

**MHL**  
**Advanced Analysis and Compliance Test Software**  
**Printable Online Help**





**MHL**  
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**Printable Online Help**

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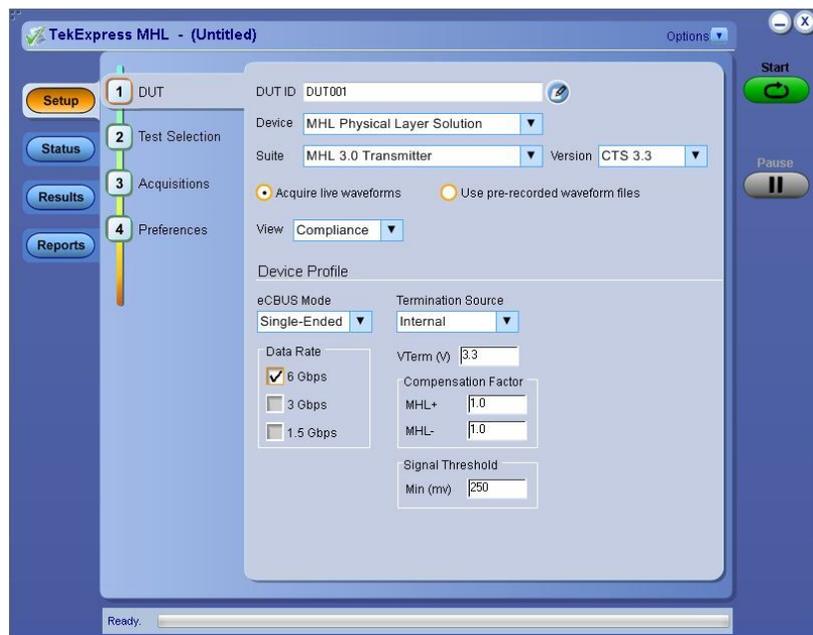
# Welcome

Engineers designing and validating the Mobile High-definition Link (MHL) Interface of their devices face constant pressure to improve efficiency. Engineers need to perform a wide range of compliance tests quickly and reliably right on their bench.

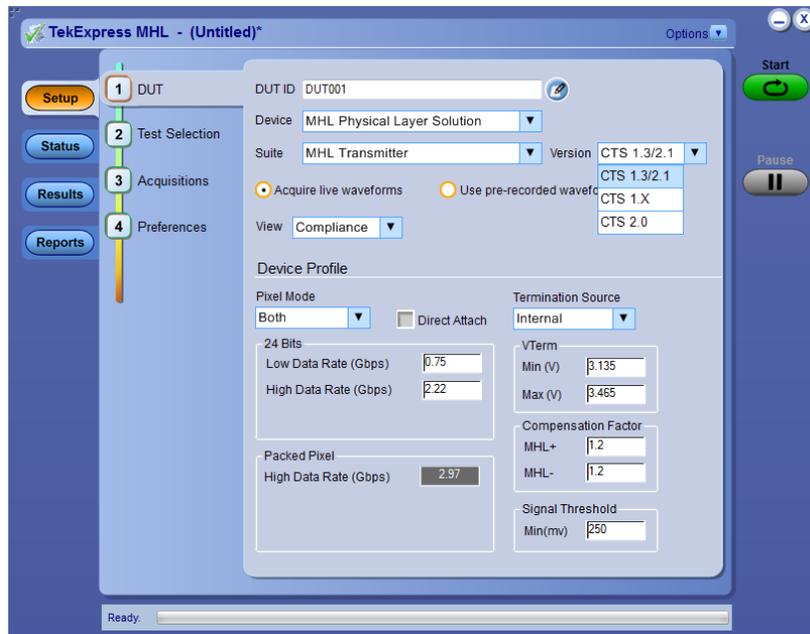
The MHL 1.X, 2.0, 1.3/2.1, 3.2 specification enables mobile devices to transmit uncompressed audio/video to an HDTV or receiver with HD capability. Option MHD advanced analysis and compliance test software meets the MHL 1.X, 2.0 and 1.3/2.1 CTS specification and option MHD3 advanced analysis and compliance test software meets the MHL 3.0 early CTS, 3.2 CTS and 3.3 CTS specification . MHD3 automates a comprehensive range of tests, enabling unprecedented efficiency with reliable results.

## MHL application

- CTS 3.3



- CTS 1.X, 2.0, 1.3 / 2.1



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# Getting help and support

## Technical support

Tektronix values your feedback on our products. To help us serve you better, please send us your suggestions, ideas, or comments on your application or oscilloscope. Contact Tektronix through mail, telephone, or the Web site, [www.tektronix.com](http://www.tektronix.com).

When you contact Tektronix Technical Support, please include the following information (be as specific as possible):

### General Information

- All instrument model numbers
- Hardware options, if any
- Probes used
- Your name, company, mailing address, phone number, FAX number
- Please indicate if you would like to be contacted by Tektronix about your suggestion or comments.

### Application Specific Information

- Software version number
- Description of the problem such that technical support can duplicate the problem
- If possible, save the setup files for all the instruments used and the application.
- If possible, save the TekExpress setup files, log.xml, \*.TekX (session files and folders), and status messages text file.
- If possible, save the waveform on which you are performing the measurement as a .wfm file.



# Overview and key specifications

## Overview and key specifications

The TekExpress MHL Advanced Analysis and Compliance Solution gives you the tools to easily run Mobile High-definition Link (MHL) tests under the MHL compliance test specifications 1.X, 2.0, 1.3 / 2.1 and 3.2. It provides a complete and reliable solution for quick testing.

The application functionality is generally divided into six parts:

- MHL 3.0 Transmitter test (CTS 3.3)
- MHL 3.0 Receiver test (CTS 3.3)
- MHL Transmitter test (CTS 1.X, 2.0, 1.3 / 2.1)
- MHL Receiver test (CTS 1.X, 2.0, 1.3 / 2.1)
- MHL Cable test (CTS 1.3 / 2.1)
- MHL Receiver Protocol test (CTS 1.X, 2.0, 1.3 / 2.1)

Select the suite and version of the CTS by clicking on the *Setup panel* and clicking the *DUT tab*. See *Application basics* for more information.

### Supported Tests:

**TekExpress MHL 3.0 Transmitter** supports these automated *Data, Clock and eCBUS tests*.

**TekExpress MHL 3.0 Receiver** supports these automated *Sink and Dongle tests*.

**TekExpress MHL Transmitter** supports these automated *Clock and Data tests*.

**TekExpress MHL Receiver** supports these automated *Sink and Dongle tests*.

**TekExpress MHL Cables** supports these automated *Clock and Data tests*.

Additional tests may be performed manually by loading the test patterns on the Tektronix Arbitrary Waveform Generator (AWG).

#### MHL Cable Assembly Electrical Tests

**NOTE.** Contact your local Tektronix representative for the MOI of cable tests.

- Impedance
- Intra-Pair Skew
- Delay
- Insertion Loss
- Differential and Common Mode Conversion

## Supported Resolutions:

*MHL Transmitter supports these resolutions.*

*MHL Receiver supports these resolutions.*

*MHL Cables supports these resolutions.*

**See also:** *Application basics*

*Equipment connection setup MHL 3.0 Transmitter*

*Equipment connection setup MHL 3.0 Receiver*

*Equipment connection setup MHL Transmitter*

*Equipment connection setup MHL Receiver*

*Equipment connection setup MHL Cables*

*Install the software*

*Application directories and usage*

*File name extensions*

## Supported tests: MHL 3.0 Transmitter

TekExpress MHL 3.0 Transmitter supports the following automated Data, Clock and eCBUS tests:

**These tests are supported for CTS Version 3.3:**

### MHL 3.0 Transmitter output tests

#### ■ TMDS Data

- 3.7.2.1: Single-ended high level output voltage of differential TMDS data +/-:  $V_{SE\_HIGH\_DF\_TMDS\_DATA}$

This test confirms that the single-ended high level voltage of the differential TMDS data output is within the specified limits.

- 3.7.2.2: Single-ended low level output voltage of differential TMDS data +/-:  $V_{SE\_LOW\_DF\_TMDS\_DATA}$

This test confirms that the single-ended low level voltage of the differential TMDS data is within the specified limits.

- 3.7.2.5: Differential output swing voltage of differential TMDS data:  $V_{DF\_SWING\_DF\_TMDS\_DATA}$

This test confirms that the differential swing voltage of the differential TMDS data is within the specified limits.

- 3.7.2.13: Rise time of differential TMDS data:  $T_{R\_DF\_TMDS\_DATA}$

This test confirms that the rise time of differential TMDS data is within the specified limits.



This test confirms that the rise time of single-ended MHL clock is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 3.7.2.26: Single-ended MHL clock jitter at TP2:

$T_{\text{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}}$

This test confirms that single-ended MHL clock jitter at TP2 is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- **MHL eCBUS**

- 3.7.2.7: Single-ended high level output voltage of single-ended eCBUS-S forward data:  $V_{\text{SE\_HIHG\_SE\_eCBUS\_FWD}}$

This test confirms that the single-ended high level voltages of the single-ended eCBUS-S forward data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 3.7.2.8: Single-ended low level output voltage of single-ended eCBUS-S forward data:  $V_{\text{SE\_LOW\_SE\_eCBUS\_FWD}}$

This test confirms that the single-ended low level voltages of the single-ended eCBUS-S forward data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 3.7.2.9: Single-ended output swing voltage of single-ended eCBUS-S forward data:  $V_{\text{SE\_SWING\_SE\_eCBUS\_FWD}}$

This test confirms that the single-ended output swing voltages of the single-ended eCBUS-S forward data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 3.7.2.24: Fall time of single-ended MHL clock, eCBUS-S forward data:  $T_{\text{F\_SE\_eCBUS\_CLK}}, T_{\text{F\_SE\_eCBUS\_FWD}}$

This test confirms that the fall times of single-ended MHL clock and eCBUS-S forward data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 3.7.2.25: Peak-to-peak amplitude of eCBUS-S forward data:  $V_{\text{PP\_TP1\_SE\_eCBUS\_FWD}}$

This test confirms that the peak-to-peak amplitude of eCBUS-S forward data is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 3.7.2.29: eCBUS-S forward data eye diagram at TP2

This test confirms that the clock jitter of the TMDS differential clock complies with the limits mentioned in specification.

### MHL 3.0 Transmitter input tests

#### ■ MHL eCBUS tests

- 3.7.2.32: Input DC voltage Tolerance of eCBUS-S backward data:  
 $V_{IDC\_SE\_eCBUS\_BWD}$

This test confirms that the source DUT tolerates the input DC voltage levels of eCBUS-S backward data specified in the specification.

- 3.7.2.36: Jitter tolerance of eCBUS-S backward data

This test confirms that the source DUT tolerates the maximum jitter of input eCBUS-S backward data specified in the specification.

- 3.7.2.40 Duty Cycle Tolerance of Single-Ended MHL Clock - Source

This test confirms that the Source DUT tolerates duty cycle variation of the input Single-Ended MHL Clock during the eCBUS-S Start-Up sequence specified in the specification

- Auto Calibration (for 3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data)

This test confirms that the Nominal Jitter & Error patterns used for "3.7.2.36 - Jitter tolerance of eCBUS-S backward data" test meets the required specification.

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#### **NOTE.**

*For Eye diagram test, TekExpress MHL solution uses the Auto mask feature to automatically place the mask to achieve zero or minimal hits. In case of Mask hit, Manual mode options permit user to manually place the mask. Refer to the [Mask movement](#) procedure.*

*TekExpress MHL solution supports only Horizontal movement of mask.*

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## Supported tests: MHL 3.0 Receiver

TekExpress MHL 3.0 Receiver supports the following automated Sink and Dongle tests.

**These tests are supported for CTS Version 3.3:**

### MHL 3.0 Receiver output tests

#### ■ MHL Sink

- 4.7.2.14: Single-ended high level output voltage of eCBUS-S backward data:  $V_{SE\_HIGH\_SE\_eCBUS\_BWD}$

This test confirms that the single-ended high level voltage of eCBUS-S backward data output is within the specified limits.. This test is applied only to the DUT with eCBUS-S.

- 4.7.2.15: Single-ended low level output voltage of eCBUS-S forward data:  $V_{SE\_LOW\_SE\_eCBUS\_BWD}$

This test confirms that the single-ended low level voltage of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 4.7.2.16: Single-ended output swing voltage of eCBUS-S backward data:  $V_{SE\_SWING\_SE\_eCBUS\_BWD}$

This test confirms that the single-ended output swing voltage of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 4.7.2.20: Rise time of eCBUS-S backward data:  $T_{R\_SE\_eCBUS\_BWD}$

This test confirms that the rise time of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 4.7.2.21: Fall time of eCBUS-S backward data:  $T_{F\_SE\_eCBUS\_BWD}$

This test confirms that the fall time of eCBUS-S BWD data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 4.7.2.22: Peak-to-peak amplitude of eCBUS-S backward data:  $V_{PP\_TP2\_SE\_eCBUS\_BWD}$

This test confirms that the peak-to-peak amplitude of eCBUS-S backward data output is within the specified limits.. This test is applied only to the DUT with eCBUS-S.

- 4.7.2.24: eCBUS-S backward data eye diagram at TP1

This test confirms that the eCBUS-S backward data eye diagram at TP1 is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- **MHL Dongle**

- 5.7.2.16: Output DC voltage of eCBUS-S backward data:

$V_{ODC\_SE\_eCBUS\_BWD}$

This test confirms that the DC voltage level of eCBUS-S backward data output signal is within the specified limits. This test is applied only to the DUT with eCBUS-D.

- 5.7.2.17: Single-ended output swing voltage of eCBUS-S backward data:

$V_{SE\_SWING\_SE\_eCBUS\_BWD}$

This test confirms that the single-ended output swing voltage of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- 5.7.2.19: eCBUS-S backward data eye diagram at TP3

This test confirms that the eCBUS-S backward data eye diagram at TP3 is within the specified limits. This test is applied only to the DUT with eCBUS-S.

### **MHL 3.0 Receiver input tests**

- **MHL Sink**

- 4.7.2.1: Input DC voltage tolerance of differential TMDS data:

$V_{IDC\_DF\_TMDS\_DATA}$

This test confirms that the Sink device supports the DC voltage level of the differential TMDS data input signal allowed by the specification.

- 4.7.2.3: Differential input swing voltage tolerance of differential TMDS data:

$V_{IDF\_SWING\_DF\_TMDS\_DATA}$

This test confirms that the Sink device supports the differential swing voltage of the differential TMDS data input signal allowed by the specification.

- 4.7.2.5: Input DC voltage tolerance of single-ended MHL clock and eCBUS-S forward data:

$V_{IDC\_SELMHL\_CLK}$ ,  $V_{IDC\_SE\_eCBUS\_FWD}$

This test confirms that the single-ended MHL clock and eCBUS-S forward data input signals allowed by the specification. This test is applied only to the DUT with eCBUS-S.

- 4.7.2.7: Differential intra-pair skew tolerance of differential TMDS data:

$T_{SKEW\_TP2\_DF\_TMDS\_DATA}$

This test confirms that the Sink device tolerates the differential intra-pair skew of the differential TMDS data input signal allowed by the specification.

- 4.7.2.10: Jitter tolerance of single-ended MHL clock:

$T_{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}$

This test confirms that the Sink device tolerates the single-ended MHL clock jitter. This test is applied only to the DUT with eCBUS-S.

- 4.7.2.28 Duty Cycle Tolerance of Single-Ended MHL Clock - Sink

This test confirms that the Sink DUT tolerates duty cycle variation of the input Single-Ended MHL Clock during the eCBUS-S Start-Up sequence specified in the specification.

- **MHL Dongle**

- 5.7.2.1: Single-ended high level input voltage tolerance of differential TMDS data:  $V_{SE\_HIGH\_DF\_TMDS\_DATA}$

This test confirms that the Dongle device supports the single-ended high level voltage of the differential TMDS data input signal allowed by the specification.

- 5.7.2.2: Single-ended low level input voltage tolerance of differential TMDS data:  $V_{SE\_LOW\_DF\_TMDS\_DATA}$

This test confirms that the Dongle device supports the single-ended low level voltage of the differential TMDS data input signal allowed by the specification.

- 5.7.2.5: Differential input swing voltage tolerance of differential TMDS data:  $V_{IDF\_SWING\_DF\_TMDS\_DATA}$

This test confirms that the Dongle device supports the differential swing voltage of the differential TMDS data input signal allowed by the specification.

- 5.7.2.7: Single-ended high level input voltage tolerance of single-ended MHL clock and eCBUS-S forward data:  $V_{SE\_HIGH\_SE\_MHL\_CLK}$ ,  $V_{SE\_HIGH\_SE\_eCBUS\_FWD}$

This test confirms that the Dongle device supports the single-ended high level voltage of the single-ended MHL clock and eCBUS-S forward data input signals allowed by the specification. This test is applied only to the DUT with eCBUS-S.

- 5.7.2.8: Single-ended low level input voltage tolerance of single-ended MHL clock and eCBUS-S forward data:  $V_{SE\_LOW\_SE\_MHL\_CLK}$ ,  $V_{SE\_LOW\_SE\_eCBUS\_FWD}$

This test confirms that the Dongle device supports the single-ended low level voltage of the single-ended MHL clock and eCBUS-S forward data input signals allowed by the specification. This test is applied only to the DUT with eCBUS-S.

- 5.7.2.10: Differential intra-pair skew tolerance of differential TMDS data:  $T_{SKEW\_TP3\_DF\_TMDS\_DATA}$

This test confirms that the Dongle device tolerates the differential intra-pair skew of the differential TMDS data input signal allowed by the specification.

- 5.7.2.13: Jitter tolerance of single-ended MHL clock

This test confirms that the Dongle device tolerates the single-ended MHL clock jitter and eCBUS-S forward data eye diagram impairments and differential TMDS data eye diagram impairments allowed by the specification. This test is applied only to the DUT with eCBUS-S.

- 5.7.2.23 Duty Cycle Tolerance of Single-Ended MHL Clock - Dongle

This test confirms that the Dongle device tolerates duty cycle variation of the input Single-Ended MHL Clock during the eCBUS-S Start-Up sequence specified in the specification.

## Supported tests: MHL Transmitter

TekExpress MHL Transmitter supports the following automated Clock and Data tests:

### These tests are supported for CTS Version 1.0:

#### Clock tests

- 3.1.1.1: Standby (Off) Output Voltage Test -  $V_{OFF}$

This test measures that the MHL source output voltage is within the specified level limits when the source device is in Standby State or power off mode as specified in the CDF.

- 3.1.1.5: Common-mode Output Swing Voltage Test -  $V_{CMSWING}$

This test confirms that common-mode output voltage swing amplitude is within the specified limits when the DUT operates in normal mode.

- 3.1.1.7: Common-mode Rise and Fall Times Test -  $T_{R\_CM}$ ,  $T_{F\_CM}$

This test confirms that the rise time and fall time of the common-mode output signal are within the specified limits.

- 3.1.1.10: MHL Clock Duty Cycle Test - 24 Bit or Packed Pixel Mode

This test confirms that the MHL clock duty cycle in 24-bit or packed pixel mode does not exceed the limits allowed by the specification.

- 3.1.1.11: MHL Clock Jitter Test

This test confirms that the MHL Clock output does not contain excessive jitter larger than the limit allowed by the specification.

#### Data tests

- 3.1.1.2: Single-ended High Level Voltage Test -  $V_{SE\_HIGH}$

This test confirms that the single-ended high output voltage level is within the specified limits when the DUT is in normal mode.

- 3.1.1.3: Single-ended Low Level Voltage Test -  $V_{SE\_LOW}$

This test confirms that the single-ended low output voltage level is within the specified limits when the DUT is in normal mode.

- 3.1.1.4: Differential Output Swing Voltage Test -  $V_{DF\_SWING}$

This test confirms that the differential output voltage swing amplitude is within the specified limits when the DUT is in normal mode.

- 3.1.1.6: Differential Rise and Fall Times Test -  $T_{R\_DF}$ ,  $T_{F\_DF}$

This test confirms that the rise and fall times of the differential output signal are equal to or larger than the minimum limit.

- 3.1.1.8: Differential Intra-Pair Skew Test -  $T_{SKEW\_DF}$

This test confirms that the timing skew in the differential signal pair is below the specified limits.

- 3.1.1.12: MHL Data Eye Diagram Test

This test confirms that the MHL Data output has signal quality that meets the eye opening required by the specification.

---

### **NOTE.**

*For Eye diagram test, TekExpress MHL solution uses the Auto mask feature to automatically place the mask to achieve zero or minimal hits. In case of Mask hit, Manual mode options permit user to manually place the mask. Refer to the [Mask movement procedure](#).*

*TekExpress MHL solution supports only Horizontal movement of mask.*

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### **These tests are supported for CTS Version 2.0:**

#### **Clock tests**

- 3.1.1.1: Standby (Off) Output Voltage Test -  $V_{OFF}$

This test measures that the MHL source output voltage is within the specified level limits when the source device is in Standby State or power off mode as specified in the CDF.

- 3.1.1.5: Common-mode Output Swing Voltage Test -  $V_{CMSWING}$

This test confirms that common-mode output voltage swing amplitude is within the specified limits when the DUT operates in normal mode.

- 3.1.1.7: Common-mode Rise and Fall Times Test -  $T_{R\_CM}$ ,  $T_{F\_CM}$

This test confirms that the rise time and fall time of the common-mode output signal are within the specified limits.

- 3.1.1.10: MHL Clock Duty Cycle Test - Normal Mode

This test confirms that the MHL clock duty cycle does not exceed the limits allowed by the specification in Normal Mode.

- 3.1.1.11: MHL Clock Jitter Test - Normal Mode

This test confirms that the MHL Clock output does not contain excessive jitter greater than the limit allowed by the specification in Normal Mode.

- 3.1.1.14: MHL Clock Duty Cycle Test - Packed Pixel Mode

This test confirms that the MHL clock duty cycle in packed pixel mode does not exceed the limits allowed by the specification.

- 3.1.1.15: MHL Clock Jitter Test - Packed Pixel Mode

This test confirms that the MHL Clock output does not contain excessive jitter larger than the limit allowed by the specification in Packed Pixel Mode.

#### Data tests

- 3.1.1.2: Single-ended High Level Voltage Test -  $V_{SE\_HIGH}$

This test confirms that the single-ended high output voltage level is within the specified limits when the DUT is in normal mode.

- 3.1.1.3: Single-ended Low Level Voltage Test -  $V_{SE\_LOW}$

This test confirms that the single-ended low output voltage level is within the specified limits when the DUT is in normal mode.

- 3.1.1.4: Differential Output Swing Voltage Test -  $V_{DF\_SWING}$

This test confirms that the differential output voltage swing amplitude is within the specified limits when the DUT is in normal mode.

- 3.1.1.6: Differential Rise and Fall Times Test -  $T_{R\_DF}$ ,  $T_{F\_DF}$

This test confirms that the rise and fall times of the differential output signal are equal to or larger than the minimum limit.

- 3.1.1.8: Differential Intra-Pair Skew Test -  $T_{SKEW\_DF}$

This test confirms that the timing skew in the differential signal pair is below the specified limits.

- 3.1.1.12: MHL Data Eye Diagram Test - Normal Mode

This test confirms that the MHL Data output has signal quality that meets the eye opening required by the specification in Normal Mode.

- 3.1.1.16: MHL Data Eye Diagram Test - Packed Pixel Mode

This test confirms that the MHL Data output has signal quality that meets the eye opening required by the specification in Packed Pixel Mode.

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#### NOTE.

*For Eye diagram test, TekExpress MHL solution uses the Auto mask feature to automatically place the mask to achieve zero or minimal hits. In case of Mask hit, Manual mode options permit user to manually place the mask. Refer to the [Mask movement](#) procedure.*

*TekExpress MHL solution supports only Horizontal movement of mask.*

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#### These tests are supported for CTS Version 1.3/2.1:Clock Tests

- 3.1.1.1: Standby (Off) Output Voltage Test -  $V_{OFF}$

This test measures that the MHL source output voltage is within the specified level limits when the source device is in Standby State or power off mode as specified in the CDF.

- 3.1.1.5: Common-mode Output Swing Voltage Test -  $V_{\text{CMSWING}}$

This test confirms that common-mode output voltage swing amplitude is within the specified limits when the DUT operates in normal mode.

- 3.1.1.7: Common-mode Rise and Fall Times Test -  $T_{\text{R\_CM}}$ ,  $T_{\text{F\_CM}}$

This test confirms that the rise time and fall time of the common-mode output signal are within the specified limits.

- 3.1.1.10: MHL Clock Duty Cycle Test - Normal Mode

This test confirms that the MHL clock duty cycle does not exceed the limits allowed by the specification in Normal Mode.

- 3.1.1.14: MHL Clock Duty Cycle Test - Packed Pixel Mode

This test confirms that the MHL clock duty cycle in packed pixel mode does not exceed the limits allowed by the specification.

- 3.1.1.17: TP2 Clock Jitter Test - Normal Mode

This test confirms that the TP2 Clock output does not contain excessive jitter larger than the limit allowed by the specification in Normal Mode.

- 3.1.1.19: TP2 Clock Jitter Test - Packed Pixel Mode

This test confirms that the TP2 Clock output does not contain excessive jitter larger than the limit allowed by the specification in Packed Pixel Mode.

#### **Data tests**

- 3.1.1.2: Single-ended High Level Voltage Test -  $V_{\text{SE\_HIGH}}$

This test confirms that the single-ended high output voltage level is within the specified limits when the DUT is in normal mode.

- 3.1.1.3: Single-ended Low Level Voltage Test -  $V_{\text{SE\_LOW}}$

This test confirms that the single-ended low output voltage level is within the specified limits when the DUT is in normal mode.

- 3.1.1.4: Differential Output Swing Voltage Test -  $V_{\text{DF\_SWING}}$

This test confirms that the differential output voltage swing amplitude is within the specified limits when the DUT is in normal mode.

- 3.1.1.6: Differential Rise and Fall Times Test -  $T_{\text{R\_DF}}$ ,  $T_{\text{F\_DF}}$

This test confirms that the rise and fall times of the differential output signal are equal to or larger than the minimum limit.

- 3.1.1.18: TP2 Data Eye Diagram Test - Normal Mode

This test confirms that the TP2 Data output has signal quality that meets the eye opening required by the specification in Normal Mode.

- 3.1.1.20: TP2 Data Eye Diagram Test - Packed Pixel Mode

This test confirms that the TP2 Data output has signal quality that meets the eye opening required by the specification in Packed Pixel Mode.

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**NOTE.**

*For Eye diagram test, TekExpress MHL solution uses the Auto mask feature to automatically place the mask to achieve zero or minimal hits. In case of Mask hit, Manual mode options permit user to manually place the mask. Refer to the [Mask movement](#) procedure.*

*TekExpress MHL solution supports only Horizontal movement of mask.*

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## Supported tests: MHL Receiver

TekExpress MHL Receiver supports the following automated Sink and Dongle tests.

### **These tests are supported for CTS version 1.0:**

#### **MHL Sink tests**

- 4.1.1.1: Input Signal DC Voltage Level Tolerance Test

This test confirms that the Sink device supports input signal DC voltage level allowed by the specification.

- 4.1.1.2: Input Signal Minimum and Maximum Swing Voltages Tolerance Test

This test confirms that the Sink device supports input signal DC voltage level and swing voltage allowed by the specification.

- 4.1.1.3: Intra Pair Skew Tolerance Test

This test confirms that the Sink device can tolerate the maximum intra-pair skew allowed by the specification.

- 4.1.1.4: Jitter Tolerance Test

This test confirms that the Sink device can tolerate the maximum clock and data jitter amounts allowed by the specification.

#### **MHL Dongle tests**

- 5.1.1.1: Input Signal Single-Ended Voltage Level Tolerance Test

This test confirms that the Dongle device supports input signal single-ended voltage level allowed by the specification.

- 5.1.1.2: Input Signal Minimum and Maximum Swing Voltages Tolerance Test

This test confirms that the Dongle device supports input signal minimum and maximum swing voltages allowed by the specification.

- 5.1.1.3: Intra-Pair Skew Tolerance Test

This test confirms that the Dongle device can tolerate the maximum intra-pair skew allowed by the specification.

- 5.1.1.4: Jitter Tolerance Test

This test confirms that the Dongle device can tolerate the maximum clock and data jitter amounts allowed by the specification.

**These tests are supported for CTS version 2.0 and version 1.3/2.1:**

### **MHL Sink tests**

- 4.1.1.1: Input Signal DC Voltage Level Tolerance Test

This test confirms that the Sink device supports input signal DC voltage level allowed by the specification.

- 4.1.1.2: Input Signal Minimum and Maximum Swing Voltages Tolerance Test

This test confirms that the Sink device supports input signal DC voltage level and swing voltage allowed by the specification.

- 4.1.1.3: Intra Pair Skew Tolerance Test

This test confirms that the Sink device can tolerate the maximum intra-pair skew allowed by the specification.

- 4.1.1.4: Jitter Tolerance Test in Normal Mode

This test confirms that the Sink device can tolerate the maximum clock and data jitter amounts allowed by the specification in Normal Mode with cable emulator.

- 4.1.1.8: Jitter Tolerance Test – Packed Pixel Mode

This test confirms that the Sink device can tolerate the maximum clock and data jitter amounts allowed by the specification in Packed Pixel Mode.

### **MHL Dongle tests**

- 5.1.1.1: Input Signal Single-Ended Voltage Level Tolerance Test

This test confirms that the Dongle device supports input signal single-ended voltage level allowed by the specification.

- 5.1.1.2: Input Signal Minimum and Maximum Swing Voltages Tolerance Test

This test confirms that the Dongle device supports input signal minimum and maximum swing voltages allowed by the specification.

- 5.1.1.3: Intra-Pair Skew Tolerance Test

This test confirms that the Dongle device can tolerate the maximum intra-pair skew allowed by the specification.

- 5.1.1.4: Jitter Tolerance Test – Normal Mode

This test confirms that the Dongle device can tolerate the maximum clock and data jitter amounts allowed by the specification in Normal Mode.

- 5.1.1.9: Jitter Tolerance Test – Packed Pixel Mode

This test confirms that the Dongle device can tolerate the maximum clock and data jitter amounts allowed by the specification in Packed Pixel Mode.

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**NOTE.** *All sink tests are applicable for CTS 1.3 / 2.1 direct attach device.*

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## Supported tests: MHL Cables

TekExpress MHL Cables supports the following automated Clock and Data tests.

**These tests are supported for CTS Version 1.3/2.1:**

### MHL Clock tests

- 7.2.1.16: Minimum clock swing test

This test confirms that minimum clock voltage swing amplitude is within the specified limits allowed by the specification.

### MHL Data tests

- 7.2.1.17: MHL eye diagram test

This test confirms that the MHL data cable output has signal quality that meets the eye opening required by the specification.

---

**NOTE.**

*For Eye diagram test, TekExpress MHL solution uses the Auto mask feature to automatically place the mask to achieve zero or minimal hits. In case of Mask hit, Manual mode options permit user to manually place the mask. Refer to the [Mask movement](#) procedure.*

*TekExpress MHL solution supports only Horizontal movement of mask.*

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## Supported tests: MHL Receiver Protocol

TekExpress MHL Receiver Protocol supports the following automated Sink and Dongle tests for CTS 1.X, 2.0, 1.3/2.1 versions.

### **MHL Sink Protocol tests based on the AWG direct synthesis patterns**

These tests confirm that the sink DUT synchronizes if the data stream provides only minimum length Control Periods.

- 4.2.1.1: Character Synchronization in Normal mode
- 4.2.1.3: Character Synchronization in Packed Pixel mode

CTS 2.0, CTS 1.3/2.1 only.

These tests confirm that the sink DUT accepts all valid packet types.

- 4.2.1.2: Packet Types in Normal Mode
- 4.2.1.4: Packet Types in Packed Pixel Mode

CTS 2.0, CTS 1.3/2.1 only.

These tests verify that the sink DUT supports the video formats with no distortion.

- 4.2.2.1: Video Formats in Normal Mode
- 4.2.2.4: Video Formats in Packed Pixel Mode

CTS 2.0, CTS 1.3/2.1 only.

This test verifies that the sink supports RGB, YCbCr, 4:2:2 pixel encoding in Normal mode.

- 4.2.2.2: Pixel Encoding in Normal Mode

This test verifies that the sink has the correct QY and QS bits in the Video Capability Data Block, and the Sink displays with no distortion.

- 4.2.2.3: Video Quantization Range

This test verifies that the sink supports the required Audio formats and reproduces audio properly.

- 4.2.3.1: IEC 60958 / IEC61937

This test verifies that the sink properly regenerates audio when different Audio Clock Regeneration parameters are used.

- 4.2.3.2: Audio Clock Regeneration

These tests confirm that the sink DUT supports the required and optional 3D video modes.

- 4.2.8.2: 3D Video Format in Normal Mode
- 4.2.8.3: 3D Video Format in Packed Pixel Mode

CTS 2.0, CTS 1.3/2.1 only.

CTS 2.0, CTS 1.3/2.1 only.

**MHL Dongle Protocol tests based on AWG direct synthesis patterns**

This test confirms that the dongle DUT synchronizes if the data stream provides only minimum length Control Periods.

- 5.2.1.1: Character Synchronization in Normal mode
- 5.2.1.3: Character Synchronization in Packed Pixel mode  
CTS 2.0, CTS 1.3/2.1 only.

These tests confirm that the dongle DUT accepts all valid packet types.

- 5.2.1.2: Packet Types in Normal Mode
- 5.2.1.4: Packet Types in Packed Pixel Mode  
CTS 2.0, CTS 1.3/2.1 only.

These tests verify that the dongle DUT supports the video formats with no distortion.

- 5.2.2.1: Video Formats in Normal Mode
- 5.2.2.4: Video Formats in Packed Pixel Mode  
CTS 2.0, CTS 1.3/2.1 only.

This test confirms that the dongle supports RGB, YCbCr, 4:2:2 pixel encoding in Normal mode.

- 5.2.2.2: Pixel Encoding in Normal Mode

This test verifies that the dongle has correct QY and QS bits in the Video Capability Data Block, and the dongle displays with no distortion.

- 5.2.2.3: Video Quantization Range

This test verifies that the dongle converts audio properly.

- 5.2.3.1: IEC 60958 / IEC61937

This test verifies that the dongle properly regenerates audio when different Audio Clock Regeneration parameters are used.

- 5.2.3.2: Audio Clock Regeneration

These tests confirm that the dongle DUT supports the required and optional 3D video modes.

- 5.2.8.2: 3D Video Format in Normal Mode  
CTS 2.0, CTS 1.3/2.1 only.
- 5.2.8.3: 3D Video Format in Packed Pixel Mode  
CTS 2.0, CTS 1.3/2.1 only.

## Supported data rate: MHL 3.0 Transmitter

**CTS 3.2:** All of the TekExpress MHL tests can be performed for DUTs operating in data between 6Gbps and 1.5Gbps. For instance, a DUT could have any of the following:

Low: 1.5Gbps High: 6 Gbps

Low: 1.5Gbps High: 3 Gbps

Low: 3Gbps High: 6 Gbps

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**NOTE.** *When data rate selected is one only, then Low and High data rate are the same and software performs the test at selected data rate.*

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## Supported data rate: MHL 3.0 Receiver

**CTS 3.3:** All of the TekExpress MHL tests can be performed for DUTs operating at these data rates (Gbps):

- 6Gbps
- 3Gbps
- 1.5Gbps

## Supported resolutions: MHL Transmitter

**CTS 1.0:** All of the TekExpress MHL tests can be performed for DUTs operating in resolutions between 25 MHz and 74.25 MHz. Other resolutions that fall within this range can be entered in the Low Resolution and High Resolution fields on the DUT tab of the Setup panel. For instance, a DUT could have any of the following:

Low : 25      High : 25

Low : 25      High : 27

Low : 25      High : 74.25

When Low and High resolutions are the same, the software performs the test at that one resolution.

**CTS 2.0, CTS 1.3/2.1:** All of the TekExpress MHL tests can be performed for DUTs operating at these data rates (Gbps):

24 Bit mode:

Low : 0.75      High : 2.22

Low : 0.81      High : 2.22

Packed Pixel mode:

Low : 2.97 High : 2.97

Other data rates that fall within this range can be entered in the Low Data Rate and High Data Rate fields on the DUT tab of the Setup panel.

**Table 1: Supported resolutions (Transmitter)**

Test group	Test name	Supported resolutions
MHL Clock	3.1.1.1: Standby Output Voltage – $V_{OFF}$	—
	3.1.1.5: Common-mode Output Swing Voltage $V_{CMSWING}$	Low resolution
	3.1.1.7: Common-mode Rise and Fall Times- $T_{R\_CM}, T_{F\_CM}$	High resolution
	CTS 1.X 3.1.1.10: MHL Clock Duty Cycle – 24 Bit or Packed Pixel Mode	High resolution
	CTS 2.0 3.1.1.10: MHL Clock Duty Cycle – Normal Mode	High resolution
	CTS 1.X 3.1.1.11: MHL Clock Jitter	Low and High resolutions
	CTS 2.0 3.1.1.11: MHL Clock Jitter – Normal Mode	Low and High resolutions
	CTS 2.0 3.1.1.14: MHL Clock Duty Cycle – Packed Pixel Mode	High resolution (PP)
	CTS 2.0 3.1.1.15: MHL Clock Jitter – Packed Pixel Mode	High resolution (PP)
	CTS 1.3 / 2.1 3.1.1.17: TP2 Clock Jitter Test - Normal Mode	Low and High resolutions
	CTS 1.3 / 2.1 3.1.1.19: TP2 Clock Jitter Test - Packed Pixel Mode	High resolution (PP)

Test group	Test name	Supported resolutions
MHL Data	3.1.1.2: Single-ended High Level Voltage – $V_{SE\_HIGH}$	Low resolution
	3.1.1.3: Single-ended Low Level Voltages – $V_{SE\_LOW}$	Low resolution
	3.1.1.4: Differential Output Swing Voltage – $V_{DF\_SWING}$	Low resolution
	3.1.1.6: Differential Rise and Fall Times – $T_{R\_DF}$ , $T_{F\_DF}$	High resolution
	3.1.1.8: Differential Intra-Pair Skew – $T_{SKEW\_DF}$	Low resolution
	CTS 1.X, CTS 2.0 3.1.1.12: MHL Data Eye Diagram	Low and High resolutions
	CTS 2.0 3.1.1.12: MHL Data Eye Diagram – Normal Mode	Low and High resolutions
	CTS 2.0 3.1.1.16: MHL Data Eye Diagram – Packed Pixel Mode	High resolution (PP)
	CTS 1.3 / 2.1 3.1.1.18: TP2 Data Eye Diagram Test - Normal Mode	Low and High resolutions
	CTS 1.3 / 2.1 3.1.1.20: TP2 Data Eye Diagram Test - Packed Pixel Mode	High resolution (PP)

## Supported resolutions: MHL Receiver

**CTS 1.X:** All of the TekExpress MHL Receiver tests can be performed for DUTs operating in resolutions of 25, 27 and 74.25 MHz according to the standard. Other resolutions that fall within this range can be entered in the **Low Resolution** and **High Resolution** fields on the **DUT** tab of the Setup panel. Either of the Resolutions can be **High** according to the Manufacturer. For instance, a DUT could have any of the following:

Low : 25      High : 25  
 Low : 25      High : 27  
 Low : 25      High : 74.25

**CTS 2.0 and CTS 1.3 / 2.1:** All of the TekExpress MHL tests can be performed for DUTs operating at these data rates (Gpbs):

24 Bit mode:

Low : 0.75      High : 2.22  
 Low : 0.81      High : 2.22

Packed Pixel mode:

Low : 2.97 High : 2.97

Other data rates that fall within this range can be entered in the Low Data Rate and High Data Rate fields on the DUT tab of the Setup panel.

**Table 2: Supported resolutions (MHL Receiver)**

Test group	Test name	Supported resolutions
<b>MHL Sink</b>	4.1.1.1: Input Signal DC Voltage Level Tolerance	Highest
	4.1.1.2: Input Signal Minimum and Maximum Swing Voltages Tolerance	Highest
	4.1.1.3: Intra-Pair Skew Tolerance	Highest
	CTS 1.X 4.1.1.4: Jitter Tolerance CTS 2.0 and CTS 1.3 / 2.1 4.1.1.4: Jitter Tolerance in Normal Mode	Lowest and Highest
	CTS 2.0 and CTS 1.3 / 2.1 4.1.1.8: Jitter Tolerance in Packed Pixel Mode	Highest
<b>MHL Dongle</b>	CTS 2.0 and CTS 1.3 / 2.1 5.1.1.1: Input Signal Single-Ended Voltage Level Tolerance	Highest
	5.1.1.2: Input Signal Minimum and Maximum Swing Voltage Tolerance	Highest
	5.1.1.3: Intra-Pair Skew Tolerance	Highest
	CTS 1.X 5.1.1.4: Jitter Tolerance CTS 2.0 and CTS 1.3 / 2.1 5.1.1.4: Jitter Tolerance in Normal Mode	Lowest and Highest
	CTS 2.0 and CTS 1.3 / 2.1 5.1.1.9: Jitter Tolerance in Packed Pixel Mode	Highest

## Supported resolutions: MHL Cables

**CTS 1.3/2.1:** All of the TekExpress MHL tests can be performed for DUTs operating at these data rates (Gbps):

Packed Pixel mode:

Low : 2.97      High : 2.97

**Table 3: Supported resolutions (Cables)**

Test group	Test name	Supported resolutions
MHL Clock	7.2.1.16: MHL Minimum Clock Swing Test	High (PP) resolution
MHL Data	7.2.1.17: MHL Cable Data Eye Diagram	High (PP) resolution

## Supported resolutions: MHL Receiver Protocol

The following MHL Receiver Protocol resolutions are supported for all CTS versions, unless noted otherwise.

**Table 4: Supported resolutions (MHL Receiver Protocol)**

Test group	Test name	Supported resolutions
MHL Sink	4.2.1.1: Character Synchronization	720x576p 720x480p
	4.2.1.2: Packet Types in Normal mode	720x576p 720x480p 640x480p
	CTS 2.0 and CTS 1.3 / 2.1 4.2.1.3: Character Synchronization in Packed Pixel Mode	1920x1080p
	CTS 2.0 and CTS 1.3 / 2.1 4.2.1.4: Packet Types in Packed Pixel mode	1920x1080p
	4.2.2.1: Video Formats in Normal mode	2880x576i 1920x1080p, 1920x1080i 1440x576p, 1440x576i 1440x480i 1280x720p 720x480p 640x480p
	4.2.2.2: Pixel Encoding in Normal mode	720x576p 720x480p
	4.2.2.3: Video Quantization Range	720x576p 720x480p
	CTS 2.0 and CTS 1.3 / 2.1 4.2.2.4: Video Formats in Packed Pixel mode	1920x1080p
	CTS 2.0 and CTS 1.3 / 2.1 4.2.8.2: 3D Video Formats in Normal mode	1920x1080p, 1920x1080i 1280x720p
	CTS 2.0 and CTS 1.3 / 2.1 4.2.8.3: 3D Video Formats in Packed Pixel mode	1920x1080p 1280x720p
	4.2.3.1: Audio Test IEC 60958 / IEC61937	720x576p 720x480p
	4.2.3.2: Audio Clock Regeneration	720x576p 720x480p

Test group	Test name	Supported resolutions
MHL Dongle	5.2.1.1: Character Synchronization	720x576p 720x480p
	CTS 2.0 and CTS 1.3 / 2.1 5.2.1.2: Packet Types in Normal mode	720x576p 720x480p 640x480p
	CTS 2.0 and CTS 1.3 / 2.1 5.2.1.3: Character Synchronization in Packed Pixel mode	1920x1080p
	CTS 2.0 and CTS 1.3 / 2.1 5.2.1.4: Packet Types in Packed Pixel mode	1920x1080p
	5.2.2.1: Video Formats in Normal mode	2880x576i 1920x1080p, 1920x1080i 1440x576p, 1440x576i 1440x480i 1280x720p 720x480p 640x480p
	5.2.2.2: Pixel Encoding in Normal mode	720x576p 720x480p
	5.2.2.3: Video Quantization Range	720x576p 720x480p
	CTS 2.0 and CTS 1.3 / 2.1 5.2.2.4: Video Formats in Packed Pixel mode	1920x1080p
	CTS 2.0 and CTS 1.3 / 2.1 5.2.8.2: 3D Video Formats in Normal mode	1920x1080p, 1920x1080i 1280x720p
	CTS 2.0 and CTS 1.3 / 2.1 5.2.8.3: 3D Video Formats in Packed Pixel mode	1920x1080p 1280x720p
	5.2.3.1: Audio Test IEC 60958 / IEC61937	720x576p 720x480p
	5.2.3.2: Audio Clock Regeneration	720x576p 720x480p

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## Operating basics

### Equipment connection setup using the TF-MHL-CBS2-SOSI (MHL transmitter and receiver)

The Source Sink board (TF-MHL-CBS2-SOSI) is a low cost alternative to the C-Bus Analyzer. It provides an alternative solution for setup and can be used for the following:

- Source tests, electrical – 3.1.1.1 to 3.1.1.20 (excluding 3.1.1.13)
- Source System tests – 3.2.2.1 to 3.2.2.3 ; 3.2.3.1 to 3.2.3.4 ; 3.2..1.12 (excluding 3.1.1.13)
- Sink tests, electrical – 4.1.1.1 to 4.1.1.8 (excluding 4.1.1.7)
- Sink system test – 4.2.1.1 to 4.2.1.2 ; 4.2.2.1 to 4.2.2.3; 4.2.3.1 to 4.2.3.2
- Dongle tests, electrical - 5.1.1.1 to 5.1.1.9 (excluding 5.1.1.7, 5.1.1.8)
- Dongle System tests - 5.2.1.1 to 5.2.1.2 ; 5.2.2.1 to 5.2.2.3; 5.2.3.1 to 5.2.3.2

---

**NOTE.** The low cost TF-MHL-CBS2-SOSI cannot be used for C-Bus tests 3.3.x.x and 4.3.x.x.

---



**Figure 1: Low cost Source Sink board (TF-MHL-CBS2-SOSI)**

### TF-MHL-CBS2-SOSI setup for source testing

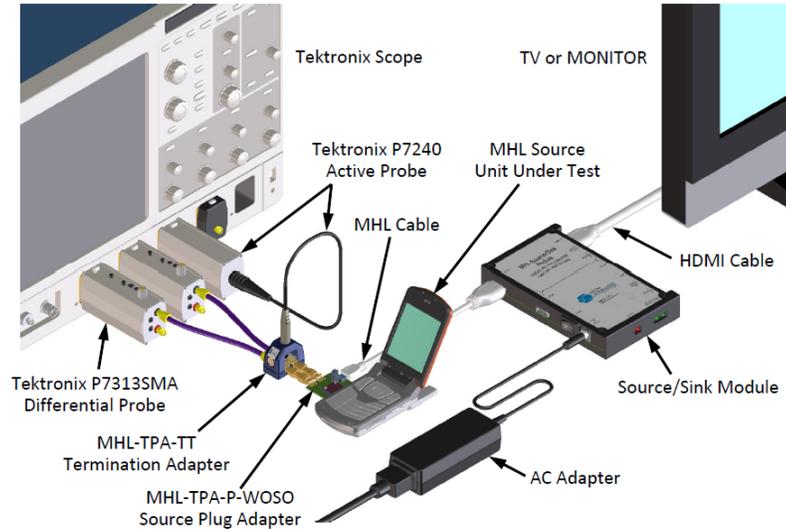


Figure 2: TF-MHL-CBS2-SOSI acting as a sink for source testing

### TF-MHL-CBS2-SOSI setup for sink testing

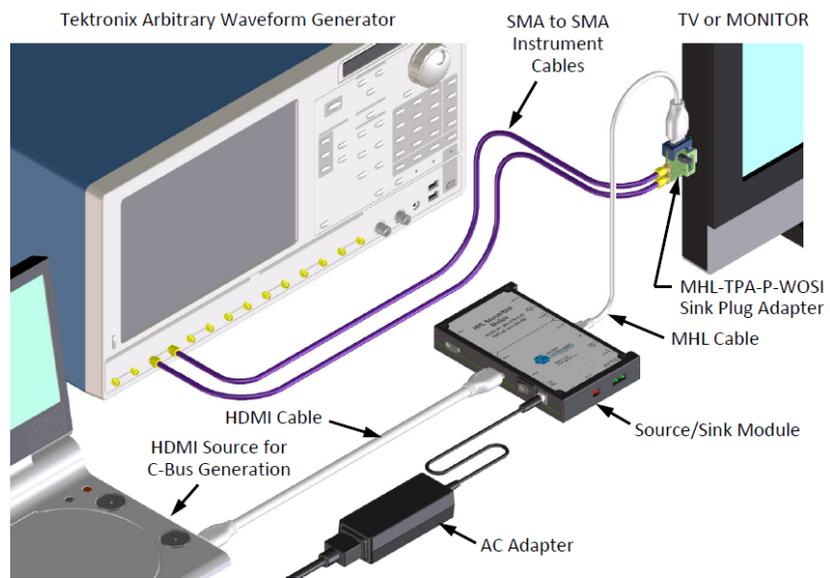


Figure 3: TF-MHL-CBS2-SOSI acting as a source for sink testing

## Equipment connection setup (MHL 3.0 Transmitter)

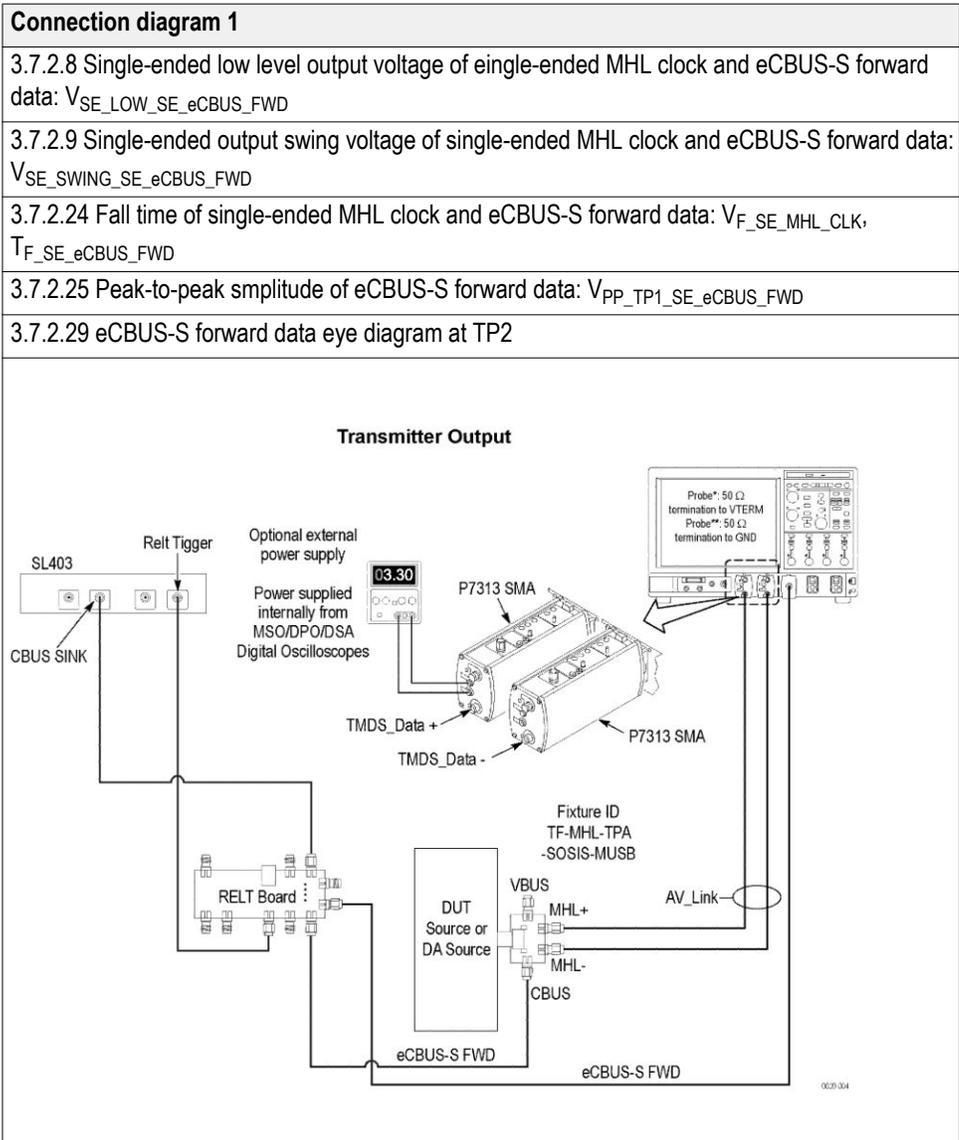
You need the following equipment to run MHL Transmitter tests. (For details, see [Minimum system requirements](#)):

- A [supported Tektronix oscilloscope](#)
- Two or three differential probes – P7313SMA, for single ended and differential tests
- Device-under-test (DUT)
- Wilder/Tektronix fixtures
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- P7240 probe
- C-Bus Sink boards
- MHL Signal generator: AWG7122C for eCBUS source

Connection diagrams and the tests they apply to are listed below.

**Table 5: MHL 3.0 Transmitter Output tests**

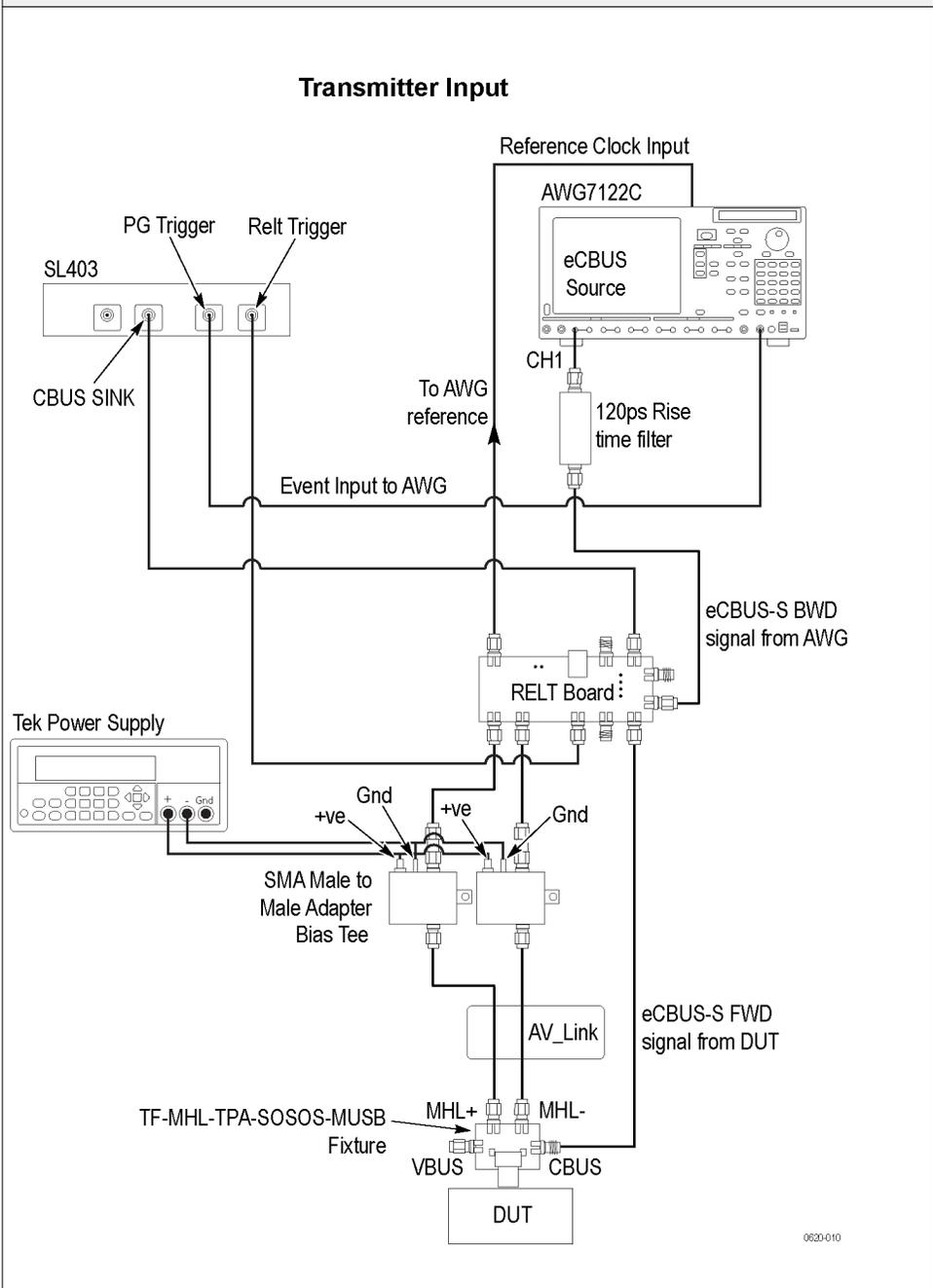
Connection diagram 1
<b>TMDS Data</b>
3.7.2.1: Single-ended high level output voltage of differential TMDS data+/-: $V_{SE\_HIGH\_DF\_TMDS\_DATA}$
3.7.2.2 Single-ended low level output voltage of differential TMDS data+/-: $V_{SE\_LOW\_DF\_TMDS\_DATA}$
3.7.2.5 Differential output swing voltage of differential TMDS data: $V_{DF\_SWING\_DF\_TMDS\_DATA}$
3.7.2.13 Rise time of differential TMDS data: $T_{R\_DF\_TMDS\_DATA}$
3.7.2.14 Fall time of differential TMDS data: $T_{F\_DF\_TMDS\_DATA}$
3.7.2.17 Peak-to-peak amplitude of differential TMDS data: $V_{PP\_TP1\_DF\_TMDS\_DATA}$
3.7.2.27 TMDS data eye diagram
<b>MHL Clock</b>
3.7.2.7 Single-ended high level output voltage of single-ended MHL clock data: $V_{SE\_HIGH\_SE\_MHL\_CLK}$
3.7.2.8 Single-ended low level output voltage of single-ended MHL clock data: $V_{SE\_LOW\_SE\_MHL\_CLK}$
3.7.2.9 Single-ended output swing voltage of single-ended MHL clock data: $V_{SE\_SWING\_SE\_MHL\_CLK}$
3.7.2.20 Single-ended MHL clock frequency: $F_{SE\_MHL\_CLK}$
3.7.2.21 Single-ended MHL clock front porch: $T_{CFP\_SE\_MHL\_CLK}$
3.7.2.22 Single-ended MHL clock back porch: $T_{CBP\_SE\_MHL\_CLK}$
3.7.2.23 Rise time of single-ended MHL clock: $T_{R\_SE\_MHL\_CLK}$
3.7.2.26 Single-ended MHL clock jitter at TP2: $T_{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}$
<b>MHL eCBUS</b>
3.7.2.7 Single-ended high level output voltage of single-ended MHL clock and eCBUS-S forward data: $V_{SE\_HIGH\_SE\_eCBUS\_FWD}$

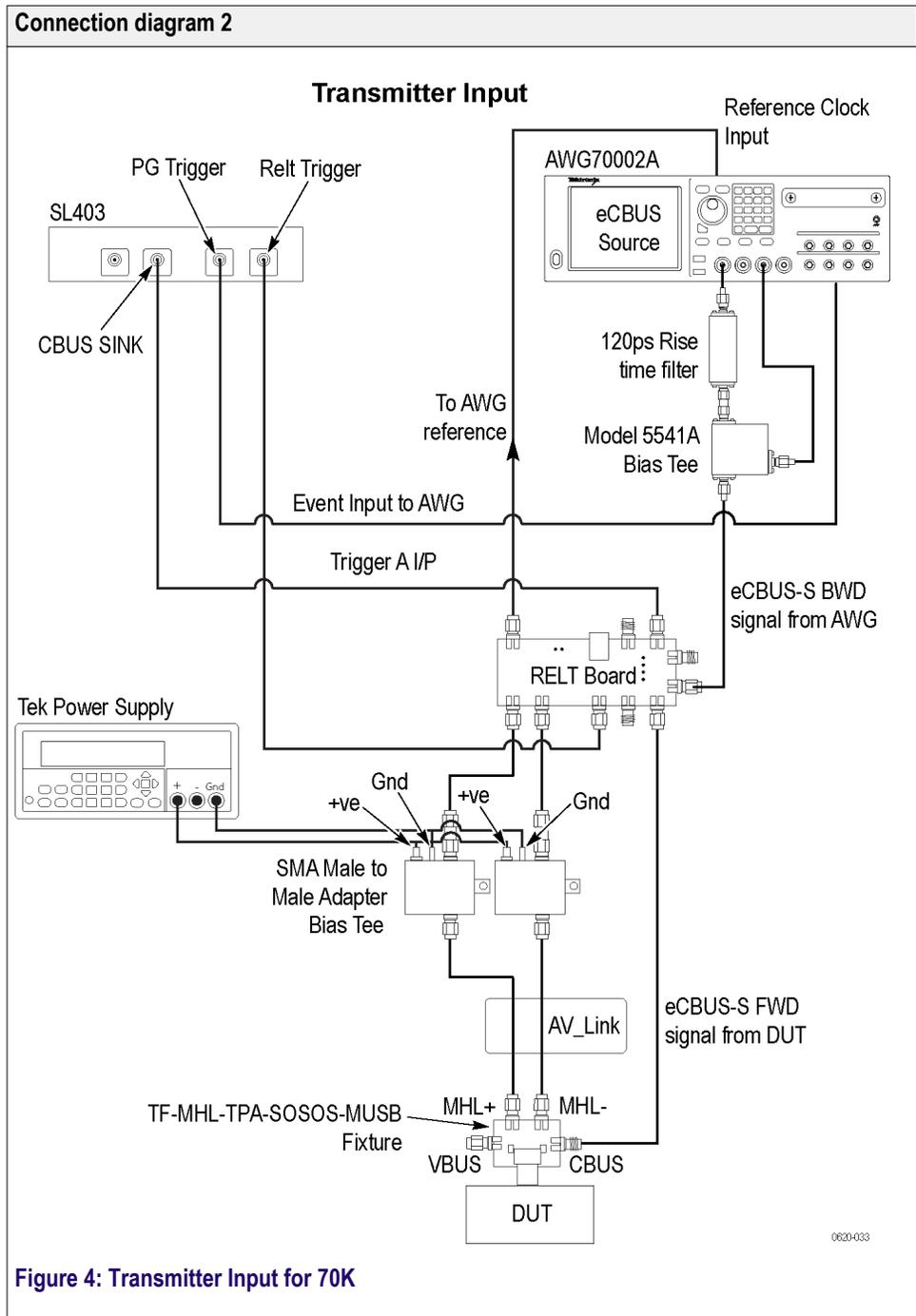


**Table 6: MHL 3.0 Transmitter Input tests**

Connection diagram 2
<b>MHL eCBUS</b>
3.7.2.32: Input DC voltage tolerance of eCBUS-S backward data: $V_{IDC\_SE\_eCBUS\_BWD}$
3.7.2.36: Jitter tolerance of eCBUS-S backward data
3.7.2.40 Duty Cycle Tolerance of Single-Ended MHLclock - Source

