_{OD} for all parameters mentioned in the previous step.

7 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1701, 1702, 1703

1 Run the following test as a prerequisite:
   - *a* Test 1.2.7 HS-TX Differential Voltages ($V_{OD-AB-Strong1}$)[Max] – (Test ID 1700).

   Store the test results after measuring all the required values of V_{OD-AB} for the test signal.

2 Report the measured values of V_{OD} that you obtain from the prerequisite test.

3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1711, 1712, 1713

1 Run the following test as a prerequisite:
   - *a* Test 1.2.7 HS-TX Differential Voltages ($V_{OD-BC-Strong1}$)[Max] – (Test ID 1710).

   Store the test results after measuring all the required values of V_{OD-BC} for the test signal.

2 Report the measured values of V_{OD} that you obtain from the prerequisite test.

3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1721, 1722, 1723

1 Run the following test as a prerequisite:
   - *a* Test 1.2.7 HS-TX Differential Voltages ($V_{OD-CA-Strong1}$)[Max] – (Test ID 1720).

   Store the test results after measuring all the required values of V_{OD-CA} for the test signal.

2 Report the measured values of V_{OD} for that you obtain from the prerequisite test.

3 Compare the measured values of V_{OD} against the compliance test limits.

Expected/Observable Results

The measured value of V_{OD} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.8 HS-TX Differential Voltage Mismatch (ΔV_{OD})

Test Overview

The purpose of this test is to verify that the Differential Voltage Mismatch (ΔV_{OD}) of the HS Transmitter DUT is within the conformance limits of the MIPI C-PHY standard specification.

Test Availability

Table 2 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Differential Voltage Mismatch (ΔV_{OD}) test.

Table 2 Configuration Options for HS-TX Differential Voltage Mismatch Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.8	1800	HS-TX Differential Voltage Mismatch (ΔV_{OD})	×	✓	✓	×	×

References

See Test 1.2.8 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 1800

1. Run the following tests as a prerequisite:
   a Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}AB\text{-}Strong1}$)[Max] — (Test ID 1700).

   Store the test results after measuring all the required values of $V_{OD\text{-}AB}$ for the test signal.

   b Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Strong1}$)[Max] — (Test ID 1710).

   Store the test results after measuring all the required values of $V_{OD\text{-}BC}$ for the test signal.

   c Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}CA\text{-}Strong1}$)[Max] — (Test ID 1720).

   Store the test results after measuring all the required values of $V_{OD\text{-}CA}$ for the test signal.
2. Derive $V_{OD\text{-}MAX}$ from the maximum values of the parameter Strong1[Max] of V_{OD} measured for the AB, BC and CA pairs.
3. Derive $V_{OD\text{-}MIN}$ from the minimum values of the parameter Strong0[Min] of V_{OD} measured for the AB, BC and CA pairs.
4. Calculate the Differential Voltage Mismatch using the equation:

$$\Delta V_{OD} = |V_{OD\text{-}MAX} - V_{OD\text{-}MIN}|$$

5. Compare the measured values of ΔV_{OD} against the compliance test limits.

Expected/Observable Results

The measured value of ΔV_{OD} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.9 HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$, $V_{OHHS(VC)}$)

Test Overview

The purpose of this test is to verify that the Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$ and $V_{OHHS(VC)}$) of the HS Transmitter DUT are less than the maximum conformance limit values of the MIPI C-PHY standard specification.

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 3 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$ and $V_{OHHS(VC)}$) test.

Table 3 Configuration Options for HS-TX Single-Ended Output High Voltages Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.9	1900	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$)	×	✓	✓	×	×
	1901	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VB)}$)	×	✓	✓	×	×
	1902	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VC)}$)	×	✓	✓	×	×

References

See Test 1.2.9 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 1900, 1901, 1902

1 Trigger on the LP-111 to LP-001 region of an HS Burst data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Calculate the UI width from the input HS Symbol Rate.
4 Fold the required single-ended data signal (V_A, V_B or V_C) to form a Data Eye.
5 Enable the Histogram feature on the Oscilloscope.
6 Place the Histogram window on the upper level of the 3-level single-ended eye diagram such that the location of the window is at 20% of the UI width before the trigger point. Configure the Histogram window settings with the following options:
   a V_{OHHS} Histogram Window [Top](V)
   b V_{OHHS} Histogram Window [Bottom](V)
   c V_{OHHS} Histogram Window Width (UI)

7. Measure the mean value of the Histogram and use this value as the final V_{OHHS} measurement result.
8. Compare the measured values of V_{OHHS} against the compliance test limits.

Expected/Observable Results

The measured value of V_{OHHS} for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.10 HS-TX Static Common-Point Voltages (V_{CPTX})

Test Overview

The purpose of this test is to verify that the Static Common-Point Voltages (V_{CPTX}) of the HS Transmitter DUT are within the conformance limits of the MIPI C-PHY standard specification. Figure 13 shows the static V_{CPTX} distortion on the single-ended high-speed signals.

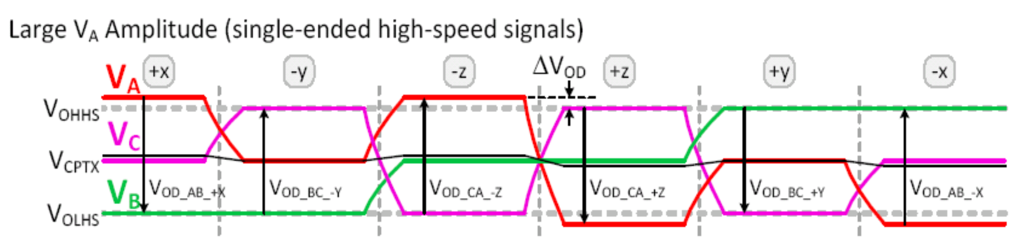


Figure 13 Static V_{CPTX} distortion on the single-ended high-speed signals

The common-point voltage V_{CPTX} is defined as the arithmetic mean value of the voltages at the A, B and C pins:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 4 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Static Common-Point Voltages (V_{CPTX}) test.

Table 4 Configuration Options for HS-TX Static Common-Point Voltages Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.10	2000	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$)	×	✓	✓	×	×
	2001	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-X}$)	×	✓	✓	×	×
	2002	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Y}$)	×	✓	✓	×	×
	2003	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Y}$)	×	✓	✓	×	×
	2004	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Z}$)	×	✓	✓	×	×
	2005	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Z}$)	×	✓	✓	×	×

References

See Test 1.2.10 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 2000

1. Trigger on the LP-111 to LP-001 region of an HS Burst data signal.
2. Capture waveforms for V_A, V_B and V_C.
3. Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4. Use the generated differential waveforms to decode the wire states of only the HS data by sampling at the center of the UI for each wire state.
5. Generate the common-point voltage V_{CPTX} signal using the equation:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

6. Group the values of V_{CPTX} for similar HS wire states. For example, all values of V_{CPTX} that are sampled at the center of each of the UI measurements for the HS wire state +X are grouped together. Apply the same procedure for HS wire states -X, +Y, -Y, +Z and -Z.
7. Derive the maximum, minimum and mean values of V_{CPTX} for each of the HS wire state groups.
8. Record the mean value of V_{CPTX} as the final test result.
9. Compare the measured mean values of V_{CPTX} against the compliance test limits.

For Test ID 2001, 2002, 2003, 2004, 2005

1 Run the following test as a prerequisite:

   a Test 1.2.10 HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$) — (Test ID 2000).

   Store the test results after measuring the actual values of V_{CPTX} for the test signal.

2 Report the measured values of V_{CPTX} for that you obtain from the prerequisite test.

3 Compare the measured values of V_{CPTX} against the compliance test limits.

Expected/Observable Results

The measured value of V_{CPTX} for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.11 HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$)

Test Overview

The purpose of this test is to verify that the Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$) of the HS Transmitter DUT is less than the maximum conformance limit values of the MIPI C-PHY standard specification.

Test Availability

Table 5 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$) test.

Table 5 Configuration Options for HS-TX Static Common-Point Voltage Mismatch Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.11	2100	HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$)	×	✓	✓	×	×

References

See Test 1.2.11 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 2100

1 Run the following tests as a prerequisite:

a Test 1.2.10 HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$) — (Test ID 2000).

Store the test results after measuring the actual values of V_{CPTX} for the test signal.

2 Calculate the V_{MAXCP}, V_{MINCP} and $\Delta V_{CPTX(HS)}$ using the equations:

$$V_{MAXCP} = \max(V_{CPTX\_HS\_+X}, V_{CPTX\_HS\_-X}, V_{CPTX\_HS\_+Y}, V_{CPTX\_HS\_-Y}, V_{CPTX\_HS\_+Z}, V_{CPTX\_HS\_-Z})$$

$$V_{MINCP} = \min(V_{CPTX\_HS\_+X}, V_{CPTX\_HS\_-X}, V_{CPTX\_HS\_+Y}, V_{CPTX\_HS\_-Y}, V_{CPTX\_HS\_+Z}, V_{CPTX\_HS\_-Z})$$

$$\Delta V_{CPTX(HS)} = (V_{MAXCP} - V_{MINCP}) / 2$$

3 Compare the measured values of $\Delta V_{CPTX(HS)}$ against the compliance test limits.

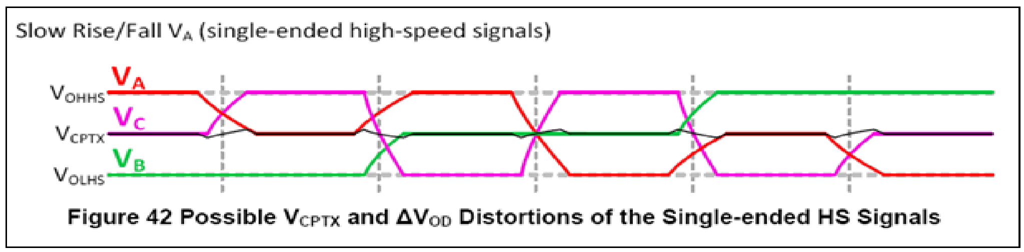
Expected/Observable Results

The measured value of $\Delta V_{CPTX(HS)}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.12 HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$)

Test Overview

The purpose of this test is to verify that the AC Common-Point Signal Level Variations Between 50 and 450MHz ($\Delta V_{CPTX(LF)}$) of the HS Transmitter DUT are less than the maximum allowable conformance limit values of the MIPI C-PHY standard specification. Figure 14 shows the dynamic V_{CPTX} distortion on the single-ended high-speed signals.



Dynamic V_{CPTX} Distortion

Figure 14 Dynamic V_{CPTX} distortion on the single-ended high-speed signals

Test Availability

Table 6 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$) test.

Table 6 Configuration Options for HS-TX Dynamic Common-Point Variations Between 50 and 450MHz Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.12	2200	HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$)	×	✓	✓	×	×

References

See Test 1.2.12 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 2200

1 Trigger on the LP-111 to LP-001 region of an HS Burst data signal.

2 Capture waveforms for V_A, V_B and V_C.

3 Generate the common-point voltage V_{CPTX} signal using the equation:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

4 Apply a band-pass filter with 3dB bandwidth frequency of 50MHz and 450MHz to the common-point waveform.
5 Measure the minimum and maximum values of voltage for the filtered waveform.
6 Record the maximum value of voltage as $\Delta V_{CPTX(LF)}$.
7 Compare the measured value of $\Delta V_{CPTX(LF)}$ against the compliance test limits.

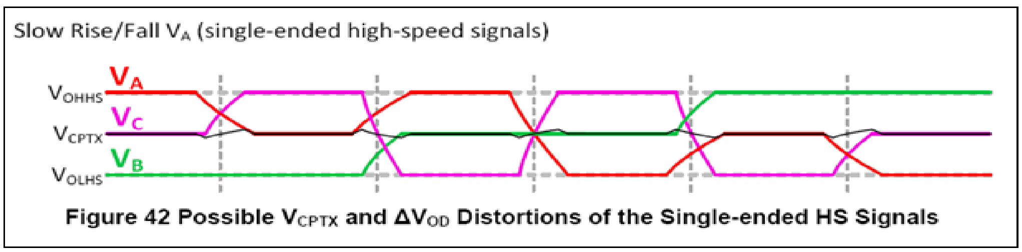
Expected/Observable Results

The measured value of $\Delta V_{CPTX(LF)}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.13 HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$)

Test Overview

The purpose of this test is to verify that the AC Common-Point Signal Level Variations Above 450MHz ($\Delta V_{CPTX(HF)}$) of the HS Transmitter DUT are less than the maximum allowable conformance limit values of the MIPI C-PHY standard specification. Figure 15 shows the dynamic V_{CPTX} distortion on the single-ended high-speed signals.



Dynamic V_{CPTX} Distortion

Figure 15 Dynamic V_{CPTX} distortion on the single-ended high-speed signals

Test Availability

Table 7 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$) test.

Table 7 Configuration Options for HS-TX Dynamic Common-Point Variations Above 450MHz Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.13	2300	HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$)	×	✓	✓	×	×

References

See Test 1.2.13 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 2300

1. Trigger on the LP-111 to LP-001 region of an HS Burst data signal.
2. Capture waveforms for V_A, V_B and V_C.
3. Generate the common-point voltage V_{CPTX} signal using the equation:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

4 Apply a high pass filter with 3dB bandwidth frequency of 450MHz to the common-point waveform.
5 Measure the RMS value of the voltage for the filtered waveform and record as $\Delta V_{CPTX(HF)}$.
6 Compare the measured value of $\Delta V_{CPTX(HF)}$ against the compliance test limits.

Expected/Observable Results

The measured value of $\Delta V_{CPTX(HF)}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.14 HS-TX Rise Time (t_R)

Test Overview

The purpose of this test is to verify that the Rise Time (t_R) of the HS Transmitter DUT is within the conformance limit value of the MIPI C-PHY standard specification.

Test Availability

Table 8 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Rise Time (t_R) test.

Table 8 Configuration Options for HS-TX Rise Time Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		HS Symbol Rate			Probing Method		
			Enabled	Disabled	<=1.0 Gsps	1.0 Gsps < x <=1.5 Gsps	>1.5 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.14	2400	HS-TX Rise Time (t_R) [1.5 Gsps and below]	×	✓	✓	✓	×	✓	×	×
	2401	HS-TX Rise Time (t_R) [Above 1.5 Gsps]	×	✓	×	×	✓	✓	×	×

References

See Test 1.2.14 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following tests as a prerequisite:
   a Test 1.2.19 HS Clock Instantaneous UI (UI_{INST_Max}) – (Test ID 2900).

   Store the test results after measuring the minimum, maximum and average Unit Interval of the differential waveform.
2 Use the waveforms for V_A and V_B captured in the prerequisite test.
3 Construct the differential data waveform using the equation:

$$DiffData(A-B) = V_A - V_B$$

4 Identify and extract all Strong zero to weak one transitions within the differential data waveform. To configure the threshold levels, which in turn, is used to identify all the states; use the following options:
   a Strong1 Threshold (V)
   b Weak1 Threshold (V)
   c Weak0 Threshold (V)
   d Strong0 Threshold (V)
5 Measure values of Rise Time for all the identified transitions between the -58mV and +58mV levels.
6 Calculate the mean Rise Time value from the values obtained in the previous step. Use the value of the mean Rise Time t_R(Mean) for the final test result.

7 Compare the measured value of t_R(Mean) against the compliance test limits.

Expected/Observable Results

The measured value of t_R for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.15 HS-TX Fall Time (t_F)

Test Overview

The purpose of this test is to verify that the Fall Time (t_F) of the HS Transmitter DUT is within the conformance limit value of the MIPI C-PHY standard specification.

Test Availability

Table 9 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Fall Time (t_F) test.

Table 9 Configuration Options for HS-TX Fall Time Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		HS Symbol Rate			Probing Method		
			Enabled	Disabled	<=1.0 Gsps	1.0 Gsps < x <=1.5 Gsps	>1.5 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.15	2500	HS-TX Fall Time (t_F) [1.5 Gsps and below]	×	✓	✓	✓	×	✓	×	×
	2501	HS-TX Fall Time (t_F) [Above 1.5 Gsps]	×	✓	×	×	✓	✓	×	×

References

See Test 1.2.15 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following tests as a prerequisite:
   a Test 1.2.19 HS Clock Instantaneous UI (UI_{INST_Max}) — (Test ID 2900).

   Store the test results after measuring the minimum, maximum and average Unit Interval of the differential waveform.
2 Use the waveforms for V_A and V_B captured in the prerequisite test.
3 Construct the differential data waveform using the equation:

$$DiffData(A-B) = V_A - V_B$$

4 Identify and extract all strong one to weak zero transitions within the differential data waveform. To configure the threshold levels, which in turn, is used to identify all the states; use the following options:
   a Strong1 Threshold (V)
   b Weak1 Threshold (V)
   c Weak0 Threshold (V)
   d Strong0 Threshold (V)
5 Measure values of Fall Time for all the identified transitions between the -58mV and +58mV levels.

6 Calculate the mean Fall Time value from the values obtained in the previous step. Use the value of the mean Fall Time t_F(Mean) for the final test result.

7 Compare the measured value of t_F(Mean) against the compliance test limits.

Expected/Observable Results

The measured value of t_F for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.19 HS Clock Instantaneous UI (UI_{INST})

Test Overview

The purpose of this test is to verify that the value of the Instantaneous Unit Interval (UI_{INST}) of the HS Transmitter DUT is within the conformance limit value of the MIPI C-PHY standard specification. Figure 16 shows the Instantaneous Unit Intervals on the High-Speed signal.

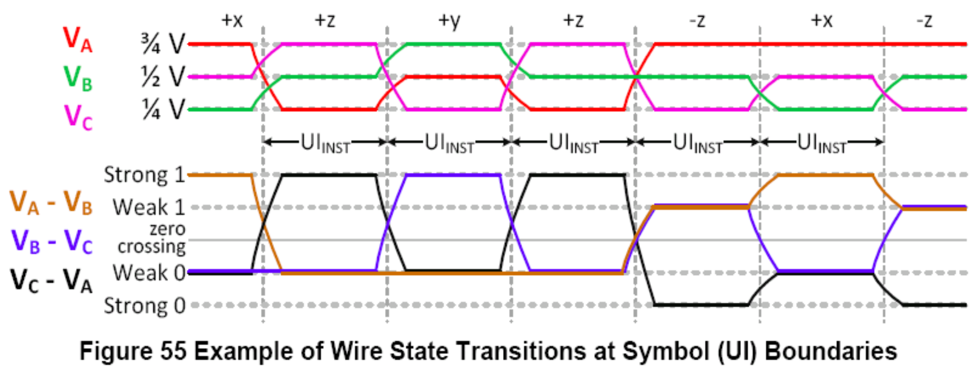


Figure 16 Instantaneous Unit Intervals on High-Speed signal

Test Availability

Table 10 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS Clock Instantaneous UI (UI_{INST}) test.

Table 10 Configuration Options for HS Clock Instantaneous UI Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.19	2900	HS Clock Instantaneous UI (UI_{INST_Max})	×	✓	✓	×	×

References

See Test 1.2.19 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 2900

1 Trigger on the LP-111 to LP-001 region of an HS Burst data signal.

2 Capture waveforms for V_A, V_B and V_C.

3 Construct the differential data waveform using the equation:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C\text{-}A) = V_C - V_A$$

4 Measure the minimum, maximum and average values of Unit Interval for the differential waveforms based on the zero crossings between each UI.
5 Store the minimum, maximum and average values of the Unit Interval as UI_Min, UI_Max and UI_Mean respectively.
6 Apply a Butterworth Low Pass test filter with a -3dB cut-off frequency of 2.0MHz to the measured UI data.
7 Measure and store the minimum, maximum and average values of the filtered Unit Interval data as $UI_{Inst\_Filt\_Min}$, $UI_{Inst\_Filt\_Max}$ and $UI_{Inst\_Filt\_Mean}$ respectively.
8 Use the value of UI_Max as the final measurement result and compare this value against the compliance test limits.

Expected/Observable Results

The measured value of UI_{INST} for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.20 HS Clock Delta UI (ΔUI)

Test Overview

The purpose of this test is to verify that the frequency stability of the DUT's HS Clock during a single burst is within the conformance limit value of the MIPI C-PHY standard specification.

Test Availability

Table 11 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS Clock Delta UI (ΔUI) test.

Table 11 Configuration Options for HS Clock Delta Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		HS Symbol Rate			Probing Method		
			Enabled	Disabled	<=1.0 Gsps	1.0 Gsps < x <=1.5 Gsps	>1.5 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.20	3000	HS Clock Delta UI (ΔUI) [1 Gsps and below]	×	✓	✓	×	×	✓	×	×
	3001	HS Clock Delta UI (ΔUI) [Above 1 Gsps]	×	✓	×	✓	✓	✓	×	×

References

See Test 1.2.20 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 3000, 3001

1 Run the following test as a prerequisite:

   a Test 1.2.19 HS Clock Instantaneous UI (UI_{INST_Max}) — (Test ID 2900).

   Store the test results after measuring the minimum, maximum and average values of the Low Pass filtered Unit Interval of the differential waveforms.

2 Calculate UI_Variant_Min and UI_Variant_Max using the equations:

$$UI\_Variant\_Min = [(UI_{Inst\_Filt\_Min} - UI_{Inst\_Filt\_Mean}) / UI_{Inst\_Filt\_Mean}] * 100\%$$

$$UI\_Variant\_Max = [(UI_{Inst\_Filt\_Max} - UI_{Inst\_Filt\_Mean}) / UI_{Inst\_Filt\_Mean}] * 100\%$$

3 Determine UI_Variant_Worst based on the values of UI_Variant_Min and UI_Variant_Max calculated in the previous step.

4 Use the value of UI_Variant_Worst as the final test result and compare the determined value of UI_Variant_Worst against the compliance test limits.

Expected/Observable Results

The measured UI variation for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

5 MIPI C-PHY 1.0 Low Power Transmitter (LP-TX) Electrical Tests

This section provides the Methods of Implementation (MOIs) for electrical tests for low-power transmitters (LP-TX) using an Keysight Infiniium Oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

KEYSIGHT TECHNOLOGIES

Probing for Low-Power Transmitter Electrical Tests

When performing the LP Electrical tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the LP Electrical tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **50pF Capacitive Load Fixture** prior to running the LP Tests.

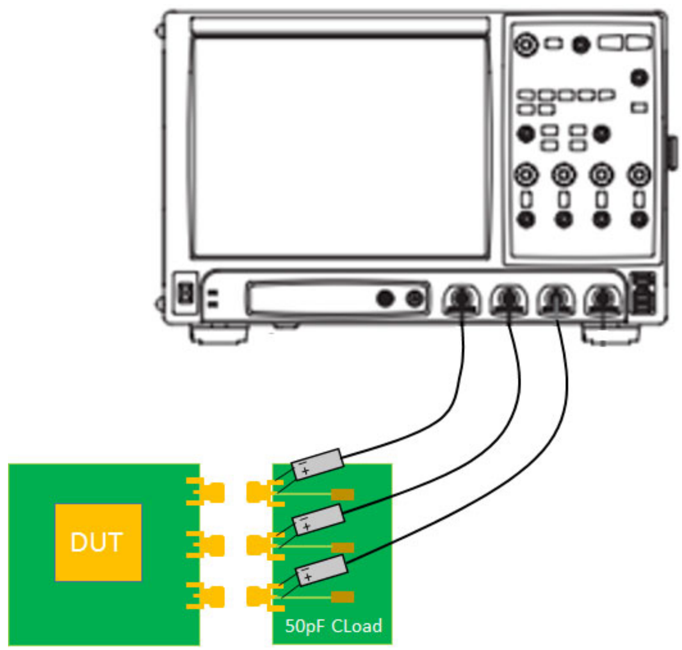


Figure 17 Sample connection diagram for LP Electrical Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 17 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.
2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3 Select the **Data Type** as **LP Escape ONLY** and in the **Device Information** section, select CTS **v1.0**.
4 Click **Connection Setup** to configure the channel selection and probing method.
5 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

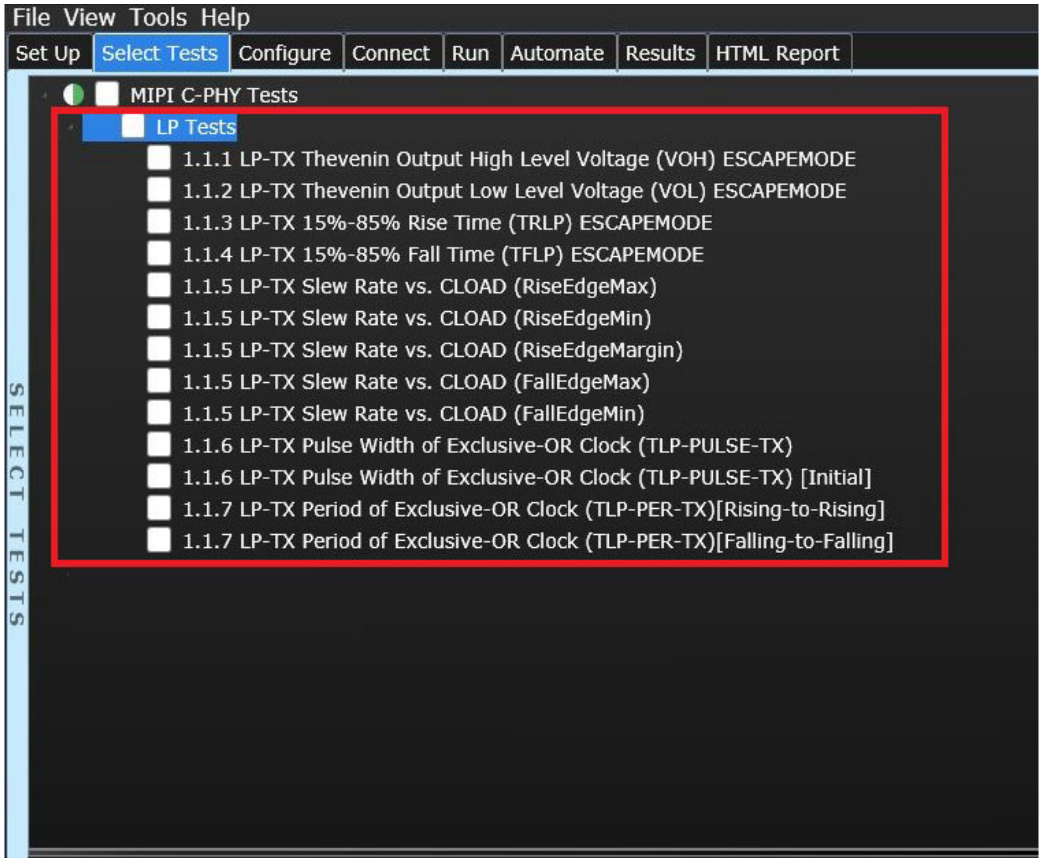


Figure 18 Selecting Low-Power Transmitter Electrical Tests

6 Follow the MIPI C-PHY Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.1.1 LP-TX Thevenin Output High Level Voltage (V_{OH})

Test Overview

The purpose of this test is to verify that the Thevenin Output High Level Voltage (V_{OH}) of the DUT's LP Transmitter is within the conformance limits of the MIPI C-PHY standard specification.

Test Availability

Table 12 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the LP-TX Thevenin Output High Level Voltage (V_{OH}) test.

Table 12 Configuration Options for LP-TX Thevenin Output High Level Voltage Test

CTS Test ID	Test ID	Test Name	HS Signal - LPEscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.1.1	100	LP-TX Thevenin Output High Level Voltage (V_{OH}) ESCAPEMODE	✓	×	✓	×	✓	×	×	—	—
	101	LP-TX Thevenin Output High Level Voltage (V_{OH}) (Informative)	×	✓	×	✓	**Dependency on [Informative Test] option setting**	×	×	✓	×

References

See Test 1.1.1 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 100 (Data LP EscapeMode [Enabled])

1. Trigger on LP Data EscapeMode entry pattern of the data signal. If the LP EscapeMode is unavailable, the trigger is unable to capture any valid signal required for data processing.
2. Locate and use the Mark-1 state pattern to determine the end of the EscapeMode sequence.
3. Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to the EscapeMode sequence waveform data of the acquired V_A.
4. Use the Histogram methodology to measure V_{OH} of the filtered test waveform data. The vertical Histogram window must start at the point that indicates 50% of the absolute peak-to-peak V_A signal amplitude.
5. Calculate the mode of the Histogram in the previous step and record this value as V_{OH} for V_A.
6. Repeat steps 3 - 5 for V_B and V_C.
7. Report the measurement results as:

Value of V_{OH} for V_A

Value of V_{OH} for V_B

Value of V_{OH} for V_C

8 Compare the measured “worst” value of V_{OH} against the compliance test limits.

For Test ID 101 (Data LP EscapeMode [Disabled], Informative Test [Enabled])

1 Trigger on the LP rising edge signal for V_A. The Oscilloscope triggers according to the configuration of the “LP Observation” attribute. By default, ten rising edges are acquired.
2 Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to each acquired LP rising edge waveform data.
3 Use the Histogram methodology to measure V_{OH} of the accumulated filtered test waveform data. The vertical Histogram window must start at the point that indicates 50% of the absolute peak-to-peak V_A signal amplitude.
4 Calculate the mode of the Histogram in the previous step and record this value as V_{OH} for V_A.
5 Repeat steps 1 - 4 for V_B and V_C.
6 Report the measurement results as:

Value of V_{OH} for V_A

Value of V_{OH} for V_B

Value of V_{OH} for V_C

7 Compare the measured “worst” value of V_{OH} against the compliance test limits.

Expected/Observable Results

The measured “worst” value of V_{OH} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (V_{OL})

Test Overview

The purpose of this test is to verify that the Thevenin Output Low Level Voltage (V_{OL}) of the DUT's LP Transmitter is within the conformance limits of the MIPI C-PHY standard specification.

Test Availability

Table 13 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the LP-TX Thevenin Output Low Level Voltage (V_{OL}) test.

Table 13 Configuration Options for LP-TX Thevenin Output Low Level Voltage Test

CTS Test ID	Test ID	Test Name	HS Signal-LPEscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.1.2	200	LP-TX Thevenin Output Low Level Voltage (V_{OL}) ESCAPEMODE	✓	×	✓	×	✓	×	×	—	—
	201	LP-TX Thevenin Output Low Level Voltage (V_{OL}) (Informative)	×	✓	×	✓	**Dependency on [Informative Test] option setting**	×	×	✓	×

References

See Test 1.1.2 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 200 (Data LP EscapeMode [Enabled])

1 Run the following test as a prerequisite:

a Test 1.1.1 LP-TX Thevenin Output High Level Voltage (V_{OH}) ESCAPEMODE – (Test ID 100).

Store the test results after measuring the V_{OH} values for the Low Power signals.

2 Use the entire LP EscapeMode sequence captured in the prerequisite test.

3 Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to the EscapeMode sequence waveform data of the acquired V_A.

4 Use the Histogram methodology to measure V_{OL} of the filtered test waveform data. The vertical Histogram window must start at the point that indicates 50% of the absolute peak-to-peak V_A signal amplitude.

5 Calculate the mode of the Histogram in the previous step and record this value as V_{OL} for V_A.

6 Repeat steps 3 - 5 for V_B and V_C.

7 Report the measurement results as:

Value of V_{OL} for V_A

Value of V_{OL} for V_B

Value of V_{OL} for V_C

8 Compare the measured “worst” value of V_{OL} against the compliance test limits.

For Test ID 201 (Data LP EscapeMode [Disabled], Informative Test [Enabled])

1 Trigger on the LP falling edge signal for V_A. The Oscilloscope triggers according to the configuration of the “LP Observation” attribute. By default, ten falling edges are acquired.

2 Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to each acquired LP falling edge waveform data.

3 Use the Histogram methodology to measure V_{OL} of the accumulated filtered test waveform data. The vertical Histogram window must start at the point that indicates 50% of the absolute peak-to-peak V_A signal amplitude.

4 Calculate the mode of the Histogram in the previous step and record this value as V_{OL} for V_A.

5 Repeat steps 1 - 4 for V_B and V_C.

6 Report the measurement results as:

Value of V_{OL} for V_A

Value of V_{OL} for V_B

Value of V_{OL} for V_C

7 Compare the measured “worst” value of V_{OL} against the compliance test limits.

Expected/Observable Results

The measured “worst” value of V_{OL} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.1.3 LP-TX 15% - 85% Rise Time (T_{RLP})

Test Overview

The purpose of this test is to verify that the 15% - 85% Rise Time (T_{RLP}) of the DUT's LP Transmitter is within the conformance limits of the MIPI C-PHY standard specification.

Test Availability

Table 14 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the LP-TX 15% - 85% Rise Time (T_{RLP}) test.

Table 14 Configuration Options for LP-TX 15% - 85% Rise Time Test

CTS Test ID	Test ID	Test Name	HS Signal - LPEscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.1.3	300	LP-TX 15% - 85% Rise Time (T_{RLP}) ESCAPEMODE	✓	×	✓	×	✓	×	×	—	—

References

See Test 1.1.3 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following tests as a prerequisite:
   a Test 1.1.1 LP-TX Thevenin Output High Level Voltage (V_{OH}) ESCAPEMODE — (Test ID 100).
   b Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (V_{OL}) ESCAPEMODE — (Test ID 200).

   Store the test results after measuring all values of V_{OH} and V_{OL} for the Low Power signals.
2 Use the entire LP EscapeMode sequence captured in the prerequisite tests.
3 Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to the EscapeMode sequence waveform data of the mentioned V_A; prior to measuring the actual Rise Time.
4 All rising edges in the filtered EscapeMode Sequence waveform data of the filtered V_A are processed to measure the corresponding Rise Time.
5 Using the values of V_{OH} and V_{OL} as reference from the prerequisite tests, measure the 15% - 85% Rise Time for each rising edge of the V_A waveform.
6 Record the average Rise Time for V_A.
7 Repeat steps 3 - 6 for V_B and V_C.
8 Report the measurement results as:

Average value of T_{RLP} for V_A

Average value of T_{RLP} for V_B

Average value of T_{RLP} for V_C

9 Compare the measured “worst” value of T_{RLP} against the compliance test limits.

Expected/Observable Results

The measured “worst” value of T_{RLP} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.1.4 LP-TX 15% - 85% Fall Time (T_{FLP})

Test Overview

The purpose of this test is to verify that the 15% - 85% Fall Time (T_{FLP}) of the DUT's LP Transmitter is within the conformance limits of the MIPI C-PHY standard specification.

Test Availability

Table 15 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the LP-TX 15% - 85% Fall Time (T_{FLP}) test.

Table 15 Configuration Options for LP-TX 15% - 85% Fall Time Test

CTS Test ID	Test ID	Test Name	HS Signal - LPEscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.1.4	400	LP-TX 15% - 85% Fall Time (T_{FLP}) ESCAPEMODE	✓	×	✓	×	✓	×	×	—	—
	401	LP-TX 15% - 85% Fall Time (T_{FLP}) (Informative)	×	✓	×	✓	**Dependency on [Informative Test] option setting**	×	×	✓	×

References

See Test 1.1.4 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

For Test ID 400 (Data LP EscapeMode [Enabled])

1 Run the following tests as a prerequisite:

  a Test 1.1.1 LP-TX Thevenin Output High Level Voltage (V_{OH}) ESCAPEMODE — (Test ID 100).

  b Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (V_{OL}) ESCAPEMODE — (Test ID 200).

  Store the test results after measuring all values of V_{OH} and V_{OL} for the Low Power signals.

2 Use the entire LP EscapeMode sequence captured in the prerequisite tests.

3 Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to the EscapeMode sequence waveform data of the mentioned V_A; prior to measuring the actual Fall Time.

4 All falling edges in the filtered EscapeMode Sequence waveform data of the filtered V_A are processed to measure the corresponding Fall Time.

5 Using the values of V_{OH} and V_{OL} as reference from the prerequisite tests, measure the 15% - 85% Fall Time for each falling edge of the V_A waveform.

6 Record the average Fall Time for V_A.
7 Repeat steps 3 - 6 for V_B and V_C.
8 Report the measurement results as:

Average value of T_{FLP} for V_A

Average value of T_{FLP} for V_B

Average value of T_{FLP} for V_C

9 Compare the measured “worst” value of T_{FLP} against the compliance test limits.

For Test ID 401 (Data LP EscapeMode [Disabled], Informative Test [Enabled])

1 Run the following tests as a prerequisite:
  a Test 1.1.1 LP-TX Thevenin Output High Level Voltage (V_{OH}) — (Test ID 101).
  b Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (V_{OL}) — (Test ID 201).

  Store the test results after measuring all values of V_{OH} and V_{OL} for the Low Power signals.
2 Use all of the LP falling edges captured in the prerequisite tests.
3 Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to each captured LP falling edge waveform data.
4 Using the values of V_{OH} and V_{OL} as reference from the prerequisite tests, measure the 15% - 85% Fall Time for each filtered falling edge of the V_A waveform.
5 Record the average Fall Time for V_A.
6 Repeat steps 3 - 5 for V_B and V_C.
7 Report the measurement results as:

Average value of T_{FLP} for V_A

Average value of T_{FLP} for V_B

Average value of T_{FLP} for V_C

8 Compare the measured “worst” value of T_{FLP} against the compliance test limits.

Expected/Observable Results

The measured “worst” value of T_{FLP} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.1.5 LP-TX Slew Rate vs. C_{LOAD}

Test Overview

The purpose of this test is to verify that the Slew Rate of the DUT's LP Transmitter is within the conformance limits of the MIPI C-PHY standard specification, for specific capacitive loading conditions.

Test Availability

Table 16 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the LP-TX Slew Rate vs. C_{LOAD} test.

Table 16 Configuration Options for LP-TX Slew Rate vs. C_{LOAD} Test

CTS Test ID	Test ID	Test Name	HS Signal - LPEscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.1.5	500	LP-TX Slew Rate vs. C_{LOAD} (RiseEdgeMax)	✓	×	✓	×	✓	×	×	—	—
	501	LP-TX Slew Rate vs. C_{LOAD} (RiseEdgeMin)	✓	×	✓	×	✓	×	×	—	—
	502	LP-TX Slew Rate vs. C_{LOAD} (RiseEdgeMargin)	✓	×	✓	×	✓	×	×	—	—
	503	LP-TX Slew Rate vs. C_{LOAD} (FallEdgeMax)	✓	×	✓	×	✓	×	×	—	—
	504	LP-TX Slew Rate vs. C_{LOAD} (FallEdgeMin)	✓	×	✓	×	✓	×	×	—	—

References

See Test 1.1.5 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following tests as a prerequisite:
   a Test 1.1.1 LP-TX Thevenin Output High Level Voltage (V_{OH}) ESCAPEMODE – (Test ID 100).
   b Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (V_{OL}) ESCAPEMODE – (Test ID 200).

   Store the test results after measuring all values of V_{OH} and V_{OL} for the Low Power signals.
2 Use the entire LP EscapeMode sequence captured in the prerequisite tests.
3 Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to the EscapeMode sequence waveform data of the mentioned V_A; prior to measuring the actual Slew Rate.
4 Measure Slew Rate on the EscapeMode sequence waveform data of the filtered V_A for the V_A waveform.
5 Repeat steps 3 and 4 for V_B and V_C.

6 Store the maximum, minimum and margin values of Slew Rate.
7 Report the measurement results.
8 Compare the measured “worst” value of Slew Rate against the compliance test limits.

Expected/Observable Results

The measured “worst” value of Slew Rate for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.1.6 LP-TX Pulse Width of Exclusive-OR Clock ($T_{LP-PULSE-TX}$)

Test Overview

The purpose of this test is to verify that the Pulse Width of the XOR Clock ($T_{LP-PULSE-TX}$) of the DUT's LP Transmitter is within the conformance limits of the MIPI C-PHY standard specification. Figure 19 shows the generation of LP XOR Clock from V_A and V_C.

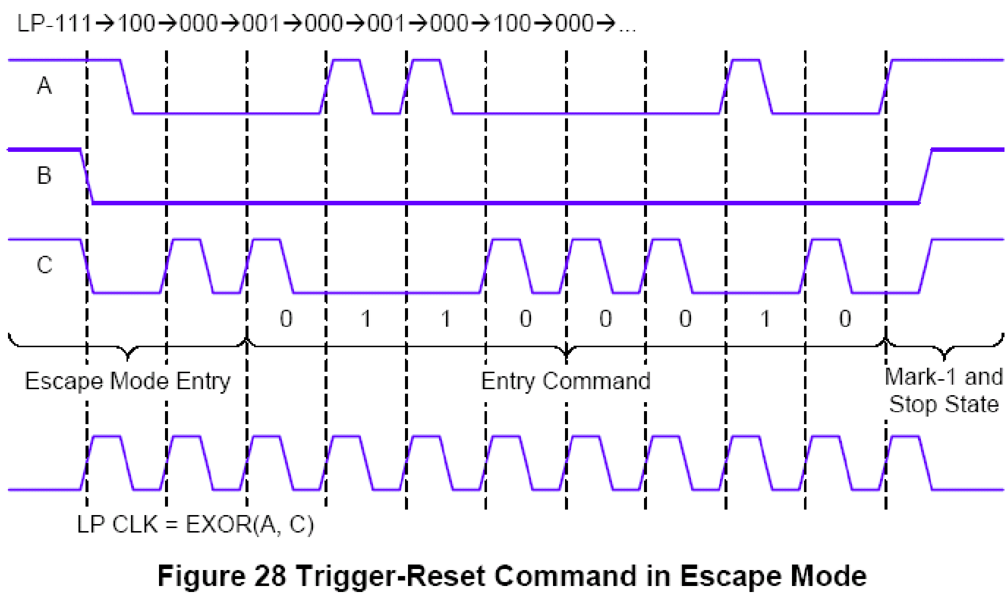


Figure 19 Generation of LP XOR Clock from V_A and V_C.

Test Availability

Table 17 shows the the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the LP-TX Pulse Width of Exclusive-OR Clock ($T_{LP-PULSE-TX}$) test.

Table 17 Configuration Options for LP-TX Pulse Width of Exclusive-OR Clock Test

CTS Test ID	Test ID	Test Name	HS Signal-LPEscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.1.6	600	LP-TX Pulse Width of Exclusive-OR Clock ($T_{LP-PULSE-TX}$)	✓	×	✓	×	✓	×	×	—	—
	601	LP-TX Pulse Width of Exclusive-OR Clock ($T_{LP-PULSE-TX}$) [Initial]	✓	×	✓	×	✓	×	×	—	—

References

See Test 1.1.6 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1. Trigger on LP Data EscapeMode entry pattern of the data signal. If the LP EscapeMode is unavailable, the trigger is unable to capture any valid signal required for data processing.
2. Locate and use the Mark-1 state pattern to determine the end of the EscapeMode sequence.
3. Apply a 400MHz, 4^{th}-order Butterworth Low Pass test filter to the EscapeMode sequence waveform data.
4. Find all crossing points at the minimum trip level (500mV) and at the maximum trip level (790mV) for V_A and V_C respectively.
5. Find the initial pulse width and the minimum pulse width of all the other signal pulses at the specified minimum trip level and maximum trip level. (Here, a pulse is defined as a positive pulse, that is, rising-to-falling-edge pulse).
6. Find the rising-to-rising and falling-to-falling periods of the XOR Clock at the specified minimum trip level and maximum trip level.
7. Record the “worst” case value for the pulse width found between the minimum trip level and maximum trip level as the value of $T_{LP\text{-}PULSE\text{-}TX}$.
8. Compare the measured “minimum” value of $T_{LP\text{-}PULSE\text{-}TX}$ against the compliance test limits.

Expected/Observable Results

The measured “minimum” value of $T_{LP\text{-}PULSE\text{-}TX}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.1.7 LP-TX Period of Exclusive-OR Clock ($T_{LP\text{-}PER\text{-}TX}$)

Test Overview

The purpose of this test is to verify that the Period ($T_{LP\text{-}PER\text{-}TX}$) of the XOR Clock of the DUT's LP Transmitter is within the conformance limits of the MIPI C-PHY standard specification. Figure 20 shows the generation of LP XOR Clock from V_A and V_C.

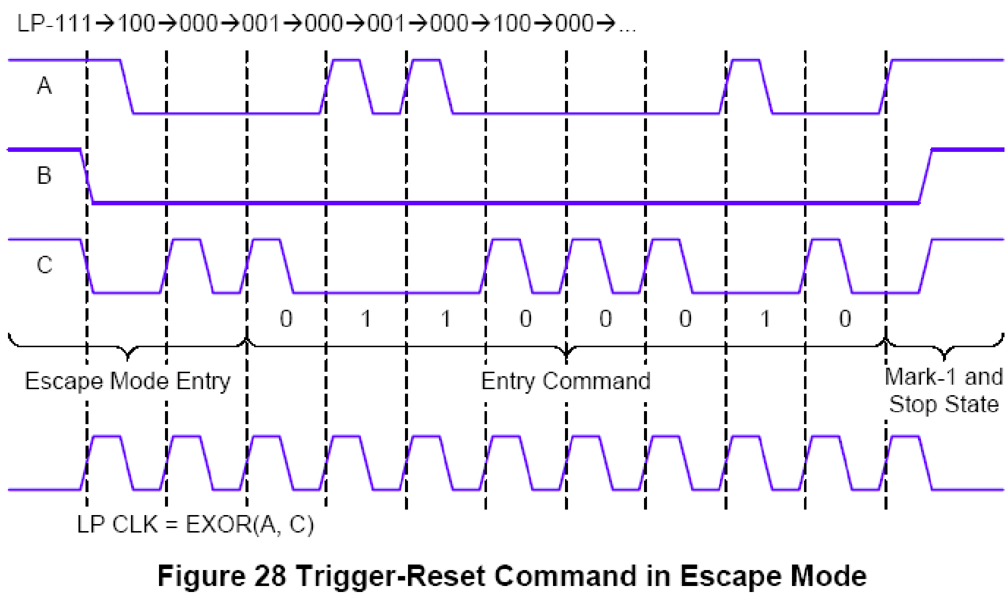


Figure 20 Generation of LP XOR Clock from V_A and V_C

Test Availability

Table 18 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the LP-TX Period of Exclusive-OR Clock ($T_{LP\text{-}PER\text{-}TX}$) test.

Table 18 LP-TX Period of Exclusive-OR Clock Test Requirements for LP Signaling

CTS Test ID	Test ID	Test Name	HS Signal - LPEscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.1.7	700	LP-TX Period of Exclusive-OR Clock ($T_{LP\text{-}PER\text{-}TX}$) [Rising-to-Rising]	✓	×	✓	×	✓	×	×	—	—
	701	LP-TX Period of Exclusive-OR Clock ($T_{LP\text{-}PER\text{-}TX}$) [Falling-to-Falling]	✓	×	✓	×	✓	×	×	—	—

References

See Test 1.1.7 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following test as a prerequisite:

   a Test 1.1.6 LP-TX Pulse Width of Exclusive-OR Clock ($T_{LP-PULSE-TX}$) – (Test ID 600).

   The actual measurement algorithm for $T_{LP-PER-TX}$ is performed as part of this prerequisite test.

2 Measure the minimum value for all the rising-to-rising and falling-to-falling periods of the XOR clock at the minimum trip level (500mV) and the maximum trip level (790mV) as $T_{LP-PER-TX}$.

3 Record the value of $T_{LP-PER-TX}$ as the final test result.

4 Compare the measured “minimum” value of $T_{LP-PER-TX}$ against the compliance test limits.

Expected/Observable Results

The measured value of $T_{LP-PER-TX}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

6 MIPI C-PHY 1.0 Global Timing Tests

This section provides the Methods of Implementation (MOIs) for the timing tests for high-speed transmitters (HS-TX) using an Keysight Infiniium Oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

Probing for Global Timing Tests

When performing the Global Timing tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the Global Timing tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **Reference Termination Board** and configure the DUT to output **Burst signal** prior to running the Global Timing Tests.

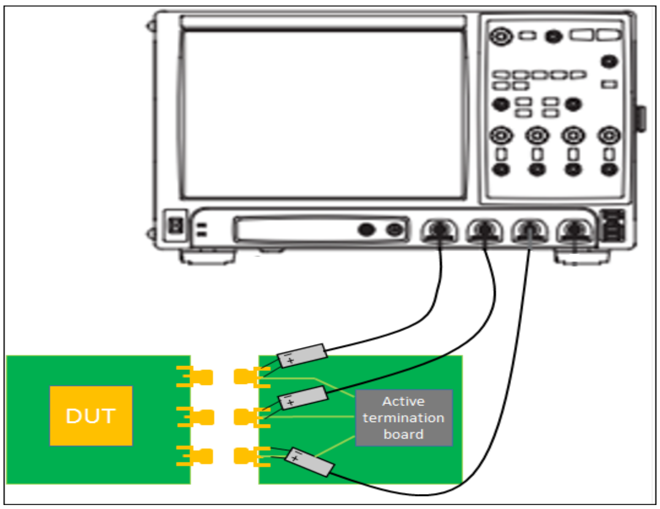


Figure 21 Sample connection diagram for HS Electrical Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 21 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, "InfiniiMax Probing," starting on page 249.

Test Procedure

1 Start the automated test application as described in "Starting the MIPI C-PHY Compliance Test Application" on page 29.
2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3 Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v1.0**.
4 Click **Connection Setup** to configure the channel selection and probing method. Select **Active Probe (Differential Probe)** as the Probing Method.
5 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

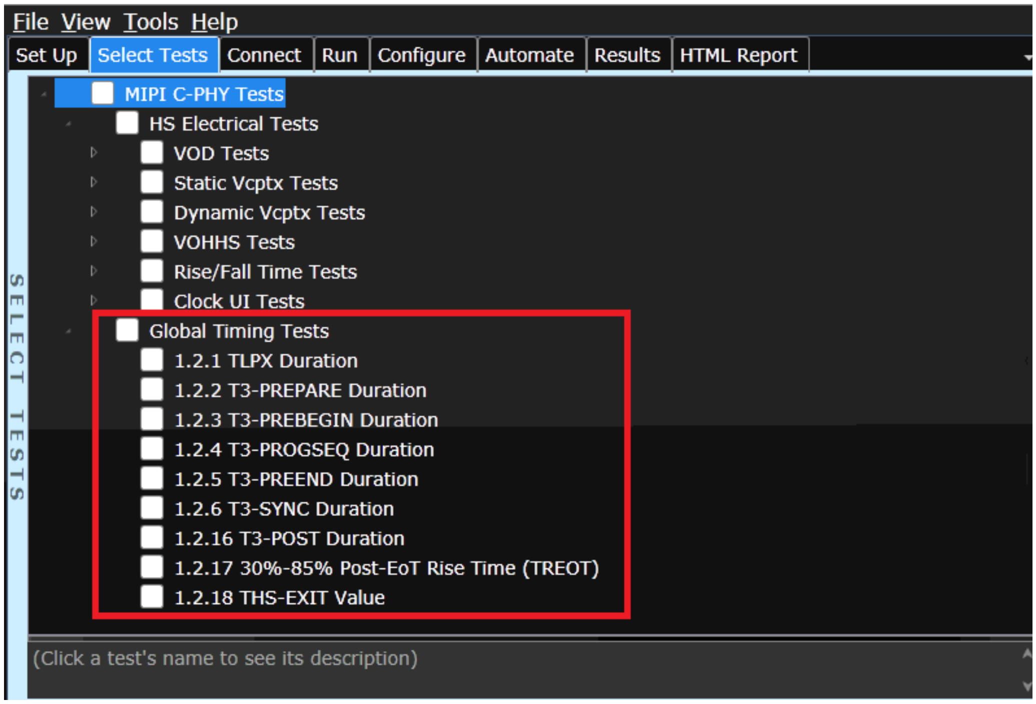


Figure 22 Selecting Global Timing Tests

6 Follow the MIPI C-PHY Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.2.1 T_{LPX} Duration

Test Overview

The purpose of this test is to verify that the duration (T_{LPX}) of the final LP-001 state immediately prior to the High Speed Transmission is greater than the minimum conformance limits of the MIPI C-PHY standard specification. Figure 23 shows the Data Lane T_{LPX} Interval in a High-Speed Data Transmission.

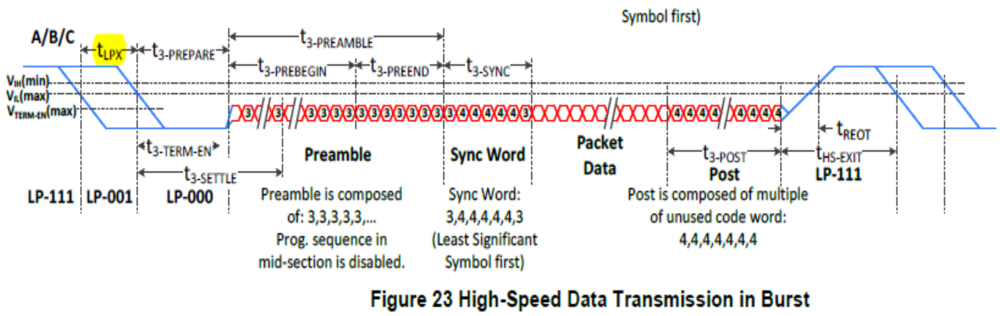


Figure 23 Data Lane T_{LPX} Interval in a High-Speed Data Transmission

Test Availability

Table 19 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration (T_{LPX}) test.

Table 19 Configuration Options for T_{LPX} Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.1	1100	T_{LPX} Duration	×	✓	✓	×	×

References

See Test 1.2.1 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1. Trigger on the falling edge of V_A in the LP-001 state, which occurs immediately before an HS Burst sequence.
2. Mark the time when the falling edge of V_A first crosses $V_{IL(Max)}$ = 550mV. Denote this time as T1.
3. Mark the time when the first falling edge of V_C after T1, crosses V_{IL_Max} = 550mV. Denote this time as T2. Note that T2 must be greater than T1.
4. Calculate T_{LPX} using the equation:

$$T_{LPX} = T2 - T1$$

5 Compare the calculated value of T_{LPX} against the compliance test limits.

Expected/Observable Results

The calculated value of T_{LPX} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.2 $T_{3\text{-}PREPARE}$ Duration

Test Overview

The purpose of this test is to verify that the duration ($T_{3\text{-}PREPARE}$) of the final LP-000 state immediately prior to the High Speed Transmission is within the conformance limits of the MIPI C-PHY standard specification. Figure 24 shows the $T_{3\text{-}PREPARE}$ Interval in a High-Speed Data Transmission.

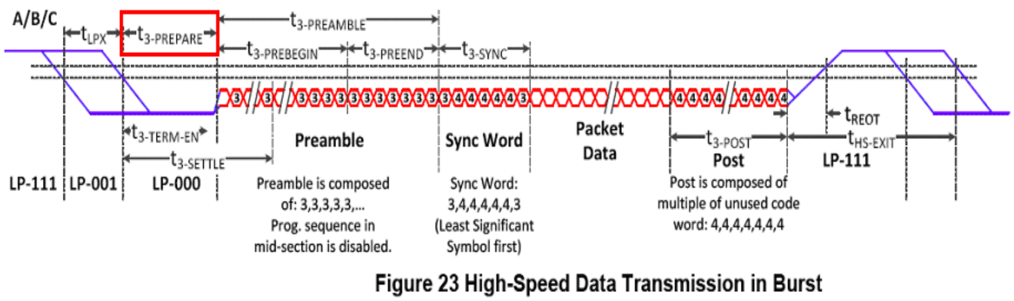


Figure 24 $T_{3\text{-}PREPARE}$ Interval in a High-Speed Data Transmission

Test Availability

Table 20 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}PREPARE}$) test.

Table 20 Configuration Options for $T_{3\text{-}PREPARE}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.2	1200	$T_{3\text{-}PREPARE}$ Duration	×	✓	✓	×	×

References

See Test 1.2.2 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following test as a prerequisite:

  a Test 1.2.1 T_{LPX} Duration – (Test ID 1100).

  Store the test results after measuring the T_{LPX} Duration of the test signal.

2 Use the waveforms V_A, V_B and V_c captured in the prerequisite test.

3 Construct the differential data waveform using the equation:

$$DiffData(A\text{-}B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C\text{-}A) = V_C - V_A$$

4 Use the measured value of T2 from the prerequisite test as the starting point for $T_{3\text{-PREPARE}}$.
5 Find and mark the first transition edge of the differential waveform, which crosses +/-40mV. Denote it as T3. Note that T3 must be greater than T2.
6 Calculate $T_{3\text{-PREPARE}}$ using the equation:

$$T_{3\text{-PREPARE}} = T3 - T2$$

7 Compare the calculated value of $T_{3\text{-PREPARE}}$ against the compliance test limits.

Expected/Observable Results

The calculated value of $T_{3\text{-PREPARE}}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.3 $T_{3\text{-PREBEGIN}}$ Duration

Test Overview

The purpose of this test is to verify that the time of $T_{3\text{-PREBEGIN}}$ is within the conformance limits of the MIPI C-PHY standard specification. Figure 25 shows the $T_{3\text{-PREBEGIN}}$ Interval in a High-Speed Data Transmission.

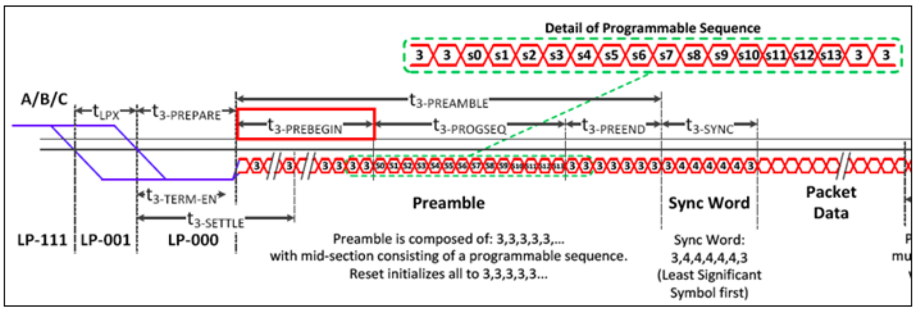


Figure 25 $T_{3\text{-PREBEGIN}}$ Interval in a High-Speed Data Transmission

Test Availability

Table 21 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-PREBEGIN}}$) test.

Table 21 Configuration Options for $T_{3\text{-PREBEGIN}}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		T3-PROGSEQMode		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.3	1300	$T_{3\text{-PREBEGIN}}$ Duration	×	✓	✓	×	✓	×	×

References

See Test 1.2.3 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following test as a prerequisite:

a Test 1.2.19 HS Instantaneous UI (UIINST_Max) - (Test ID: 2900).
Measure and store the min, max, and average values for the low pass filtered unit interval of the differential waveforms.

b Test 1.2.2 $T_{3\text{-PREPARE}}$ Duration - (Test ID: 1200):
Perform the $T_{3\text{-PREPARE}}$ Duration measurement for the test signal and store the test results.

2 Use the waveforms V_A, V_B and V_c captured in the prerequisite test.

3 Construct the differential data waveform using the equation:

$$DiffData(A\text{-}B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Use the measured value of T_3 from the prerequisite test as the starting point for $T_{3\text{-PREBEGIN}}$.
5 Decode the C-PHY signals.
6 Find and identify the $T_{3\text{-PROGSEQ}}$ symbol sequence based on the programmable sequence specified in the “T3-PROGSEQ Sequence” configuration option in the Set Up tab. The location of the first bit of this $T_{3\text{-PROGSEQ}}$ symbol sequence is marked as T_4 and value is stored as the $T_{3\text{-PROGSEQ}}$ start point.
7 Using the $T_{3\text{-PROGSEQ}}$ sequence location as a reference, find and identify the location of the next bit symbol after the $T_{3\text{-PROGSEQ}}$ symbol sequence. This location is marked as T_5 and value is stored as $T_{3\text{-PREEND}}$ start point.
8 Find and identify the $T_{3\text{-SYNC}}$ symbol sequence of ‘3, 4, 4, 4, 4, 4, 3’. The location of the first bit of this $T_{3\text{-SYNC}}$ symbol sequence is marked as T_6 and value is stored as $T_{3\text{-SYNC}}$ start point.
9 Using the $T_{3\text{-SYNC}}$ sequence location as a reference, find and identify the location of the next bit symbol after the $T_{3\text{-SYNC}}$ symbol sequence. This location is marked as T_7 and value is stored as packet data start point.
10 Calculate $T_{3\text{-PREBEGIN}}$ using the equation:

$$T_{3\text{-PREBEGIN}} = T4 - T3$$

11 Compare the calculated value of $T_{3\text{-PREBEGIN}}$ against the compliance test limits.

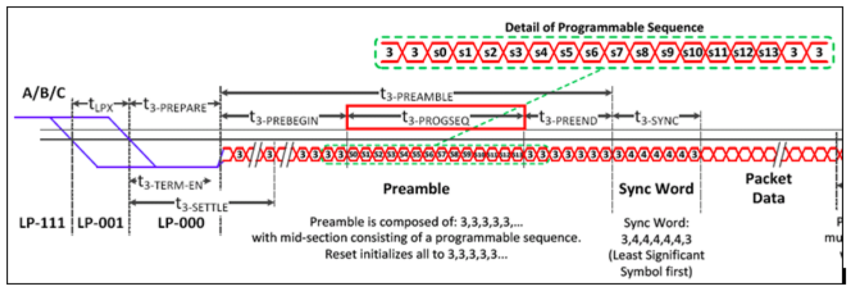
Expected/Observable Results

The calculated value of $T_{3\text{-PREBEGIN}}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.4 $T_{3\text{-}PROGSEQ}$ Duration

Test Overview

The purpose of this test is to verify that the length of $T_{3\text{-}PROGSEQ}$ is within the conformance limits of the MIPI C-PHY standard specification. Figure 26 shows the $T_{3\text{-}PROGSEQ}$ Interval in a High-Speed Data Transmission.



$T_{3\text{-}PROGSEQ}$ Interval

Figure 26 $T_{3\text{-}PROGSEQ}$ Interval in a High-Speed Data Transmission

Test Availability

Table 22 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}PROGSEQ}$) test.

Table 22 Configuration Options for $T_{3\text{-}PROGSEQ}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		T3-PROGSEQMode		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.4	1400	$T_{3\text{-}PROGSEQ}$ Duration	×	✓	✓	×	✓	×	×

References

See Test 1.2.4 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following test as a prerequisite:

   a Test 1.2.3 $T_{3\text{-}PREBEGIN}$ Duration - (Test ID: 1300)
   Measure and store the location of the first bit of the $T_{3\text{-}PROGSEQ}$ sequence (marked as T_4) and the location of the first bit of the $T_{3\text{-}PREEND}$ sequence (marked as T_5).

2 Calculate $T_{3\text{-}PROGSEQ}$ using the equation:

$$T_{3\text{-}PROGSEQ} = T_5 - T_4$$

3 Compare the calculated value of $T_{3\text{-}PROGSEQ}$ against the compliance test limits.

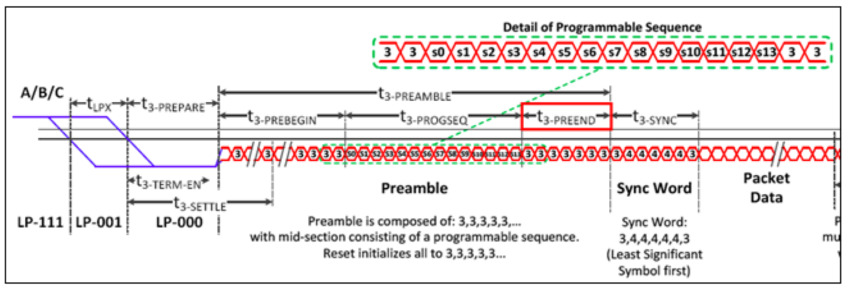
Expected/Observable Results

The calculated value of $T_{3\text{-}PROGSEQ}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.5 $T_{3\text{-PREEND}}$ Duration

Test Overview

The purpose of this test is to verify that the duration of $T_{3\text{-PREEND}}$ is within the conformance limits of the MIPI C-PHY standard specification. Figure 27 shows the $T_{3\text{-PREEND}}$ Interval in a High-Speed Data Transmission.



$T_{3\text{-PREEND}}$ Interval

Figure 27 $T_{3\text{-PREEND}}$ Interval in a High-Speed Data Transmission

Test Availability

Table 23 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-PREEND}}$) test.

Table 23 Configuration Options for $T_{3\text{-PREEND}}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		T3-PROGSEQMode		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.5	1500	$T_{3\text{-PREEND}}$ Duration	×	✓	✓	×	✓	×	×

References

See Test 1.2.5 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following test as a prerequisite:
   a Test 1.2.3 $T_{3\text{-PREBEGIN}}$ Duration - (Test ID: 1300)
   Measure and store the location of the first bit of the $T_{3\text{-PREEND}}$ sequence (marked as T_5) and the location of the first bit of the $T_{3\text{-SYNC}}$ sequence (marked as T_6).

2 Calculate $T_{3\text{-PREEND}}$ using the equation:

$$T_{3\text{-PREEND}} = T_6 - T_5$$

3 Compare the calculated value of $T_{3\text{-PREEND}}$ against the compliance test limits.

Expected/Observable Results

The calculated value of $T_{3\text{-}PREEND}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.6 $T_{3\text{-}SYNC}$ Duration

Test Overview

The purpose of this test is to verify that the duration of $T_{3\text{-}SYNC}$ is within the conformance limits of the MIPI C-PHY standard specification.

Test Availability

Table 24 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}SYNC}$) test.

Table 24 Configuration Options for $T_{3\text{-}SYNC}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		T3-PROGSEQMode		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.6	1600	$T_{3\text{-}SYNC}$ Duration	×	✓	✓	×	✓	×	×

References

See Test 1.2.6 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following test as a prerequisite:

a Test 1.2.3 $T_{3\text{-}PREBEGIN}$ Duration - (Test ID: 1300)
Measure and store the location of the first bit of the $T_{3\text{-}SYNC}$ sequence (marked as T_6) and the location of the first bit of the packet data (marked as T_7).

2 Calculate $T_{3\text{-}SYNC}$ using the equation:

$$T_{3\text{-}SYNC} = T_7 - T_6$$

3 Compare the calculated value of $T_{3\text{-}SYNC}$ against the compliance test limits.

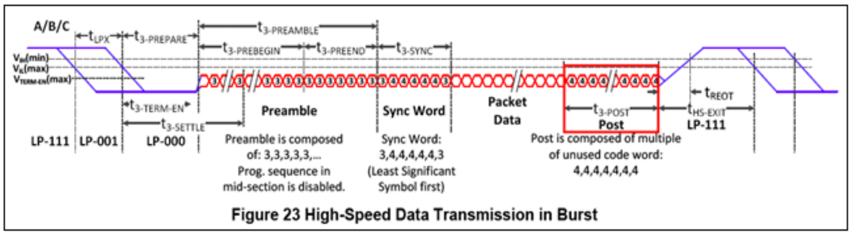
Expected/Observable Results

The calculated value of $T_{3\text{-}SYNC}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.16 $T_{3\text{-}POST}$ Duration

Test Overview

The purpose of this test is to verify that the duration the DUT TX drives the final differential states following the payload data of a HS-TX burst ($T_{3\text{-}POST}$), is greater than the minimum required value.



$T_{3\text{-}POST}$ Interval

Figure 28 $T_{3\text{-}POST}$ Interval

Test Availability

Table 25 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the $T_{3\text{-}POST}$ Duration test.

Table 25 Configuration Options for $T_{3\text{-}POST}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.16	2600	$T_{3\text{-}POST}$ Duration	×	✓	✓	×	×

References

See Test 1.2.16 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following test as a prerequisite:

a Test 1.2.19 HS Clock Instantaneous UI (UIINST_Max) - (Test ID: 2900). Measure and store the min, max, and average values for the unit interval of the differential waveforms.

2 Trigger on the falling edge of V_A in the LP-001 state that occurs immediately before an HS Burst sequence.

3 Construct the differential data waveform using the following equations:

$$DiffData(A\text{-}B) = V_A - V_B$$
$$DiffData(B\text{-}C) = V_B - V_C$$
$$DiffData(C\text{-}A) = V_C - V_A$$

4 Decode the C-PHY signals and find the last symbol's location.

5 Using the last symbol's location as a reference, find and mark the last transition edge of the differential waveform. Mark this location as T2 and store the value as T3-POST end point.

6 From the T2 location, verify that the previous symbols are consecutive “4” symbols. Identify the location where the previous symbol is non “4” symbol. Mark this location as T_1 and store the value as $T_{3\text{-}POST}$ start point.

7 Calculate $T_{3\text{-}POST}$ using the equation:

$$T_{3\text{-}POST} = T_2 - T_1$$

8 Compare the measured value of $T_{3\text{-}POST}$ against the compliance test limits.

Expected/Observable Results

The measured value of $T_{3\text{-}POST}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.17 30%-85% Post-EoT Rise Time (T_{REOT})

Test Overview

The purpose of this test is to verify that the 30%-85% Post EoT Rise Time (T_{REOT}) of the LP Transmitter DUT is within the conformance limits of the MIPI C-PHY standard specification.

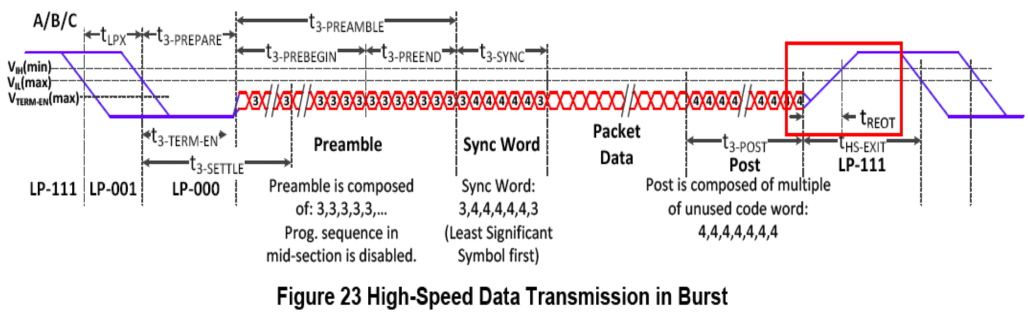


Figure 29 T_{REOT} Rise Time

Test Availability

Table 26 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the 30%-85% Post-EoT Rise Time (T_{REOT}) test.

Table 26 Configuration Options for 30%-85% Post-EoT Rise Time Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.17	2700	30%-85% Post EoT Rise Time (T_{REOT})	×	✓	✓	×	×

References

See Test 1.2.17 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1. Position the trigger point at the center of the screen.
2. Trigger on the rising edge of V_A in the LP-111 state that occurs immediately after an HS Burst sequence.
3. Construct a differential data waveform using the equation:

$$DiffData(C-A) = V_C - V_A$$

4. Find the last transition edge of the differential waveform, DiffData(C-A) that crosses +/-40mV. Mark this time as T1.

5 Find the time after T1, when the rising edge of V_A crosses $V_{IH(min)}$ = 740mV. Mark this time as T2. Note that T2 must be greater than T1.

6 Calculate T_{REOT} using the equation:

$$T_{REOT} = T2 - T1$$

7 Compare the measured value of T_{REOT} against the compliance test limits.

Expected/Observable Results

The measured value of T_{REOT} for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.18 $T_{HS\text{-}EXIT}$ Value

Test Overview

The purpose of this test is to verify that the duration ($T_{HS\text{-}EXIT}$) the Data Lane Transmitter remains in the LP-111 (Stop) state after exiting HS mode is greater than minimum required value as per the conformance limits of the MIPI C-PHY standard specification. Figure 30 shows the $T_{HS\text{-}EXIT}$ Interval in a High-Speed Data Transmission.

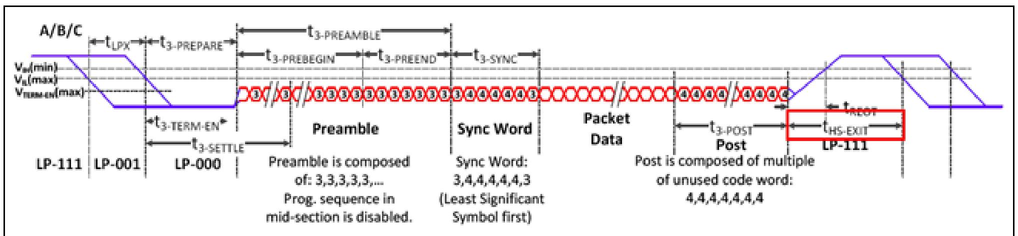


Figure 23 High-Speed Data Transmission in Burst

$T_{HS\text{-}EXIT}$ Interval

Figure 30 $T_{HS\text{-}EXIT}$ Interval in a High-Speed Data Transmission

Test Availability

Table 27 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the $T_{HS\text{-}EXIT}$ Value test.

Table 27 Configuration Options for $T_{HS\text{-}EXIT}$ Value Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.18	2800	$T_{HS\text{-}EXIT}$ Value	×	✓	✓	×	×

References

See Test 1.2.18 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1. Position the trigger point at the center of the screen. Trigger on the rising edge of V_A in the LP-111 state, which occurs immediately after an HS Burst sequence.
2. Construct the differential data waveform using the equation:

$$DiffData(C\text{-}A) = V_C - V_A$$

3. Find and mark the last transition edge of the differential waveform, DiffData(C-A), which crosses +/-70mV. Denote it as T4.
4. Find the time after T4 when the falling edge of V_A crosses $V_{IL(Max)}$ = 550mV. Mark this time as T5. Note that T5 must be greater than T4.
5. Calculate $T_{HS\text{-}EXIT}$ using the equation:

$$T_{HS-EXIT} = T5 - T4$$

6 Compare the calculated value of $T_{HS-EXIT}$ against the compliance test limits.

Expected/Observable Results

The calculated value of $T_{HS-EXIT}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

7 Informative Tests

This section provides the Methods of Implementation (MOIs) for the Informative tests. This group of tests provides additional test information about the DUT. The MIPI C-PHY CTS does not explicitly specify these tests.

Probing for Informative Tests

When performing the Informative tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the Informative tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **Reference Termination Board** and configure the DUT to output **Burst signal** prior to running the Informative Tests.