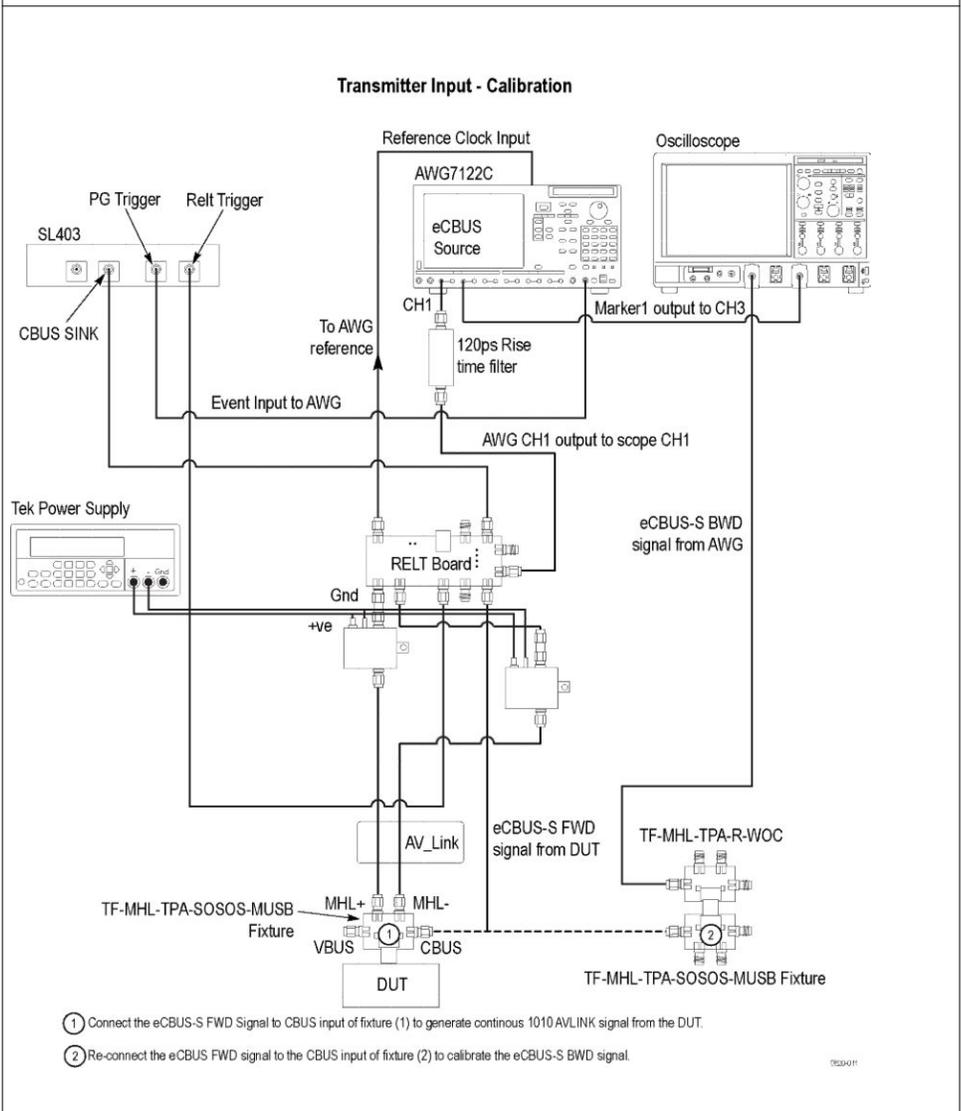
Connection diagram 2

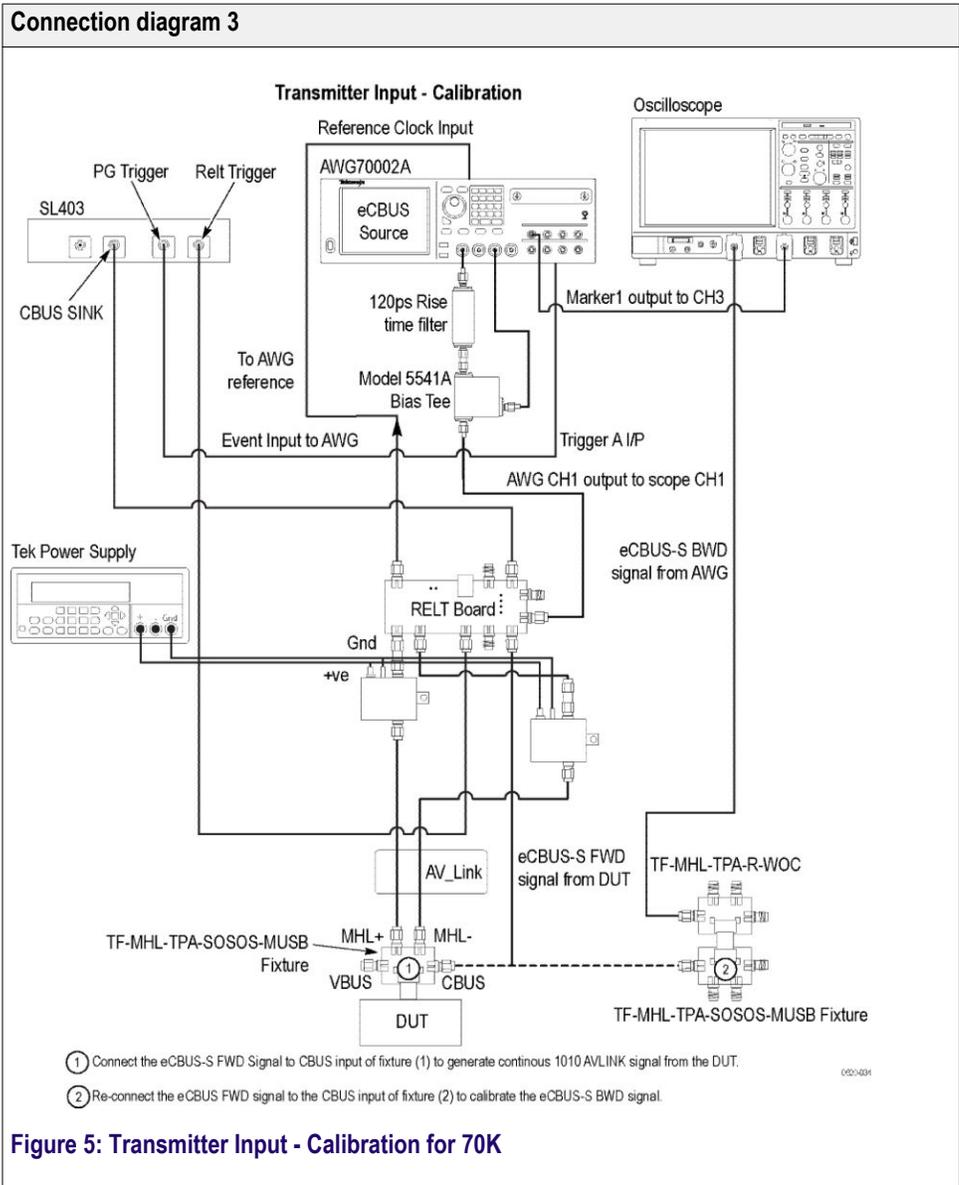




**Connection diagram 3**

Auto Calibration (for 3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data)





**Figure 5: Transmitter Input - Calibration for 70K**

**See Also** [Equipment connection setup MHL 3.0 Receiver](#)  
[Equipment connection Setup MHL Receiver](#)  
[Equipment connection setup MHL Cables](#)  
[About algorithms](#)  
[View connected instruments](#)

## Equipment connection setup (MHL 3.0 Receiver)

You need the following equipment (for details, see [Minimum system requirements](#)):

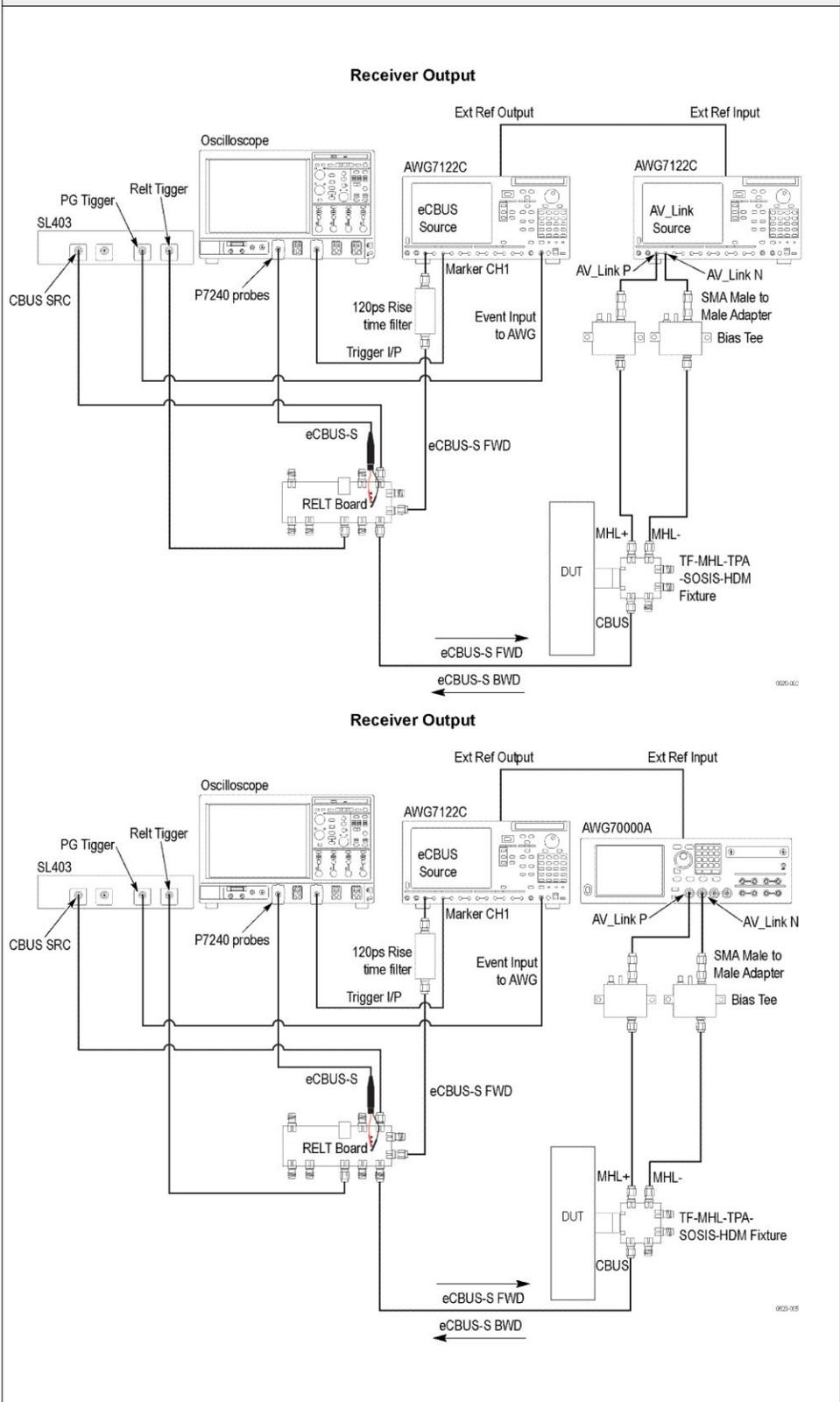
- A [supported Tektronix oscilloscope](#)
- Two or three differential probes – P7313SMA, for single ended and differential tests
- Device-under-test (DUT)
- Wilder fixtures
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- C-Bus Sink boards
- MHL Signal generator: AWG7122C for eCBUS source with AWG70002A or AWG7122C for AV\_Link

Connection diagrams and the tests they apply to are listed below.

**Table 7: MHL 3.0 Receiver Output tests**

Connection diagram 4
<b>MHL Sink</b>
4.7.2.14: Single-ended high level output voltage of eCBUS-S backward data: $V_{SE\_HIGH\_SE\_eCBUS\_BWD}$
4.7.2.15: Single-ended low level output voltage of eCBUS-S forward data: $V_{SE\_LOW\_SE\_eCBUS\_BWD}$
4.7.2.16: Single-ended output swing voltage of eCBUS-S backward data: $V_{SE\_SWING\_SE\_eCBUS\_BWD}$
4.7.2.20: Rise time of eCBUS-S backward data: $T_{R\_SE\_eCBUS\_BWD}$
4.7.2.21: Fall time of eCBUS-S backward data: $T_{F\_SE\_eCBUS\_BWD}$
4.7.2.22: Peak-to-peak amplitude of eCBUS-S backward data: $V_{PP\_TP2\_SE\_eCBUS\_BWD}$
4.7.2.24: eCBUS-S backward data eye diagram at TP1
<b>MHL Dongle</b>
5.7.2.16: Output DC voltage of eCBUS-S backward data: $V_{ODC\_SE\_eCBUS\_BWD}$
5.7.2.17: Single-ended output swing voltage of eCBUS-S backward data: $V_{SE\_SWING\_SE\_eCBUS\_BWD}$
5.7.2.19: eCBUS-S backward data eye diagram at TP3

Connection diagram 4



Connection diagram 4

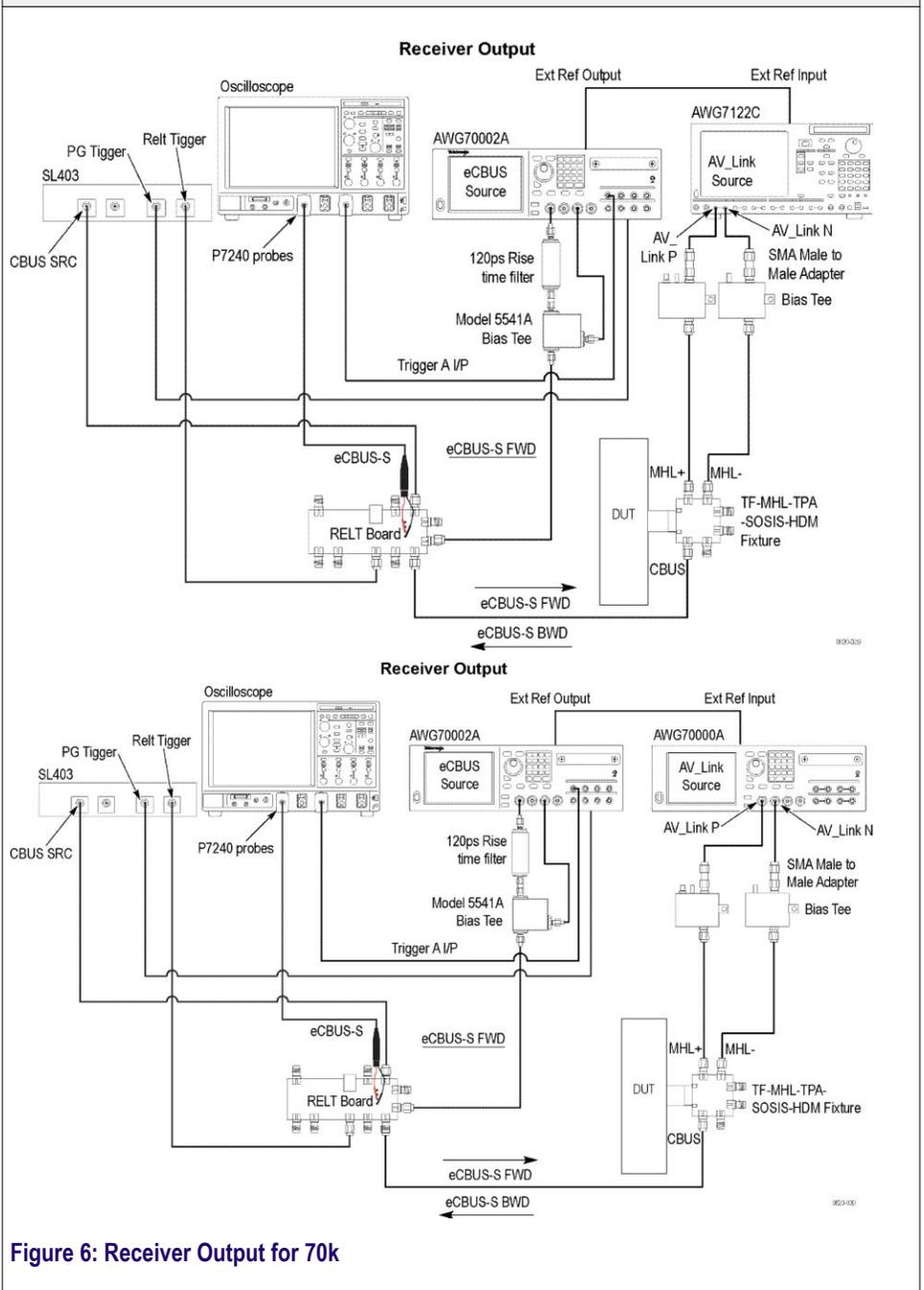


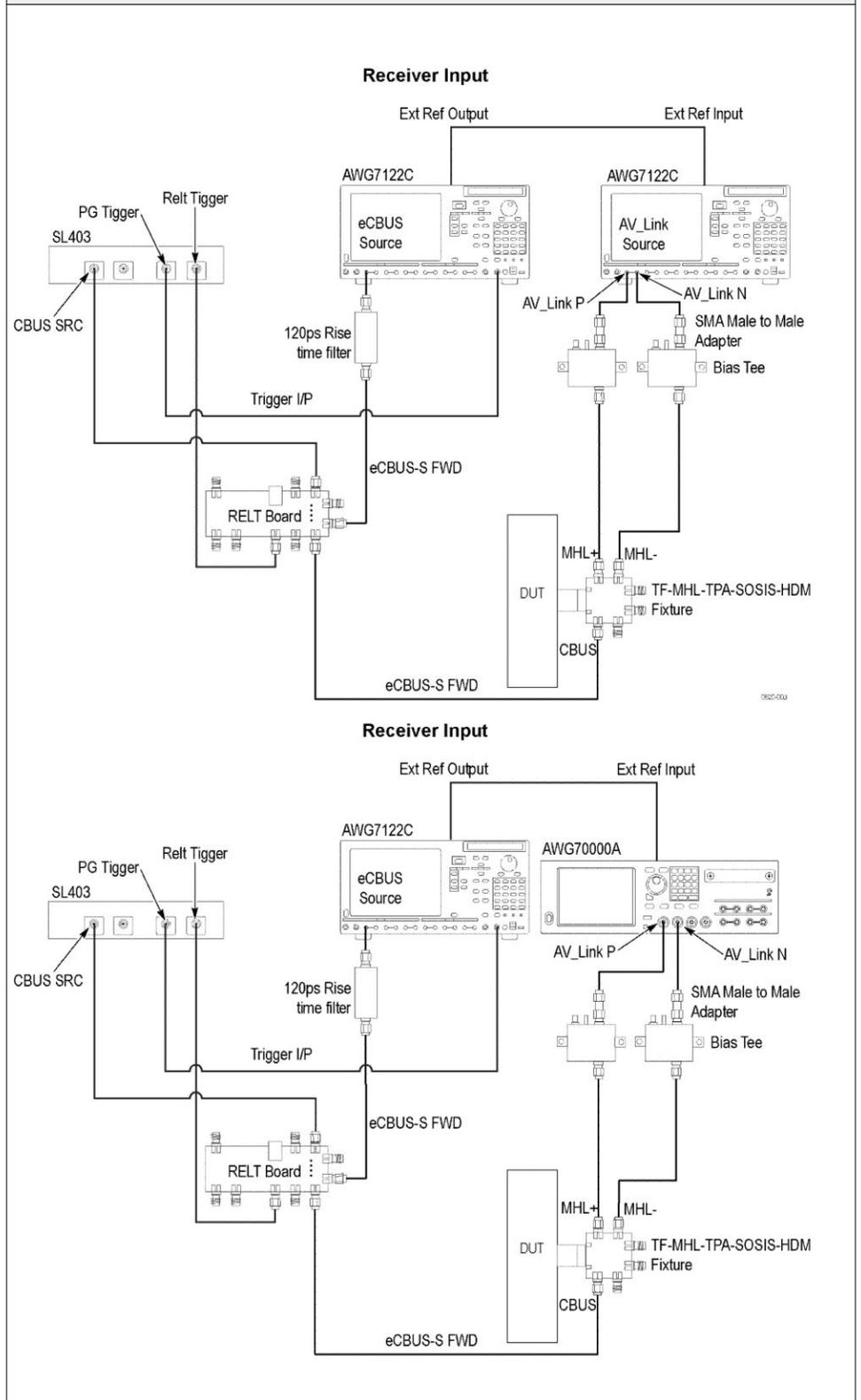
Figure 6: Receiver Output for 70k

Table 8: MHL 3.0 Receiver Input tests

Connection diagram 5
MHL Sink
4.7.2.1: Input DC voltage tolerance of differential TMDS data: $V_{IDC\_DF\_TMDS\_DATA}$
4.7.2.3: Differential input swing voltage tolerance of differential TMDS data: $V_{IDF\_SWING\_DF\_TMDS\_DATA}$

<b>Connection diagram 5</b>
4.7.2.5: Input DC voltage tolerance of single-ended MHL clock and eCBUS-S forward data: $V_{IDC\_SE\_MHL\_CLK}$ , $V_{IDC\_SE\_eCBUS\_FWD}$
4.7.2.10: Jitter tolerance of single-ended MHL clock: $T_{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}$
4.7.2.28 Duty Cycle Tolerance of Single-Ended MHL Clock - Sink
<b>MHL Dongle</b>
5.7.2.1: Single-ended high level input voltage tolerance of differential TMDS data: $V_{SE\_HIGH\_DF\_TMDS\_DATA}$
5.7.2.2: Single-ended low level input voltage tolerance of differential TMDS data: $V_{SE\_LOW\_DF\_TMDS\_DATA}$
5.7.2.5: Differential input swing voltage tolerance of differential TMDS data: $V_{IDF\_SWING\_DF\_TMDS\_DATA}$
5.7.2.7: Single-ended high level input voltage tolerance of single-ended MHL clock and eCBUS-S forward data: $V_{SE\_HIGH\_SE\_MHL\_CLK}$ , $V_{SE\_HIGH\_SE\_eCBUS\_FWD}$
5.7.2.8: Single-ended low level input voltage tolerance of single-ended MHL clock and eCBUS-S forward data: $V_{SE\_LOW\_SE\_MHL\_CLK}$ , $V_{SE\_LOW\_SE\_eCBUS\_FWD}$
5.7.2.23 Duty Cycle Tolerance of Single-Ended MHL Clock - Dongle
<b>MHL Sink</b>
4.7.2.7: Differential intra-pair skew tolerance of differential TMDS data: $T_{SKEW\_TP2\_DF\_TMDS\_DATA}$
<b>MHL Dongle</b>
5.7.2.10: Differential intra-pair skew tolerance of differential TMDS data: $T_{SKEW\_TP3\_DF\_TMDS\_DATA}$
5.7.2.13: Jitter tolerance of single-ended MHL clock, eCBUS-S forward data and differential TMDS data

Connection diagram 5





**See Also** [Equipment connection setup MHL 3.0 Transmitter](#)  
[Equipment connection setup MHL Transmitter](#)  
[Equipment connection setup MHL Cables](#)  
[About algorithms](#)  
[View connected instruments](#)

## Equipment connection setup (MHL Transmitter)

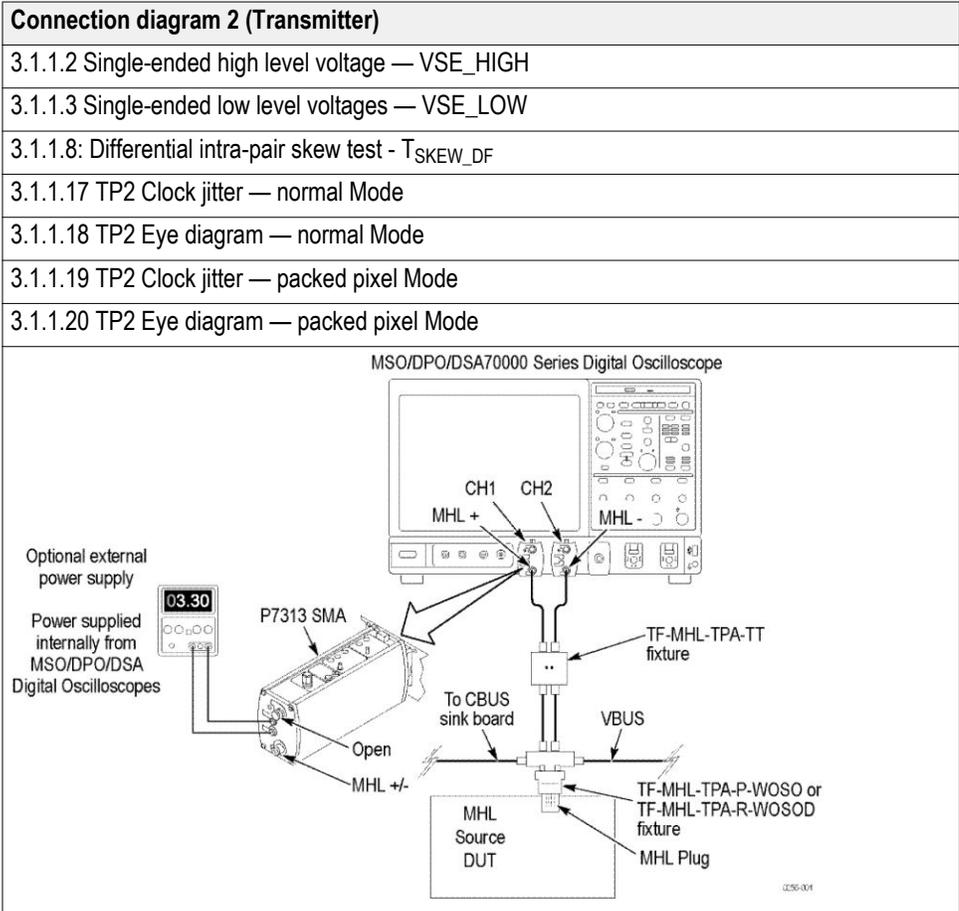
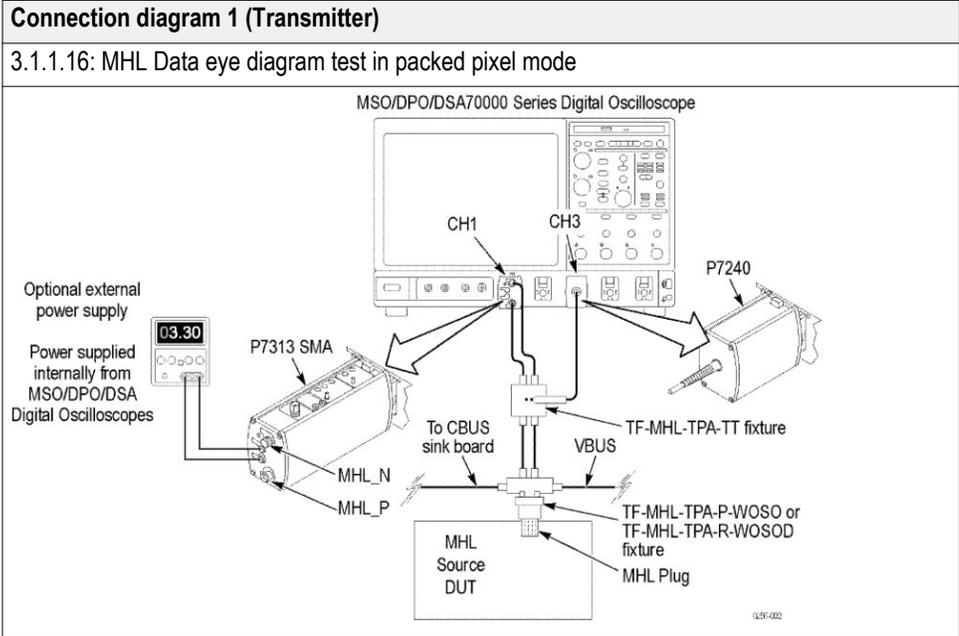
You need the following equipment to run MHL Transmitter tests. (For details, see [Minimum system requirements](#)):

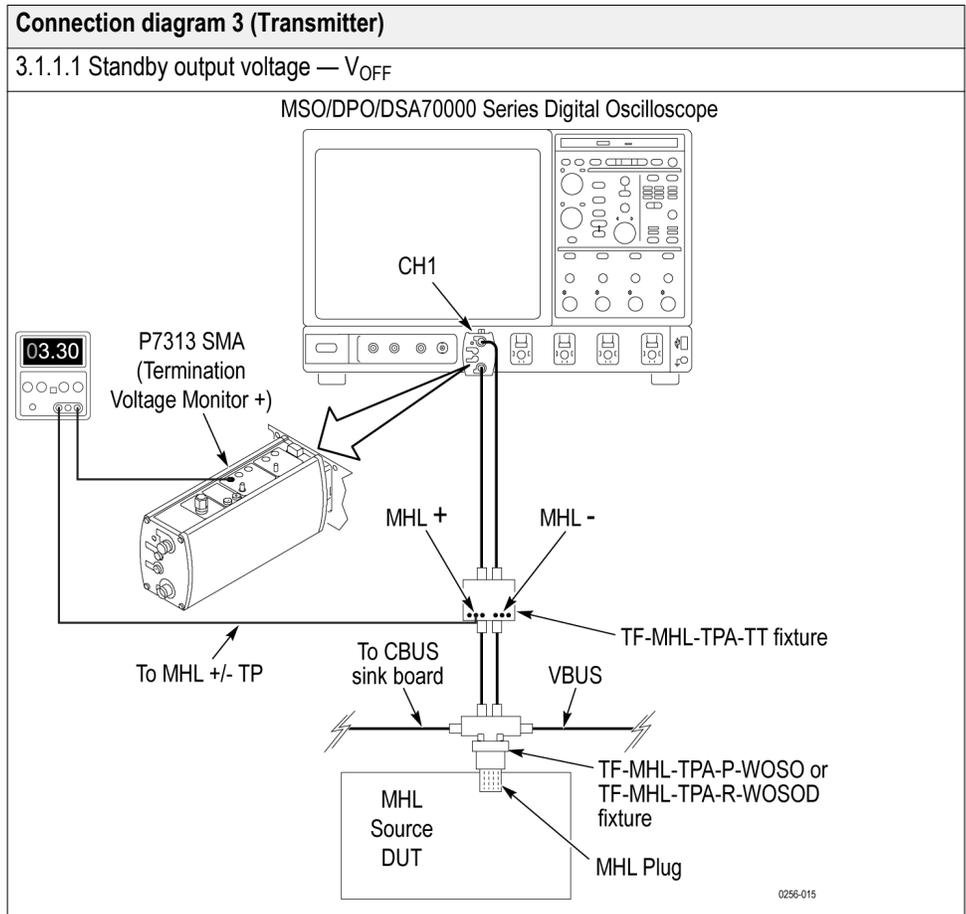
- A [supported Tektronix oscilloscope](#)
- Two differential probes – P7313SMA, for single ended and differential tests
- One single ended probe – Probe P7240 for common mode tests
- Device under test (DUT)
- Wilder/Tektronix fixtures
- C-Bus Sink boards

Connection diagrams and the tests they apply to are listed below.

### Clock and Data Tests

Connection diagram 1 (Transmitter)
3.1.1.4: Differential output swing voltage Test - $V_{DF\_SWING}$
3.1.1.5: Common-mode output swing voltage Test - $V_{CMSWING}$
3.1.1.6: Differential rise and fall times test - $T_{R\_DF}$ , $T_{F\_DF}$
3.1.1.7: Common-mode rise and fall times test - $T_{R\_CM}$ , $T_{F\_CM}$
3.1.1.10: MHL Clock duty cycle test – normal mode
3.1.1.11: MHL Clock jitter test – normal mode
3.1.1.12: MHL Data eye diagram test – normal mode
3.1.1.14: MHL Clock duty cycle test – packed pixel mode
3.1.1.15: MHL Clock jitter test – packed pixel mode





**See Also** [Equipment connection setup MHL Receiver](#)  
[Equipment connection setup MHL Cables](#)  
[About algorithms](#)  
[View connected instruments](#)

## Equipment connection setup (MHL Receiver protocol and MHL protocol)

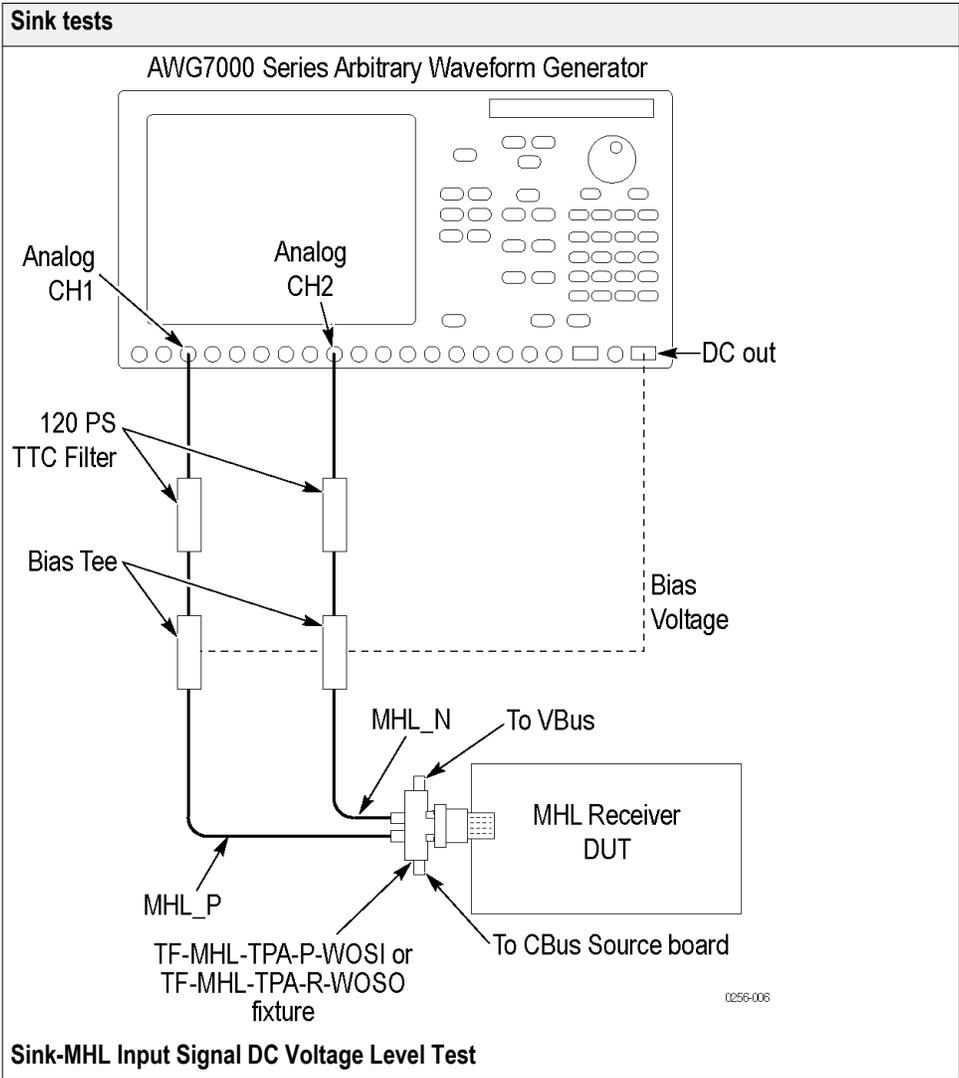
You need the following equipment (for details, see [Minimum system requirements](#)):

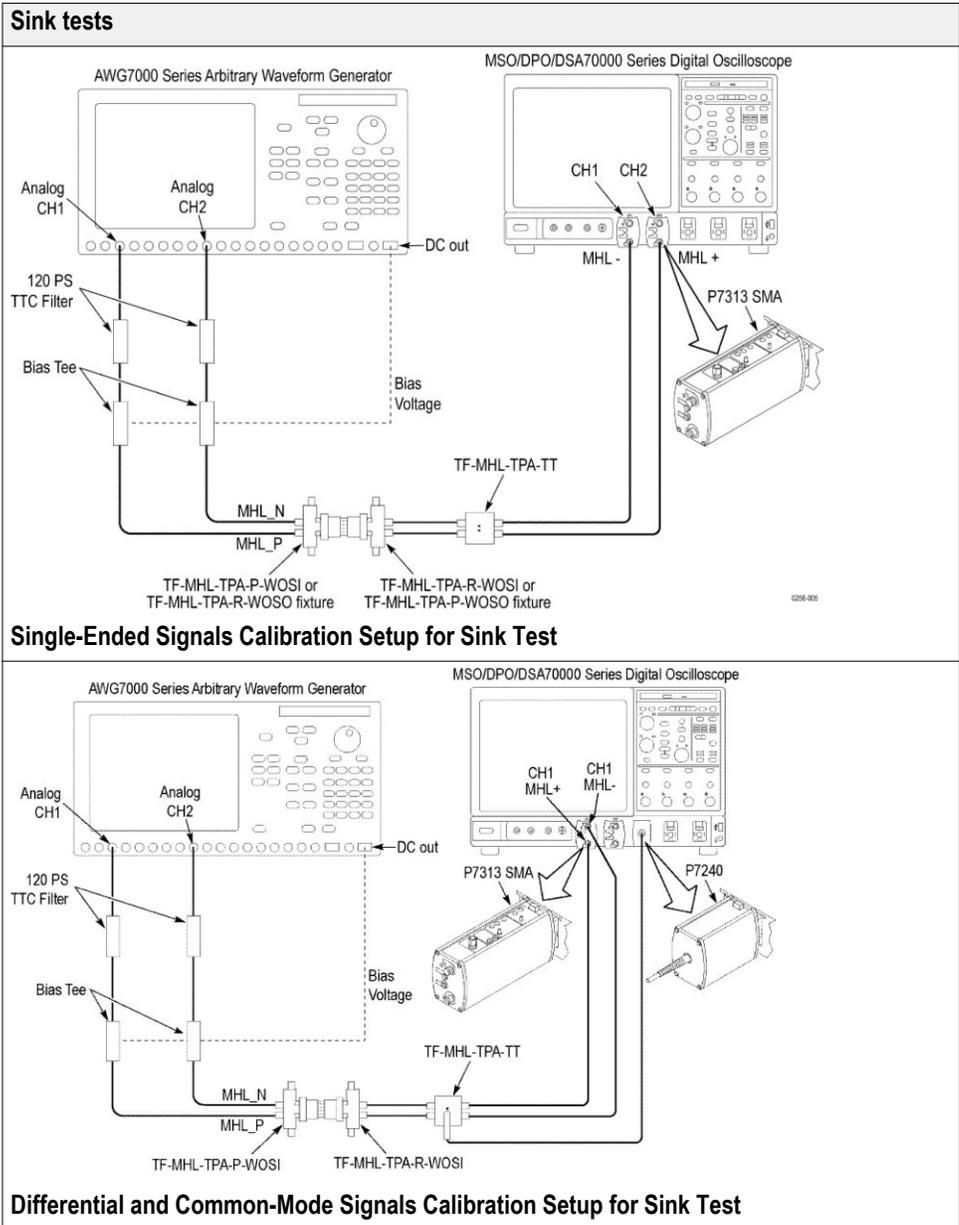
- A [supported Tektronix oscilloscope](#)
- One differential probe – P7313SMA
- Device under test (DUT)
- Wilder fixtures
- C-Bus Sink boards
- MHL Signal generator: AWG7122B/C with option 01 and 02 or 06 and 08

Connection diagrams and the tests they apply to are listed below.

### Sink tests

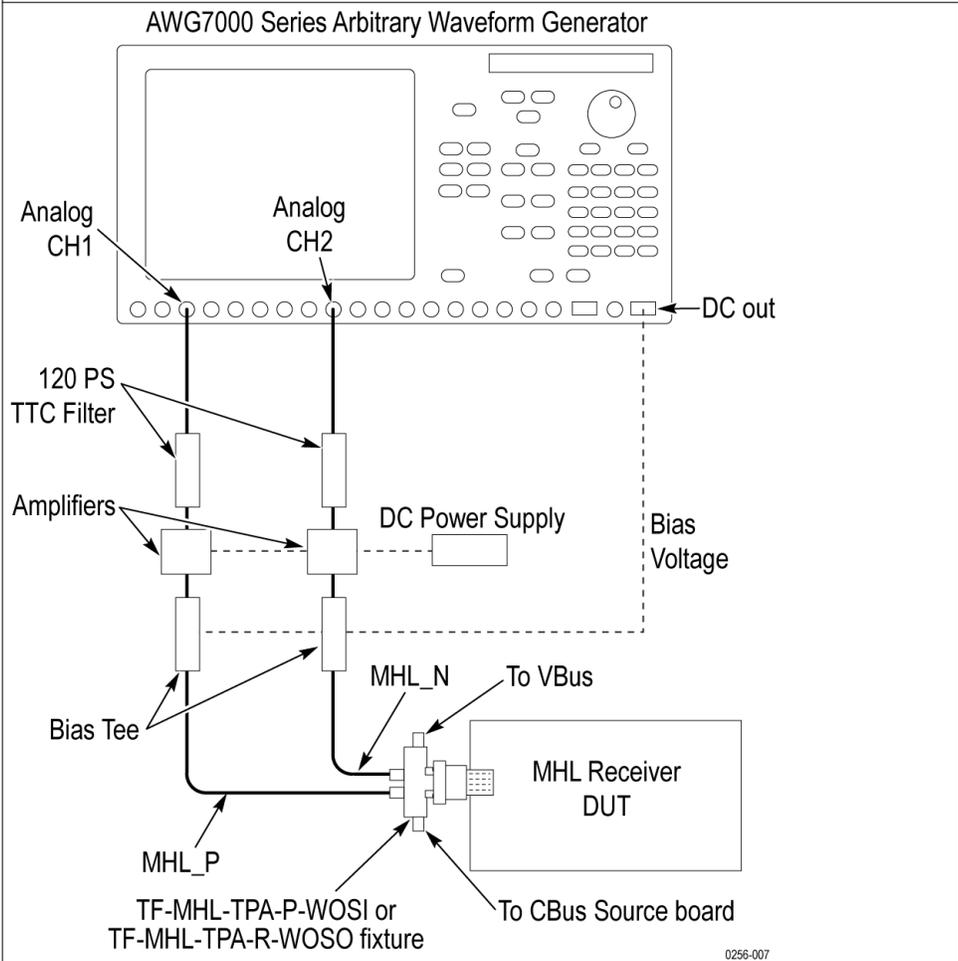
Sink tests
4.1.1.1: Input signal DC voltage level tolerance
4.1.1.3: Intra-pair skew tolerance
CTS 1.X 4.1.1.4: Jitter tolerance CTS 2.0, CTS 1.3 / 2.1 4.1.1.4: Jitter tolerance in normal mode
CTS 2.0, CTS 1.3 / 2.1 4.1.1.8: Jitter tolerance in packed pixel mode
4.2.1.1: Character synchronization
CTS 2.0, CTS 1.3 / 2.1 4.2.1.3: Character synchronization in packed pixel mode
4.2.1.2: Packet types in normal node
CTS 2.0, CTS 1.3 / 2.1 4.2.1.4: Packet types in packed pixel node
4.2.2.1: Video formats in normal mode
CTS 2.0, CTS 1.3 / 2.1 4.2.2.4: Video formats in packed pixel mode
4.2.2.2: Pixel encoding in normal mode
4.2.2.3: Video quantization range
CTS 2.0, CTS 1.3 / 2.1 4.2.8.2: 3D Video format in normal mode
CTS 2.0, CTS 1.3 / 2.1 4.2.8.3: 3D Video format in packed pixel mode
4.2.3.1: IEC 60958 / IEC61937
4.2.3.2: Audio clock regeneration



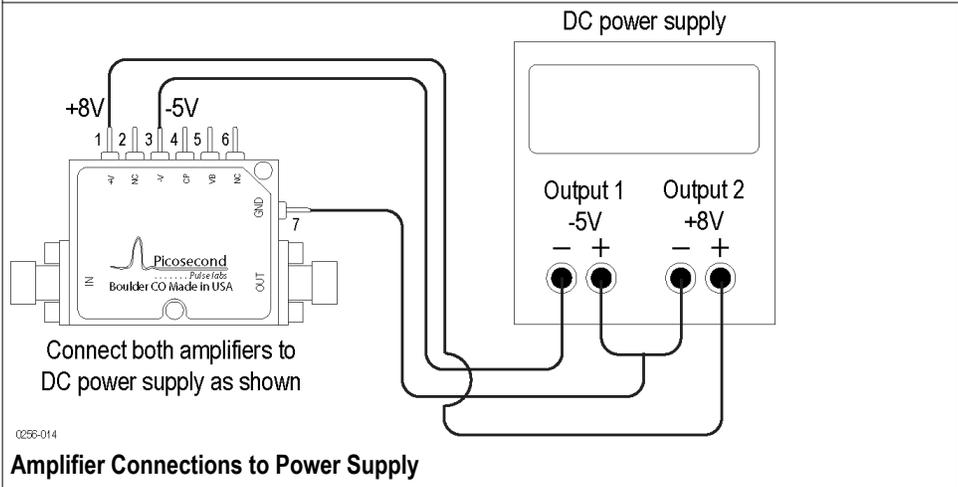


**Sink tests**

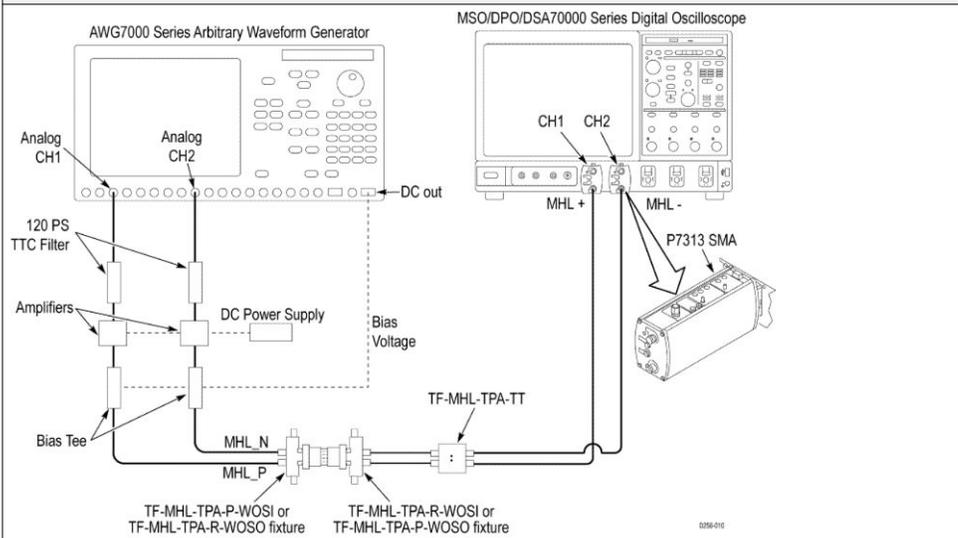
4.1.1.2: Input signal minimum and maximum swing voltages tolerance:



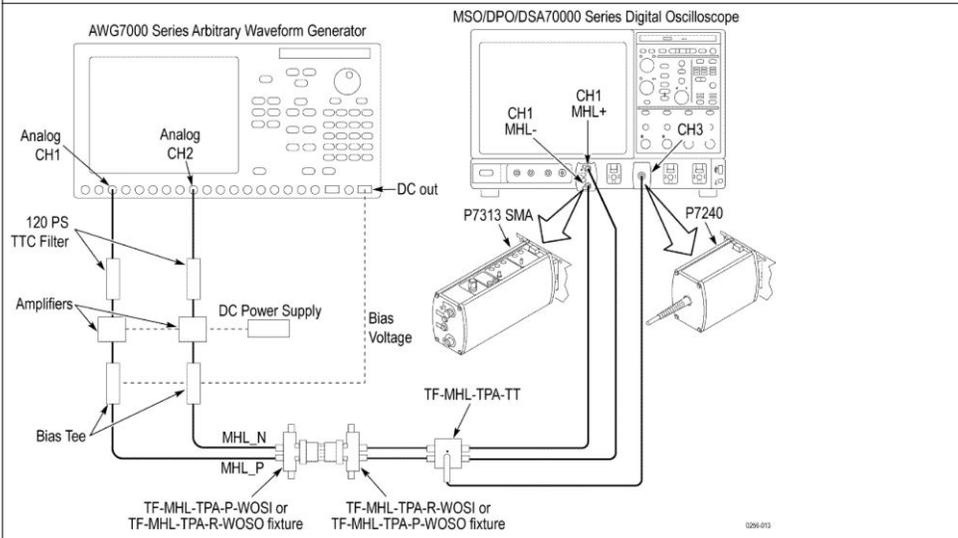
**Sink — MHL Input Signal DC Voltage Level Min-Max Test**



**Sink tests**



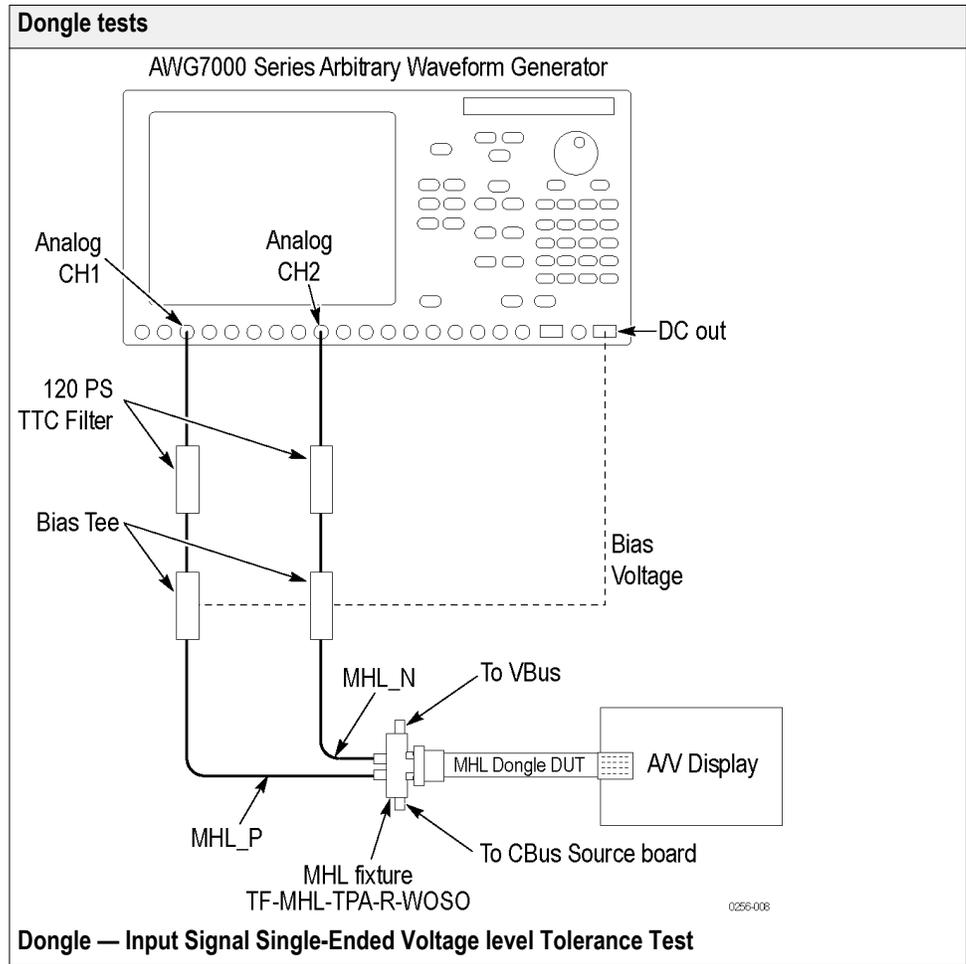
**Single Ended Signals Calibration Setup for Sink Min-Max Test**



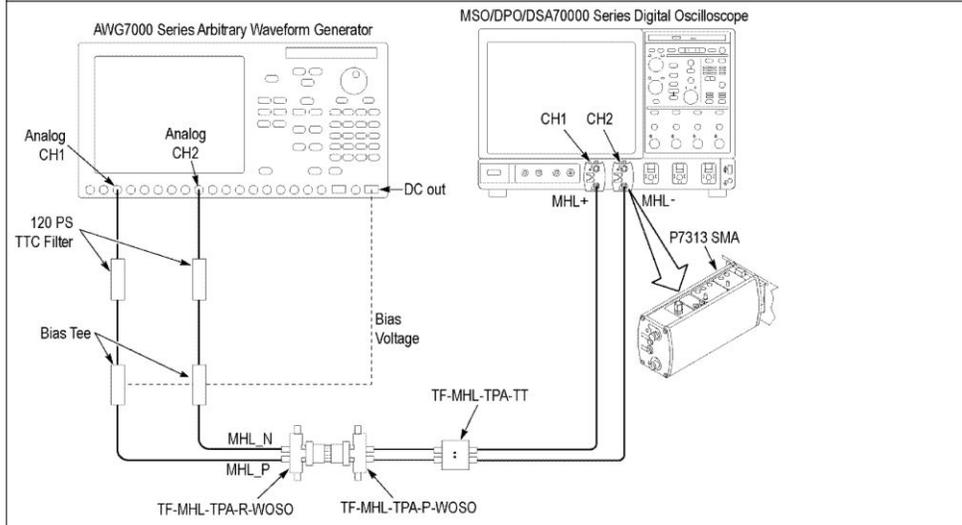
**Differential and Common-Mode Signals Calibration Setup for Sink Min-Max Test**

**Dongle tests**

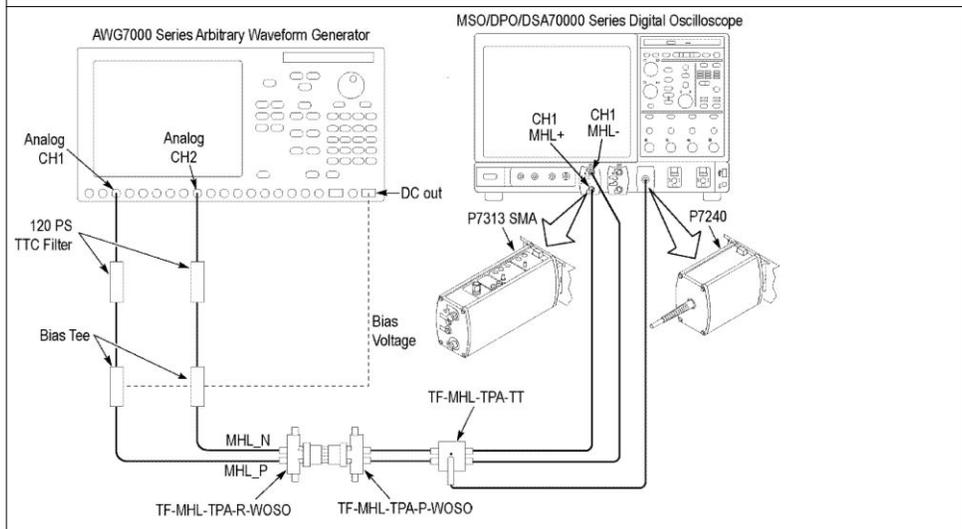
<b>Dongle tests</b>
5.1.1.1: Input signal single-ended voltage level tolerance
5.1.1.3: Intra-pair skew tolerance test
CTS 1.X 5.1.1.4: Jitter tolerance
CTS 2.0 5.1.1.4: Jitter tolerance in normal mode
CTS 2.0 5.1.1.9: Jitter tolerance in packed pixel mode
5.2.1.1: Character synchronization
CTS 2.0, CTS 1.3 / 2.1 5.2.1.3: Character synchronization in packed pixel mode
5.2.1.2: Packet types in normal mode
CTS 2.0, CTS 1.3 / 2.1 5.2.1.4: Packet types in packed pixel mode
5.2.2.1: Video formats in normal mode
CTS 2.0, CTS 1.3 / 2.1 5.2.2.4: Video formats in packed pixel mode
5.2.2.2: Pixel encoding in normal mode
5.2.2.3: Video quantization range
CTS 2.0, CTS 1.3 / 2.1 5.2.8.2: 3D Video format in normal mode
CTS 2.0, CTS 1.3 / 2.1 5.2.8.3: 3D Video format in packed pixel mode
5.2.3.1: IEC 60958 / IEC61937
5.2.3.2: Audio clock regeneration



**Dongle tests**



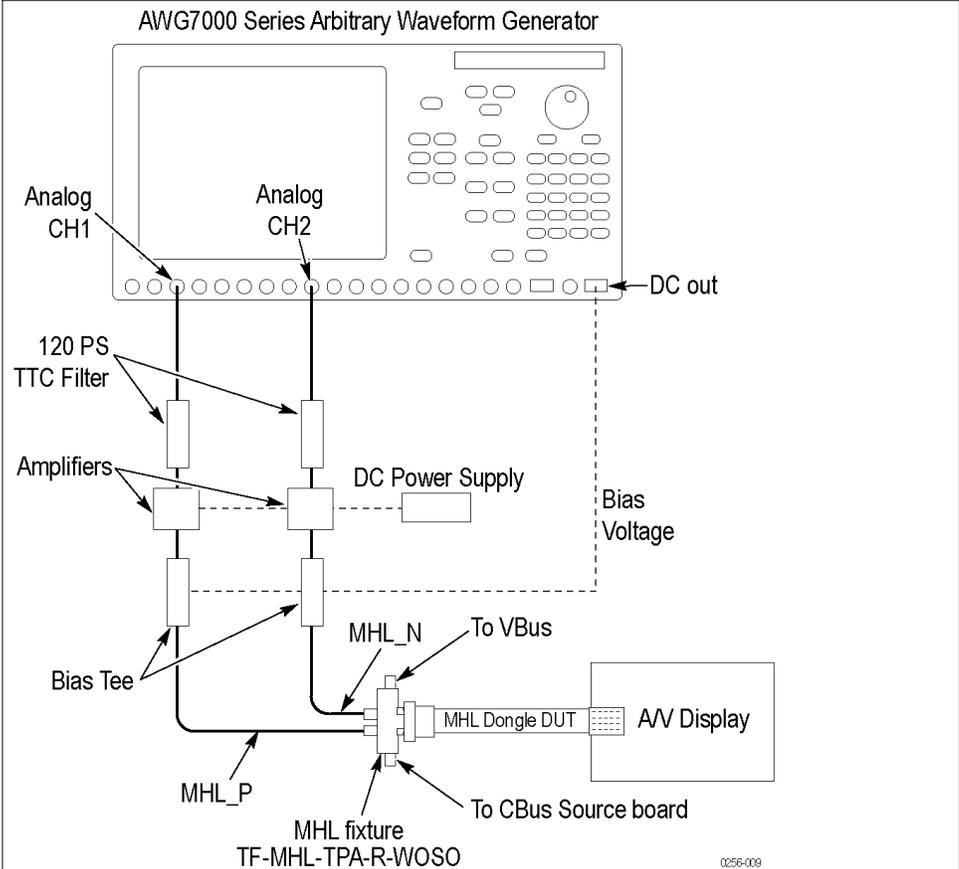
**Single-Ended Signals Calibration Setup for Dongle Test**



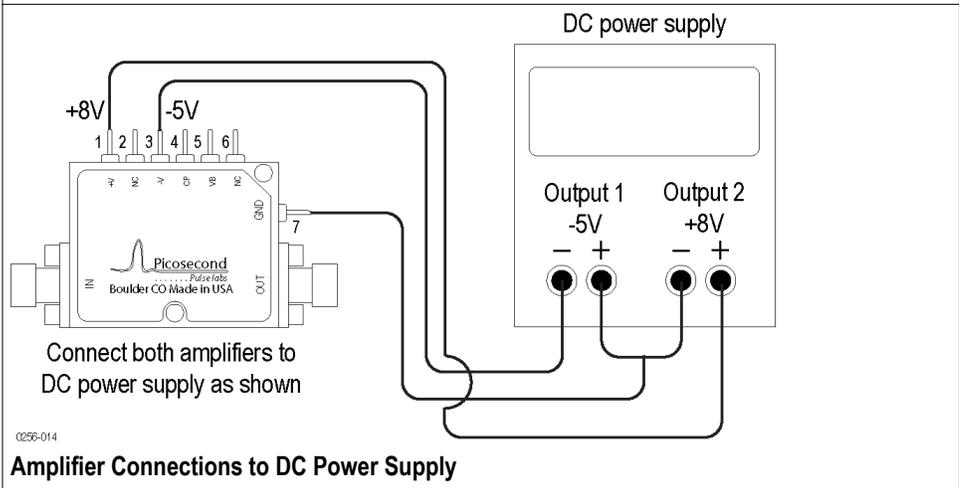
**Differential and Common-Mode Signals Calibration Setup for Dongle Test**

**Dongle tests**

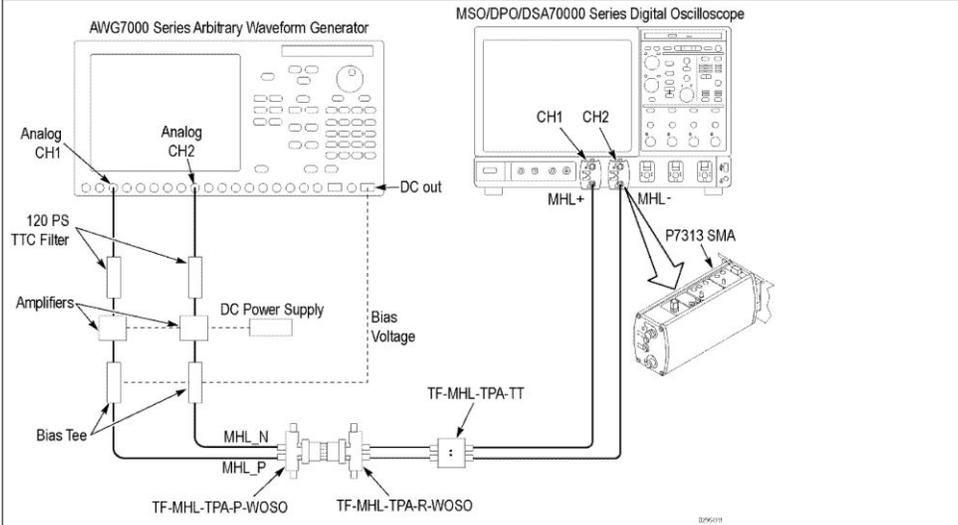
5.1.1.2: Input signal minimum and maximum swing voltage tolerance



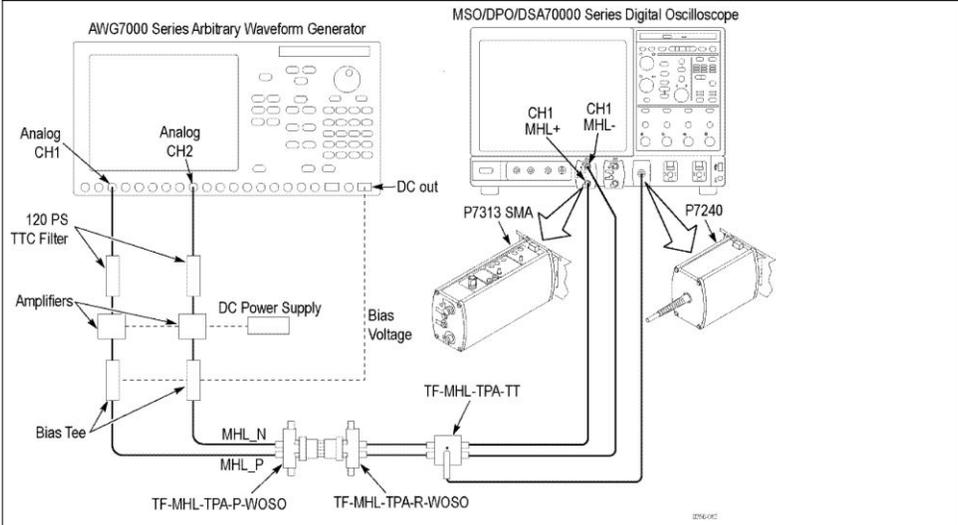
**Dongle Min-Max Setup**



**Dongle tests**



**Single-Ended Signals Calibration Setup for Dongle Min Max Test**



**Differential and Common-Mode Signals Calibration Setup for Dongle Min Max Test**

**See Also** [Equipment connection setup MHL Transmitter](#)  
[Equipment connection setup MHL Cables](#)  
[About algorithms](#)  
[View connected instruments](#)

## Equipment connection setup (MHL Cables)

You need the following equipment to run MHL Cables tests. (For details, see [Minimum system requirements](#)):

- A [supported Tektronix oscilloscope](#)
- Two differential probes – P7313SMA, for single ended and differential tests
- One single ended probe – P7240 for common mode tests
- Device under test (DUT)
- Wilder/Tektronix fixtures
- C-Bus source boards
- MHL Signal generator: AWG7122B/C with option 01 and 02 or 06 and 08

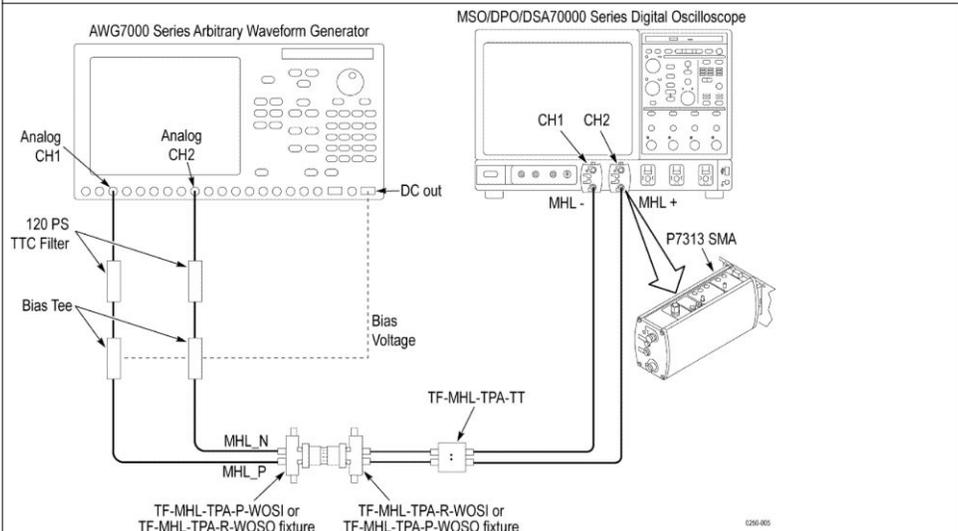
Connection diagrams and the tests they apply to are listed below.