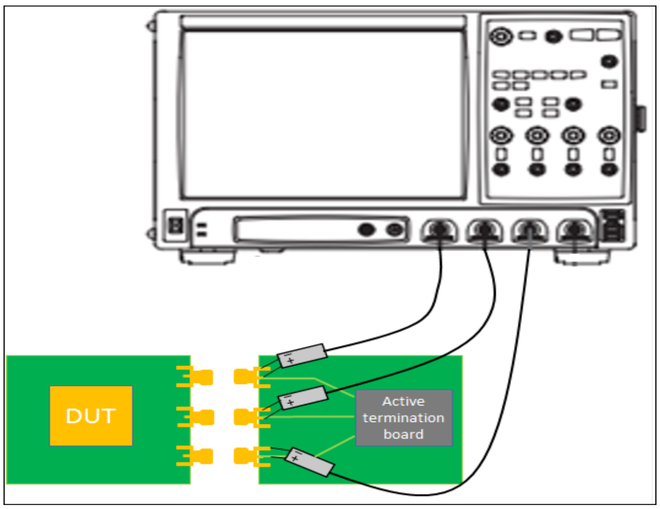


Figure 31 Sample connection diagram for Informative Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 31 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.
2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3 Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v1.0**.
4 Click **Connection Setup** to configure the channel selection and probing method.
5 Enable the **Informative Tests** check box.
6 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

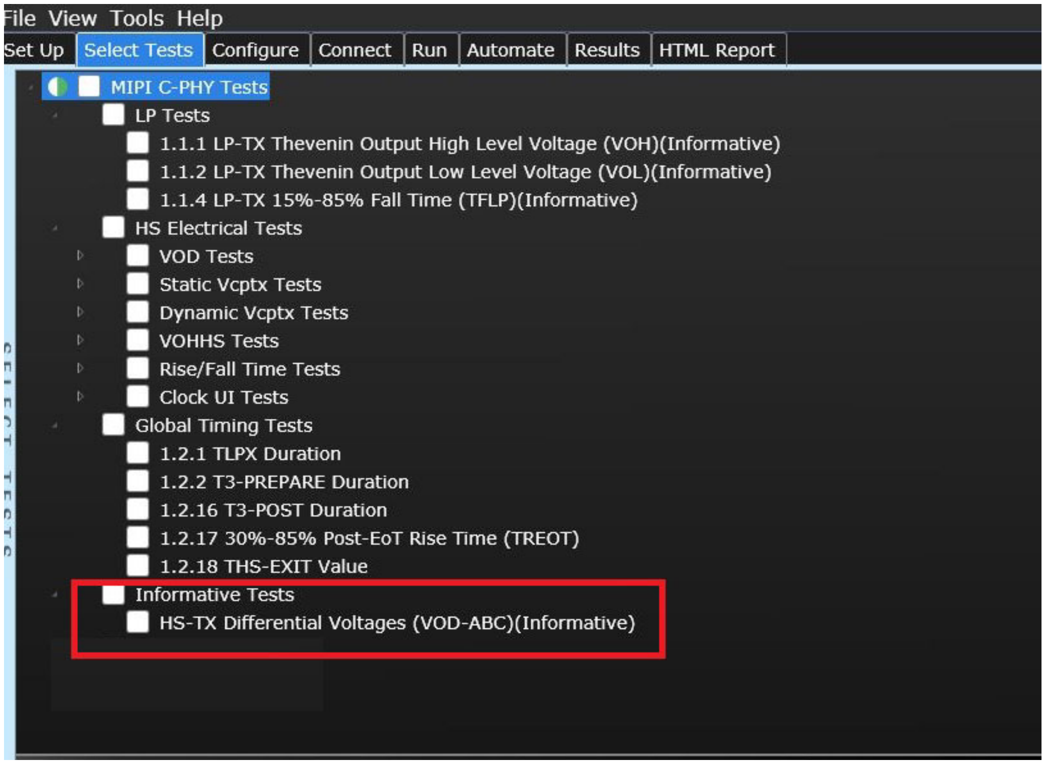


Figure 32 Selecting Informative Tests

7 Follow the MIPI C-PHY Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

Test HS-TX Differential Voltages (VOD-ABC)

Test Overview

The purpose of this test is to generate an eye diagram using VAB, VBC, and VCA differential data.

Test Availability

Table 28 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of HS-TX Differential Voltages (VOD-ABC) test.

Table 28 Configuration Options for HS-TX Differential Voltages (VOD-ABC) Test

Test ID	Test Name	LP Escape ONLY		Probing Method			Informative Tests	
		Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1730	HS-TX Differential Voltages (VOD-ABC) (Informative)	×	✓	✓	×	×	✓	×

Test Procedure

For Test ID 1730

1. Trigger on the LP-111 to LP-001 region of an HS Burst data signal.
2. Capture waveforms for V_A, V_B and V_C.
3. Construct the differential data waveform using the following equations:

$$DiffData(A\text{-}B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C\text{-}A) = V_C - V_A$$

4. Generate DiffData (A-B-C) from DiffData(A-B), DiffData(B-C), and DiffData(C-A) using a Matlab UDF script.
5. Fold the DiffData(A-B-C) to form a data eye.

8 MIPI C-PHY 1.1 High-Speed Transmitter (HS-TX) Electrical Tests

This section provides the Methods of Implementation (MOIs) for the electrical tests for high-speed transmitters (HS-TX) using an Keysight Infiniium oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

Probing for High-Speed Transmitter Electrical Tests

When performing the HS Electrical tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the HS Electrical tests may look similar to the following diagrams. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

For the Burst Mode, when you select **Active Probe (Differential Probe)** in the Connection Setup window (refer to step 4 in the "Test Procedure"), connect the DUT to Reference Termination Board and configure the DUT to output Burst signal prior to running the HS Electrical Tests.

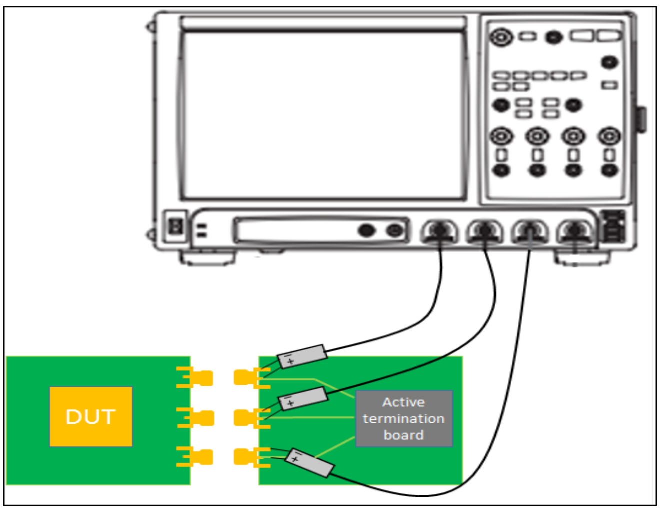


Figure 33 Sample connection diagram for HS Electrical Tests for "Active Probe (Differential Probe)" probing method

For the Continuous Mode, when you select **Direct Connect** or **Direct Connect (Active Termination Adapter)** in the Connection Setup window (refer to step 4 in the "Test Procedure"), connect the DUT to the oscilloscope using Direct Connection and configure the DUT to output Continuous signal prior to running the HS Electrical Tests.

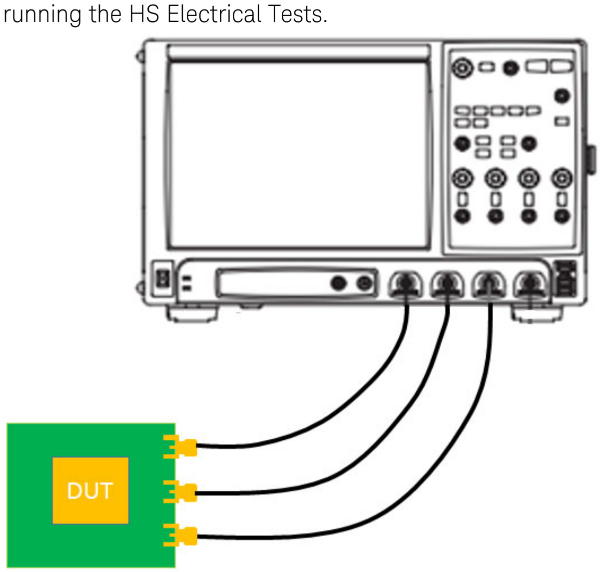


Figure 34 Sample connection diagram for HS Electrical Tests for "Direct Connect" or "Direct Connect (Active Termination Adapter)" probing method

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in the figures are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.

2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.

3 Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v1.1**.

4 Click **Connection Setup** to configure the channel selection and probing method.

   a For the **Burst Mode**, select **Active Probe (Differential Probe)** as the Probing Method.

   b For the **Continuous Mode**, select **Direct Connect** or **Direct Connect (Active Termination Adapter)** as the Probing Method.

5 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

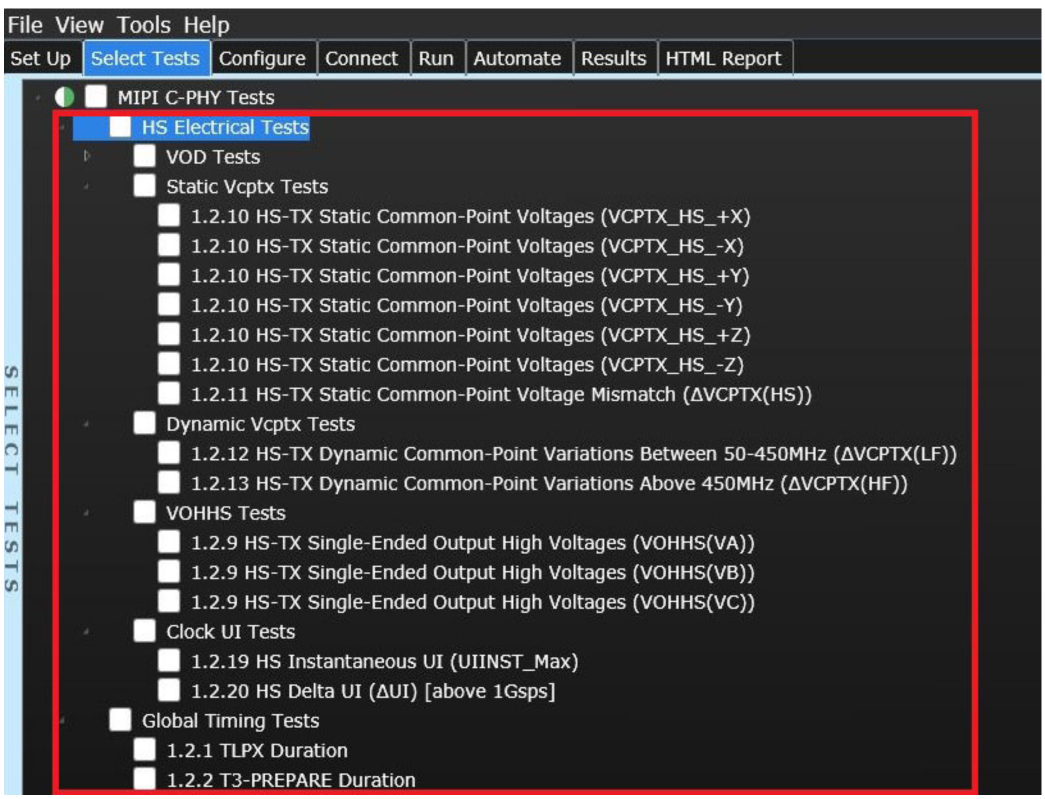


Figure 35 Selecting High-Speed Transmitter Electrical Tests

6 Follow the MIPI C-PHY Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.2.7 HS-TX Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA})

Test Overview

The purpose of this test is to verify that the Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA}) of the HS Transmitter DUT are within the conformance limits of the MIPI C-PHY standard specification.

The single-ended output voltages are defined V_A, V_B and V_C at the A, B and C pins, respectively. The differential output voltages V_{OD_AB}, V_{OD_BC} and V_{OD_CA} are defined at the difference of the voltages:

$$V_{OD\_AB} = V_A - V_B$$

$$V_{OD\_BC} = V_B - V_C$$

$$V_{OD\_CA} = V_C - V_A$$

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 29 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA}) test.

Table 29 Configuration Options for HS-TX Differential Voltages Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.7	1704	HS-TX Differential Voltages ($V_{OD-AB-Strong1}$) [Mean]	-	-	×	✓	✓	×	×
	1705	HS-TX Differential Voltages ($V_{OD-AB-Weak1}$) [Mean]	-	-	×	✓	✓	×	×
	1706	HS-TX Differential Voltages ($V_{OD-AB-Weak0}$) [Mean]	-	-	×	✓	✓	×	×
	1707	HS-TX Differential Voltages ($V_{OD-AB-Strong0}$) [Mean]	-	-	×	✓	✓	×	×
	1714	HS-TX Differential Voltages ($V_{OD-BC-Strong1}$) [Mean]	-	-	×	✓	✓	×	×
	1715	HS-TX Differential Voltages ($V_{OD-BC-Weak1}$) [Mean]	-	-	×	✓	✓	×	×
	1716	HS-TX Differential Voltages ($V_{OD-BC-Weak0}$) [Mean]	-	-	×	✓	✓	×	×
	1717	HS-TX Differential Voltages ($V_{OD-BC-Strong0}$) [Mean]	-	-	×	✓	✓	×	×
	1724	HS-TX Differential Voltages ($V_{OD-CA-Strong1}$) [Mean]	-	-	×	✓	✓	×	×

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.7	1725	HS-TX Differential Voltages ($V_{OD-CA-Weak1}$) [Mean]	-	-	×	✓	✓	×	×
	1726	HS-TX Differential Voltages ($V_{OD-CA-Weak0}$) [Mean]	-	-	×	✓	✓	×	×
	1727	HS-TX Differential Voltages ($V_{OD-CA-Strong0}$) [Mean]	-	-	×	✓	✓	×	×
	1740	HS-TX Differential Voltages ($V_{OD-AB-Strong1}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1741	HS-TX Differential Voltages ($V_{OD-AB-Weak1}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1742	HS-TX Differential Voltages ($V_{OD-AB-Weak0}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1743	HS-TX Differential Voltages ($V_{OD-AB-Strong0}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1750	HS-TX Differential Voltages ($V_{OD-BC-Strong1}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1751	HS-TX Differential Voltages ($V_{OD-BC-Weak1}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1752	HS-TX Differential Voltages ($V_{OD-BC-Weak0}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1753	HS-TX Differential Voltages ($V_{OD-BC-Strong0}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1760	HS-TX Differential Voltages ($V_{OD-CA-Strong1}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1761	HS-TX Differential Voltages ($V_{OD-CA-Weak1}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1762	HS-TX Differential Voltages ($V_{OD-CA-Weak0}$) [Mean] (C)	×	✓	×	✓	×	✓	✓
	1763	HS-TX Differential Voltages ($V_{OD-CA-Strong0}$) [Mean] (C)	×	✓	×	✓	×	✓	✓

References

See Test 1.2.7 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

For Test ID 1704, 1714, 1724

1 Trigger on the LP-111 to LP-001 region of an HS Burst data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Fold the required DiffData waveform to form a Data Eye.
5 Use the Histogram feature to measure the mean values for the parameters Strong1, Weak1, Weak0 and Strong0 at a point, which is 20% of the UI width before the trigger point. Configure the Histogram window position using thee following options:
  a *VOD Histogram Window Mode* with the following available options:
    i "AUTO" mode: The histogram window is placed automatically.
    ii "MANUAL" mode: Configure the histogram window settings using the following options:
    a. "$V_{OD(Strong1, Weak1)}$ Histogram Window(V)[Manual Mode]"
    b. "$V_{OD(Strong0, Weak0)}$ Histogram Window(V)[Manual Mode]"
6 Report the measured values of V_{OD} for all parameters mentioned in the previous step.
7 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1705, 1706, 1707

1 Run the following test as a prerequisite:
  a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-AB-Strong1}$)[Mean] – (Test ID 1704).
  Store the test results after measuring all the required values of V_{OD-AB} for the test signal.
2 Report the measured values of V_{OD} that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1715, 1716, 1717

1 Run the following test as a prerequisite:
  a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-BC-Strong1}$)[Mean] – (Test ID 1714).
  Store the test results after measuring all the required values of V_{OD-BC} for the test signal.
2 Report the measured values of V_{OD} that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1725, 1726, 1727

1 Run the following test as a prerequisite:
  a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-CA-Strong1}$)[Mean] – (Test ID 1724).
  Store the test results after measuring all the required values of V_{OD-CA} for the test signal.
2 Report the measured values of V_{OD} for that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1740, 1750, 1760

1 Trigger on an HS Continuous data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Fold the required DiffData waveform to form a Data Eye.
5 Use the Histogram feature to measure the minimum and maximum values for the parameters Strong1, Weak1, Weak0 and Strong0 at a point, which is 20% of the UI width before the trigger point. Configure the Histogram window position using thee following options:
   a *VOD Histogram Window Mode* with the following available options:
      i "AUTO" mode: The histogram window is placed automatically.
      ii "MANUAL" mode: Configure the histogram window settings using the following options:
      a. "$V_{OD(Strong1, Weak1)}$ Histogram Window(V)[Manual Mode]"
      b. "$V_{OD(Strong0, Weak0)}$ Histogram Window(V)[Manual Mode]"
6 Report the measured values of V_{OD} for all parameters mentioned in the previous step.
7 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1741, 1742, 1743

1 Run the following test as a prerequisite:
   a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-AB-Strong1}$)[Mean] (C) – (Test ID 1740).

   Store the test results after measuring all the required values of V_{OD-AB} for the test signal.
2 Report the measured values of V_{OD} that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1751, 1752, 1753

1 Run the following test as a prerequisite:
   a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-BC-Strong1}$)[Mean] (C) – (Test ID 1750).

   Store the test results after measuring all the required values of V_{OD-BC} for the test signal.
2 Report the measured values of V_{OD} that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1761, 1762, 1763

1 Run the following test as a prerequisite:
   a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-CA-Strong1}$)[Mean] (C) – (Test ID 1760).

   Store the test results after measuring all the required values of V_{OD-CA} for the test signal.
2 Report the measured values of V_{OD} for that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

Expected/Observable Results

The measured value of V_{OD} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.8 HS-TX Differential Voltage Mismatch (ΔV_{OD})

Test Overview

The purpose of this test is to verify that the Differential Voltage Mismatch (ΔV_{OD}) of the HS Transmitter DUT is within the conformance limits of the MIPI C-PHY standard specification.

Test Availability

Table 30 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Differential Voltage Mismatch (ΔV_{OD}) test.

Table 30 Configuration Options for HS-TX Differential Voltage Mismatch Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.8	1801	HS-TX Differential Voltage Mismatch (ΔV_{OD})	—	—	×	✓	✓	×	×
	1810	HS-TX Differential Voltage Mismatch (ΔV_{OD}) (C)	×	✓	×	✓	×	✓	✓

References

See Test 1.2.8 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

For Test ID 1801

1 Run the following tests as a prerequisite:

a Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}AB\text{-}Strong1}$)[Mean] — (Test ID 1704).

Store the test results after measuring all the required values of $V_{OD\text{-}AB}$ for the test signal.

b Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Strong1}$)[Mean] — (Test ID 1714).

Store the test results after measuring all the required values of $V_{OD\text{-}BC}$ for the test signal.

c Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}CA\text{-}Strong1}$)[Mean] — (Test ID 1724).

Store the test results after measuring all the required values of $V_{OD\text{-}CA}$ for the test signal.

2 Derive $V_{OD\text{-}MAX}$ by taking the maximum value among the three Strong1[Mean] of V_{OD} values and absolute values of three Strong 0(Mean) VOD values for AB, BC and CA pairs.

3 Derive $V_{OD\text{-}MIN}$ by taking the minimum value among the three Strong1[Mean] of V_{OD} values and absolute values of three Strong 0(Mean) VOD values for AB, BC and CA pairs.

4 Calculate the Differential Voltage Mismatch using the equation:

$$\Delta V_{OD} = |V_{OD\text{-}MAX}| - |V_{OD\text{-}MIN}|$$

5 Compare the measured values of ΔV_{OD} against the compliance test limits.

For Test ID 1810

1 Run the following tests as a prerequisite:

a Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}AB\text{-}Strong1}$)[Mean] (C) — (Test ID 1740).

Store the test results after measuring all the required values of $V_{OD\text{-}AB}$ for the test signal.

b Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Strong1}$)[Mean] (C) — (Test ID 1750).

Store the test results after measuring all the required values of $V_{OD\text{-}BC}$ for the test signal.

c Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}CA\text{-}Strong1}$)[Mean] (C) — (Test ID 1760).

Store the test results after measuring all the required values of $V_{OD\text{-}CA}$ for the test signal.

2 Derive $V_{OD\text{-}MAX}$ by taking the maximum value among the three Strong1[Mean] of V_{OD} values and absolute values of three Strong 0(Mean) VOD values for AB, BC and CA pairs.

3 Derive $V_{OD\text{-}MIN}$ by taking the minimum value among the three Strong1[Mean] of V_{OD} values and absolute values of three Strong 0(Mean) VOD values for AB, BC and CA pairs.

4 Calculate the Differential Voltage Mismatch using the equation:

$$\Delta V_{OD} = |V_{OD\text{-}MAX}| - |V_{OD\text{-}MIN}|$$

5 Compare the measured values of ΔV_{OD} against the compliance test limits.

Expected/Observable Results

The measured value of ΔV_{OD} for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.9 HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$, $V_{OHHS(VC)}$)

Test Overview

The purpose of this test is to verify that the Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$ and $V_{OHHS(VC)}$) of the HS Transmitter DUT are less than the maximum conformance limit values of the MIPI C-PHY standard specification.

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 31 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$ and $V_{OHHS(VC)}$) test.

Table 31 Configuration Options for HS-TX Single-Ended Output High Voltages Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.9	1900	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$)	-	-	×	✓	✓	×	×
	1901	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VB)}$)	-	-	×	✓	✓	×	×
	1902	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VC)}$)	-	-	×	✓	✓	×	×
	1910	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$)(C)	×	✓	×	✓	×	×	✓
	1911	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VB)}$)(C)	×	✓	×	✓	×	×	✓
	1912	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VC)}$)(C)	×	✓	×	✓	×	×	✓

References

See Test 1.2.9 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 1900, 1901, 1902" on page 47

For Test ID 1910, 1911, 1912

1 Trigger on an HS Continuous data signal.
2 Capture waveforms for V_A, V_B and V_C.

3 Calculate the UI width from the input HS Symbol Rate.
4 Fold the required single-ended data signal (V_A, V_B or V_C) to form a Data Eye.
5 Enable the Histogram feature on the Oscilloscope.
6 Place the Histogram window on the upper level of the 3-level single-ended eye diagram such that the location of the window is at 20% of the UI width before the trigger point. Configure the Histogram window settings with the following options:
   a V_{OHHS} Histogram Window [Top](V)
   b V_{OHHS} Histogram Window [Bottom](V)
   c V_{OHHS} Histogram Window Width (UI)
7 Measure the mean value of the Histogram and use this value as the final V_{OHHS} measurement result.
8 Compare the measured values of V_{OHHS} against the compliance test limits.

Expected/Observable Results

The measured value of V_{OHHS} for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.10 HS-TX Static Common-Point Voltages (V_{CPTX})

Test Overview

The purpose of this test is to verify that the Static Common-Point Voltages (V_{CPTX}) of the HS Transmitter DUT are within the conformance limits of the MIPI C-PHY standard specification. Figure shows the static V_{CPTX} distortion on the single-ended high-speed signals.

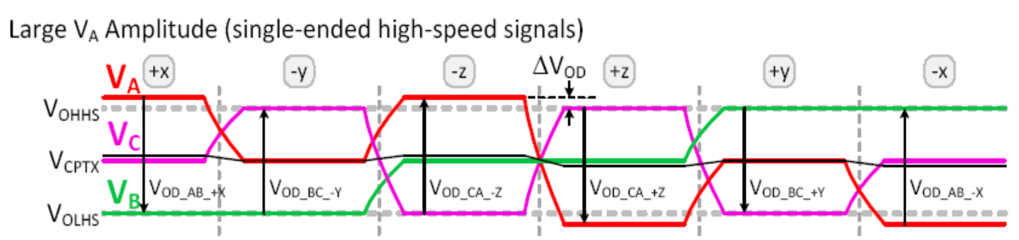


Figure 36 Static V_{CPTX} distortion on the single-ended high-speed signals

The common-point voltage V_{CPTX} is defined as the arithmetic mean value of the voltages at the A, B and C pins:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 32 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Static Common-Point Voltages (V_{CPTX}) test.

Table 32 Configuration Options for HS-TX Static Common-Point Voltages Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.10	2000	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$)	-	-	×	✓	✓	×	×
	2001	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-X}$)	-	-	×	✓	✓	×	×
	2002	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Y}$)	-	-	×	✓	✓	×	×
	2003	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Y}$)	-	-	×	✓	✓	×	×
	2004	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Z}$)	-	-	×	✓	✓	×	×
	2005	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Z}$)	-	-	×	✓	✓	×	×

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
	2010	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$)(C)	×	✓	×	✓	×	×	✓
	2011	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-X}$)(C)	×	✓	×	✓	×	×	✓
	2012	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Y}$)(C)	×	✓	×	✓	×	×	✓
	2013	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Y}$)(C)	×	✓	×	✓	×	×	✓
	2014	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Z}$)(C)	×	✓	×	✓	×	×	✓
	2015	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Z}$)(C)	×	✓	×	✓	×	×	✓

References

See Test 1.2.10 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 2000" on page 50

"For Test ID 2001, 2002, 2003, 2004, 2005" on page 51

For Test ID 2010

1 Trigger on an HS Continuous data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Use the generated differential waveforms to decode the wire states of only the HS data by sampling at the center of the UI for each wire state.
5 Generate the common-point voltage V_{CPTX} signal using the equation:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

6 Group the values of V_{CPTX} for similar HS wire states. For example, all values of V_{CPTX} that are sampled at the center of each of the UI measurements for the HS wire state +X are grouped together. Apply the same procedure for HS wire states -X, +Y, -Y, +Z and -Z.
7 Derive the maximum, minimum and mean values of V_{CPTX} for each of the HS wire state groups.

8 Record the mean value of V_{CPTX} as the final test result.

9 Compare the measured mean values of V_{CPTX} against the compliance test limits.

For Test ID 2011, 2012, 2013, 2014, 2015

1 Run the following test as a prerequisite:

   a Test 1.2.10 HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$)(C) — (Test ID 2010).

   Store the test results after measuring the actual values of V_{CPTX} for the test signal.

2 Report the measured values of V_{CPTX} for that you obtain from the prerequisite test.

3 Compare the measured values of V_{CPTX} against the compliance test limits.

Expected/Observable Results

The measured value of V_{CPTX} for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.11 HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$)

Test Overview

The purpose of this test is to verify that the Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$) of the HS Transmitter DUT is less than the maximum conformance limit values of the MIPI C-PHY standard specification.

Test Availability

Table 33 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$) test.

Table 33 Configuration Options for HS-TX Static Common-Point Voltage Mismatch Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.11	2100	HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$)	-	-	×	✓	✓	×	×
	2110	HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$)(C)	×	✓	×	✓	×	×	✓

References

See Test 1.2.11 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 2100" on page 52

For Test ID 2110

1 Run the following tests as a prerequisite:

a Test 1.2.10 HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$)(C) — (Test ID 2010).

Store the test results after measuring the actual values of V_{CPTX} for the test signal.

2 Calculate the V_{MAXCP}, V_{MINCP} and $\Delta V_{CPTX(HS)}$ using the equations:

$$V_{MAXCP} = \max(V_{CPTX\_HS\_+X}, V_{CPTX\_HS\_-X}, V_{CPTX\_HS\_+Y}, V_{CPTX\_HS\_-Y}, V_{CPTX\_HS\_+Z}, V_{CPTX\_HS\_-Z})$$

$$V_{MINCP} = \min(V_{CPTX\_HS\_+X}, V_{CPTX\_HS\_-X}, V_{CPTX\_HS\_+Y}, V_{CPTX\_HS\_-Y}, V_{CPTX\_HS\_+Z}, V_{CPTX\_HS\_-Z})$$

$$\Delta V_{CPTX(HS)} = (V_{MAXCP} - V_{MINCP}) / 2$$

3 Compare the measured values of $\Delta V_{CPTX(HS)}$ against the compliance test limits.

Expected/Observable Results

The measured value of $\Delta V_{CPTX(HS)}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.12 HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$)

Test Overview

The purpose of this test is to verify that the AC Common-Point Signal Level Variations Between 50 and 450MHz ($\Delta V_{CPTX(LF)}$) of the HS Transmitter DUT are less than the maximum allowable conformance limit values of the MIPI C-PHY standard specification. Figure 37 shows the dynamic V_{CPTX} distortion on the single-ended high-speed signals.

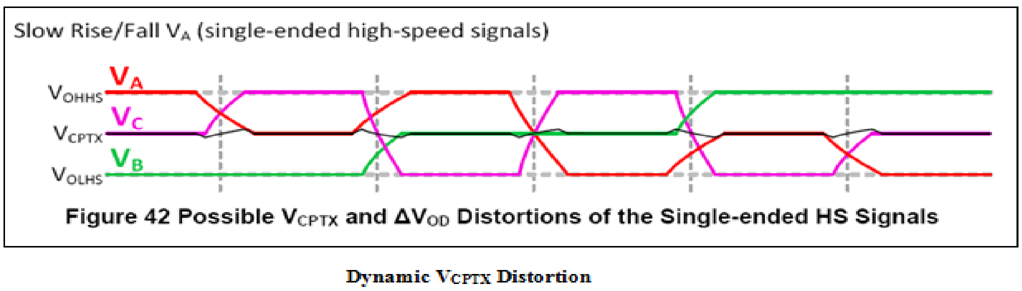


Figure 37 Dynamic V_{CPTX} distortion on the single-ended high-speed signals

Test Availability

Table 34 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$) test.

Table 34 Configuration Options for HS-TX Dynamic Common-Point Variations Between 50 and 450MHz Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.12	2200	HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$)	-	-	×	✓	✓	×	×
	2210	HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$) (C)	×	✓	×	✓	×	×	✓

References

See Test 1.2.12 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 2200" on page 53

For Test ID 2210

1. Trigger on an HS Continuous data signal.
2. Capture waveforms for V_A, V_B and V_C.
3. Generate the common-point voltage V_{CPTX} signal using the equation:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

4. Apply a band-pass filter with 3dB bandwidth frequency of 50MHz and 450MHz to the common-point waveform.
5. Measure the minimum and maximum values of voltage for the filtered waveform.
6. Record the maximum value of voltage as $\Delta V_{CPTX(LF)}$.
7. Compare the measured value of $\Delta V_{CPTX(LF)}$ against the compliance test limits.

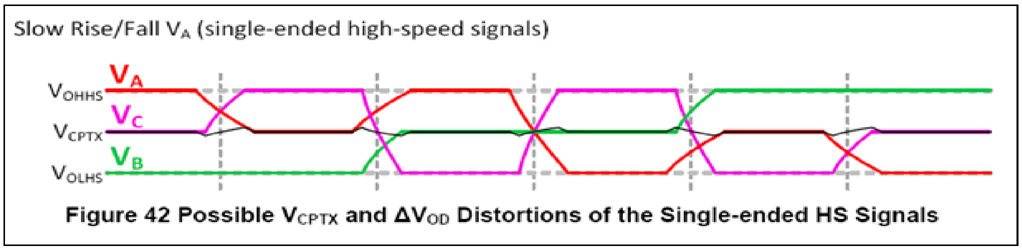
Expected/Observable Results

The measured value of $\Delta V_{CPTX(LF)}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.13 HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$)

Test Overview

The purpose of this test is to verify that the AC Common-Point Signal Level Variations Above 450MHz ($\Delta V_{CPTX(HF)}$) of the HS Transmitter DUT are less than the maximum allowable conformance limit values of the MIPI C-PHY standard specification. Figure shows the dynamic V_{CPTX} distortion on the single-ended high-speed signals.



Dynamic V_{CPTX} Distortion

Figure 38 Dynamic V_{CPTX} distortion on the single-ended high-speed signals

Test Availability

Table 35 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$) test.

Table 35 Configuration Options for HS-TX Dynamic Common-Point Variations Above 450MHz Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.13	2300	HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$)	-	-	×	✓	✓	×	×
	2310	HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$)(C)	×	✓	×	✓	×	×	✓

References

See Test 1.2.13 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

“For Test ID 2300" on page 55

For Test ID 2310

1 Trigger on an HS Continuous data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Generate the common-point voltage V_{CPTX} signal using the equation:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

4 Apply a high pass filter with 3dB bandwidth frequency of 450MHz to the common-point waveform.
5 Measure the RMS value of the voltage for the filtered waveform and record as $\Delta V_{CPTX(HF)}$.
6 Compare the measured value of $\Delta V_{CPTX(HF)}$ against the compliance test limits.

Expected/Observable Results

The measured value of $\Delta V_{CPTX(HF)}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.14 HS-TX Rise Time (t_R)

For information about this test, refer to "Test 1.2.14 HS-TX Rise Time (tR)" on page 57. This test is similar to the corresponding MIPI C-PHY 1.0 test, the only difference being that the v1.1 tests are informative tests.

References

See Test 1.2.14 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.2.15 HS-TX Fall Time (t_F)

For information about this test, refer to "Test 1.2.15 HS-TX Fall Time (tF)" on page 59. This test is similar to the corresponding MIPI C-PHY 1.0 test, the only difference being that the v1.1 tests are informative tests.

References

See Test 1.2.15 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.2.19 HS Clock Instantaneous UI (UI_{INST})

Test Overview

The purpose of this test is to verify that the value of the Instantaneous Unit Interval (UI_{INST}) of the HS Transmitter DUT is within the conformance limit value of the MIPI C-PHY standard specification. Figure 39 shows the Instantaneous Unit Intervals on the High-Speed signal.

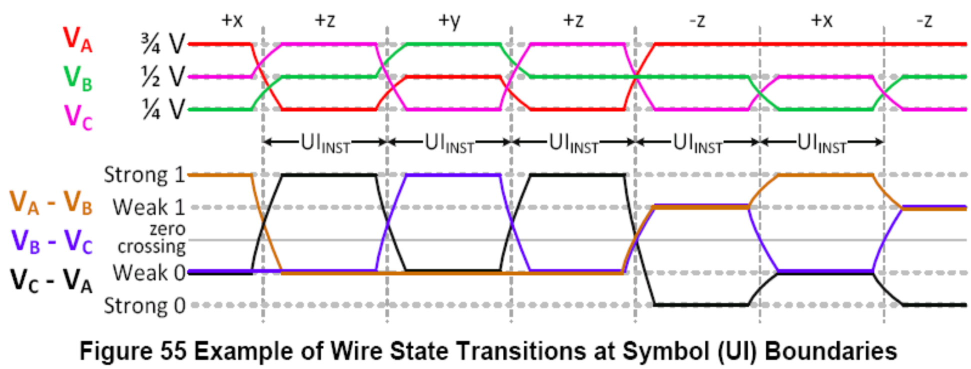


Figure 39 Instantaneous Unit Intervals on High-Speed signal

Test Availability

Table 36 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS Clock Instantaneous UI (UI_{INST}) test.

Table 36 Configuration Options for HS Clock Instantaneous UI Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.19	2900	HS Clock Instantaneous UI (UI_{INST_Max})	—	—	×	✓	✓	×	×
	2910	HS Clock Instantaneous UI (UI_{INST_Max}) (C)	×	✓	×	✓	×	✓	✓

References

See Test 1.2.19 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 2900" on page 61

For Test ID 2910

1 Trigger on an HS Continuous data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Construct the differential data waveform using the equation:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Measure the minimum, maximum and average values of Unit Interval for the differential waveforms based on the zero crossings between each UI.
5 Store the minimum, maximum and average values of the Unit Interval as UI_Min, UI_Max and UI_Mean respectively.
6 Apply a Butterworth Low Pass test filter with a -3dB cut-off frequency of 2.0MHz to the measured UI data.
7 Measure and store the minimum, maximum and average values of the filtered Unit Interval data as $UI_{Inst\_Filt\_Min}$, $UI_{Inst\_Filt\_Max}$ and $UI_{Inst\_Filt\_Mean}$ respectively.
8 Use the value of UI_Max as the final measurement result and compare this value against the compliance test limits.

Expected/Observable Results

The measured value of UI_{INST} for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.20 HS Clock Delta UI (ΔUI)

Test Overview

The purpose of this test is to verify that the frequency stability of the DUT's HS Clock during a single burst is within the conformance limit value of the MIPI C-PHY standard specification.

Test Availability

Table 37 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS Clock Delta UI (ΔUI) test.

Table 37 Configuration Options for HS Clock Delta Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Symbol Rate			Probing Method		
			Enabled	Disabled	Enabled	Disabled	<=1.0 Gsps	1.0 Gsps < x <=1.5 Gsps	>1.5 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.20	3000	HS Clock Delta UI (ΔUI) [1 Gsps and below]	—	—	×	✓	✓	×	×	✓	×	×
	3001	HS Clock Delta UI (ΔUI) [Above 1 Gsps]	—	—	×	✓	×	✓	✓	✓	×	×
	3010	HS Clock Delta UI (ΔUI) [1 Gsps and below]	×	✓	×	✓	✓	×	×	×	✓	✓
	3011	HS Clock Delta UI (ΔUI) [Above 1 Gsps]	×	✓	×	✓	×	✓	✓	×	✓	✓

References

See Test 1.2.20 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 3000, 3001" on page 63

For Test ID 3010, 3011

1 Run the following test as a prerequisite:

a Test 1.2.19 HS Clock Instantaneous UI (UI_{INST_Max}) (C) – (Test ID 2910).

Store the test results after measuring the minimum, maximum and average values of the Low Pass filtered Unit Interval of the differential waveforms.

2 Calculate UI_Variant_Min and UI_Variant_Max using the equations:

$$UI\_Variant\_Min = [(UI_{Inst\_Filt\_Min} - UI_{Inst\_Filt\_Mean}) / UI_{Inst\_Filt\_Mean}] * 100\%$$

$$UI\_Variant\_Max = [(UI_{Inst\_Filt\_Max} - UI_{Inst\_Filt\_Mean}) / UI_{Inst\_Filt\_Mean}] * 100\%$$

3 Determine UI_Variant_Worst based on the values of UI_Variant_Min and UI_Variant_Max calculated in the previous step.

4 Use the value of UI_Variant_Worst as the final test result and compare the determined value of UI_Variant_Worst against the compliance test limits.

Expected/Observable Results

The measured UI variation for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.21 HS-TX Eye Diagram

Test Overview

The purpose of this test is to verify that the DUT's HS-TX meets the requirements for Transmitter Eye Diagram specification.

Test Availability

Table 38 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Eye Diagram test.

Table 38 Configuration Options for HS-TX Eye Diagram Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method			Eye Diagram Type	
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Combined	Separated 3
1.2.21	3100	HS-TX Eye Diagram (VAB) (C)	×	✓	×	✓	×	✓	✓	×	✓
	3101	HS-TX Eye Diagram (VBC) (C)	×	✓	×	✓	×	✓	✓	×	✓
	3102	HS-TX Eye Diagram (VCA) (C)	×	✓	×	✓	×	✓	✓	×	✓
	3103	HS-TX Eye Diagram (VABC) (C)	×	✓	×	✓	×	✓	✓	✓	×

References

See Test 1.2.21 of the C-PHY Physical Layer Conformance Test Suite v1.0r03 for C-PHY v1.0/v1.1 (30Sept2018).

Test Procedure

For Test ID 3100

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.

2 Embed the "Standard Channel" reference channel using the "InfiniiSim" function of the scope for V_A, V_B and V_C signals.

3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Fold the DiffData(A-B) to form a Data Eye.

5 Make one acquisition and run the mask testing feature in the scope.

6 Check the mask violation result.
7 If there is mask violation, move the mask horizontally to the left from the trigger point by increment of a value specified by “Moving Mask Unit” configuration option, until a position where there are no mask hits or a maximum of 0.2UI from the trigger point.
8 Acquire 3M UIs and run the mask testing feature in the scope.
9 Check the mask violation result.
10 The mask violation result is used as the final test result for this test.

For Test ID 3101

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.
2 Embed the “Standard Channel” reference channel using the “InfiniiSim” function of the scope for V_A, V_B and V_C signals.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Fold the DiffData(B-C) to form a Data Eye.
5 Make one acquisition and run the mask testing feature in the scope.
6 Check the mask violation result.
7 If there is mask violation, move the mask horizontally to the left from the trigger point by increment of a value specified by “Moving Mask Unit” configuration option, until a position where there are no mask hits or a maximum of 0.2UI from the trigger point.
8 Acquire 3M UIs and run the mask testing feature in the scope.
9 Check the mask violation result.
10 The mask violation result is used as the final test result for this test.

For Test ID 3102

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.
2 Embed the “Standard Channel” reference channel using the “InfiniiSim” function of the scope for V_A, V_B and V_C signals.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Fold the DiffData(C-A) waveform to form a Data Eye.
5 Make one acquisition and run the mask testing feature in the scope.
6 Check the mask violation result.
7 If there is mask violation, move the mask horizontally to the left from the trigger point by increment of a value specified by “Moving Mask Unit” configuration option, until a position where there are no mask hits or a maximum of 0.2UI from the trigger point.
8 Acquire 3M UIs and run the mask testing feature in the scope.
9 Check the mask violation result.
10 The mask violation result is used as the final test result for this test.

For Test ID 3103

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.
2 Embed the “Standard Channel” reference channel using the “InfiniiSim” function of the scope for V_A, V_B and V_C signals.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Generate DiffData (A-B-C) from DiffData(A-B), DiffData(B-C), and DiffData(C-A) using a Matlab UDF script.
5 Fold the DiffData (A-B-C) to form a Data Eye.
6 Make one acquisition and run the mask testing feature in the scope.
7 Check the mask violation result.
8 If there is mask violation, move the mask horizontally to the left from the trigger point by increment of a value specified by “Moving Mask Unit” configuration option, until a position where there are no mask hits or a maximum of 0.2UI from the trigger point.
9 Acquire 3M UIs and run the mask testing feature in the scope.
10 Check the mask violation result.
11 The mask violation result is used as the final test result for this test.

Expected/Observable Results

The measured UI variation for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

9 MIPI C-PHY 1.1 Low Power Transmitter (LP-TX) Electrical Tests

This section provides the Methods of Implementation (MOIs) for electrical tests for low-power transmitters (LP-TX) using an Keysight Infiniium Oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

Probing for Low-Power Transmitter Electrical Tests

When performing the LP Electrical tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the LP Electrical tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **50pF Capacitive Load Fixture** prior to running the LP Tests.

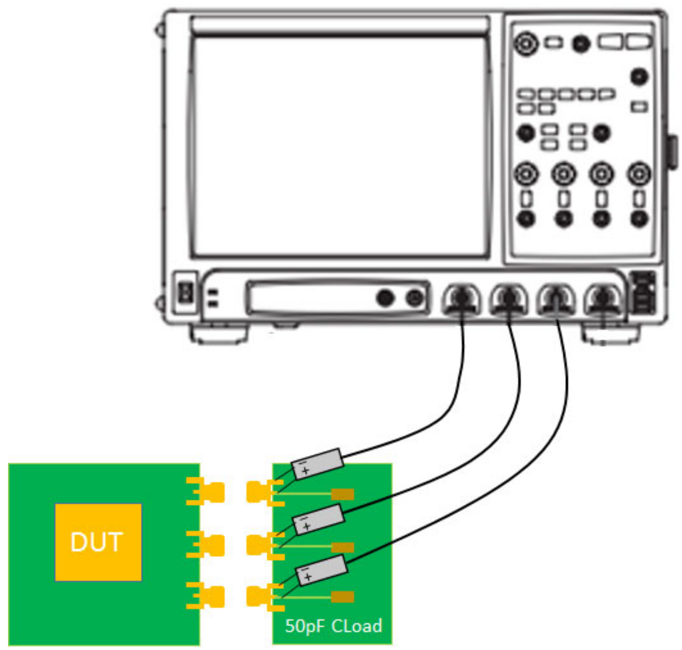


Figure 40 Sample connection diagram for LP Electrical Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 40 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, "InfiniiMax Probing," starting on page 249.

Test Procedure

1 Start the automated test application as described in "Starting the MIPI C-PHY Compliance Test Application" on page 29.
2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3 Select the **Data Type** as **LP Escape ONLY** and in the **Device Information** section, select CTS **v1.1**.
4 Click **Connection Setup** to configure the channel selection and probing method.
5 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

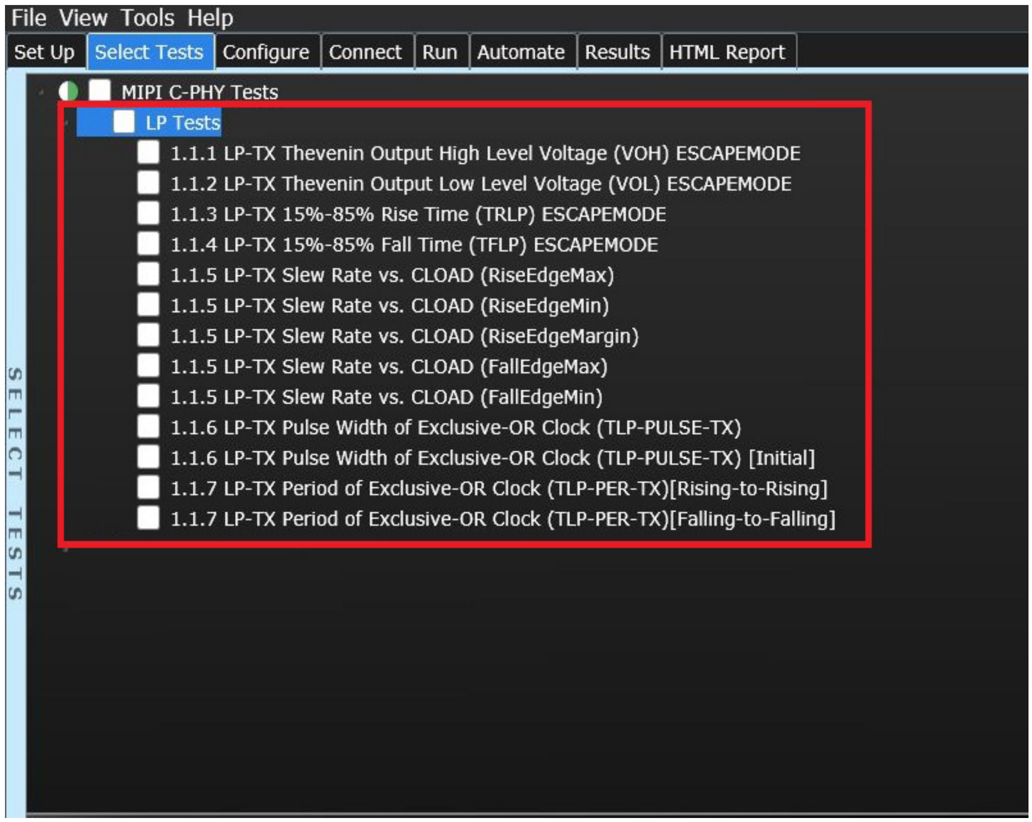


Figure 41 Selecting Low-Power Transmitter Electrical Tests

6 Follow the MIPI C-PHY Compliance Test Application's task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.1.1 LP-TX Thevenin Output High Level Voltage (V_{OH})

For information about this test, refer to "Test 1.1.1 LP-TX Thevenin Output High Level Voltage (VOH)" on page 68.

References

See Test 1.1.1 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (V_{OL})

For information about this test, refer to "Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (VOL)" on page 70.

References

See Test 1.1.2 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.1.3 LP-TX 15% - 85% Rise Time (T_{RLP})

For information about this test, refer to "Test 1.1.3 LP-TX 15% - 85% Rise Time (TRLP)" on page 72.

References

See Test 1.1.3 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.1.4 LP-TX 15% - 85% Fall Time (T_{FLP})

For information about this test, refer to "Test 1.1.4 LP-TX 15% - 85% Fall Time (TFLP)" on page 74.

References

See Test 1.1.4 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.1.5 LP-TX Slew Rate vs. C_{LOAD}

For information about this test, refer to "Test 1.1.5 LP-TX Slew Rate vs. CLOAD" on page 76.

References

See Test 1.1.5 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.1.6 LP-TX Pulse Width of Exclusive-OR Clock ($T_{LP-PULSE-TX}$)

For information about this test, refer to "Test 1.1.6 LP-TX Pulse Width of Exclusive-OR Clock (TLP-PULSE-TX)" on page 78.

References

See Test 1.1.6 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.1.7 LP-TX Period of Exclusive-OR Clock ($T_{LP-PER-TX}$)

For information about this test, refer to "Test 1.1.7 LP-TX Period of Exclusive-OR Clock (TLP-PER-TX)" on page 80.

References

See Test 1.1.7 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

10 MIPI C-PHY 1.1 Global Timing Tests

This section provides the Methods of Implementation (MOIs) for the timing tests for high-speed transmitters (HS-TX) using an Keysight Infiniium Oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

Probing for Global Timing Tests

When performing the Global Timing tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the Global Timing tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **Reference Termination Board** and configure the DUT to output **Burst signal** prior to running the Global Timing Tests.

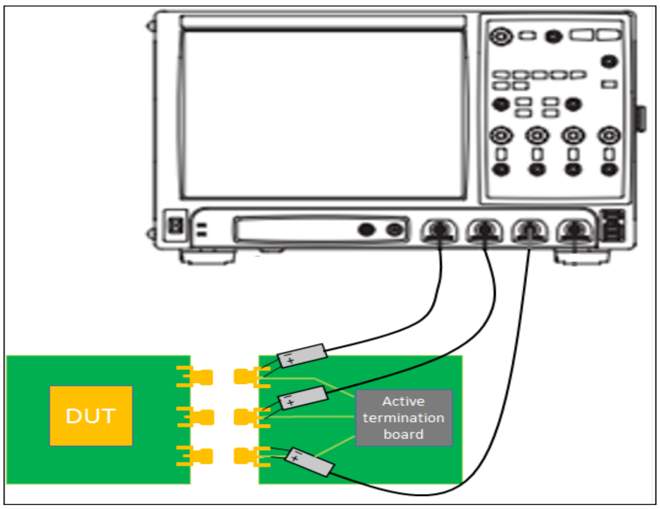


Figure 42 Sample connection diagram for HS Electrical Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 42 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.
2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3 Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v1.1**.
4 Click **Connection Setup** to configure the channel selection and probing method.
5 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

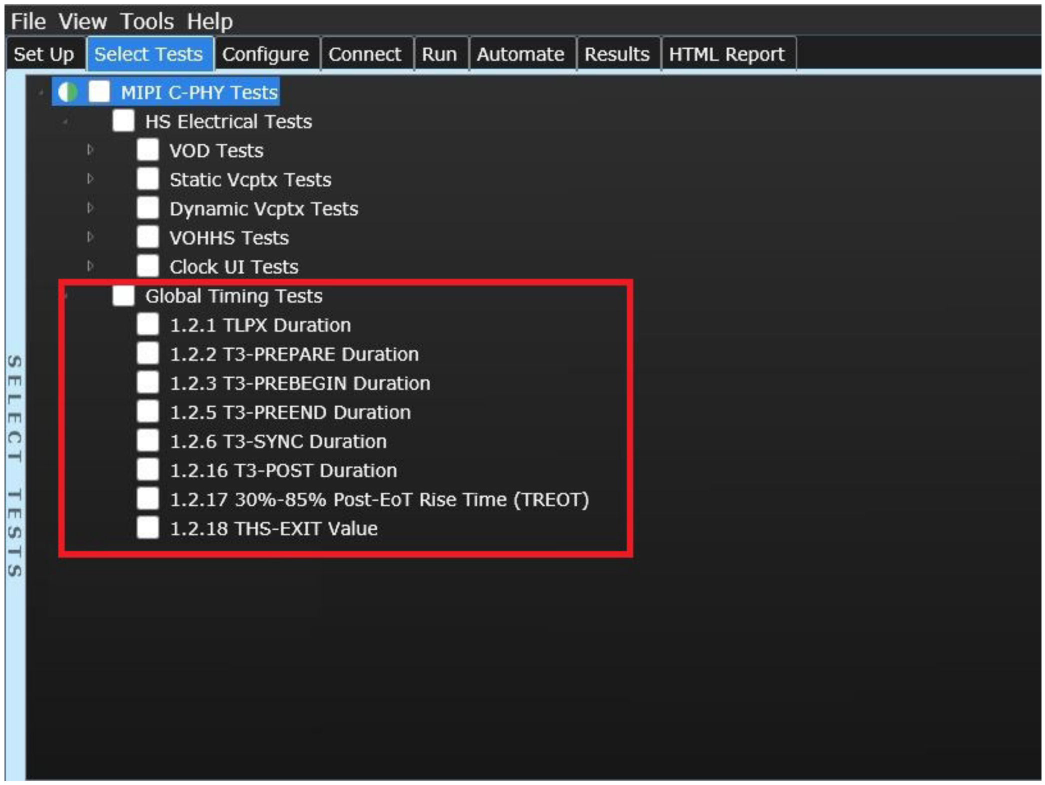


Figure 43 Selecting Global Timing Tests

6 Follow the MIPI C-PHY Compliance Test Application's task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.2.1 T_{LPX} Duration

For information about this test, refer to "Test 1.2.1 TLPX Duration" on page 86.

References

See Test 1.2.1 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.2.2 $T_{3\text{-}PREPARE}$ Duration

Test Overview

The purpose of this test is to verify that the duration ($T_{3\text{-}PREPARE}$) of the final LP-000 state immediately prior to the High Speed Transmission is within the conformance limits of the MIPI C-PHY standard specification. Figure 44 shows the $T_{3\text{-}PREPARE}$ Interval in a High-Speed Data Transmission.

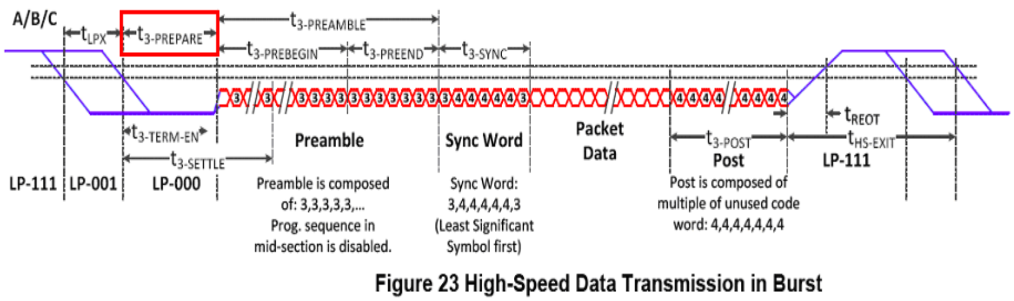


Figure 44 $T_{3\text{-}PREPARE}$ Interval in a High-Speed Data Transmission

Test Availability

Table 39 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}PREPARE}$) test.

Table 39 Configuration Options for $T_{3\text{-}PREPARE}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.2	1200	$T_{3\text{-}PREPARE}$ Duration	×	✓	✓	×	×

References

See Test 1.2.2 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

1 Run the following test as a prerequisite:

   a Test 1.2.1 T_{LPX} Duration — (Test ID 1100).

   Store the test results after measuring the T_{LPX} Duration of the test signal.

2 Use the waveforms V_A, V_B and V_c captured in the prerequisite test.

3 Construct the differential data waveform using the equation:

$$DiffData(A\text{-}B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Use the measured value of T2 from the prerequisite test as the starting point for $T_{3\text{-PREPARE}}$.

5 Find the first transition edge of DiffData(A-B), DiffData(B-C) and DiffData(C-A) that crosses +/-40mV. Mark the last transition edge from these transition edge as T3. Note that T3 must be > T2.

6 Calculate $T_{3\text{-PREPARE}}$ using the equation:

$$T_{3\text{-PREPARE}} = T3 - T2$$

7 Compare the calculated value of $T_{3\text{-PREPARE}}$ against the compliance test limits.

Expected/Observable Results

The calculated value of $T_{3\text{-PREPARE}}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.3 $T_{3\text{-}PREBEGIN}$ Duration

Test Overview

The purpose of this test is to verify that the time of $T_{3\text{-}PREBEGIN}$ is within the conformance limits of the MIPI C-PHY standard specification. Figure 45 shows the $T_{3\text{-}PREBEGIN}$ Interval in a High-Speed Data Transmission.

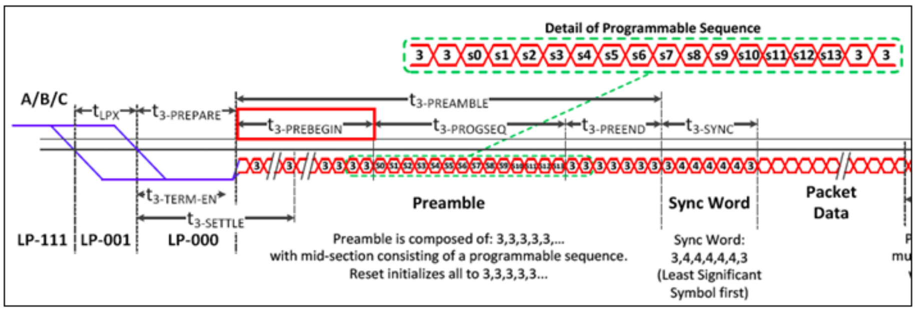


Figure 45 $T_{3\text{-}PREBEGIN}$ Interval in a High-Speed Data Transmission

Test Availability

Table 40 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}PREBEGIN}$) test.

Table 40 Configuration Options for $T_{3\text{-}PREBEGIN}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.3	1300	$T_{3\text{-}PREBEGIN}$ Duration	×	✓	✓	×	×

References

See Test 1.2.3 of the Conformance Test Suite v1.0 for C-PHY v1.0 (12Feb2016).

Test Procedure

1 Run the following test as a prerequisite:
   - *a* Test 1.2.19 HS Instantaneous UI (UIINST_Max) - (Test ID: 2900).
     Measure and store the min, max, and average values for the low pass filtered unit interval of the differential waveforms.
   - *b* Test 1.2.2 $T_{3\text{-}PREPARE}$ Duration - (Test ID: 1200):
     Perform the $T_{3\text{-}PREPARE}$ Duration measurement for the test signal and store the test results.

2 Use the waveforms V_A, V_B and V_c captured in the prerequisite test.

3 Construct the differential data waveform using the equation:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C\text{-}A) = V_C - V_A$$

4 Use the measured value of T_3 from the prerequisite test as the starting point for $T_{3\text{-}PREBEGIN}$.

5 Decode the C-PHY signals.

The test procedure are varied based on the optional T3-PROGSEQ mode.

6 When the T3-PROGSEQMode option is enabled on the Set Up tab.

  a Find and identify the $T_{3\text{-}PROGSEQ}$ symbol sequence based on the programmable sequence specified in the “T3-PROGSEQ Sequence” configuration option in the Set Up tab. The location of the first bit of this $T_{3\text{-}PROGSEQ}$ symbol sequence is marked as T_4 and value is stored as the $T_{3\text{-}PROGSEQ}$ start point.

  b Using the $T_{3\text{-}PROGSEQ}$ sequence location as a reference, find and identify the location of the next bit symbol after the $T_{3\text{-}PROGSEQ}$ symbol sequence. This location is marked as T_5 and value is stored as $T_{3\text{-}PREEND}$ start point.

  c Find and identify the $T_{3\text{-}SYNC}$ symbol sequence of ‘3, 4, 4, 4, 4, 4, 3’. The location of the first bit of this $T_{3\text{-}SYNC}$ symbol sequence is marked as T_6 and value is stored as $T_{3\text{-}SYNC}$ start point.

  d Using the $T_{3\text{-}SYNC}$ sequence location as a reference, find and identify the location of the next bit symbol after the $T_{3\text{-}SYNC}$ symbol sequence. This location is marked as T_7 and value is stored as packet data start point.

  e Calculate $T_{3\text{-}PREBEGIN}$ using the equation:
  $T_{3\text{-}PREBEGIN} = T_4 - T_3$

7 When the T3-PROGSEQMode option is not enabled on the Set Up tab.

  a Find and identify the $T_{3\text{-}SYNC}$ symbol sequence of ‘3, 4, 4, 4, 4, 4, 3’. The location of the first bit of this $T_{3\text{-}SYNC}$ symbol sequence is marked as T_6 and value is stored as $T_{3\text{-}SYNC}$ start point.

  b Using the $T_{3\text{-}SYNC}$ sequence location as a reference, subtract 7UI from the $T_{3\text{-}SYNC}$ start point. This value is marked as T_5 and is stored as $T_{3\text{-}PREEND}$ start point.

  c Using the $T_{3\text{-}SYNC}$ sequence location as a reference, find and identify the location of the next bit symbol after the $T_{3\text{-}SYNC}$ symbol sequence. This location is marked as T_7 and value is stored as packet data start point.

  d Calculate $T_{3\text{-}PREBEGIN}$ using the equation:
  $T_{3\text{-}PREBEGIN} = T_5 - T_3$

8 Compare the calculated value of $T_{3\text{-}PREBEGIN}$ against the compliance test limits.

Expected/Observable Results

The calculated value of $T_{3\text{-}PREBEGIN}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.2.4 $T_{3\text{-}PROGSEQ}$ Duration

For information about this test, refer to “Test 1.2.4 T3-PROGSEQ Duration" on page 92.

References

See Test 1.2.4 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.2.5 $T_{3\text{-}PREEND}$ Duration

For information about this test, refer to "Test 1.2.5 T3-PREEND Duration" on page 94.

Test Availability

Table 41 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}PREEND}$) test.

Table 41 Configuration Options for $T_{3\text{-}PREEND}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.5	1500	$T_{3\text{-}PREEND}$ Duration	×	✓	✓	×	×

References

See Test 1.2.5 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.2.6 $T_{3\text{-}SYNC}$ Duration

For information about this test, refer to "Test 1.2.6 T3-SYNC Duration" on page 96.

Test Availability

Table 42 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}SYNC}$) test.

Table 42 Configuration Options for $T_{3\text{-}SYNC}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.6	1600	$T_{3\text{-}SYNC}$ Duration	×	✓	✓	×	×

References

See Test 1.2.6 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.2.16 $T_{3\text{-}POST}$ Duration

Test Overview

The purpose of this test is to verify that the duration the DUT TX drives the final differential states following the payload data of a HS-TX burst ($T_{3\text{-}POST}$), is greater than the minimum required value.

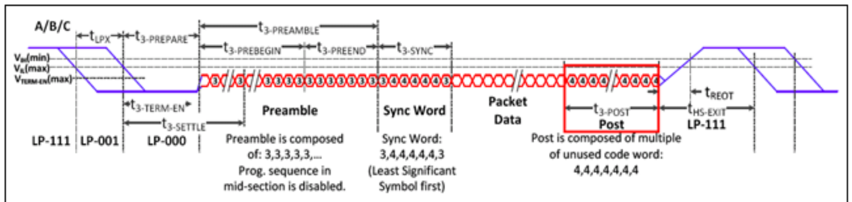


Figure 23 High-Speed Data Transmission in Burst

$T_{3\text{-}POST}$ Interval

Figure 46 $T_{3\text{-}POST}$ Interval

Test Availability

Table 43 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the $T_{3\text{-}POST}$ Duration test.

Table 43 Configuration Options for $T_{3\text{-}POST}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.16	2600	$T_{3\text{-}POST}$ Duration	×	✓	✓	×	×

References

See Test 1.2.16 of the Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

1 Run the following test as a prerequisite:

   a Test 1.2.19 HS Clock Instantaneous UI (UIINST_Max) - (Test ID: 2900). Measure and store the min, max, and average values for the unit interval of the differential waveforms.

2 Trigger on the falling edge of V_A in the LP-001 state that occurs immediately before an HS Burst sequence.

3 Construct the differential data waveform using the following equations:

$$DiffData(A\text{-}B) = V_A - V_B$$
$$DiffData(B\text{-}C) = V_B - V_C$$
$$DiffData(C\text{-}A) = V_C - V_A$$

4 Decode the C-PHY signals and find the last symbol's location.

5 Using the last symbol's location as a reference, verify that the previous symbols are consecutive "4" symbols. Identify the location where the previous symbol is non "4" symbol. This location will be marked as T1 and value will be stored as T3-POST start point.

6 Find and mark the last transition edge of the differential waveform, DiffData(C-A) that crosses +/-40mV after the last symbol location as T2. T2 must be greater than T1.

7 Calculate $T_{3\text{-}POST}$ using the equation:

$$T_{3\text{-}POST} = T_2 - T_1$$

8 Compare the measured value of $T_{3\text{-}POST}$ against the compliance test limits.

Expected/Observable Results

The measured value of $T_{3\text{-}POST}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.17 30%-85% Post-EoT Rise Time (T_{REOT})

For information about this test, refer to "Test 1.2.17 30%-85% Post-EoT Rise Time (TREOT)" on page 99.

References

See Test 1.2.17 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test 1.2.18 $T_{HS-EXIT}$ Value

Test Overview

The purpose of this test is to verify that the duration ($T_{HS-EXIT}$) the Data Lane Transmitter remains in the LP-111 (Stop) state after exiting HS mode is greater than minimum required value as per the conformance limits of the MIPI C-PHY standard specification. Figure 47 shows the $T_{HS-EXIT}$ Interval in a High-Speed Data Transmission.

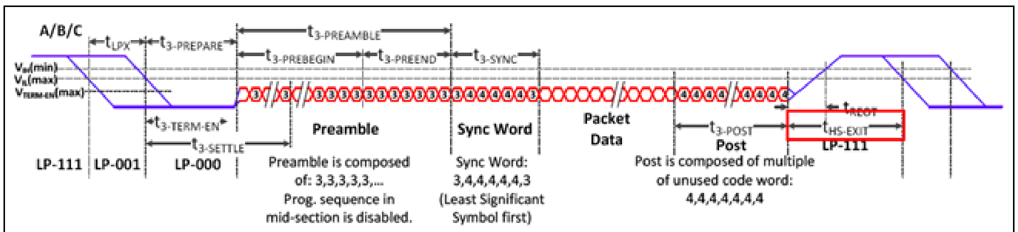


Figure 23 High-Speed Data Transmission in Burst

$T_{HS-EXIT}$ Interval

Figure 47 $T_{HS-EXIT}$ Interval in a High-Speed Data Transmission

Test Availability

Table 44 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the $T_{HS-EXIT}$ Value test.

Table 44 Configuration Options for $T_{HS-EXIT}$ Value Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method		
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.18	2800	$T_{HS-EXIT}$ Value	×	✓	✓	×	×

References

See Test 1.2.18 of the C-PHY Physical Layer Conformance Test Suite v1.0r01 for C-PHY v1.0/v1.1 (29Feb2016).

Test Procedure

1 Position the trigger point at the center of the screen. Trigger on the rising edge of V_A in the LP-111 state, which occurs immediately after an HS Burst sequence.

2 Construct the differential data waveform using the equation:

$$DiffData(C-A) = V_C - V_A$$

3 Find and mark the last transition edge of the differential waveform, DiffData(C-A), which crosses +/-40mV. Denote it as T4.

4 Find the time after T4 when the falling edge of V_A crosses $V_{IL(Max)}$ = 550mV. Mark this time as T5. Note that T5 must be greater than T4.

5 Calculate $T_{HS-EXIT}$ using the equation:

$$T_{HS-EXIT} = T5 - T4$$

6 Compare the calculated value of $T_{HS-EXIT}$ against the compliance test limits.

Expected/Observable Results

The calculated value of $T_{HS-EXIT}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

11 Informative Tests

This section provides the Methods of Implementation (MOIs) for the Informative tests. This group of tests provides additional test information about the DUT. The MIPI C-PHY CTS does not explicitly specify these tests.

Probing for Informative Tests

When performing the Informative tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the Informative tests may look similar to the following diagrams. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

For the Burst Mode, when you select **Active Probe (Differential Probe)** in the Connection Setup window (refer to step 4 in the "Test Procedure"), connect the DUT to Reference Termination Board and configure the DUT to output Burst signal prior to running the Informative Tests.

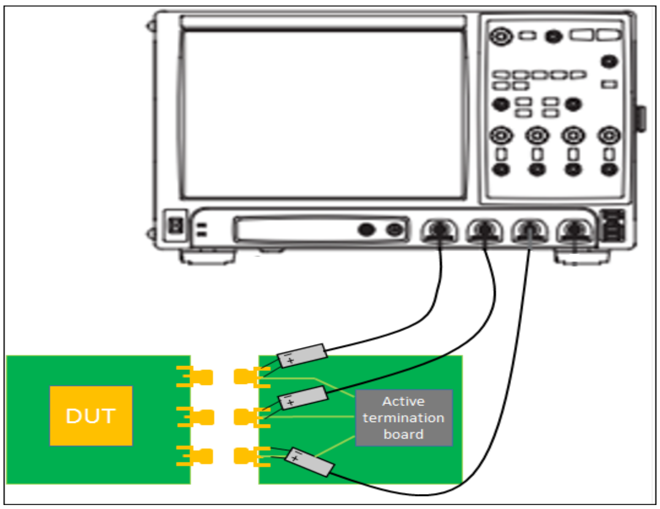


Figure 48 Sample connection diagram for Informative Tests for "Active Probe (Differential Probe)" probing method

For the Continuous Mode, when you select **Direct Connect** or **Direct Connect (Active Termination Adapter)** in the Connection Setup window (refer to step 4 in the "Test Procedure"), connect the DUT to the oscilloscope using Direct Connection and configure the DUT to output Continuous signal prior to running the Informative Tests.

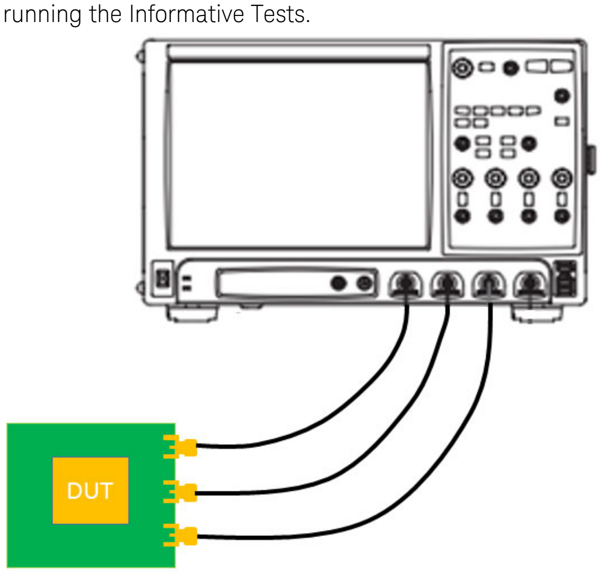


Figure 49 Sample connection diagram for Informative Tests for "Direct Connect" or Direct Connect (Active Termination Adapter) probing method

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in the figures are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.

2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.

3 Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v1.1**.

4 Click **Connection Setup** to configure the channel selection and probing method.

   a For the **Burst Mode**, select **Active Probe (Differential Probe)** as the Probing Method.

   b For the **Continuous Mode**, select **Direct Connect** or **Direct Connect (Active Termination Adapter)** as the Probing Method.

5 Enable the **Informative Tests** check box.

6 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

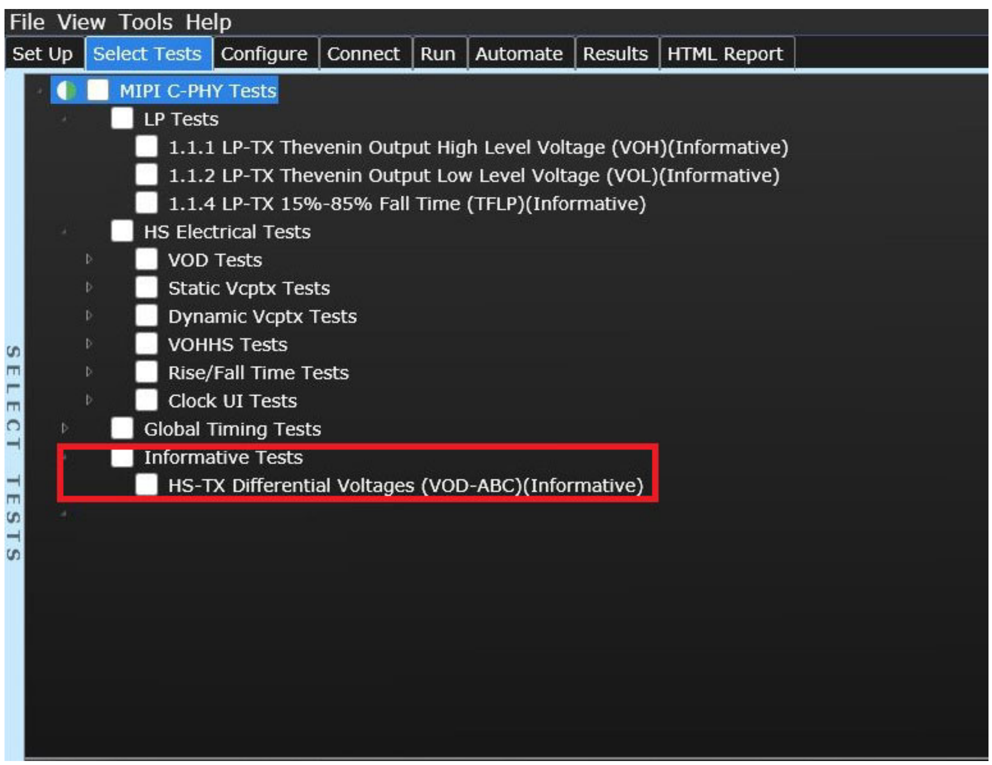


Figure 50 Selecting Informative Tests

7 Follow the MIPI C-PHY Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

Test HS-TX Differential Voltages (VOD-ABC)

Test Overview

The purpose of this test is to generate an eye diagram using VAB, VBC and VCA differential data.

Test Availability

Table 45 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of HS-TX Differential Voltages (VOD-ABC) test.

Table 45 Configuration Options for HS-TX Differential Voltages (VOD-ABC) Test

Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
		Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1730	HS-TX Differential Voltages (VOD-ABC) (Informative)	-	-	×	✓	✓	×	×	✓	×
1770	HS-TX Differential Voltages (VOD-ABC) (Informative) (C)	×	✓	×	✓	×	✓	✓	✓	×

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 1730" on page 106

For Test ID 1770

1 Trigger on an HS Continuous data signal.

2 Capture waveforms for V_A, V_B and V_C.

3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Generate DiffData(A-B-C) from DiffData(A-B), DiffData(B-C), and DiffData(C-A) using a Matlab UDF script.

5 Fold the DiffData(A-B-C) to form a data eye.

12 MIPI C-PHY 2.0 High-Speed Transmitter (HS-TX) Electrical Tests

This section provides the Methods of Implementation (MOIs) for the electrical tests for high-speed transmitters (HS-TX) using a Keysight Infiniium oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

KEYSIGHT TECHNOLOGIES

Probing for High-Speed Transmitter Electrical Tests

When performing the HS Electrical tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the HS Electrical tests may look similar to the following diagrams. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

For the Burst Mode, when you select **Active Probe (Differential Probe)** in the Connection Setup window (refer to step 4 in the "Test Procedure"), connect the DUT to Reference Termination Board and configure the DUT to output Burst signal prior to running the HS Electrical Tests.