**Clock and Data Tests**

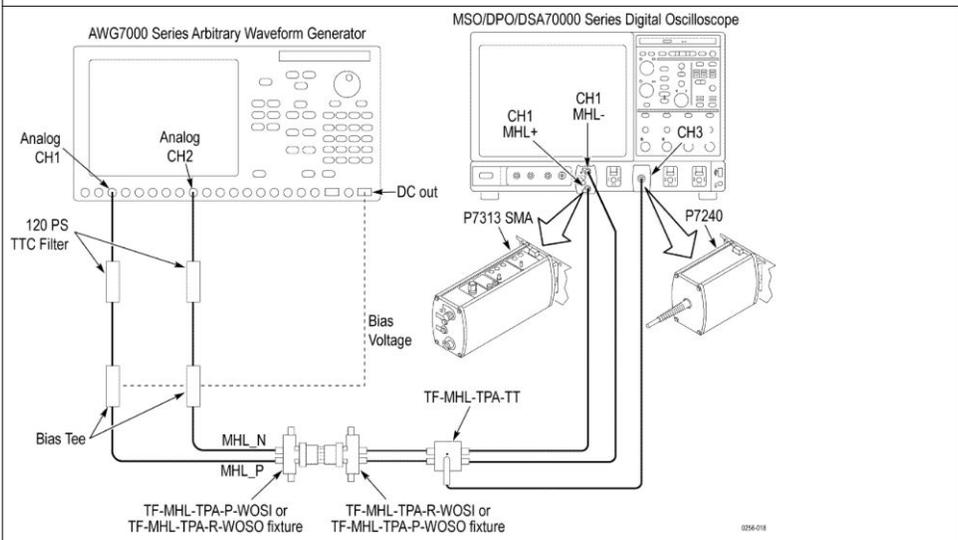
**Connection diagram 1 (Cables)**

7.2.1.16: Minimum clock swing test

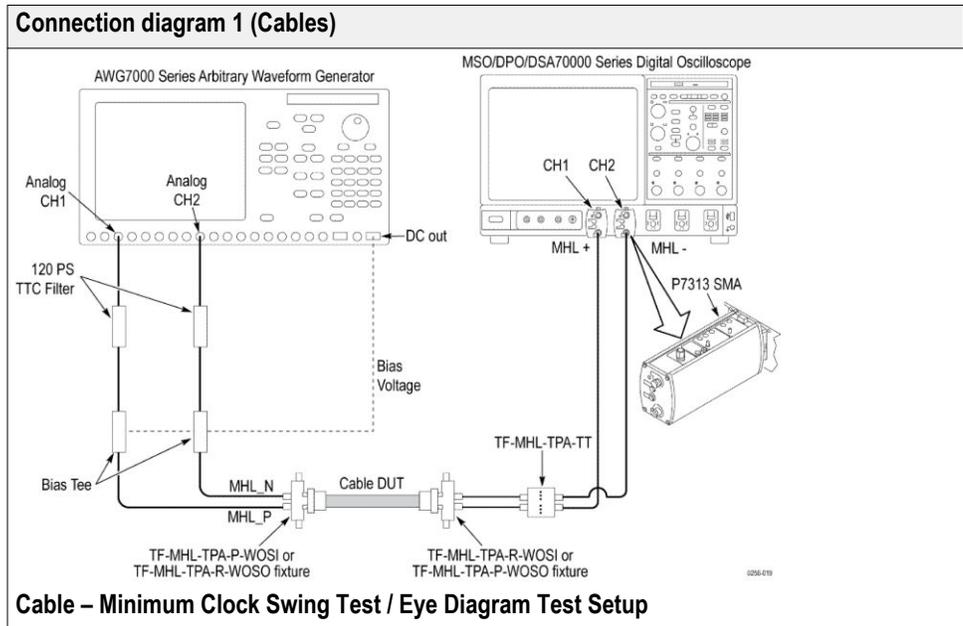
7.2.1.17: Eye diagram test



**Single-Ended Signals Calibration Setup for Cable Tests**



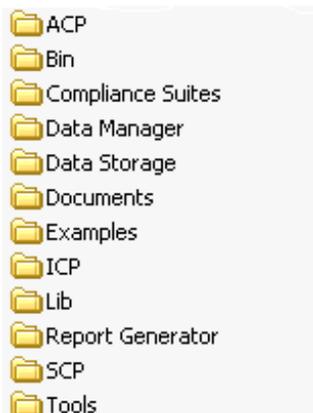
**Differential & Common-Mode Signals Calibration Setup for Cable Tests**



- See Also**
- [Equipment connection setup MHL Transmitter](#)
  - [Equipment connection setup MHL Receiver](#)
  - [About algorithms](#)
  - [View connected Instruments](#)

## Application directories and usage

The application directory and associated files are organized as follows:



The following table lists the default directory names and their usage.

**Table 9: Application directories and usage**

Directory names	Usage
InstallDir\TekExpress\TekExpress MHL	Contains the application and associated files
TekExpress MHL\ACP	Contains instrument and MHL application-specific interface libraries
TekExpress MHL\Bin	Contains miscellaneous MHL application libraries
TekExpress MHL\Compliance Suites	Contains compliance-specific files and filter files
TekExpress MHL\Data Manager	Contains result management-specific libraries of the MHL application
TekExpress MHL\Data Storage	Contains libraries needed for storing data
TekExpress MHL\Documents	Contains the technical documentation for the MHL application
TekExpress MHL\Examples	Contains various support files
TekExpress MHL\ICP	Contains instrument and MHL application-specific interface libraries
TekExpress MHL\Lib	Contains utility files specific to the MHL application
TekExpress MHL\Report Generator	Contains style sheets for report generation
TekExpress MHL\SCP	Contains instrument and MHL application-specific interface libraries
TekExpress MHL\Tools	Contains instrument and MHL application-specific files

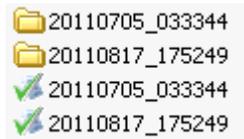
**See Also** [View test-related files](#)

## View test-related files

Files related to MHL tests are stored in the MHL folder under the My TekExpress shared folder. In the MHL folder, each test setup has a test setup file and a test setup folder, both with the test setup name. The test setup file is preceded by the MHL icon and usually has no file extension displayed.

Inside the test setup folder is another folder named for the DUT ID used in the test sessions (the default is DUT001).

Inside the DUT001 folder are the session folders and files. Each session has a folder and file pair, both named for the test session using the naming convention (date)\_(time). Each session file is stored outside of its matching session folder.



Each session folder contains image files of any plots generated by the test session, and any waveform files if prerecorded waveform files were used during the session.

The first time you run a new, unsaved session, the session files are stored in the Untitled Session folder located at ..\My TekExpress\MHL. Once you name and save the session, the Untitled Session folder name is changed to the one you specified.

---

**NOTE.** *By default, test report files are saved in the session folder. You can [change the report file location](#) for a specific test.*

---

**See Also** [File name extensions](#)

## File name extensions

The TekExpress MHL software uses the following file name extensions:

File name extension	Description
.TekX	Session files are saved in this format but the extensions may not be displayed
.py	The test sequence file
.xml	The encrypted XML file that contains the test-specific configuration information The log file extension is also xml
.wfm	The test waveform file
.mht	Test result reports are saved in this format by default. Test reports can also be <a href="#">saved in MHTML format</a> .
.flt	Filter file used with transmitter tests

**See Also** [Application directories and usage](#)



# Getting started

## Installing the software

### Compatibility

The TekExpress Suite MHL 3.0 Transmitter and MHL 3.0 Receiver of version CTS 3.3 application runs on the following Tektronix oscilloscopes:

- DPO/DSA/MSO71254C, DPO/DSA/MSO71604C, DPO/DSA/MSO72004C, DPO/DSA72504D, DPO/DSA73304D Digital Oscilloscopes with Option DJA.
- DPO/MSO72304Dx, DPO/MSO72504Dx, DPO/MSO73304Dx Digital Oscilloscopes with Option DJA.

The TekExpress Suite MHL Transmitter, MHL Receiver, MHL Cable test and MHL Receiver protocol of version CTS 1.x, 2.0, 1.3/2.1 application runs on the following Tektronix oscilloscopes:

- DPO/DSA/MSO70804C, DPO/DSA/MSO71254C, DPO/DSA/MSO71604C, DPO/DSA/MSO72004C, DPO/DSA72504D, DPO/DSA73304D Digital Oscilloscopes with Option DJA.
- DPO/MSO72304Dx, DPO/MSO72504Dx, DPO/MSO73304Dx Digital Oscilloscopes with Option DJA.

**See Also.** [Minimum system requirements](#)

### Minimum system requirements

The following table shows the minimum system requirements for an oscilloscope to run TekExpress.

**Table 10: System requirements**

Component	Minimum requirement
Oscilloscope	BW ≥ 12.5 GHz for MHL 3.0 Advanced Analysis and Compliance Software (Needs Option MHD). BW ≥ 12.5 GHz with Opt 20XL for MHL 1.x/2.0 and CTS 2.1 Protocol Analysis software. BW ≥ 8 GHz for MHL 1.x, 2.0, and 1.3/2.1 Advanced Analysis and Compliance Software (Needs Option DJA). For a list of compatible oscilloscopes, see <a href="#">Compatibility</a> .
Processor	Same as the oscilloscope
Operating system	Same as the oscilloscope
Memory	Same as the oscilloscope

Component	Minimum requirement
<b>Hard disk</b>	Same as the oscilloscope
<b>Display</b>	Same as the oscilloscope <sup>1</sup>
<b>Software</b>	<ul style="list-style-type: none"> <li>■ TekExpress MHL Advanced Analysis and Compliance software.</li> <li>■ DPOJET, Jitter and Eye Diagram Analysis Tool Ver 7.0.0.416 for Windows 7 Scopes.</li> <li>■ Microsoft Internet Explorer 6.0 SP1 or later.</li> <li>■ Microsoft Photo Editor 3.0 or equivalent software for viewing image files.</li> <li>■ Adobe Reader 8.0 or equivalent software for viewing portable document format (PDF) files.</li> </ul>
<b>Probes</b>	<ul style="list-style-type: none"> <li>■ Two Differential Probes – P7313SMA for Single-Ended and Differential tests.</li> <li>■ One Differential Probe – P7240 for Common-Mode tests.</li> </ul>
<b>MHL sources</b>	<ul style="list-style-type: none"> <li>■ MHL Tx DUTs</li> <li>■ One AWG7122 C with Option 01, 02/06 and 08 which can be used as an MHL DUT</li> <li>■ MHL Ref waveforms</li> </ul>
<b>MHL 3.0 sources</b>	<ul style="list-style-type: none"> <li>■ MHL 3.0 Tx DUTs</li> </ul> <p>Either</p> <ul style="list-style-type: none"> <li>■ AWG7122C with Option 01 and 02 or 06 and 08 or</li> <li>■ AWG70002A with option 01, 3, 225</li> </ul> <p>which can be used as an MHL 3.0 DUT</p> <ul style="list-style-type: none"> <li>■ MHL 3.0 Ref waveforms</li> </ul>
<b>TDR tests</b>	<ul style="list-style-type: none"> <li>■ Oscilloscope – DSA8200 or equivalent with 80E03 and 80E04 modules and I-Connect software</li> </ul>

<sup>1</sup> If TekExpress is running on an instrument having a video resolution lower than 800 x 600 (for example, sampling oscilloscope), it is recommended that you connect a secondary monitor, which must be enabled before launching the application.

Component	Minimum requirement
<b>MHL Generator for Sink and Dongle and Cable tests</b>	<ul style="list-style-type: none"> <li>■ AWG7122C with option 01 and 02 or 06 and 08 or AWG7002A with option 01,03,225</li> </ul>
<b>MHL 3.0 Generator for Sink and Dongle and Cable tests</b>	<ul style="list-style-type: none"> <li>■ Signal generators should be AWG7122C for eCBUS Source with AWG70002A or AWG7122C for AV_Link</li> </ul>
<b>MHL fixtures</b>	<p>MHL fixture kits from Tektronix</p> <ul style="list-style-type: none"> <li>■ TF-MHL-TPA-TEK (Complete MHL Fixture kit)</li> <li>■ TF-MHL-TPA-TEK-SO (Source Fixture Only kit)</li> <li>■ TF-MHL-TPA-TEK-SI (Sink Fixture kit)</li> <li>■ TF-MHL-TPA-TEK-DG (Dongle Adopter kit)</li> <li>■ TF-MHL-TPA-TEK-CB (MHL Cable Adopter kit)</li> </ul>
<b>MHL 3.0 fixtures</b>	<p>MHL 3.0 fixture kits from Tektronix</p> <ul style="list-style-type: none"> <li>■ TF-MHL3-TPA-KIT</li> </ul> <p>TF-MHL3-TPA-KIT contains one TF-MHL-TPA-SOS-MUSB <sup>2</sup> and one TF-MHL-TPA-SOSIS-HDM</p>

<sup>2</sup> Two numbers are required for 3.7.2.6 Auto Calibration test measurement

Component	Minimum requirement
<b>MHL accessory kit</b> (to be used with Tektronix AWG)	TF-MHL-DS-Acckit from Tektronix contains the following: <ul style="list-style-type: none"> <li>■ Two Bias Tees from Mini-Circuits – ZX85-12G-S+</li> <li>■ Two Amplifiers from Pico Second Pulse Labs – 5866 (needed only for Sink/Dongle Min/Max test)</li> <li>■ Two 120PS TTC filters from Pico Second Pulse Labs – 5915-100-120PS</li> </ul>
<b>Other devices</b>	<ul style="list-style-type: none"> <li>■ Microsoft compatible mouse or compatible pointing device</li> <li>■ Four USB ports (two USB ports minimum)</li> <li>■ PCI-GPIB or equivalent interface for instrument connectivity.<sup>3</sup></li> <li>■ 2 pair of SMA cables</li> </ul>

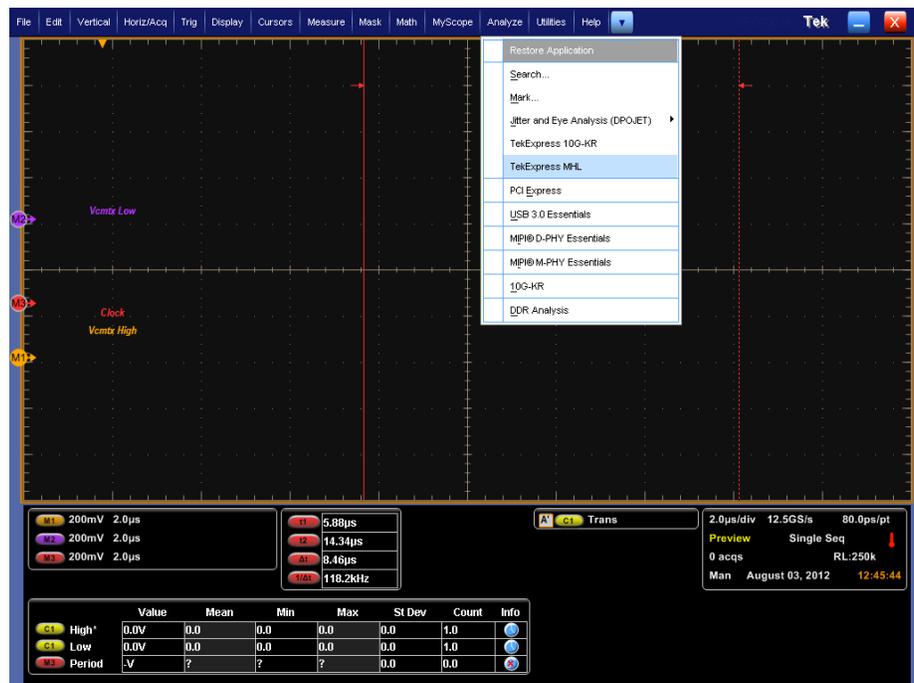
**See Also.** [Compatibility](#)

## Install the software

The software can be installed on any compatible instrument running Windows 7.

1. Close all applications (including the TekScope application).
2. Go to the [www.tek.com](http://www.tek.com) Web site and search for MHL to locate the installation file. Download the file MHL WebInstaller.exe.
3. Double-click the executable file to extract the installation files. After extraction, the installer launches and displays the InstallShield Wizard.
  - Check TekExpress application for MHL to install the TekExpress MHL application.
4. The software automatically installs in the following location:
  - Windows 7 location: C:\Program Files (x86)\Tektronix\TekExpress\TekExpress MHL
5. The installer updates the TekScope Analyze menu to include TekExpress MHL:

<sup>3</sup> If TekExpress is installed on a Tektronix oscilloscope, the virtual GPIB port will be used by TekExpress for communicating with oscilloscope applications. If external GPIB communication devices such as USB-GPIB-HS or equivalent are used for instrument connectivity, ensure that the Talker Listener utility is enabled in the DPO/DSA oscilloscope's GPIB menu. For ease of use, connect to an external (secondary) monitor.



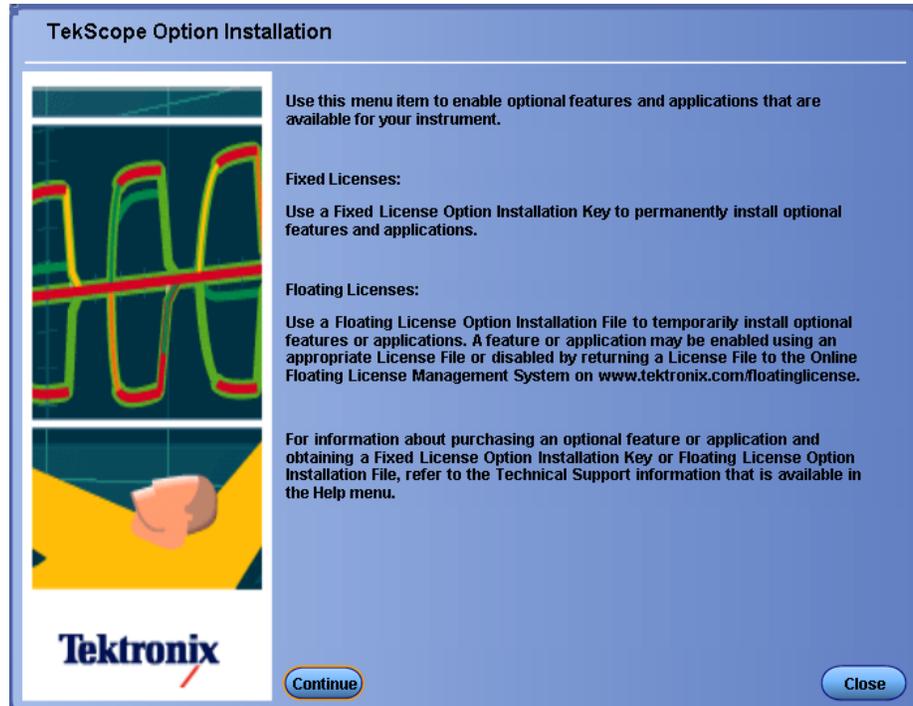
See Also. [Minimum system requirements](#)

[Compatibility](#)

### Activate the license

Activate the license using the option installation wizard on the oscilloscope. Follow these steps to activate the TekExpress MHL license:

1. From the oscilloscope menu bar, click **Utilities > Option Installation**.  
The TekScope Option Installation wizard opens.



2. Instructions for using the Options Installation window to activate licenses for installed applications is provided in the oscilloscope online help. Press the **F1** key on the oscilloscope keyboard to open the Option Installation help topic. Follow the directions in the topic to activate the license.

**See Also.** [View version and license information](#)

### View version and license information

Use the following instructions to view application version information and version information for the application modules such as the Programmatic Interface and the Programmatic Interface Client.

To view version information:

1. From the Options menu, select **About TekExpress**.



To view license information:

1. From the oscilloscope Help menu, select **About TekScope**.

The Options section in the dialog box displays a list of installed options, including TekExpress MHL.

2. To view the Option key, look in the Option Installation Key section. When finished, click **OK** to close the dialog box.

**See Also.** [Activate the license](#)

[Options menu](#)

## Starting the software

### Start the application

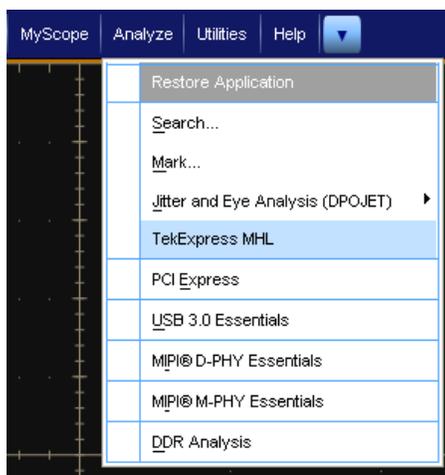
The first time you open the application after installation, you are required to enter a license key. The application also checks for a file called Resources.xml located in the My TekExpress folder. If this file is not found, instrument discovery is performed before launching TekExpress MHL. The Resources.xml file contains information regarding instruments available on your network.

---

**NOTE.** *When the application starts, it checks for the appropriate license key. If the valid license key is not present, the application switches to the Evaluation mode. If the application fails to detect the key, it continues to run in Evaluation mode. You are allowed 10 free trials in Evaluation mode. Each time you open the application without supplying a valid license key, one of the free trials is used.*

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To run the MHL application, from the TekScope menu, select **Analyze > TekExpress MHL**.



While running the application, you can switch between the oscilloscope screen and MHL by clicking the desired window. To keep the application window on top, select **Keep On Top** from the Options menu.

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**NOTE.** *If the application was not terminated properly during the last use, a dialog box asks to recall the previously unsaved session.*

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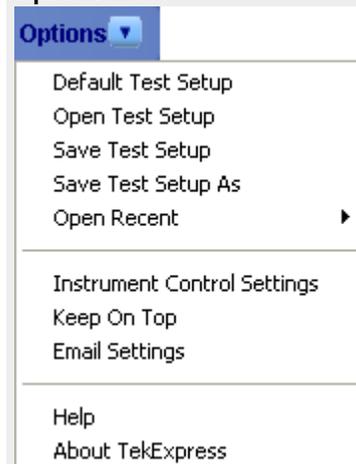
## Options menu

**Options menu.** The Options menu is located in the upper right corner of the application.

It has the following selections:

Menu	Function
Default Test Setup	Opens an untitled test setup with defaults selected
Open Test Setup	Opens a saved test setup
Save Test Setup	Saves the current test setup selections
Save Test Setup As	Creates a new test setup based on an existing one
Open Recent	Displays a menu of recently opened test setups to select from
Instrument control settings	Shows the list of instruments connected to the test setup and allows you to locate and refresh connections to connected instruments
Keep On Top	Keeps the TekExpress MHL application on top of other open windows on the desktop
Email settings	Use to configure email options for test run and results notifications
Help	Displays TekExpress Help
About TekExpress	<ul style="list-style-type: none"> <li>■ Displays application details such as software name, version number, and copyright</li> <li>■ Provides access to <a href="#">license information</a> for your MHL installation</li> <li>■ Provides a link to the Tektronix Web site</li> </ul>

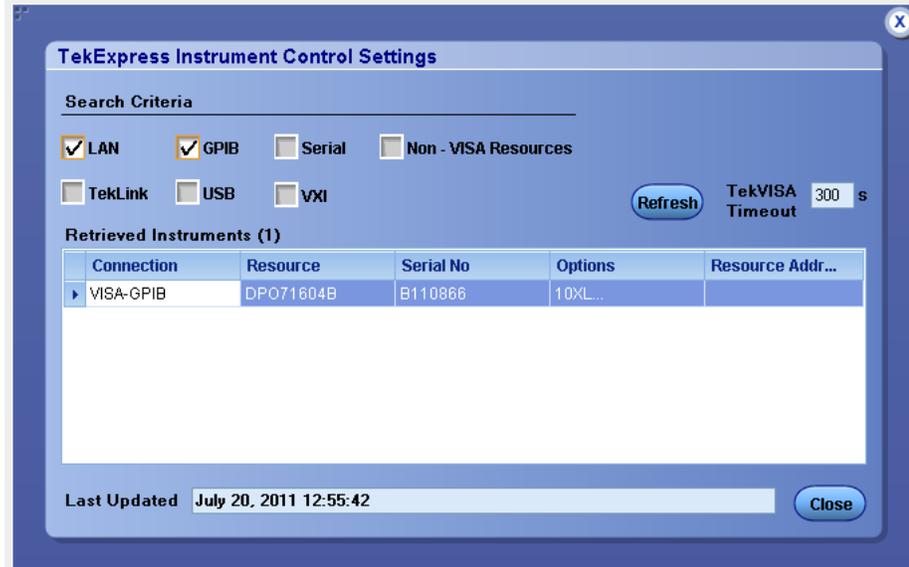
### Options Menu



## Instrument Control Settings

The Instrument Control Settings dialog box shows the list of resources found on different connections. It serves two purposes:

- Discovers the connected instruments
- Confirms the instrument connection setup



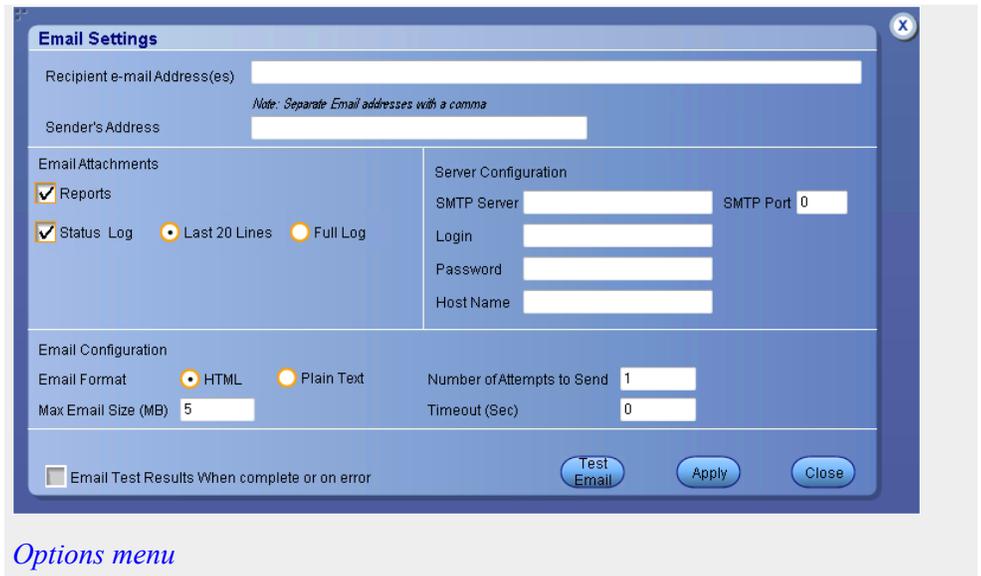
Use the Instrument Control Settings feature to *search for and view connected instruments* and view instrument connection details. Connected instruments displayed here can be selected for use in the Global Settings section of the Setup panel's Configuration section.

### See Also

[Options menu](#)

### Email Settings

Use the Email Settings utility to *configure email notifications* if you want the application to notify you when a tests completes or produces an error. Select the type of test run information to be included in the notification, such as test reports and test logs, the email message format, and the email message size limit.



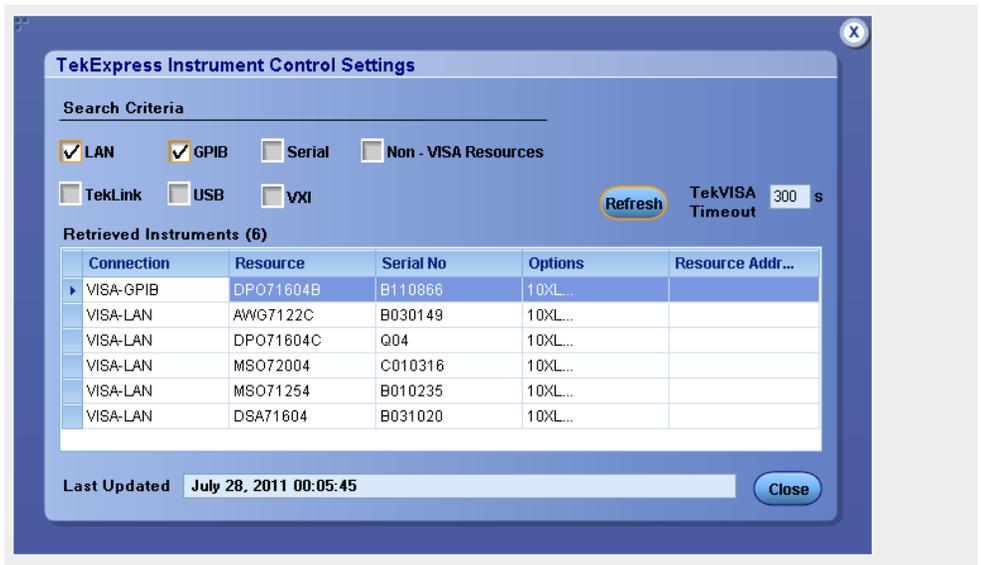
### Options menu

### View connected instruments: the instrument control settings

Use the Instrument Control Settings dialog box to view or search for connected instruments required for the tests. The application uses TekVISA to discover the connected instruments.

To refresh the list of connected instruments:

1. From the Options menu, select Instrument control settings.



2. In the Search Criteria section of the Instrument Control Settings dialog box, select the connection types of the instruments to search for.

Instrument search is based on the VISA layer but different connected cables determine the resource type, such as LAN, GPIB, USB. For example, if you choose LAN, you can search for all the instruments supported by TekExpress that are communicating over the LAN. If the search does not find any instruments that match a selected resource type, a message appears telling you that no such instruments were found. Click **OK** to close the message window.

3. Click **Refresh**. TekExpress searches for connected instruments.
4. After discovery, the dialog box lists the instrument-related details based on the search criteria you selected. For example, if you selected LAN and GPIB as the search criteria, the application checks for the availability of instruments over LAN, then GPIB.

The details of the instruments are displayed in the Retrieved Instruments table. The time and date of instrument refresh is displayed in the Last Updated field.

**See Also.** [Equipment connection setup \(MHL Transmitter\)](#)  
[Equipment connection setup \(MHL Receiver\)](#)  
[Equipment connection setup \(MHL Cables\)](#)

## Application controls

**Table 11: Application controls descriptions**

Item	Description
<a href="#">Options menu</a>	Opens the Options menu for access to global controls
Panels	Visual frames with sets of related options. Some panels are further divided into tabs and other sections.
Start button	<p><b>Start</b></p>  <p>Use the Start button to continuously acquire and accumulate measurements. If prior acquired measurements have not been cleared, the new measurements are added to the existing set.</p>
Stop button	<p><b>Stop</b></p>  <p>Use the Stop button to abort a test in progress.</p>
Pause \ Continue button	<p><b>Pause</b></p>  <p>Use the Pause button to interrupt the current acquisition. When a test is paused, the button name changes to Continue.</p>

Item	Description
Clear button	 <p>Available only on the <a href="#">Results panel</a>. Use the Clear button to clear all existing measurement results. Note that adding or deleting a measurement, or changing a configuration parameter of an existing measurement also clears measurements. This is to prevent the accumulation of measurement statistics or sets of statistics that are not coherent.</p>
Application window move icon	 <p>Place the cursor over the three-dot pattern in the upper left corner of the application window. When the cursor changes to a hand, drag the window to the desired location.</p>

### Exit the application

Use the following method to exit the application:

---

**NOTE.** *Using other methods to exit the application results in abnormal termination of the application.*

---

1. Click  on the application title bar.
2. Do one of the following:
  - A message box appears asking if you really want to exit TekExpress. To exit, click **Yes**. Otherwise, click **No**.
  - If you have an unsaved session or test setup open, you will be asked if you want to save it before exiting. To save it, click **Yes**. If you do not wish to save, click **No**. To remain in the session, click **Cancel**.



---

# Application basics

## Application basics

The TekExpress MHL software user interface is intuitive and easy to use. In addition to the UI, a *programmatic interface* is available.

The user interface has four main panels whose options differ depending upon Suite selected from the following list:

- MHL 3.0 Transmitter
- MHL 3.0 Receiver
- MHL Transmitter
- MHL Receiver
- MHL Cable
- MHL Receiver protocol

The following steps explains application basics:

- First, *set up the tests*.
- Then, *prepare to run the tests*.
- Then, *run the tests and view the progress of analysis*.
- Then, *view the results of the tests*.
- You can *configure and view reports*.
- You can *save and recall test setups*.

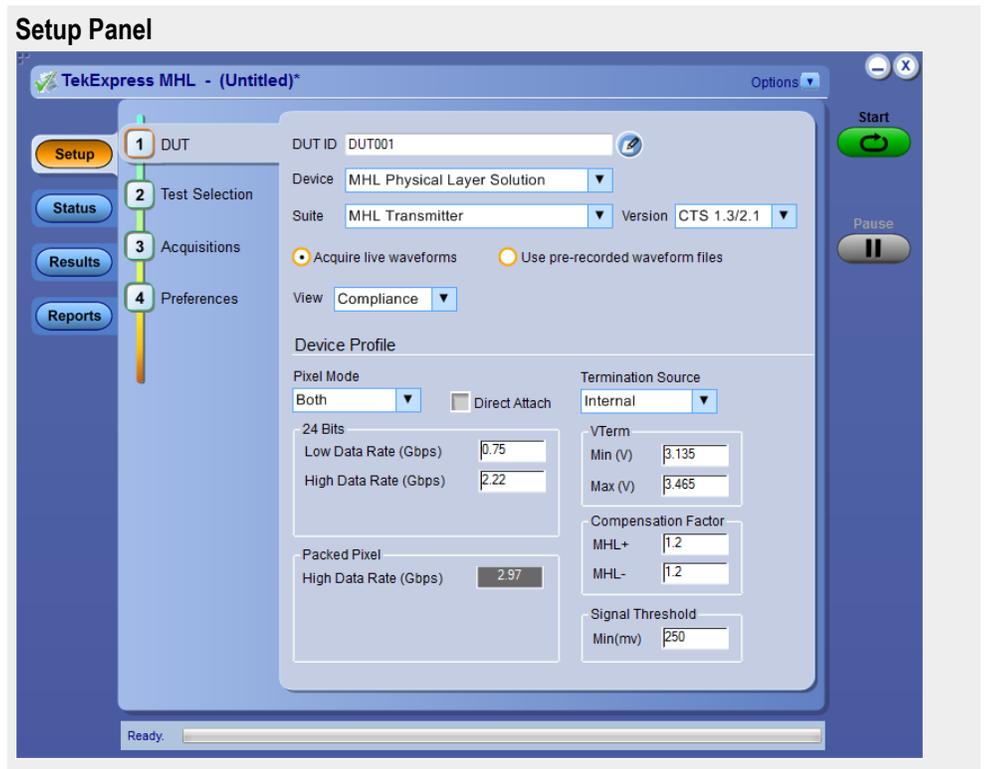
**See Also** [Overview and key specifications](#)



# Setting up tests

## Setting up tests: the Setup panel

The Setup panel guides you through the MHL test setup process using tabs. The options selected in a tab affect the options available in the following tab. The available options differ depending on options selected under Suite and Version tab.



**NOTE.** A check mark next to a tab title means you have made changes. However, if you make changes on a tab that significantly affects a previous tab, the check mark of the affected tab is replaced with its number, indicating that you should check the settings on that tab.

- [DUT tab](#)

Here, you can Specify the DUT ID, device, applications suite (MHL 3.0 Transmitter/MHL 3.0 Receiver/MHL Transmitter/Receiver/MHL Cable), the CTS version, the view and device profile settings. These settings apply to all tests for the current session, and affect the test list in the Test Selection tab.

- [Test selection tab](#)

Here, Select tests individually or by group, view a short description of a selected test, and view a schematic showing appropriate device connections.

- *Acquisitions tab* (MHL 3.0 Transmitter, MHL 3.0 Receiver, MHL Transmitter and MHL Cable Test only)

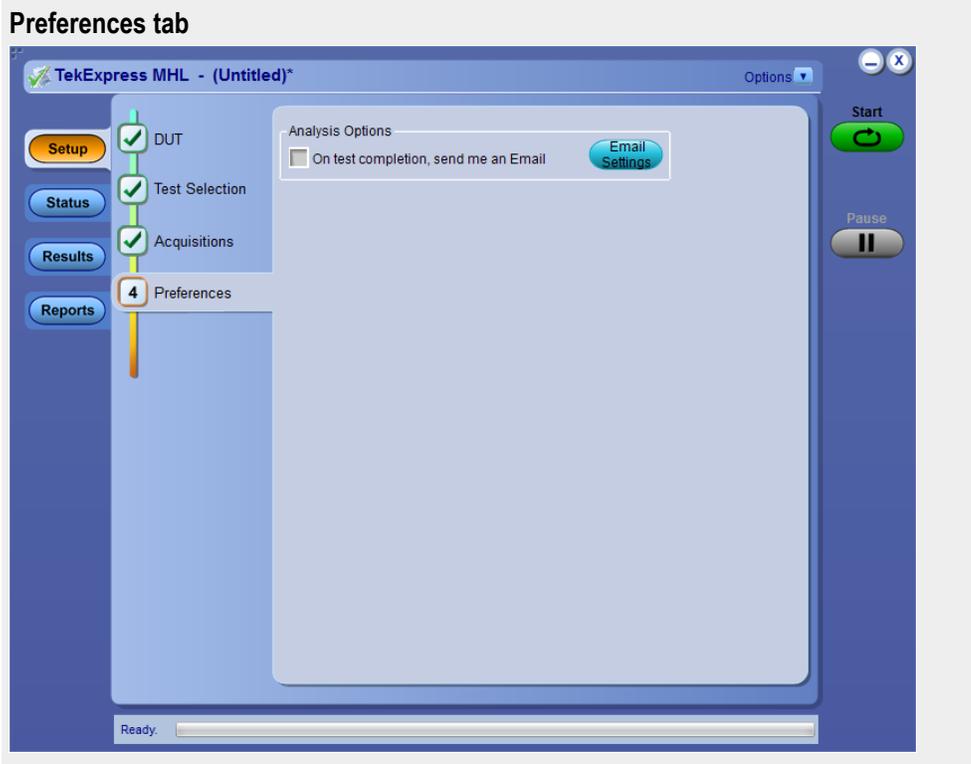
View configurations for attached probes, view a list of signals and sources, and view the Acquisitions table.

- *Configuration tab* (Displays only when View: Advanced is selected in the DUT tab.)

Here, Select either **Compliance Mode** or **User Defined Mode**, view Global Settings, select measurement settings, and view or edit test parameter limits.

- Preferences tab

Here, you may specify that an email be sent to you upon test completion.

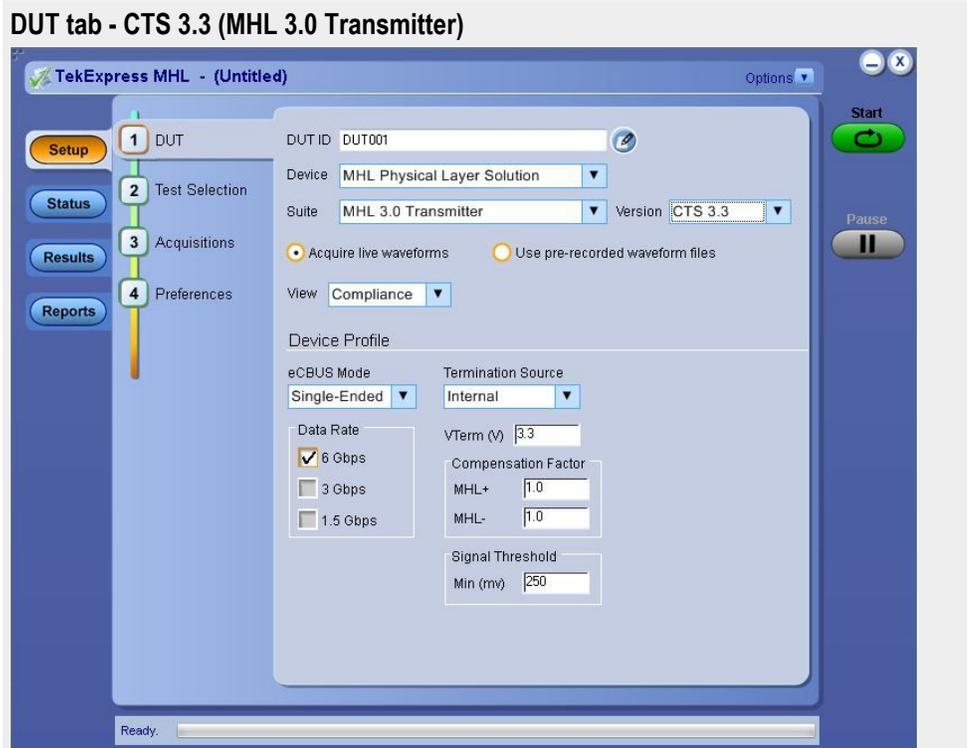


- See also** [Saving a test setup](#)  
[Run test and view progress on the Status panel](#)  
[Viewing test results the results panel](#)  
[Configuring and viewing reports the reports panel](#)

## Select the device parameters on the DUT tab

1. Click the DUT on the Setup panel  
Specify the DUT ID, Device, Suite (MHL 3.0 Transmitter/ MHL 3.0 Receiver/ MHL Transmitter/ MHLReceiver/ MHL Cable), CTS version, View, Acquisition method and Device Profile settings. These settings apply to all current tests, and affect the test list in the Test Selection tab.
2. Enter the device **ID**: The default value is DUT001. This ID appears on test reports. To add comments to the top of a report, click  and enter up to 256 characters.
3. Select **Suite**: Scroll down and select Suite from the following list.
  - MHL 3.0 Transmitter
  - MHL 3.0 Receiver
  - MHL Transmitter
  - MHL Receiver
  - MHL Cable
  - MHL Receiver protocol
4. Select **Version**: Version choice determines which Device Profile options appear on the screen, and which tests appear on the Test Selection tab.  
CTS 1.X, CTS 2.0, or CTS 1.3/2.1 version test selection measurements will be displayed when Suite selection is either MHL Transmitter, MHL Receiver, MHL Cable or MHL Receiver protocol.  
CTS 3.2 version test selection measurements will be displayed when Suite selection is MHL 3.0 Transmitter or MHL 3.0 Receiver Suite.
5. Select **Waveform** type : Select either “Acquire Live Waveforms” or “Use pre-recorded waveform files” for testing. If the suite selection is MHL Receiver, only pre-recorded waveform measurement option is available.

6. Select **View**: Select either **Compliance** or **Advanced**. If the suite selection is MHL Receiver, only compliance view is supported.
  - If you select the **Advanced** view, an additional **Configuration** tab appears.
  - To access configuration options for **Compliance** view, click the **Configure** button on the Test Selection tab.
7. Set the **Device Profile** options (again, these will differ depending upon the CTS version selected above).
  - *MHL 3.0 Transmitter only*: If you select Version CTS 3.3, you will see this DUT screen. These Device profile options will be available.

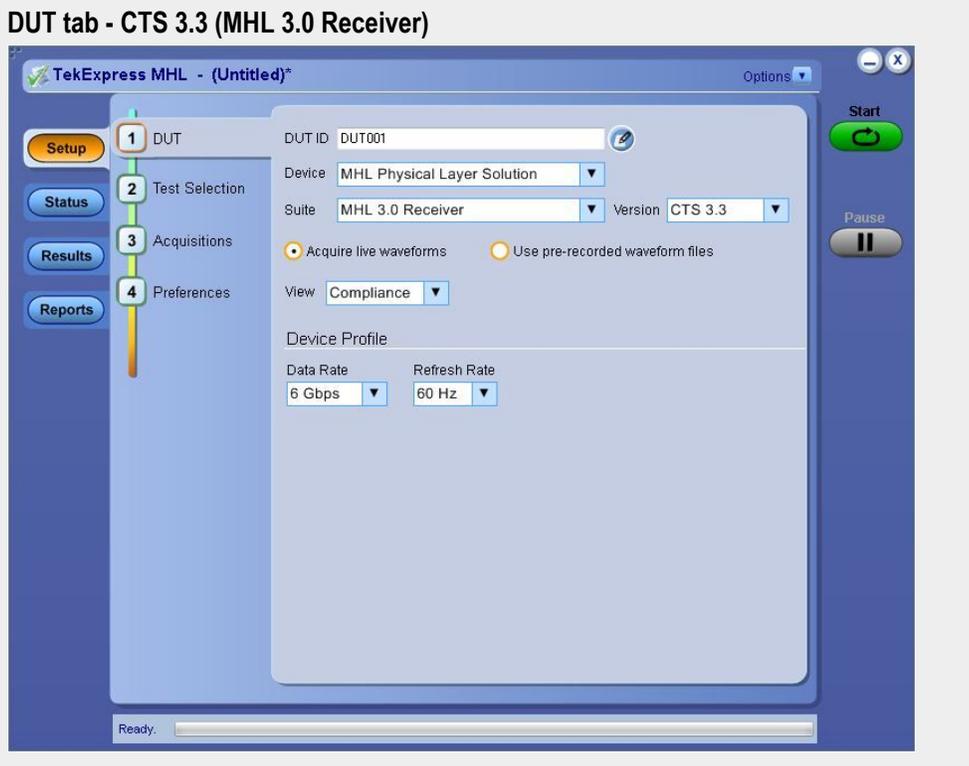


**Table 12: Device Profile options for CTS 3.0 (MHL 3.0 Transmitter)**

Setting	Option	Description
eCBUS mode	Single-ended	Single ended eCBUS mode.
Data rate	6 GBPS	Select high and low data rate.
	3 GBPS	
	1 GBPS	
Termination source	Internal	Select this if the termination voltage control mode is INT (Internal).
	External other	Select this if the termination voltage control mode is EXT (External) and you are using an external power supply.

Setting	Option	Description
VTerm (v)	3.3	Value must be greater than or equal to ( $\geq$ ) 1 V and less than or equal to ( $\leq$ ) 5 V.
MHL+ compensation factor	1.0	Used for fixture compensation. Value should be between 1 and 2. Default value of MHL+ Compensation factor is 1.0.
MHL- compensation factor	1.0	Used for fixture compensation. Value should be between 1 and 2. Default value of MHL- Compensation factor is 1.0.
Single threshold Min(mv)	250	Used for signal validation. Value should be between 50 and 600 mV.

- MHL 3.0 Receiver only:** If you select Version CTS 3.3, you will see this DUT screen. These Device profile options will be available.

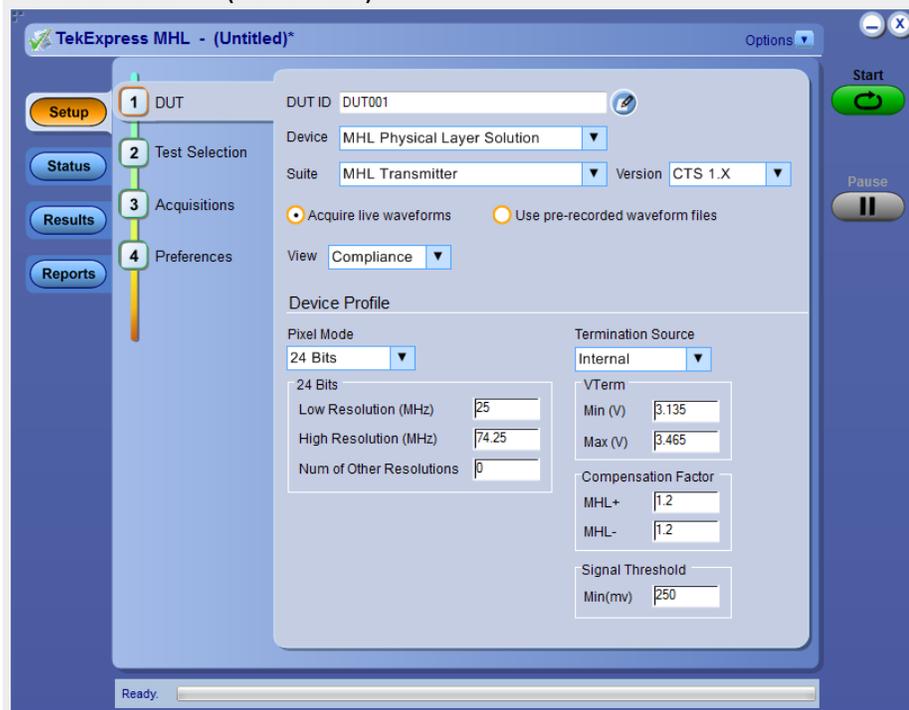


**Table 13: Device Profile options for CTS 3.0 (MHL 3.0 Receiver)**

Setting	Option	Description
Data Rate	6 GBPS	Select the highest data rate supported by the DUT.
	3 GBPS	
	1.5 GBPS	
Refresh Rate	60Hz	Select this if the DUT refresh rate is 60 Hz.

- *MHL Transmitter only:* If you select Version CTS 1.X, you will see this DUT screen. These Device Profile options will be available.

**DUT tab – CTS 1.X (Transmitter)**



**Table 14: Device Profile options for CTS 1.X (Transmitter)**

Setting	Option	Description
Pixel Mode	24 Bits	This is the only option available.
Low Resolution (MHz)	25	Enter a value from 25 to 100. Low Resolution value should be less than or equal to High Resolution, and High Resolutions should be greater than or equal to Low resolution.
High Resolution (MHz)	74.25	

Setting	Option	Description
Num of Other Resolutions	0	If the DUT can support more than the three standard resolutions, enter the number here. Value can be from 0 to 10. Applicable tests will be run for the number of other resolutions specified here.
MHL+ Compensation Factor	1.2	Used for fixture compensation. Value should be between 1 and 2.
MHL- Compensation Factor	1.2	Used for fixture compensation. Value should be between 1 and 2.
Min Signal Threshold	250	Used for signal validation. Value should be between 50 and 600 mV.
Termination Source	Internal	Select this if the termination voltage control mode is INT (Internal).
	External Other	Select this if the termination voltage control mode is EXT (External) and you are using an external power supply.
VTerm Min (V)	3.135	Value must be greater than or equal to ( $\geq$ ) 1V and less than or equal to ( $\leq$ ) VTerm Max.
VTerm Max (V)	3.465	Value must be greater than or equal to ( $\geq$ ) VTerm Min, and less than or equal to ( $\leq$ ) 5V.

- *MHL Transmitter only:* If you select Version CTS 2.0, the DUT screen and Device Profile options you will see will differ depending upon the Pixel Mode selected. This screen shows the DUT tab with pixel mode of both. These Device profile options will be available.

DUT tab – CTS 2.0 with Pixel Mode of Both (Transmitter)

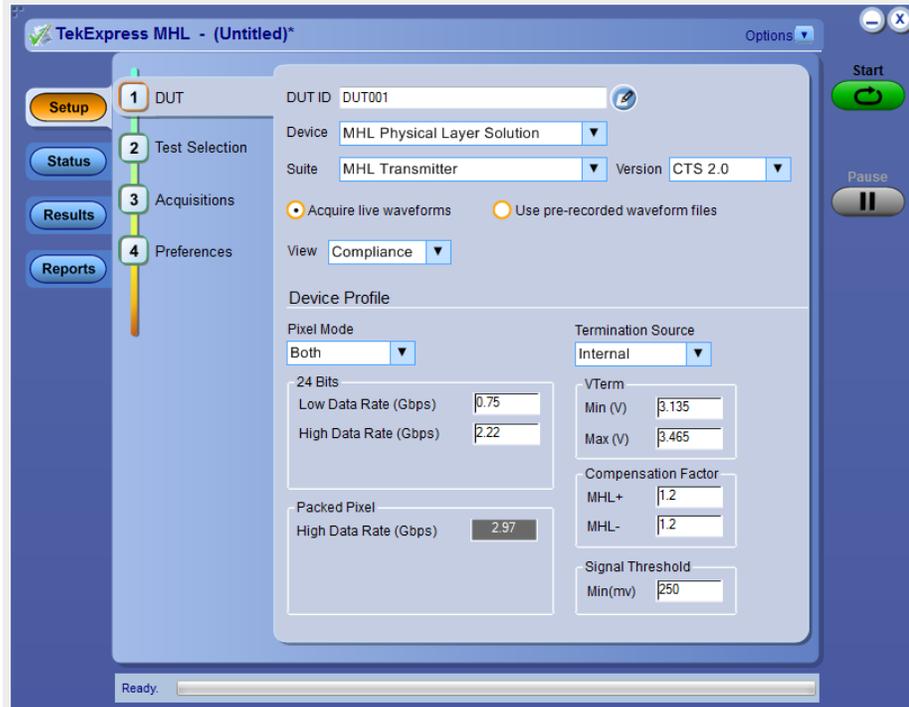


Table 15: Device Profile options for CTS 2.0 (Transmitter)

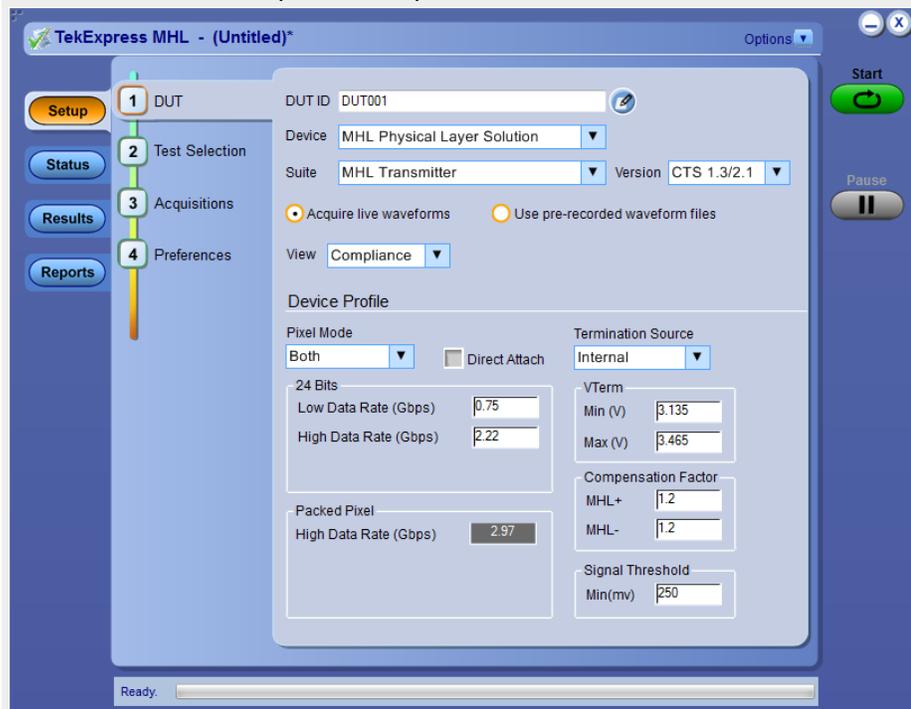
Setting	Option	Description
Pixel Mode	24 Bits	Select this if the DUT uses 24 Bit mode.
	Packed Pixel	Select this if the DUT uses packed pixel mode.
	Both	Select this if the DUT uses both 24 Bit and packed pixel mode.
When Pixel Mode is 24 Bits:		
Low Data Rate (Gbps)	0.75	Enter a value from 0.75 – 2.22 Gbps. Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
High Data Rate (Gbps)	2.22	
Num of Other Data Rates	0	If the DUT can support more than the three standard resolutions, enter the number here. Value can be from 0 to 10. Applicable tests will be run for the number of other resolutions specified here.
When Pixel Mode is Packed Pixel:		

Setting	Option	Description
Low Data Rate (Gbps)	2.25	Enter a value from 2.25 – 2.97 Gbps. Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
High Data Rate (Gbps)	2.97	
Num of Other Data Rates	0	If the DUT can support more than the three standard resolutions; enter the number here. Value can be from 0 to 10. Applicable tests will be run for the number of other resolutions specified here.
When Pixel Mode is Both:		
24 Bits:		
Low Data Rate (Gbps)	0.75	Enter a value from 0.75 – 2.22 Gbps. Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
High Data Rate (Gbps)	2.22	
Packed Pixel:		
High Data Rate (Gbps)	2.97	Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
MHL+ Compensation Factor	1.2	Used for fixture compensation. Value should be between 1 and 2.
MHL– Compensation Factor	1.2	Used for fixture compensation. Value should be between 1 and 2.
Min Signal Threshold	250	Used for signal validation. Value should be between 50 and 600 mV.
Termination Source	Internal	Select this if the termination voltage control mode is INT (Internal).
	External Other	Select this if the termination voltage control mode is EXT (External) and you are using an external power supply.
VTerm Min (V)	3.135	Value must be greater than or equal to ( $\geq$ ) 1V and less than or equal to ( $\leq$ ) VTerm Max.

Setting	Option	Description
VTerm Max (V)	3.465	Value must be greater than or equal to ( $\geq$ ) VTerm Min, and less than or equal to ( $\leq$ ) 5V.
Direct Attach (Applicable for CTS 1.3 / 2.1 only)	Check / Uncheck	Select the checkbox when you are testing Direct Attach Device.

- *MHL Transmitter only*: If you select Version CTS 1.3 / 2.1, the DUT screen and Device Profile options you will see will differ depending upon the Pixel Mode selected. This screen shows this DUT tab screen. These Device profile options will be available.

**DUT tab – CTS 1.3 / 2.1 (Transmitter)**



**Table 16: Device Profile options for CTS 1.3 / 2.1 (Transmitter)**

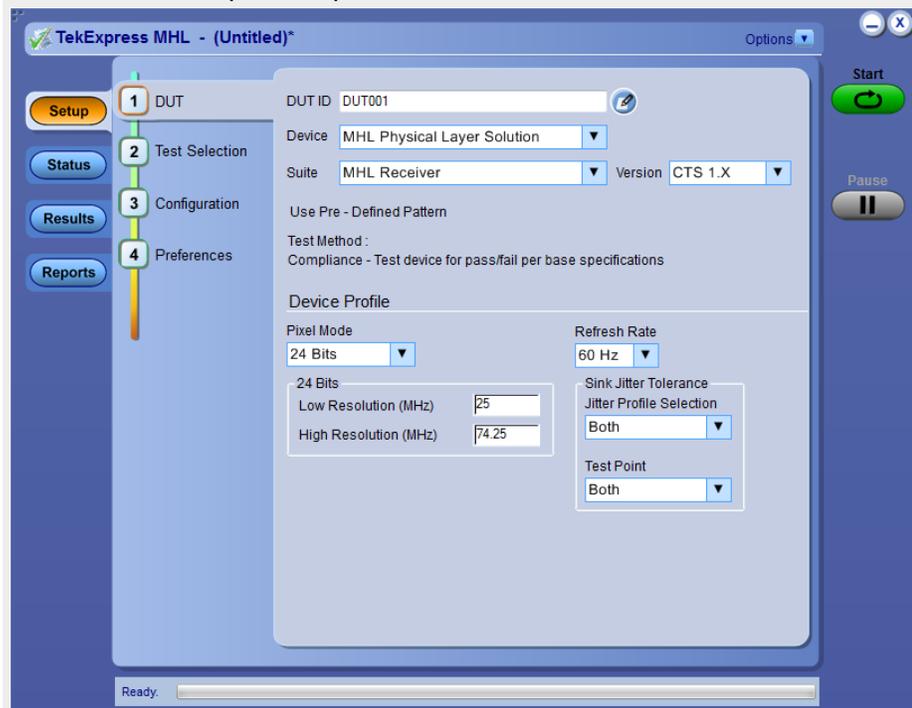
Setting	Option	Description
Pixel Mode	24 Bits	Select this if the DUT uses 24 Bit mode.
	Packed Pixel	Select this if the DUT uses packed pixel mode.
	Both	Select this if the DUT uses both 24 Bit and packed pixel mode.
When Pixel Mode is 24 Bits:		

Setting	Option	Description
Low Data Rate (Gbps)	0.75	Enter a value from 0.75 – 2.22 Gbps. Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
High Data Rate (Gbps)	2.22	
Num of Other Data Rates	0	If the DUT can support more than the three standard resolutions, enter the number here. Value can be from 0 to 10. Applicable tests will be run for the number of other resolutions specified here.
When Pixel Mode is Packed Pixel:		
Low Data Rate (Gbps)	2.25	Enter a value from 2.25 – 2.97 Gbps. Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
High Data Rate (Gbps)	2.97	
Num of Other Data Rates	0	If the DUT can support more than the three standard resolutions; enter the number here. Value can be from 0 to 10. Applicable tests will be run for the number of other resolutions specified here.
When Pixel Mode is Both:		
24 Bits:		
Low Data Rate (Gbps)	0.75	Enter a value from 0.75 – 2.22 Gbps. Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
High Data Rate (Gbps)	2.22	
Packed Pixel:		
High Data Rate (Gbps)	2.97	Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
MHL+ Compensation Factor	1.2	Used for fixture compensation. Value should be between 1 and 2.

Setting	Option	Description
MHL- Compensation Factor	1.2	Used for fixture compensation. Value should be between 1 and 2.
Min Signal Threshold	250	Used for signal validation. Value should be between 50 and 600 mV.
Termination Source	Internal	Select this if the termination voltage control mode is INT (Internal).
	External Other	Select this if the termination voltage control mode is EXT (External) and you are using an external power supply.
VTerm Min (V)	3.135	Value must be greater than or equal to ( $\geq$ ) 1V and less than or equal to ( $\leq$ ) VTerm Max.
VTerm Max (V)	3.465	Value must be greater than or equal to ( $\geq$ ) VTerm Min, and less than or equal to ( $\leq$ ) 5V.
Direct Attach (Applicable for CTS 1.3 / 2.1 only)	Check / Uncheck	Select the checkbox when you are testing Direct Attach Device.

- MHL Receiver only:** If you select Version CTS 1.X, you will see this DUT tab screen. These Device Profile options will be available.

#### DUT tab – CTS 1.X (Receiver)

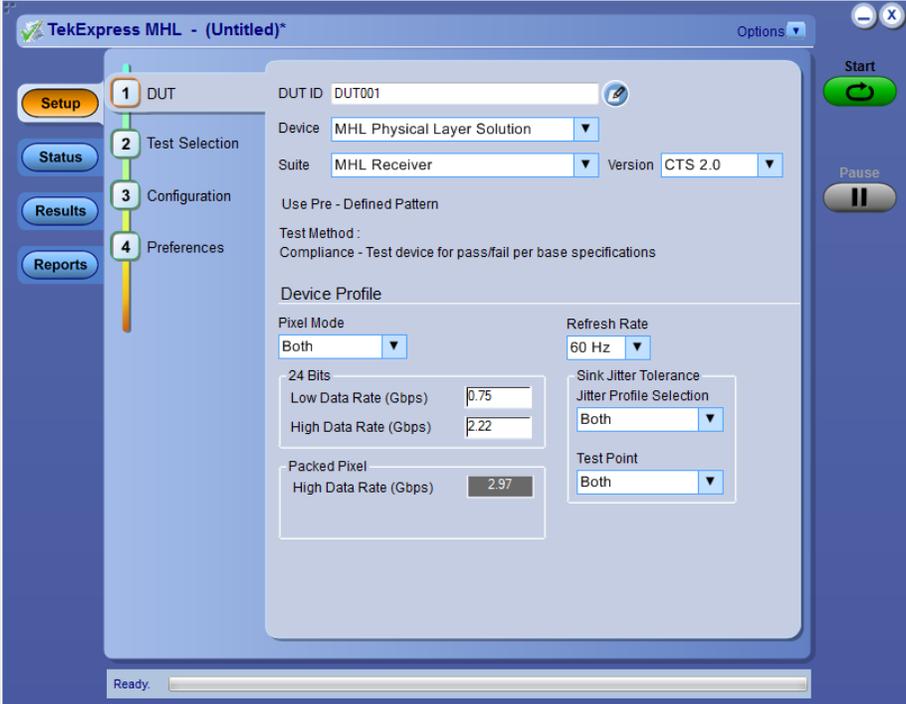


**Table 17: Device Profile options for CTS 1.X (Receiver)**

Setting	Option	Description
Pixel Mode	24 Bits	This is the only option available.
Refresh Rate	50 Hz	
	60 Hz	
	Both	
Low Resolution (MHz) when Refresh Rate is 50 Hz	27	Enter a value of 25 MHz, 27 MHz, or 74.25 MHz. Low Resolution value should be less than or equal to High Resolution, and High Resolutions should be greater than or equal to Low resolution.
Low Resolution (MHz) when Refresh Rate is 60 Hz	25	
Low Resolution (MHz) when Refresh Rate is Both	27	
High Resolution (MHz)	74.25	

- MHL Receiver only:** If you select Version CTS 2.0, the DUT screen and Device Profile options you will see will differ depending upon the Pixel Mode selected. This screen shows the DUT tab with pixel mode of both. These Device profile options will be available.

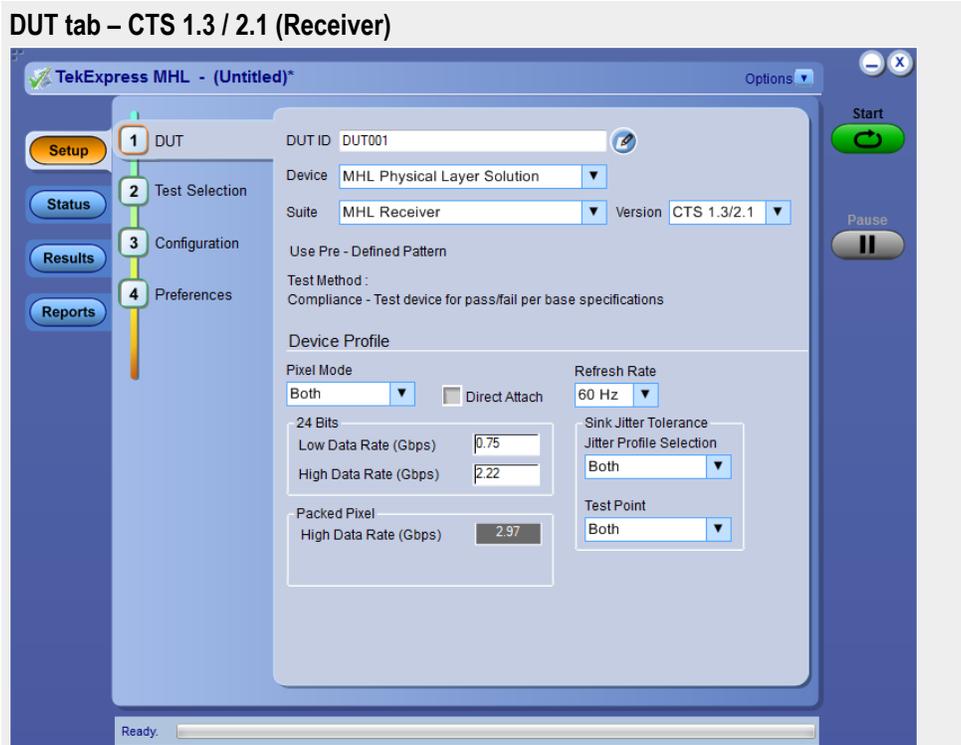
**DUT tab – CTS 2.0 with Pixel Mode of Both (Receiver)**



**Table 18: Device Profile options for CTS 2.0 (Receiver)**

Setting	Option	Description
Pixel Mode	24 Bits	Select this if the DUT uses 24 Bit mode.
	Packed Pixel	Select this if the DUT uses packed pixel mode.
	Both	Select this if the DUT uses both 24 Bit and packed pixel mode.
Low Data Rate (Gbps) when Pixel Mode is 24 Bits, 50 Hz Refresh Rate:	0.81	Enter a value of 0.81 or 2.22.
Low Data Rate (Gbps) when Pixel Mode is 24 Bits, 60 Hz Refresh Rate:	0.75	Enter a value of 0.75, 0.81, or 2.22.
Low Data Rate (Gbps) when Pixel Mode is 24 Bits, Refresh Rate is Both:	0.81	Enter a value of 0.81 or 2.22.
Low Data Rate (Gbps) when Pixel Mode is Packed Pixel, 50 Hz Refresh Rate:	2.97	2.97
Low Data Rate (Gbps) when Pixel Mode is Packed Pixel, 60 Hz Refresh Rate:	2.97	2.97
Low Data Rate (Gbps) when Pixel Mode is Packed Pixel, Refresh Rate is Both:	2.97	2.97
Low Data Rate (Gbps) when Pixel Mode is Both, 50 Hz Refresh Rate:	0.81	Enter a value of 0.81 or 2.22.
Low Data Rate (Gbps) when Pixel Mode is Both, 60 Hz Refresh Rate:	0.75	Enter a value of 0.75, 0.81, or 2.22.
Low Data Rate (Gbps) when Pixel Mode is Both, Refresh Rate is Both:	0.81	Enter a value of 0.81 or 2.22.
High Data Rate (Gbps) when Pixel Mode is Both, Refresh Rate is Both:	2.22	Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
High Data Rate (Gbps, Packed Pixel) when Pixel Mode is Both, Refresh Rate is Both:	2.97	2.97
Direct Attach (Applicable for CTS 1.3 / 2.1 only)	Check / Uncheck	Select the checkbox when you are testing Direct Attach Device.

- *MHL Receiver only*: If you select Version CTS 1.3 / 2.1, the DUT screen and Device Profile options you will see will differ depending upon the Pixel Mode selected. This screen shows the DUT tab with pixel mode of both. These Device profile options will be available.



**Table 19: Device Profile options for CTS 1.3 / 2.1 (Receiver Protocol)**

Setting	Option	Description
Refresh rate	60 Hz	Select this if the DUT uses 60 Hz.
	50 Hz	Select this if the DUT uses 50 Hz.
	30 Hz	Select this if the DUT uses 30 Hz.
	25 Hz	Select this if the DUT uses 25 Hz.
	24 Hz	Select this if the DUT uses 24 Hz.

- *MHL Receiver Protocol only*: If you select Version CTS 1.3 / 2.1, you will see this DUT tab screen. These Device profile options will be available.

DUT tab – CTS 1.3 / 2.1 (Receiver Protocol)

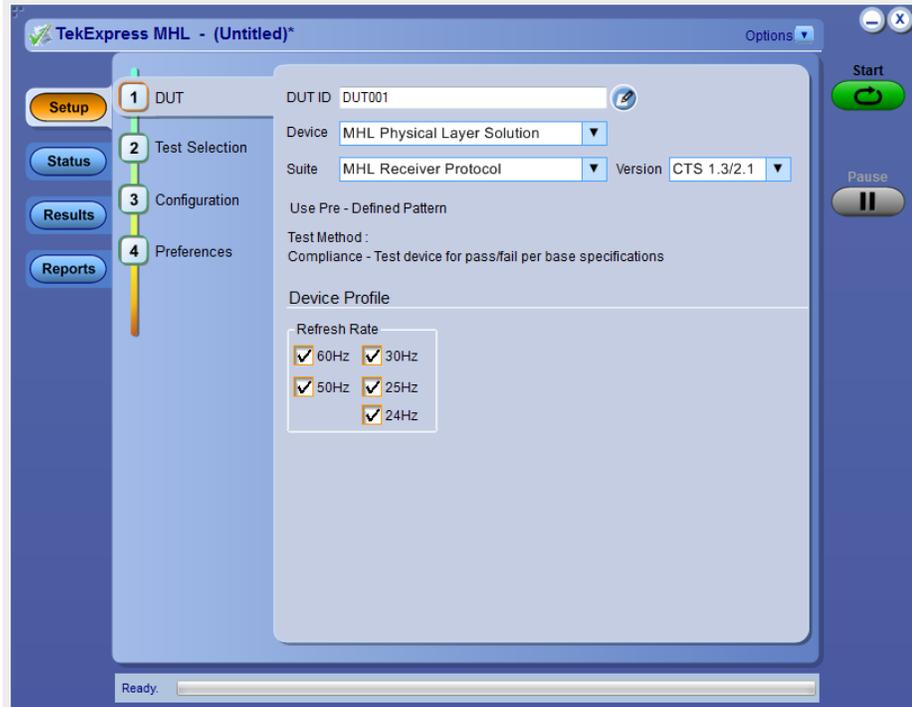


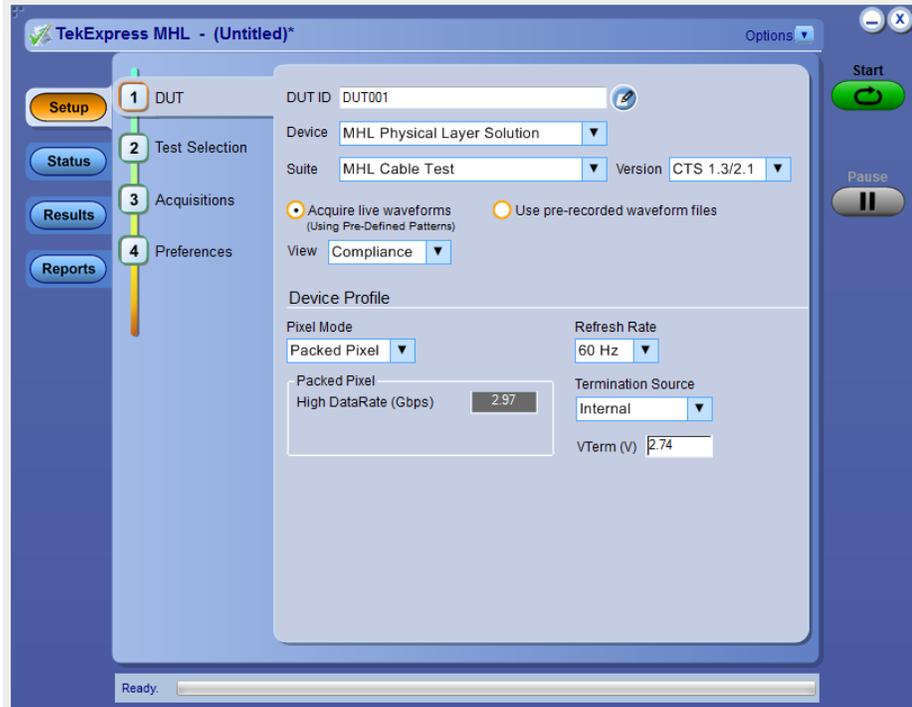
Table 20: Device Profile options for CTS 1.3 / 2.1 (Receiver)

Setting	Option	Description
Pixel Mode	24 Bits	Select this if the DUT uses 24 Bit mode.
	Packed Pixel	Select this if the DUT uses packed pixel mode.
	Both	Select this if the DUT uses both 24 Bit and packed pixel mode.
Low Data Rate (Gbps) when Pixel Mode is 24 Bits, 50 Hz Refresh Rate:	0.81	Enter a value of 0.81 or 2.22.
Low Data Rate (Gbps) when Pixel Mode is 24 Bits, 60 Hz Refresh Rate:	0.75	Enter a value of 0.75, 0.81, or 2.22.
Low Data Rate (Gbps) when Pixel Mode is 24 Bits, Refresh Rate is Both:	0.81	Enter a value of 0.81 or 2.22.
Low Data Rate (Gbps) when Pixel Mode is Packed Pixel, 50 Hz Refresh Rate:	2.97	2.97
Low Data Rate (Gbps) when Pixel Mode is Packed Pixel, 60 Hz Refresh Rate:	2.97	2.97

Setting	Option	Description
Low Data Rate (Gbps) when Pixel Mode is Packed Pixel, Refresh Rate is Both:	2.97	2.97
Low Data Rate (Gbps) when Pixel Mode is Both, 50 Hz Refresh Rate:	0.81	Enter a value of 0.81 or 2.22.
Low Data Rate (Gbps) when Pixel Mode is Both, 60 Hz Refresh Rate:	0.75	Enter a value of 0.75, 0.81, or 2.22.
Low Data Rate (Gbps) when Pixel Mode is Both, Refresh Rate is Both:	0.81	Enter a value of 0.81 or 2.22.
High Data Rate (Gbps) when Pixel Mode is Both, Refresh Rate is Both:	2.22	Low Data Rate value should be less than or equal to High Data Rate and High Data Rate values should be greater than or equal to Low Data Rate.
High Data Rate (Gbps, Packed Pixel) when Pixel Mode is Both, Refresh Rate is Both:	2.97	2.97
Direct Attach (Applicable for CTS 1.3 / 2.1 only)	Check / Uncheck	Select the checkbox when you are testing Direct Attach Device.

- *MHL Cable only*: If you select Version CTS 1.3/2.1, the DUT screen and Device Profile options you will see will differ depending upon the Pixel Mode selected. This screen shows the DUT tab with packed pixel mode. These Device profile options will be available.

### DUT tab – CTS 1.3 / 2.1 (Cable)



**Table 21: Device Profile options for CTS 1.3 / 2.1 (Cable)**

Setting	Option	Description
Packed Pixel Mode	Packed Pixel	Select this if the DUT uses packed pixel mode.
High Data Rate (Gbps) when Pixel Mode is Packed Pixel, 60 Hz Refresh Rate:	2.97	2.97
VTerm	2.74	Value must be greater than or equal to ( $\geq$ ) 1 V and less than or equal to ( $\leq$ ) 5 V.

**See Also**    [Setting up tests the: Setup panel](#)  
[Select tests from the Test Selection tab](#)  
[Acquire waveforms with the acquisitions tab](#)  
[Configure tests using the Configuration tab](#)

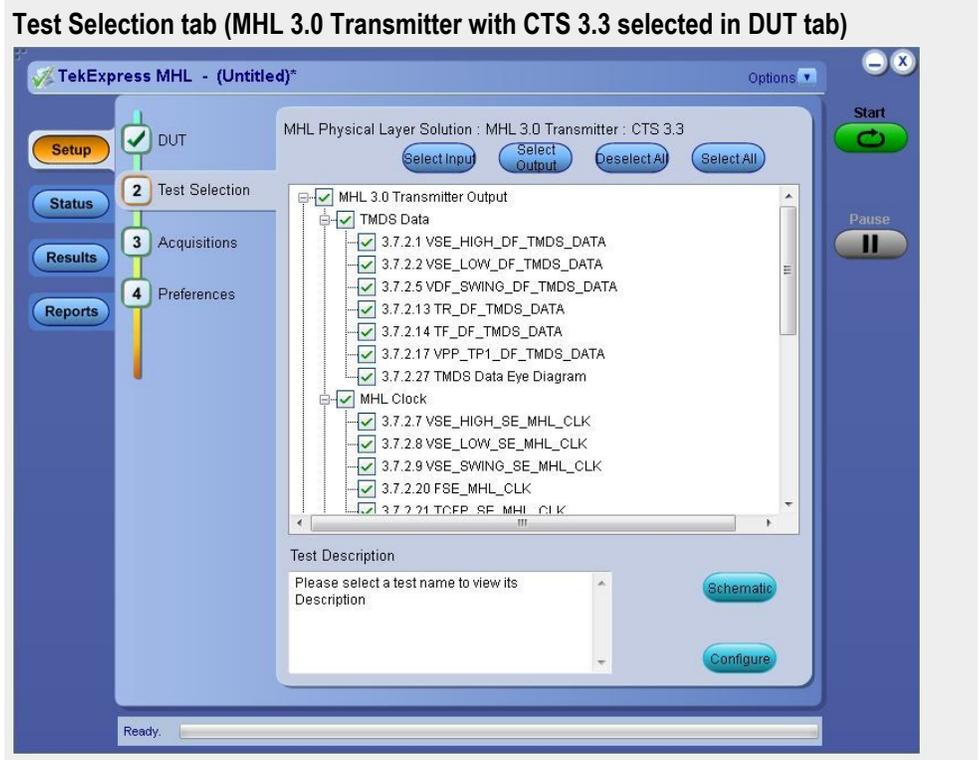
## Choose test from the Test Selection tab

Use these instructions to select the tests to run on the connected DUT. *MHL 3.0 Transmitter, MHL 3.0 Receiver, MHL Transmitter and MHL Cable Test*: Tests that you select here impact the parameters available in the Acquisitions tab.

1. In the Setup panel, click the Test Selection tab.

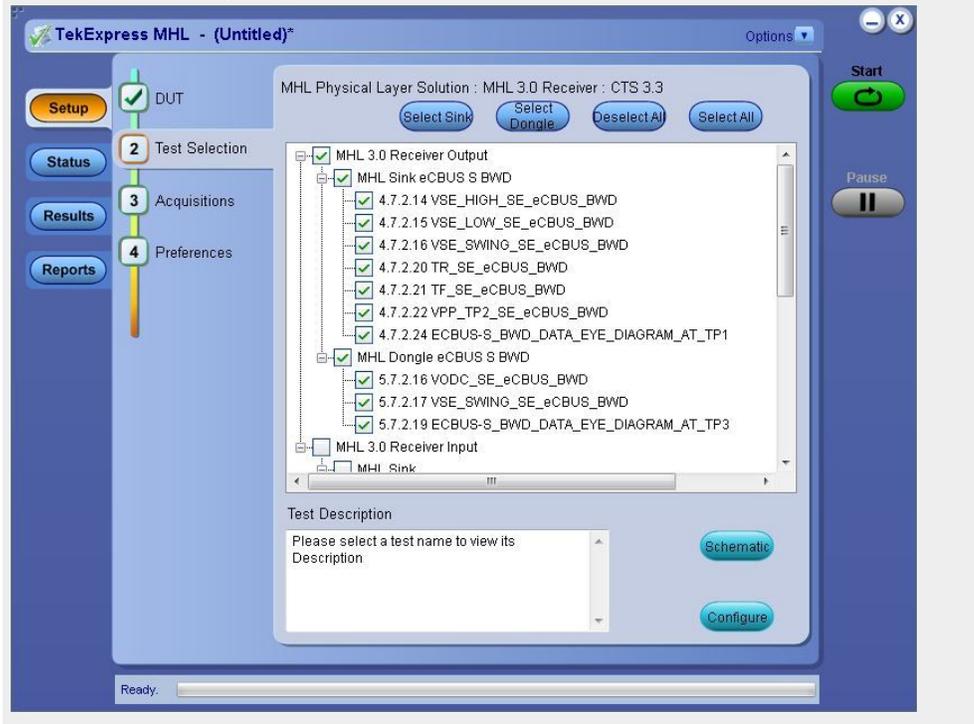
Different sets of tests are displayed depending upon which MHL solution and which CTS version you have selected in the DUT tab.

If you selected MHL 3.0 Transmitter and Version CTS 3.3, the following screen displays.



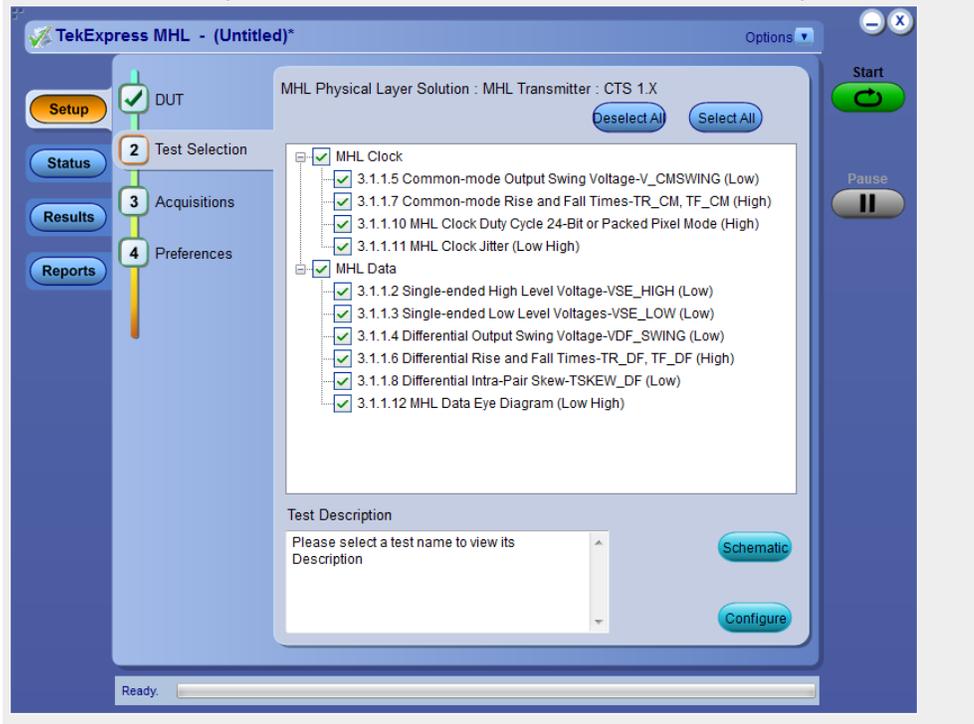
If you selected MHL 3.0 Receiver and Version CTS 3.3, the following screen displays.

**Test Selection tab (MHL 3.0 Receiver with CTS 3.3 selected in DUT tab)**



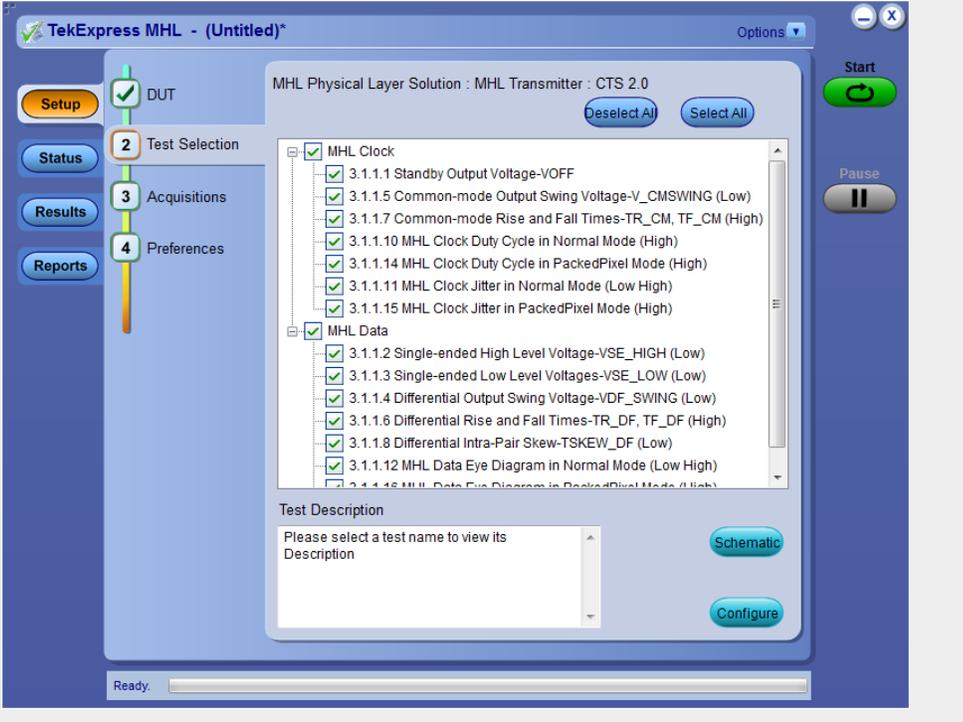
If you selected MHL Transmitter and Version CTS 1.X, the following screen displays.

**Test Selection tab (MHL Transmitter with CTS 1.X selected in DUT tab)**



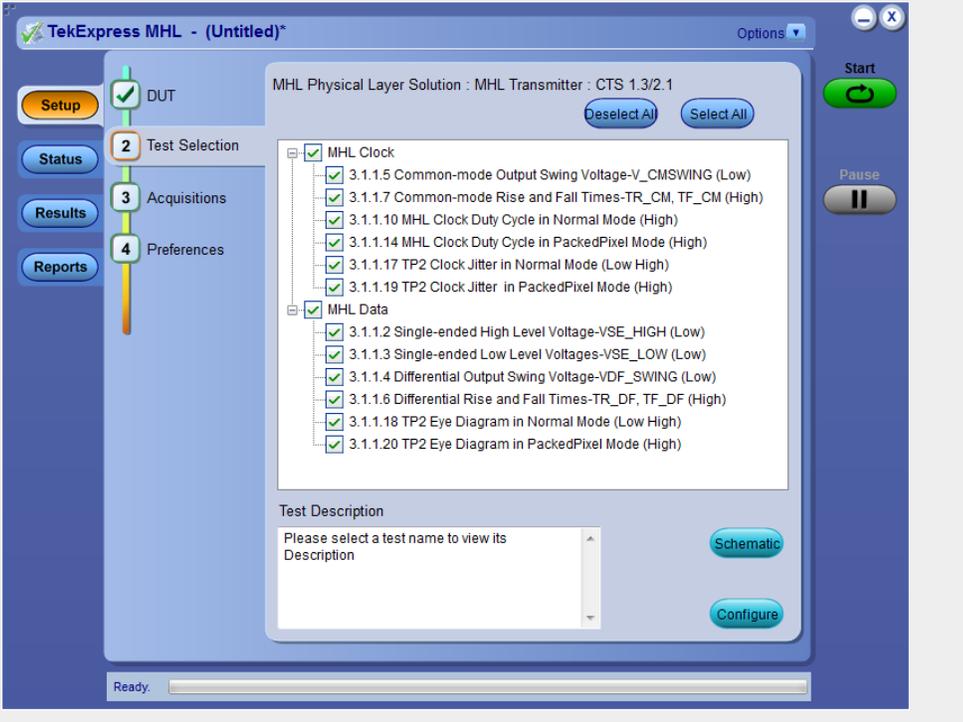
If you selected MHL Transmitter and Version CTX 2.0 the following screen displays.

**Test Selection tab – (MHL Transmitter with CTS 2.0 selected in DUT tab)**



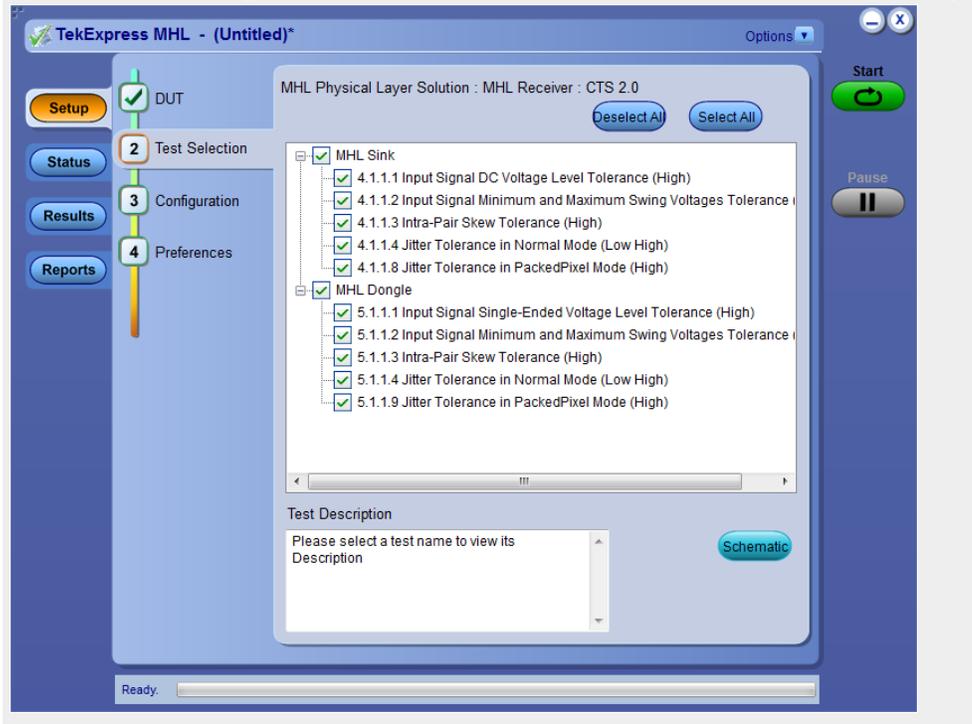
If you selected MHL Transmitter and Version CTX 2.0 or CTS 1.3/2.1, the following screen displays.

**Test Selection tab – (MHL Transmitter with CTS 1.3 / 2.1 selected in DUT tab)**



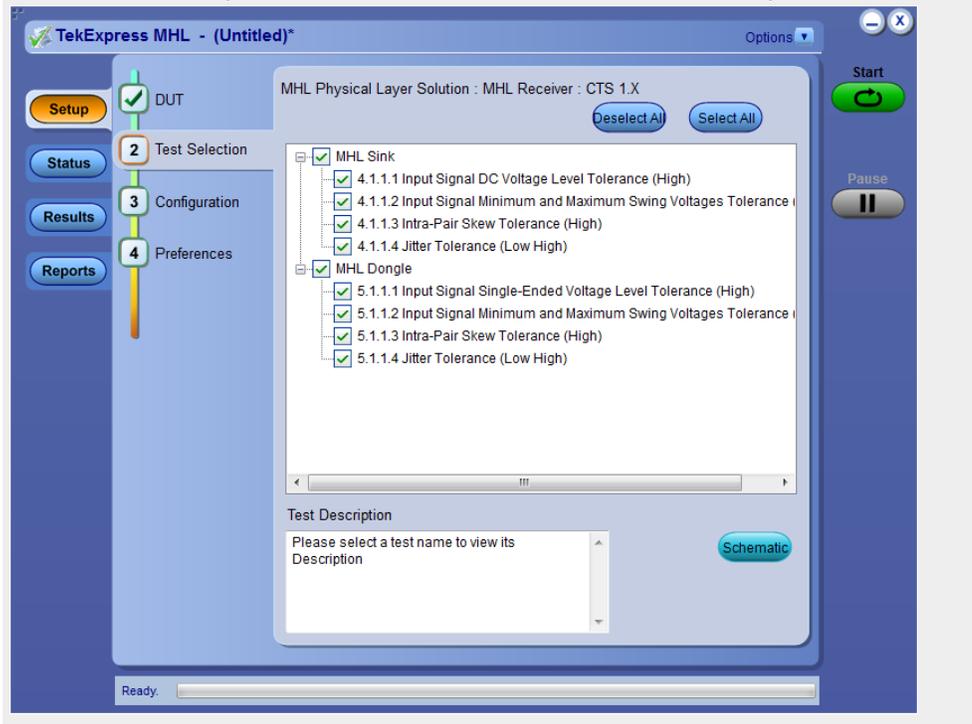
If you selected MHL Receiver and Version CTS 2.0 or CTS 1.3/2.1, the following screen will be displayed.

**Test Selection tab – (MHL Receiver with CTS 2.0 or CTS 1.3/2.1 selected in DUT tab)**



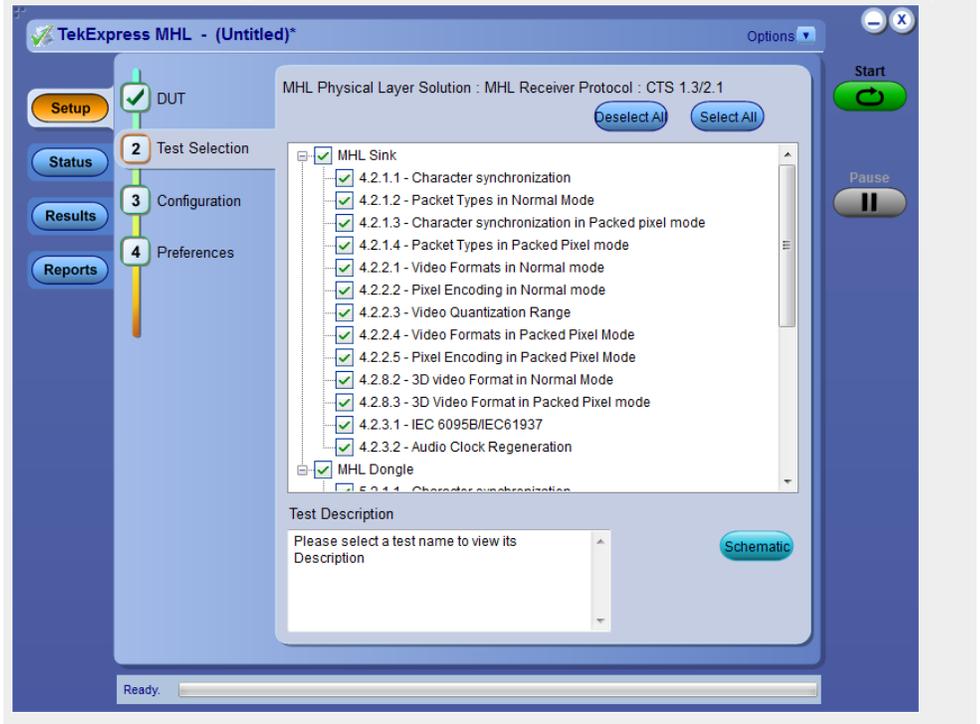
If you selected MHL Receiver and Version CTS 1.X, the following screen will be displayed.

**Test Selection tab (MHL Receiver with CTS 1.X selected in DUT tab)**



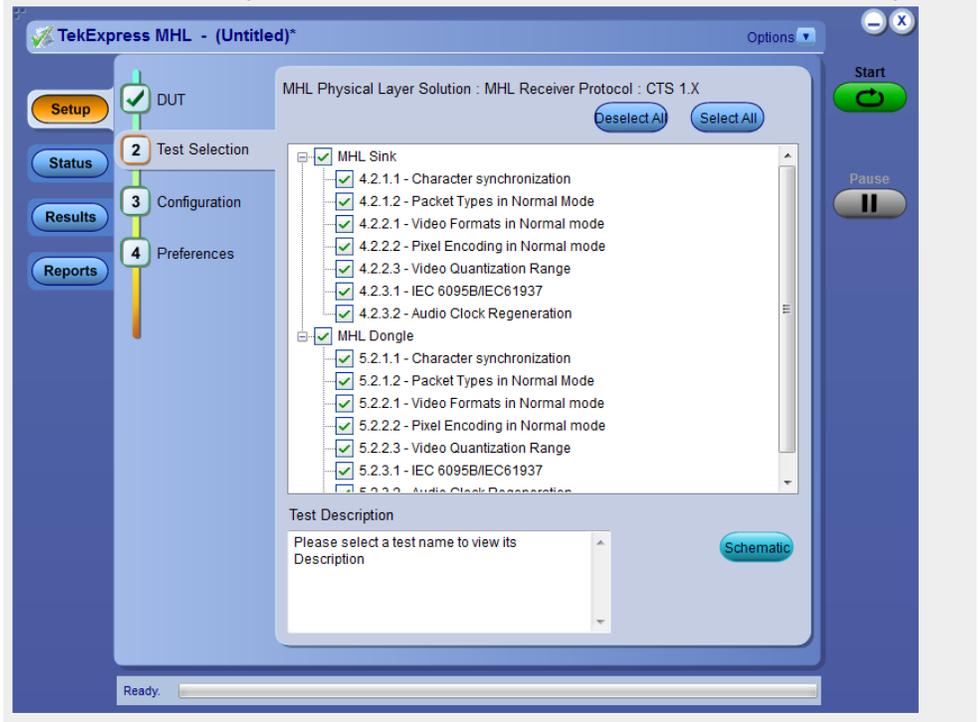
If you selected MHL Receiver Protocol and Version CTS 1.3/2.1, the following screen will be displayed.

**Test Selection tab – (MHL Receiver Protocol with CTS 1.3/2.1 selected in DUT tab)**

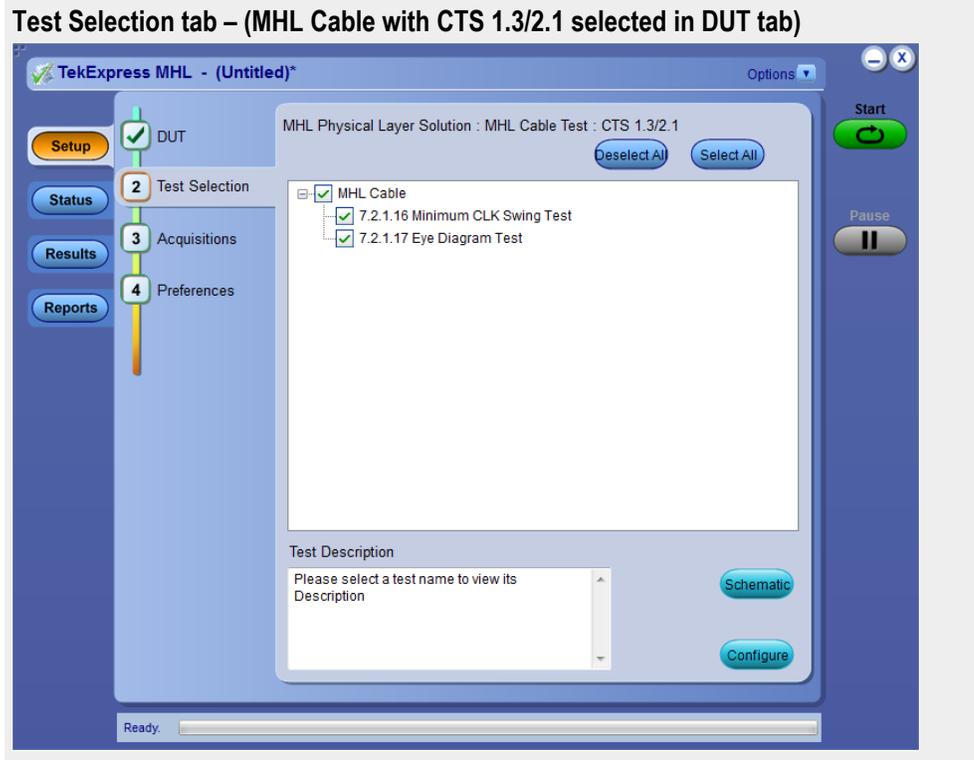


If you selected MHL Receiver Protocol and Version CTS 1.X, the following screen will be displayed.

**Test Selection tab – (MHL Receiver Protocol with CTS 1.X selected in DUT tab)**



If you selected MHL Cable and Version CTS 1.3/2.1, the following screen will be displayed.

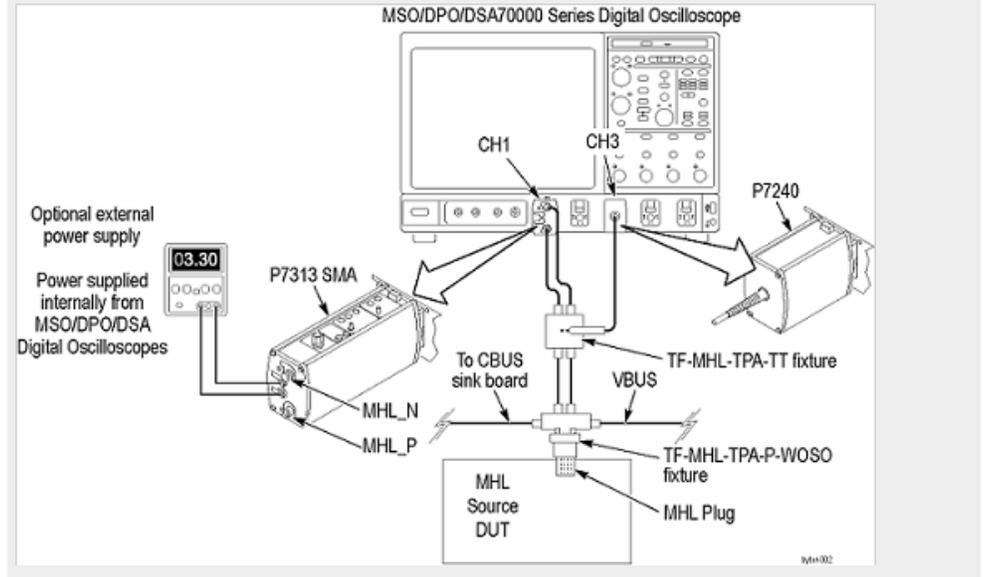


2. Click **Deselect All** unless you want to run all tests. All tests are selected by default.
3. Select the desired tests.
  - For descriptions of the supported MHL 3.0 Transmitter tests, [click here](#).
  - For descriptions of the supported MHL 3.0 Receiver tests, [click here](#).
  - For descriptions of the supported MHL Transmitter tests, [click here](#).
  - For descriptions of the supported MHL Receiver tests, [click here](#).
  - For descriptions of the supported MHL Cables tests, [click here](#).
  - For descriptions of the supported MHL Receiver Protocol tests, [click here](#).

Click the check boxes of individual tests or of entire groups of tests. To select all tests in the list, click the **Select All** button.

Use **Schematic** button to display schematic for the selected test and verify the test setup before configuring the test.

## Example of a schematic



- Once you have selected the tests, then you can *configure the tests*.

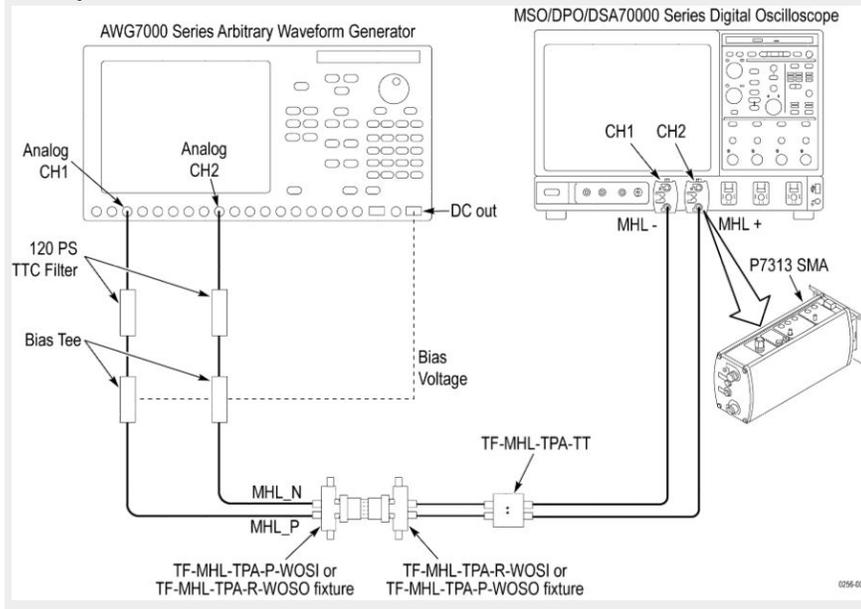
**See Also** [Setting up tests: the Setup panel](#)  
[Acquire waveforms with the acquisition tab](#)  
[Configure tests using the Configuration tab](#)  
[Run tests and view progress on the Status panel](#)

## Configure the cable tests using the Configuration tab

Use these instructions to configure MHL Cable tests for Version CTS 1.3/2.1.

1. Click the Configuration tab in the Setup panel.
2. Click **Deselect All** unless you want to run all tests. All tests are selected by default.
3. Select the desired tests. For descriptions of the supported MHL Cable tests, [click here](#).
  - To select all tests in the list, click **Select All** button. Click the check boxes of individual tests or entire group of tests.
  - Use **Schematic** button to display the schematic for the selected test and verify the test setup before configuring.

### Example of Schematic Document



4. Once you have selected the tests, then you can [configure the tests](#).

**See Also** [Setting up tests: the Setup panel](#)  
[Acquire waveforms with the acquisition tab](#)  
[Configure tests using the Configuration tab](#)  
[Run tests and view progress on the Status panel](#)

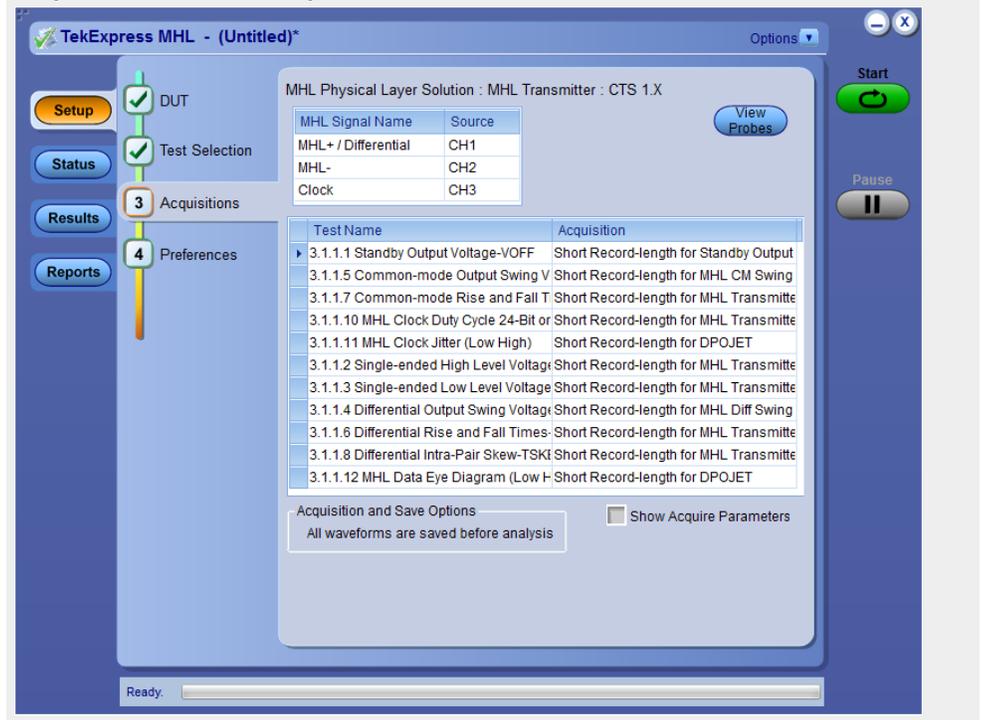
## Selecting acquisitions

### Acquire waveforms with the acquisitions tab

**NOTE.** If the **Suite** selection is either MHL 3.0 transmitter, MHL 3.0 receiver, MHL transmitter or MHL Cable, then you can view the **Acquisition** in the setup panel and you can set the parameters for selected tests.

The Acquisitions in the Setup panel is used to view and set acquisitions parameters for the selected tests. Before you can do this, you must first:

#### Acquisitions Tab with Acquire Live Waveforms selected



- Select either **Acquire Live Waveforms** or **Use Pre-recorded waveform files** in the Setup Panel on the DUT tab.
- The parameters displayed on the Acquisitions tab differ depending on the selection in the DUT tab.

If you select **Acquire Live Waveforms** on the DUT tab, do the following steps:

1. In the Setup panel, click the Acquisitions tab.
2. Select the probe source channel for each listed MHL signal in the Signal selection table.

Source channel for MHL signal

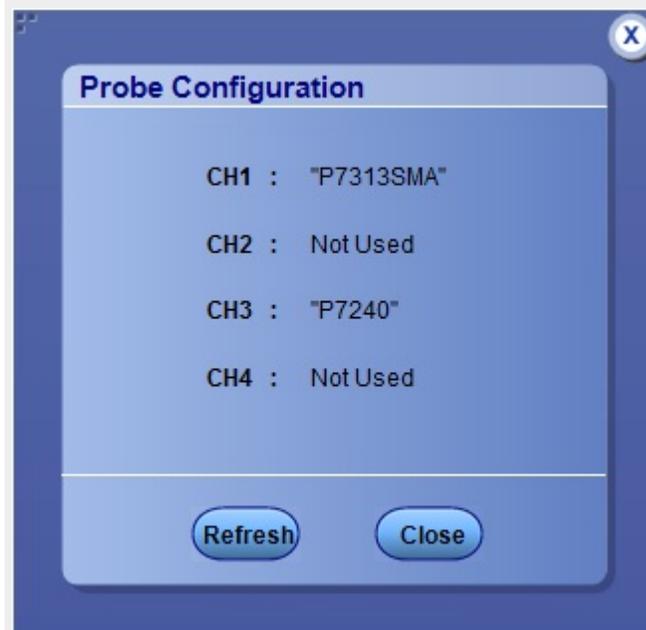
MHL Signal Name	Source
MHL+ / Differential	CH1
MHL-	CH2
Clock	CH3

Source channel for MHL 3.0 receiver only

MHL Signal Name	Source
eCBUS	CH1
Trigger Input	CH3

3. You may Click the View probes button to view probe configuration for each channel used.

View Probes Button



4. You will see the Acquisitions table. For information about the possible parameter columns displayed in the Acquisitions table, click [here](#).

The following table lists the possible parameter columns displayed in the Acquisitions table in the Acquisitions tab. The displayed column depend on the tests selected in the **Test Selection** tab, and whether or not the **Show Acquire Parameters** check box has been selected.

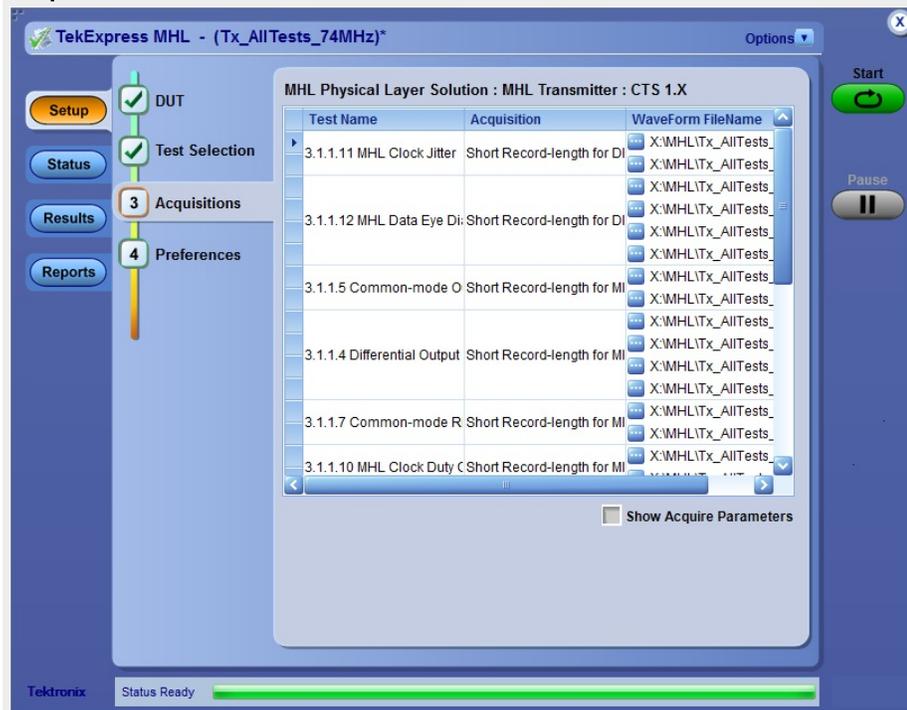
Column name	Function
Test Name	Displays the name of the selected test for performing acquisitions. One or more tests can perform the same acquisitions.
Acquisition	Updates the location of the named acquisition
Record Length	Displays the size of the record in M
Sample Rate (GS/s)	Frequency at which oscilloscope takes a snapshot or sample of the signal
Diff Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
Diff Probe Vertical Position (Div)	Displays the vertical position of the differential probe
CM Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
CM Probe Vertical Position (Div)	Displays the vertical position of the differential probe
Probe attenuation (X)	Displays attenuation factor for the probe
Edge Trigger Level (%)	Displays the edge trigger level, in percentage
Measurement Repetition (count)	Displays the number of measurement repetitions
Population Count	Specifies a limit to the amount of waveform data that is analyzed
Vertical Scale	Displays the vertical scale for the non differential probe
Vertical Position	Displays the vertical position for the non differential probe
WaveForm FileName	Displays the name and location of the waveform file to be used for the measurement. Applies only to testing using prerecorded waveforms.

5. Select the Show Acquired Parameters check box below the table. When you select the checkbox, the acquisition parameters for each test appears in additional columns in the table.
6. Select the Acquire Step by Step check box to have the software prompts you to continue after each phase of the test completes.

If you have chosen **Use Pre-recorded waveform files** on the DUT tab:

1. In the Setup panel, click the Acquisitions tab.

### Acquisitions Tab with Use Pre-recorded Waveform Files selected



- In the Acquisitions table, locate the row for the desired test and then click the ellipsis button (⋮) in the Waveform FileName column.

Navigate and select the file. You can select more than one file for each test. For information about the possible parameter columns displayed in the Acquisitions table, click [here](#).

The following table lists the possible parameter columns displayed in the Acquisitions table in the Acquisitions tab. The displayed Columns depend on the tests selected in the **Test Selection** tab, and whether or not the **Show Acquire Parameters** check box has been selected.

Column name	Function
Test Name	Displays the name of the selected test for performing acquisitions. One or more tests can perform the same acquisitions.
Acquisition	Updates the location of the named acquisition
Record Length	Displays the size of the record in M
Sample Rate (GS/s)	How often the oscilloscope takes a snapshot or sample of the signal
Diff Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
Diff Probe Vertical Position (Div)	Displays the vertical position of the differential probe

Column name	Function
CM Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
CM Probe Vertical Position (Div)	Displays the vertical position of the differential probe
Probe attenuation (X)	Displays attenuation factor for the probe
Edge Trigger Level (%)	Displays the edge trigger level, in percentage
Measurement Repetition (count)	Displays the number of measurement repetitions
Population Count	Specifies a limit to the amount of waveform data that is analyzed
Vertical Scale	Displays the vertical scale for the non differential probe
Vertical Position	Displays the vertical position for the non differential probe
WaveForm FileName	Displays the name and location of the waveform file to be used for the measurement. Applies only to testing using prerecorded waveforms.

3. Select the Show Acquired Parameters check box below the table. When you select the checkbox, the acquisition parameters for each test appears in additional columns in the table.

#### Acquisitions table

The following table lists the possible parameter columns displayed in the Acquisitions table in the Acquisitions tab. The displayed Columns depend on the tests selected in the **Test Selection** tab, and whether or not the **Show Acquire Parameters** check box has been selected.

Column name	Function
Test Name	Displays the name of the selected test for performing acquisitions. One or more tests can perform the same acquisitions.
Acquisition	Updates the location of the named acquisition
Record Length	Displays the size of the record in M
Sample Rate (GS/s)	How often the oscilloscope takes a snapshot or sample of the signal
Diff Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
Diff Probe Vertical Position (Div)	Displays the vertical position of the differential probe
CM Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
CM Probe Vertical Position (Div)	Displays the vertical position of the differential probe
Probe attenuation (X)	Displays attenuation factor for the probe

Column name	Function
Edge Trigger Level (%)	Displays the edge trigger level, in percentage
Measurement Repetition (count)	Displays the number of measurement repetitions
Population Count	Specifies a limit to the amount of waveform data that is analyzed
Vertical Scale	Displays the vertical scale for the non differential probe
Vertical Position	Displays the vertical position for the non differential probe
WaveForm FileName	Displays the name and location of the waveform file to be used for the measurement. Applies only to testing using prerecorded waveforms.

**See also.** [Use prerecorded waveforms for analysis](#)

[Acquire live waveforms for analysis MHL](#)

[Setting up tests: the Setup panel](#)

## Use prerecorded waveforms for analysis

**NOTE.** *If you are using the prerecorded waveform files option, it is recommended that you use a waveform file (.wfm) that was captured from a Tektronix oscilloscope. This eliminates the need to use an oscilloscope. You can manually select waveforms and perform the tests by clicking the button.*

1. [Open a saved test setup](#) or [create a new one](#).
2. In the Setup panel, select the **DUT** tab, select the desired DUT and then select **Use pre-recorded waveform files**.
3. In the **Test Selection** tab, [select the desired tests](#).
4. In the **Acquisitions** tab, locate the row for the desired test in the Acquisitions table. In the **Waveform FileName** column for that test, click the ellipses button () and select the desired waveform file.
5. Perform any additional desired test setup, such as [test configuration](#), and then click **Start** to run the test.

You can select a different waveform file for each test, deselect a test from the current run, or add a test to the current run. Once you click **Start**, data corresponding to that test run populates the other panels (such as the test status and test results).

### Acquisitions Table

The table below lists the possible parameter columns displayed in the Acquisitions table in the Acquisitions tab of the Setup panel. Columns displayed depend on the tests selected in the **Test Selection** tab, and whether or not the **Show Acquire Parameters** check box has been selected.

Column name	Function
Test Name	Displays the name of the selected test for performing acquisitions. One or more tests can perform the same acquisitions.
Acquisition	Updates the location of the named acquisition
Record Length	Displays the size of the record in M
Sample Rate (GS/s)	How often the oscilloscope takes a snapshot or sample of the signal
Diff Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
Diff Probe Vertical Position (Div)	Displays the vertical position of the differential probe
CM Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
CM Probe Vertical Position (Div)	Displays the vertical position of the differential probe
Probe attenuation (X)	Displays attenuation factor for the probe
Edge Trigger Level (%)	Displays the edge trigger level, in percentage
Measurement Repetition (count)	Displays the number of measurement repetitions
Population Count	Specifies a limit to the amount of waveform data that is analyzed
Vertical Scale	Displays the vertical scale for the non differential probe
Vertical Position	Displays the vertical position for the non differential probe
WaveForm FileName	Displays the name and location of the waveform file to be used for the measurement. Applies only to testing using prerecorded waveforms.

**See also.** [Acquire waveforms with the acquisitions tab](#)

[Acquire live waveforms for analysis](#)

## Acquire live waveforms for analysis

Use these instructions to set up acquisition for a live waveform.

1. *Open a saved test setup* or *create a new one*.
2. In the Setup panel, select the **DUT** tab, enter the desired DUT and then select **Acquire live waveforms**.
3. *Select other DUT options* as desired.
4. In the **Test Selection** tab, *select the desired tests*.
5. In the **Acquisitions** tab, select or view the desired parameters in the Acquisitions table.
6. *Configure the tests* if you have not done so already. Then click **Start** to run the test.

### Acquisitions Table

The following table lists the possible parameter columns displayed in the Acquisitions table in the Acquisitions tab. The displayed column depend on the tests selected in the **Test Selection** tab, and whether or not the **Show Acquire Parameters** check box has been selected.

Column name	Function
Test Name	Displays the name of the selected test for performing acquisitions. One or more tests can perform the same acquisitions.
Acquisition	Updates the location of the named acquisition
Record Length	Displays the size of the record in M
Sample Rate (GS/s)	How often the oscilloscope takes a snapshot or sample of the signal
Diff Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
Diff Probe Vertical Position (Div)	Displays the vertical position of the differential probe
CM Probe Vertical Scale (mV/Div)	Displays the vertical scale for the differential probe
CM Probe Vertical Position (Div)	Displays the vertical position of the differential probe
Probe attenuation (X)	Displays attenuation factor for the probe
Edge Trigger Level (%)	Displays the edge trigger level, in percentage
Measurement Repetition (count)	Displays the number of measurement repetitions
Population Count	Specifies a limit to the amount of waveform data that is analyzed
Vertical Scale	Displays the vertical scale for the non differential probe

Column name	Function
Vertical Position	Displays the vertical position for the non differential probe
WaveForm FileName	Displays the name and location of the waveform file to be used for the measurement. Applies only to testing using prerecorded waveforms.