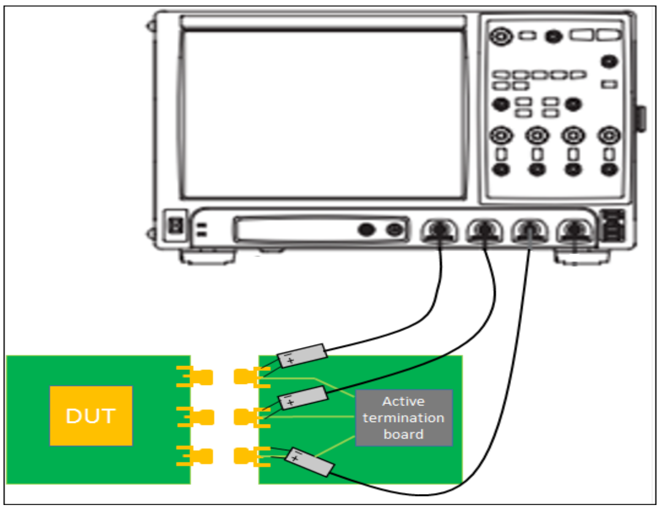


Figure 51 Sample connection diagram for HS Electrical Tests for "Active Probe (Differential Probe)" probing method

For the Continuous Mode, when you select **Direct Connect** or **Direct Connect (Active Termination Adapter)** in the Connection Setup window (refer to step 4 in the "Test Procedure"), connect the DUT to the oscilloscope using Direct Connection and configure the DUT to output Continuous signal prior to running the HS Electrical Tests.

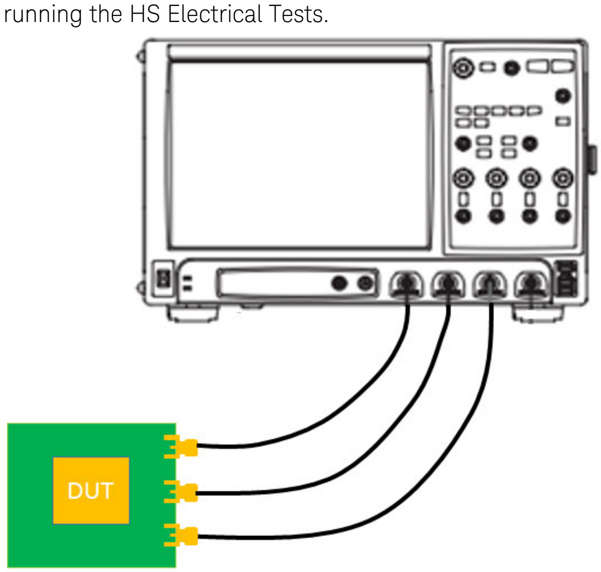


Figure 52 Sample connection diagram for HS Electrical Tests for "Direct Connect" or "Direct Connect (Active Termination Adapter)" probing method

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in the figures are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.

2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.

3 Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v2.0**.

4 Click **Connection Setup** to configure the channel selection and probing method.

   a For the **Burst Mode**, select **Active Probe (Differential Probe)** as the Probing Method.

   b For the **Continuous Mode**, select **Direct Connect** or **Direct Connect (Active Termination Adapter)** as the Probing Method.

5 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

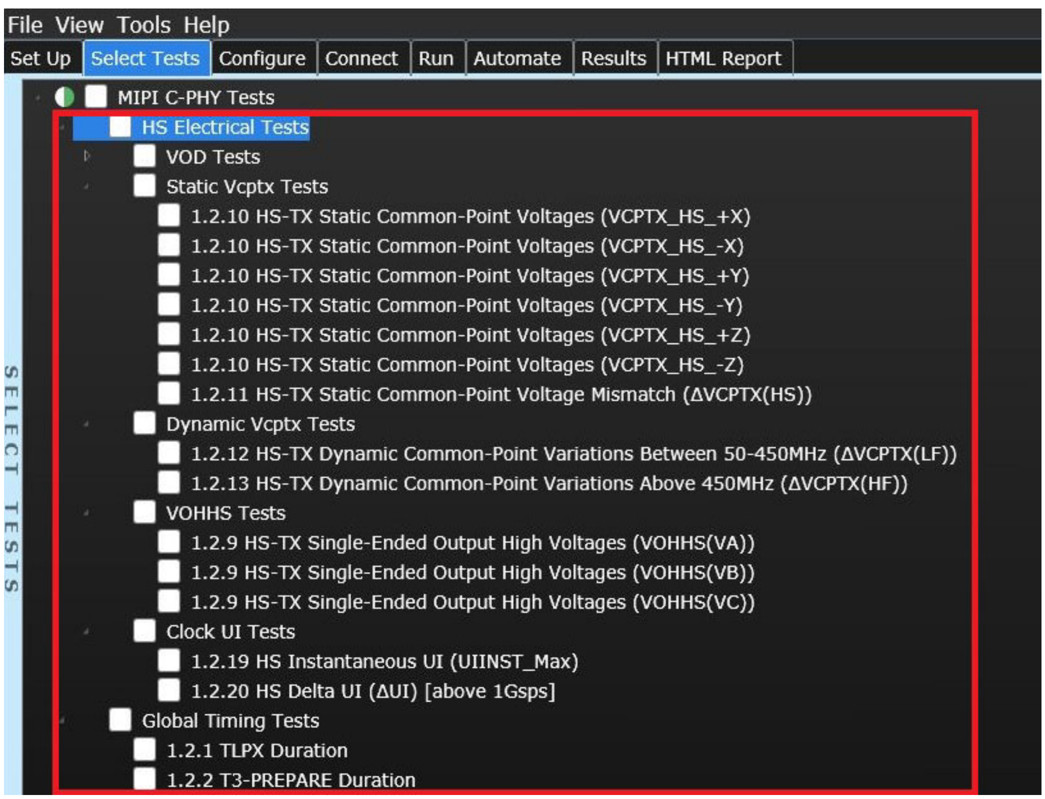


Figure 53 Selecting High-Speed Transmitter Electrical Tests

6 Follow the MIPI C-PHY Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.2.7 HS-TX Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA})

Test Overview

The purpose of this test is to verify that the Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA}) of the HS Transmitter DUT are within the conformance limits of the MIPI C-PHY standard specification.

The single-ended output voltages are defined V_A, V_B and V_C at the A, B and C pins, respectively. The differential output voltages V_{OD_AB}, V_{OD_BC} and V_{OD_CA} are defined at the difference of the voltages:

$$V_{OD\_AB} = V_A - V_B$$

$$V_{OD\_BC} = V_B - V_C$$

$$V_{OD\_CA} = V_C - V_A$$

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 46 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Differential Voltages (V_{OD-AB}, V_{OD-BC}, V_{OD-CA}) test.

Table 46 Configuration Options for HS-TX Differential Voltages Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.2.7	1704	HS-TX Differential Voltages ($V_{OD-AB-Strong1}$) [Mean]	-	-	×	✓	-	-	✓	×	×	-	-
	1705	HS-TX Differential Voltages ($V_{OD-AB-Weak1}$) [Mean]	-	-	×	✓	✓	×	✓	×	×	✓	×
	1706	HS-TX Differential Voltages ($V_{OD-AB-Weak0}$) [Mean]	-	-	×	✓	✓	×	✓	×	×	✓	×
	1707	HS-TX Differential Voltages ($V_{OD-AB-Strong0}$) [Mean]	-	-	×	✓	-	-	✓	×	×	-	-

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
	1708	HS-TX Differential Voltages ($V_{OD-AB-Weak1}$) (LVHS) [Mean]	-	-	×	✓	×	✓	✓	×	×	✓	×
	1709	HS-TX Differential Voltages ($V_{OD-AB-Weak0}$) (LVHS) [Mean]	-	-	×	✓	×	✓	✓	×	×	✓	×
	1714	HS-TX Differential Voltages ($V_{OD-BC-Strong1}$) [Mean]	-	-	×	✓	-	-	✓	×	×	-	-
	1715	HS-TX Differential Voltages ($V_{OD-BC-Weak1}$) [Mean]	-	-	×	✓	✓	×	✓	×	×	✓	×
	1716	HS-TX Differential Voltages ($V_{OD-BC-Weak0}$) [Mean]	-	-	×	✓	✓	×	✓	×	×	✓	×
	1717	HS-TX Differential Voltages ($V_{OD-BC-Strong0}$) [Mean]	-	-	×	✓	-	-	✓	×	×	-	-
	1718	HS-TX Differential Voltages ($V_{OD-BC-Weak1}$) (LVHS) [Mean]	-	-	×	✓	×	✓	✓	×	×	✓	×
	1719	HS-TX Differential Voltages ($V_{OD-BC-Weak0}$) (LVHS) [Mean]	-	-	×	✓	×	✓	✓	×	×	✓	×
	1724	HS-TX Differential Voltages ($V_{OD-CA-Strong1}$) [Mean]	-	-	×	✓	-	-	✓	×	×	-	-

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.2.7	1725	HS-TX Differential Voltages ($V_{OD-CA-Weak1}$) [Mean]	-	-	×	✓	✓	×	✓	×	×	✓	×
	1726	HS-TX Differential Voltages ($V_{OD-CA-Weak0}$) [Mean]	-	-	×	✓	✓	×	✓	×	×	✓	×
	1727	HS-TX Differential Voltages ($V_{OD-CA-Strong0}$) [Mean]	-	-	×	✓	-	-	✓	×	×	-	-
	1728	HS-TX Differential Voltages ($V_{OD-CA-Weak1}$) (LVHS) [Mean]	-	-	×	✓	×	✓	✓	×	×	✓	×
	1729	HS-TX Differential Voltages ($V_{OD-CA-Weak0}$) (LVHS) [Mean]	-	-	×	✓	×	✓	✓	×	×	✓	×
	1740	HS-TX Differential Voltages ($V_{OD-AB-Strong1}$) [Mean] (C)	×	✓	×	✓	-	-	×	✓	✓	-	-
	1741	HS-TX Differential Voltages ($V_{OD-AB-Weak1}$) [Mean] (C)	×	✓	×	✓	×	✓	×	✓	✓	✓	×
	1742	HS-TX Differential Voltages ($V_{OD-AB-Weak0}$) [Mean] (C)	×	✓	×	✓	×	✓	×	✓	✓	✓	×
	1743	HS-TX Differential Voltages ($V_{OD-AB-Strong0}$) [Mean] (C)	×	✓	×	✓	-	-	×	✓	✓	-	-

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
	1744	HS-TX Differential Voltages ($V_{OD\text{-}AB\text{-}Weak1}$) (LVHS) [Mean] (C)	×	✓	×	✓	✓	×	×	✓	✓	✓	×
	1745	HS-TX Differential Voltages ($V_{OD\text{-}AB\text{-}Weak0}$) (LVHS) [Mean] (C)	×	✓	×	✓	✓	×	×	✓	✓	✓	×
	1750	HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Strong1}$) [Mean] (C)	×	✓	×	✓	-	-	×	✓	✓	-	-
	1751	HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Weak1}$) [Mean] (C)	×	✓	×	✓	×	✓	×	✓	✓	✓	×
	1752	HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Weak0}$) [Mean] (C)	×	✓	×	✓	×	✓	×	✓	✓	✓	×
	1753	HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Strong0}$) [Mean] (C)	×	✓	×	✓	-	-	×	✓	✓	-	-
	1754	HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Weak1}$) (LVHS) [Mean] (C)	×	✓	×	✓	✓	×	×	✓	✓	✓	×
	1755	HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Weak0}$) (LVHS) [Mean] (C)	×	✓	×	✓	✓	×	×	✓	✓	✓	×

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
	1760	HS-TX Differential Voltages ($V_{OD-CA-Strong1}$) [Mean] (C)	×	✓	×	✓	-	-	×	✓	✓	-	-
	1761	HS-TX Differential Voltages ($V_{OD-CA-Weak1}$) [Mean] (C)	×	✓	×	✓	×	✓	×	✓	✓	✓	×
	1762	HS-TX Differential Voltages ($V_{OD-CA-Weak0}$) [Mean] (C)	×	✓	×	✓	×	✓	×	✓	✓	✓	×
	1763	HS-TX Differential Voltages ($V_{OD-CA-Strong0}$) [Mean] (C)	×	✓	×	✓	-	-	×	✓	✓	-	-
	1764	HS-TX Differential Voltages ($V_{OD-CA-Weak1}$) (LVHS) [Mean] (C)	×	✓	×	✓	✓	×	×	✓	✓	✓	×
	1765	HS-TX Differential Voltages ($V_{OD-CA-Weak0}$) (LVHS) [Mean] (C)	×	✓	×	✓	✓	×	×	✓	✓	✓	×

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

For Test ID 1704, 1714, 1724

1 Trigger on the LP-111 to LP-001 region of an HS Burst data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C\text{-}A) = V_C - V_A$$

4 Fold the required DiffData waveform to form a Data Eye.

5 Use the Histogram feature to measure the mean values for the parameters Strong1, Weak1, Weak0 and Strong0 at a point, which is 20% of the UI width before the trigger point. Configure the Histogram window position using thee following options:

  a *VOD Histogram Window Mode* with the following available options:

    i "AUTO" mode: The histogram window is placed automatically.

    ii "MANUAL" mode: Configure the histogram window settings using the following options:
    a. "$V_{OD(Strong1,\ Weak1)}$ Histogram Window(V)[Manual Mode]"
    b. "$V_{OD(Strong0,\ Weak0)}$ Histogram Window(V)[Manual Mode]"

6 Report the measured values of V_{OD} for all parameters mentioned in the previous step.

7 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1705, 1706, 1707, 1708, 1709

1 Run the following test as a prerequisite:

  a Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}AB\text{-}Strong1}$)[Mean] – (Test ID 1704).

  Store the test results after measuring all the required values of $V_{OD\text{-}AB}$ for the test signal.

2 Report the measured values of V_{OD} that you obtain from the prerequisite test.

3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1715, 1716, 1717, 1718, 1719

1 Run the following test as a prerequisite:

  a Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}BC\text{-}Strong1}$)[Mean] – (Test ID 1714).

  Store the test results after measuring all the required values of $V_{OD\text{-}BC}$ for the test signal.

2 Report the measured values of V_{OD} that you obtain from the prerequisite test.

3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1725, 1726, 1727, 1728, 1729

1 Run the following test as a prerequisite:

  a Test 1.2.7 HS-TX Differential Voltages ($V_{OD\text{-}CA\text{-}Strong1}$)[Mean] – (Test ID 1724).

  Store the test results after measuring all the required values of $V_{OD\text{-}CA}$ for the test signal.

2 Report the measured values of V_{OD} for that you obtain from the prerequisite test.

3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1740, 1750, 1760

1 Trigger on an HS Continuous data signal.

2 Capture waveforms for V_A, V_B and V_C.

3 Construct the differential data waveform using the following equations:

$$DiffData(A\text{-}B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C\text{-}A) = V_C - V_A$$

4 Fold the required DiffData waveform to form a Data Eye.

5 By utilizing histogram, the mean values for Strong 1, Weak 1, Weak 0 and Strong 0 parameters are measured at a point that is at 20% UI width before the trigger point.
Configure the Histogram window position using thee following options:
   a *VOD Histogram Window Mode* with the following available options:
      i "AUTO" mode: The histogram window is placed automatically.
      ii "MANUAL" mode: Configure the histogram window settings using the following options:
      a. "$V_{OD(Strong1, Weak1)}$ Histogram Window(V)[Manual Mode]"
      b. "$V_{OD(Strong0, Weak0)}$ Histogram Window(V)[Manual Mode]"
6 Report the measured values of V_{OD} for all parameters mentioned in the previous step.
7 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1741, 1742, 1743, 1744, 1745

1 Run the following test as a prerequisite:
   a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-AB-Strong1}$)[Mean] (C) – (Test ID 1740).

   Store the test results after measuring all the required values of V_{OD-AB} for the test signal.
2 Report the measured values of V_{OD} that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1751, 1752, 1753, 1754, 1755

1 Run the following test as a prerequisite:
   a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-BC-Strong1}$)[Mean] (C) – (Test ID 1750).

   Store the test results after measuring all the required values of V_{OD-BC} for the test signal.
2 Report the measured values of V_{OD} that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

For Test ID 1761, 1762, 1763, 1764, 1765

1 Run the following test as a prerequisite:
   a Test 1.2.7 HS-TX Differential Voltages ($V_{OD-CA-Strong1}$)[Mean] (C) – (Test ID 1760).

   Store the test results after measuring all the required values of V_{OD-CA} for the test signal.
2 Report the measured values of V_{OD} for that you obtain from the prerequisite test.
3 Compare the measured values of V_{OD} against the compliance test limits.

Expected/Observable Results

The measured value of V_{OD} for the test signal must be within the conformance limit as specified in the CTS/Specification mentioned under the References section.

Test 1.2.8 HS-TX Differential Voltage Mismatch (ΔV_{OD})

Test Overview

The purpose of this test is to verify that the Differential Voltage Mismatch (ΔV_{OD}) of the HS Transmitter DUT is within the conformance limits of the MIPI C-PHY standard specification.

Test Availability

Table 47 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Differential Voltage Mismatch (ΔV_{OD}) test.

Table 47 Configuration Options for HS-TX Differential Voltage Mismatch Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.8	1801	HS-TX Differential Voltage Mismatch (ΔV_{OD})	—	—	×	✓	✓	×	×
	1810	HS-TX Differential Voltage Mismatch (ΔV_{OD}) (C)	×	✓	×	✓	×	✓	✓

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

Refer to the MIPI C-PHY 1.1 tests description:

“For Test ID 1801" on page 114

“For Test ID 1810" on page 115

Expected/Observable Results

The measured value of ΔV_{OD} for the test signal must be within the conformance limit as specified in the CTS/Specification mentioned under the References section.

Test 1.2.9 HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$, $V_{OHHS(VC)}$)

Test Overview

The purpose of this test is to verify that the Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$ and $V_{OHHS(VC)}$) of the HS Transmitter DUT are less than the maximum conformance limit values of the MIPI C-PHY standard specification.

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 48 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$, $V_{OHHS(VB)}$ and $V_{OHHS(VC)}$) test.

Table 48 Configuration Options for HS-TX Single-Ended Output High Voltages Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.9	1900	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$)	-	-	×	✓	✓	×	×
	1901	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VB)}$)	-	-	×	✓	✓	×	×
	1902	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VC)}$)	-	-	×	✓	✓	×	×
	1910	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VA)}$)(C)	×	✓	×	✓	×	×	✓
	1911	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VB)}$)(C)	×	✓	×	✓	×	×	✓
	1912	HS-TX Single-Ended Output High Voltages ($V_{OHHS(VC)}$)(C)	×	✓	×	✓	×	×	✓

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

“For Test ID 1900, 1901, 1902" on page 47

Refer to the MIPI C-PHY 1.1 tests description:

“For Test ID 1910, 1911, 1912" on page 116

Expected/Observable Results

The measured value of V_{OHHS} for the test signal must be within the conformance limit values as specified in the CTS/Specification mentioned under the References section.

Test 1.2.10 HS-TX Static Common-Point Voltages (V_{CPTX})

Test Overview

The purpose of this test is to verify that the Static Common-Point Voltages (V_{CPTX}) of the HS Transmitter DUT are within the conformance limits of the MIPI C-PHY standard specification. Figure shows the static V_{CPTX} distortion on the single-ended high-speed signals.

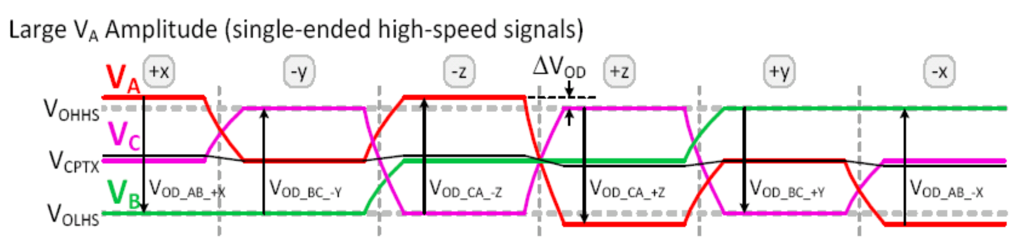


Figure 54 Static V_{CPTX} distortion on the single-ended high-speed signals

The common-point voltage V_{CPTX} is defined as the arithmetic mean value of the voltages at the A, B and C pins:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

This test requires the DUT to run at a slower symbol rate.

Test Availability

Table 49 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Static Common-Point Voltages (V_{CPTX}) test.

Table 49 Configuration Options for HS-TX Static Common-Point Voltages Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.10	2000	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$)	-	-	×	✓	✓	×	✓	×	×
	2001	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-X}$)	-	-	×	✓	✓	×	✓	×	×
	2002	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Y}$)	-	-	×	✓	✓	×	✓	×	×
	2003	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Y}$)	-	-	×	✓	✓	×	✓	×	×
	2004	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Z}$)	-	-	×	✓	✓	×	✓	×	×
	2005	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Z}$)	-	-	×	✓	✓	×	✓	×	×
	2010	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$)(C)	×	✓	×	✓	✓	×	×	×	✓
	2011	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-X}$)(C)	×	✓	×	✓	✓	×	×	×	✓
	2012	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Y}$)(C)	×	✓	×	✓	✓	×	×	×	✓
	2013	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Y}$)(C)	×	✓	×	✓	✓	×	×	×	✓
	2014	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Z}$)(C)	×	✓	×	✓	✓	×	×	×	✓

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
	2015	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Z}$)(C)	×	✓	×	✓	✓	×	×	×	✓
	2020	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$) (LVHS)	-	-	×	✓	×	✓	✓	×	×
	2021	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-X}$) (LVHS)	-	-	×	✓	×	✓	✓	×	×
	2022	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Y}$) (LVHS)	-	-	×	✓	×	✓	✓	×	×
	2023	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Y}$) (LVHS)	-	-	×	✓	×	✓	✓	×	×
	2024	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Z}$) (LVHS)	-	-	×	✓	×	✓	✓	×	×
	2025	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Z}$) (LVHS)	-	-	×	✓	×	✓	✓	×	×
	2030	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$) (LVHS) (C)	×	✓	×	✓	×	✓	×	×	✓
	2031	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-X}$) (LVHS) (C)	×	✓	×	✓	×	✓	×	×	✓

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
	2032	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Y}$) (LVHS) (C)	×	✓	×	✓	×	✓	×	×	✓
	2033	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Y}$)(C)	×	✓	×	✓	×	✓	×	×	✓
	2034	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+Z}$)(C)	×	✓	×	✓	×	✓	×	×	✓
	2035	HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_-Z}$)(C)	×	✓	×	✓	×	✓	×	×	✓

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 2000" on page 50

"For Test ID 2001, 2002, 2003, 2004, 2005" on page 51

Refer to the MIPI C-PHY 1.1 tests description:

"For Test ID 2010" on page 119

"For Test ID 2011, 2012, 2013, 2014, 2015" on page 120

For Test ID 2020

1 Trigger on the LP-111 to LP-001 region of an HS Burst data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Decode the wire states of the HS data portion using the differential waveforms generated by sampling at the center of the UI for each wire state.
5 Generate the common-point voltage V_{CPTX} signal using the equation:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

6 Group the values of V_{CPTX} for similar HS wire states. For example, all values of V_{CPTX} that are sampled at the center of each of the UI measurements for the HS wire state +X are grouped together. Apply the same procedure for HS wire states -X, +Y, -Y, +Z and -Z.
7 Derive the maximum, minimum and mean values of V_{CPTX} for each of the HS wire state groups.
8 Record the mean value of V_{CPTX} as the final test result.
9 Compare the measured mean values of V_{CPTX} against the compliance test limits.

For Test ID 2021, 2022, 2023, 2024, 2025

1 Run the following test as a prerequisite:
   a Test 1.2.10 HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$) (LVHS) – (Test ID 2020).

   Store the test results after measuring the actual values of V_{CPTX} for the test signal.
2 Report the measured values of V_{CPTX} for that you obtain from the prerequisite test.
3 Compare the measured values of V_{CPTX} against the compliance test limits.

For Test ID 2030

1 Trigger on an HS Continuous data signal.
2 Capture waveforms for V_A, V_B and V_C.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Decode the wire states of the HS data portion using the differential waveforms generated by sampling at the center of the UI for each wire state.
5 Generate the common-point voltage V_{CPTX} signal using the equation:

$$V_{CPTX} = (V_A + V_B + V_C) / 3$$

6 Group the values of V_{CPTX} for similar HS wire states. For example, all values of V_{CPTX} that are sampled at the center of each of the UI measurements for the HS wire state +X are grouped together. Apply the same procedure for HS wire states -X, +Y, -Y, +Z and -Z.
7 Derive the maximum, minimum and mean values of V_{CPTX} for each of the HS wire state groups.
8 Record the mean value of V_{CPTX} as the final test result.
9 Compare the measured mean values of V_{CPTX} against the compliance test limits.

For Test ID 2031, 2032, 2033, 2034, 2035

1 Run the following test as a prerequisite:
   a Test 1.2.10 HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$) (LVHS) (C) – (Test ID 2030).

   Store the test results after measuring the actual values of V_{CPTX} for the test signal.
2 Report the measured values of V_{CPTX} for that you obtain from the prerequisite test.
3 Compare the measured values of V_{CPTX} against the compliance test limits.

Expected/Observable Results

The measured value of V_{CPTX} for the test signal must be within the conformance limit values as specified in the CTS/Specification mentioned under the References section.

Test 1.2.11 HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$)

Test Overview

The purpose of this test is to verify that the Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$) of the HS Transmitter DUT is less than the maximum conformance limit values of the MIPI C-PHY standard specification.

Test Availability

Table 50 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$) test.

Table 50 Configuration Options for HS-TX Static Common-Point Voltage Mismatch Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Mode		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Normal HS	LVHS	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.11	2100	HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$)	-	-	×	✓	✓	×	✓	×	×
	2110	HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$)(C)	×	✓	×	✓	✓	×	×	×	✓
	2120	HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$) (LVHS)	-	-	×	✓	×	✓	✓	×	×
	2130	HS-TX Static Common-Point Voltage Mismatch ($\Delta V_{CPTX(HS)}$) (LVHS) (C)	×	✓	×	✓	×	✓	×	×	✓

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

“For Test ID 2100" on page 52

Refer to the MIPI C-PHY 1.1 tests description:

“For Test ID 2110" on page 121

For Test ID 2120

1 Run the following tests as a prerequisite:

a Test 1.2.10 HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$) (LVHS) — (Test ID 2020).

Store the test results after measuring the actual values of V_{CPTX} for the test signal.

2 Calculate the V_{MAXCP}, V_{MINCP} and $\Delta V_{CPTX(HS)}$ using the equations:

$$V_{MAXCP} = \max(V_{CPTX\_HS\_+X}, V_{CPTX\_HS\_-X}, V_{CPTX\_HS\_+Y}, V_{CPTX\_HS\_-Y}, V_{CPTX\_HS\_+Z}, V_{CPTX\_HS\_-Z})$$

$$V_{MINCP} = \min(V_{CPTX\_HS\_+X}, V_{CPTX\_HS\_-X}, V_{CPTX\_HS\_+Y}, V_{CPTX\_HS\_-Y}, V_{CPTX\_HS\_+Z}, V_{CPTX\_HS\_-Z})$$

$$\Delta V_{CPTX(HS)} = (V_{MAXCP} - V_{MINCP}) / 2$$

3 Compare the measured values of $\Delta V_{CPTX(HS)}$ against the compliance test limits.

For Test ID 2130

1 Run the following tests as a prerequisite:

a Test 1.2.10 HS-TX Static Common-Point Voltages ($V_{CPTX\_HS\_+X}$) (LVHS) (C) — (Test ID 2030).

Store the test results after measuring the actual values of V_{CPTX} for the test signal.

2 Calculate the V_{MAXCP}, V_{MINCP} and $\Delta V_{CPTX(HS)}$ using the equations:

$$V_{MAXCP} = \max(V_{CPTX\_HS\_+X}, V_{CPTX\_HS\_-X}, V_{CPTX\_HS\_+Y}, V_{CPTX\_HS\_-Y}, V_{CPTX\_HS\_+Z}, V_{CPTX\_HS\_-Z})$$

$$V_{MINCP} = \min(V_{CPTX\_HS\_+X}, V_{CPTX\_HS\_-X}, V_{CPTX\_HS\_+Y}, V_{CPTX\_HS\_-Y}, V_{CPTX\_HS\_+Z}, V_{CPTX\_HS\_-Z})$$

$$\Delta V_{CPTX(HS)} = (V_{MAXCP} - V_{MINCP}) / 2$$

3 Compare the measured values of $\Delta V_{CPTX(HS)}$ against the compliance test limits.

Expected/Observable Results

The measured value of $\Delta V_{CPTX(HS)}$ for the test signal must be within the conformance limit values as specified in the CTS/Specification mentioned under the References section.

Test 1.2.12 HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$)

Test Overview

The purpose of this test is to verify that the AC Common-Point Signal Level Variations Between 50 and 450MHz ($\Delta V_{CPTX(LF)}$) of the HS Transmitter DUT are less than the maximum allowable conformance limit values of the MIPI C-PHY standard specification. Figure 55 shows the dynamic V_{CPTX} distortion on the single-ended high-speed signals.

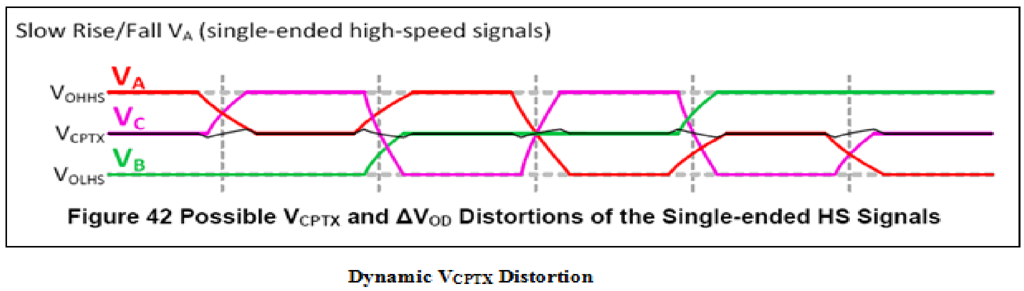


Figure 55 Dynamic V_{CPTX} distortion on the single-ended high-speed signals

Test Availability

Table 51 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$) test.

Table 51 Configuration Options for HS-TX Dynamic Common-Point Variations Between 50 and 450MHz Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.12	2200	HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$)	-	-	×	✓	✓	×	×
	2210	HS-TX Dynamic Common-Point Variations Between 50-450MHz ($\Delta V_{CPTX(LF)}$) (C)	×	✓	×	✓	×	×	✓

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 2200" on page 53

Refer to the MIPI C-PHY 1.1 tests description:

"For Test ID 2210" on page 124

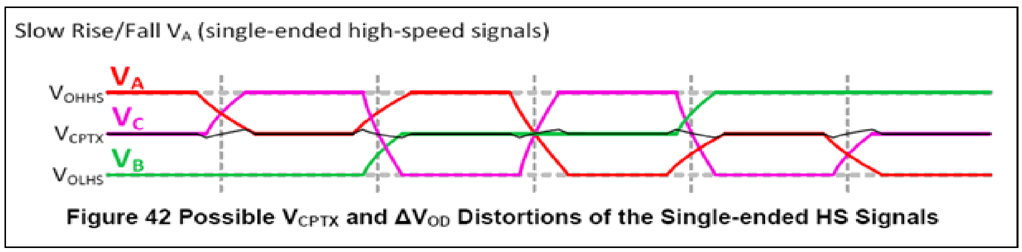
Expected/Observable Results

The measured value of $\Delta V_{CPTX(LF)}$ for the test signal must be within the conformance limit values as specified in the CTS Specification mentioned under the References section.

Test 1.2.13 HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$)

Test Overview

The purpose of this test is to verify that the AC Common-Point Signal Level Variations Above 450MHz ($\Delta V_{CPTX(HF)}$) of the HS Transmitter DUT are less than the maximum allowable conformance limit values of the MIPI C-PHY standard specification. Figure shows the dynamic V_{CPTX} distortion on the single-ended high-speed signals.



Dynamic V_{CPTX} Distortion

Figure 56 Dynamic V_{CPTX} distortion on the single-ended high-speed signals

Test Availability

Table 52 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$) test.

Table 52 Configuration Options for HS-TX Dynamic Common-Point Variations Above 450MHz Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.13	2300	HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$)	-	-	×	✓	✓	×	×
	2310	HS-TX Dynamic Common-Point Variations Above 450MHz ($\Delta V_{CPTX(HF)}$)(C)	×	✓	×	✓	×	×	✓

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 2300" on page 55

Refer to the MIPI C-PHY 1.1 tests description:

"For Test ID 2310" on page 126

Expected/Observable Results

The measured value of $\Delta V_{CPTX(HF)}$ for the test signal must be within the conformance limit values as specified in the CTS/Specification mentioned under the References section.

Test 1.2.14 HS-TX Rise Time (t_R)

For information about this test, refer to "Test 1.2.14 HS-TX Rise Time (tR)" on page 57. This test is similar to the corresponding MIPI C-PHY 1.0 test, the only difference being that the v2.0 tests are informative tests.

Test Availability

Table 53 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Rise Time (t_R) test.

Table 53 Configuration Options for HS-TX Rise Time Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		HS Symbol Rate		Probing Method		
			Enabled	Disabled	<=1.5 Gsps	>1.5 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.14	2400	HS-TX Rise Time (t_R) [1.5 Gsps and below]	×	✓	✓	×	✓	×	×
	2401	HS-TX Rise Time (t_R) [Above 1.5 Gsps]	×	✓	×	✓	✓	×	×

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.15 HS-TX Fall Time (t_F)

For information about this test, refer to “Test 1.2.15 HS-TX Fall Time (tF)" on page 59. This test is similar to the corresponding MIPI C-PHY 1.0 test, the only difference being that the v2.0 tests are informative tests.

Test Availability

Table 54 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Fall Time (t_F) test.

Table 54 Configuration Options for HS-TX Fall Time Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		HS Symbol Rate		Probing Method		
			Enabled	Disabled	<=1.5 Gsps	>1.5 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.15	2500	HS-TX Fall Time (t_F) [1.5 Gsps and below]	×	✓	✓	×	✓	×	×
	2501	HS-TX Fall Time (t_F) [Above 1.5 Gsps]	×	✓	×	✓	✓	×	×

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.19 HS Clock Instantaneous UI (UI_{INST})

Test Overview

The purpose of this test is to verify that the value of the Instantaneous Unit Interval (UI_{INST}) of the HS Transmitter DUT is within the conformance limit value of the MIPI C-PHY standard specification. Figure 57 shows the Instantaneous Unit Intervals on the High-Speed signal.

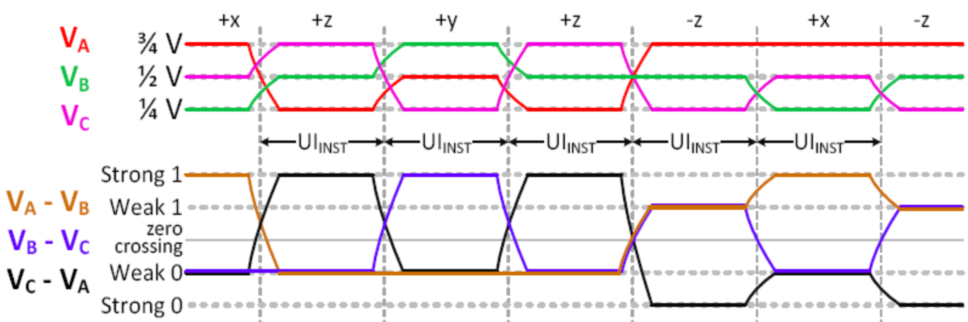


Figure 55 Example of Wire State Transitions at Symbol (UI) Boundaries

Figure 57 Instantaneous Unit Intervals on High-Speed signal

Test Availability

Table 55 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS Clock Instantaneous UI (UI_{INST}) test.

Table 55 Configuration Options for HS Clock Instantaneous UI Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method		
			Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.19	2900	HS Clock Instantaneous UI (UI_{INST_Max})	—	—	×	✓	✓	×	×
	2910	HS Clock Instantaneous UI (UI_{INST_Max}) (C)	×	✓	×	✓	×	✓	✓

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 2900" on page 61

Refer to the MIPI C-PHY 1.1 tests description:

"For Test ID 2910" on page 130

Expected/Observable Results

The measured value of UI_{INST} for the test signal must be within the conformance limit values as specified in the CTS/Specification mentioned under the References section.

Test 1.2.20 HS Clock Delta UI (ΔUI)

Test Overview

The purpose of this test is to verify that the frequency stability of the DUT's HS Clock during a single burst is within the conformance limit value of the MIPI C-PHY standard specification.

Test Availability

Table 56 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS Clock Delta UI (ΔUI) test.

Table 56 Configuration Options for HS Clock Delta Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Symbol Rate		Probing Method			Informative Tests	
			Enabled	Disabled	Enabled	Disabled	<=1.0 Gsps	>1.0 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1.2.20	3002	HS Clock Delta UI (ΔUI) [1 Gsps and below] (obsolete)	-	-	×	✓	✓	×	✓	×	×	✓	×
	3003	HS Clock Delta UI (ΔUI) [Above 1 Gsps] (obsolete)	-	-	×	✓	×	✓	✓	×	×	✓	×
	3012	HS Clock Delta UI (ΔUI) [1 Gsps and below] (obsolete)	×	✓	×	✓	✓	×	×	✓	✓	✓	×
	3013	HS Clock Delta UI (ΔUI) [Above 1 Gsps] (obsolete)	×	✓	×	✓	×	✓	×	✓	✓	✓	×

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

For Test ID 3002, 3003

1 Run the following test as a prerequisite:

   a Test 1.2.19 HS Clock Instantaneous UI (UI_{INST_Max}) – (Test ID 2900).

   Store the test results after measuring the minimum, maximum and average values of the Low Pass filtered Unit Interval of the differential waveforms.

2 Calculate UI_Variant_Min and UI_Variant_Max using the equations:

$$UI\_Variant\_Min = [(UI_{Inst\_Filt\_Min} - UI_{Inst\_Filt\_Mean}) / UI_{Inst\_Filt\_Mean}] * 100\%$$

$$UI\_Variant\_Max = [(UI_{Inst\_Filt\_Max} - UI_{Inst\_Filt\_Mean}) / UI_{Inst\_Filt\_Mean}] * 100\%$$

3 Determine UI_Variant_Worst based on the values of UI_Variant_Min and UI_Variant_Max calculated in the previous step.

4 Use the value of UI_Variant_Worst as the final test result and compare the determined value of UI_Variant_Worst against the compliance test limits.

For Test ID 3012, 3013

1 Run the following test as a prerequisite:

   a Test 1.2.19 HS Clock Instantaneous UI (UI_{INST_Max}) (C) – (Test ID 2910).

   Store the test results after measuring the minimum, maximum and average values of the Low Pass filtered Unit Interval of the differential waveforms.

2 Calculate UI_Variant_Min and UI_Variant_Max using the equations:

$$UI\_Variant\_Min = [(UI_{Inst\_Filt\_Min} - UI_{Inst\_Filt\_Mean}) / UI_{Inst\_Filt\_Mean}] * 100\%$$

$$UI\_Variant\_Max = [(UI_{Inst\_Filt\_Max} - UI_{Inst\_Filt\_Mean}) / UI_{Inst\_Filt\_Mean}] * 100\%$$

3 Determine UI_Variant_Worst based on the values of UI_Variant_Min and UI_Variant_Max calculated in the previous step.

4 Use the value of UI_Variant_Worst as the final test result and compare the determined value of UI_Variant_Worst against the compliance test limits.

Expected/Observable Results

The measured UI variation for the test signal must be within the conformance limit values as specified in the CTS/Specification mentioned under the References section.

Test 1.2.21 HS-TX Eye Diagram

Test Overview

The purpose of this test is to verify that the DUT's HS-TX meets the requirements for Transmitter Eye Diagram specification.

Test Availability

Table 57 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX Eye Diagram test.

Table 57 Configuration Options for HS-TX Eye Diagram Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Symbol Rate		Probing Method			Eye Diagram Type	
			Enabled	Disabled	Enabled	Disabled	<=3.5 Gsps	>3.5 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Combined	Separated
1.2.21	3100	HS-TX Eye Diagram (VAB) (C)	×	✓	×	✓	✓	×	×	✓	✓	×	✓
	3101	HS-TX Eye Diagram (VBC) (C)	×	✓	×	✓	✓	×	×	✓	✓	×	✓
	3102	HS-TX Eye Diagram (VCA) (C)	×	✓	×	✓	✓	×	×	✓	✓	×	✓
	3103	HS-TX Eye Diagram (VABC) (C)	×	✓	×	✓	✓	×	×	✓	✓	✓	×
	3104	HS-TX Eye Diagram (VAB)[CTLE] [above 3.5Gsps] (C)	×	✓	×	✓	×	✓	×	✓	✓	×	✓
	3105	HS-TX Eye Diagram (VBC)[CTLE] [above 3.5Gsps] (C)	×	✓	×	✓	×	✓	×	✓	✓	×	✓
	3106	HS-TX Eye Diagram (VCA) [CTLE] [above 3.5Gsps](C)	×	✓	×	✓	×	✓	×	✓	✓	×	✓
	3107	HS-TX Eye Diagram (VABC) [CTLE] [above 3.5Gsps] (C)	×	✓	×	✓	×	✓	×	✓	✓	✓	×

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

Refer to the MIPI C-PHY 1.1 tests description:

"For Test ID 3100" on page 133

"For Test ID 3101" on page 134

"For Test ID 3102" on page 134

"For Test ID 3103" on page 135

For Test ID 3104

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.
2 Embed the "Standard Channel" reference channel and package model using the "InfiniiSim" function of the scope for V_A, V_B and V_C signals.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Enable the multilane CTLE feature from Infiniium on the DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals.
5 Generate the RCLK from the CTLE output of DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals using a MATLAB UDF script.
6 Fold the CTLE output of DiffData(A-B) to form a data eye using the RCLK output.
7 Iterate through each CTLE setting by applying each CTLE setting extracted from default CTLE Setting File on DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals. Find the optimal CTLE setting based on the highest eye area of the eye diagram. The "CTLE Setting File" and "CTLE Optimization Criterion" values are configurable in the Configure tab.
8 Acquire one acquisition and run the mask testing feature in the oscilloscope.
9 Check the mask violation result.
10 If there is mask violation, move the mask horizontally to the left from the trigger point by increment of a value specified by "Moving Mask Unit" configuration option until a position where there is no mask hits or maximum of 0.2UI from the trigger point.
11 Acquire 3M UIs and run the mask testing feature in the oscilloscope.
12 Check the mask violation result.
13 The mask violation result is used as the final test result for this test.

For Test ID 3105

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.
2 Embed the "Standard Channel" reference channel and package model using the "InfiniiSim" function of the scope for V_A, V_B and V_C signals.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Enable the multilane CTLE feature from Infiniium on the DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals.

5 Generate the RCLK from the CTLE output of DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals using a MATLAB UDF script.
6 Fold the CTLE output of DiffData(B-C) to form a data eye using the RCLK output.
7 Iterate through each CTLE setting by applying each CTLE setting extracted from default CTLE Setting File on DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals. Find the optimal CTLE setting based on the highest eye area of the eye diagram. The “CTLE Setting File” and “CTLE Optimization Criterion” values are configurable in the Configure tab.
8 Acquire one acquisition and run the mask testing feature in the oscilloscope.
9 Check the mask violation result.
10 If there is mask violation, move the mask horizontally to the left from the trigger point by increment of a value specified by “Moving Mask Unit” configuration option until a position where there is no mask hits or maximum of 0.2UI from the trigger point.
11 Acquire 3M UIs and run the mask testing feature in the oscilloscope.
12 Check the mask violation result.
13 The mask violation result is used as the final test result for this test.

For Test ID 3106

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.
2 Embed the “Standard Channel” reference channel and package model using the “InfiniiSim” function of the scope for V_A, V_B and V_C signals.
3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Enable the multilane CTLE feature from Infiniium on the DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals.
5 Generate the RCLK from the CTLE output of DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals using a MATLAB UDF script.
6 Fold the CTLE output of DiffData(C-A) to form a data eye using the RCLK output.
7 Iterate through each CTLE setting by applying each CTLE setting extracted from default CTLE Setting File on DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals. Find the optimal CTLE setting based on the highest eye area of the eye diagram. The “CTLE Setting File” and “CTLE Optimization Criterion” values are configurable in the Configure tab.
8 Acquire one acquisition and run the mask testing feature in the oscilloscope.
9 Check the mask violation result.
10 If there is mask violation, move the mask horizontally to the left from the trigger point by increment of a value specified by “Moving Mask Unit” configuration option until a position where there is no mask hits or maximum of 0.2UI from the trigger point.
11 Acquire 3M UIs and run the mask testing feature in the oscilloscope.
12 Check the mask violation result.
13 The mask violation result is used as the final test result for this test.

For Test ID 3107

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.
2 Embed the “Standard Channel” reference channel and package model using the “InfiniiSim” function of the scope for V_A, V_B and V_C signals.

3 Construct the differential data waveform using the following equations:

$$DiffData(A\text{-}B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C\text{-}A) = V_C - V_A$$

4 Enable the multilane CTLE feature from Infiniium on the DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals.
5 Generate the RCLK from the CTLE output of DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals using a MATLAB UDF script.
6 Generate DiffData (A-B-C) from the CTLE output of DiffData(A-B), DiffData(B-C) and DiffData(C-A) using a Matlab UDF script.
7 Fold the DiffData(A-B-C) to form a data eye using the RCLK output.
8 Iterate through each CTLE setting by applying each CTLE setting extracted from default CTLE Setting File on DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals. Find the optimal CTLE setting based on the highest eye area of the eye diagram. The “CTLE Setting File” and “CTLE Optimization Criterion” values are configurable in the Configure tab.
9 Acquire one acquisition and run the mask testing feature in the oscilloscope.
10 Check the mask violation result.
11 If there is mask violation, move the mask horizontally to the left from the trigger point by increment of a value specified by “Moving Mask Unit” configuration option until a position where there is no mask hits or maximum of 0.2UI from the trigger point.
12 Acquire 3M UIs and run the mask testing feature in the oscilloscope.
13 Check the mask violation result.
14 The mask violation result is used as the final test result for this test.

Expected/Observable Results

The measured UI variation for the test signal must be within the conformance limit values as specified in the CTS/Specification mentioned under the References section.

Test 1.2.22 HS-TX UI Jitter ($UI\_Jitter_{PEAK\_TX}$)

Test Overview

The purpose of this test is to verify that the DUT's HS-TX meets the requirements for the Transmitter UI Jitter specification.

Test Availability

Table 58 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the HS-TX UI Jitter test.

Table 58 Configuration Options for HS-TX UI Jitter Test

CTS Test ID	Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		HS Symbol Rate			Probing Method		
			Enabled	Disabled	Enabled	Disabled	<2.5 Gsps	2.5 Gsps <= x <=3.5 Gsps	>3.5 Gsps	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)
1.2.21	3201	HS-TX UI Jitter Peak [2.5Gsps - 3.5Gsps](C)	×	✓	×	✓	×	✓	×	×	✓	✓
	3202	HS-TX UI Jitter Peak [CTLE] [above 3.5Gsps](C)	×	✓	×	✓	×	×	✓	×	✓	✓

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test Procedure

For Test ID 3201

1 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.

2 Embed the "Standard Channel" reference channel using the "InfiniiSim" function of the oscilloscope for V_A, V_B and V_C signals.

3 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

4 Generate the RCLK signal from DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals using a MATLAB UDF script.

5 Apply low pass filter on the RCLK output.

6 Fold a self-triggered eye using the filtered RCLK output.

7 Using histogram feature from Infiniium, measure the UI Jitter Peak from the self-triggered eye.

For Test ID 3202

1 Run the following test as a prerequisite:
   a Test 1.2.21 HS-TX Eye Diagram (VABC)[CTLE][above 3.5Gsps](C) (Test ID: 3107): Stores the optimal CTLE settings.
2 Set up the oscilloscope to trigger on an HS Continuous data signal to acquire V_A, V_B and V_C signals.
3 Embed the “Standard Channel” reference channel and package model using the “InfiniiSim” function of the scope for V_A, V_B and V_C signals.
4 Construct the differential data waveform using the following equations:

$$DiffData(A-B) = V_A - V_B$$

$$DiffData(B-C) = V_B - V_C$$

$$DiffData(C-A) = V_C - V_A$$

5 Enable the multilane CTLE feature from Infiniium on the DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals.
6 Apply the optimal CTLE setting obtained from the prerequisite test.
7 Generate the RCLK from the CTLE output of DiffData(A-B), DiffData(B-C) and DiffData(C-A) signals using a MATLAB UDF script.
8 Apply low pass filter on the RCLK output.
9 Fold a self-triggered eye using the filtered RCLK output.
10 Using histogram feature from Infiniium, measure the UI Jitter Peak from the self-triggered eye.

Expected/Observable Results

The measured UI Jitter Peak for the test signal must be within the conformance limit values as specified in the CTS/Specification mentioned under the References section.

13 MIPI C-PHY 2.0 Low Power Transmitter (LP-TX) Electrical Tests

This section provides the Methods of Implementation (MOIs) for electrical tests for low-power transmitters (LP-TX) using an Keysight Infiniium Oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

KEYSIGHT TECHNOLOGIES

Probing for Low-Power Transmitter Electrical Tests

When performing the LP Electrical tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the LP Electrical tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **50pF Capacitive Load Fixture** prior to running the LP Tests.

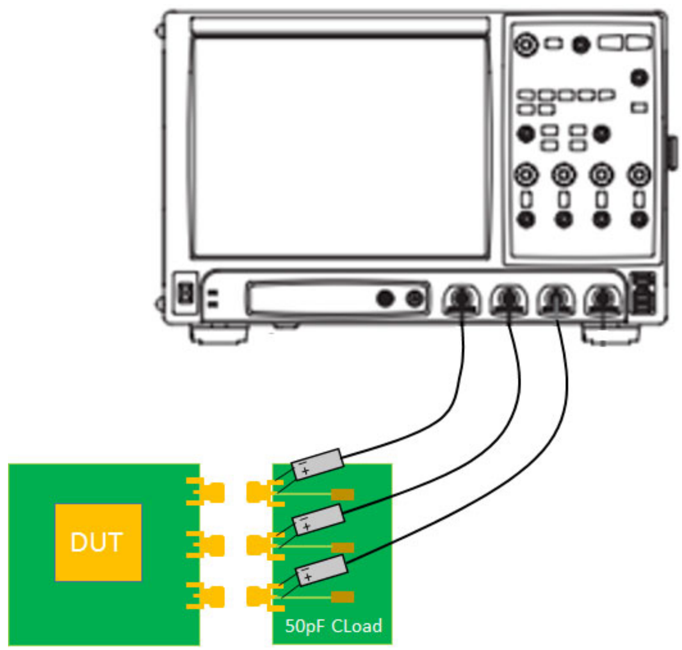


Figure 58 Sample connection diagram for LP Electrical Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 58 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.
2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3 Select the **Data Type** as **LP Escape ONLY** and in the **Device Information** section, select CTS **v2.0**.
4 Click **Connection Setup** to configure the channel selection and probing method.
5 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

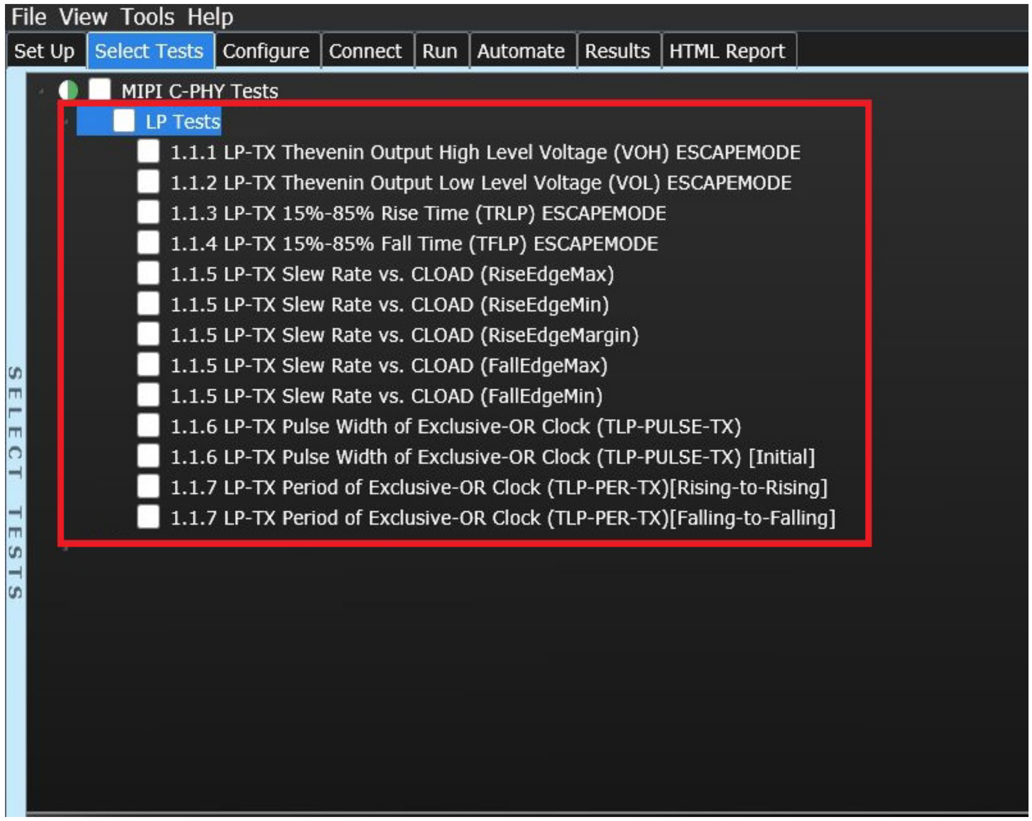


Figure 59 Selecting Low-Power Transmitter Electrical Tests

6 Follow the MIPI C-PHY Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.1.1 LP-TX Thevenin Output High Level Voltage (V_{OH})

For information about this test, refer to "Test 1.1.1 LP-TX Thevenin Output High Level Voltage (VOH)" on page 68.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (V_{OL})

For information about this test, refer to "Test 1.1.2 LP-TX Thevenin Output Low Level Voltage (VOL)" on page 70.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.1.3 LP-TX 15% - 85% Rise Time (T_{RLP})

For information about this test, refer to "Test 1.1.3 LP-TX 15% - 85% Rise Time (TRLP)" on page 72.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.1.4 LP-TX 15% - 85% Fall Time (T_{FLP})

For information about this test, refer to "Test 1.1.4 LP-TX 15% - 85% Fall Time (TFLP)" on page 74.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.1.5 LP-TX Slew Rate vs. C_{LOAD}

For information about this test, refer to "Test 1.1.5 LP-TX Slew Rate vs. CLOAD" on page 76.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.1.6 LP-TX Pulse Width of Exclusive-OR Clock ($T_{LP\text{-}PULSE\text{-}TX}$)

For information about this test, refer to "Test 1.1.6 LP-TX Pulse Width of Exclusive-OR Clock (TLP-PULSE-TX)" on page 78.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.1.7 LP-TX Period of Exclusive-OR Clock ($T_{LP-PER-TX}$)

For information about this test, refer to "Test 1.1.7 LP-TX Period of Exclusive-OR Clock (TLP-PER-TX)" on page 80.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

14 MIPI C-PHY 2.0 Global Timing Tests

This section provides the Methods of Implementation (MOIs) for the timing tests for high-speed transmitters (HS-TX) using a Keysight Infiniium Oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

Probing for Global Timing Tests

When performing the Global Timing tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the Global Timing tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **Reference Termination Board** and configure the DUT to output **Burst signal** prior to running the Global Timing Tests.

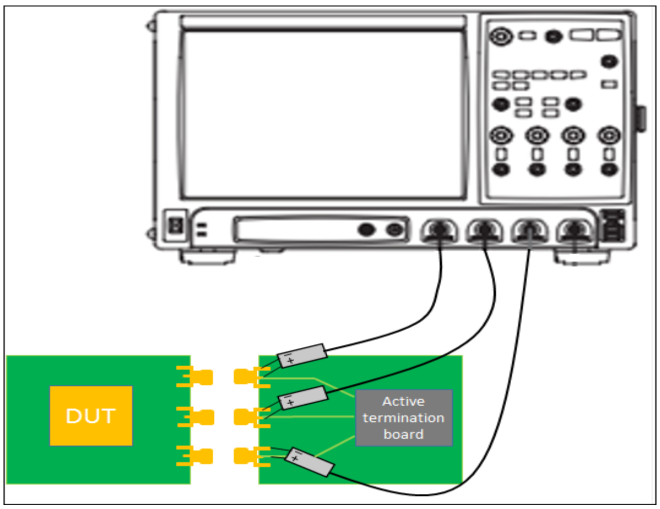


Figure 60 Sample connection diagram for HS Electrical Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 60 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, "InfiniiMax Probing," starting on page 249.

Test Procedure

1. Start the automated test application as described in "Starting the MIPI C-PHY Compliance Test Application" on page 29.
2. In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3. Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v2.0**.
4. Click **Connection Setup** to configure the channel selection and probing method.
5. Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

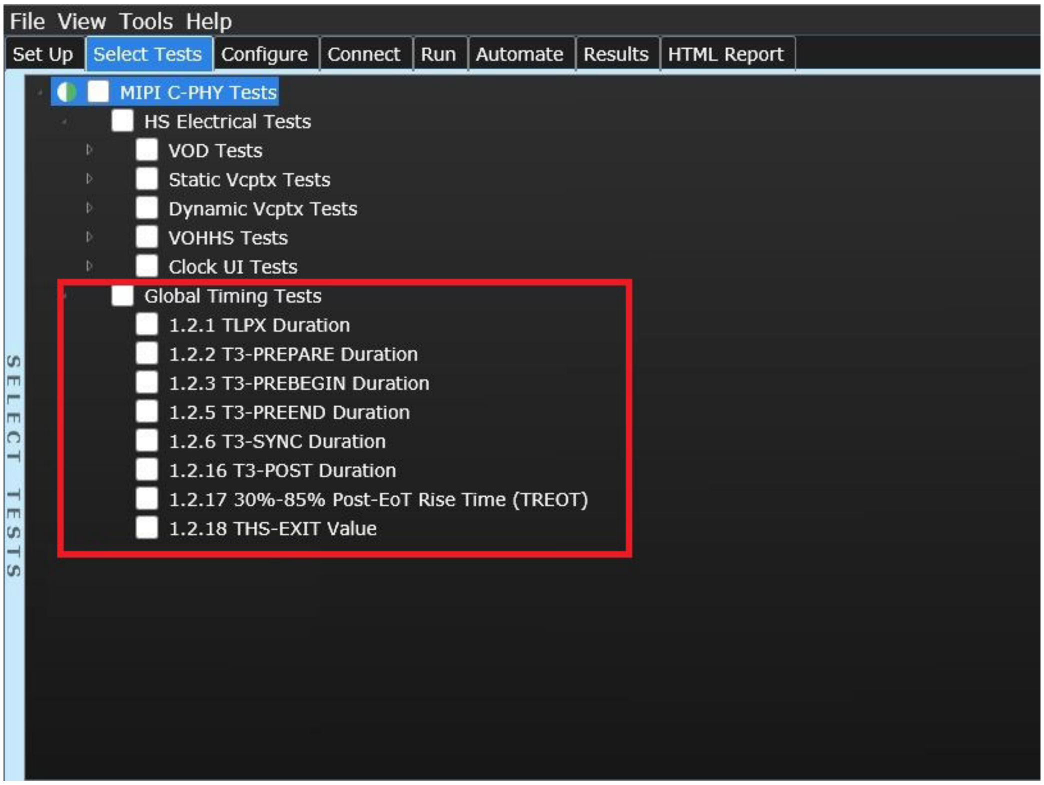


Figure 61 Selecting Global Timing Tests

6 Follow the MIPI C-PHY Compliance Test Application's task flow to set up the configuration options, run the tests, and view the tests results.

Test 1.2.1 T_{LPX} Duration

For information about this test, refer to “Test 1.2.1 TLPX Duration" on page 86.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.2 $T_{3\text{-}PREPARE}$ Duration

For information about this test, refer to “Test 1.2.2 T3-PREPARE Duration" on page 147.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.3 $T_{3\text{-}PREBEGIN}$ Duration

For information about this test, refer to “Test 1.2.3 T3-PREBEGIN Duration" on page 149.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.4 $T_{3\text{-}PROGSEQ}$ Duration

For information about this test, refer to “Test 1.2.4 T3-PROGSEQ Duration" on page 92.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.5 $T_{3\text{-}PREEND}$ Duration

For information about this test, refer to “Test 1.2.5 T3-PREEND Duration" on page 152.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.6 $T_{3\text{-}SYNC}$ Duration

For information about this test, refer to “Test 1.2.6 T3-SYNC Duration" on page 153.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.16 $T_{3\text{-}POST}$ Duration

For information about this test, refer to "Test 1.2.16 T3-POST Duration" on page 154.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.17 30%-85% Post-EoT Rise Time (T_{REOT})

For information about this test, refer to "Test 1.2.17 30%-85% Post-EoT Rise Time (TREOT)" on page 99.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

Test 1.2.18 $T_{HS\text{-}EXIT}$ Value

For information about this test, refer to "Test 1.2.18 THS-EXIT Value" on page 157.

References

C-PHY Specification draft v2.0r03 (29Dec2018)

15 MIPI C-PHY 2.0 High Speed Calibration Preamble Tests

This section provides the Methods of Implementation (MOIs) for the calibration preamble tests for high-speed transmitters (HS-TX) using a Keysight Infiniium Oscilloscope, InfiniiMax probes, and the MIPI C-PHY Compliance Test Application.

Probing for High-Speed Calibration Preamble Tests

When performing the HS Calibration Preamble tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the HS Calibration Preamble tests may look similar to the following diagram. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

Connect the DUT to **Reference Termination Board** and configure the DUT to output **Burst signal** prior to running the HS Calibration Preamble Tests.

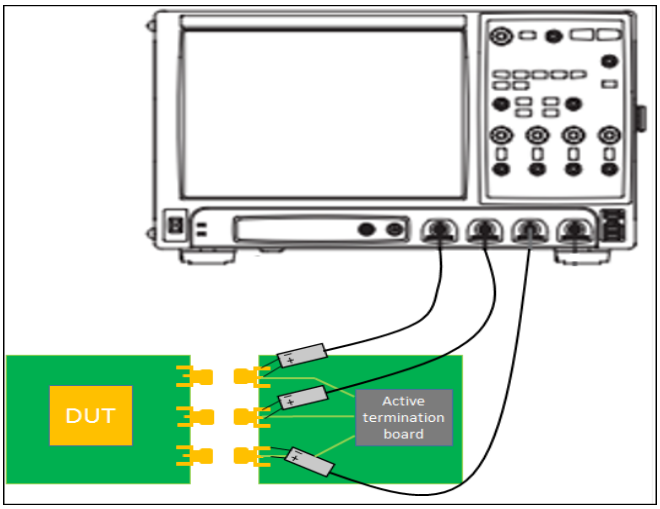


Figure 62 Sample connection diagram for HS Calibration Preamble Tests

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in Figure 62 are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.
2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.
3 Select the **Data Type** and in the **Device Information** section, select CTS **v2.0**.
4 Select the **Informative Tests** check box.
5 Select the **Calibration** check box.
6 Select a Format from the **Preamble** drop-down list. The available options include Format 1 and Format 2.
7 Click **Connection Setup** to configure the channel selection and probing method.
8 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

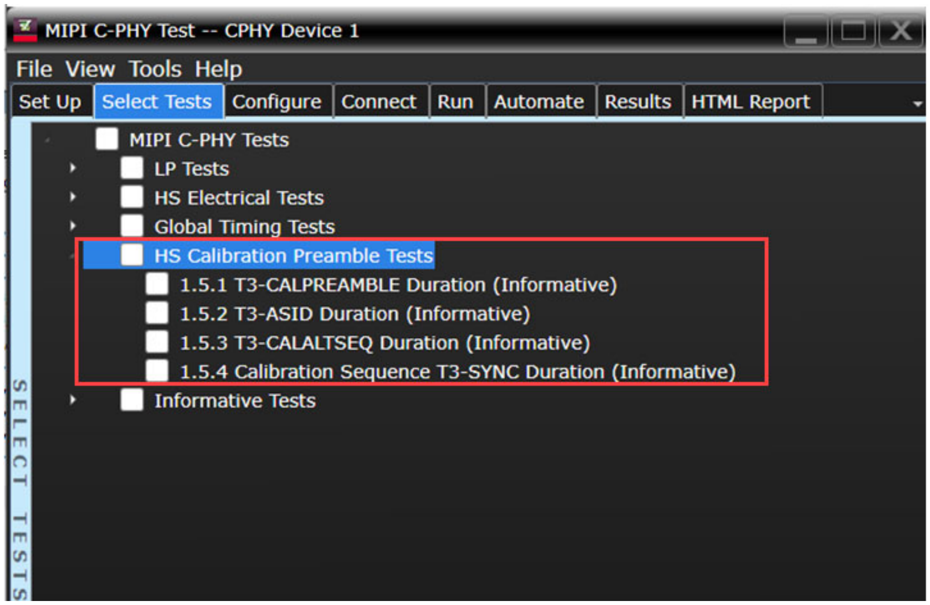


Figure 63 Selecting HS Calibration Preamble Tests

9 Follow the MIPI C-PHY Compliance Test Application's task flow to set up the configuration options, run the tests, and view the tests results.

.

Test 1.5.1 $T_{3\text{-CALPREAMBLE}}$ Duration

Test Overview

The purpose of this test is to verify that the time of $T_{3\text{-CALPREAMBLE}}$ is within the conformance limits of the MIPI C-PHY standard specification. Figure 64 shows the $T_{3\text{-CALPREAMBLE}}$ Interval in a High-Speed Data Transmission.

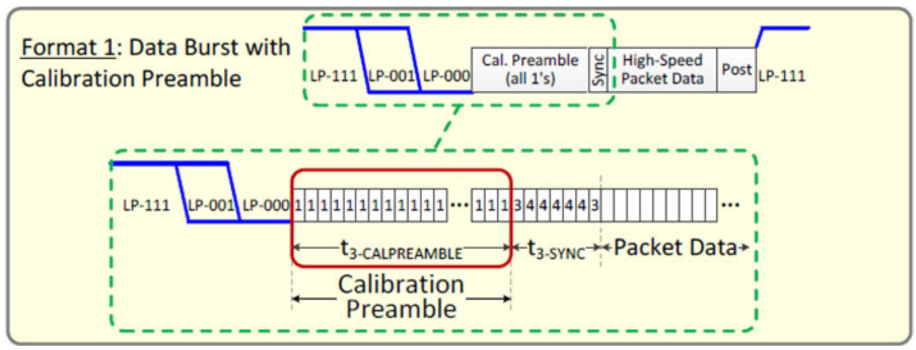


Figure 64 $T_{3\text{-CALPREAMBLE}}$ Interval

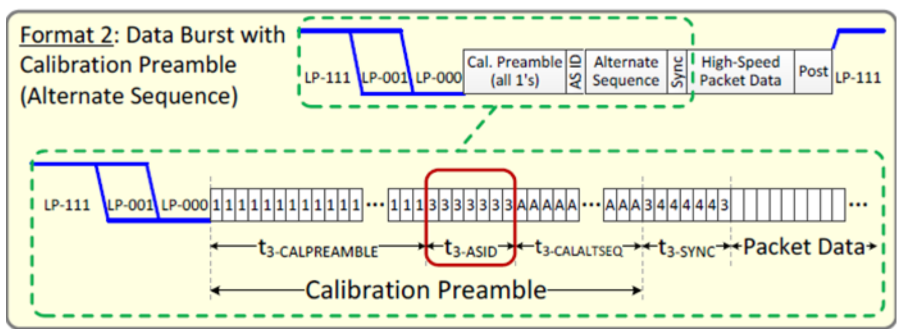


Figure 65 $T_{3\text{-ASID}}$ Interval

Test Availability

Table 59 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-CALPREAMBLE}}$) test.

Table 59 Configuration Options for $T_{3\text{-CALPREAMBLE}}$ Duration

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method			Informative Tests		Calibration Preamble	
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled	Format 1	Format 2
1.5.1	4100	$T_{3\text{-CALPREAMBLE}}$ Duration	×	✓	✓	×	×	✓	×	✓	×

Test References

- C-PHY Conformance Test Suite v1.0r0.3 for C-PHY v2.0 (20April2020)
- C-PHY Specification v2.0 (28May2019)

Test Procedure

1 Run the following test as a prerequisite:

a Test 1.2.19 HS Instantaneous UI (UI_{INST_Max}) - (Test ID: 2900)

Measure and store the min, max and average values for the low pass filtered unit interval of the differential waveforms.

2 Use the waveforms V_A, V_B and V_c captured in the prerequisite test.

3 Construct the differential data waveform using the following equations:

$$DiffData(A\text{-}B) = V_A - V_B$$

$$DiffData(B\text{-}C) = V_B - V_C$$

$$DiffData(C\text{-}A) = V_C - V_A$$

4 Perform and measure the $T_{3\text{-}PREPARE}$ duration test. See "Test 1.2.2 T3-PREPARE Duration" on page 210.

5 Use the measured $T_{3\text{-}PREPARE}$ duration as a reference, the last bit of $T_{3\text{-}PREPARE}$ is marked as $T_{3\text{-}CALPREAMBLE}$ start point.

6 Decode the CPHY signals.

The test procedures are varied based on the Calibration Preamble format.

7 When Calibration Preamble Format 1 is selected on the Setup tab.

a Find and identify the $T_{3\text{-}SYNC}$ symbol sequence of '3,4,4,4,4,4,3'.

b The location of the first bit of this $T_{3\text{-}SYNC}$ symbol sequence is marked as $T_{3\text{-}SYNC\ start\ point}$ and $T_{3\text{-}CALPREAMBLE\ end\ point}$.

c Calculate the $T_{3\text{-}CALPREAMBLE}$ using the equation:

$T_{3\text{-}CALPREAMBLE} = T_{3\text{-}CALPREAMBLE\ end\ point} - T_{3\text{-}CALPREAMBLE\ start\ point}$

d The location of the last bit of $T_{3\text{-}SYNC}$ symbol sequence is marked as $T_{3\text{-}SYNC\ end\ point}$.

$T_{3\text{-}SYNC} = T_{3\text{-}SYNC\ end\ point} - T_{3\text{-}SYNC\ start\ point}$

8 When Calibration Preamble Format 2 is selected on the Setup tab.
   a Find and identify the $T_{3\text{-}ASID}$ symbol sequence of ‘3,3,3,3,3,3,3’.
   b The location of the first bit of this $T_{3\text{-}ASID}$ symbol sequence is marked as $T_{3\text{-}ASID\ start\ point}$ and $T_{3\text{-}CALPREAMBLE\ end\ point}$.
   c Calculate the $T_{3\text{-}CALPREAMBLE}$ using the equation:
   $T_{3\text{-}CALPREAMBLE} = T_{3\text{-}CALPREAMBLE\ end\ point} - T_{3\text{-}CALPREAMBLE\ start\ point}$
   d The location of the last bit of this $T_{3\text{-}ASID}$ symbol sequence is marked as $T_{3\text{-}ASID\ end\ point}$ and $T_{3\text{-}CALALTSEQ\ start\ point}$.
   e Calculate $T_{3\text{-}ASID}$ using the equation:
   $T_{3\text{-}ASID} = T_{3\text{-}ASID\ end\ point} - T_{3\text{-}ASID\ start\ point}$
   f Find and identify the $T_{3\text{-}SYNC}$ symbol sequence of ‘3,4,4,4,4,4,3’.
   g The location of the first bit of this $T_{3\text{-}SYNC}$ symbol sequence is marked as $T_{3\text{-}SYNC\ start\ point}$ and $T_{3\text{-}CALALTSEQ\ end\ point}$.
   h Calculate the $T_{3\text{-}CALALTSEQ}$ using the equation:
   $T_{3\text{-}CALALTSEQ} = T_{3\text{-}CALALTSEQ\ end\ point} - T_{3\text{-}CALALTSEQ\ start\ point}$
   i The location of the last bit of this $T_{3\text{-}SYNC}$ symbol sequence is marked as $T_{3\text{-}SYNC\ end\ point}$.
   j Calculate the $T_{3\text{-}SYNC}$ using the equation:
   $T_{3\text{-}SYNC} = T_{3\text{-}SYNC\ end\ point} - T_{3\text{-}SYNC\ start\ point}$
9 Compare $T_{3\text{-}CALPREAMBLE}$ to the conformance limit.

Expected/Observable Results

The calculated value of $T_{3\text{-}CALPREAMBLE}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.5.2 $T_{3\text{-}ASID}$ Duration

Test Overview

The purpose of this test is to verify that the duration of $T_{3\text{-}ASID}$ is within the conformance limits of the MIPI C-PHY standard specification.

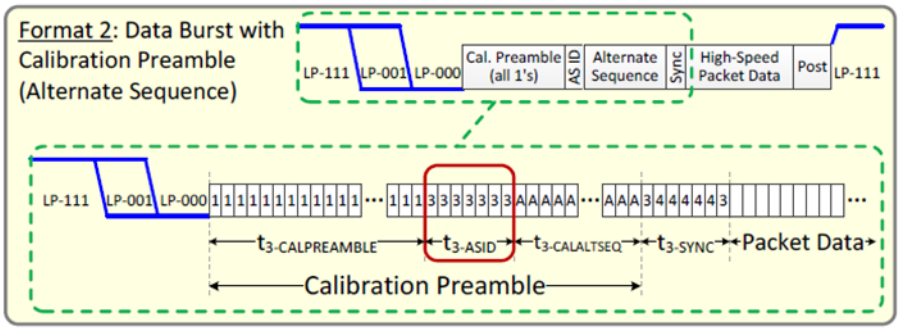


Figure 66 $t_{3\text{-}ASID}$ Interval (Format 2)

Test Availability

Table 62 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}ASID}$) test.

Table 60 Configuration Options for $T_{3\text{-}ASID}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method			Informative Tests		Calibration Preamble	
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled	Format 1	Format 2
1.5.2	4200	$T_{3\text{-}ASID}$ Duration	×	✓	✓	×	×	✓	×	×	✓

References

- C-PHY Conformance Test Suite v1.0r0.3 for C-PHY v2.0 (20April2020)
- C-PHY Specification v2.0 (28May2019)

Test Procedure

1. Run the following test as a prerequisite:
   a Test 1.5.1 $T_{3\text{-}CALPREAMBLE}$ Duration - (Test ID: 4100)
2. The location of the first bit of this $T_{3\text{-}ASID}$ symbol sequence is marked as $T_{3\text{-}ASID\ start\ point}$.
3. The location of the last bit of this $T_{3\text{-}ASID}$ symbol sequence is marked as $T_{3\text{-}ASID\ end\ point}$.
4. Calculate $T_{3\text{-}ASID}$ using the equation:

$$T_{3\text{-}ASID} = T_{3\text{-}ASID\ end\ point} - T_{3\text{-}ASID\ start\ point}$$

Expected/Observable Results

The calculated value of $T_{3\text{-}ASID}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.5.3 $T_{3\text{-}CALALTSEQ}$ Duration

Test Overview

The purpose of this test is to verify that the duration of $T_{3\text{-}CALALTSEQ}$ is within the conformance limits of the MIPI C-PHY standard specification.