**See also.** [Acquire waveforms with the acquisitions tab](#)

[Use prerecorded waveforms for analysis](#)

## Configure tests

### Configure tests using the Configuration tab

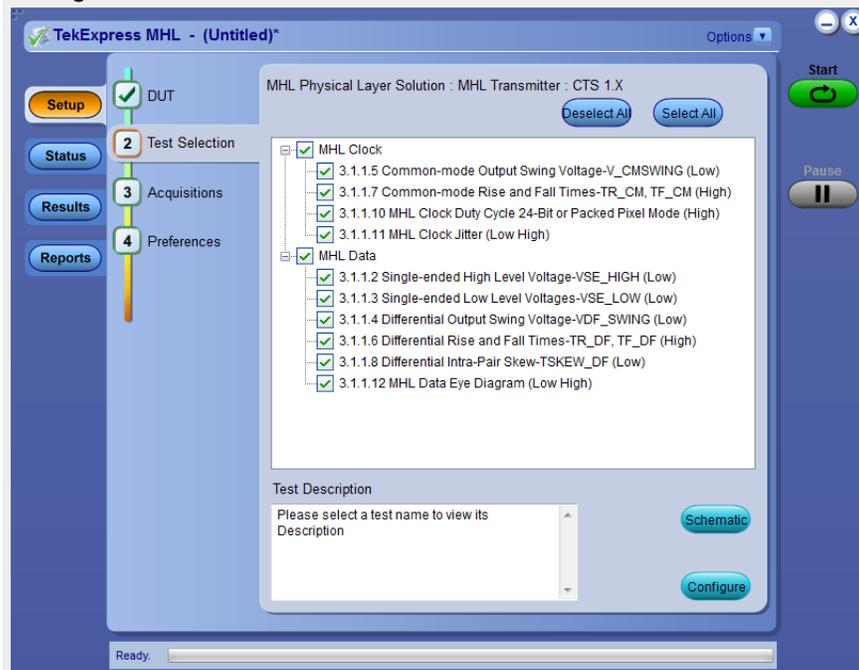
Once you've selected tests, you may use the Configuration screen. There are two ways to access the screen: the Configuration tab or the configure button.

The MHL solution you are using determines how to access the Configuration screen.

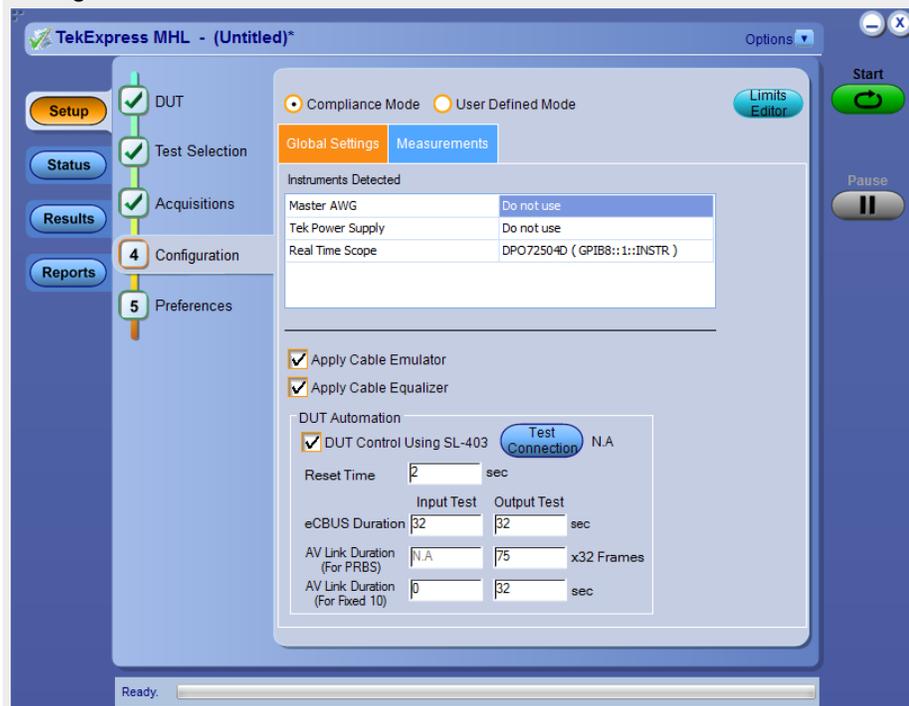
If you chose **MHL 3.3 Transmitter, MHL 3.3 Receiver, MHL Transmitter or MHL Cable Test, MHL Receiver protocol suite** in the *Setup panel DUT tab*:

- If you select **Compliance** View in the Setup panel DUT tab, click on the **Test Selection** tab and select the desired test. Then click on the Configure button in the lower right corner of the Test Selection tab.
- If you select **Advanced** View in the Setup panel DUT tab, click the Configuration tab in the Setup panel.

### Configure button on Test Selection tab



### Configuration Screen



If you chose **MHL Receiver** in the Setup panel DUT tab: You may view the configuration settings by either clicking on the **Configuration** tab, or clicking on the **Configure** button on the Test Selection tab.

The **Configuration** screen shows **Global** parameters, which are common for all tests, and **Measurement** parameters, which are specific to selected tests, including acquisition, analysis, and limit parameters.

---

**NOTE.** *Test parameters that are grayed-out cannot be changed.*

---

### Settings.

- [Compliance mode or user defined mode](#) (MHL 3.0 Transmitter, MHL 3.0 Receiver, MHL Transmitter, MHL Cable test only)
- Global settings tab

In the Instruments Detected section, click in the shaded area opposite Real Time Scope and select the desired instrument from the drop-down list. If you don't see the instrument, refresh the list by using the [Instrument control settings](#).

- DSP filter (8 GHz) (MHL Transmitter and MHL Cable test only)

You may check this box if the DUT has a bandwidth greater than 8 GHz. This applies an 8 GHz low pass filter to all transmitter tests.

- Measurements tab

- *If you are using MHL 3.0 Transmitter:*

You may change test parameters. Select the test whose parameters you'd like to change. The options below the test list change to reflect the selected test.

To modify the parameters, select the desired tab and parameters. For parameter details, see [Measurement parameter descriptions: MHL 3.0 Transmitter](#).

- *If you are using MHL 3.0 Receiver:*

You may change test parameters. Select the test whose parameters you'd like to change. The options below the test list change to reflect the selected test.

To modify the parameters, select the desired tab and parameters. For parameter details, see [Measurement parameter descriptions: MHL 3.0 Receiver](#).

- *If you are using MHL Transmitter:*

You may change test parameters. Select the test whose parameters you'd like to change. The options below the test list change to reflect the selected test.

To modify the parameters, select the desired tab and parameters. For parameter details, see [Measurement parameter descriptions: MHL Transmitter](#).

- *If you are using MHL Receiver:*

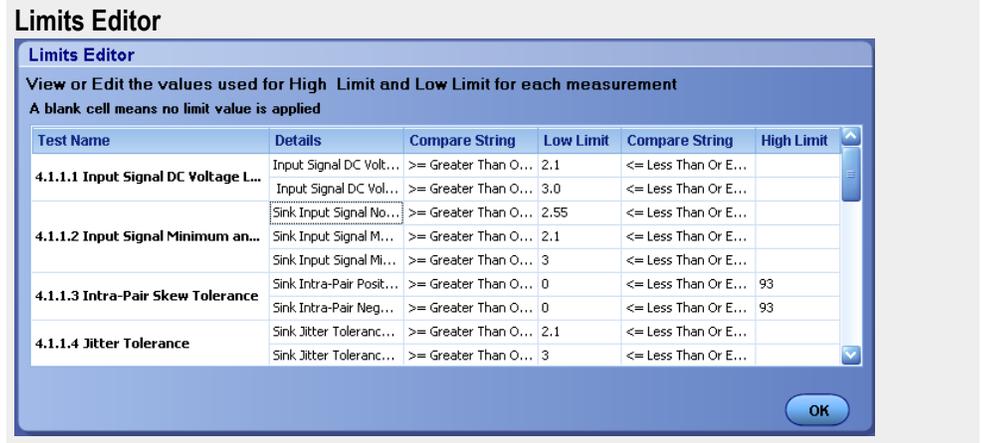
You may not change test parameters, but you may view the [Measurement parameter descriptions: MHL Receiver](#).

- *If you are using MHL Cable:*

You may not change test parameters, but you may view the [Measurement parameter descriptions: MHL Cable](#).

- Limits editor

Use the Limits editor button in the upper right corner to view or change the High Limit and Low Limit values used for each measurement.



Next, *prepare to run the tests*.

**See Also.** *Setting up tests: the Setup panel*

*Selecting device parameters: the DUT tab*

*Choosing tests: the test selection tab*

*Acquire waveforms with the acquisitions tab*

*About saving and recalling test setups*

### Compliance mode or user defined mode

From the Configuration screen, if you are selecting MHL 3.0 Transmitter, MHL 3.0 Receiver, MHL Transmitter or MHL Cable Test, you will have the option to select either Compliance Mode or User Defined Mode.

- **Compliance Mode:** Select to use Compliance Mode values. You cannot change most of the test parameters in Compliance Mode, but you can view the compliance parameters.
- **User Defined Mode:** Select to run tests using custom parameters. You may change parameters that are not grayed out.

Note that these modes are not to be confused with the two views available for MHL 3.0 Transmitter, MHL 3.0 Receiver, MHL Transmitter or MHL Cable Test: Compliance View and Advanced View (selected in the **DUT** tab of the Setup panel).

**Pairing Modes and Views for Test Operation.** Your selections of Modes and Views will change the way the tests operate. These pairings of views and modes are possible for MHL 3.0 Transmitter, MHL 3.0 Receiver, MHL Transmitter or MHL Cable Test

- **Compliance View** selected with **Compliance Mode**: Tests will run automatically with little or no user intervention. Parameters should be within compliance standards and cannot be changed to values other than compliance standards. To view configuration options, click the Test Selection tab of the Setup panel and click the Configure button.
- **Compliance View** selected with **User Defined Mode**: Tests will run automatically but you will be able to change test parameters before starting the tests. To view configuration options, click the Test Selection tab of the Setup panel and click the Configure button.
- **Advanced View** selected with **Compliance Mode**: Tests will run automatically with little or no user intervention. You will not be able to change test parameters to anything that deviates from the compliance standards. To view configuration options, click the Configuration tab of the Setup panel.
- **Advanced View** selected with **User Defined Mode**: Tests will run automatically but you will be able to change test parameters before starting the tests. To view configuration options, click the Configuration tab of the Setup panel.

### DUT Automation (MHL 3.0 transmitter)

You can use DUT Automation to automate MHL 3.0 Transmitter measurements. Selecting the DUT Automation validates the equipment connection, sets the default value for standard parameters and performs measurement with minimal human intervention.

**Table 22: DUT Automation settings - MHL 3.0 Transmitter**

Item	Description
DUT Control Using SL-403	Select the check-box to perform DUT Automation using SL-403
Test Connection	Use this button to validate the test connection and display the appropriate status (True, False or N.A)
Reset Time	The time required for the DUT to become stable after each power cycle.
eCBUS Duration	eCBUS signal generate duration from the DUT
AV Link Duration (For PRBS)	AV LINK PRBS signal available duration from source DUT
AV Link Duration (For Fixed 10)	AV LINK Fixed 10 signal available duration from source DUT

### DUT Automation (MHL 3.0 receiver)

You can use DUT Automation to automate MHL 3.0 Receiver measurements. Selecting the DUT Automation validates the equipment connection, sets the default value for standard parameters and performs measurement with minimal human intervention.

**Table 23: DUT Automation settings - MHL 3.0 receiver**

Item	Description
DUT Control Using SL-403	Select the check-box to perform DUT Automation using SL-403
Test Connection	Click this button to validate the test connection and display the status as True, False or N.A
eCBUS Duration	eCBUS signal generate duration from DUT
AV Link Duration (For PRBS)	AV LINK PRBS signal available duration from sink DUT
AV Link Duration (For Fixed 10)	AV LINK Fixed 10 signal available duration from sink DUT

### Measurement parameter descriptions (MHL 3.0 Transmitter)

View or change measurement parameters in the **Configuration** tab of the Setup panel. *Measurement parameters* are displayed for the test selected in the tree view section. Not all of the parameters listed apply to all tests. Parameters which can be changed will be displayed on selecting measurements.

**Table 24: MHL 3.0 Transmitter Clock , MHL 3.0 Transmitter Data and MHL 3.0 eCBUS measurements**

Parameter type	Parameter	Description	Applies to ...
Clock Settings	Loop Band Width (MHz)	Sets the bandwidth of the clock recovery PLL.	3.7.2.26, 3.7.2.27, 3.7.2.29, and 3.7.2.40
Analyze	Pattern Type	<ul style="list-style-type: none"> <li>■ Nominal and Error: Calibrates the nominal and error patterns for 500 KHz and 1 MHz. It saves four pattern files.</li> <li>■ Nominal: Calibrates only nominal pattern for 500 KHz and 1 MHz. It saves two pattern files.</li> <li>■ Error: Calibrates only error pattern for 500 KHz and 1 MHz. It saves two pattern files.</li> </ul> <p>The calibrated pattern files is saved at C:\MHL Patterns\MHL_3.2\</p>	Auto Calibration (for 3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data)
	Tolerance	Defines the Eye opening parameters to adjust the Jitter component with-in the range. For example 5% means +/-2.5% of actual eye mask width which is 3.2ns as per specification. The range is from 3.12e-9 to 3.28e-9ns.	

**See Also.** [Measurement parameter descriptions \(MHL 3.0 Receiver\)](#)

[Measurement parameter descriptions \(MHL Transmitter\)](#)

[Measurement parameter descriptions \(MHL Receiver\)](#)

[Measurement parameter descriptions \(MHL Cable\)](#)

[Configure tests using the Configuration tab](#)

### Measurement parameter descriptions (MHL 3.0 Receiver)

MHL 3.0 receiver measurement parameters cannot be modified either in the **Compliance Mode** or in **User Defined Mode**.

**See Also.** [Measurement parameter descriptions \(MHL 3.0 Transmitter\)](#)

[Measurement parameter descriptions \(MHL Transmitter\)](#)

[Measurement parameter descriptions \(MHL Receiver\)](#)

[Measurement parameter descriptions \(MHL Cable\)](#)

[Configure tests using the Configuration tab](#)

### Measurement parameter descriptions (MHL Transmitter)

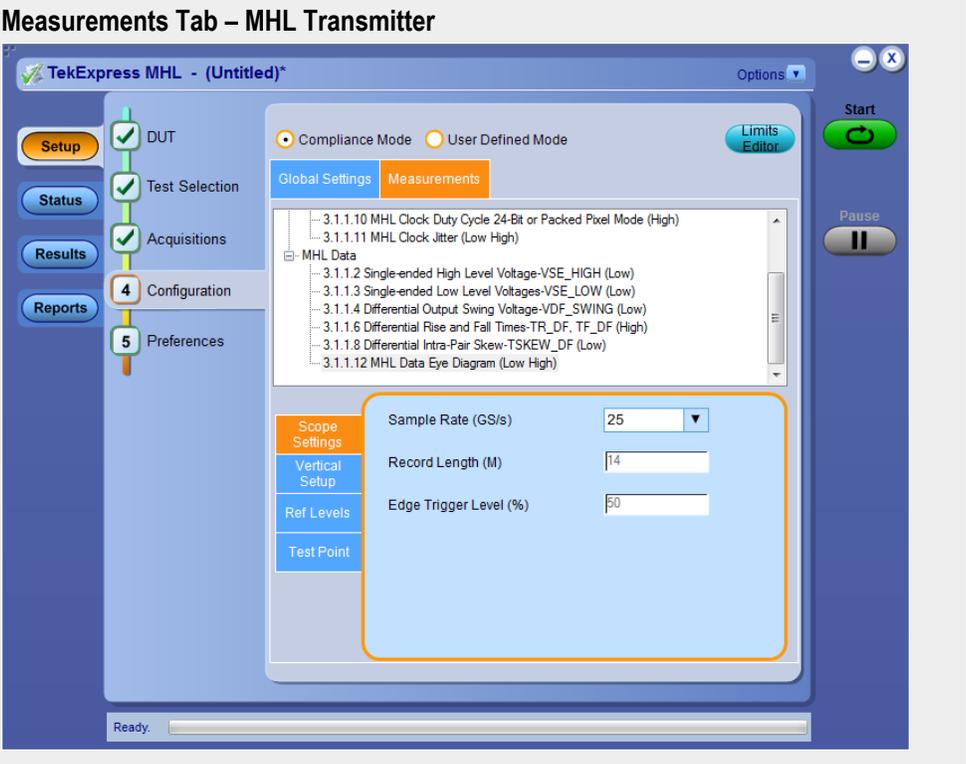
View or change measurement parameters in the **Configuration** tab of the Setup panel. [Measurement parameters](#) are displayed for the test selected in the tree view section. Not all of the parameters listed apply to all tests, and some are only available when running tests in **User Defined Mode**. Most of the parameters cannot be changed when you select **Compliance Mode**.

**Table 25: MHL Transmitter Clock and MHL Data measurements**

Parameter type	Parameter	Description	Applies to ...
Scope Settings	Sample Rate	Specified in GS/s. How often the digital oscilloscope takes a snapshot or sample of the signal.	All tests
	Record Length (M)	Set the record length to use.	All tests
	Edge Trigger Level (%)	Select the edge trigger level, in percentage.	All tests
	Population Count	Specifies a limit to the amount of waveform data that is analyzed.	3.1.1.2, 3.1.1.3, 3.1.1.4, 3.1.1.5, 3.1.1.6, 3.1.1.7, 3.1.1.8
	Measurement Repetition (Count)	Specifies the number of measurement repetitions used to measure the average value in the Clock Jitter test (3.1.1.11). If the Required Population count is not received from the acquired waveform, the application will take that count from this field.	3.1.1.11, 3.1.1.15, 3.1.1.17, 3.1.1.19

Parameter type	Parameter	Description	Applies to ...
Vertical Setup	Probe Attenuation (X)	Select the appropriate attenuation factor for the probe.	All tests
	Diff Probe Vertical Position (Div)	Select the vertical position of the differential probe.	3.1.1.4, 3.1.1.5, 3.1.1.6, 3.1.1.7, 3.1.1.10, 3.1.1.11, 3.1.1.12, 3.1.1.14, 3.1.1.15, 3.1.1.16
	Diff Probe Vertical Scale (mV/Div)	Select the vertical scale for the differential probe.	3.1.1.4, 3.1.1.5, 3.1.1.6, 3.1.1.7, 3.1.1.10, 3.1.1.11, 3.1.1.12, 3.1.1.14, 3.1.1.15, 3.1.1.16
	CM Probe Vertical Position (Div)	Select the vertical position for the common mode probe.	3.1.1.4, 3.1.1.5, 3.1.1.6, 3.1.1.7, 3.1.1.10, 3.1.1.11, 3.1.1.12, 3.1.1.14, 3.1.1.15, 3.1.1.16
	CM Probe Vertical Scale (mV/Div)	Select the vertical scale for the common mode probe.	3.1.1.4, 3.1.1.5, 3.1.1.6, 3.1.1.7, 3.1.1.10, 3.1.1.11, 3.1.1.12, 3.1.1.14, 3.1.1.15, 3.1.1.16
	Vertical Position (Div)	Used in vertical setup to position the waveform. Sets the number of divisions of the signal. Adjusts the display of the graticule relative to the vertical acquisition window.	3.1.1.2, 3.1.1.3, 3.1.1.8
	Vertical Scale (mV/Div)	Used in vertical setup to position the waveform. Specifies the waveform vertical scale.	3.1.1.2, 3.1.1.3, 3.1.1.8

Parameter type	Parameter	Description	Applies to ...
Ref Levels	Absolute	Use to manually set the reference levels.	All tests
	Percentage	Use to set the reference levels as a percentage.	All tests
	Mid Level	A reference voltage level that defines when the waveform state transition occurs at a given threshold.	All tests
	Hysteresis	Used to prevent small amounts of noise in a waveform from producing multiple threshold crossings. Use when the rising and falling thresholds for a given reference voltage level are set to the same value.	All tests
Test Point	TP1	Sets test point to TP1.	3.1.1.12, 3.1.1.16
	TP2	Sets test point to TP2.	



**See Also.** [Measurement parameter descriptions \(MHL 3.0 Transmitter\)](#)  
[Measurement parameter descriptions \(MHL 3.0 Receiver\)](#)  
[Measurement parameter descriptions \(MHL Receiver\)](#)  
[Measurement parameter descriptions \(MHL Cable\)](#)  
[Configure tests using the Configuration tab](#)

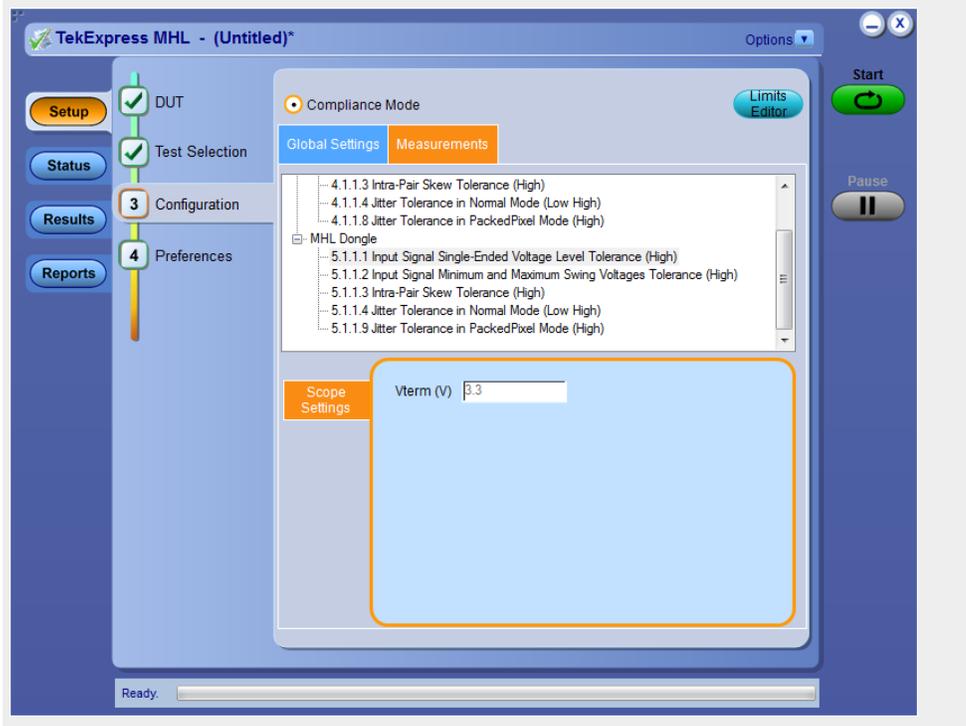
**Measurement parameter descriptions (MHL Receiver)**

View or change measurement parameters in the **Configuration** tab of the Setup panel. [Measurement parameters](#) are displayed for the test selected in the tree view section. Not all of the parameters listed apply to all tests.

**Table 26: MHL Receiver Sink and MHL Dongle measurements**

Parameter type	Parameter	Description	Applies to ...
Scope Setting	VTerm (V)	VTerm voltage of the fixture	All tests

**Measurements Tab – MHL Receiver**



**See Also.** [Measurement parameter descriptions \(MHL 3.0 Transmitter\)](#)  
[Measurement parameter descriptions \(MHL 3.0 Receiver\)](#)  
[Measurement parameter descriptions \(MHL Transmitter\)](#)  
[Measurement parameter descriptions \(MHL Cable\)](#)  
[Configure tests using the Configuration tab](#)

### Measurement parameter descriptions (MHL Cable)

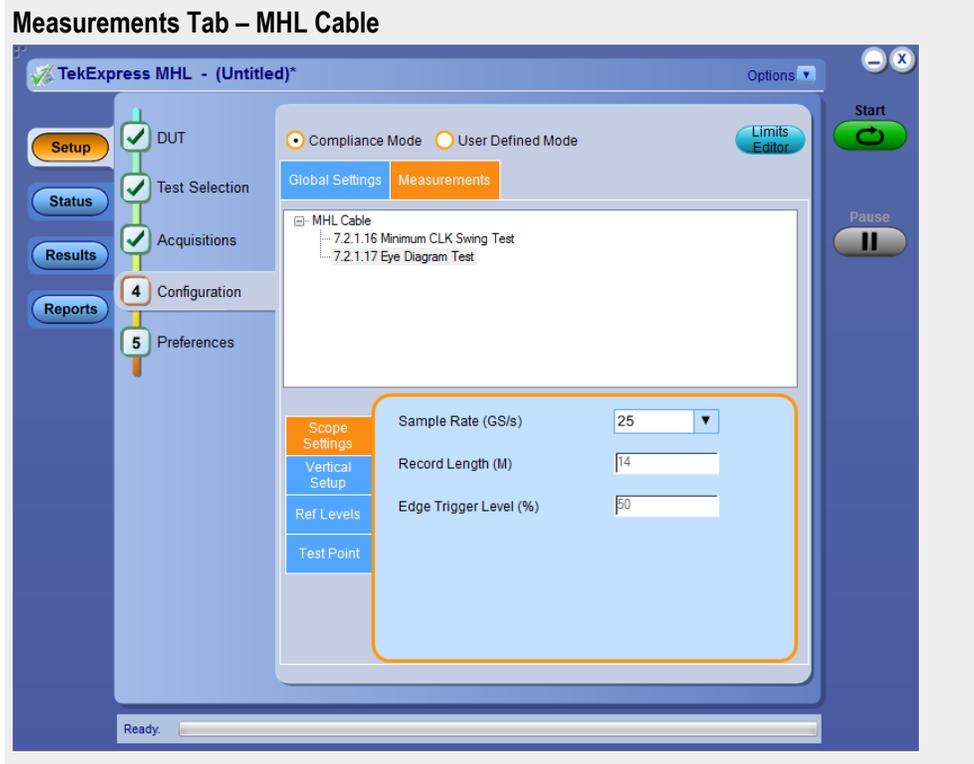
View or change measurement parameters in the **Configuration** tab of the Setup panel. *Measurement parameters* are displayed for the test selected in the tree view section. Not all of the parameters listed apply to all tests, and some are only available when running tests in **User Defined** Mode. Most of the parameters cannot be changed when you select **Compliance** Mode.

**Table 27: MHL Cable Clock and MHL Data measurements**

Parameter type	Parameter	Description	Applies to ...
Scope Settings	Sample Rate (GS/s)	Specified in GS/s. How often the digital oscilloscope takes a snapshot or sample of the signal.	All tests
	Record Length (M)	Set the record length to use.	
	Edge Trigger Level (%)	Select the edge trigger level, in percentage.	
	Population Count	Specifies a limit to the amount of waveform data that is analyzed.	7.1.1.16
Vertical Setup	Probe Attenuation (X)	Select the appropriate attenuation factor for the probe.	All tests
	Diff Probe Vertical Position (Div)	Select the vertical position of the differential probe.	
	Diff Probe Vertical Scale (mV/Div)	Select the vertical scale for the differential probe.	
	CM Probe Vertical Position (Div)	Select the vertical position for the common mode probe.	
	CM Probe Vertical Scale (mV/Div)	Select the vertical scale for the common mode probe.	

Parameter type	Parameter	Description	Applies to ...
Ref Levels	Absolute	Use to manually set the reference levels.	All tests
	Percentage	Use to set the reference levels as a percentage.	
	Mid Level	A reference voltage level that defines when the waveform state transition occurs at a given threshold.	
	Hysteresis	Used to prevent small amounts of noise in a waveform from producing multiple threshold crossings. Use when the rising and falling thresholds for a given reference voltage level are set to the same value.	

Parameter type	Parameter	Description	Applies to ...
Clock Settings	PLL Model	Selects between Type 1 and Type 2 phase-locked loop.	7.2.1.17
	Clock Recovery Method	<ul style="list-style-type: none"> <li>■ PLL-Custom BW</li> <li>■ Constant Clock-Mean</li> <li>■ Explicit Clock: (Applies to test 3.1.1.12 only) This method derives the reference clock from a channel other than the one upon which the measurement is defined.</li> </ul>	
	Clock Multiplier	Specifies the number of edges to be used in the measurement.	
	Loop Band Width (MHz)	Sets the bandwidth of the clock recovery PLL.	
	Clock Edge	Specifies whether the rising, falling, or both edges of the selected source should be considered in the measurement.	
Test Point	TP1 and TP2	Sets test points to TP1 and TP2.	7.2.1.17
	TP2	Sets test point to TP2.	



**See Also.** [Measurement parameter descriptions \(MHL 3.0 Transmitter\)](#)

[Measurement parameter descriptions \(MHL 3.0 Receiver\)](#)

[Measurement parameter descriptions \(MHL Receiver\)](#)

[Measurement parameter descriptions \(MHL Transmitter\)](#)

[Configure tests using the Configuration tab](#)

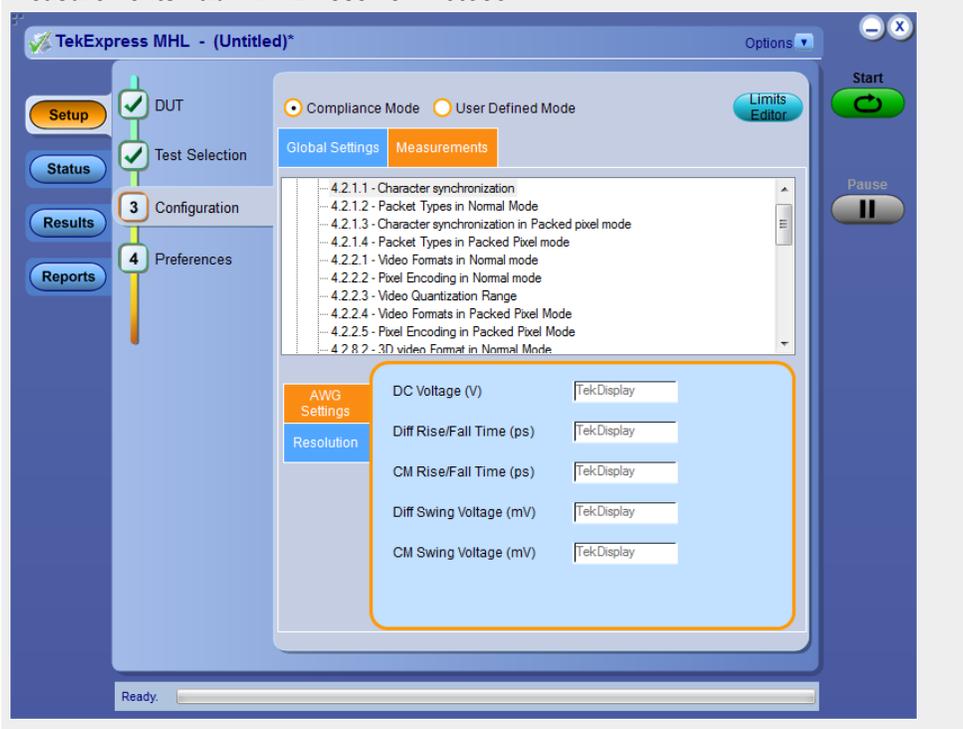
**Measurement parameter descriptions (MHL Receiver protocol)**

View or change measurement parameters in the **Configuration** tab of the Setup panel. [Measurement parameters](#) are displayed for the test selected in the tree view section. Not all of the parameters listed apply to all tests.

Table 28: MHL Receiver Protocol Sink and Dongle measurements

Parameter type	Parameter	Description	Applies to ...
AWG Settings	DC Voltage (V)	DC voltage	All tests
Resolution	Resolution	Pixels per line	All tests
Audio	Audio (kHz)	Audio signal in kHz	4.2.1.2, 4.2.2.1, 4.2.2.2, 4.2.3.1, 4.2.3.2, 5.2.1.2, 5.2.2.1, 5.2.2.2, 5.2.3.1, 5.2.3.2
Encoding	Encoding	Frame rate	4.2.2.2, 4.2.2.3, 5.2.2.2, 5.2.2.3
3D	3D	3D signal can be carried as a left/right image, top/bottom image, or frame sequence image	4.2.8.2, 4.2.8.3, 5.2.8.2, 5.2.8.3

## Measurements Tab – MHL Receiver Protocol



**See Also.** [Measurement parameter descriptions \(MHL 3.0 Transmitter\)](#)

[Measurement parameter descriptions \(MHL 3.0 Receiver\)](#)

[Measurement parameter descriptions \(MHL Transmitter\)](#)

[Measurement parameter descriptions \(MHL Cable\)](#)

[Configure tests using the Configuration tab](#)



# Running tests

## Before you click Start

### Before Running a Test for the First time

Before you run a test for the first time, review these steps:

1. Understand where your test files are stored on the instrument.

After you install and launch TekExpress MHL, it creates the following folders on the oscilloscope:

- \Program Files (x86)\Tektronix\TekExpress\**TekExpress MHL** (for WIN7 scopes)
- \My Documents\My TekExpress\**MHL**
- \My Documents\My TekExpress\MHL\**Untitled Session**

Every time you launch TekExpress MHL.exe, an Untitled Session folder is created in the MHL folder. The Untitled Session folder is automatically deleted when you exit the MHL application.



#### **CAUTION.**

*Do not modify any of the session files or folders because this may result in loss of data or corrupted session files. Each session has multiple files associated with it. When you save a session, a .TekX file, and a folder named for the session that contains the associated files, is created on the oscilloscope X: drive.*

2. *Map the shared My TekExpress folder as X:*

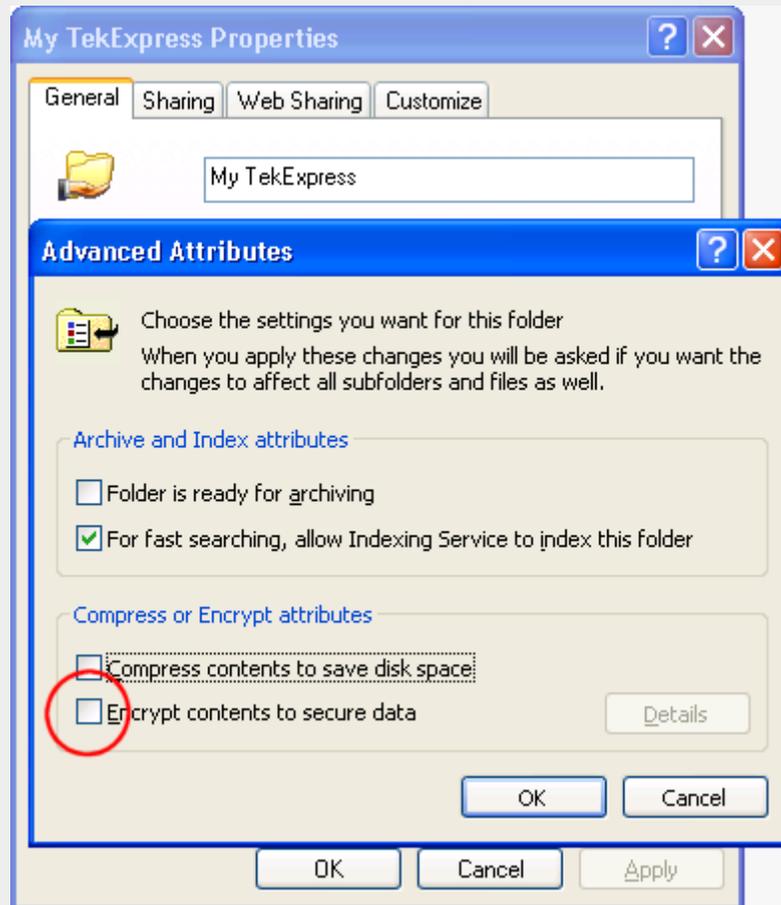
**NOTE.** *If the X: drive is mapped to any other shared folder, the application will display a warning message asking you to disconnect the X: drive manually.*

3. Ensure that the **My TekExpress** folder has read and write access, and that the contents are not set to be encrypted:

- a. Right-click the folder and select **Properties**.
- b. Select the **General** tab and then click **Advanced**.

- c. In the Advanced Attributes dialog box, ensure that the option **Encrypt contents to secure data** is NOT selected.

Example:



**Before running any test**

1. Review the *Pre-run check list*.
2. Configure the *Email notification options* if you want the application to notify you by email when a test completes or produces an error. Access the email options either from the Options menu in the upper right corner, or from the **Preferences tab** on the Setup panel.
3. Select the *Report options*.

**See Also** [Pre-run check list](#)  
[Configure email notification](#)  
[Run test and view progress on the Status panel](#)

## Pre-run check list

Do the following before you click Start to run a test. If this is the first time you are running a test on a setup, then refer also to the guidelines above.

1. Ensure that all the required instruments are properly warmed up (about 20 minutes).
2. Perform the Signal path compensation (SPC).
  - a. On the oscilloscope main menu, select the **Utilities** menu.
  - b. Select **Instrument Calibration**.
3. Deskew any cables.
4. Ensure that the application is able to find the DUT. If it cannot, [perform a search for connected instruments](#).

To find the DUT:

- a. Launch the TekExpress MHL application.
- b. Select the **Setup** panel and then click the **DUT** tab. For **Suite**, select MHL Transmitter.
- c. Click the **Test Selection** tab. Select any test and then click **Configure**.
- d. In the Configuration section, click **Global Settings**.
- e. In the Instruments Detected section, click in the shaded area opposite Real Time Scope and make sure that the oscilloscope with the (GPIB8::1::INSTR) designation is in the drop-down list.

**See also** [Before you click start](#)  
[Configure email notification](#)  
[Running the tests and viewing their progress](#)

## Configure email notification

Set up these email settings if you want the application to notify you by email when a test completes or produces an error. Configure email from the Options menu.

1. From the **Options** menu in the upper right corner, select **Email Settings** to open the Email settings dialog box, or click the **Preferences** tab on the Setup panel.

2. (Required) For **Recipient email Address(es)**, enter your email address. You can include multiple addresses as long as you separate the addresses with commas.
3. (Required) For **Sender's Address**, enter the email address used by the instrument. This address consists of the instrument name, followed by an underscore, followed by the instrument serial number, the @ symbol, and the email server used. For example: DPO72004C\_B130099@yourcompany.com.
4. (Required) In the **Server Configuration** section, type the SMTP Server address of the Mail server configured at the client location, and the SMTP Port number, in the corresponding fields.

If this server requires password authentication, enter a valid login name, password, and host name in the corresponding fields.

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**NOTE.** *If any of the above required fields are left blank, the settings will not be saved and email notifications will not be sent.*

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5. In the **Email Attachments** section, select from the following options:
  - **Reports:** Select to receive the test report with the notification email.
  - **Status Log:** Select to receive the test status log with the notification email. If you select this option, then also select whether you want to receive the full log or just the last 20 lines.

6. In the **Email Configuration** section, select as desired:
  - Select the message file format to send: HTML (the default) or plain text.
  - Enter a maximum file size for the email message. Messages with attachments larger than this limit will not be sent. The default is 5 MB.
  - To limit the number of attempts the system makes to send a notification, enter the number in the **Number of Attempts to Send** field. The default is 1. You can also specify a timeout.
7. Select the **Email Test Results when complete or on error** check box. Use this check box to quickly enable or disable email notifications.
8. To test your email settings, click **Test Email**.
9. To apply your settings, click **Apply**.
10. Click **Close** to exit the Email Settings dialog box.

**See also** [Before you click start](#)  
[Pre-run check list](#)  
[Running the tests and viewing their progress](#)

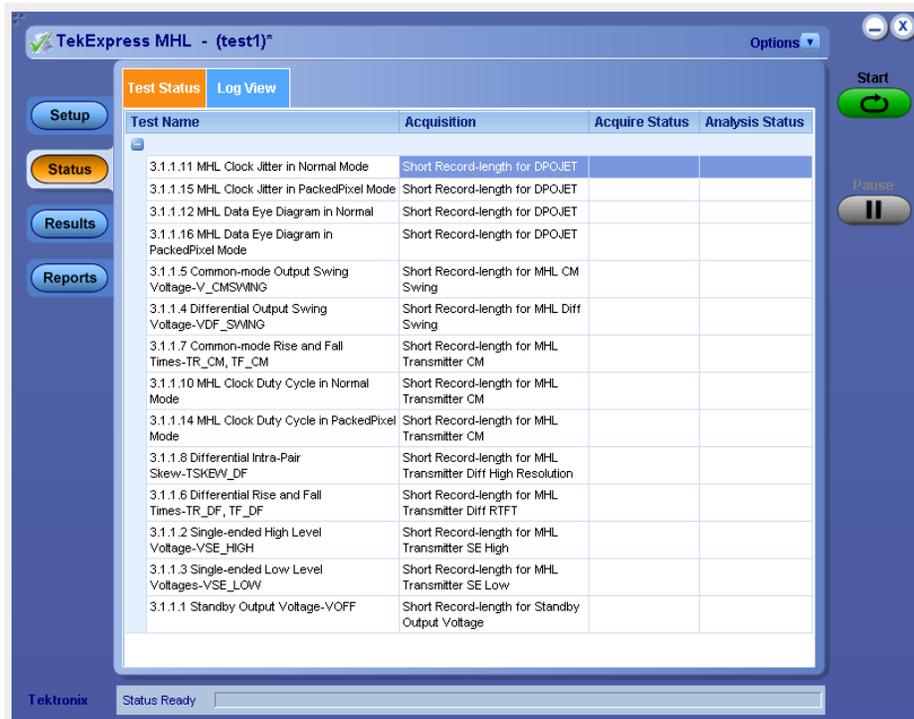
## Run test and view progress on the Status panel

Once you've configured the tests and gone through the [Pre-run check list](#), from any screen, click the green **Start** button.

The application acquires and analyzes the data, then displays a report when the tests are complete. While the tests are running, other applications may display windows in the background. The TekScope application takes precedence over other applications, but you can switch to other applications using the Alt+Tab key combination. To keep the TekExpress MHL application on top, select Keep On Top from the Options menu in the upper right corner.

### Viewing the Progress of Analysis

The Status panel displays a record of the test as it is executed. By default, the application switches to this panel after you click the Start button to run a test. You can choose from the following two views by selecting the named tab, even while a test is in progress:



**Status Panel**

**Test status view**

The Test status tab presents a collapsible table with information about each test as it is running. To collapse and expand the table rows, click the expand (+)/(−) collapse button.

**Test Status Tab**

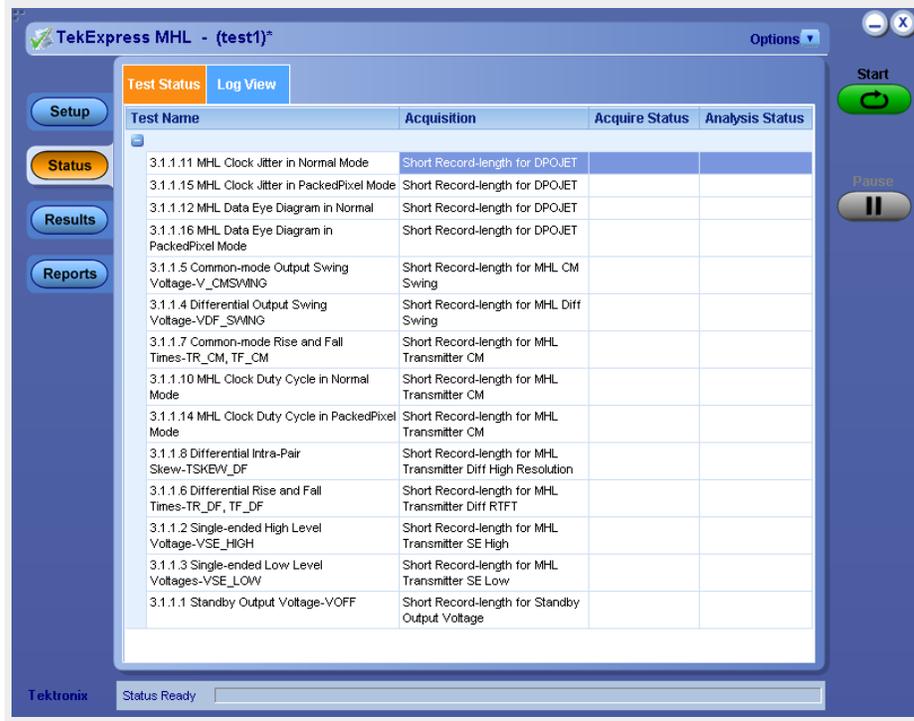


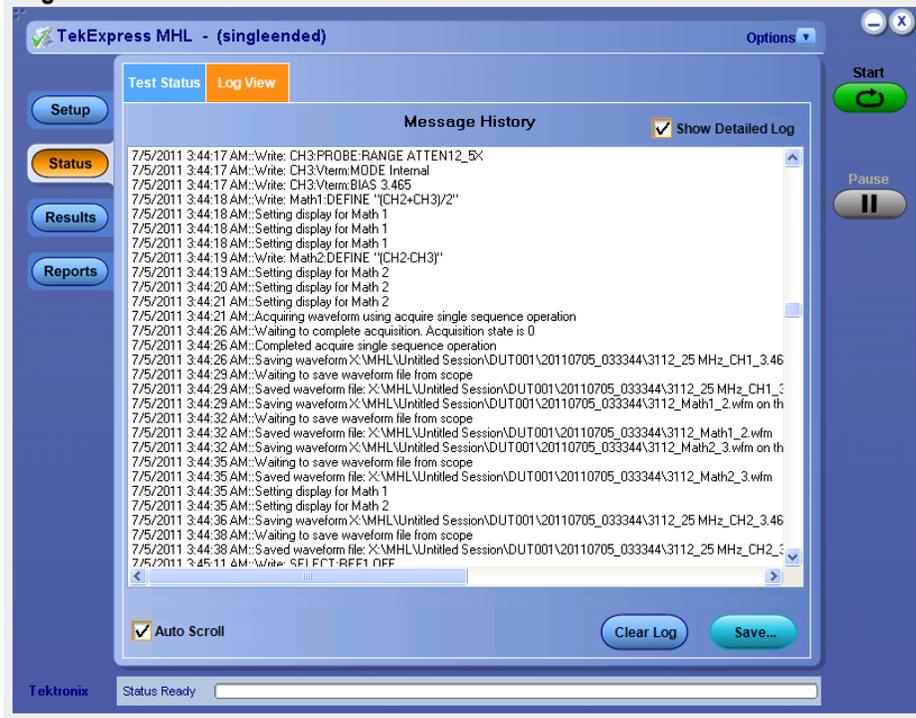
Table 29: Status tab table

Column	Description
Test Name	Name of the test
Acquisition	Describes the type of data being acquired
Acquire Status	Progress of the acquisition: <ul style="list-style-type: none"> <li>■ To be started</li> <li>■ Started Acquisition</li> <li>■ Completed Acquisition</li> <li>■ Pre-Recorded Mode</li> </ul>
Analysis Status	Progress state of the analysis: <ul style="list-style-type: none"> <li>■ To be started</li> <li>■ In Progress</li> <li>■ Completed</li> <li>■ Aborted</li> </ul>

### Log view

The Log view tab provides a list of actions that happen as the test executes. You can use this tab to review or troubleshoot tests.

### Log View on Status Panel



**Table 30: Log View options**

Item	Description
Message History	This window time-stamps and displays all run messages.
Show Detailed Log	Select this check box to record a detailed history of test execution.
Auto Scroll	Select this check box to have the program automatically scroll down as information is added to the log during test execution.
Clear Log	Click this button to clear all messages in the Message History area.
Save	Use to save the log file as a text file for examination. Displays a standard Save File window and saves the status messages file that you specify.

**See also** [Before you click start](#)  
[Pre-run check List](#)  
[Configure email notification](#)

---

# Viewing results

## Viewing test results: the Results panel

When a test completes running, the application switches to the Results Panel.

Set result viewing preferences from the Preferences menu in the upper right corner.

Each test result occupies a row in the Results table. By default, results are displayed in summary format, with the measurement details collapsed, and with the Pass/Fail column visible. You can change the display view.

- To expand all test rows listed, from the **Preferences** menu in the upper right corner, select **View Results Details**.
- To expand a collapsed test row, click the plus button (+) to the left of the test row.
- To collapse all expanded test rows, select **Preferences > View Results Summary**.
- To collapse a single expanded test row, click the minus button (-) to the left of the test row.
- To remove or restore the Pass/Fail column, select **Preferences > Show Pass/Fail**.
- To enable or disable the wordwrap feature, select **Preferences > Enable Wordwrap**.
- To expand the width of a column, place the cursor over the vertical line that separates the column from the one to the right. When the cursor changes to a double-ended arrow, hold down the mouse button and drag the column to the desired width.
- To sort the test information by column, click the column head. When sorted in ascending order, a small up arrow is displayed. When sorted in descending order, a small down arrow is displayed.
- To clear all test results displayed, click **Clear** .

**See Also** [Setting up tests: the Setup Panel](#)  
[Configuring and viewing reports: the Reports Panel](#)  
[Run test and view progress on the Status panel](#)

**TekExpress MHL - (singleended)**

Overall Test Result: ✔ Pass

Description	Pass/Fail	Details	TBit	VTerm	Value	Margin
3.1.1.2 Single-ended High Level Voltage-VSE_HIGH	<span style="color: green;">✔</span> Pass	Single-ended Positive High Level Voltage at VTerm1	1322.77 ps	3.135 V	2868.6	273.6, 276.4
High Limit	<span style="color: green;">✔</span> Pass				3145 mV	
Low Limit	<span style="color: green;">✔</span> Pass				2595 mV	
3.1.1.2 Single-ended High Level Voltage-VSE_HIGH	<span style="color: green;">✔</span> Pass	Single-ended Negative High Level Voltage at	1322.77 ps	3.135 V	2847	252, 298
High Limit	<span style="color: green;">✔</span> Pass				3145 mV	
Low Limit	<span style="color: green;">✔</span> Pass				2595 mV	
3.1.1.2 Single-ended High Level Voltage-VSE_HIGH	<span style="color: green;">✔</span> Pass	Single-ended Positive High Level Voltage at VTerm2	1322.77 ps	3.465 V	3177	252, 298
3.1.1.2 Single-ended High Level Voltage-VSE_HIGH	<span style="color: green;">✔</span> Pass	Single-ended Negative High Level Voltage at	1322.77 ps	3.465 V	3148.2	223.2, 326.8
3.1.1.8 Differential Intra-Pair Skew-TSKEW_DF	<span style="color: green;">✔</span> Pass	Differential Intra-Pair Skew at VTerm1	1322.76 ps	3.135 V	11.4684	38.5316

Tektronix Status Ready

**Results Preferences**

**Results Preferences**

Options

Preferences

Term	Value
	<input checked="" type="checkbox"/> Show Pass/Fail
	<input type="checkbox"/> View Results Summary
	<input type="checkbox"/> View Results Details
	<input checked="" type="checkbox"/> Enable Wordwrap

Start

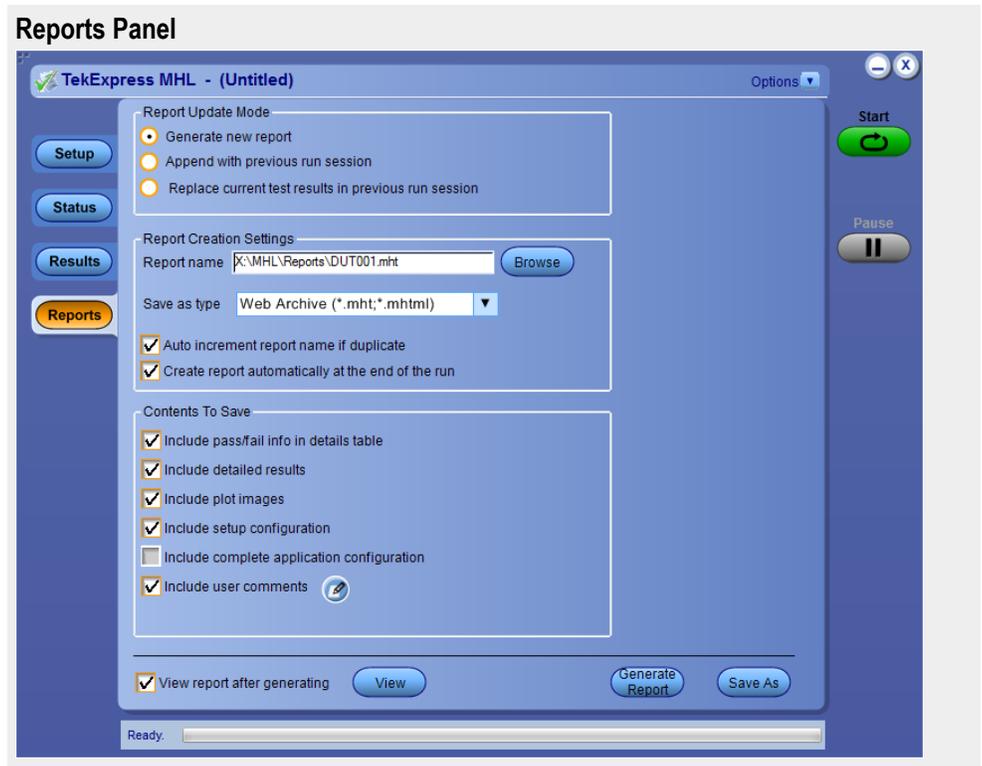
Pause

Clear

# Configuring and viewing reports

## Configuring and viewing reports: the Reports panel

Use the Reports panel to browse for, name, and save reports, select report viewing options, and to view reports.



### Naming a report

Use the Reports Panel to select the naming convention to use for the report. By default, the test report file is located in the session folder to which it belongs, and gets overwritten each time you run the test under the same device name if you don't change the test report name before running the test.

If you do not want your test results to be overwritten each time you run any test, always give the report a unique name, or select to have the name increment each time you run a particular test. Generally, you would select report options before running a test, or when creating and saving test setups. Report settings are included in saved test setups.

### Selecting report options

#### ■ Report name

Displays the default name and location where the report will be saved when generated.

To change the report name or location, type over the current folder path and name and then save the test setup. Be sure to include the entire folder path, the file name, and the file type. For example: C:\Documents and Settings\your user name\My Documents\My TekExpress\MHL\DUT001\_group1.mht.

To open an existing report, click **Browse**, locate the report file and then click **View**.

---

**NOTE.** You cannot change the file location using the *Browse* button.

---

- Save as type

Saves a report in a file type different from the default. Lists supported file types to choose from.

---

**NOTE.** If you select a file type different from the default, be sure to change the report file name extension in the *Report Name* field to match.

---

- Auto increment report name if duplicate

If the application finds a report with the same name as the one being generated, the application automatically increments the name of the report. For example: DUT001, DUT002, DUT003

- Create report automatically at the end of the run

Select to create report at the end of the Run. This option is selected by default.

- Include complete application configuration

Select to include complete configuration application in the report. A table listing general, common, and acquired parameters used in the test will be included in the report. This option is deselected by default.

- Include user comments

Select to include comments added in the DUT tab of the Setup panel. They appear in the Comments section under summary box in the beginning of the report.

- Append reports

This option adds new report data to the end of an existing report of the same name. This option is deselected by default.

- View report after generating

Automatically opens the report in your Web browser when the test completes. This option is selected by default.

**NOTE.** If you unchecked this option before running a test but now would like to view the report, then when analysis is complete, click the button at the top of the Reports panel and navigate to the report file.

### Viewing a report

You can view any report by locating and opening the report file, which ends in .mht unless you changed the file type before running the report.

The top of the report displays information about the instruments and probes used, the duration of the test, software versions, and some summary test information. Below that is a table that shows the test name, measurement details, various measurements, test result (pass/fail), Compliance Mode status (Yes/No), and analysis time. Additional test parameter information that does not fall into the other columns is put in the Comments column.

### Report example

TekExpress Automated Test Solution  
TekExpress MHL 3.0

Setup Information			
DUT ID	DUT001	Scope Model	MSO72004C
Date/Time	2014-04-09 12:34:43	Scope Serial Number	C250006
Device Type	MHL Physical Layer Solution	SPC_FactoryCalibration	PASS:PASS
TekExpress Version	MHL:5.0.0.49 Framework:3.0.1.45	Scope F/W Version	7.1.1 Build 1
Spec Version	CTS 3.2	DPOJET Version	6.1.0.543
Overall Compliance Mode	Yes	Probe1 Model	P73135MA
Execution Mode	Live	Probe1 Serial Number	B020797
Overall Execution Time	0:16:59	Probe2 Model	P73135MA
Overall Test Result	Pass	Probe2 Serial Number	B020883
		Probe3 Model	P7240
		Probe3 Serial Number	B018430
		Probe4 Model	N/A
		Probe4 Serial Number	N/A

DUT COMMENT: MHL 3.0 Physical Layer Solution - Transmitter Output

Test Name Summary Table	
3.7.2.1 VSE_HIGH_DF_TMDS_DATA	Pass
3.7.2.2 VSE_LOW_DF_TMDS_DATA	Pass

3.7.2.1 VSE_HIGH_DF_TMDS_DATA								
Measurement Details	TBit	VTerm	Measured Value	Units	Test Result	Margin	Low Limit	High Limit
VHigh Positive at 6 Gbps	168.3500 ps	3.3 V	3.1048V	V	Pass	L: 1.0048 V H: 0.2152 V	2.1V	3.32V
VHigh Negative at 6 Gbps	168.3500 ps	3.3 V	3.0852V	V	Pass	L: 0.9852 V H: 0.2348 V	2.1V	3.32V
EXECUTION TIME	0:01:32							
COMMENTS								

[Back to Summary Table](#)

3.7.2.2 VSE_LOW_DF_TMDS_DATA								
Measurement Details	TBit	VTerm	Measured Value	Units	Test Result	Margin	Low Limit	High Limit
VLow Positive at 6 Gbps	168.3500 ps	3.3 V	2.7851V	V	Pass	L: 0.9851 V H: 0.1349 V	1.8V	2.92V
VLow Negative at 6 Gbps	168.3500 ps	3.3 V	2.7599V	V	Pass	L: 0.9599 V H: 0.1601 V	1.8V	2.92V
EXECUTION TIME	0:01:32							
COMMENTS								

[Back to Summary Table](#)

- See Also**
- [Setting up tests: the Setup panel](#)
  - [Run test and view progress on the Status panel](#)
  - [Viewing test results: the Results panel](#)
  - [About saving and recalling test setups](#)



---

# Saving and recalling test setups

## About saving and recalling test setups

TekExpress MHL opens with the default test setup selected. Any time you want to create a new test setup, you can select the default test setup to clear the previous test setup selections and take the settings back to their defaults.

You can run a test before or after saving a setup. When you save a setup, the selected oscilloscope, general parameters, acquisition parameters, measurement limits, prerecorded waveform files (if applicable), test, and other configuration settings are all saved under the setup name. You can open a setup and click **Start** without having to do any other setting up except ensuring that the oscilloscope is detected and ready. For details, see [Before You Click Start](#).

- See Also**
- [Save a test setup](#)
  - [Recall a saved test setup](#)
  - [Create a new test setup based on an existing one](#)
  - [Delete a test setup](#)
  - [Setting up tests: the Setup panel](#)

## Saving a test setup

Save a test setup before or after running a test using the parameters you want saved. You can create a new setup from any setup you have open or from the default setup. When you select the default test setup, all parameters are returned to their defaults. The following instructions start from the default setup:

1. From the **Options** menu, select **Default Test Setup**.
2. Select the desired options in the *Setup panel*.
3. Select the desired *report options*.
4. If desired, run the test to ensure that it captures the information you want. If it does not, edit the parameters.
5. From the **Options** menu, select **Save Test Setup**.
6. Name the test and then click **Save**.

**See Also** [About test setups](#)  
[Recall a saved test setup](#)  
[Create a new test setup based on an existing one](#)  
[Delete a test setup](#)

## Recalling a saved test setup

These instructions are for recalling saved test setups.

1. From the **Options** menu, select **Open Test Setup**.
2. In the **File Open** dialog box, select the desired setup from the list and then click **Open**.

[About test setups](#)  
[Save a test setup](#)  
[Create a new test setup based on an existing one](#)  
[Delete a test setup](#)

## Creating a new test setup based on an existing one

Use this method to create a variation on a test setup without having to create the setup from the beginning.

1. From the **Options** menu, select **Open Test Setup**.
2. In the **File Open** dialog box, select the desired setup from the list and then click **Open**.
3. Modify the parameters as desired.
4. From the **Options** menu, select **Save Test Setup As**.
5. In the **File Save As** dialog box, enter a test setup name and then click **Save**.

*[About test setups](#)*

*[Save a test setup](#)*

*[Recall a saved test setup](#)*

*[Delete a test setup](#)*

## Deleting a test setup

If you no longer need a test setup, delete it from the test setup list in the Options menu using these instructions.

Each saved test setup consists of two main parts, the test setup file and the test setup folder, both named for the test session.

1. Make sure the setup you want to delete is not currently selected in TekExpress MHL.
2. Navigate to the MHL folder where test setup files are stored. For example, X:\MHL\test setup name).
3. Locate the test setup file and then delete it. This removes the setup from the list in the **Options** menu.
4. Locate the test setup folder. If you want to keep any of the session files, move them out of the test setup folder and then delete the test setup folder.

*[About test setups](#)*

*[Save a test setup](#)*

*[Recall a saved test setup](#)*

*[Create a new test setup based on an existing one](#)*



---

# TekExpress programmatic interface

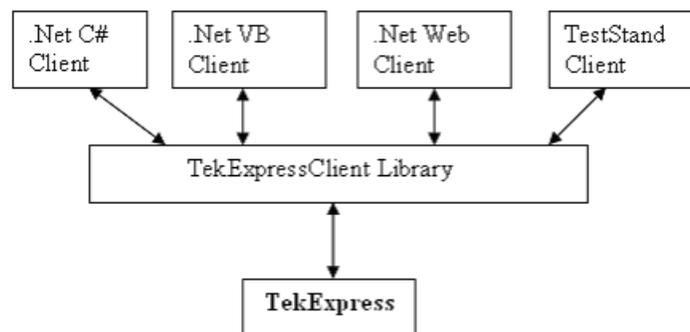
## About the programmatic interface

The Programmatic interface allows you to seamlessly integrate the TekExpress test automation application with the high-level automation layer. This also allows you to control the state of the TekExpress application running on a local or a remote computer.

For simplifying the descriptions, the following terminologies are used in this section:

- **TekExpress Client:** A high-level automation application that communicates with TekExpress using TekExpress Programmatic Interface.
- **TekExpress Server:** The TekExpress application when being controlled by TekExpress Client.

TekExpress leverages .Net Marshalling to enable the Programmatic Interface for TekExpress Client. TekExpress provides a client library for TekExpress clients to use the programmatic interface. The TekExpress client library is inherited from .Net MarshalByRef class to provide the proxy object for the clients. The TekExpress client library maintains a reference to the TekExpress Server and this reference allows the client to control the server state.



**See Also**    [Requirements for developing TekExpress client](#)  
[Remote proxy object](#)  
[Client proxy object](#)

## Requirements for developing TekExpress client

While developing TekExpress Client, use the TekExpressClient.dll. The client can be a VB .Net, C# .Net, TestStand or Web application. The examples for interfaces in each of these applications are in the Samples folder.

### References Required

- *TekExpressClient.dll* has an internal reference to *IIdlglib.dll* and *IRemoteInterface.dll*.
- *IIdlglib.dll* has a reference to *TekDotNetLib.dll*.
- *IRemoteInterface.dll* provides the interfaces required to perform the remote automations. It is an interface that forms the communication line between the server and the client.
- *IIdlglib.dll* provides the methods to generate and direct the secondary dialog messages at the client-end.