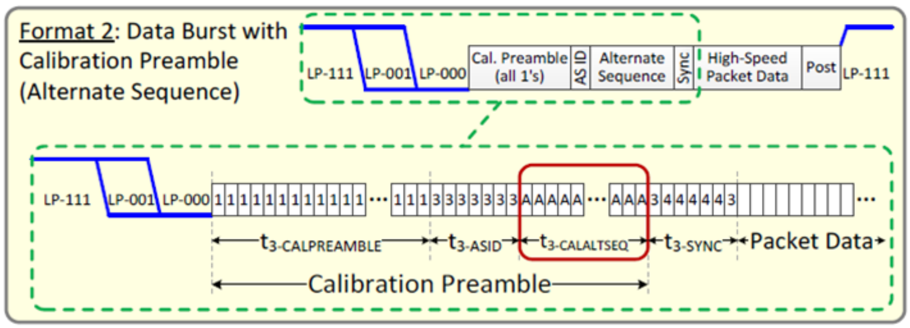


Figure 67 $t_{3\text{-}CALALTSEQ}$ Interval (Format 2)

Test Availability

Table 62 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}CALALTSEQ}$) test.

Table 61 Configuration Options for $T_{3\text{-}CALALTSEQ}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method			Informative Tests		Calibration Preamble	
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled	Format 1	Format 2
1.5.3	4300	$T_{3\text{-}CALALTSEQ}$ Duration	×	✓	✓	×	×	✓	×	×	✓

References

- C-PHY Conformance Test Suite v1.0r0.3 for C-PHY v2.0 (20April2020)
- C-PHY Specification v2.0 (28May2019)

Test Procedure

1 Run the following test as a prerequisite:

a Test 1.5.1 $T_{3\text{-}CALPREAMBLE}$ Duration - (Test ID: 4100)

2 The location of the last bit of this $T_{3\text{-}ASID}$ symbol sequence is marked as $T_{3\text{-}ASID\ end\ point}$ and $T_{3\text{-}CALALTSEQ\ start\ point}$.

3 The location of the first bit of this $T_{3\text{-}SYNC}$ symbol sequence is marked as $T_{3\text{-}SYNC\ start\ point}$ and $T_{3\text{-}CALALTSEQ\ end\ point}$.

4 Calculate $T_{3\text{-}CALALTSEQ}$ using the equation:

$$T_{3\text{-}CALALTSEQ} = T_{3\text{-}CALALTSEQ\ end\ point} - T_{3\text{-}CALALTSEQ\ start\ point}$$

5 Compare the calculated value of $T_{3\text{-}CALALTSEQ}$ against the compliance test limits.

Expected/Observable Results

The calculated value of $T_{3\text{-}CALALTSEQ}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

Test 1.5.4 $T_{3\text{-}SYNC}$ Duration

Test Overview

The purpose of this test is to verify that the duration of $T_{3\text{-}SYNC}$ is within the conformance limits of the MIPI C-PHY standard specification.

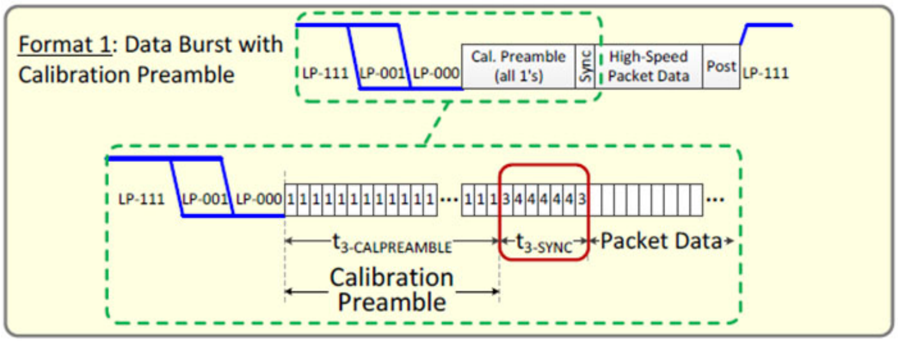


Figure 68 $t_{3\text{-}SYNC}$ Interval (Format 1)

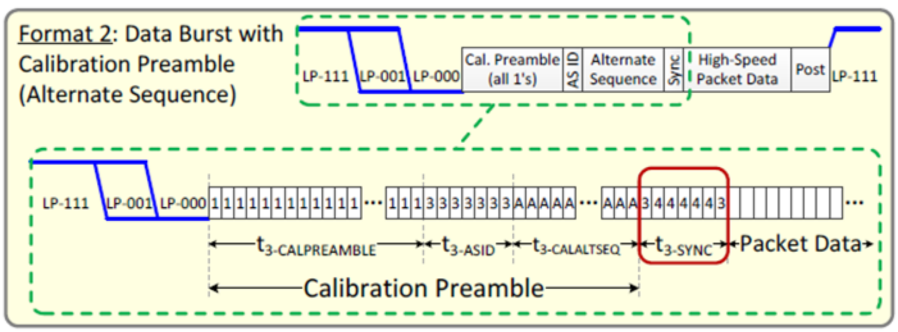


Figure 69 $t_{3\text{-}SYNC}$ Interval (Format 2)

Test Availability

Table 62 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of the Duration ($T_{3\text{-}SYNC}$) test.

Table 62 Configuration Options for $T_{3\text{-}SYNC}$ Duration Test

CTS Test ID	Test ID	Test Name	LP Escape ONLY		Probing Method			Informative Tests		Calibration Preamble	
			Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled	Format 1	Format 2
1.5.4	4400	$T_{3\text{-}SYNC}$ Duration	×	✓	✓	×	×	✓	×	✓	×

References

- C-PHY Conformance Test Suite v1.0r0.3 for C-PHY v2.0 (20April2020)
- C-PHY Specification v2.0 (28May2019)

Test Procedure

1 Run the following test as a prerequisite:
   a Test 1.5.1 $T_{3\text{-}CALPREAMBLE}$ Duration - (Test ID: 4100)
2 The location of the first bit of this $T_{3\text{-}SYNC}$ symbol sequence is marked as $T_{3\text{-}SYNC\ start\ point}$.
3 The location of the last bit of $T_{3\text{-}SYNC}$ symbol sequence is marked as $T_{3\text{-}SYNC\ end\ point}$.
4 Calculate $T_{3\text{-}SYNC}$ using the equation:

$$T_{3\text{-}SYNC} = T_{3\text{-}SYNC\ end\ point} - T_{3\text{-}SYNC\ start\ point}$$

5 Compare the calculated value of $T_{3\text{-}SYNC}$ against the compliance test limits.

Expected/Observable Results

The calculated value of $T_{3\text{-}SYNC}$ for the test signal must be within the conformance limit as specified in the CTS Specification mentioned under the References section.

16 Informative Tests

This section provides the Methods of Implementation (MOIs) for the Informative tests. This group of tests provides additional test information about the DUT. The MIPI C-PHY CTS does not explicitly specify these tests.

Probing for Informative Tests

When performing the Informative tests, the MIPI C-PHY Compliance Test Application will prompt you to make the proper connections. The connections for the Informative tests may look similar to the following diagrams. Refer to the **Connect** tab in the MIPI C-PHY Compliance Test Application for the exact number of probe connections.

For the Burst Mode, when you select **Active Probe (Differential Probe)** in the Connection Setup window (refer to step 4 in the "Test Procedure"), connect the DUT to Reference Termination Board and configure the DUT to output Burst signal prior to running the Informative Tests.

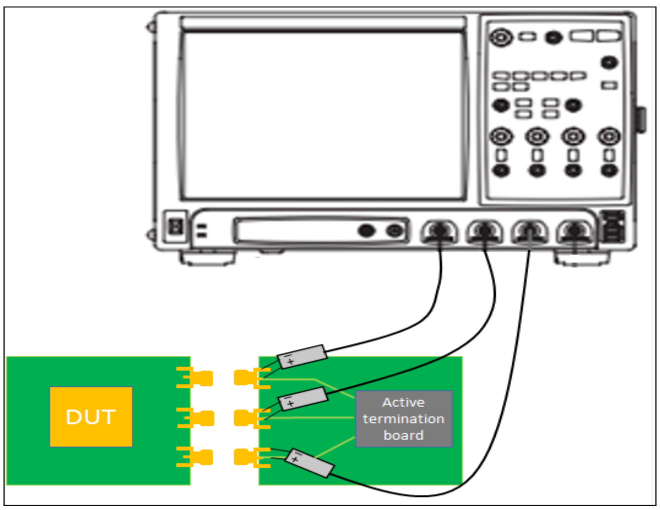


Figure 70 Sample connection diagram for Informative Tests for "Active Probe (Differential Probe)" probing method

For the Continuous Mode, when you select **Direct Connect** or **Direct Connect (Active Termination Adapter)** in the Connection Setup window (refer to step 4 in the "Test Procedure"), connect the DUT to the oscilloscope using Direct Connection and configure the DUT to output Continuous signal prior to running the Informative Tests.

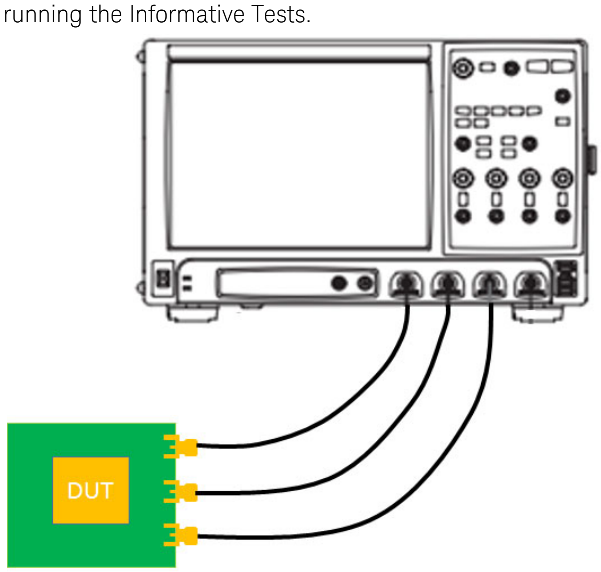


Figure 71 Sample connection diagram for Informative Tests for "Direct Connect" or Direct Connect (Active Termination Adapter) probing method

You can identify the channels used for each signal in the **Configure** tab of the MIPI C-PHY Compliance Test Application. (The channels shown in the figures are just examples).

For more information on the probe amplifiers and probe heads, see Chapter 18, “InfiniiMax Probing,” starting on page 249.

Test Procedure

1 Start the automated test application as described in “Starting the MIPI C-PHY Compliance Test Application" on page 29.

2 In the MIPI C-PHY Compliance Test Application, click the **Set Up** tab.

3 Select the **Data Type** as **HS Signal** and in the **Device Information** section, select CTS **v2.0**.

4 Click **Connection Setup** to configure the channel selection and probing method.

   a For the **Burst Mode**, select **Active Probe (Differential Probe)** as the Probing Method.

   b For the **Continuous Mode**, select **Direct Connect** or **Direct Connect (Active Termination Adapter)** as the Probing Method.

5 Enable the **Informative Tests** check box.

6 Click the **Select Tests** tab and check the tests you want to run. Check the parent node or group to check all the available tests within the group.

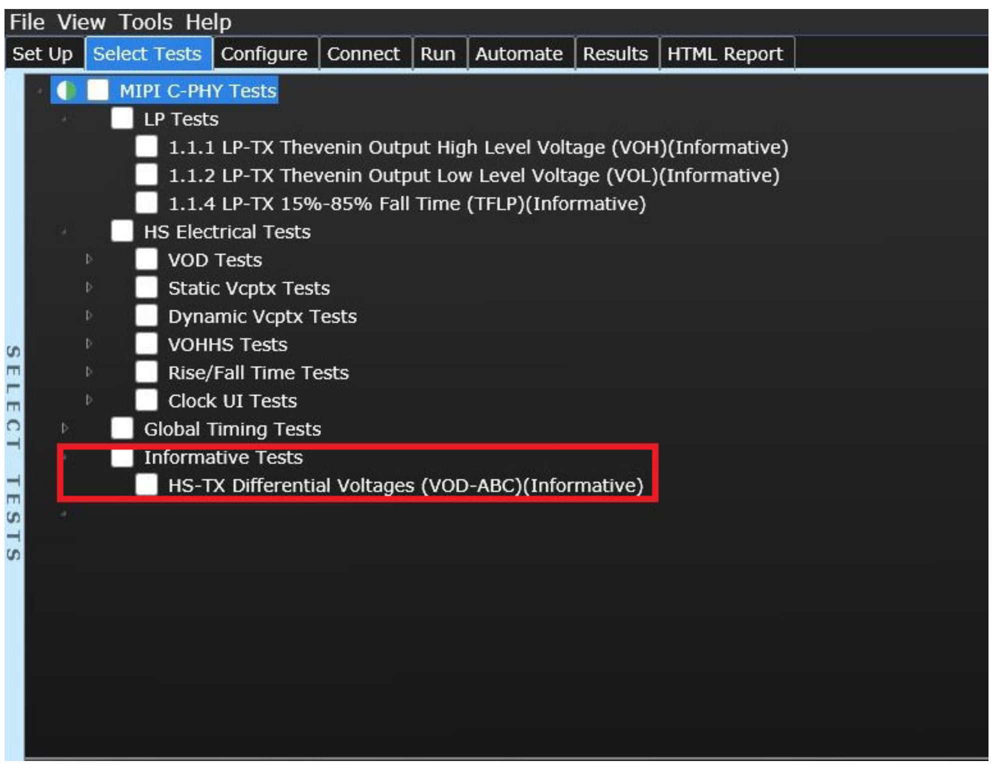


Figure 72 Selecting Informative Tests

7 Follow the MIPI C-PHY Compliance Test Application’s task flow to set up the configuration options, run the tests, and view the tests results.

Test HS-TX Differential Voltages (VOD-ABC)

Test Overview

The purpose of this test is to generate an eye diagram using VAB, VBC and VCA differential data.

Test Availability

Table 63 shows the configuration options on the MIPI C-PHY Compliance Test Application that affect the availability of HS-TX Differential Voltages (VOD-ABC) test.

Table 63 Configuration Options for HS-TX Differential Voltages (VOD-ABC) Test

Test ID	Test Name	HS Signal - LP EscapeMode		LP Escape ONLY		Probing Method			Informative Tests	
		Enabled	Disabled	Enabled	Disabled	Active Probe	Direct Connect	Direct Connect (Active Termination Adapter)	Enabled	Disabled
1730	HS-TX Differential Voltages (VOD-ABC) (Informative)	-	-	×	✓	✓	×	×	✓	×
1770	HS-TX Differential Voltages (VOD-ABC) (Informative) (C)	×	✓	×	✓	×	✓	✓	✓	×

Test Procedure

Refer to the MIPI C-PHY 1.0 tests description:

"For Test ID 1730" on page 106

Refer to the MIPI C-PHY 1.1 tests description:

"For Test ID 1770" on page 162

17 Calibrating the Infiniium Oscilloscope

This section describes the calibration procedures for Keysight Infiniium Oscilloscopes other than the UXR-series oscilloscopes. For the calibration information related to the UXR-series oscilloscopes, refer to *Keysight Infiniium UXR Real-Time Oscilloscopes User's Guide*.

Additionally, probe calibration and de-skew steps have been described in this section. To get more information, you can refer to the respective probes documentation.

Required Equipment for Oscilloscope Calibration

To calibrate the Infiniium oscilloscope in preparation for running the MIPI C-PHY automated tests, you need the following equipment:

- Keyboard, qty = 1, (provided with the Keysight Infiniium oscilloscope).
- Mouse, qty = 1, (provided with the Keysight Infiniium oscilloscope).
- 9000, S-Series and 90000A series oscilloscope: Precision 3.5 mm BNC to SMA male adapter, Keysight p/n 54855-67604, qty = 2 (provided with the Keysight Infiniium oscilloscope).
- V ,X and Z series oscilloscope: 3.5 mm Female to Female adapter, Keysight p/n 5061-5311, qty = 2 (provided with Keysight Infiniium oscilloscope).
- Calibration cable (provided with the Keysight Infiniium oscilloscopes). Use a good quality 50 Ω BNC cable.

To Run the Self Calibration

NOTE **Let the Oscilloscope warm up before adjusting. Warm up the Oscilloscope for 30 minutes before starting calibration procedure. Failure to allow warm up may result in inaccurate calibration.**

The self calibration uses signals generated in the Oscilloscope to calibrate Channel sensitivity, offsets, and trigger parameters. You should run the self calibration

- yearly or according to your periodic needs,
- when you replace the acquisition assembly or acquisition hybrids,
- when you replace the hard drive or any other assembly,
- when the oscilloscope's operating temperature (after the 30 minute warm-up period) is more than ±5 °C different from that of the last calibration.

Internal or Self Calibration

NOTE **Calibration time: It takes approximately 1 hour to run the self calibration on the Oscilloscope, including the time required to change cables from Channel to Channel.**

This will perform an internal diagnostic and calibration cycle for the oscilloscope. For the Keysight oscilloscope, this is referred to as Calibration. This Calibration will take about 20 minutes. Perform the following steps:

1 Set up the oscilloscope with the following steps:
   a Connect the keyboard, mouse, and power cord to the rear of the oscilloscope.
   b Plug in the power cord.
   c Turn on the oscilloscope by pressing the power button located on the lower left of the front panel.
   d Allow the oscilloscope to warm up at least 30 minutes prior to starting the calibration procedure in step 3 below.
2 Locate and prepare the accessories that will be required for the internal calibration:
   a Locate the BNC shorting cap.
   b Locate the calibration cable.
   c Locate the two Keysight precision SMA/BNC or SMA female to female connector adapters.
   d Attach one SMA adapter to the other end of the calibration cable — hand tighten snugly.
   e Attach another SMA adapter to the other end of the calibration cable — hand tighten snugly.

3 From the Infiniium Oscilloscope’s main menu, click **Utilities>Calibration...**.

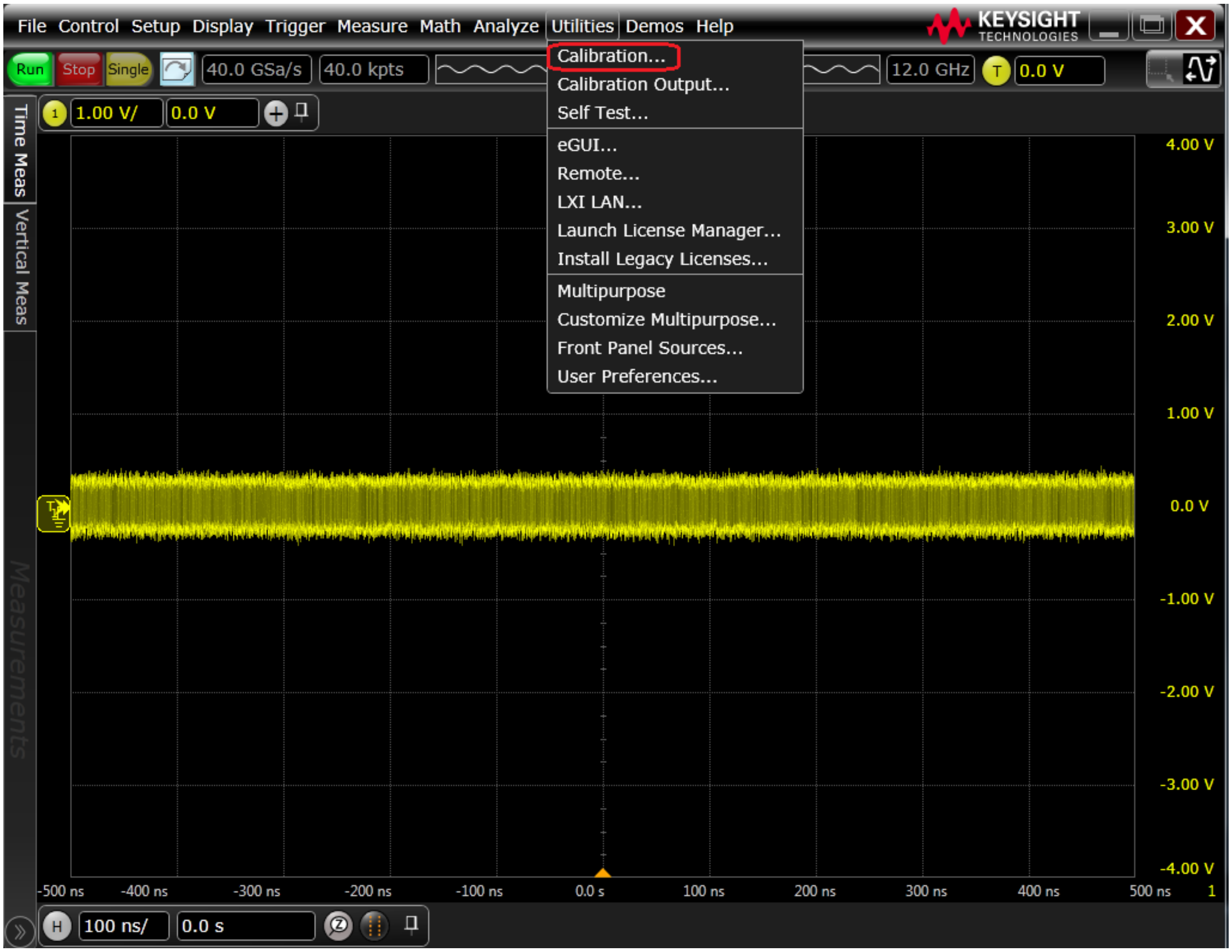


Figure 73 Accessing Calibration dialog on the Oscilloscope

The **Calibration** dialog appears.

4 To start the calibration process:

a Clear the **Cal Memory Protect** checkbox.

You cannot run self calibration if this box is checked. See Figure 74.

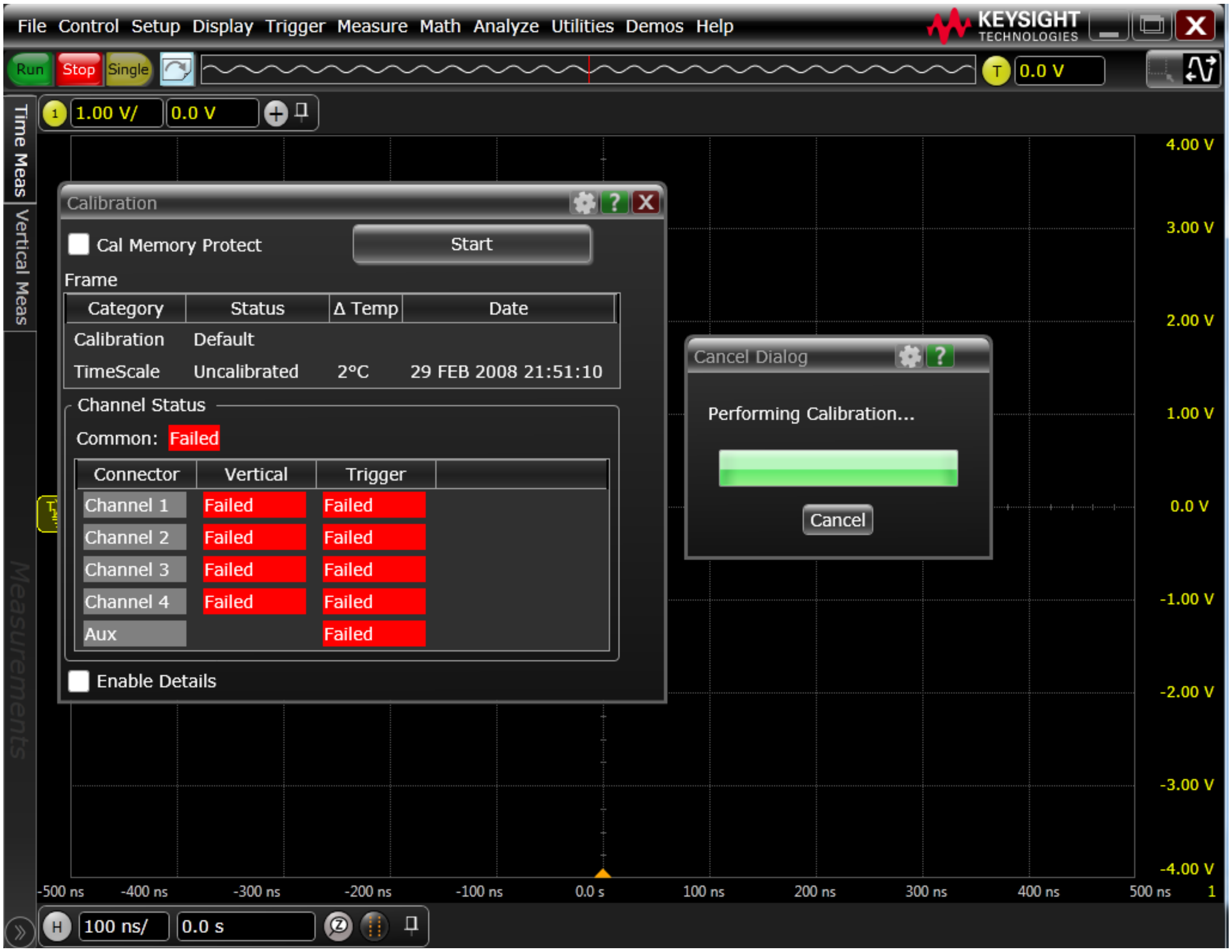


Figure 74 Clearing **Cal Memory Protect** and Starting Calibration

b Click **Start** to begin calibration.

c Follow the on-screen instructions.

d During the calibration of any Oscilloscope Channel, if the oscilloscope prompts you to perform a Time Scale Calibration, select **Standard Cal and Default Time Scale** in the **Calibration Options** dialog.

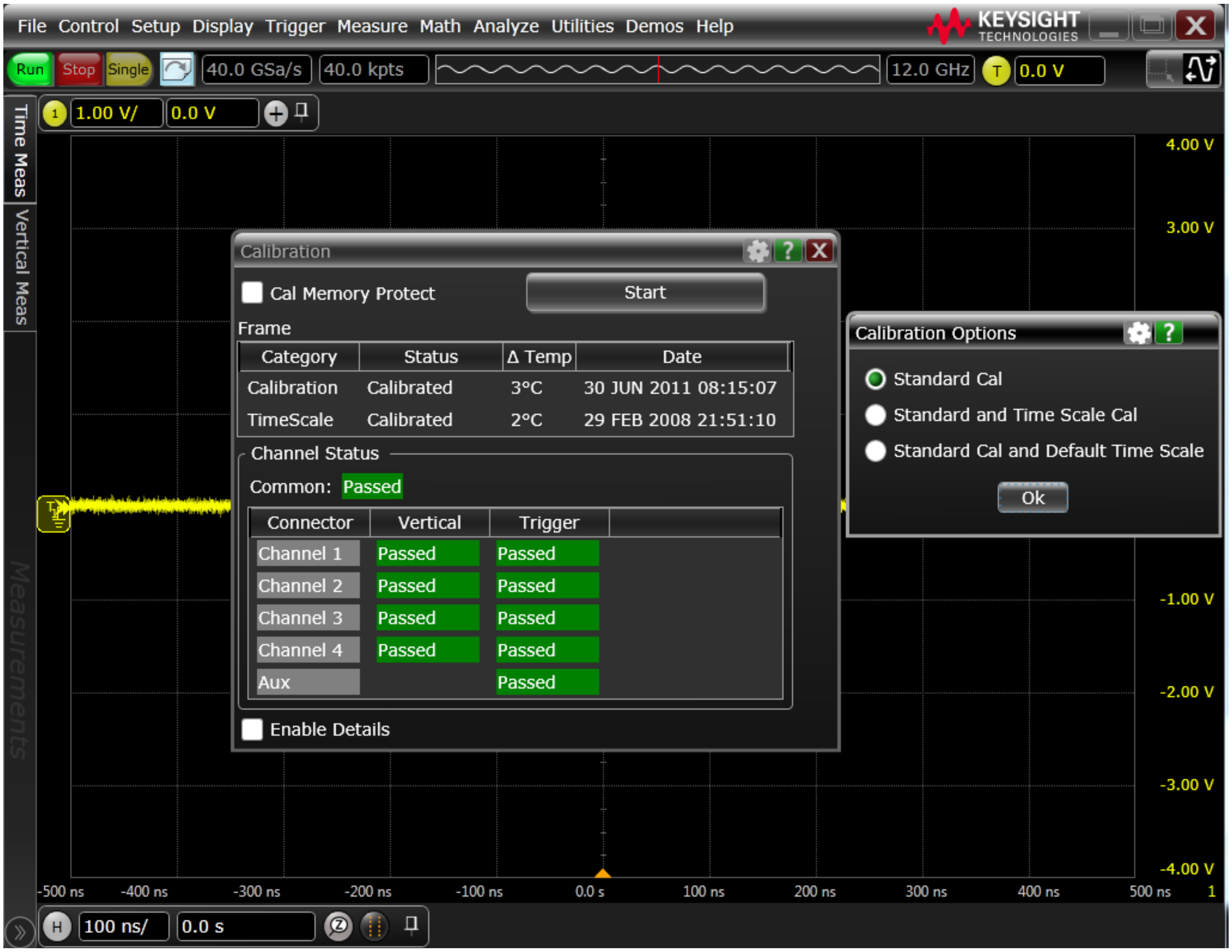


Figure 75 Selecting options from the **Calibration Options** dialog

The options under the **Calibration Options** dialog are:

- **Standard Calibration**—Oscilloscope does not perform time scale calibration and uses calibration factors from the previous time scale calibration and the reference signal is not required. The rest of the calibration procedure continues.
- **Standard and Time Scale Cal**—Oscilloscope performs time scale calibration. You must connect a reference signal to the Oscilloscope Channel, after ensuring that the reference signal meets the following specifications. Failure to meet these specifications result in an inaccurate calibration.

- **Standard Cal and Default Time Scale**—Oscilloscope uses the default time scale calibration factors and does not require the 10 MHz reference signal. The rest of the calibration procedure continues.

e Disconnect everything from all inputs and Aux Out.

f Connect the calibration cable from Aux Out to a specific Channel.

g Connect the calibration cable from Aux Out to each of the Channel inputs as requested.

h Connect the 50 Ω BNC or SMA cable from the Aux Out to the Aux Trig on the front panel of the Oscilloscope.

i A Passed/Failed indication is displayed for each calibration section. If any section fails, check the calibration cables and run the Oscilloscope **Self Test...** in the **Utilities...** menu.

j After the calibration procedure is completed, click **Close**.

NOTE These steps do not need to be performed every time a test is run. However, if the ambient temperature changes more than 5 degrees Celsius from the calibration temperature, this calibration should be performed again. The delta between the calibration temperature and the present operating temperature is shown in the **Utilities>Calibration** menu.

Probe Calibration and De-skew

Along with calibrating the Infiniium Oscilloscope, it is a good practice to calibrate and de-skew the probes, before you start running the automated tests.

Required Equipment for Probe Calibration

Before performing the compliance tests, calibrate the probes. Calibration of the solder-in probe heads consists of a vertical calibration and a skew calibration. The vertical calibration should be performed before the skew calibration. Both calibrations should be performed for best probe measurement performance.

The calibration procedure requires the following parts.

- BNC (male) to SMA (male) adapter or SMA female to female adapter
- Deskew fixture
- 50 Ω SMA terminator

SMA Probe Head Attenuation/Offset Calibration

Perform the following steps

1. Connect BNC (male) to SMA (male) adapter of 9000, S-series and 90000A series oscilloscope to the deskew fixture on the connector closest to the yellow pincher.
2. Connect the 50 Ω SMA terminator to the connector farthest from the yellow pincher.
3. Connect the BNC side of the deskew fixture or SMA side closest to the yellow pincher to the Aux Out BNC or SMA of the Infiniium oscilloscope.
4. Connect the probe to an oscilloscope channel.
5. To minimize the wear and tear on the probe head, it should be placed on a support to relieve the strain on the probe head cables.
6. Push down the back side of the yellow pincher. Insert the probe head resistor lead underneath the center of the yellow pincher and over the center conductor of the deskew fixture. The negative probe head resistor lead or ground lead must be underneath the yellow pincher and over one of the outside copper conductors (ground) of the deskew fixture. Make sure that the probe head is approximately perpendicular to the deskew fixture.
7. Release the yellow pincher.

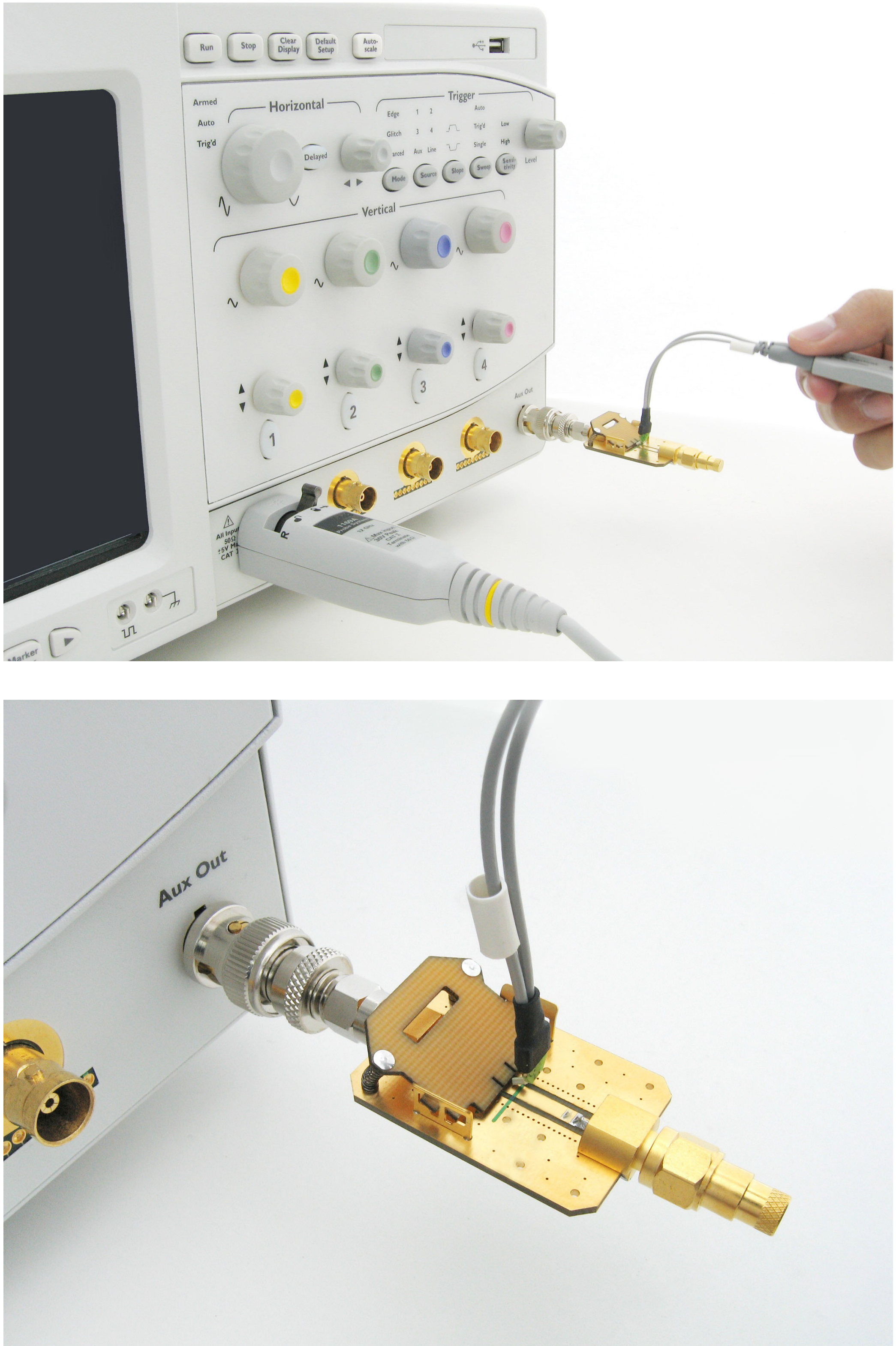


Figure 76 Example of Solder-in Probe Head Calibration Connection

8 To verify the connection, press the autoscale button on the front panel of the Infiniium Oscilloscope.
9 Set the volts per division to 100 mV/div.
10 Set the horizontal scale to 1.00 ns/div.
11 Set the horizontal position to approximately 3ns. A waveform similar to the one displayed in Figure 77 must appear.

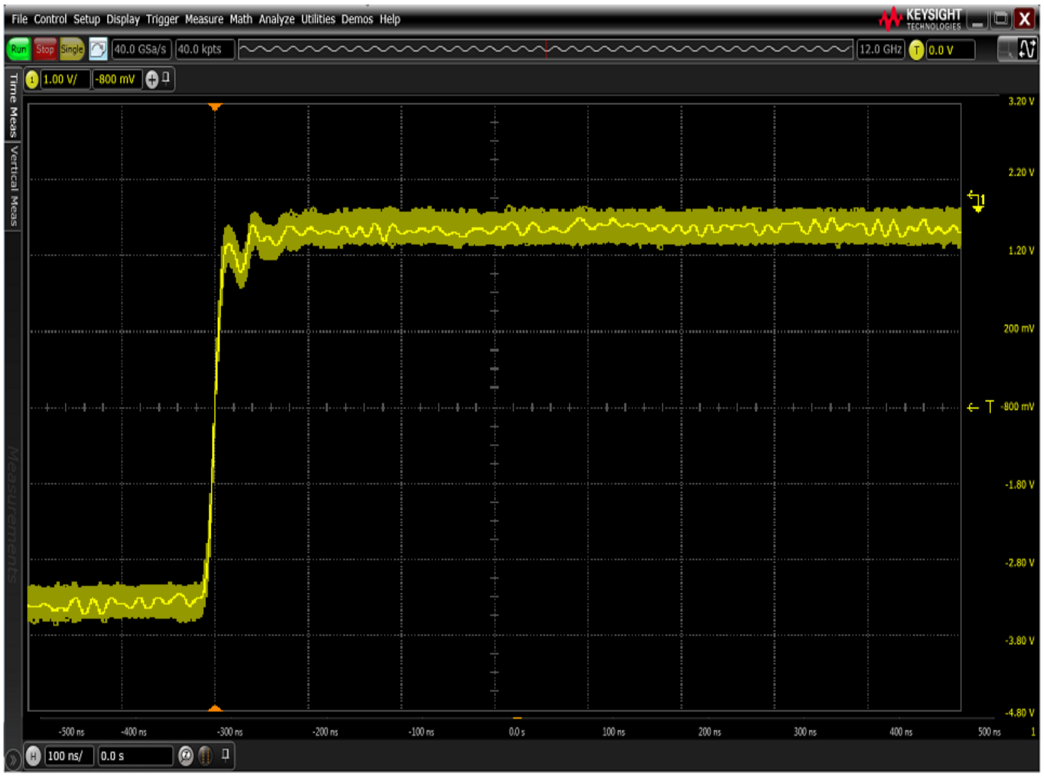


Figure 77 Example of a waveform when the probe connection is good

If a waveform similar to that shown in Figure 78 appears, it indicates that there is a bad connection and you must check all your probe connections.

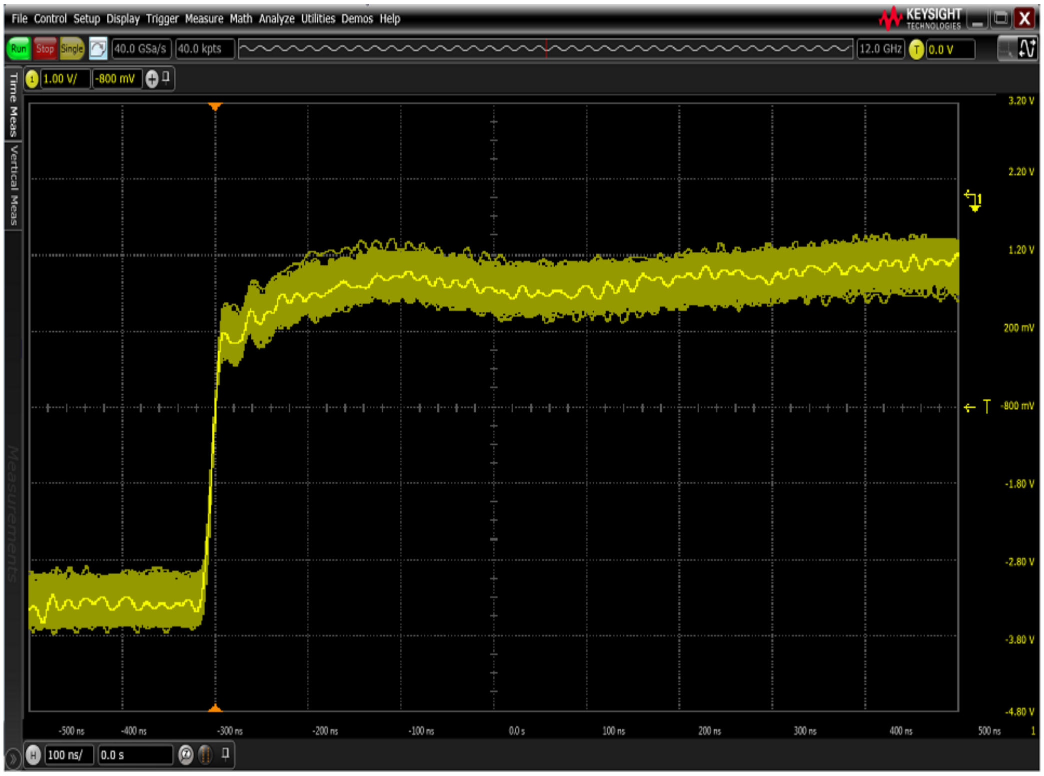
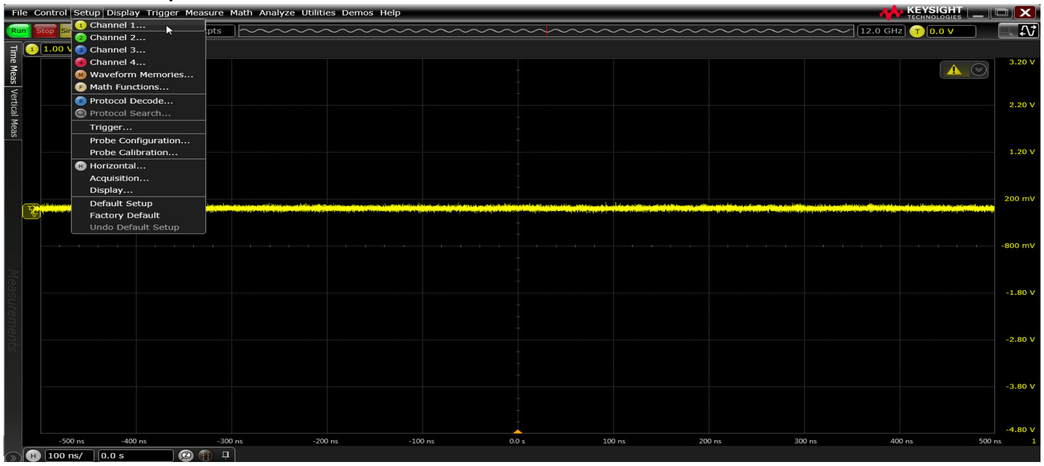


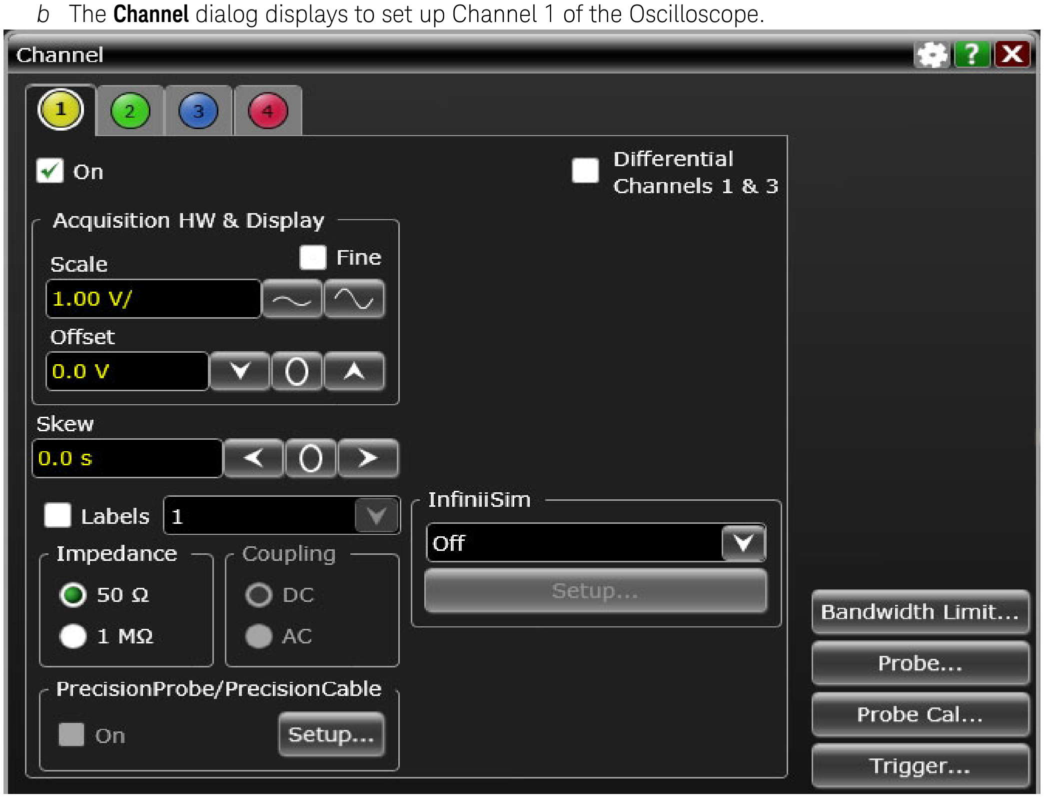
Figure 78 Example of a waveform when the probe connection is bad

12 On the Infiniium Oscilloscope,

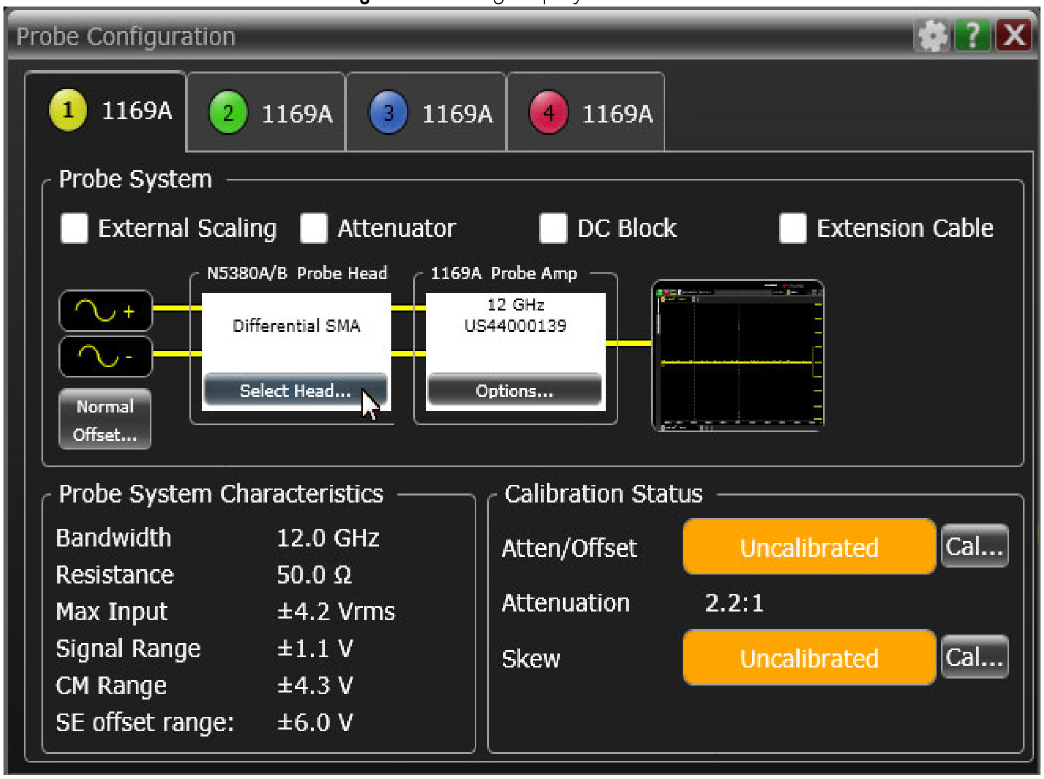
a Click **Setup>Channel 1...**.



b The **Channel** dialog displays to set up Channel 1 of the Oscilloscope.



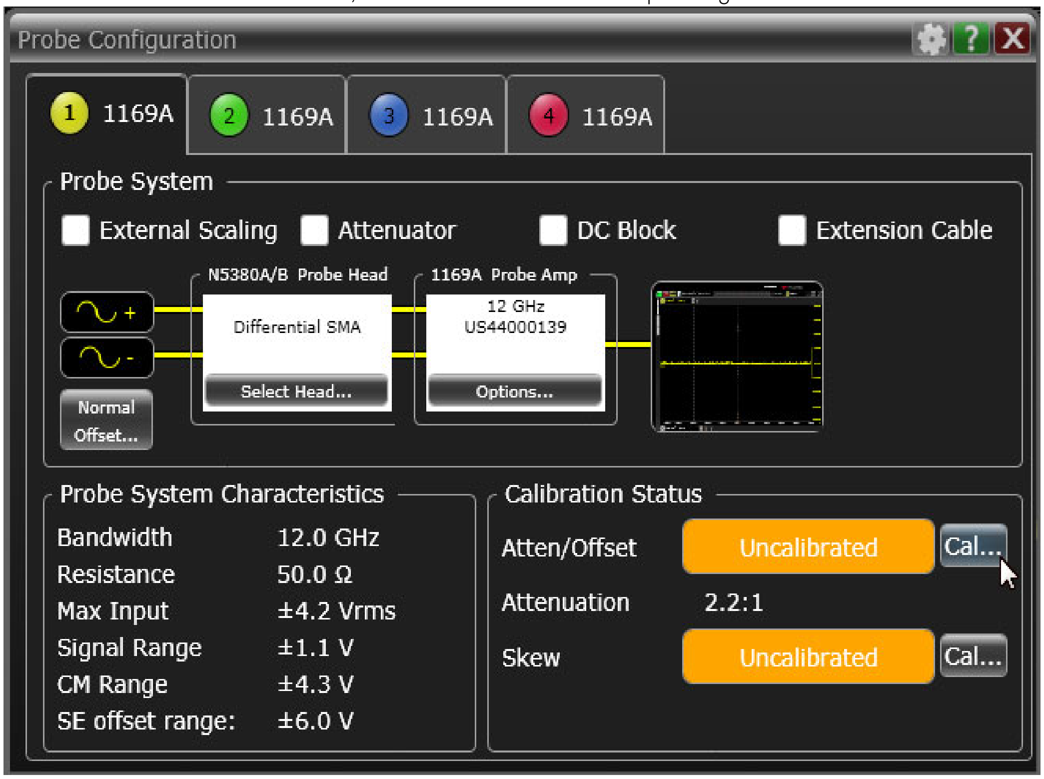
c Click **Probe...**. The **Probe Configuration** dialog displays.



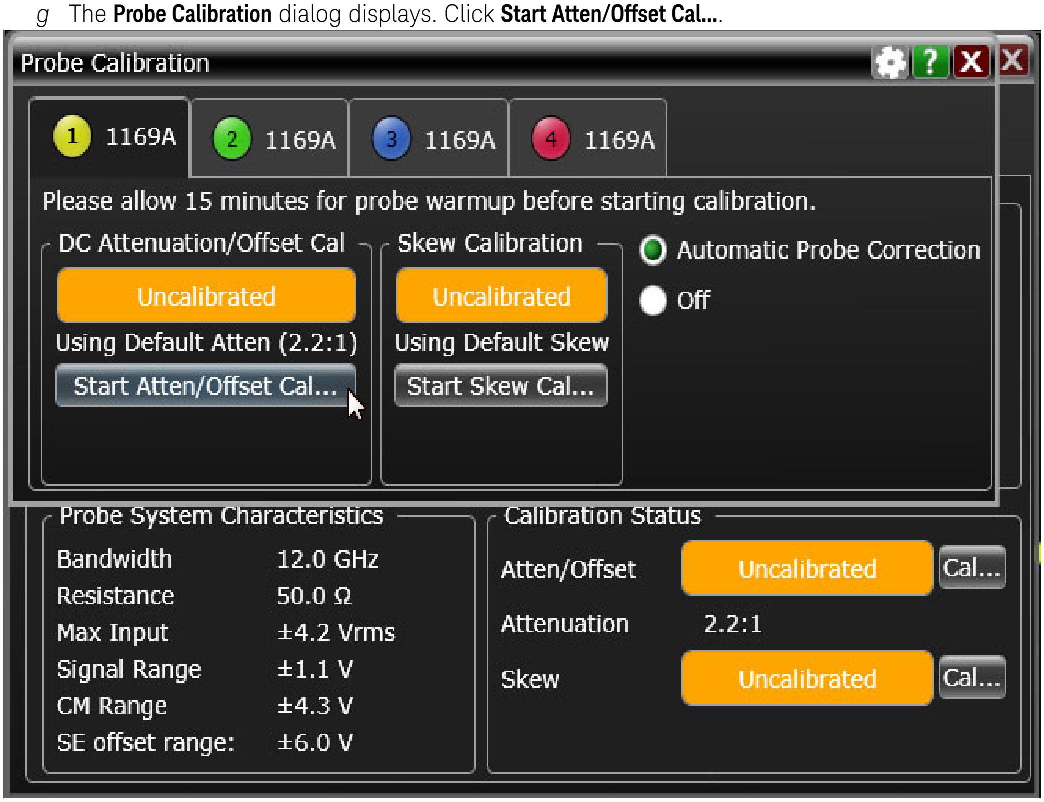
d In the **Differential SMA** block, click the **Select Head...** button.

e Select **N5380A/B** from the list.

f In the **Calibration Status** area, click the **Cal...** button corresponding to **Atten/Offset**.



g The **Probe Calibration** dialog displays. Click **Start Atten/Offset Cal...**.

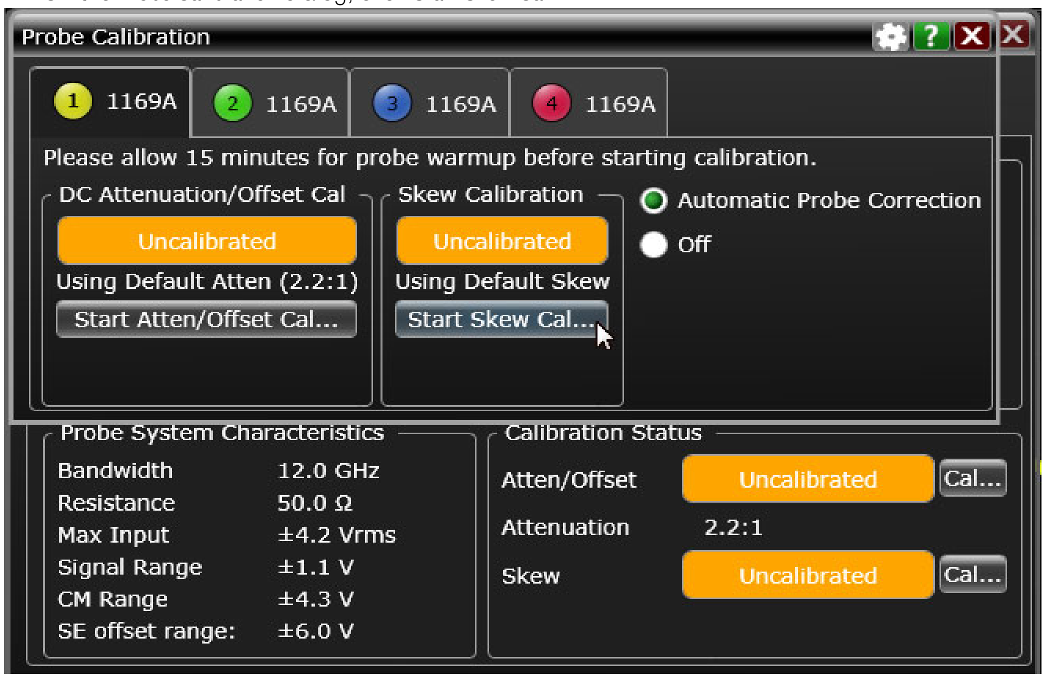


h The Calibration wizard displays. Follow the on-screen instructions. At the end of the Atten/Offset Calibration, perform the Skew calibration for the SMA Probe Head.

SMA Probe Head Skew Calibration

This procedure ensures that the timing skew errors between channels are minimized. After the Atten/Offset Calibration is done, perform the following steps for skew calibration:

1 On the **Probe Calibration** dialog, click **Start Skew Cal...**.



2 The Calibration wizard displays. Follow the on-screen instructions.

Differential SMA Probe Head Atten/Offset Calibration

Perform the following steps

1 Ensure that a probe, attached to an SMA Probe Head is connected to Channel 1 of the Oscilloscope.

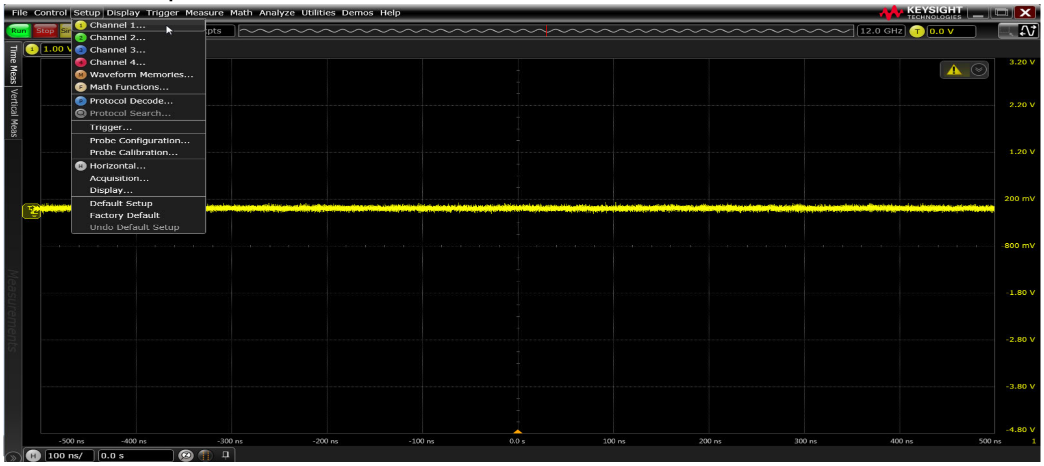
2 Install the 80 Ω resistors into the SMA Probe Head. These resistors are required only for probe calibration and de-skew.

3 Connect the De-skew fixture to AUX Out.

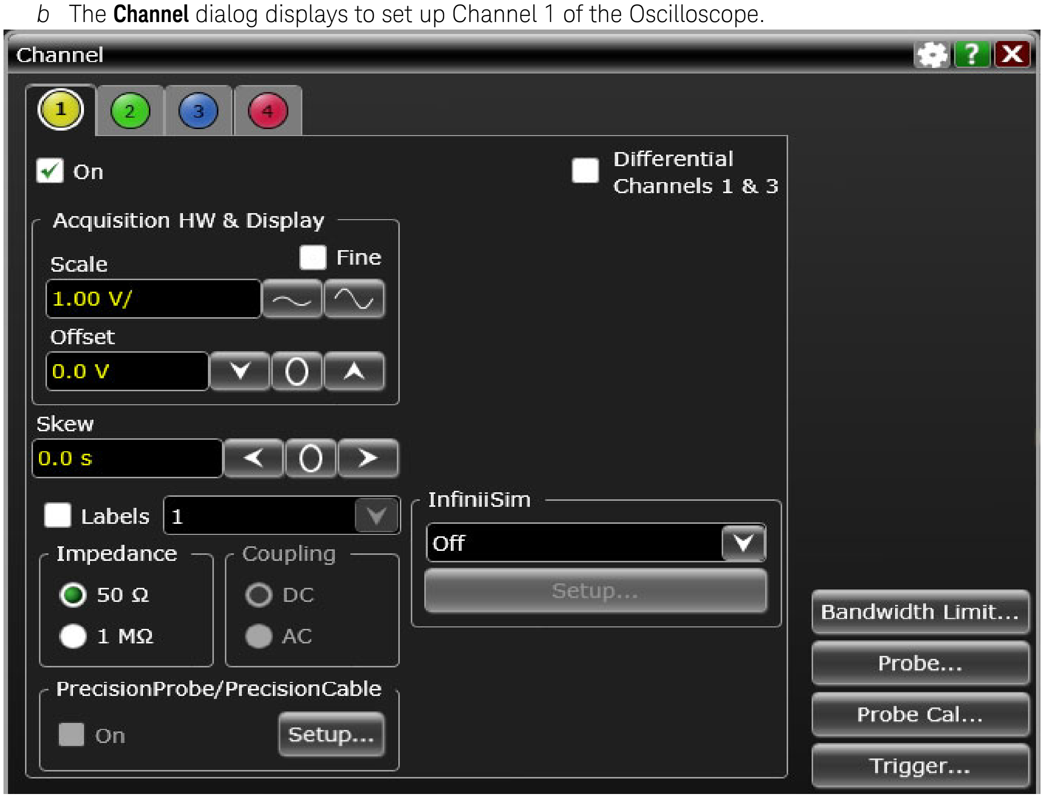
4 Clip the resistors on the De-Skew fixture.

5 On the Infiniium Oscilloscope,

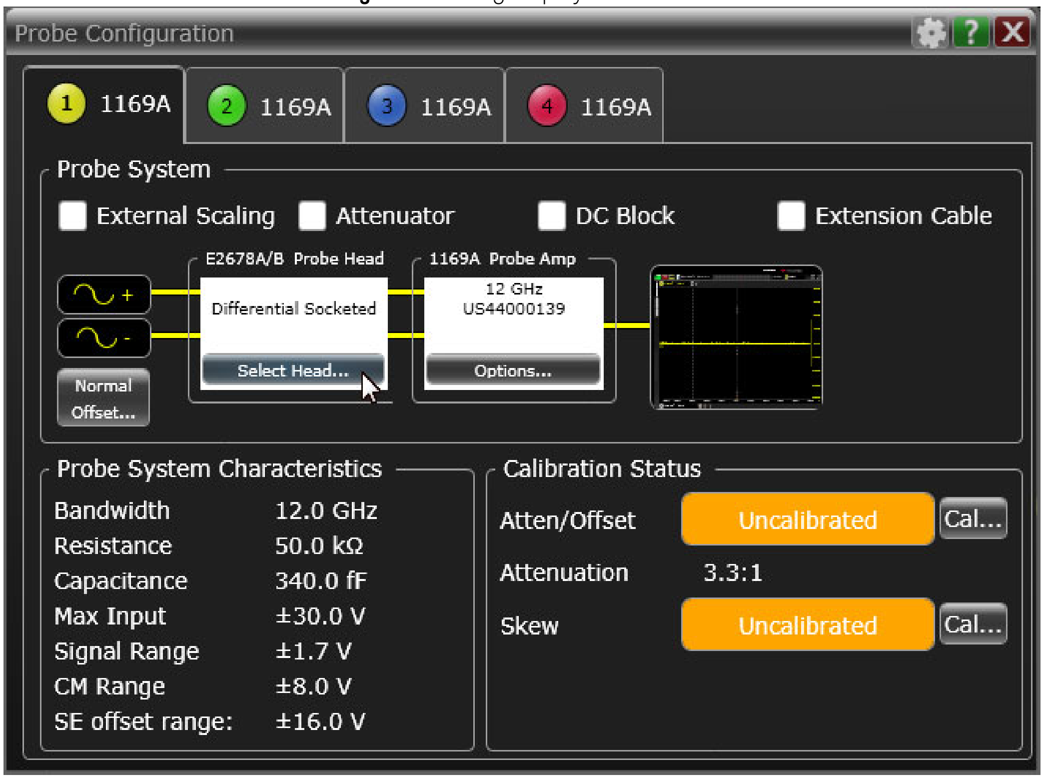
a Click **Setup>Channel 1...**.



b The **Channel** dialog displays to set up Channel 1 of the Oscilloscope.



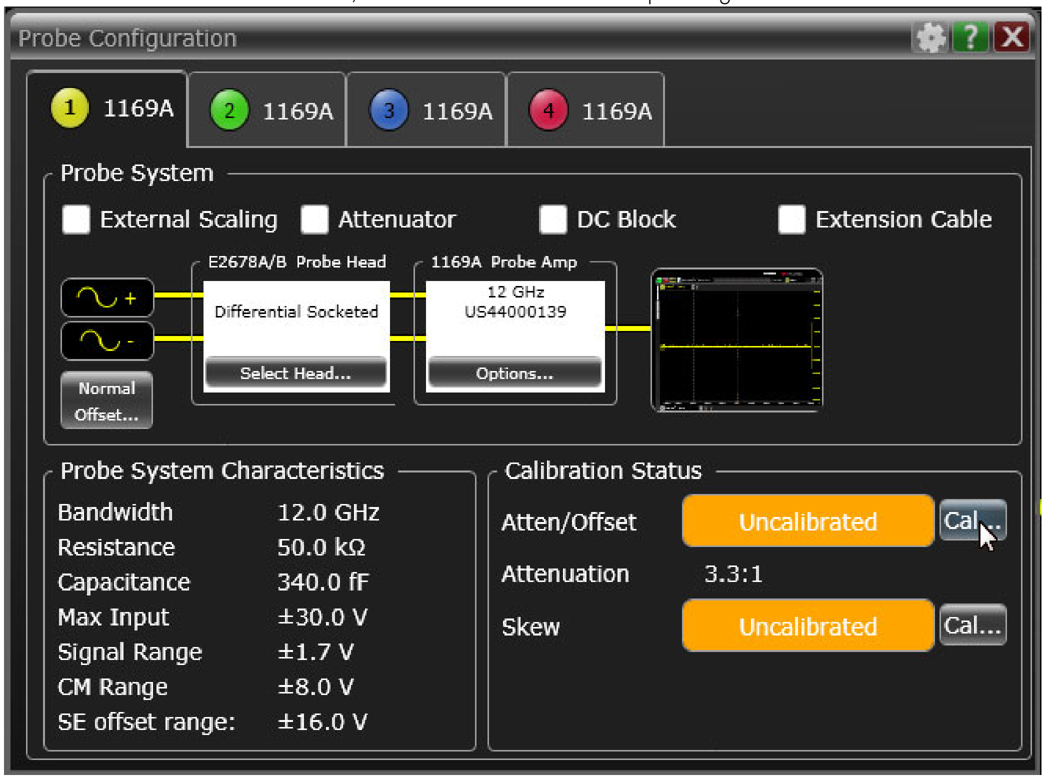
c Click **Probe...**. The **Probe Configuration** dialog displays.



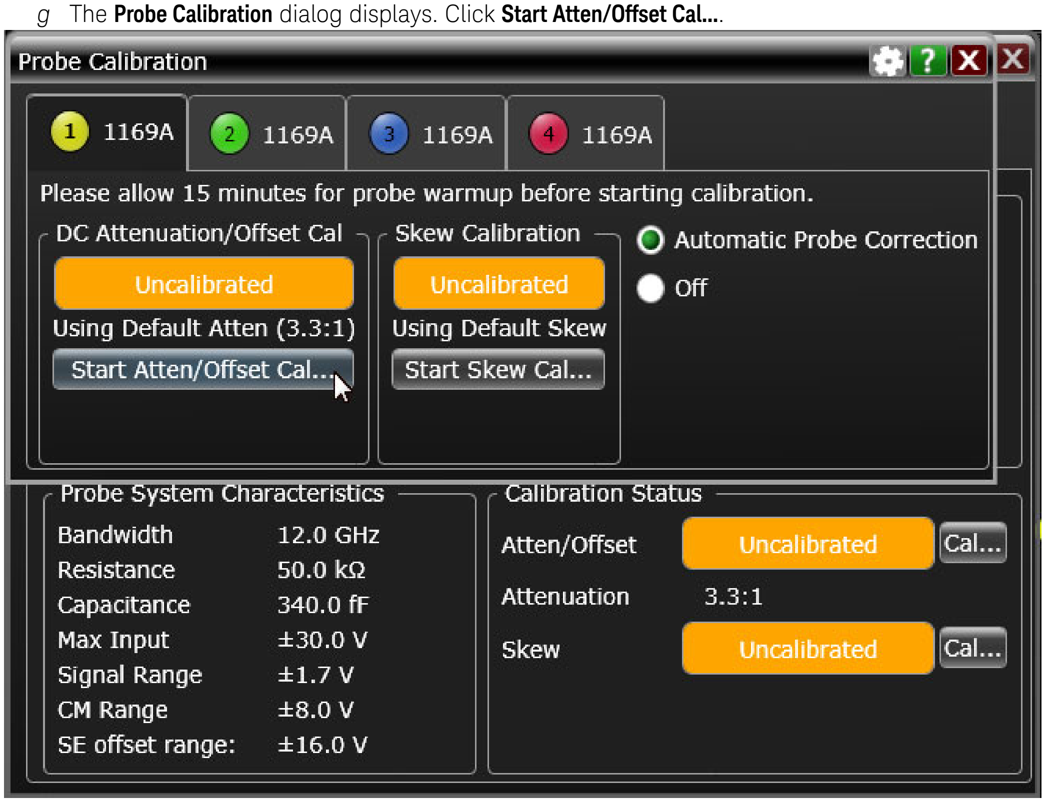
d In the **Differential Socketed** block, click the **Select Head...** button.

e Select **E2678A/B** from the list.

f In the **Calibration Status** area, click the **Cal...** button corresponding to **Atten/Offset**.



g The **Probe Calibration** dialog displays. Click **Start Atten/Offset Cal...**.

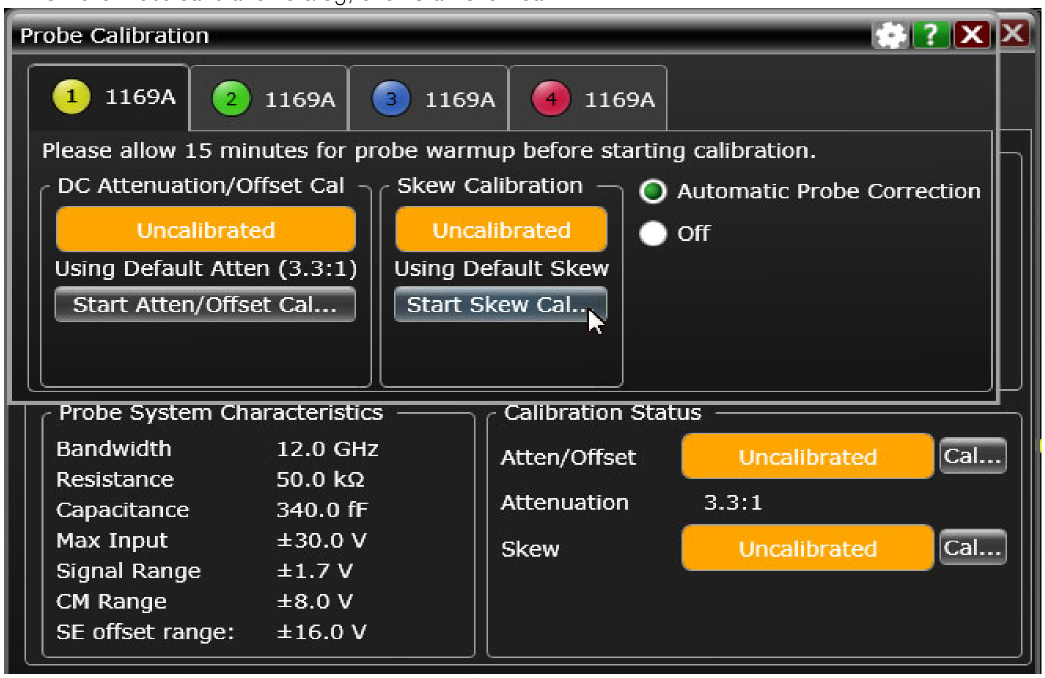


h The Calibration wizard displays. Follow the on-screen instructions. At the end of the Atten/Offset Calibration, perform the Skew calibration for the Differential SMA Probe Head.

Differential SMA Probe Head Skew Calibration

This procedure ensures that the timing skew errors between channels are minimized. After the Atten/Offset Calibration is done, perform the following steps for skew calibration:

1 On the **Probe Calibration** dialog, click **Start Skew Cal...**.



2 The Calibration wizard displays. Follow the on-screen instructions.

For more information on connecting probes to the Infiniium Oscilloscope, refer to the De-skew and Calibration manual. This manual comes together with the E2655A/B/C Probe De-skew and Performance Verification Kit.

NOTE Each probe is calibrated to the Oscilloscope Channel to which it is connected. Do not switch probes between Channels or other Oscilloscopes, else it becomes necessary to calibrate them again. One of the best practices is to label the probes with the Channel number on which they are calibrated.

18 InfiniiMax Probing

This section describes the recommended InfiniiMax Probes used with Keysight Infiniium Oscilloscopes.

Figure 79 1134B InfiniiMax Probe Amplifier

Keysight recommends 116xA/B or 113xA/B probe amplifiers, which range from 3.5 GHz to 12 GHz.

Keysight also recommends the E2677A/B differential solder-in probe head. Other probe head options include N5381A/B InfiniiMax II 12 GHz differential solder-in probe head, N5425A/B InfiniiMax ZIF probe head and N5426A ZIF Tips.

Figure 80 E2677A/B / N5381A/B Differential Solder-in Probe Head

Table 64 Probe Head Characteristics (with 1134B probe amplifier)

Probe Head	Model Number	Differential Measurement (BW, input C, input R)	Single-Ended Measurement (BW, input C, input R)
Differential Solder-in	E2677A/B	7 GHz, 0.27 pF, 50 kOhm	7 GHz, 0.44 pF, 25 kOhm

Used with 1168A/B or 1169A/B probe amplifier, the E2677A/B differential solder-in probe head provides 10 GHz and 12 GHz bandwidth respectively.

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