---

**NOTE.** *The end-user client application does not need any reference to the above mentioned DLL files. It is essential to have these DLLs (IRemoteInterface.dll, IIdlglib.dll and TekDotNetLib.dll) in the same folder as that of TekExpressClient.dll.*

---

### Required Steps for a Client

The following are the steps that a client needs to follow to use TekExpressClient.dll to programmatically control the server:

A client UI must be developed to access the interfaces exposed through the server. This client needs to load TekExpressClient.dll to access the interfaces. After TekExpressClient.dll is loaded, the client UI can call the specific functions to run the operations requested by the client. When the client is up and running, it must do the following to run a remote operation:

1. The client needs to provide the IP address of the PC at which the server is running in order to connect to the server.
2. The client needs to lock the server application to avoid conflict with any other Client that may try to control the server simultaneously. “Lock” would also disable all user controls on the server so that server state cannot be changed by manual operation. Note that this does not lock the UI.

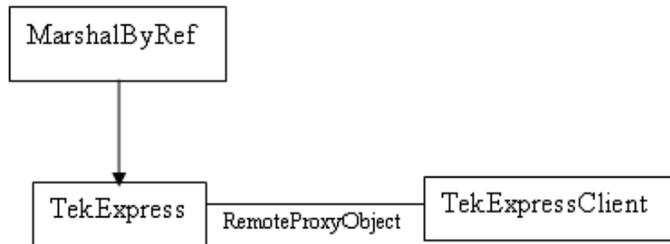
If any other client tries to access a server that is locked, it will get a notification that the server is locked by another client.

3. When the client has connected to and locked the server, the client can access any of the programmatic controls to run the remote automations.
4. After the client operations are completed, the server needs to be unlocked by the client.

**See Also** [About MHL application commands](#)

## Remote proxy object

The server exposes a remote object to let the remote client access and perform the server side operations remotely. The proxy object is instantiated and exposed at the server-end through marshalling.



The following is an example:

```
RemotingConfiguration.RegisterWellKnownServiceType (typeof
(TekExpressRemoteInterface), "TekExpress Remote interface",
WellKnownObjectMode.Singleton);
```

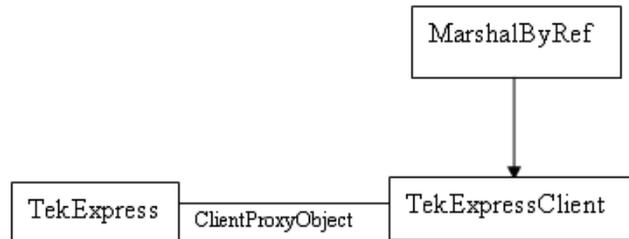
This object lets the remote client access the interfaces exposed at the server side. The client gets the reference to this object when the client gets connected to the server.

For example,

```
//Get a reference to the remote object
remoteObject =
(IRemoteInterface)Activator.GetObject(typeof(IRemoteInterface),
URL.ToString());
```

## Client proxy object

Client exposes a proxy object to receive certain information.



For example,

```
//Register the client proxy object
WellKnownServiceTypeEntry[] e =
RemotingConfiguration.GetRegisteredWellKnownServiceTypes();
clientInterface = new ClientInterface();
RemotingConfiguration.RegisterWellKnownServiceType(typeof(ClientInterface)
, "Remote Client Interface", WellKnownObjectMode.Singleton);
//Expose the client proxy object through marshalling
RemotingServices.Marshal(clientInterface, "Remote Client Inteface");
```

The client proxy object is used for the following:

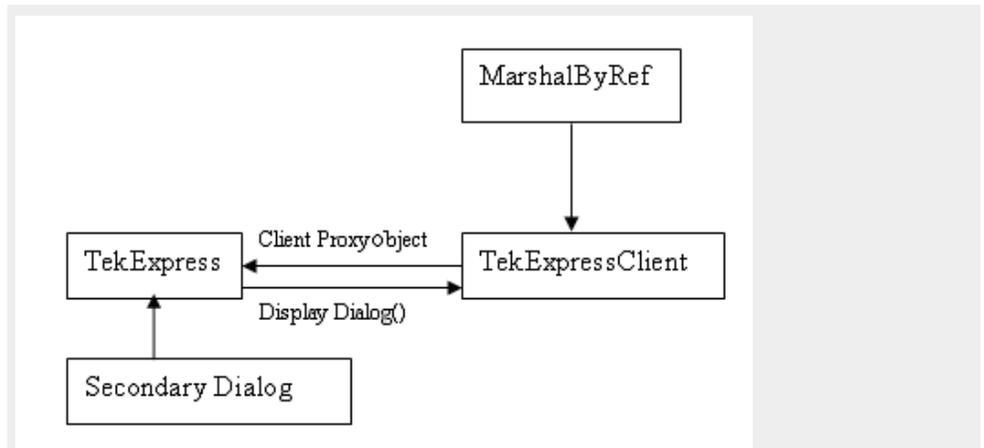
- To get the secondary dialog messages from the server.
- To get the file transfer commands from the server while transferring the report.

Examples

```
clientObject.clientIntf.DisplayDialog(caption, msg, iconType, btnType);
clientObject.clientIntf.TransferBytes(buffer, read, fileLength);
```

For more information, click the topic links listed below.

**Secondary Dialog Message Handling**



The secondary dialog messages from the Secondary Dialog library are redirected to the client-end when a client is performing the automations at the remote end.

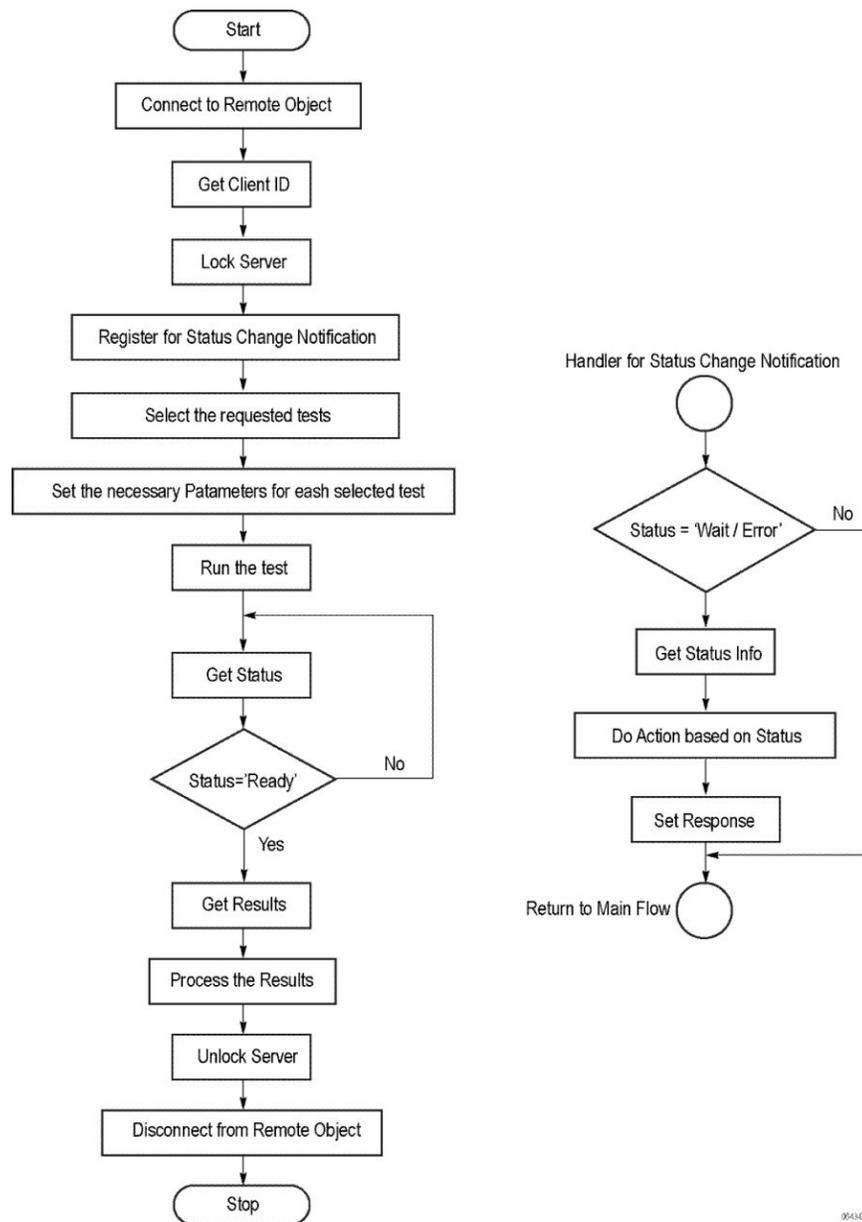
In the secondary dialog library, the assembly that is calling for the dialog box to be displayed is checked and if a remote connection is detected, the messages are directed to the remote end.

#### **File transfer events**

When the client requests the transfer of the report, the server reads the report and transfers the file by calling the file transfer methods at the client-end.

## **Client programmatic interface example**

An example of the client programmatic interface is described and shown as follows:



1. Connect to a server or remote object using the programmatic interface provided.
2. Get the client ID that is created when connecting to the remote object. This client ID is one of the required parameters to communicate with the server.

---

**NOTE.** Server identifies the client with this ID only and rejects any request if the ID is invalid.

---

3. Lock the server for further operations. This disables the application interface.

---

**NOTE.** *You can get values from the server or set values from the server to the client only if the application is locked.*

---

4. Register for receiving notifications on status change events on the server. To register you need to give a handler as a parameter.

---

**NOTE.** *Whenever there is a change in the status of the server, all the clients registered with the server receive a notification from the server.*

---

5. Select the tests that you want to run through the programmatic interface.
6. Set the necessary parameters for each test.
7. Run the tests.
8. Poll for the status of the application.

---

**NOTE.** *Skip this step if you are registered for the status change notification and when the status is Ready.*

---

9. After completing the tests, get the results.
10. Create a report or display the results and verify or process the results.
11. Unlock the server after you complete all the tasks.
12. Disconnect from the remote object.

### Handler of Status Change Notification

1. Get the status. If the status is Wait or Error, get the information that contains the title, message description, and the expected responses for the status.
2. Perform the actions based on the status information.
3. Set the response as expected.

**See Also** [About MHL application commands](#)  
[Program example](#)

## Program examples

The following program examples show how to communicate between a PC and TekExpress MHL remotely, using typical steps.

For detailed information about each command, see the [MHL application commands](#) section.

**Table 31: Remote access code example 1**

Task	Code
Start the application	
Connect through an IP address.	{'Set String Details string devicename = "MHL Physical Layer Solution" string suiteName = "MHL Transmitter" m_Client.Connect("localhost") True or False clientID = m_Client.getClientID }
Lock the server	m_Client.LockServer(clientID)
Disable the Popups	m_Client.SetVerboseMode(clientID, false)
Set the DUT ID	m_Client.SetDutId(clientID, "DUT_Name")
Set pixel mode	m_Client.SetGeneralParameter(clientID, devicename, suiteName, string.Empty, "Pixel Mode\$24 Bits");
Set resolutions	m_Client.SetGeneralParameter(clientID, devicename, suiteName, string.Empty, "24Bits Lowest Resolution (MHz)\$25"); m_Client.SetGeneralParameter(clientID, devicename, suiteName, string.Empty, "24Bits Highest Resolution (MHz)\$74.25"); m_Client.SetGeneralParameter(clientID, devicename, suiteName, string.Empty, "24Bits Number of Other Resolution (Count)\$0");
Select voltage termination method	m_Client.SetGeneralParameter(clientID, devicename, suiteName, string.Empty, "Voltage termination\$Internal");
Set voltage	m_Client.SetGeneralParameter(clientID, devicename, suiteName, string.Empty, "VTerm1 (V)\$3.1"); m_Client.SetGeneralParameter(clientID, devicename, suiteName, string.Empty, "VTerm2 (V)\$3.5");

Task	Code
Select channels	<pre>m_Client.SetGeneralParameter(clientID, devicename, suiteName, String.Empty, "P7313SMA Diff mode / MHL Positive Connected to\$CH1"); m_Client.SetGeneralParameter(clientID, devicename, suiteName, String.Empty, "P7313SMA MHL Negative Connected to \$CH2"); m_Client.SetGeneralParameter(clientID, devicename, suiteName, String.Empty, "P7240 Common Mode Connected to\$CH3");</pre>
Select a measurement	<pre>m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", True)</pre>
Configure the selected measurement (Acquire Parameters)	<pre>m_client.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET \$Sample Rate (GS/s)\$25") m_client.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET \$Record Length (M)\$12.5") m_client.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET \$Edge trigger level (%)\$50") m_client.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET \$Probe attenuation (X)\$12.5") m_client.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET\$Diff Probe Vertical Position (Div)\$0") m_client.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET\$Diff Probe Vertical Scale (mV/Div)\$125") m_client.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET\$CM Probe Vertical Position (Div)\$0") m_client.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET\$CM Probe Vertical Scale (mV/Div)\$80")</pre>

Task	Code
Configure the selected measurement (Analyze Parameters)	<pre> m_client.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Reference levels\$Absolute") m_client.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Reference Level - Mid Level (%)\$2") m_client.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Reference Level - Hysteresis (%)\$1") m_client.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","PLL model type\$2") m_client.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Clock recovery method\$PLL-Custom BW") m_client.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Clock Multiplier\$15") m_client.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Loop bandwidth (MHz)\$4") m_client.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Clock Edge\$RISE") </pre>
Run with set configurations	<pre> m_Client.Run(clientID) </pre>
Wait for the test to complete	<pre> Do Thread.Sleep(500) m_Client.Application_Status(clientID) Select Case status Case "Wait" 'Get the Current State Information mClient.GetCurrentStateInfo(clientID, WaitingMsbBxCaption, WaitingMsbBxMessage, WaitingMsbBxButtontexts) 'Send the Response mClient.SendResponse(clientID, WaitingMsbBxCaption, WaitingMsbBxMessage, WaitingMsbBxResponse) End Select Loop Until status = "Ready" </pre>
After the test is complete	<pre> 'Save all results values from folder for current run m_Client.TransferResult(clientID, logDirname) 'Save all waveforms from folder for current run m_Client.TransferWaveforms(clientID, logDirname) 'Save all images from folder for current run m_Client.TransferImages(clientID, logDirname) </pre>
Unlock the server	<pre> m_Client.UnlockServer(clientID) </pre>

Task	Code
Disconnect from server	m_Client.Disconnect()
Exit the application	

**Table 32: Remote access code example 2**

Task	Code
Start the application	
Connect through an IP address.	m_Client.Connect("localhost") 'True or False clientID = m_Client.getClientID
Lock the server	m_Client.LockServer(clientID)
Disable the Popups	m_Client.SetVerboseMode(clientID, false)
Set the DUT ID	m_Client.SetDutId(clientID, "DUT_Name")
Select a test	mClient.SelectsingleTest(clientID, "Transmitter", "Detachable", "Spec 1.0", "400KHz-1MHz", true)
Select a Sample Rate	mClient.SetAcquireParameter(clientID, "Transmitter", "Detachable", "400KHz-1MHz", "Sample Rate (Ms/sec)\$250")
Select a Record Length	mClient.SetAcquireParameter(clientID, "Transmitter", "Detachable", "400KHz-1MHz", "Record Length\$10")
Run with set configurations	m_Client.Run(clientID)
Wait for the test to complete.	Do Thread.Sleep(500) m_Client.Application_Status(clientID) Select Case status Case "Wait"
Get the current state information	mClient.GetCurrentStateInfo(clientID, WaitingMsbBxCaption, WaitingMsbBxMessage, WaitingMsbBxButtontexts)
Send the response	mClient.SendResponse(clientID, WaitingMsbBxCaption, WaitingMsbBxMessage, WaitingMsbBxResponse) End Select Loop Until status = "Ready"
Save results	Save all results values from folder for current run m_Client.TransferResult(clientID, logDirname)
Unlock the server	m_Client.UnlockServer(clientID)

## MHL application commands

Click a client action below to see the command name, description, parameters, return value, and an example, associated with the action.

### Connect through an IP address

Command name	Parameters	Description	Return value	Example
Connect()	string ipAddress out string clientID	This method connects the client to the server. Note The client provides the IP address to connect to the server. The server provides a unique client identification number when connected to it.	Return value is either True or False.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as boolean returnval = m_Client.Connect(ipaddress,m_clientID)

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

#### string ipAddress

Name	Type	Direction	Description
ipAddress	string	IN	The ip address of the server to which the client is trying to connect to. This is required to establish the connection between the server and the client.

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**NOTE.** The server must be active and running for the client to connect to the server. Any number of clients can be connected to the server at a time.

**Lock the server**

**NOTE.** This method does not lock the UI, but you need this method to set the value that gives the status of the operation after it has been performed.

Command name	Parameters	Description	Return value	Example
LockSession()	out string clientID	This method locks the server. Note The client must call this method before running any of the remote automations. The server can be locked by only one client.	String value that gives the status of the operation after it has been performed. The return value is "Session Locked..." on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval = m_Client.LockServer(clientID)

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**NOTE.** *When the client tries to lock a server that is locked by another client, the client gets a notification that the server is already locked and it must wait until the server is unlocked. If the client locks the server and is idle for a certain amount of time then the server is unlocked automatically from that client.*

**Disable the popups**

Command name	Parameters	Description	Return value	Example
SetVerboseMode()	string clientID bool _verbose	This method sets the verbose mode to either True or False. When the value is set to True, any of the message boxes appearing during the application run will be routed to the client machine that is controlling TekExpress. When the value is set to False, then all the message boxes are shown on the server machine.	String that displays the status of the operation after it has been performed. When Verbose mode is set to True, the return value is "Verbose mode turned on. All dialog boxes will be shown to client ...". When Verbose mode is set to False, the return value is "Verbose mode turned off. All dialog boxes will be shown to server ...".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <b>Verbose mode is turned on</b> return=m_Client.SetVerboseMode(clientID, True) <b>Verbose mode is turned off</b> returnval=m_Client.SetVerboseMode(clientID, False)

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

#### out string clientID

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

#### bool\_verbose

Name	Type	Direction	Description
_verbose	bool	IN	Specifies whether the verbose mode should be turned ON or OFF

**Set or get the DUT ID**

Command name	Parameters	Description	Return value	Example
SetDutId()	string clientID string dutName	This method changes the DUT ID of the setup. The client must provide a valid DUT ID.	String that gives the status of the operation after it has been performed. Return value is "DUT Id Changed..." on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string return=m_Client.SetDutId(clientID,desiredDutId) Note
GetDutId()	string clientID string dutId	This method gets the DUT ID of the current set up.	String that gives the status of the operation after it has been performed.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string return=m_Client.GetDutId(clientID,out DutId)

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

**NOTE.** If the dutName parameter is null, the client is prompted to provide a valid DUT ID.

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string dutName**

Name	Type	Direction	Description
dutName	string	IN	The new DUT ID of the setup

**string dutId**

Name	Type	Direction	Description
dutId	string	OUT	The DUT ID of the setup

The dutId parameter is set after the server processes the request.

### Set the configuration parameters for a suite or measurement

Command name	Parameters	Description	Return value	Example
SetGeneralParameter	string clientID string device string suite string test string parameterString	This method sets the general parameters.	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval = m_Client.SetGeneralParameter(clientID, devicename, suiteName, string.Empty, parameterstring); SetGeneralParameters Examples
SetAnalyzeParameter()	string clientID string device string suite string test string parameterString	This method sets the parameter values in the Ref Levels and Clock Settings tabs in the test configuration section.	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	mClient = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Select Analyze parameter: returnval = mClient.SetAnalyzeParameter(clientID, devicename, suiteName, test, parameterstring) SetAnalyzeParameter Examples
SetAcquireParameter()	string clientID string device string suite string test string parameterString	This method sets the parameter values in the Vertical Setup and the Scope Settings tabs in the test configuration section.	String that displays the status of the operation after it has been performed. The return value is "" (an empty string) on success.	mClient = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Set Acquire Parameter: returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName, test, parameterstring) SetAcquireParameter Example

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

### SetAnalyzeParameter Examples

This example uses MHL test 3.1.1.12 MHL Data Eye Diagram.

Parameter	Example
Reference Level	returnval =mClient.SetAnalyzeParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Reference levels\$Absolute")
Mid Level	returnval =mClient.SetAnalyzeParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Reference Level - Mid Level (%)\$2")
Hysteresis	returnval =mClient.SetAnalyzeParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Reference Level - Hysteresis (%)\$1")
PLL Model Type	returnval =mClient.SetAnalyzeParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "PLL model type\$2")
Clock Recovery Method	returnval =mClient.SetAnalyzeParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Clock recovery method\$PLL-Custom BW")
Clock Multiplier	returnval =mClient.SetAnalyzeParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Clock Multiplier\$15")

Parameter	Example
Loop bandwidth	returnval =mClient.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Loop bandwidth (MHz)\$4")
Clock Edge	returnval =mClient.SetAnalyzeParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Clock Edge\$RISE")

### SetAcquireParameter Examples

This configuration example uses MHL test 3.1.1.12 MHL Data Eye Diagram.

Parameter	Example
Sample Rate (GS/s)	returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET \$Sample Rate (GS/s)\$25")
Record Length	returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET \$Record Length (M)\$12.5")
Edge Trigger	returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET \$Edge trigger level (%)\$50")
Probe Attenuation	returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET \$Probe attenuation (X)\$12.5")
Diff Vertical Position	returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET\$Diff Probe Vertical Position (Div)\$0")
Diff Vertical Scale	returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET\$Diff Probe Vertical Scale (mV/Div)\$125")

Parameter	Example
CM Vertical Position	returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET\$CM Probe Vertical Position (Div)\$0")
CM Vertical Scale	returnval = mClient.SetAcquireParameter(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", "Short Record-length for DPOJET\$CM Probe Vertical Scale (mV/Div)\$80")

### SetGeneralParameter Examples

```
returnval = mClient.SetGeneralParameter(clientID, devicename, suiteName, String.Empty, "P7313SMA Diff mode / MHL Positive Connected to$CH1");
```

```
returnval = mClient.SetGeneralParameter(clientID, devicename, suiteName, String.Empty, "P7313SMA MHL Negative Connected to$CH2");
```

```
returnval = mClient.SetGeneralParameter(clientID, devicename, suiteName, String.Empty, "P7240 Common Mode Connected to$CH3");
```

### out string clientID

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

### string device

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

### string suite

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

### Query the configuration parameters for a suite or measurement

Command name	Parameters	Description	Return value	Example
GetGeneralParameter()	string clientID string device string suite string test string parameterString	This method gets the general configuration parameters for a given suite or measurement.	The return value is the general configuration parameter for a given suite or measurement that is set.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string
GetAnalyzeParameter()	string clientID string device string suite string test string parameterString	This method queries the parameter values in the Ref Level and Clock Settings tabs in the test configuration section.	The return value is the configuration parameter for a given suite or measurement.	mClient = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Get Analyze parameter: returnval = mClient.GetAnalyzeParameter(clientID, devicename, suitename, test, parameterstring) GetAnalyzeParameter Examples
GetAcquireParameter()	string clientID string device string suite string test string parameterString	This method queries the parameter values in the Vertical Setup and Scope Settings tabs in the test configuration section.	The return value is the configuration parameter for a given suite or measurement.	mClient = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Get Acquire Parameter: returnval = mClient.GetAcquireParameter(clientID, devicename, suitename, test, parameterstring) GetAcquireParameter Examples

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

### GetAcquireParameter Examples

This example uses MHL test 3.1.1.12 MHL Data Eye Diagram.

Parameter	Example
Sample Rate (GS/s)	returnval = mClient.GetAcquireParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET \$Sample Rate (GS/s)")
Record Length	returnval = mClient.GetAcquireParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET \$Record Length (M)")
Edge Trigger	returnval = mClient.GetAcquireParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET \$Edge trigger level (%)")
Probe Attenuation	returnval = mClient.GetAcquireParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET \$Probe attenuation (X)")
Diff Probe Vertical Position	returnval = mClient.GetAcquireParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET\$Diff Probe Vertical Position (Div)")
Diff Probe Vertical Scale	returnval = mClient.GetAcquireParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET\$Diff Probe Vertical Scale (mV/Div)")

Parameter	Example
CM Probe Vertical Position	returnval = mClient.GetAcquireParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET\$CM Probe Vertical Position (Div)")
CM Probe Vertical Scale	returnval = mClient.GetAcquireParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Short Record-length for DPOJET\$CM Probe Vertical Scale (mV/Div)")

### GetAnalyzeParameter Examples

This example uses MHL test 3.1.1.12 MHL Data Eye Diagram.

Parameter	Example
Reference Level	returnval =mClient.GetAnalyzeParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Reference levels")
Mid Level	returnval =mClient.GetAnalyzeParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Reference Level - Mid Level (%)")
Hysteresis	returnval =mClient.GetAnalyzeParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Reference Level - Hysteresis (%)")
PLL Model Type	returnval =mClient.GetAnalyzeParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","PLL model type")
Clock Recovery Method	returnval =mClient.GetAnalyzeParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Clock recovery method")
Clock Multiplier	returnval =mClient.GetAnalyzeParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Clock Multiplier")
Loop Bandwidth	returnval =mClient.GetAnalyzeParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Loop bandwidth (MHz)")
Clock Edge	returnval =mClient.GetAnalyzeParameter(clientID, devicename, suitename,"3.1.1.12 MHL Data Eye Diagram","Clock Edge")

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

**Select a measurement**

Command name	Parameters	Description	Return value	Example
SelectTest()	string clientID string device string suite string test bool isSelected	This method selects or deselects a given test.	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string <b>Select test: (test name)</b> returnval=m_Client. SelectTest(clientID , devicename, suiteName, testname, isSelected); Select a specific test.

**Select a Specific Test**

Test	Command
3.1.1.1 Standby Output Voltage — VOFF	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.1 Standby Output Voltage-VOFF", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.1 Standby Output Voltage-VOFF", False)
3.1.1.2 Single-ended High Level Voltage — VSE_HIGH	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.2 Single-ended High Level Voltage-VSE_HIGH", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.2 Single-ended High Level Voltage-VSE_HIGH", False);
3.1.1.3 Single-ended Low Level Voltages — VSE_LOW	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.3 Single-ended Low Level Voltages-VSE_LOW", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.3 Single-ended Low Level Voltages-VSE_LOW", False);

Test	Command
3.1.1.4 Differential Output Swing Voltage — VDF_SWING	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.4 Differential Output Swing Voltage-VDF_SWING", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.4 Differential Output Swing Voltage-VDF_SWING", False);
3.1.1.5 Common-mode Output Swing Voltage — V_CMSWING	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.5 Common-mode Output Swing Voltage-V_CMSWING", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.5 Common-mode Output Swing Voltage-V_CMSWING", False);
3.1.1.6 Differential Rise and Fall Times-TR_DF, TF_DF	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.6 Differential Rise and Fall Times-TR_DF, TF_DF", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.6 Differential Rise and Fall Times-TR_DF, TF_DF", False);
3.1.1.7 Common-mode Rise and Fall Times — TR_CM, TF_CM	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.7 Common-mode Rise and Fall Times-TR_CM, TF_CM", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.7 Common-mode Rise and Fall Times-TR_CM, TF_CM", False);
3.1.1.8 Differential Intra-Pair Skew — TSKEW_DF	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.8 Differential Intra-Pair Skew-TSKEW_DF", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.8 Differential Intra-Pair Skew-TSKEW_DF", False);

Test	Command
3.1.1.10 MHL Clock Duty Cycle – 24 Bit or Packed Pixel (CTS 1.X)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.10 MHL Clock Duty Cycle 24-Bit or Packed Pixel Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.10 MHL Clock Duty Cycle 24-Bit or Packed Pixel Mode", False);
3.1.1.10 MHL Clock Duty Cycle – Normal Mode (CTS 2.0)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.10 MHL Clock Duty Cycle Normal Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.10 MHL Clock Duty Cycle Normal Mode", False);
3.1.1.11 MHL Clock Jitter (CTS 1.X)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.11 MHL Clock Jitter", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.11 MHL Clock Jitter", False);
3.1.1.11 MHL Clock Jitter – Normal Mode (CTS 2.0)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.11 MHL Clock Jitter Normal Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.11 MHL Clock Jitter Normal Mode", False);
3.1.1.12 MHL Data Eye Diagram (CTS 1.X)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram", False);
3.1.1.12 MHL Data Eye Diagram Normal Mode (CTS 2.0)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram Normal Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.12 MHL Data Eye Diagram Normal Mode", False);

Test	Command
3.1.1.14 MHL Clock Duty Cycle – Packed Pixel Mode (CTS 2.0)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.14 MHL Clock Duty Cycle Packed Pixel Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.14 MHL Clock Duty Cycle Packed Pixel Mode", False);
3.1.1.15 MHL Clock Jitter – Packed Pixel Mode (CTS 2.0)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.15 MHL Clock Jitter Packed Pixel Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.15 MHL Clock Jitter Packed Pixel Mode", False);
3.1.1.16 MHL Data Eye Diagram – Packed Pixel Mode (CTS 2.0)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.16 MHL Data Eye Diagram Packed Pixel Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.16 MHL Data Eye Diagram Packed Pixel Mode", False);
3.1.1.17 MHL TP2 Clock Jitter – Normal Mode (CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.17 TP2 Clock Jitter in Normal Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.17 TP2 Clock Jitter in Normal Mode", False);
3.1.1.18 MHL TP2 Eye Diagram – Normal Mode (CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.18 TP2 Eye Diagram in Normal Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.18 TP2 Eye Diagram in Normal Mode", False);
3.1.1.19 MHL TP2 Clock Jitter – Packed Pixel Mode (CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.19 TP2 Clock Jitter in PackedPixel Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.19 TP2 Clock Jitter in PackedPixel Mode", False);

Test	Command
3.1.1.20 MHL TP2 Eye Diagram – Packed Pixel Mode (CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.20 TP2 Eye Diagram in PackedPixel Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.1.1.20 TP2 Eye Diagram in PackedPixel Mode", False);
3.7.2.1 VSE_HIGH_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.1 VSE_HIGH_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.1 VSE_HIGH_DF_TMDS_DATA", False);
3.7.2.2 VSE_LOW_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.2 VSE_LOW_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.2 VSE_LOW_DF_TMDS_DATA", False);
3.7.2.5 VDF_SWING_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.5 VDF_SWING_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.5 VDF_SWING_DF_TMDS_DATA", False);
3.7.2.13 TR_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.13 TR_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.13 TR_DF_TMDS_DATA", False);

Test	Command
3.7.2.14 TF_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.14 TF_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.14 TF_DF_TMDS_DATA", False);
3.7.2.17 VPP_TP1_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.17 VPP_TP1_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.17 VPP_TP1_DF_TMDS_DATA", False);
3.7.2.27 TMDS Data Eye Diagram (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.27 TMDS Data Eye Diagram", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.27 TMDS Data Eye Diagram", False);
3.7.2.7 VSE_HIGH_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.7 VSE_HIGH_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.7 VSE_HIGH_SE_MHL_CLK", False);
3.7.2.7 VSE_HIGH_SE_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.7 VSE_HIGH_SE_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.7 VSE_HIGH_SE_eCBUS_FWD", False);
3.7.2.8 VSE_LOW_SE_MHL_CLK - Clock(CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.8 VSE_LOW_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.8 VSE_LOW_SE_MHL_CLK", False);

Test	Command
3.7.2.8 VSE_LOW_SE_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.8 VSE_LOW_SE_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.8 VSE_LOW_SE_eCBUS_FWD", False);
3.7.2.9 VSE_SWING_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.9 VSE_SWING_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.9 VSE_SWING_SE_MHL_CLK", False);
3.7.2.9 VSE_SWING_SE_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.9 VSE_SWING_SE_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.9 VSE_SWING_SE_eCBUS_FWD", False);
3.7.2.20 FSE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.20 FSE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.20 FSE_MHL_CLK", False);
3.7.2.21 TCFP_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.21 TCFP_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.21 TCFP_SE_MHL_CLK", False);

Test	Command
3.7.2.22 TCBP_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.22 TCBP_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.22 TCBP_SE_MHL_CLK", False);
3.7.2.23 TR_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.23 TR_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.23 TR_SE_MHL_CLK", False);
3.7.2.24 TF_SE_eCBUS_CLK,TF_SE_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.24 TF_SE_eCBUS_CLK,TF_SE_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.24 TF_SE_eCBUS_CLK,TF_SE_eCBUS_FWD", False);
3.7.2.25 VPP_TP1_SE_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.25 VPP_TP1_SE_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.25 VPP_TP1_SE_eCBUS_FWD", False);
3.7.2.26 TCLOCK_JITTER_TP2_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.26 TCLOCK_JITTER_TP2_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.26 TCLOCK_JITTER_TP2_SE_MHL_CLK", False);

Test	Command
3.7.2.29 eCBUS-S FWD Data Eye Diagram at TP2 (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.29 eCBUS-S FWD Data Eye Diagram at TP2", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.29 eCBUS-S FWD Data Eye Diagram at TP2", False);
3.7.2.32 VIDC_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.32 VIDC_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.32 VIDC_SE_eCBUS_BWD", False);
3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data", False);
3.7.2.40 DUTY_CYCLE_Tolerance_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.40 DUTY_CYCLE_Tolerance_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "3.7.2.40 DUTY_CYCLE_Tolerance_SE_MHL_CLK", False);
4.1.1.1. Input Signal DC Voltage Level Tolerance Test	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.1 Input Signal DC Voltage Level Tolerance", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.1 Input Signal DC Voltage Level Tolerance", False);

Test	Command
4.1.1.2 Input Signal Minimum and Maximum Swing Voltages Tolerance	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.2 Input Signal Minimum and Maximum Swing Voltages Tolerance", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.2 Input Signal Minimum and Maximum Swing Voltages Tolerance", False);
4.1.1.3 Intra-Pair Skew Tolerance Test	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.3 Intra-Pair Skew Tolerance", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.3 Intra-Pair Skew Tolerance", False);
4.1.1.4 Jitter Tolerance Test (CTS 1.X)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.4 Jitter Tolerance", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.4 Jitter Tolerance", False);
4.1.1.4 Jitter Tolerance in Normal Mode Test (CTS 2.0, CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.4 Jitter Tolerance Normal Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.4 Jitter Tolerance Normal Mode", False);
4.1.1.8 Jitter Tolerance in Packed Pixel Mode Test (CTS 2.0, CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.8 Jitter Tolerance Packed Pixel Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.1.1.8 Jitter Tolerance Packed Pixel Mode", False);

Test	Command
4.7.2.1 VIDC_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.1 VIDC_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.1 VIDC_DF_TMDS_DATA", False);
4.7.2.3 VIDC_SWING_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.3 VIDC_SWING_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.3 VIDC_SWING_DF_TMDS_DATA", False);
4.7.2.5 VIDC_SE_MHL_CLK, VIDC_SE_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.5 VIDC_SE_MHL_CLK, VIDC_SE_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.5 VIDC_SE_MHL_CLK, VIDC_SE_eCBUS_FWD", False);
4.7.2.7 TSKEW_TP2_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.7 TSKEW_TP2_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.7 TSKEW_TP2_DF_TMDS_DATA", False);
4.7.2.10 TCLOCK_JITTER_TP2_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.10 TCLOCK_JITTER_TP2_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.10 TCLOCK_JITTER_TP2_SE_MHL_CLK", False);

Test	Command
4.7.2.14 VSE_HIGH_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.14 VSE_HIGH_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.14 VSE_HIGH_SE_eCBUS_BWD", False);
4.7.2.15 VSE_LOW_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.15 VSE_LOW_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.15 VSE_LOW_SE_eCBUS_BWD", False);
4.7.2.16 VSE_SWING_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.16 VSE_SWING_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.16 VSE_SWING_SE_eCBUS_BWD", False);
4.7.2.20 TR_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.20 TR_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.20 TR_SE_eCBUS_BWD", False);
4.7.2.21 TF_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.21 TF_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.21 TF_SE_eCBUS_BWD", False);

Test	Command
4.7.2.22 TPP_TP2_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.22 TPP_TP2_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.22 TPP_TP2_SE_eCBUS_BWD", False);
4.7.2.24 ECBUS-S_BWD_DATA_EYE_DIAGRAM_AT_TP1(CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.24 ECBUS-S_BWD_DATA_EYE_DIAGRAM_AT_TP1", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.24 ECBUS-S_BWD_DATA_EYE_DIAGRAM_AT_TP1", False);
4.7.2.28 DUTY_CYCLE_Tolerance_SE_MHL_CLK(CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.28 DUTY_CYCLE_Tolerance_SE_MHL_CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "4.7.2.28 DUTY_CYCLE_Tolerance_SE_MHL_CLK", False);
5.1.1.1 Input Signal Single-Ended Voltage Level Tolerance Test	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.1 Input Signal Single-Ended Voltage Level Tolerance", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.1 Input Signal Single-Ended Voltage Level Tolerance", False);
5.1.1.2 Input Signal Minimum and Maximum Swing Voltage Tolerance Test	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.2 Input Signal Minimum and Maximum Swing Voltages Tolerance", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.2 Input Signal Minimum and Maximum Swing Voltages Tolerance", False);

Test	Command
5.1.1.3 Intra-Pair Skew Tolerance Test	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.3 Intra-Pair Skew Tolerance", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.3 Intra-Pair Skew Tolerance", False);
5.1.1.4 Jitter Tolerance Test (CTS 1.X)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.4 Jitter Tolerance", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.4 Jitter Tolerance", False);
5.1.1.4 Jitter Tolerance in Normal Mode Test (CTS 2.0, CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.4 Jitter Tolerance Normal Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.4 Jitter Tolerance Normal Mode", False);
5.1.1.9 Jitter Tolerance in Packed Pixel Mode Test (CTS 2.0, CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.9 Jitter Tolerance Packed Pixel Mode", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.1.1.9 Jitter Tolerance Packed Pixel Mode", False);
5.7.2.1 VSE_HIGH_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.1 VSE_HIGH_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.1 VSE_HIGH_DF_TMDS_DATA", False);
5.7.2.2 VSE_LOW_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.2 VSE_LOW_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.2 VSE_LOW_DF_TMDS_DATA", False);

Test	Command
5.7.2.5 VIDF_SWING_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.5 VIDF_SWING_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.5 VIDF_SWING_DF_TMDS_DATA", False);
5.7.2.7 VSE_HIGH_SE_MHL_CLK, VSE_HIGH_SE_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.7 VSE_HIGH_SE_MHL_CLK, VSE_HIGH_SE_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.7 VSE_HIGH_SE_MHL_CLK, VSE_HIGH_SE_eCBUS_FWD", False);
5.7.2.8 VSE_LOW_SE_MHL_CLK, VSE_LOW_SE_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.8 VSE_LOW_SE_MHL_CLK, VSE_LOW_SE_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.8 VSE_LOW_SE_MHL_CLK, VSE_LOW_SE_eCBUS_FWD", False);
5.7.2.10 TSKEW_TP3_DF_TMDS_DATA (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.10 TSKEW_TP3_DF_TMDS_DATA", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.10 TSKEW_TP3_DF_TMDS_DATA", False);
5.7.2.13 TSKEW_TP3_DF_MHL_CLK, TSKEW_TP3_DF_eCBUS_FWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.13 TSKEW_TP3_DF_MHL_CLK, TSKEW_TP3_DF_eCBUS_FWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.13 TSKEW_TP3_DF_MHL_CLK, TSKEW_TP3_DF_eCBUS_FWD", False);

Test	Command
5.7.2.16 VODC_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.16 VODC_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.16 VODC_SE_eCBUS_BWD", False);
5.7.2.17 VSE_SWING_SE_eCBUS_BWD (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.17 VSE_SWING_SE_eCBUS_BWD", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.17 VSE_SWING_SE_eCBUS_BWD", False);
5.7.2.19 ECBUS-S_BWD_DATA_EYE_DIAGRAM_AT_TP3 (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.19 ECBUS- S_BWD_DATA_EYE_DIAGRAM_AT_TP3", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.19 ECBUS- S_BWD_DATA_EYE_DIAGRAM_AT_TP3", False);
5.7.2.23 DUTY_CYCLE_Tolerance_SE_MHL_CLK (CTS 3.3)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.23 DUTY_CYCLE_Tolerance_SE_MHL_ CLK", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "5.7.2.23 DUTY_CYCLE_Tolerance_SE_MHL_ CLK", False);

Test	Command
7.2.1.16 MHL Clock Swing test - Cable (CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "7.2.1.16 Minimum CLK Swing Test", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "7.2.1.16 Minimum CLK Swing Test", False);
7.2.1.17 MHL Eye Diagram Test - Cable (CTS 1.3/2.1)	For selecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "7.2.1.17 Eye Diagram Test", True); For deselecting the test: returnval=m_Client.SelectTest(clientID, devicename, suiteName, "7.2.1.17 Eye Diagram Test", False);

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**bool isSelected**

Name	Type	Direction	Description
isSelected	bool	IN	Selects or deselects a test

**Select a suite**

Command name	Parameters	Description	Return value	Example
SelectSuite()	string clientID string device string suite bool isSelected	This method selects or deselects a given suite. Setting parameter is selected to True, you can select a suite. Setting parameter is selected to False, you can deselect a suite.	String that gives the status of the operation after it has been performed. The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <b>Select Suite (Default):</b> returnval=m_Client.SelectTest(clientID, "MHL Physical Layer Solution", "MHL Transmitter", True)

---

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

---

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**bool isSelected**

Name	Type	Direction	Description
isSelected	bool	IN	Selects or deselects a test

**Set pixel mode**

Command name	Parameters	Description	Return value	Example
SetGeneralParameter()	string clientID string device string suite string test string parameterString	This method sets the Pixel Mode for the given suite or measurement.	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Select Pixel Mode: returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, parameterstring); Set Pixel Mode to 24 Bits Example Set Pixel Mode to Packed Pixel Example

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

**Set Pixel Mode to 24 Bits Example**

```
returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, "Pixel Mode$24 Bits");
```

**Set Pixel Mode to Packed Pixel Example**

```
returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, "Pixel Mode$Packed Pixel");
```

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

**Set resolution**

Command name	Parameters	Description	Return value	Example
SetGeneralParameter()	string clientID string device string suite string test string parameterString	This method can be used to set the Low Resolution, High Resolution, or Number of Other Resolutions parameters for a given suite or measurement.	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Set Resolution: returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, parameterstring); Set Resolution to 24 Bits Pixel Mode Examples Set Resolution for Packed Pixel Mode Examples

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

**Set Resolution to 24 Bits Pixel Mode Examples**

```
returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, "24Bits Lowest Resolution (MHz)$25");
```

```
returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, "24Bits Highest Resolution (MHz)$74.25");
```

```
returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, "24Bits Number of Other Resolution (Count)$0");
```

**Set Resolution for Packed Pixel Mode Examples**

```
returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, "PackedPixel Lowest Resolution (MHz)$25");
```

```
returnval = m_Client.SetGeneralParameter(clientID, devicename, suitename, string.Empty, "PackedPixel Highest Resolution (MHz)$74.25");
```

```
returnval = m_Client.SetGeneralParameter(clientID, devicename, suiteName,
string.Empty, "PackedPixel Number of Other Resolution (Count)$0");
```

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

**Set data rate (CTS 3.2)**

Command name	Parameters	Description	Return value	Example
SetGeneralParameter()	string clientID string device string suite string test string parameterString	This method can be used to set the Low Resolution, High Resolution, or Number of Other Resolutions parameters for a given suite or measurement.	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Set Resolution: returnval = m_Client.SetGeneralParameter(clientId, devicename, suiteName, string.Empty, parameterstring); Set to Data Rate 6Gbps for MHL 3.0 Transmitter examples Set to Data Rate 6Gbps for MHL 3.0 Receiver examples

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

**Examples to select and deselect Data rate 6Gbps for MHL3.0 Transmitter suite**

```
returnval = m_Client.SetGeneralParameter(clientID, "MHL Physical Layer Solution", "MHL 3.0 Transmitter", string.Empty, "Data Rate 6 (Gbps)$True");
```

```
returnval = m_Client.SetGeneralParameter(clientID, "MHL Physical Layer Solution", "MHL 3.0 Transmitter", string.Empty, "Data Rate 6 (Gbps)$False");
```

**Examples to select Data Rate 6Gbps for MHL3.0 Receiver suite**

```
returnval = m_Client.SetGeneralParameter(clientID, "MHL Physical Layer Solution", "MHL 3.0 Receiver", string.Empty, "DataRate$6 Gbps");
```

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

**Set termination source method**

Command name	Parameters	Description	Return value	Example
SetGeneralParameter()	string clientID string device string suite string test string parameterString	This method sets the Type of Termination source to be used for a given suite or measurement.	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Set Termination Source Method:returnval = m_Client.SetGeneralParameter(clientId, devicename, suitename, string.Empty, parameterstring); Set Termination Source Method Examples

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

**Set Termination Source Method Examples**

```
returnval = m_Client.SetGeneralParameter(clientId, devicename, suitename, string.Empty, "Voltage termination$Internal");
```

```
returnval = m_Client.SetGeneralParameter(clientId, devicename, suitename, string.Empty, "Voltage termination$External Other");
```

```
returnval = m_Client.SetGeneralParameter(clientId, devicename, suitename, string.Empty, "Voltage termination$Tek Power Supply");
```

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**Set termination voltage**

Command name	Parameters	Description	Return value	Example
SetGeneralParameter()	string clientID string device string suite string test string parameterString	This method sets the VTerm (Min) and VTerm (Max) voltages for a given suite or measurement. The Limit is between 1V and 5V.	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL returnval as string Set Termination Voltage: returnval = m_Client.SetGeneralParameter(clientId, devicename, suiteName, string.Empty, parameterstring); Set Termination Voltage Examples

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

**Set Termination Voltage Examples**

```
returnval = m_Client.SetGeneralParameter(clientId, devicename, suiteName,
string.Empty, "VTerm1 (V)$3.1");
```

```
returnval = m_Client.SetGeneralParameter(clientId, devicename, suiteName,
string.Empty, "VTerm2 (V)$3.5");
```

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

**Set the Auto Calibration patterns**

Command name	Parameters	Description	Return value	Example
SetAnalyzeParameter()	string clientID string device string suite string test string parameterString	This method sets the Auto Calibration patterns and Tolerance (for 3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data)	String that displays the status of the operation after it has been performed. The return value is "" (an empty String) on success.	returnval = mClient.SetAnalyzeParameter(clientID, devicename, suitename, "Auto Calibration (for 3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data)", "Patterns to be Calibrated \$Nominal and Error") returnval as string returnval = mClient.SetAnalyzeParameter(clientID, devicename, suitename, "Auto Calibration (for 3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data)", "Jitter Tolerance\$5")

**Run with set configurations or stop the run operation**

Command name	Parameters	Description	Return value	Example
Run()	string clientID	Runs the selected tests. Note Once the server is set up and is configured, it can be run remotely using this function.	String that gives the status of the operation after it has been performed. The return value is "Run started..." on success.	m_Client = new Client() // m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Run(clientID)
Stop()	string clientID	Stops the currently running tests. Note	String that gives the status of the operation after it has been performed. The return value is "Stopped..." on success.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Stop(clientID)

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**NOTE.** When the run is performed, the status of the run is updated periodically using a timer.

**NOTE.** When the session is stopped, the client is prompted to stop the session and is stopped at the consent.

**Handle error codes**

The return value of the remote automations at the server-end is OP\_STATUS, which is changed to a string value depending on its code and returned to the client. The values of OP\_STATUS are as follows:

Value	Code	Description
FAIL	-1	The operation failed.
SUCCESS	1	The operation succeeded.
NOTFOUND	2	Server not found
LOCKED	3	The server is locked by another client, so the operation cannot be performed.
UNLOCK	4	The server is not locked. Lock the server before performing the operation.
NULL	0	Nothing

---

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

---

**Get or set the timeout value**

Command name	Parameters	Description	Return value	Example
GetTimeOut()	string clientID	Returns the current timeout period set by the client.	String that gives the status of the operation after it has been performed. The default return value is 1800000.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.GetTimeOut()
SetTimeOut()	string clientID string time	Sets a timeout period specified by client. After expiry of this timeout period, the server is automatically unlocked.	String that gives the status of the operation after it has been performed. On success the return value is "TimeOut Period Changed".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.SetTimeOut(clientID, desiredTimeOut)

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string time**

Name	Type	Direction	Description
time	string	IN	The time in seconds that refers to the timeout period

The time parameter gives the timeout period, which is the time the client is allowed to be locked and idle. After the timeout period, if the client is still idle, it gets unlocked.

The time parameter should be a positive integer. Else, the client is prompted to provide a valid timeout period.

**Wait for the test to complete**

The commands in this group are executed while tests are running. The GetCurrentStateInfo() and SendResponse() commands are executed when application is running and in wait state.

Command name	Parameters	Description	Return value	Example
ApplicationStatus()	string clientID	This method gets the status of the server application. The states at a given time are Ready, Running, Paused, Wait, or Error.	String value that gives the status of the server application.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.ApplicationStatus(clientID)
QueryStatus()	string clientID out string[] status	This is an interface for the user to transfer Analyze panel status messages from the server to the client.	String that gives the status of the operation after it has been performed. On success the return value is "Transferred...".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnVal=m_Client.QueryStatus(clientID, out statusMessages) if ((OP_STATUS)returnVal == OP_STATUS.SUCCESS) return "Status updated..." else return CommandFailed(returnVal)
GetCurrentStateInfo()  <i><b>NOTE.</b> This command is used when the application is running and is in the wait or error state.</i>	string clientID out string caption out string message out string[] buttonTexts	This method gets the additional information of the states when the application is in Wait or Error state. Except client ID, all the others are out parameters.	This command does not return any value. This function fills up the out parameters that are passed when invoking this function.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. m_Client.GetCurrentStateInfo(clientID, caption,message, buttonTexts)

Command name	Parameters	Description	Return value	Example
SendResponse()  <i><b>NOTE.</b> This command is used when the application is running and is in the wait or error state.</i>	string clientID out string caption out string message string response	After receiving the additional information using the method GetCurrentStateInfo(), the client can decide on the response to send and send the response to the application using this function. The response should be one of the strings that was earlier received as a string array in the GetCurrentStateInfo function. The _caption and _message should match the information received earlier in the GetCurrentStateInfo function.	This command does not return any value.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. m_Client.SendResponse(clientID, caption,message, response)

---

**NOTE.** *The Fail condition for PI commands occurs in any of the following cases:*

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

---

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**out string[] status**

Name	Type	Direction	Description
status	string array	OUT	The list of status messages generated during run

**out string caption**

Name	Type	Direction	Description
caption	string	OUT	The wait state or error state message sent to you

**out string message**

Name	Type	Direction	Description
message	string	OUT	The wait state/error state message to you

**out string[] buttonTexts**

Name	Type	Direction	Description
buttonTexts	string array	OUT	An array of strings containing the possible response types that you can send

**string response**

Name	Type	Direction	Description
response	string	IN	A string containing the response type that you can select (it must be one of the strings in the string array buttonTexts)

Ready: Test configured and ready to start

Running: Test running

Paused: Test paused

Wait: A popup that needs your inputs

Error: An error has occurred

**After the test is complete**

Command name	Parameters	Description	Return value	Example
GetPassFailStatus()	string clientID string device string suite string test	This method gets the pass or fail status of the measurement after test completion.  <i><b>NOTE.</b> Execute this command after completing the measurement.</i>	String that gives the status of the operation after it has been performed. Returns the pass or fail status in the form of a string.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.GetPassFailStatus(clientID, device, suite, "3.1.1.3 Single-ended Low Level Voltages-VSE_LOW") // Pass or Fail
GetResultsValue()	string clientID string device string suite string test string parameterString	This method gets the result values of the measurement after the run.	String that gives the status of the operation after it has been performed. Returns the result value in the form of a string.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.GetResultsValue(clientID, "MHL Physical Layer Solution", "MHL Transmitter", "3.1.1.3 Single-ended Low Level Voltages-VSE_LOW", "Measured Value")

Command name	Parameters	Description	Return value	Example
GetResultsValueForSubMeasurements()	string clientID string device string suite string test string parameterString int rowNr	This method gets the result values for individual sub-measurements, after the run.	String that gives the status of the operation after it has been performed. Returns the result value in the form of a string.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <b>Single-ended Low Level Voltages DP (nS)</b> returnval=m_Client.GetResultsValueForSubMeasurements(clientID, "MHL Physical Layer Solution", "MHL Transmitter", "3.1.1.3 Single-ended Low Level Voltages-VSE_LOW", "3.1.1.3 Single-ended Low Level Voltages-VSE_LOW ", "Measured Value", 0) //For DP wfm returnval=m_Client.GetResultsValueForSubMeasurements(clientID, "MHL Physical Layer Solution", "MHL Transmitter", "3.1.1.3 Single-ended Low Level Voltages-VSE_LOW", "Measured Value", 1) //For DN wfm

Command name	Parameters	Description	Return value	Example
GetReportParameter()	string clientID string device string suite string test string parameterString	This method gets the general report details such as oscilloscope model, TekExpress version, and MHL version.	The return value is the oscilloscope model, TekExpress version, and MHL version.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string <b>Oscilloscope Model</b> returnval=m_Client.GetReportParameter(clientID,"Scope Model") <b>TekExpress Version</b> returnval=m_Client.GetReportParameter(clientID,"TekExpress Version") <b>MHL Version</b> returnval=m_Client.GetReportParameter(clientID,"Application Version")
TransferReport()	string clientID string filePath	This method transfers the report generated after the run. The report contains the summary of the run. The client must provide the location where the report is to be saved at the client-end.	String that gives the status of the operation after it has been performed. Transfers all the result values in the form of a string.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.TransferReport(clientID,"C:\Report")

Command name	Parameters	Description	Return value	Example
TransferWaveforms()	string clientID string filePath	This method transfers all the waveforms from the folder for the current run.  <b>NOTE.</b> For each click of Run button, a folder is created in the X: drive. Transfer the waveforms before clicking the Run button.	String that gives the status of the operation after it has been performed. Transfers all the waveforms in the form of a string. On success the return value is "Transferred...".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.TransferWaveforms(clientID,"C:\Waveforms")
TransferImages()	string clientID string filePath	This method transfers all the images (screenshots) from the folder for the current run (for a given suite or measurement).  <b>NOTE.</b> For each click of Run button, a folder is created in the X: drive. Transfer the waveforms before clicking the Run button.	String that gives the status of the operation after it has been performed. Transfers all the images in the form of a string.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.TransferImages(clientID, "C:\Waveforms")

---

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

---

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**string device**

Name	Type	Direction	Description
device	string	IN	Specifies the name of the device

**string suite**

Name	Type	Direction	Description
suite	string	IN	Specifies the name of the suite

**string test**

Name	Type	Direction	Description
test	string	IN	Specifies the name of the test to obtain the pass or fail status

**string parameterString**

Name	Type	Direction	Description
parameterString	string	IN	Selects or deselects a test

**int rowNr**

Name	Type	Direction	Description
rowNr	int	IN	Specifies the zero based row index of the sub-measurement for obtaining the result value

**string filePath**

Name	Type	Direction	Description
filePath	string	IN	The location where the report must be saved in the client

---

**NOTE.** *If the client does not provide the location to save the report, the report is saved at C:\ProgramFiles.*

---

**Save recall or check if a session is saved**

Command name	Parameters	Description	Return value	Example
CheckSessionSaved()	string clientID out bool saved	This method is called when a check is to be made to know if the current session is saved.	Return value is either True or False.	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.CheckSessionSaved(m_clientID, out savedStatus)
RecallSession()	string clientID string name	Recalls a saved session. The name of the session is provided by the client.	String that gives the status of the operation after it has been performed. The return value is "Session Recalled...".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.RecallSession(clientID, savedSessionName)
SaveSession()	string clientID string name	Saves the current session. The name of the session is provided by the client.	String that gives the status of the operation after it has been performed. The return value is "Session Saved..."/"Failed...".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.SaveSession(clientID, desiredSessionName)
SaveSessionAs()	string clientID string name	Saves the current session in a different name every time this method is called. The name of the session is provided by the client.	String that gives the status of the operation after it has been performed. The return value is "Session Saved...".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.SaveSessionAs(clientID, desiredSessionName)

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**out bool saved**

Name	Type	Direction	Description
saved	bool	OUT	Boolean representing whether the current session is saved

This parameter is used as a check in SaveSession() and SaveSessionAs() functions.

**string name**

Name	Type	Direction	Description
name	string	IN	The name of the session being recalled

The name parameter cannot be empty. If it is empty, the client is prompted to provide a valid name.

**Unlock the server**

Command name	Parameters	Description	Return value	Example
UnlockSession()	string clientID	This method unlocks the server from the client. The ID of the client to be unlocked must be provided. Note	String that gives the status of the operation after it has been performed. The return value is "Session Un-Locked...".	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.UnlockServer(clientID)

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

The server is **LOCKED** and the message displayed is "Server is locked by another client".

The session is **UNLOCKED** and the message displayed is "Lock Session to execute the command".

The server is **NOTFOUND** and the message displayed is "Server not found...Disconnect!".

When none of these fail conditions occur, then the message displayed is "Failed...".

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**NOTE.** When the client is disconnected, the client is automatically unlocked.

**Disconnect from the server**

Command name	Parameters	Description	Return value	Example
Disconnect()	string clientID	This method disconnects the client from the server it is connected to. Note	Integer value that gives the status of the operation after it has been performed. 1 for Success -1 for Failure	m_Client = new Client() //m_Client is a reference to the Client class in the Client DLL. returnval as string returnval=m_Client.Disconnect(m_clientID)

**NOTE.** The Fail condition for PI commands occurs in any of the following cases:

*The server is LOCKED and the message displayed is "Server is locked by another client".*

*The session is UNLOCKED and the message displayed is "Lock Session to execute the command".*

*The server is NOTFOUND and the message displayed is "Server not found...Disconnect!".*

*When none of these fail conditions occur, then the message displayed is "Failed...".*

**out string clientID**

Name	Type	Direction	Description
clientID	string	OUT	Identifier of the client that is connected to the server clientID = unique number + ipaddress of the client. For example, 1065-192.157.98.70

**NOTE.** When the client is disconnected, the client is automatically unlocked.

---

# Algorithms

## About algorithms

For all measurements, use the following guidelines to set up the oscilloscope.

### Oscilloscope Setup Guidelines

The following guidelines are generalized.

- The signal is any channel, reference, or math waveform.
- The vertical scale for the waveform must be set so that the waveform does not exceed the vertical range of the oscilloscope.
- The sample rate must be set to capture sufficient waveform detail and avoid aliasing.
- Longer record lengths increase measurement accuracy but the oscilloscope takes longer to measure each waveform.

### Measurement Procedure

Signal validation is an automatic, default feature in MHL.

Before each measurement, the signal is validated.

## 3.1.1.1: Standby output voltage test - $V_{OFF}$

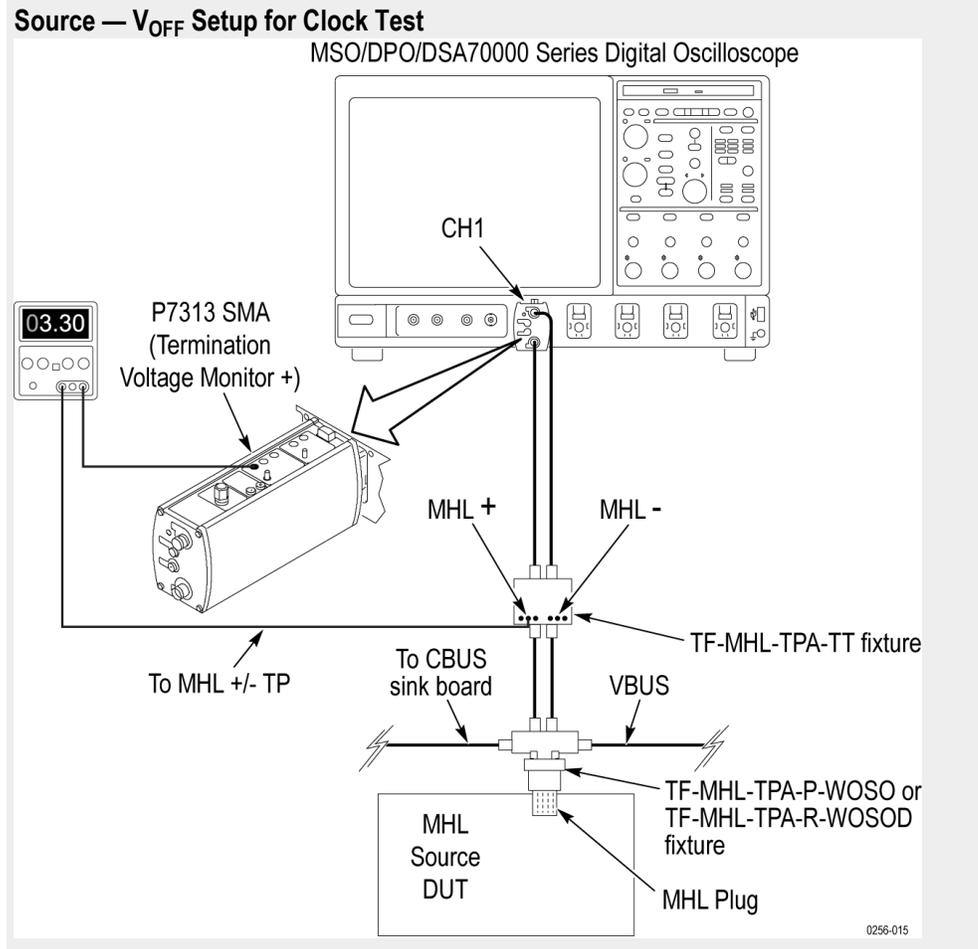
This MHL Transmitter test measures that the MHL source output voltage is within the specified level limits when the source device is in Standby State or power off mode as specified in the CDF.

### Required Test Equipment

In addition to the DUT, you will need the following:

- Digital Multimeter: DMM4020
- Digital Storage Oscilloscope: DPO/DSA/MSO 70000/B/C/D Series Real time Oscilloscope with BW greater than or equal to 8GHz with Opt DJA, Opt 2XL and Opt. MHD (MHL Advanced Analysis and Compliance Software)
- One Probe: P7313SMA
- Test Fixture: TF-MHL-TPA-P-WOSO\*TF-MHL-TPA-TT or TF-MHL-TPA-P-TTSSO
- Power supply: PWS4205 or PWS2185 (if using external Power Supply option)
- CBus Sink Board: Simplay Labs MHL Rx/Tx Analyzer SL-860 (Source DUT Port) or TF-MHL-CBS2-SOSI Tektronix board

Connect the equipment as shown in Source —  $V_{OFF}$  Setup for Clock Test.



Connect the CBUS Sink board to the CBUS and VBUS of the test fixture to enable device discovery and CBUS information exchange.

Set the DUT to operate in normal mode.

### Measurement Algorithm

Do the following test for all stand-by and power off modes specified in CDF of the DUT.

1. Connect the equipment as shown in Source — V<sub>OFF</sub> Setup for Clock Test and unplug the DUT from the Test Fixture. Connect the CBUS and VBUS from the Test Fixture to the Source DUT port of the SL-860 (Source DUT Port) or TF-MHL-CBS2-SOSI Tektronix board.
2. Turn on the DC Power Supply and provide power to VTERM\_IN if external Power Supply is used for VTERM, else the Tektronix Oscilloscope provides the VTERM supply internally through the probes.
3. Set  $V_{TERM} = V_{TERM}\{\min\} 3.135V$  using Oscilloscope probe control settings if internal power supply is used, else use the external power supply.
4. Measure and record the voltages (VBASELINE) between MHL+ and VTERM and between MHL- and VTERM.
5. Set  $V_{TERM} = V_{TERM}\{\min\} 3.465V$  using Oscilloscope probe control settings if internal power supply is used, else use the external power supply.

6. Measure and record the voltages (VBASELINE) between MHL+ and VTERM and between MHL- and VTERM.
7. Plug the DUT to the Test Fixture as shown in Source — VOFF Setup for Clock Test. Connect the CBus and VBus from the Test Fixture to the Source DUT port of the SL-860 (Source DUT Port) or TF-MHL-CBS2-SOSI Tektronix board.
8. Put the DUT in the power mode following the instruction in CDF. VBus provision should follow the instruction in CDF.
9. Set  $VTERM = VTERM\{\min\} 3.135V$ .
10. Measure the voltage (VOFF\_BEFORE\_COMPENSATION) between MHL+ and VTERM.
11. Measure the voltage (VOFF\_BEFORE\_COMPENSATION) between MHL- and VTERM.
12. Record VOFF values for MHL+ and MHL-;  $VOFF = VOFF\_BEFORE\_COMPENSATION - VBASELINE$ .
13. Set  $VTERM = VTERM\{\max\} 3.465V$  and repeat steps 10 – 12.
14. If all recorded VOFF values are within +/- 10mV (inclusive), PASS. Otherwise FAIL.



---

# MHL 3.0 transmitter output group: Data tests

## 3.7.2.1: Single-ended high level output voltage of differential TMDS data+/-: $V_{SE\_HIGH\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the single-ended high level voltage of the differential TMDS data output is within the specified limits.

### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform using real time oscilloscope with record length good enough to capture 1000 cycle of 5H-5L for the measurement. (If not, re-acquire it again till 1000 population is considered for the measurement.)
4. Locate the region between third High bit and fourth High bit of the high period and record the histogram mode value.
5. The Mode value is  $V_{SE\_HIGH\_DF\_TMDS\_DATA}$ .
6. If  $V_{TERM} - 1200mV \leq V_{SE\_HIGH\_DF\_TMDS\_DATA} \leq V_{TERM} + 20mV$  for recorded  $V_{SE\_HIGH\_DF\_TMDS\_DATA}$  values, PASS, otherwise FAIL.

### 3.7.2.2: Single-ended low level output voltage of differential TMDS data+/-: $V_{SE\_LOW\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the single-ended low level voltage of the differential TMDS data is within the specified limits.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform using real time oscilloscope with record length good enough to capture 1000 cycle of 5H-5L for the measurement. (If not, re-acquire it again till 1000 population is considered for the measurement.)
4. Locate the region between third high bit and fourth low bit of the low period and record the histogram mode value.
5. The Mode value is  $V_{SE\_LOW\_DF\_TMDS\_DATA}$ .
6. If  $V_{TERM} - 1500mV \leq V_{SE\_LOW\_DF\_TMDS\_DATA} \leq V_{TERM} - 380mV$  for recorded  $V_{SE\_LOW\_DF\_TMDS\_DATA}$  values, PASS, otherwise FAIL.

### 3.7.2.5: Differential output swing voltage of differential TMDS data: $V_{DF\_SWING\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the differential swing voltage of the differential TMDS data is within the specified limits.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Acquire the waveform using real time oscilloscope with record length good enough to capture 1000 cycle of 5H-5L for the measurement. (If not, re-acquire it again till 1000 population is considered for the measurement.)
3. Locate the region between fourth High bit and fifth low bit of the high period and record the histogram mode value.
4. The Mode value is  $V_{DF\_SWING\_DF\_TMDS\_DATA}$  is the difference between low period mode and high period mode performed in step 4.
5. If  $V_{TERM} \leq V_{DF\_SWING\_DF\_TMDS\_DATA} \leq 1000mV$  for recorded  $V_{DF\_SWING\_DF\_TMDS\_DATA}$  values, PASS, otherwise FAIL.

### 3.7.2.13: Rise time of differential TMDS data: $T_{R\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the rise time of differential TMDS data is within the specified limits.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for Differential TMDS data.
4. Measure the swing and derive 20% and 80% level.
5. Differential TMDS data waveform obtain 20% - 80% rise time of differential TMDS data ( $T_{F\_DF\_TMDS\_DATA}$ ).
6. If  $45ps \leq T_{F\_DF\_TMDS\_DATA}$ , then PASS else FAIL.

### 3.7.2.14: Fall time of differential TMDS data: $T_{F\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the fall time of differential TMDS data is within the specified limits.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

- Measurement algorithm**
1. Set the  $V_{\text{TERM}} = 3.3\text{V}$ .
  2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
  3. Acquire the waveform for Differential TMDS data.
  4. Measure the swing and derive 20% and 80% level.
  5. Differential TMDS data waveform obtain 20% - 80% fall time of differential TMDS data ( $T_{\text{F\_DF\_TMDS\_DATA}}$ ).
  6. If  $45\text{ps} \leq T_{\text{F\_DF\_TMDS\_DATA}}$ , then PASS else FAIL.

### 3.7.2.17: Peak-to-peak amplitude of differential TMDS data: $T_{\text{PP\_TP1\_DF\_TMDS\_DATA}}$ (CTS 3.3)

This test confirms that the peak-to-peak amplitude of differential TMDS data is within the specified limits.

- Required test equipment**
- In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:
- Two or three probes: P7313SMA
  - Test fixture: TF-MHL-TPA-SOS-MUSB
  - Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
  - TCA-SMA adapter (Not required if third probe used is P7313SMA)
  - CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

- Measurement algorithm**
1. Set the  $V_{\text{TERM}} = 3.3\text{V}$ .
  2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
  3. Acquire the waveform for differential TMDS data. Ensure that waveform is acquired for at least 500 microsecond.
  4. Calculate the peak to peak voltage. If peak-to-peak voltage  $\leq 1560\text{ mV}$ , then PASS else FAIL.

### 3.7.2.27: Differential TMDS data eye diagram at TP2 (CTS 3.3)

This test confirms that the differential TMDS data eye diagram is within the specified limits.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{\text{TERM}} = 3.3\text{V}$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire capture concurrent differential TMDS data waveform and MHL clock waveform of 500 microseconds long.
4. Pass the clock waveform through the filters as described in previous section. Pass the TMDS data waveform through filter as shown in the block diagram below based on the data rate.
5. Open **Analyze > Jitter and Eye > Select TIE measurement in Jitter tab**.
6. Change measurement source appropriately.
7. Follow the following configurations for measuring the Single-Ended MHL Clock Jitter
  - a. Edges => Signal Type: Clock, Clock Edge: Rise
  - b. Clock Recovery => Method: Explicit Clock – PLL, Clock Edge: Rise, Clock Multiplier: 80, PLL Model: Type I, Damping: 700m, Loop BW: 1MHz.
  - c. Load the appropriate mask file.
8. Click Run button and check the number of mask hits .Perform the test for all data rates.
9. Mask Hits =0, then PASS; else FAIL.

---

## MHL 3.0 transmitter output group: Clock tests

### 3.7.2.7: Single-ended high level output voltage of single-ended MHL clock data: $V_{SE\_HIGH\_SE\_MHL\_CLK}$ (CTS 3.3)

This test confirms that the single-ended high level voltages of the single-ended MHL clock are within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for single ended MHL clock and eCBUS-S forward data.
4. Measure the mean value ( $V_{SE\_HIGH\_SE\_MHL\_CLK}$ ) of the voltage histogram for middle one  $T_{BIT\_SE\_eCBUS\_FWD}$  period of single-ended MHL clock back porch period.
5. If  $220mV \leq V_{SE\_HIGH\_SE\_MHL\_CLK} \leq 430mV$  AND  $220mV \leq V_{SE\_HIGH\_SE\_eCBUS\_FWD} \leq 430mV$ , then PASS else FAIL.

### 3.7.2.8: Single-ended low level output voltage of single-ended MHL clock data: $V_{SE\_LOW\_SE\_MHL\_CLK}$ (CTS 3.3)

This test confirms that the single-ended low level voltages of the single-ended MHL clock data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS4305 or PWS4323 or PWS4602 or PWS4721 power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for single ended MHL clock and eCBUS-S forward data.
4. Measure the mean value ( $V_{SE\_LOW\_SE\_MHL\_CLK}$ ) of the voltage histogram for middle one  $T_{BIT\_SE\_eCBUS\_FWD}$  period of single-ended MHL clock front porch period.
5. If  $-30mV \leq V_{SE\_LOW\_SE\_MHL\_CLK} \leq 30mV$  AND  $-30mV \leq V_{SE\_LOW\_SE\_eCBUS\_FWD} \leq 30mV$ , then PASS else FAIL.

### 3.7.2.9: Single-ended output swing voltage of single-ended MHL clock data: $V_{SE\_SWING\_SE\_MHL\_CLK}$ (CTS 3.3)

This test confirms that the single-ended output swing voltages of the single-ended MHL clock data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Obtain  $V_{SE\_SWING\_SE\_MHL\_CLK}$  by subtracting  $V_{SE\_LOW\_SE\_MHL\_CLK}$  from  $V_{SE\_HIGH\_SE\_MHL\_CLK}$ .
2. Obtain  $V_{SE\_SWING\_SE\_eCBUS\_FWD}$  by subtracting  $V_{SE\_LOW\_SE\_eCBUS\_FWD}$  from  $V_{SE\_HIGH\_SE\_eCBUS\_FWD}$ .
3. If  $250\text{mV} \leq V_{SE\_SWING\_SE\_MHL\_CLK} \leq 400\text{mV}$  AND  $250\text{mV} \leq V_{SE\_SWING\_SE\_eCBUS\_FWD} \leq 400\text{mV}$ , then PASS else FAIL.

### 3.7.2.20: Single-ended MHL clock frequency: $F_{SE\_MHL\_CLK}$ (CTS 3.3)

This test confirms that the single-ended MHL clock frequency is within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

- Measurement algorithm**
1. Set the  $V_{\text{TERM}} = 3.3\text{V}$ .
  2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink Board or the direct device access.
  3. Acquire the waveform for MHL Clock for over 500 microseconds. Use math operator to pass the waveform through 1 Ghz low pass filter.
  4. Measure the frequency of the signal for each complete cycle in the acquired waveform.
  5. Derive the mean value of frequency as the single-ended MHL clock frequency ( $F_{\text{SE\_MHL\_CLK}}$ ).
  6. If  $74.9625\text{ MHz} \leq F_{\text{SE\_MHL\_CLK}} \leq 75.0375\text{ MHz}$ , then PASS else FAIL.

### 3.7.2.21: Single-ended MHL clock front porch: $T_{\text{CFP\_SE\_MHL\_CLK}}$ (CTS 3.3)

This test confirms that the single-ended MHL clock front porch time is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- Required test equipment**
- In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:
- Two or three probes: P7313SMA
  - Test fixture: TF-MHL-TPA-SOS-MUSB
  - Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
  - TCA-SMA adapter (Not required if third probe used is P7313SMA)
  - CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

- Measurement algorithm**
1. Set the  $V_{\text{TERM}} = 3.3\text{V}$ .
  2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
  3. Acquire the waveform for MHL clock for over 500 microseconds.
  4. From the single-ended MHL clock and eCBUS-S forward data waveform, obtain single-ended MHL clock front porch time ( $T_{\text{CFP\_SE\_MHL\_CLK}}$ ) by measuring the time between the falling edge of '1' bit of eCBUS-S forward data and the subsequent rising edge of single-ended MHL clock for all the 1 bit of eCBUS-S forward and calculate the mean time.
  5. If  $5000\text{ ps} \leq T_{\text{CFP\_SE\_MHL\_CLK}} \leq 5666.67\text{ ps}$ , then PASS else FAIL.

### 3.7.2.22: Single-ended MHL clock back porth: $T_{CBP\_SE\_MHL\_CLK}$ (CTS 3.3)

This test confirms that the single-ended MHL clock back porch time is within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for MHL clock for over 500 microseconds.
4. From the single-ended MHL clock and eCBUS-S forward data waveform, obtain single-ended MHL clock back porch time ( $T_{CBP\_SE\_MHL\_CLK}$ ) by measuring the time between the falling edge of '0' bit of eCBUS-S forward data and the subsequent rising edge of single-ended MHL clock for all the 0 bit of eCBUS-S forward and calculate the mean time.
5. If  $5000\text{ ps} \leq T_{CBP\_SE\_MHL\_CLK} \leq 5666.67\text{ ps}$ , then PASS else FAIL.

### 3.7.2.23: Rise time of single-ended MHL clock: $T_{TR\_SE\_MHL\_CLK}$ (CTS 3.3)

This test confirms that the rise time of single-ended MHL clock is within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire clock for over 500 microsecond.
4. Setup rise time between 20% to 80% and calculate rise time.
5. If  $500\text{ ps} \leq T_{R\_SE\_MHL\_CLK} \leq 1000\text{ ps}$ , then PASS else FAIL.

### 3.7.2.26: Single-ended MHL clock jitter at TP2: $T_{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}$ (CTS 3.3)

This test confirms that single-ended MHL clock jitter at TP2 is within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

**Measurement algorithm**

1. Set the  $V_{\text{TERM}} = 3.3\text{V}$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for MHL clock for over 500 microseconds.
4. Pass the acquired waveform through the following filters:
  - a. Apply the MHL3 cable emulator to the single-ended MHL clock waveform.
  - b. Apply the low pass filter after the MHL3 cable emulator.
  - c. Apply MHL 2.1 reference cable equalizer after the low pass filter.
  - d. Apply MHL clock recovery unit after MHL 2.1 reference cable equalizer.
  - e. Measure the single-ended MHL clock jitter ( $T_{\text{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}}$ ) using the recovered clock in step 4.d.
5. If  $T_{\text{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}} \leq 150$  ps, then PASS else FAIL



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## MHL 3.0 transmitter output group: eCBUS tests

### 3.7.2.7: Single-ended high level output voltage of single-ended eCBUS-S forward data: $V_{SE\_HIGH\_SE\_eCBUS\_FWD}$ (CTS 3.3)

This test confirms that the single-ended high level voltages of the single-ended eCBUS-S forward data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement Algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for single ended MHL clock and eCBUS-S forward data.
4. Measure the mean value ( $V_{SE\_HIGH\_SE\_eCBUS\_FWD}$ ) of the voltage histogram for middle half  $T_{BIT\_SE\_eCBUS\_FWD}$  period of the high eCBUS-S forward data bits.
5. If  $220mV \leq V_{SE\_HIGH\_SE\_MHL\_CLK} \leq 430mV$  AND  $220mV \leq V_{SE\_HIGH\_SE\_eCBUS\_FWD} \leq 430mV$ , then PASS else FAIL.

### 3.7.2.8: Single-ended low level output voltage of single-ended eCBUS-S forward data: $V_{SE\_LOW\_SE\_eCBUS\_FWD}$ (CTS 3.3)

This test confirms that the single-ended low level voltages of the single-ended eCBUS-S forward data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement Algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for single ended MHL clock and eCBUS-S forward data.
4. Measure the mean value ( $V_{SE\_LOW\_SE\_eCBUS\_FWD}$ ) of the voltage histogram for middle half  $T_{BIT\_SE\_eCBUS\_FWD}$  period of the low eCBUS-S forward data bits.
5. If  $-30mV \leq V_{SE\_LOW\_SE\_MHL\_CLK} \leq 30mV$  AND  $-30mV \leq V_{SE\_LOW\_SE\_eCBUS\_FWD} \leq 30mV$ , then PASS else FAIL.

### 3.7.2.9: Single-ended output swing voltage of single-ended eCBUS-S forward data: $V_{SE\_SWING\_SE\_eCBUS\_FWD}$ (CTS 3.3)

This test confirms that the single-ended output swing voltages of the single-ended eCBUS-S forward data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for differential TMDS data.
4. Measure the swing and derive 20% and 80% level.
5. Differential TMDS data waveform, obtain 20% - 80% rise time of differential TMDS data ( $T_{F\_DF\_TMDS\_DATA}$ ).
6. If  $45\text{ ps} \leq T_{R\_DF\_TMDS\_DATA}$ , then PASS else FAIL.

### 3.7.2.24: Fall time of single-ended eCBUS-S forward data: $T_{F\_SE\_eCBUS\_FWD}$ (CTS 3.3)

This test confirms that the fall times of single-ended eCBUS-S forward data are within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement Algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for MHL clock for over 500 microseconds.
4. Calculate fall time between 20% to 80%.
5.  $T_{F\_SE\_eCBUS\_FWD}$  is same as  $T_{F\_SE\_MHL\_CLK}$ .
6. If  $500\text{ ps} \leq T_{F\_SE\_MHL\_CLK} \leq 1000\text{ ps}$ , then PASS else FAIL.

### 3.7.2.25: Peak-to-peak amplitude of eCBUS-S forward data: $V_{PP\_TP1\_SE\_eCBUS\_FWD}$ (CTS 3.3)

This test confirms that the peak-to-peak Amplitude of eCBUS-S forward data is within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement Algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Set the Digital Oscilloscope horizontal setting: sampling rate  $\geq 50Gsa/sec$  and approximately 10 bits displayed on the screen.
4. Measure the peak-to-peak amplitude of eCBUS-S forward Data ( $V_{PP\_TP1\_SE\_eCBUS\_FWD}$ ).
5. If  $V_{PP\_TP1\_SE\_eCBUS\_FWD} \leq 550 mV$ , then PASS else FAIL.

### 3.7.2.29: eCBUS-S forward data eye diagram at TP2 (CTS 3.3)

This test confirms that the clock jitter of the TMDS differential clock complies with the limits mentioned in specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 1](#).

#### Measurement Algorithm

1. Set the  $V_{TERM} = 3.3V$ .
2. Turn on the DUT and enable MHL output signal through Device Discovery and CBUS Information Exchange with the CBUS Sink board or the direct device access.
3. Acquire the waveform for MHL clock for over 500 microseconds.
4. Pass the acquired waveform through the following filters:
  - a. Apply the MHL3 cable emulator to the single-ended MHL clock waveform.
  - b. Apply the low pass filter defined MHL 3.2 specification after the MHL3 cable emulator.
  - c. Apply MHL 2.1 reference cable equalizer after the low pass filter.
  - d. Apply MHL clock recovery unit after MHL 2.1 reference cable equalizer .
  - e. Measure the single-ended MHL clock jitter ( $T_{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}$ ) using the recovered clock in step 4.d.
5. If Mask Hits=0 then PASS else FAIL.

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## MHL 3.0 transmitter input group: eCBUS tests

### 3.7.2.32: Input DC voltage tolerance of eCBUS-S backward data:

#### $V_{IDC\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the source DUT tolerates the input DC voltage levels of eCBUS-S backward data specified in the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- MHL Signal generator: AWG7122C/AWG70002A for eCBUS source
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Rise time filter: 1 Picosecond Pulse labs 120PS

Connect the equipment as shown in [Connection diagram 2](#).

#### Measurement algorithm

1. Set the DUT in mode where Transmitter can count frame error when PRBS is used as backward data.
2. Transmit backward data from AWG for min voltage, max voltage.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

### 3.7.2.36: Jitter tolerance of eCBUS-S backward data (CTS 3.3)

This test confirms that the source DUT tolerates the maximum jitter of input eCBUS-S backward data specified in the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- MHL Signal generator: AWG7122C / AWG70002A for eCBUS source
- Bias Tee-Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Rise time filter: 1 Picosecond Pulse labs 120PS

Connect the equipment as shown in [Connection diagram 2](#).

#### Measurement algorithm

1. Set the DUT in mode where Transmitter can count frame error when PRBS is used as backward data.
2. Transmit backward data from AWG for 500kHz and 1 MHz jitter.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

### 3.7.2.40 Duty Cycle Tolerance of Single-Ended MHLClock - Source

This test confirms that the Source DUT tolerates duty cycle variation of the input Single-Ended MHL Clock during the eCBUS-S Start-Up sequence specified in the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOS-MUSB
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option)
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board

- MHL Signal generator: AWG7122C/AWG70002A for eCBUS source
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Rise time filter: 1 Picosecond Pulse labs 120PS

Connect the equipment as shown in [Connection diagram 2](#).

#### Measurement algorithm

1. Set the DUT in mode where Transmitter can count frame error when PRBS is used as backward data.
2. Transmit backward data from AWG for min duty cycle, max duty cycle.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

### Auto Calibration (for 3.7.2.36 Jitter Tolerance of eCBUS-S BWD Data)

This test auto calibrates Nominal Jitter and Error patterns for 500kHz and 1MHz from AWG for eCBUS-S BWD data until a marginally pass eCBUS-S BWD data eye is obtained.

The Auto Calibration module (Auto Cal) input pattern starts with the eCBUS BWD which is supplied to AWG installer package.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Probes: P7313SMA (two or three)
- Test fixture: TF-MHL-TPA-SOS-MUSB (two), TF-MHL-TPA-R-WOC
- Power supply: Tek Power Supply
- Adapter: TCA-SMA
- CBUS: CBUS Sink adapter board
- MHL Signal generator: AWG7122C/AWG70002A for eCBUS source
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Rise time filter: 1 Picosecond Pulse labs 120PS

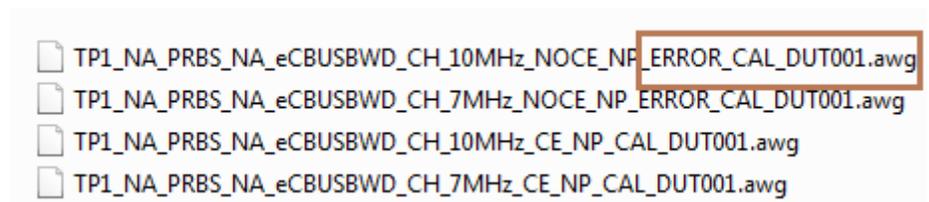
Connect the equipment as shown in [Connection diagram 3](#).

**Auto Calibration steps:**

1. The Auto Cal module loads Nominal Jitter and Error patterns based on the 'Pattern Type' selected.
2. The Auto Cal module will read and adjust the Input bit streams.
3. First the swing value adjustment is done, then the 'Periodic Jitter' of 500 KHz and 1 MHz is adjusted to the 'Swing' value.
4. The generated bit streams with adjusted 'Swing' and 'Jitter' value is loaded into the AWG memory.
5. The Auto Cal module validate the 'Marginal EYE' using Period, TIE and Eye diagram measurements of DPOJET.
6. Checks if any further adjustments is needed for 'Swing' and 'Jitter', if not saves the patterns with suffix as 'Calibrated' in the AWG path where patterns is installed. The default path is C:\MHL Patterns\MHL\_3.2\.
7. The calibrated AWG patterns is picked up by the TE to perform 3.7.2.36 measurement testing. User has to change the connections as per [Connection diagram 3](#).

**Calibrated AWG Pattern files**

The below image shows an example of \_CAL\_DUTID added to the ERROR pattern of 500 KHz jitter component.



When you select only 3.2.7.36 measurement, then the application will search for the available patterns with suffix '\_CAL\_DUTID' in the AWG location . If patterns are not available, "Patterns are not calibrated for the given DUT, Press OK to use the Factory calibrated pattern or Press cancel to abort the test." error message is displayed

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## MHL 3.0 receiver output group: Sink tests

### 4.7.2.14: Single-ended high level output voltage of eCBUS-S backward data: $V_{SE\_HIGH\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the single-ended high level voltage of eCBUS-S backward data output is within the specified limits.. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

#### Measurement algorithm

1. Capture the backward waveform by subtracting forward waveform from forward+backward waveform.
2. Measure the mean value ( $V_{SE\_HIGH\_SE\_eCBUS\_BWD}$ ) of the voltage histogram for middle portion of eCBUS-S data high period.
3. If  $220\text{ mV} \leq V_{SE\_HIGH\_SE\_eCBUS\_BWD} \leq 400\text{ mV}$ , then PASS else FAIL.

## 4.7.2.15: Single-ended low level output voltage of eCBUS-S backward data: $V_{SE\_LOW\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the single-ended low level voltage of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

### Measurement algorithm

1. Capture the backward waveform by subtracting forward waveform from forward+backward waveform.
2. Measure the mean value ( $V_{SE\_LOW\_SE\_eCBUS\_BWD}$ ) of the voltage histogram for middle portion of eCBUS-S data low period.
3. If  $-30 \text{ mV} \leq V_{SE\_LOW\_SE\_eCBUS\_BWD} \leq 30 \text{ mV}$ , then PASS else FAIL.

### 4.7.2.16: Single-ended output swing voltage of eCBUS-S backward data: $V_{SE\_SWING\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the single-ended output swing voltage of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

#### Measurement algorithm

1. Obtain  $V_{SE\_SWING\_SE\_eCBUS\_BWD}$  by subtracting  $V_{SE\_LOW\_SE\_eCBUS\_BWD}$  from  $V_{SE\_HIGH\_SE\_eCBUS\_BWD}$ .
2. If  $250\text{mV} \leq V_{SE\_SWING\_SE\_eCBUS\_BWD} \leq 400\text{mV}$ , then PASS else FAIL.

#### 4.7.2.20: Rise time of eCBUS-S backward data: $T_{R\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the rise time of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

##### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

##### Measurement algorithm

1. Capture the backward waveform by subtracting forward waveform from forward+backward waveform.
2. From the BWD\_ONLY\_WFM data waveform, obtain 20% - 80% rise time of eCBUS-S backward data ( $T_{R\_SE\_eCBUS\_BWD}$ ).
3. If  $500 \text{ ps} \leq T_{R\_SE\_eCBUS\_BWD} \leq 1000 \text{ ps}$ , then PASS else FAIL.

#### 4.7.2.21: Fall time of eCBUS-S backward data: $T_{F\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the fall time of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

##### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS

- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

#### Measurement algorithm

1. Capture the backward waveform by subtracting forward waveform from forward+backward waveform.
2. From the BWD\_ONLY\_WFM data waveform, obtain 20% - 80% fall time of eCBUS-S backward data ( $T_{F\_SE\_eCBUS\_BWD}$ ).
3. If  $500 \text{ ps} \leq T_{F\_SE\_eCBUS\_BWD} \leq 1000 \text{ ps}$ , then PASS else FAIL.

### 4.7.2.22: Peak-to-peak amplitude of eCBUS-S backward data:

#### $V_{PP\_TP2\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the peak-to-peak amplitude of eCBUS-S backward data output is within the specified limits.. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

- Measurement algorithm**
1. Capture the backward waveform by subtracting forward waveform from forward+backward waveform.
  2. From the BWD\_ONLY\_WFM data waveform of 500 microseconds long, measure the peak-to-peak amplitude of eCBUS-S backward data ( $V_{PP\_TP2\_SE\_eCBUS\_BWD}$ ).
  3. If  $V_{PP\_TP2\_SE\_eCBUS\_BWD} \leq 550\text{mV}$ , then PASS else FAIL.

#### 4.7.2.24: eCBUS-S backward data eye diagram at TP1 (CTS 3.3)

This test confirms that the eCBUS-S backward data eye diagram at TP1 is within the specified limits. This test is applied only to the DUT with eCBUS-S.

- Required test equipment**
- In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:
- Two or three probes: P7313SMA
  - Test fixture: TF-MHL-TPA-SOSIS-HDM
  - Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
  - TCA-SMA adapter (Not required if third probe used is P7313SMA)
  - CBUS: CBUS Sink adapter board
  - Rise time Filter: 1 Picosecond Pulse labs 120PS
  - Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
  - Any of the two combination of AWG7122C/AWG7002A
- Connect the equipment as shown in [Connection diagram 4](#).

- Measurement algorithm**
1. Capture the backward waveform by subtracting forward waveform from forward+backward waveform.
  2. From the BWD\_ONLY\_WFM data waveform, measure the eye diagram.
    - a. Capture eCBUS-S backward data waveform of 500 microseconds long.
    - b. Apply the worst case cable emulator to the eCBUS-S backward data waveform.
    - c. Apply the low pass filter after the worst case cable emulator.
    - d. Measure the eye diagram using the MHL clock from the MHL3 signal generator using forward clock bar waveform. Process the clock as described in  $T_{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}$ .
  3. Perform the eye diagrams, If no mask hit then PASS else FAIL.

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## MHL 3.0 receiver output group: Dongle tests

### 5.7.2.16: Output DC Voltage of eCBUS-S BWD Data: $V_{ODC\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the DC voltage level of eCBUS-S backward data output signal is within the specified limits. This test is applied only to the DUT with eCBUS-D.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

#### Measurement algorithm

1. Capture the backward waveform by subtracting forward waveform from forward+backward waveform.
2. Measure the mean value of the voltage histogram for middle portion of backward data high period.
3. Measure the mean value of the voltage histogram for middle portion of backward data low period.
4. Obtain  $V_{ODC\_SE\_eCBUS\_BWD}$  by subtracting low voltage calculated in step 3 from high voltage.

### 5.7.2.17: Single-ended output swing voltage of eCBUS-S backward data: $V_{SE\_SWING\_SE\_eCBUS\_BWD}$ (CTS 3.3)

This test confirms that the single-ended output swing voltage of eCBUS-S backward data output is within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

#### Measurement algorithm

1. Obtain  $V_{SE\_SWING\_SE\_eCBUS\_BWD}$  by subtracting  $V_{SE\_LOW\_SE\_eCBUS\_BWD}$  from  $V_{SE\_HIGH\_SE\_eCBUS\_BWD}$  obtained in sections 4.7.2.14 and 4.7.2.15.
2. If  $250\text{mV} \leq V_{SE\_SWING\_SE\_eCBUS\_BWD} \leq 400\text{mV}$ , then PASS else FAIL.

### 5.7.2.19: eCBUS-S backward data eye diagram at TP3 (CTS 3.3)

This test confirms that the eCBUS-S backward data eye diagram at TP3 is within the specified limits. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 4](#).

#### Measurement algorithm

1. Capture the backward waveform by subtracting forward waveform from forward+backward waveform.
2. From the BWD\_ONLY\_WFM data waveform, measure the eye diagram.
  - a. Capture eCBUS-S backward data waveform of 500 microseconds long.
  - b. Apply the worst case cable emulator to the eCBUS-S backward data waveform.
  - c. Apply the low pass filter defined MHL 3.2 specification after the worst case cable emulator.
  - d. Measure the eye diagram using the MHL clock from the MHL3 signal generator using forward clock bar waveform. Process the clock as described in  $T_{\text{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}}$ .
3. Perform the eye diagrams, If no mask hit then PASS else FAIL.



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# MHL 3.0 receiver input group: Sink tests

## 4.7.2.1: Input DC voltage tolerance of differential TMDS data:

### $V_{IDC\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the sink device supports the DC voltage level of the differential TMDS input signal allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit TMDS Data from AWG for Min voltage, Max Voltage.
3. Check the eCBUS RX BIST Error Count.
4. If the Error Count is zero then PASS; else FAIL.

### 4.7.2.3: Differential input swing voltage tolerance of differential TMDS data: $V_{IDF\_SWING\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the sink device supports the differential swing voltage of the differential TMDS data input signal allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit TMDS data from AWG for min TMDS, max TMDS voltage.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero in step 3, then PASS else FAIL.

### 4.7.2.5: Input DC voltage tolerance of single-ended MHL clock and eCBUS-S forward data: $V_{IDC\_SE\_MHL\_CLK}$ , $V_{IDC\_SE\_eCBUS\_FWD}$ (CTS 3.3)

This test confirms that the sink device tolerates the single-ended MHL clock and eCBUS-S forward data input signals allowed by the specification. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit single ended eCBUS clock from AWG for min , max voltage.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero in step 3, then PASS else FAIL.

### 4.7.2.7: Differential intra-pair skew tolerance of differential TMDS data: $T_{\text{SKEW\_TP2\_DF\_TMDS\_DATA}}$ (CTS 3.3)

This test confirms that the sink device tolerates the differential intra-pair skew of the differential TMDS data input signal allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit TMDS data from AWG for positive skew and negative skew.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

### 4.7.2.10: Jitter tolerance of single-ended MHL clock: $T_{\text{CLOCK\_JITTER\_TP2\_SE\_MHL\_CLK}}$ (CTS 3.3)

This test confirms that the sink device tolerates the single-ended MHL clock jitter. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit TMDS clock data from AWG for required jitter values.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

## 4.7.2.28 Duty Cycle Tolerance of Single-Ended MHLClock - Sink

This test confirms that the Sink DUT tolerates duty cycle variation of the input Single-Ended MHL Clock during the eCBUS-S Start-Up sequence specified in the specification.

### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit single ended eCBUS clock from AWG for min duty cycle, max duty cycle.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero in step 3, then PASS else FAIL.

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## MHL 3.0 receiver input group: Dongle tests

### 5.7.2.1: Single-ended high level input voltage tolerance of differential TMDS data:

#### $V_{SE\_HIGH\_DF\_TMDS\_DATA}$

This test confirms that the dongle device supports the single-ended high level voltage of the differential TMDS data input signal allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit TMDS data from AWG for max TMDS voltage.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero, then PASS else FAIL.

### 5.7.2.2: Single-ended low level input voltage tolerance of differential TMDS data: $V_{SE\_LOW\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the dongle device supports the single-ended low level voltage of the differential TMDS data input signal allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit TMDS data from AWG for min TMDS voltage.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero, then PASS else FAIL.

### 5.7.2.5: Differential input swing voltage tolerance of differential TMDS data: $V_{IDF\_SWING\_DF\_TMDS\_DATA}$ (CTS 3.3)

This test confirms that the dongle device supports the differential swing voltage of the differential TMDS data input signal allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit single ended eCBUS clock from AWG for min , max voltage.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero in steps 3, then PASS else FAIL.

### 5.7.2.7: Single-ended high level input voltage tolerance of single-ended MHL clock and eCBUS-S forward data: $V_{SE\_HIGH\_SE\_MHL\_CLK}$ , $V_{SE\_HIGH\_SE\_eCBUS\_FWD}$ (CTS 3.3)

This test confirms that the dongle device supports the single-ended high level voltage of the single-ended MHL clock and eCBUS-S forward data input signals allowed by the specification. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit single ended eCBUS clock from AWG max voltage.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

### 5.7.2.8: Single-ended low level input voltage tolerance of single-ended MHL clock and eCBUS-S forward data: $V_{SE\_LOW\_SE\_MHL\_CLK}$ , $V_{SE\_LOW\_SE\_eCBUS\_FWD}$ (CTS 3.3)

This test confirms that the dongle device supports the single-ended low level voltage of the single-ended MHL clock and eCBUS-S forward data input signals allowed by the specification. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit single ended eCBUS clock from AWG for min voltage.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

### 5.7.2.10: Differential intra-pair skew tolerance of differential TMDS data: $T_{\text{SKEW\_TP3\_DF\_TMDS\_DATA}}$ (CTS 3.3)

This test confirms that the dongle device tolerates the differential intra-pair skew of the differential TMDS data input signal allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit TMDS,clock data from AWG for required jitter values.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

### 5.7.2.13: Jitter tolerance of single-ended MHL clock (CTS 3.3)

This test confirms that the dongle device tolerates the single-ended MHL clock jitter and eCBUS-S forward data eye diagram impairments and differential TMDS data eye diagram impairments allowed by the specification. This test is applied only to the DUT with eCBUS-S.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit TMDS clock data from AWG for required jitter values.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

### 5.7.2.23 Duty Cycle Tolerance of Single-Ended MHL Clock - Dongle

This test confirms that the Dongle device tolerates duty cycle variation of the input Single-Ended MHL Clock during the eCBUS-S Start-Up sequence specified in the specification .

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two or three probes: P7313SMA
- Test fixture: TF-MHL-TPA-SOSIS-HDM
- Power supply: PWS4205 or PWS2185 or 2220-30-1/2220J-30-1 Dual power supply if using external power supply option
- TCA-SMA adapter (Not required if third probe used is P7313SMA)
- CBUS: CBUS Sink adapter board
- Rise time Filter: 1 Picosecond Pulse labs 120PS
- Bias Tee -Model 5541A (not required in case of AWG7122C used as MHL Signal Generator)
- Any of the two combination of AWG7122C/AWG7002A

Connect the equipment as shown in [Connection diagram 5](#).

#### Measurement algorithm

1. Set the DUT in mode such as PRBS can be provided as TMDS data with Forward clock also containing PRBS data.
2. Transmit single ended eCBUS clock from AWG min duty cycle and max duty cycle.
3. Check the eCBUS RX BIST error count.
4. If the error count is zero then PASS else FAIL.

---

# MHL transmitter group 1: Clock tests

## 3.1.1.5: Common-mode output swing voltage test - $V_{CMSWING}$

This MHL Transmitter test confirms that common-mode output voltage swing amplitude is within the specified limits when the DUT operates in normal mode.

### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P313SMA and one P7240
- Test Fixture: TPA-P Source with a micro USB, pluggable to be used for Source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in [Connection diagram 1 \(Transmitter\)](#).

### Measurement Algorithm

TekExpress MHL automatically executes the calculations described below.

1. Acquire the waveform.
2. Consider the data point in the region of 3 unit intervals from the Rise transition for  $V_{High}$  and Fall transition for  $V_{Low}$ .
3. Average the respective  $V_{High}$  and  $V_{Low}$  for 10,000 regions and get  $V_{High}$  and  $V_{Low}$  measurements.
4. Calculate  $V_{CMSWING}$  for the given  $V_{TERM}$ ,

Where:

- $V_{TERM} = 3.135 \text{ V}$  (lowest)
- $V_{TERM} = 3.465 \text{ V}$  (highest)

If  $360 \text{ mV} \leq V_{CMSWING} \leq \text{Minimum (720 mV, } 0.85 V_{DFSWING})$  for all recorded  $V_{CMSWING}$  values, then PASS. Otherwise, FAIL.

### 3.1.1.7: Common-mode rise and fall times test - $T_{R\_CM}, T_{F\_CM}$

This MHL Transmitter test confirms that the rise time and fall time of the common-mode output signal are within the specified limits.

Rise time and Fall time are measured on the Transition of the common-mode signal by measuring the time difference between the 20% and 80% level during the Transition. The Reference Level is calculated based on the Common-mode Swing measurement. This measurement is performed by averaging the measured RT and FT for 10,000 or more transitions.

#### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- 2 Probes: one P7313SMA and one P7240
- Test Fixture TPA-P Source with a micro USB pluggable for source testing
- DC Power Supply: PWS4205 or PWS2815 (to be used if an external power supply-based test setup is used)
- CBUS Sink Adapter board

Connect the equipment as shown in [Connection diagram 1 \(Transmitter\)](#).

#### Measurement Algorithm

TekExpress MHL automatically executes the calculations described below.

The Rise Time measurement is the time difference between when the VRefHi reference level is crossed and the VRefLo reference level is crossed on the rising edge of the waveform. The Rise Time algorithm uses the VRef values as the reference voltage level. Each edge is defined by the slope, voltage reference level (threshold), and hysteresis. The application calculates this measurement using the following equations:

Where:

- $T^{\text{Rise}}$  is the Rise Time
- $T^{\text{Hi}+}$  is the VRefHi crossing on the rising edge
- $T^{\text{Lo}+}$  is the VRefLo crossing on the rising edge

$V_{\text{RefHi}}$  is 80% of the Ref level and  $V_{\text{RefLo}}$  is 20% of the Ref level.

$$T_{n\text{Fall}} = T_{n\text{Hi}} - T_{n\text{Lo}}$$

$$T_{\text{Fall}} = \frac{\sum^n T_{\text{Fall}}(n)}{n}$$

$$T_{n\text{Rise}} = T_{n\text{Hi}} - T_{n\text{Lo}}$$

$$T_{Rise} = \frac{\sum_1^n T_{Rise}(n)}{n}$$

### 3.1.1.10: MHL clock duty cycle test - 24 bit or packed pixel mode (CTS 1.0); normal mode (CTS 2.0 and CTS 1.3/2.1)

This test confirms that the MHL clock duty cycle in 24-bit or packed pixel mode does not exceed the limits allowed by the specification. (CTS 1.0)

This test confirms that the MHL clock duty cycle does not exceed the limits allowed by the specification in Normal Mode. (CTS 2.0 and CTS 1.3/2.1.)

#### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P7313SMA and one P7240
- Test Fixture: TPA-P Source with a micro USB pluggable to be used for source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in [Connection diagram 1 \(Transmitter\)](#).

#### Measurement Algorithm

TekExpress MHL automatically executes the calculations described below.

The +Duty Cycle and –Duty Cycle measurements calculate the ratio of the positive (or negative) portion of the cycle relative to the period. The application calculates these measurements as follows:

Where:

- D+ is the positive duty cycle
- D– is the negative duty cycle
- W+ is the positive pulse width
- W– is the negative pulse width
- p<sup>Clock</sup> is the period

### 3.1.1.11: MHL clock jitter test (CTS 1.0) - in normal mode (CTS 2.0)

This MHL Transmitter test confirms that the MHL Clock output does not contain excessive jitter greater than the limit allowed by the specification.

#### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P313SMA and one P7240
- Test Fixture: TPA-P Source with a micro USB pluggable to be used for source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in [Connection diagram 1 \(Transmitter\)](#).

#### Measurement Algorithm

TekExpress MHL automatically executes the calculations described below.

TIE (Time Interval Error) is the difference in time between an edge in the source waveform and the corresponding edge in a reference clock. The reference clock is usually determined by a clock recovery process performed on the source waveform. The source waveform is filtered using a 2-GHz low-pass filter. For Explicit-Clock clock recovery, the process is performed on an explicitly identified source.

If the signal is Clock Type,

The application calculates the Clock TIE measurement using the following equation:

$$\text{TIE}_n^{\text{Clock}} = T_n^{\text{Clock}} - T_n^{\prime\text{Clock}}$$

Where:

- $\text{TIE}^{\text{Clock}}$  is the VRefMid crossing time for the specified clock edge.
- $T^{\prime\text{Clock}}$  is the corresponding edge time for the specified reference clock after recovering it using PLL with a bandwidth of 4 MHz.

### 3.1.1.14: MHL clock duty cycle test - packed pixel mode (CTS 2.0 and CTS 1.3/2.1)

This test confirms that the MHL clock duty cycle in packed pixel mode does not exceed the limits allowed by the specification.

For this test, use the same Required Test Equipment and Measurement Algorithm as

[3.1.1.10 MHL clock duty cycle 24 bit or packed pixel mode CTS 1 X normal mode CTS 2 0](#)

### 3.1.1.15: MHL clock jitter test - packed pixel mode

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**NOTE.** *This test is only available in CTS 2.0.*

---

This test confirms that the MHL Clock output does not contain excessive jitter larger than the limit allowed by the specification in Packed Pixel Mode.

For this test, use the same Required Test Equipment and Measurement Algorithm as

[3.1.1.11: MHL clock jitter test in normal mode.](#)

### 3.1.1.17: TP2 clock jitter test (CTS 1.3/2.1) - normal mode

This TP2 test confirms that the TP2 Clock output does not contain excessive jitter greater than the limit allowed by the specification in Normal Mode.

#### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: two P7313SMA
- Test Fixture: TPA-P Source with a micro USB pluggable to be used for source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in the [Single-ended measurement](#) connection diagram.

**Measurement Algorithm**

TekExpress MHL automatically executes the calculations described below.

TIE (Time Interval Error) is the difference in time between an edge in the source waveform and the corresponding edge in a reference clock. The reference clock is usually determined by a clock recovery process performed on the source waveform, as follows.

1. Acquire the waveform MHL +ve and MHL-ve as single ended waveform.
2. The source waveform is embedded with Skew effect of +43 psec on MHL +ve and MHL- Ve channel using software filters.
3. The Clock waveform is deduced using Math operation, and then applies the 500 MHz band limit filter on the clock and equalizer.
4. For Explicit-Clock clock recovery, the process is performed on an explicitly identified source. If the signal is Clock Type, The application calculates the Clock TIE measurement using the following equation:

$$TIE_n^{Clock} = T_n^{Clock} - T_n'^{Clock}$$

Where:

- $TIE^{Clock}$  is the VRefMid crossing time for the specified clock edge.
  - $T'^{Clock}$  is the corresponding edge time for the specified reference clock after recovering it using PLL with a bandwidth of 4 MHz.
5. The source waveform is embedded with Skew effect of -43 psec on MHL +ve and MHL- Ve channel using software filters.
  6. Steps 3 and 4 are repeated for the waveform obtained in step 5 for -43 psec skew.

### 3.1.1.19: TP2 clock jitter test - packed pixel mode

This TP2 test confirms that the TP2 Clock output does not contain excessive jitter greater than the limit allowed by the specification in Packed Pixel Mode.

For this test, use the same Required Test Equipment and Measurement Algorithm as in test [3.1.1.17: TP2 clock jitter test CTS 1.3/2.1 in normal mode](#).

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## MHL transmitter group 2: Data tests

### 3.1.1.2: Single-ended high level voltage test - $V_{SE\_HIGH}$

This MHL Transmitter test confirms that the single-ended high output voltage level is within the specified limits when the DUT is in normal mode.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two differential probes: P7313SMA
- Test fixture: TPA-P source with a micro USB, pluggable to be used for source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 2 \(Transmitter\)](#).

#### Measurement algorithm

TekExpress MHL automatically executes the calculations described below.

The single-ended High and Low are measured using a customized algorithm to find regions that were identified based on the Bit stream.

1. Acquire the waveform by capturing at least 1000 regions using a real-time oscilloscope.
2. Find the region of LHHHH transition on the region of single-ended measurement.
3. Measure and record the histogram mode value at the middle HH pattern of the MHL-P signal when the common-mode voltage is high and it is MHLP-SEHIGH.
4. Measure and record the histogram mode value at the middle HLLLL of the MHL-N signal when the common-mode signal is high and it is MHLN-SEHIGH.
5. Compare the measured values with the limit values:

If  $V_{TERM} - 540 \text{ mV} \leq V_{SE\_HIGH} \leq V_{TERM} + 10 \text{ mV}$  for all recorded  $V_{SE\_HIGH}$  values, then PASS. Otherwise, FAIL.

Where:

- $V_{TERM} = 3.135 \text{ V}$  (lowest)
- $V_{TERM} = 3.465 \text{ V}$  (highest)
- Limit values are  $\geq 2595 \text{ mV}$  and  $\leq 3145 \text{ mV}$

### 3.1.1.3: Single-ended low level voltages test - $V_{SE\_LOW}$

This MHL Transmitter test confirms that the single-ended low output voltage level is within the specified limits when the source device is in normal mode.

#### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two Differential Probes: P7313SMA
- Test Fixture: TPA-P Source with a micro USB, pluggable to be used for source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in [Connection diagram 2 \(Transmitter\)](#)

#### Measurement Algorithm

TekExpress MHL automatically executes the calculations described below.

The single-ended High and Low are measured using a customized algorithm to find regions of LHHHH transition on single-ended measurement regions.

1. Acquire the waveform by capturing at least 1000 regions using a real-time oscilloscope.
2. Find the region of LHHHH transition on the region of single-ended measurement
3. Measure and record the Histogram mode value at the middle HH on the MHL-N signal when the common-mode signal is low, and it is MHLN-SE-LOW.
4. Measure and record the Histogram mode value at the middle HLLLL pattern on the MHL-P signal using the Histogram technique when the common-mode voltage is low, and it is MHLP-SELOW.
5. Compare the measured values with limit values:

If  $V_{TERM} - 1760 \text{ mV} \leq V_{SE\_LOW} \leq V_{TERM} - 700 \text{ mV}$  for all recorded  $V_{SE\_Low}$  values, then PASS. Otherwise, FAIL

Where:

- $V_{TERM} = 3.135 \text{ V}$  (lowest)
- $V_{TERM} = 3.465 \text{ V}$  (highest)
- Limit values are  $\geq 1375$  and  $\leq 2435$

### 3.1.1.4: Differential output swing voltage test - $V_{DF\_SWING}$

This MHL Transmitter test confirms that the differential output voltage swing amplitude is within the specified limits when the source device is in normal mode.

#### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P313SMA and one P7240
- Test Fixture: TPA-P Source with a micro USB, pluggable to be used for source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in [Connection diagram 1 \(Transmitter\)](#).

#### Measurement Algorithm

TekExpress MHL automatically executes the calculations described below.

1. Acquire the waveform. Slice and overlap data points for approximately 5 UI and then measure the minimum and maximum using a common-mode clock waveform.
2. Consider the histogram vertical window for the data point of value  $>$  minimum + 0.75\* (maximum – minimum) and measure the mode as  $V_{High}$ .
3. Consider the histogram vertical window for the data point of value  $>$  maximum – 0.75\* (maximum – minimum) and measure the mode as  $V_{Low}$ .
4. Calculate the average ( $V_{CMSWING}$ ) of the measured common-mode High and Low values.
5. Record the histogram mode value for the common-mode Low.
6. Calculate  $V_{CMSWING}$  for the given  $V_{TERM}$ .

Where:

- $V_{TERM} = 3.135$  V (lowest)
- $V_{TERM} = 3.465$  V (highest)

If  $600 \text{ mV} \leq V_{DFSWING} \leq 1000 \text{ mV}$  for all recorded  $V_{DFSWING}$  values, then Pass. Otherwise, Fail

The measurement takes into consideration all the data points on the differential signal for 10,000 clock periods.

### 3.1.1.6: Differential rise and fall times test - $T_{R\_DF}, T_{F\_DF}$

This MHL Transmitter test confirms that the rise and fall times of the differential output signal are equal to or larger than the minimum limit.

#### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P313SMA and one P7240
- Test Fixture: TPA-P Source with a micro USB, pluggable to be used for Source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in [Connection diagram 1 \(Transmitter\)](#).

#### Measurement Algorithm

TekExpress MHL automatically executes the calculations described below.

1. Perform the Differential Swing measurement.
2. Arrive at 20% and 80% levels of the signal.
3. Perform the Rise time and Fall time calculations similar to the Common-mode Rise time and Fall time on the data using the Reference level arrived at in step 2.

### 3.1.1.8: Differential intra-pair skew test - $T_{SKEW\_DF}$

---

**NOTE.** *This test is only available in 1.X and CTS 2.0.*

---

This MHL Transmitter test confirms that the timing skew in the differential signal pair is below the specified limits.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two differential probes: P7313SMA
- Test fixture: TPA-P Source with a micro USB, pluggable to be used for Source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in [Connection diagram 2 \(Transmitter\)](#).

**Measurement algorithm** This measurement is performed using a custom algorithm that evaluates the qualified region for the measurement. The skew is the average of 1000 qualified regions.

### 3.1.1.12: MHL data eye diagram test (CTS 1.0) - in normal mode (CTS 2.0)

This MHL Transmitter test confirms that the MHL Data output has a signal quality that meets the eye opening required by the specification.

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**NOTE.** *If the MHL Data Eye diagram test fails due to mask hits, TekExpress MHL Solution provides the option to the user to move the mask horizontally to achieve zero or minimal hits. Refer to the [Mask movement](#) procedure.*

---

**Required Test Equipment** In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P313SMA and one P7240
- Test Fixture: TPA-P Source with micro USB, pluggable to be used for Source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in [Connection diagram 1 \(Transmitter\)](#).

**Measurement Algorithm** TekExpress MHL automatically executes the algorithm described below.

1. Acquire the Waveform Differential Data and Common-mode clock waveforms.
2. Filter the clock signal using the 2-GHz low-pass filter.
3. Recover the clock using 4 MHz PLL
4. Plot the Eye diagram using the Differential data signal with the recovered clock from the common-mode signal.
5. The Jitter is measured as:  
Data period – Eye opening (EYE width)

### 3.1.1.16: MHL data eye diagram test in packed pixel mode

---

**NOTE.** *This test is only available in CTS 2.0.*

---

This test confirms that the MHL Data output has signal quality that meets the eye opening required by the specification in Packed Pixel Mode.

For this test, use the same Required Test Equipment and Measurement Algorithm as

[3.1.1.12: MHL data eye diagram test in normal mode.](#)

### 3.1.1.18: TP2 data eye diagram test (CTS 1.3/2.1) - normal mode

This test confirms that the TP2 Data output has a signal quality that meets the eye opening required by the specification in Normal Mode.

---

**NOTE.** *If the TP2 Data Eye diagram test fails due to mask hits, TekExpress MHL Solution provides the option to the user to move the mask horizontally to achieve zero or minimal hits. Refer to the [Mask movement](#) procedure.*

---

#### Required Test Equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P313SMA and one P7240
- Test Fixture: TPA-P Source with micro USB, pluggable to be used for Source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink Adapter board

Connect the equipment as shown in the [Single-ended measurement](#) connection diagram.

**Measurement Algorithm**

TekExpress MHL automatically executes the algorithm described below.

TekExpress MHL automatically executes the calculations described below.

TIE (Time Interval Error) is the difference in time between an edge in the source waveform and the corresponding edge in a reference clock. The reference clock is usually determined by a clock recovery process performed on the source waveform, as follows.

1. Acquire the waveform MHL +ve and MHL-ve as single ended waveform.
2. The source waveform is embedded with Skew effect of +43 psec on MHL +ve and MHL- Ve channel using software filters.
3. Create the differential data using the Math operation and apply the equalizer for the data signal.
4. The Clock waveform is derived using the Math operation. Then apply the 500 MHz band limit filter on the clock waveform, and then apply the equalizer.
5. For Explicit-Clock clock recovery, the process is performed on an explicitly identified source. If the signal is Clock Type, the application recovers the clock and creates the clock using the Jitter transfer function.
6. Plot the Eye diagram for the Differential data signal with the recovered clock from the Common-mode signal. Set the clock multiplier to 30 in normal mode or set to 40 in packed pixel mode.
7. Measure the Eye opening (EYE width) measurement and deduce the Jitter as UI- EYE width.
8. The source waveform is embedded with Skew effect of -43 psec on MHL +ve and MHL- Ve channel using software filters.
9. Steps 3 to 7 are repeated for the waveform obtained in step 8 for -43 psec skew.

**3.1.1.20: TP2 data eye diagram test - packed pixel mode**

This test confirms that the TP2 Data output has a signal quality that meets the eye opening required by the specification in Packed Pixel Mode.

For this test, use the same Required Test Equipment and Measurement Algorithm as in test [3.1.1.17: TP2 clock jitter test CTS 1.3/2.1 in normal mode](#).



---

# MHL receiver group 1: Sink tests

## 4.1.1.1: Input signal DC voltage level tolerance test

This MHL Receiver test confirms that the sink device supports input signal DC voltage level allowed by the specification.

Make the connection after signal calibration is done. Set the DUT to operate in normal mode.

### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- MHL Signal Generator: 7122C with option 01, 02 or 06 and 08, and Option SDX with Direct Synthesis capability to simulate Cable emulator effect and rise time filter effect.
- Test Fixture: 1 set TF-MHL-TPA-P-WOSI
- Rise time Filter: 2 Picosecond Pulse labs 120PS
- Bias Tees: 2 Mini Circuits Bias Tees ZX85-12G-S+
- CBUS Source Board: Simplay Labs MHL Rx/Tx Analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board

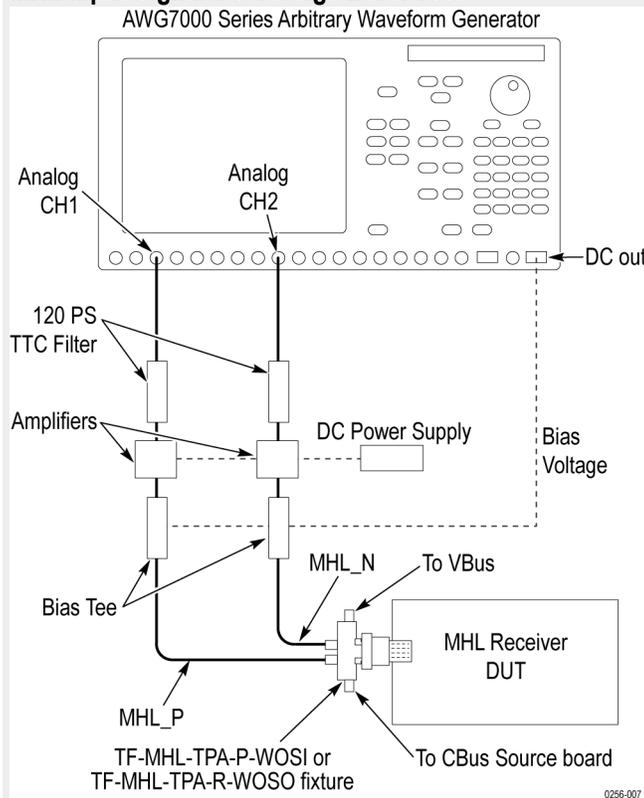
Connect the equipment as shown in MHL input signal DC voltage level test.

### Measurement algorithm

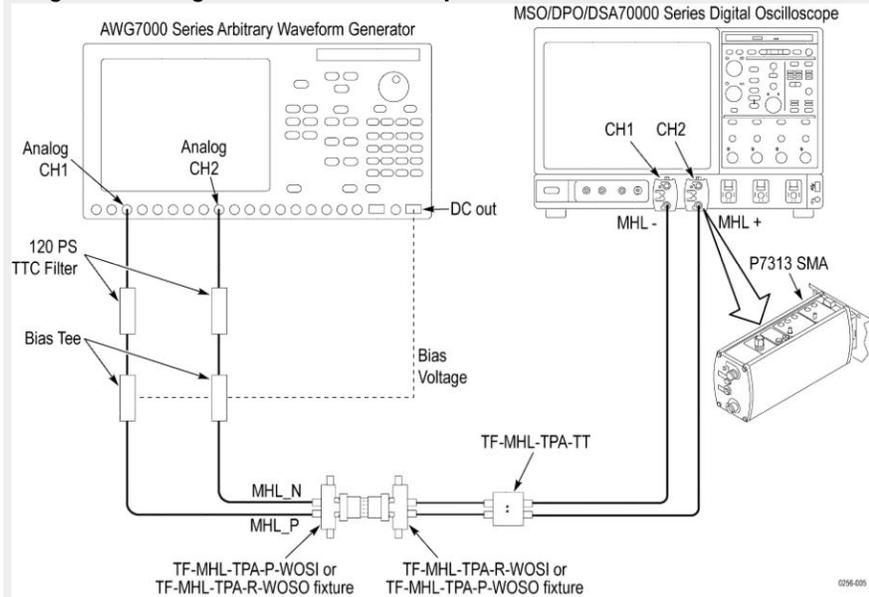
1. Connect the equipment as shown for Single-ended signals calibration setup for sink tests and Differential & common-mode signals calibration setup for sink tests. Set VTERM = 3.3V, AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the Signal Generator AWG7122C output for the following settings.
  - a. Frequency: Highest frequency supported by the Sink DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%), Common-mode signal 600ps (20% - 80%)
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%), Common-mode signal 600ps (20% - 80%)
  - a. Swing voltages: Differential signal 800mV, Common-mode signal 540mV

3. DC level of the output single-ended signal:  $V_{\text{TERM}} - 300\text{mV}$
4. Connect the equipment MHL input signal DC voltage level test with the CBus Source board connected to the Tektronix fixture CBus and VBus ports.
5. Turn on the DUT and enable MHL mode through Device Discovery and CBus Information Exchange with the CBus Source board.
6. Examine the output of the Sink through the display image.
7. Record errors on the display if any for the given  $V_{\text{TERM}}$  frequency and DC voltage level.
8. Set DC level of the output single-ended signal:  $V_{\text{TERM}} - 1200\text{mV}$
9. Turn on the DUT and enable MHL mode through Device Discovery and CBus Information Exchange with the CBus Source board.
10. Examine the output of the Sink through the display image.
11. Record errors on the display if any for the given  $V_{\text{TERM}}$ , frequency and DC voltage level.
12. If there is no error on the display in all recorded results, then PASS. Otherwise FAIL.

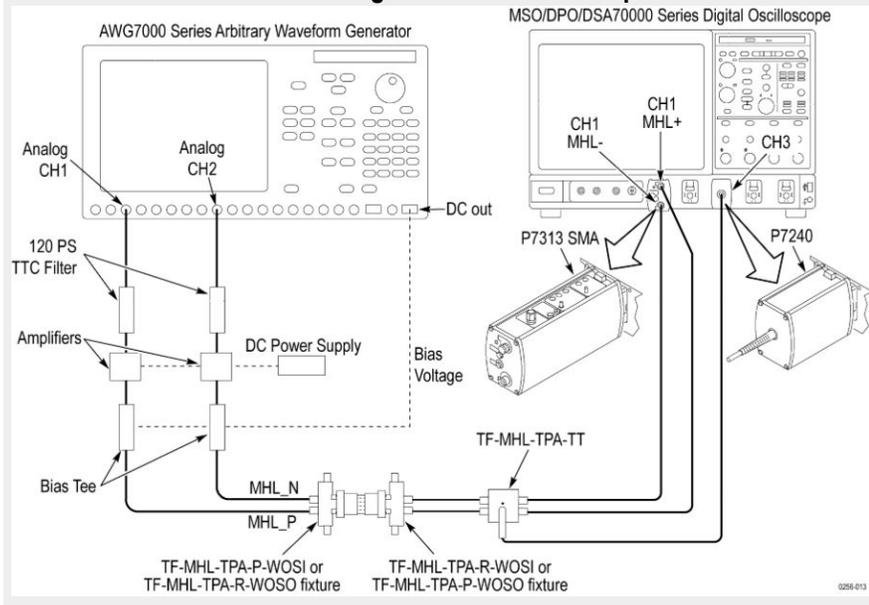
### MHL Input Signal DC Voltage Level Test



### Single-ended Signals Calibration Setup for Sink Test



### Differential & Common-Mode Signals Calibration Setup for Sink Test



### 4.1.1.2: Input signal minimum and maximum swing voltages tolerance test

This MHL Receiver test confirms that the sink device supports input signal DC voltage level and swing voltage allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- MHL Signal Generator: AWG7122C with option 01, 02 or 06 and 08 and Option SDX with Direct Synthesis capability, to simulate Cable emulator effect and Rise time filter effect.
- Test fixture: 1 set TF-MHL-TPA-P-WOSI
- Rise time filter: 2 Picosecond Pulse labs 120PS
- Bias tees: 2 Mini circuits bias tees ZX85–12G-S+
- CBUS Source board: Simplay labs MHL Rx/Tx analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board

Make the connection as shown in Sink MHL input signal DC voltage level min-max test and Amplifier connections to DC power supply after signal calibration is done. Set the DUT to operate in normal mode.

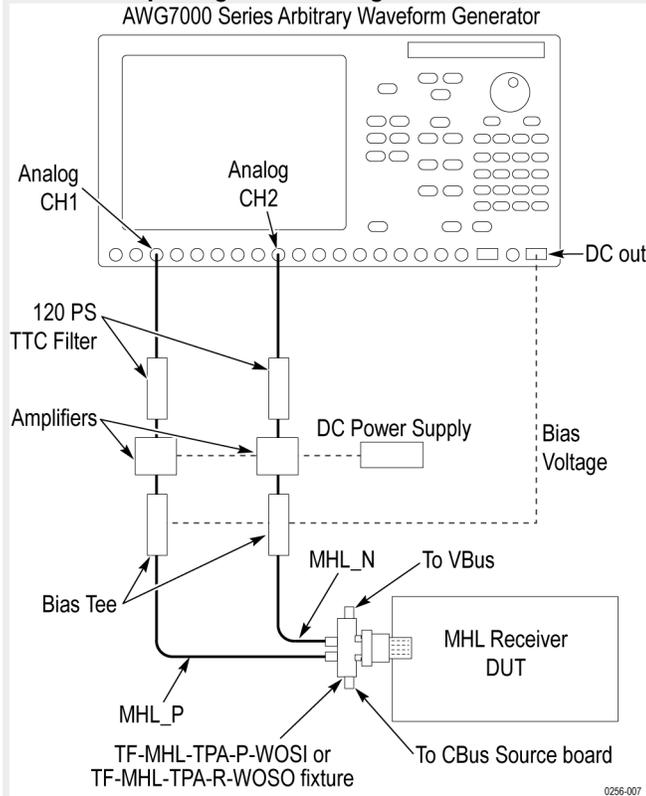
#### Measurement algorithm

The below procedure is fully automated by Tektronix MHL Compliance Software (Option MHD).

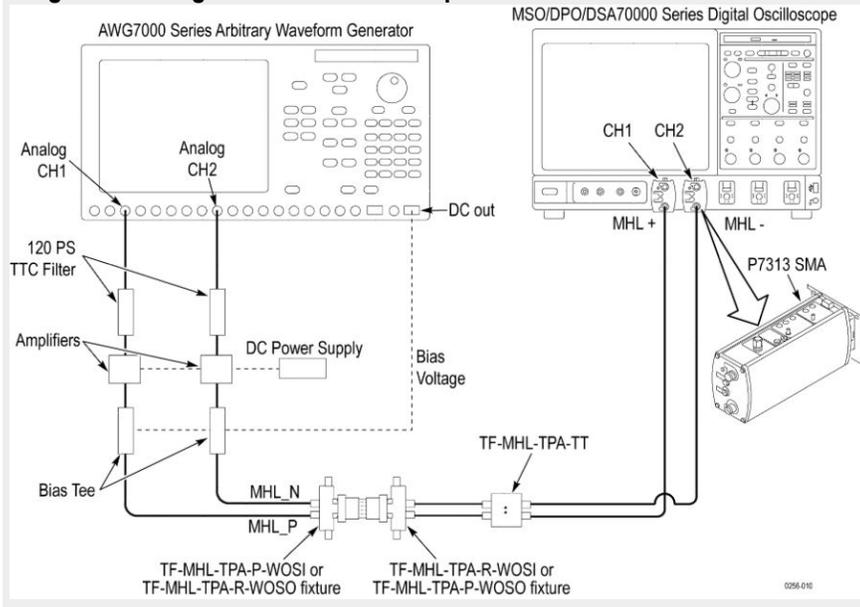
1. Connect the equipment as shown for Single ended signals calibration setup for sink min max test, and Differential and common mode signals salibration setup for min max test. Set  $V_{TERM} = 3.3V$ , AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the Signal Generator AWG7122C output for the following settings.
  - a. Frequency: Highest frequency supported by the Sink DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%), Common-mode signal 600ps (20% - 80%)
    - Above 2.25Gbps  
Differential signal 100ps (20% - 80%), Common-mode signal 600ps (20% - 80%)
  - a. Swing voltages: Differential signal 800mV, Common-mode signal 540mV
  - b. DC level of the output single-ended signal:  $V_{TERM} - 750mV$
3. Connect the equipment as shown in Sink MHL input signal DC voltage level min-max test with CBus Source board connected to Tektronix fixture CBus and VBus ports.

4. Turn on the DUT and enable MHL mode through Device Discovery and CBus Information Exchange with the CBus Source board.
5. Examine the output of the Sink through the display image.
6. Record errors on the display if any for the given  $V_{\text{TERM}}$ , frequency and differential and common-mode swing voltages.
7. Adjust the differential swing voltage to 1000mV, the common-mode swing voltage to 720mV and the DC level of the output single-ended signal to  $V_{\text{TERM}} - 1200\text{mV}$ .
8. Connect the equipment as shown in as shown in Sink MHL input signal DC voltage level min-max tests.
9. Turn on the DUT and enable MHL mode through Device Discovery and CBus Information Exchange with the CBus Source board.
10. Examine the output of the Sink through the display image.
11. Record errors on the display if any for the given  $V_{\text{TERM}}$ , frequency and differential and common-mode swing voltages.
12. Adjust the differential swing voltage to 200mV, the common-mode swing voltage to 170mV and the DC level of the output single-ended signal to  $V_{\text{TERM}} - 300\text{mV}$ .
13. Connect the equipment as shown in as shown in Sink MHL input signal DC voltage mevel min-max tests.
14. Turn on the DUT and enable MHL mode through Device Discovery and CBus Information Exchange with the CBus Source board.
15. Examine the output of the Sink through the display image.
16. Record errors on the display if any for the given  $V_{\text{TERM}}$ , frequency and differential and common-mode swing voltages.
17. If there is no error on the display in all recorded results, then PASS. Otherwise FAIL.

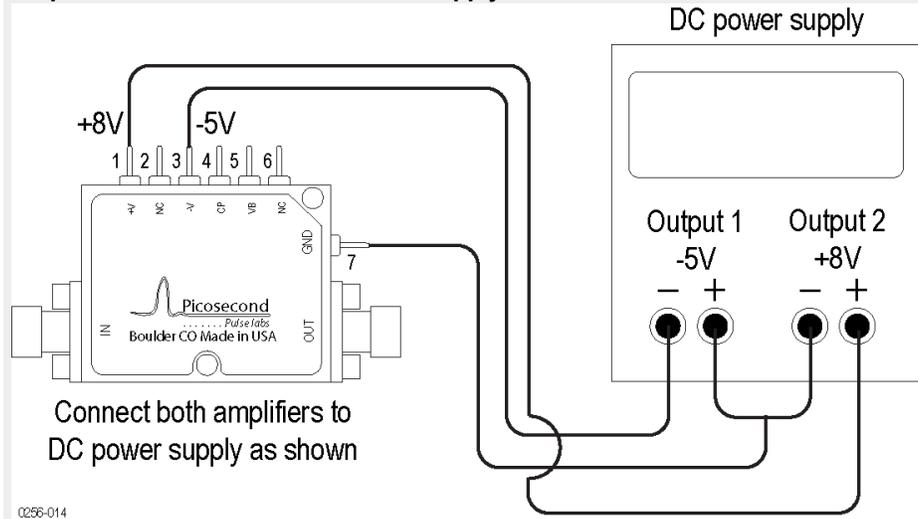
### Sink MHL Input Signal DC Voltage Level Min Max Test



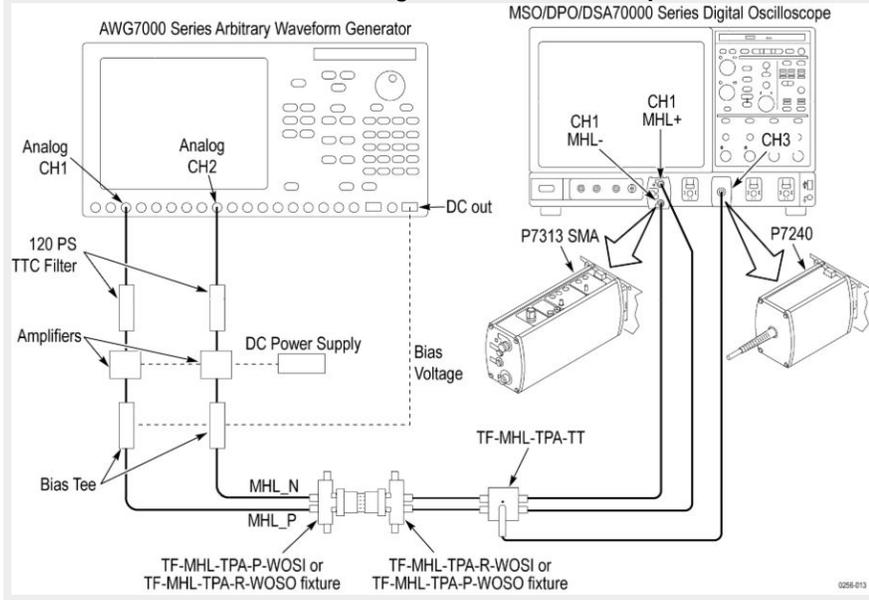
### Single Ended Signals Calibration Setup for Sink Min Max Test



### Amplifier Connections to DC Power Supply



### Differential and Common Mode Signals Calibration Setup for Sink Min Max Test



### 4.1.1.3: Intra-pair skew tolerance test

This MHL Receiver test confirms that the sink device supports input signal DC voltage level and swing voltage allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

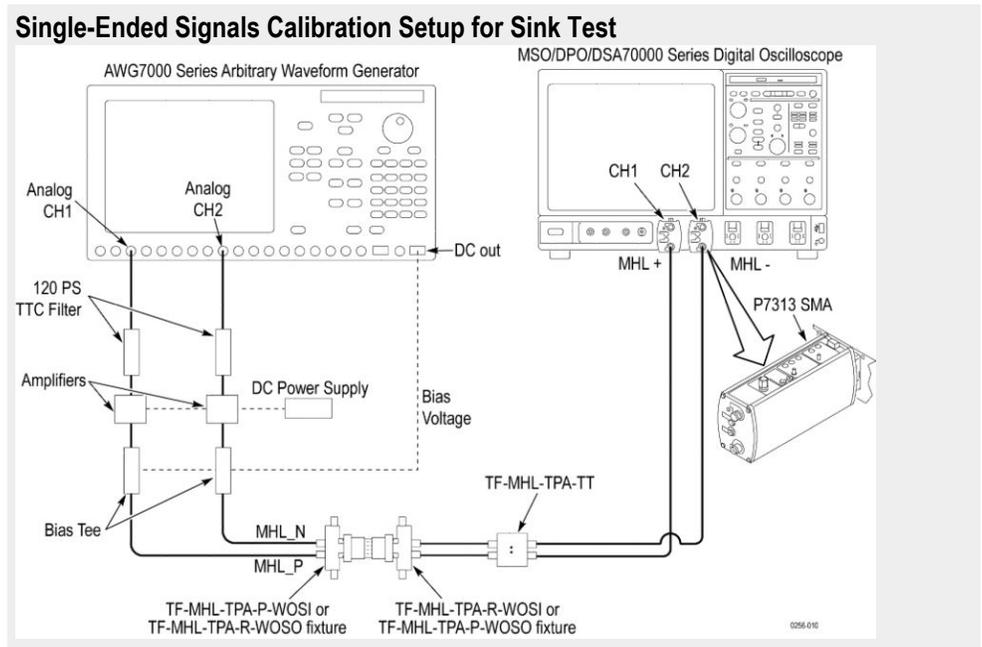
- MHL Signal Generator: AWG7122C with option 01, 02 or 06 and 08 and Option SDX with Direct Synthesis capability, to simulate Cable emulator effect and Rise time filter effect.
- Test Fixture: 1 set TF-MHL-TPA-P-WOSI
- Rise time filter: 2 Picosecond pulse labs 120PS
- Bias tees: 2 Mini Circuits Bias Tees ZX85-12G-S+
- CBUS Source board: Simplay labs MHL Rx/Tx analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board

Connect the equipment as shown in MHL input signal DC voltage level test.

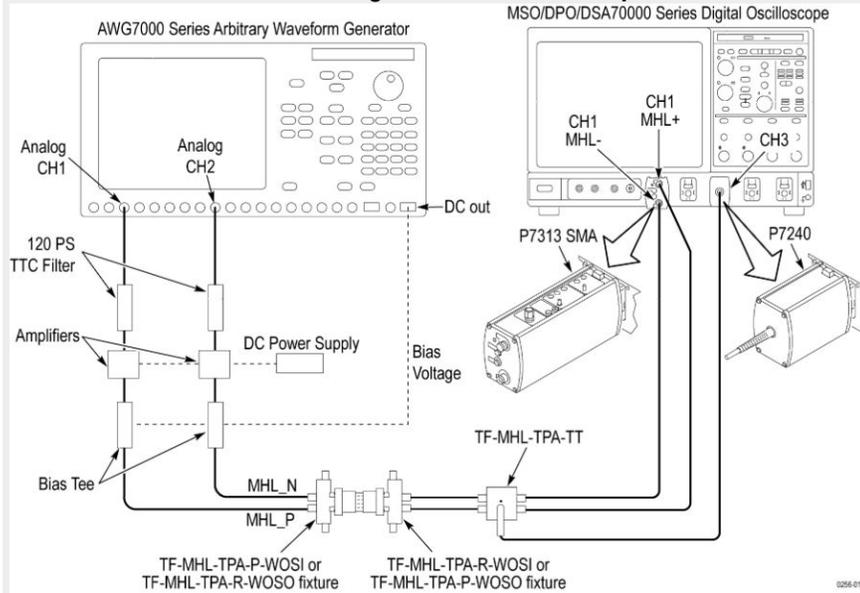
#### Measurement algorithm

1. Connect the equipment as shown for Single-ended signals calibration setup for sink test and Differential & common-mode signals calibration setup for sink test. Set  $V_{\text{TERM}} = 3.3\text{V}$ , AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the Signal Generator AWG7122C output for the following settings.
  - a. Frequency: Highest frequency supported by the Sink DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%), Common-mode signal 600ps (20% - 80%)
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%), Common-mode signal 600ps (20% - 80%)
  - a. Swing voltages: Differential signal 800mV, Common-mode signal 540mV
  - b. DC level of the output single-ended signal:  $V_{\text{TERM}} - 750\text{mV}$
  - c. Intra-pair skew: Differential skew 0ps, Common-mode skew 0ps
3. Connect the equipment as shown in MHL input signal DC voltage level test with the CBus Source board connected to the Tektronix fixture CBus port.
4. Turn on the DUT and enable MHL mode through Device Discovery and CBus Information Exchange with the CBus Source board.
5. Examine the output of the Sink through the display image.

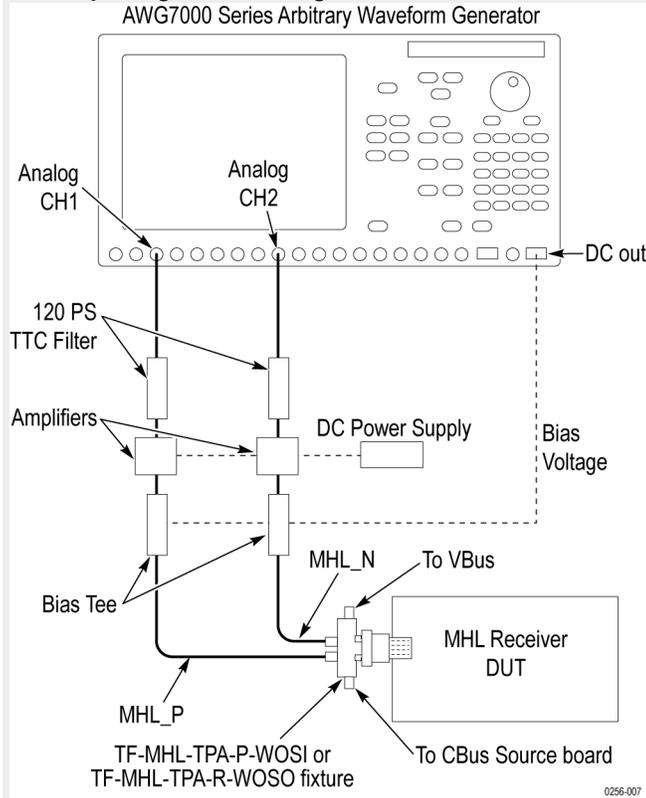
6. Confirm that there is no error on the display. If there is any error, STOP. The test Failed.
7. Increase the intra-pair skew of differential signal and common-mode signal by the same amount to the maximum where error appears on the display. Make the positive channel leads the negative channel in time, which is called positive skew direction.
8. Record the maximum intra-pair skew for the given  $V_{\text{TERM}}$ , frequency and skew direction.
9. Set the differential and common-mode intra-pair skews to 0ps.
10. Increase the intra-pair skew of differential signal and common-mode signal by the same amount to the maximum where error appears on the display. Make the positive channel lags the negative channel in time, which is called negative skew direction.
11. Record the maximum intra-pair skew for the given  $V_{\text{TERM}}$ , frequency and skew direction.



### Differential & Common Mode Signals Calibration Setup for Sink Test



### MHL Input Signal DC Voltage Level Test



#### 4.1.1.4: Jitter tolerance test (CTS 1.X) - in normal mode (CTS 2.0 and CTS 1.3/2.1)

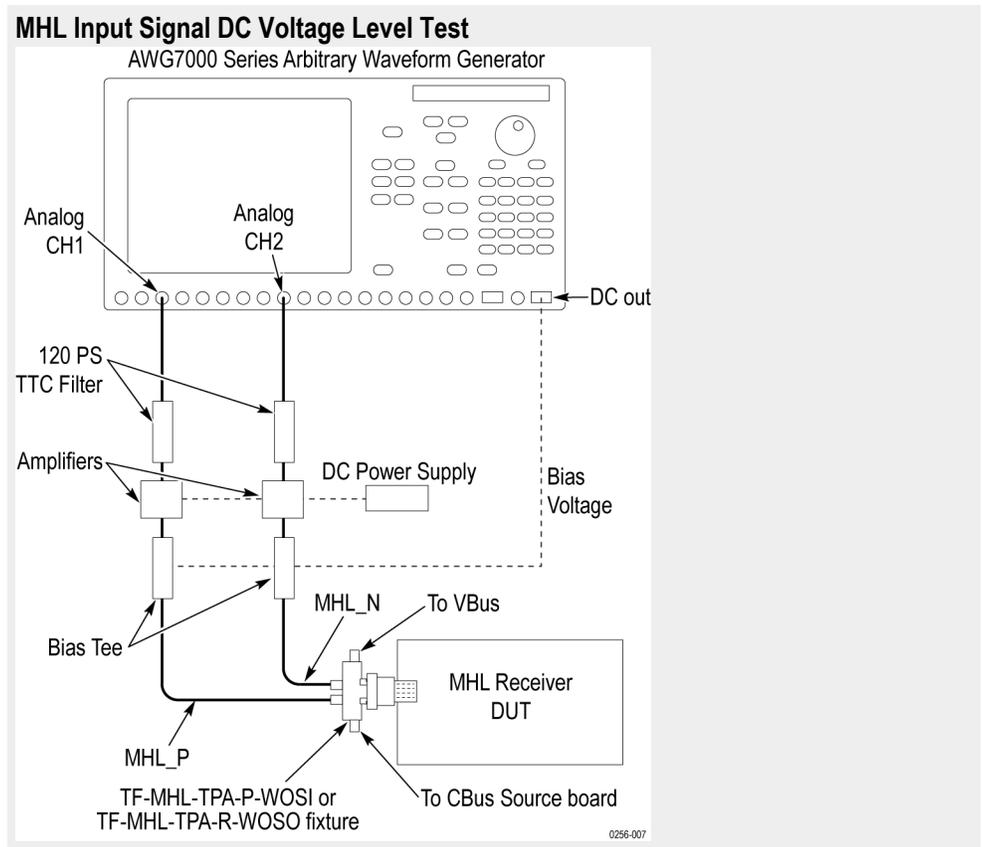
This MHL Receiver test confirms that the sink device can tolerate the maximum clock and data jitter amounts allowed by the specification.

##### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- MHL Signal Generator: AWG7122C with option 01, 02 or 06 and 08 and Option SDX with Direct Synthesis capability, to simulate Cable emulator effect and Rise time filter effect.
- Test fixture: 1 set TF-MHL-TPA-P-WOSI
- Rise time filter: 2 Picosecond Pulse labs 120PS
- Bias tees: 2 Mini circuits bias tees ZX85-12G-S+
- CBUS Source board: Simplay labs MHL Rx/Tx analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board

Connect the equipment as shown in MHL input signal DC voltage level test.

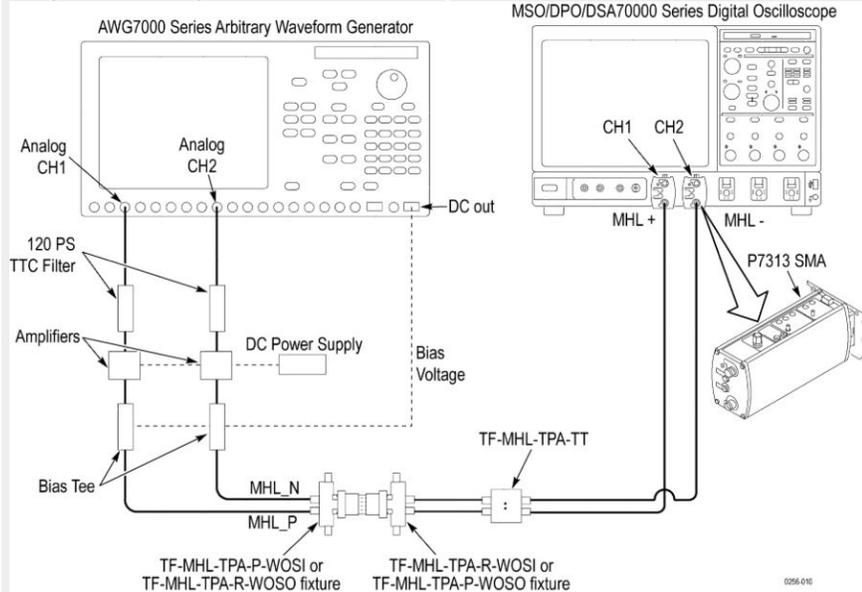


**Measurement algorithm**

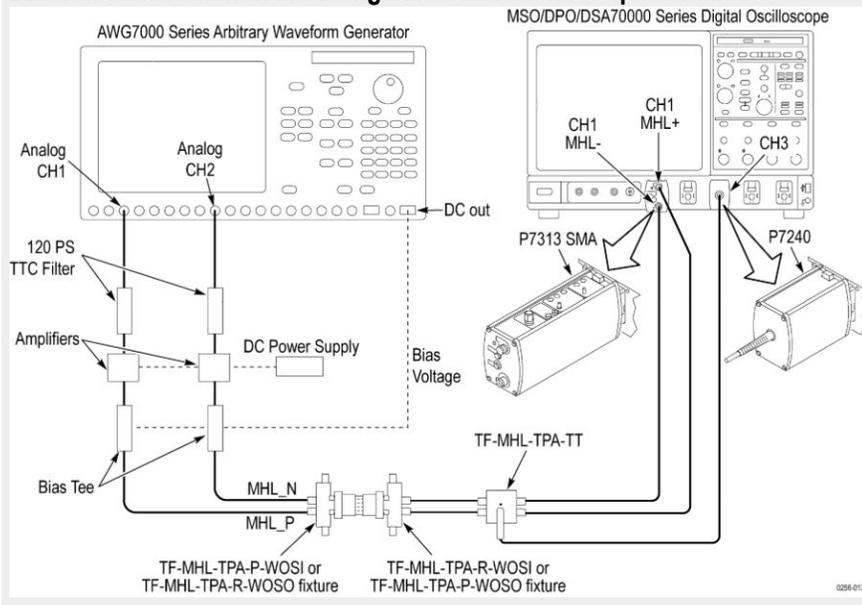
1. Connect the equipment as shown for Single-ended signals calibration setup for sink tests and Differential & common-mode signals calibration setup for sink tests. Set  $V_{\text{TERM}} = 3.3\text{V}$ , AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the Signal Generator AWG7122C output for the following settings.
  - a. Frequency: Lowest frequency supported by the Sink DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%), Common-mode signal 600ps (20% - 80%)
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%), Common-mode signal 600ps (20% - 80%)
  - a. Swing voltages: Differential signal 800mV, Common-mode signal 360mV
  - b. DC level of the output single-ended signal:  $V_{\text{TERM}} - 540\text{mV}$
1. Set the clock jitter frequency to 10MHz and the data jitter frequency to 500KHz. Inject clock jitter and data jitter to the TP1 maximum amount specified in MHL Spec for the given clock frequency.
2. Adjust the differential signal swing to get the marginal eye diagram specified in MHL Spec.
3. Generate MHL signals with Cable emulator effects using the innovative Direct Synthesis capability of AWG7122C.
4. Connect the equipment as shown in MHL input signal DC voltage level test with the CBus Source board connected to the Tektronix fixture CBus and VBus ports.
5. Turn on the DUT and enable MHL mode through Device Discovery and CBus Information Exchange with the CBus Source board.
6. Examine the output of the Sink through the display image.
7. Record error on the display if any for the given  $V_{\text{TERM}}$ , clock frequency, jitter frequency and clock edge location.
8. Change the common-mode clock edge location by  $0.1T_{\text{bit}}$  step with respect the differential data edge for 10 times.
9. Examine the display at each step and record error on the display if any for the given  $V_{\text{TERM}}$ , clock frequency, jitter frequency and clock edge location.
10. Repeat the above steps 4-11 for clock jitter frequency 7MHz and data jitter frequency 1MHz.
11. Repeat the above steps 2-12 for the minimum resolution supported by the DUT.

12. If there is no error on the display in all recorded results, then PASS. Otherwise FAIL.
13. Perform steps 4 to 13 for the given resolution without effect of cable emulator on generated TP2 signal. (This step is applicable only for CTS 1.3 / 2.1)

### Single-Ended Signals Calibration Setup for Sink Test



### Differential & Common Mode Signals Calibration Setup for Sink Test



#### **4.1.1.8: Jitter tolerance test in packed pixel mode (CTS 2.0 and CTS 1.3/2.1)**

This test confirms that the sink device can tolerate the maximum clock and data jitter amounts allowed by the specification in Packed Pixel Mode.

For this test, use the same Required Test Equipment and Measurement Algorithm as

*[4.1.1.4 Jitter tolerance test in normal mode](#)*

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# MHL receiver group 2: Dongle tests

## 5.1.1.1: Input signal single-ended voltage level tolerance

This MHL Receiver test confirms that the dongle device supports input signal single-ended voltage level allowed by the specification.

### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- MHL Signal Generator: AWG7122C with option 01, 02 or 06 and 08 and Option SDX with Direct Synthesis capability, to simulate Cable emulator effect and Rise time filter effect.
- Rise time filter: 2 Picosecond pulse labs 120PS
- Test fixture: 1 set TF-MHL-TPA-R-WOSO
- DC Power supply: PWS4205 or PWS2185
- Bias tees: 2 Mini circuits bias tees ZX85–12G-S+
- CBUS Source board: Simplay labs MHL Rx/Tx analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board
- A/V Display

Make the connection as shown in Dongle – input signal single-ended voltage level tolerance test after calibration is done. Set the DUT to operate in normal mode.

### Measurement algorithm

The below procedure is fully automated by Tektronix MHL Compliance Software (Option MHD).

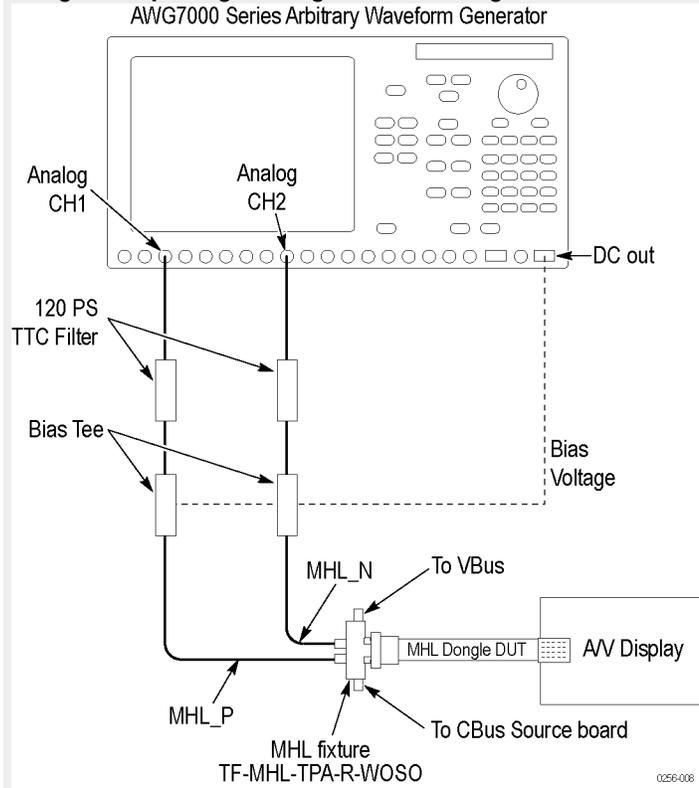
1. Connect the equipment as shown in Single-ended signals calibration setup for dongle tests and as shown in Differential & common-mode signals calibration setup for dongle tests. Set  $V_{TERM} = 3.3V$ , AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the MHL Signal Generator AWG7122C output for the following settings. (Calibration of differential and common-mode signals).
  - a. Frequency: Highest frequency supported by the Dongle DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
    - Less than or equal to 2.25Gbps

Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)

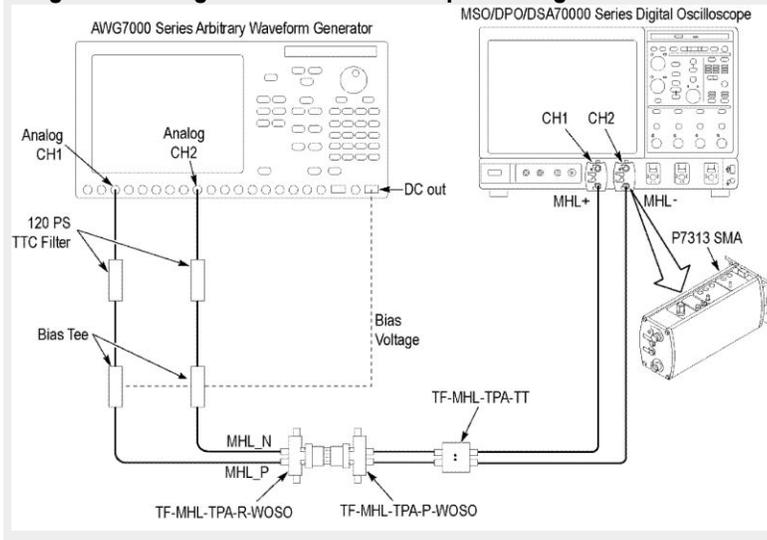
**d.** Swing voltages: Differential signal 800mV, Common-mode signal 540mV e.

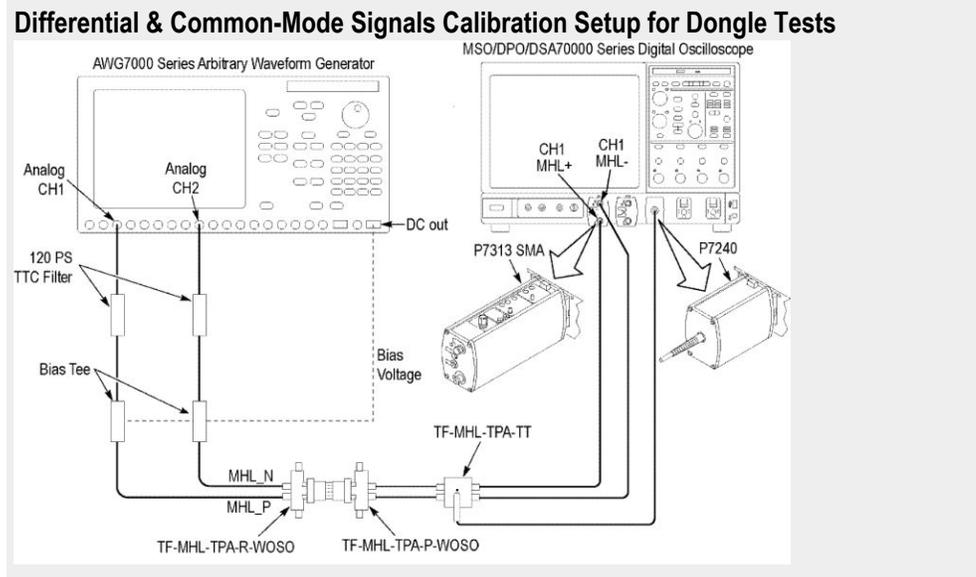
1. Adjust the DC level of the MHL Signal Generator AWG7122C so that  $V_{SE\_HIGH} = V_{TERM} + 10 \text{ mV}$ ,  $V_{SE\_HIGH} = V_{TERM} - 540 \text{ mV}$ ,  $V_{SE\_LOW} = V_{TERM} - 700 \text{ mV}$  and  $V_{SE\_LOW} = V_{TERM} - 1760 \text{ mV}$ . Record the DC level setting for each single-ended value setting. (Calibration of single-ended signals)
2. Connect the equipment as shown in Dongle – input signal single-ended voltage level tolerance test with CBus Source board connected to Tektronix fixture CBus port. Provide VBus if DUT is unpowered dongle. Do not provide VBus if DUT is powered dongle.
3. Turn on the DUT and enable the MHL mode through Device Discovery and CBUS Information Exchange with the CBUS Source board.
4. Adjust the DC level of the MHL Signal Generator AWG7122C output so that  $V_{SE\_HIGH} = V_{TERM} + 10 \text{ mV}$ .
5. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{TERM}$ , frequency and single-ended voltage.
1. Adjust the DC level of the output so that  $V_{SE\_HIGH} = V_{TERM} - 540 \text{ mV}$ .
2. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{TERM}$ , frequency and single-ended voltage.
3. Adjust the DC level of the output so that  $V_{SE\_LOW} = V_{TERM} - 700 \text{ mV}$ .
4. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{TERM}$ , frequency and single-ended voltage.
5. Adjust the DC level of the output so that  $V_{SE\_LOW} = V_{TERM} - 1760 \text{ mV}$ .
6. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{TERM}$ , frequency and single-ended voltage.
7. If there is no error on the display in all recorded results, then PASS. Otherwise FAIL.

### Dongle — Input Signal Single-ended Voltage Level Tolerance Test



### Single-Ended Signals Calibration Setup for Dongle Tests





### 5.1.1.2: Input signal minimum and maximum swing voltage tolerance test

This MHL Receiver test confirms that the dongle device supports input signal minimum and maximum swing voltages allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- MHL Signal Generator: AWG7122C with option 01, 02 or 06 and 08 and Option SDX with Direct Synthesis capability, to simulate Cable emulator effect and Rise time filter effect.
- Rise time Filter: 2 Picosecond Pulse labs 120PS
- Test Fixture: 1 set TF-MHL-TPA-R-WOSO
- DC Power Supply: PWS4205 or PWS2185
- Bias Tees: 2 Mini Circuits Bias Tees ZX85–12G-S+
- CBUS Source Board: Simplay Labs MHL Rx/Tx Analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board
- A/V Display

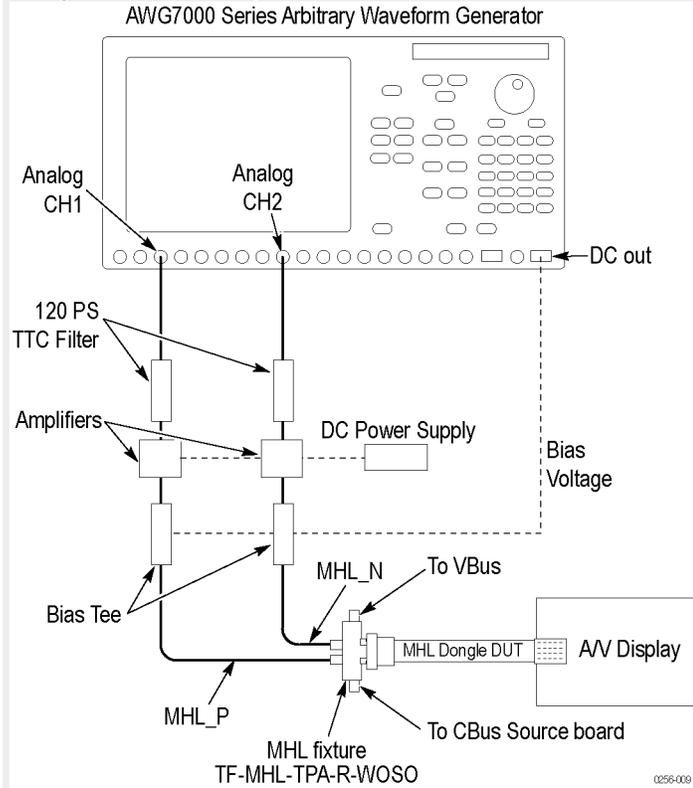
Make the connection as shown in Dongle min-max setup and Amplifier connections to DC power supply after calibration is done. Set the DUT to operate in normal mode.

**Measurement algorithm**

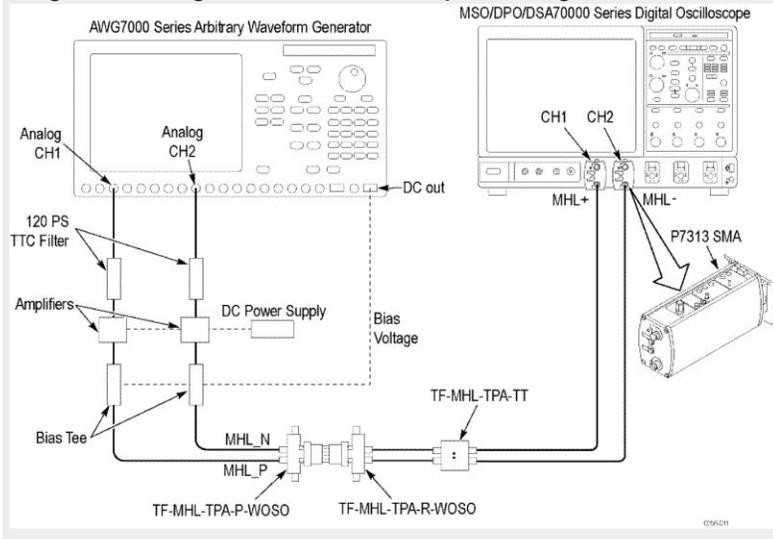
The below procedure is fully automated by Tektronix MHL Compliance Software (Option MHD).

1. Connect the equipment as shown in Single ended signals calibration setup for dongle min max test and as shown in Differential and common-mode signals calibration setup for dongle min max test. Set  $V_{\text{TERM}} = 3.3\text{V}$ , AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the MHL Signal Generator AWG7122C output for the following settings.
  - a. Frequency: Highest frequency supported by the Dongle DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
1. Adjust the DC level and swing amplitudes of the MHL Signal Generator AWG7122C so that  $V_{\text{SE\_HIGH}} = V_{\text{TERM}} + 10\text{ mV}$ ,  $V_{\text{SFSWING}} = 600\text{ mV}$  and  $V_{\text{CMSWING}} = 360\text{ mV}$ . Record the DC level and swing amplitude settings.
2. Adjust the DC level and swing amplitudes of the MHL Signal Generator AWG7122C so that  $V_{\text{SE\_LOW}} = V_{\text{TERM}} - 1760\text{ mV}$ ,  $V_{\text{DFSWING}} = 1000\text{ mV}$  and  $V_{\text{CMSWING}} = 720\text{ mV}$ . Record the DC level and swing amplitude settings.
3. Connect the equipment as shown in Single-ended signals calibration setup for dongle tests with the CBus Source board connected to the Tektronix fixture CBus port. Provide VBus if DUT is unpowered dongle. Do not provide VBus if DUT is powered dongle.
4. Turn on the DUT and enable the MHL mode through Device Discovery and CBUS Information Exchange with the CBUS Source board.
5. Adjust the DC level of the MHL Signal Generator so that  $V_{\text{SE\_HIGH}} = V_{\text{TERM}} + 10\text{ mV}$ ,  $V_{\text{DFSWING}} = 600\text{ mV}$  and  $V_{\text{CMSWING}} = 360\text{ mV}$ .
6. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display, if any, for the given  $V_{\text{TERM}}$ , frequency and single-ended voltage.
7. Adjust the DC level and swing amplitudes of the MHL Signal Generator so that  $V_{\text{SE\_LOW}} = V_{\text{TERM}} - 1760\text{ mV}$ ,  $V_{\text{DFSWING}} = 1000\text{ mV}$  and  $V_{\text{CMSWING}} = 720\text{ mV}$ .
1. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{\text{TERM}}$ , frequency and single-ended voltage.
2. If there is no error on the display in all recorded results, then PASS. Otherwise FAIL.

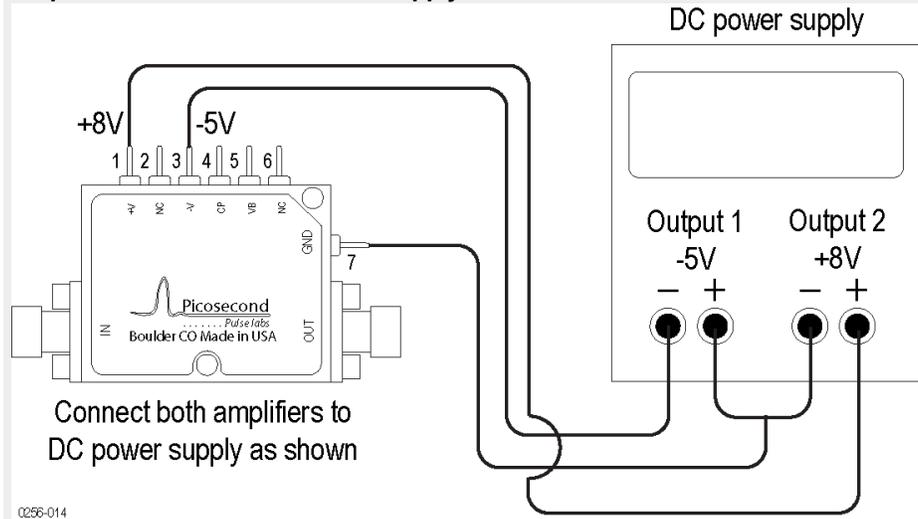
### Dongle Min-Max Setup



### Single Ended Signals Calibration Setup For Dongle Min Max Test

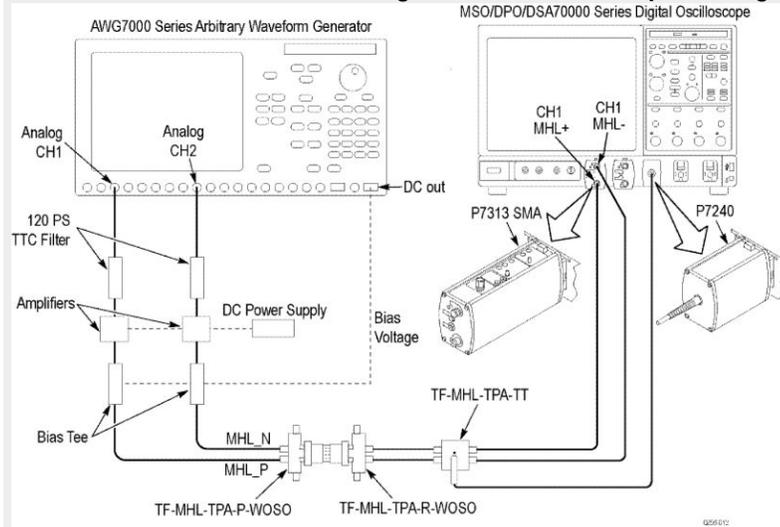


### Amplifier Connections to Power Supply



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### Differential and Common-Mode Signals Calibration Setup for Dongle Min Max Test



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### 5.1.1.3: Intra-pair skew tolerance test

This MHL Receiver test confirms that the dongle device can tolerate the maximum intra-pair skew allowed by the specification.

#### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- MHL Signal Generator: AWG7122C with option 01, 02 or 06 and 08 and Option SDX with Direct Synthesis capability, to simulate Cable emulator effect and Rise time filter effect.
- Rise time filter: 2 Picosecond Pulse labs 120PS
- Test fixture: 1 set TF-MHL-TPA-R-WOSO
- DC Power supply: PWS4205 or PWS2185
- Bias tees: 2 Mini circuits bias tees ZX85–12G-S+
- CBUS Source board: Simplay labs MHL Rx/Tx analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board
- A/V Display

Make the connection as shown in Dongle – input signal single-ended voltage level tolerance test after calibration is done.

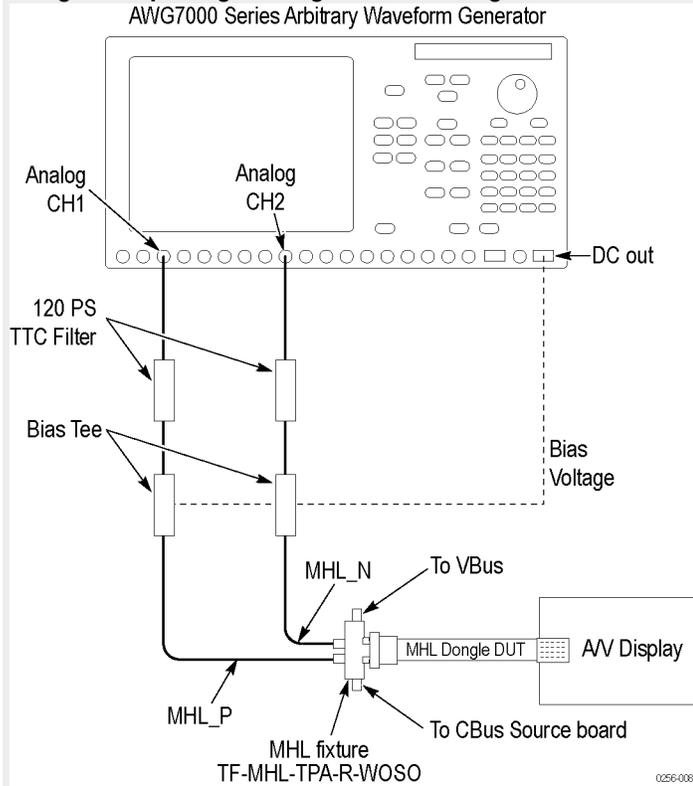
#### Measurement algorithm

The below procedure is fully automated by Tektronix MHL Compliance software (Option MHD).

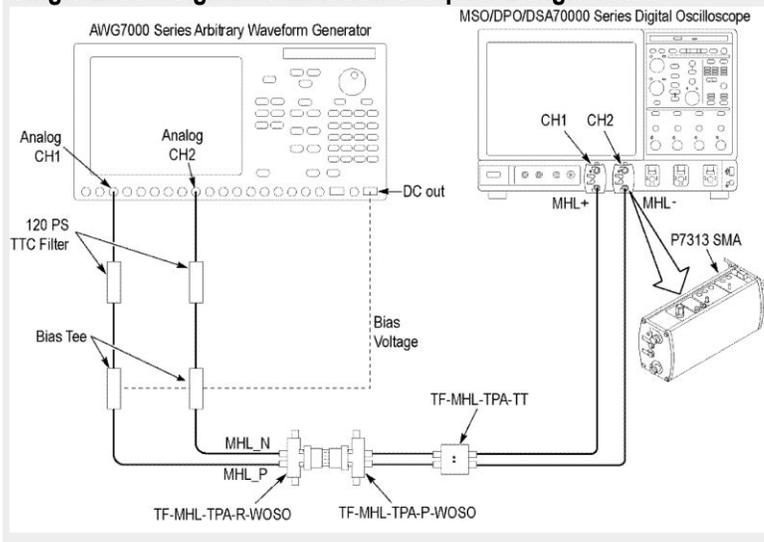
1. Connect the equipment as shown in Single-ended signals calibration setup for dongle tests and as shown in Differential & common-mode signals calibration setup for dongle tests. Set  $V_{\text{TERM}} = 3.3\text{V}$ , AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the MHL Signal Generator AWG7122C output for the following settings.
  - a. Frequency: Highest frequency supported by the Dongle DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
  - d. Swing voltages: Differential signal 800mV, Common-mode signal 540mV

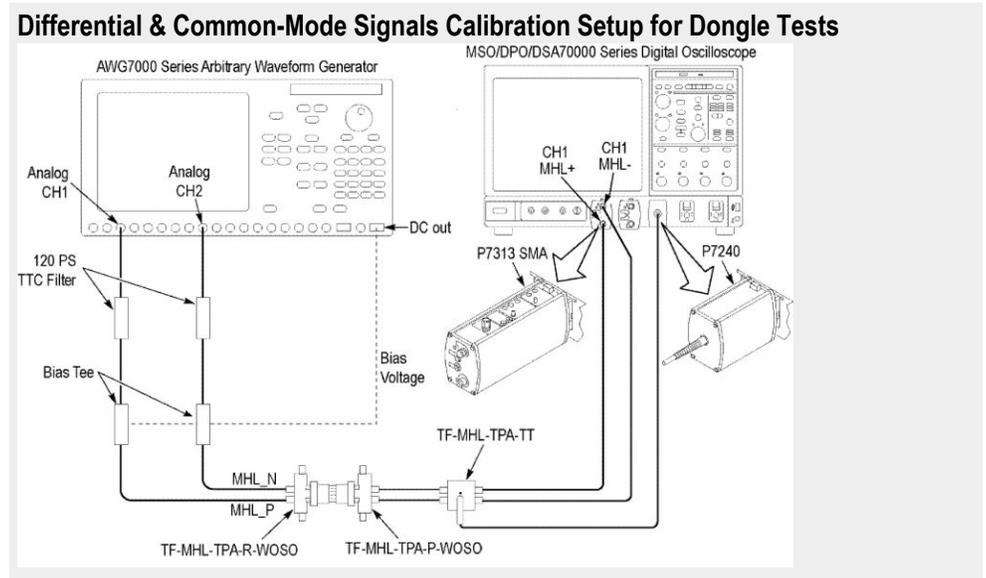
- e. DC level of the output single-ended signal:  $V_{\text{TERM}} - 750\text{mV}$
  - f. Intra-pair skew: Differential skew 0ps, Common-mode skew 0ps
1. Connect the equipment as shown in Dongle – input signal single-ended voltage level tolerance test with the CBus Source board connected to the Tektronix fixture CBus port. Provide VBus if DUT is unpowered dongle. Do not provide VBus if DUT is powered dongle.
  2. Turn on the DUT and enable the MHL mode through Device Discovery and CBUS Information Exchange with the CBUS Source board.
  3. Examine the output of the Dongle DUT on the Display.
  4. Confirm that there is no error on the display. If there is any error on the display, STOP. The test FAILED.
  5. Increase the intra-pair skew of differential signal and common-mode signal by the same amount to the maximum where error appears on the display. Make the positive channel leads the negative channel in time, which is called positive skew direction.
  6. Record the maximum intra-pair skew for the given  $V_{\text{TERM}}$ , frequency and skew direction.
  7. Set the differential and common-mode intra-pair skews to 0ps.
  8. Increase the intra-pair skew of differential signal and common-mode signal by the same amount to the maximum where error appears on the display. Make the positive channel lags the negative channel in time, which is called negative skew direction.
  9. Record the maximum intra-pair skew for the given  $V_{\text{TERM}}$ , frequency and skew direction.
  10. If the all recorded maximum intra-pair skew value is larger than the spec limit, then PASS. Otherwise FAIL

### Dongle — Input Signal Single-ended Voltage Level Tolerance Test



### Single-Ended Signals Calibration Setup for Dongle Tests





#### 5.1.1.4: Jitter tolerance test (CTS 1.X) - in normal mode (CTS 2.0 and CTS 1.3/2.1)

This MHL Receiver test confirms that the dongle device can tolerate the maximum clock and data jitter amounts allowed by the specification.

##### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- MHL Signal Generator: AWG7122C with option 01, 02 or 06 and 08 and Option SDX with Direct Synthesis capability, to simulate Cable emulator effect and Rise time filter effect.
- Rise time Filter: 2 Picosecond Pulse labs 120PS
- Test fixture: 1 set TF-MHL-TPA-R-WOSO
- DC Power supply: PWS4205 or PWS2185
- Bias Tees: 2 Mini circuits bias Tees ZX85–12G-S+
- CBUS Source board: Simplay labs MHL Rx/Tx analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board
- A/V Display

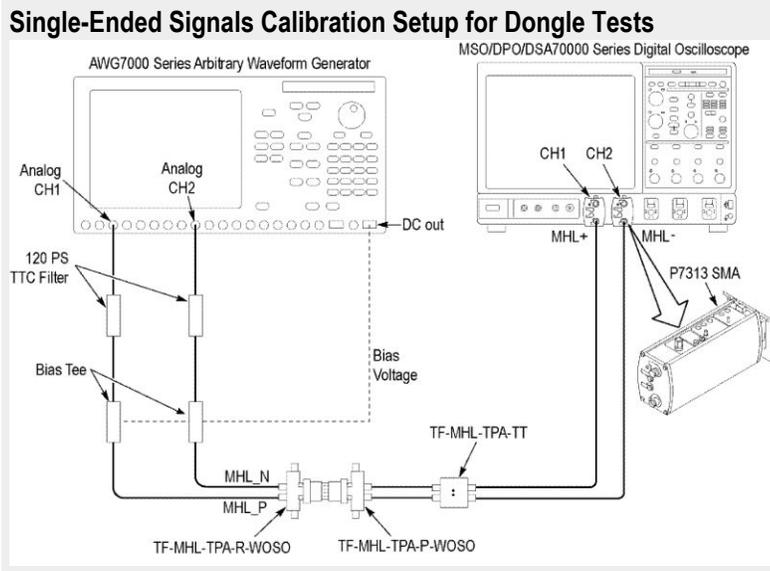
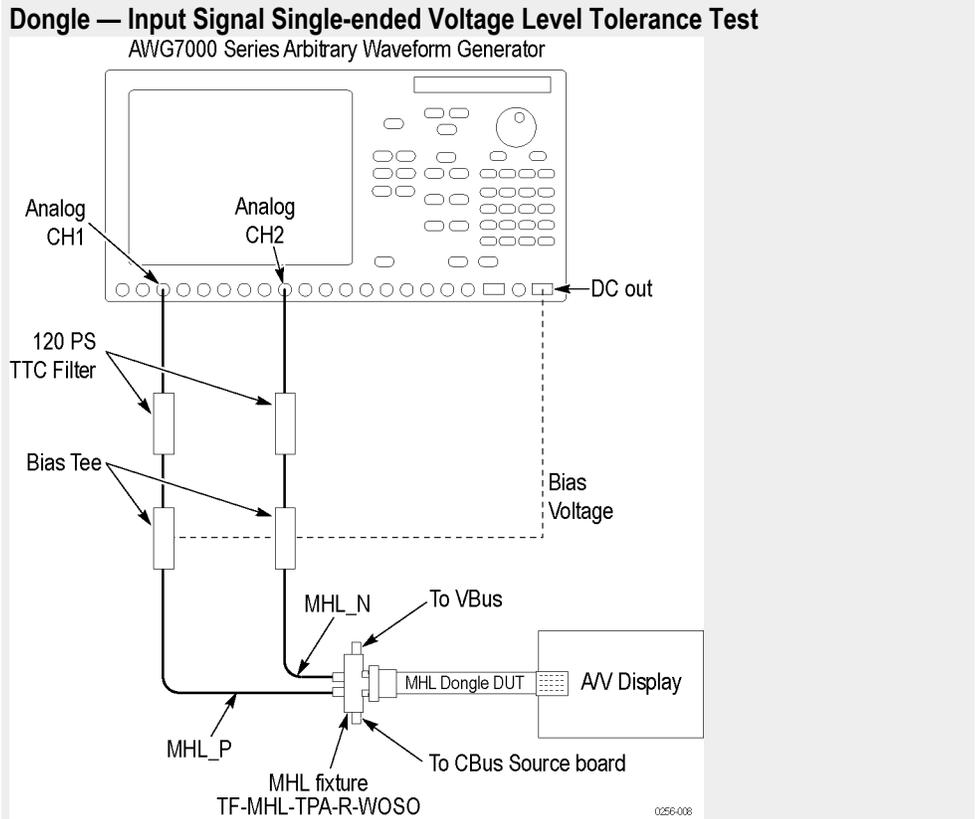
Make the connection as shown in Dongle – input signal single-ended voltage level tolerance test after calibration is done.

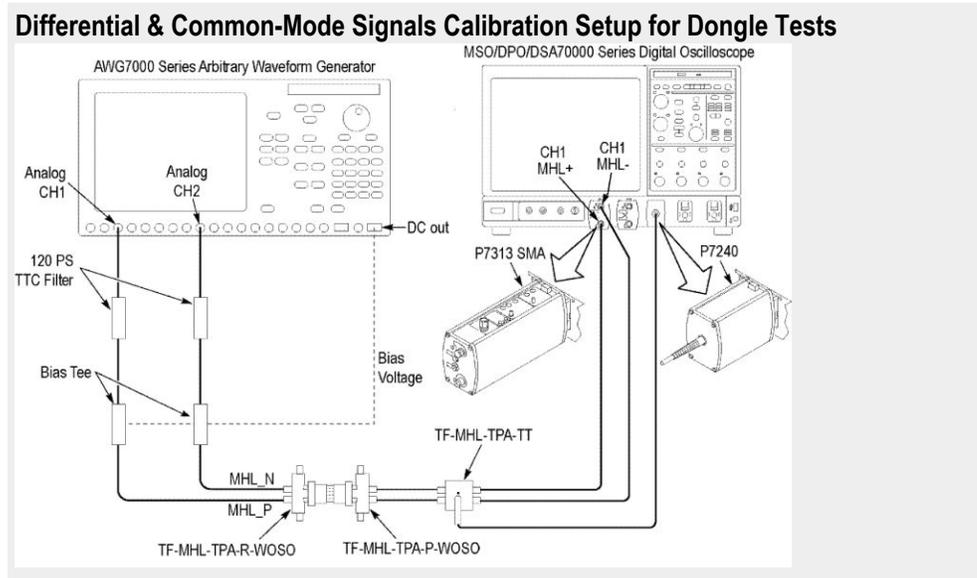
**Measurement Algorithm**

The below procedure is fully automated by Tektronix MHL Compliance Software (Option MHD).

1. Connect the equipment as shown in Single-ended signals calibration setup for dongle tests and as shown in Differential & common-mode signals calibration setup for dongle tests. Set  $V_{\text{TERM}} = 3.3\text{V}$ , AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the MHL Signal Generator AWG7122C output for the following settings.
  - a. Frequency: Highest frequency supported by the Dongle DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
  - d. Swing voltages: Differential signal 800mV, Common-mode signal 360mV
  - e. DC level of the output single-ended signal:  $V_{\text{TERM}} - 540\text{mV}$
1. Set the clock jitter frequency to 10MHz and the data jitter frequency to 500KHz. Inject clock jitter and data jitter with TP1 maximum amount specified in MHL Spec for the given frequency. 4. Adjust the differential signal swing to the marginal TP1 eye opening specified in MHL Spec for the given frequency.
2. Adjust the differential signal swing to the marginal TP1 eye opening specified in MHL Spec for the given frequency.
3. Connect the equipment as shown in Dongle – input Signal single-ended voltage level tolerance test with the CBus Source board connected to the Tektronix fixture CBus port. Provide VBus if DUT is unpowered dongle. Do not provide VBus if DUT is powered dongle.
4. Turn on the DUT and enable the MHL mode through Device Discovery and CBUS Information Exchange with the CBUS Source board.
5. Examine the output of the Dongle DUT on the Display.
6. Record error on the Display if any for the given  $V_{\text{TERM}}$ , clock frequency, jitter frequency and clock edge location.
7. Change the common-mode clock edge location by 0.1Tbit step with respect the differential data edge for 10 times and examine the Display at each step.
8. Record error on the Display if any for the given  $V_{\text{TERM}}$ , clock frequency, jitter frequency and clock edge location.
9. Repeat the above test for clock jitter frequency 7MHz and data jitter frequency 1MHz.

10. Repeat the above test for the minimum resolution supported by the DUT.
11. If there is no error on the display in all recorded results, then PASS. Otherwise FAIL.





### 5.1.1.9: Jitter tolerance test in packed pixel mode (CTS 2.0 and CTS 1.3/2.1)

This test confirms that the dongle device can tolerate the maximum clock and data jitter amounts allowed by the specification in Packed Pixel Mode.

For this test, use the same Required Test Equipment and Measurement Algorithm as

[5.1.1.4 Jitter tolerance test in normal mode](#)

---

# MHL cable group 1: Clock tests

## 7.2.1.16 Cable test: MHL minimum clock measurement

This MHL Transmitter test confirms that common-mode output voltage swing amplitude is within the specified limits when the DUT operates in normal mode.

### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P313SMA and one P7240
- Test fixture: TPA-P source with micro USB, pluggable to be used for source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS Source board: Simplay labs MHL Rx/Tx Analyzer SL-860 (Sink DUT Port) or TF-MHL-CBS2-SOSI Tektronix board

Connect the equipment as shown in the [single ended measurement after using the respective fixture and cable under test](#) connection diagram.

### Measurement algorithm

TekExpress MHL automatically executes the algorithm described below.

1. Acquire the waveform MHL +ve and MHL-ve as single ended waveform.
2. The source waveform is embedded with Skew effect of +43 psec on MHL +ve and MHL- Ve channel using software filters.
3. The Clock waveform is derived using the Math operation. The 500 MHz band limit filter is then applied on the clock waveform, and then the equalizer is applied.
4. Consider the data point in the region of 3 unit intervals from the Rise transition for  $V_{High}$  and Fall transition for  $V_{Low}$ .
5. Average the respective  $V_{High}$  and  $V_{Low}$  for 10,000 regions and get  $V_{High}$  and  $V_{Low}$  measurements.
6. Calculate  $V_{CMSING}$  for given  $V_{TERM}$ .
7. The source waveform is embedded with Skew effect of -43 psec on MHL +ve and MHL- Ve channel using software filters.
8. Steps 3 to 6 are repeated for the waveform obtained in step 7 for -43 psec skew.



---

# MHL cable group 2: Data tests

## 7.2.1.17 Cable test: eye diagram test

This test confirms that the TP2 Data output has a signal quality that meets the eye opening required by the specification in Normal Mode.

---

**NOTE.** *If the TP2 Data Eye diagram test fails due to mask hits, TekExpress MHL Solution provides the option to the user to move the mask horizontally to achieve zero or minimal hits. Refer to the [Mask movement](#) procedure.*

---

### Required test equipment

In addition to the DUT and high-bandwidth digital oscilloscope, you will need the following equipment:

- Two probes: one P313SMA and one P7240
- Test fixture: TPA-P source with micro USB, pluggable to be used for source testing
- Power supply: PWS4205 or PWS2185 (to be used if an external power supply-based test setup is used)
- CBUS: CBUS Sink adapter board

Connect the equipment as shown in the [single-ended measurement](#) connection diagram.

### Measurement algorithm

TekExpress MHL automatically executes the algorithm described below.

1. Acquire the waveform MHL +ve and MHL-ve as single ended waveform.
2. Create the differential data using the math operation and then apply the equalizer for the data signal.
3. The Clock waveform is deduced using the math operation, and then applies the 500 MHz band limit filter on the clock waveform and then applies the equalizer.
4. For Explicit-Clock clock recovery, the process is performed on an explicitly identified source. If the signal is Clock Type, the application recovers the clock and creates it using the Jitter transfer function.
5. Plot the Eye diagram for the Differential data signal with the recovered clock from the Common-mode signal. The reference clock is scaled down, so set the clock multiplier to 40 in packed pixel mode.
6. Measure the Eye opening (EYE width) measurement and deduce the Jitter as UI- EYE width.
7. Perform steps 1 to 6 without applying the cable equalizer in step 2 and 3 on the data and clock signal.

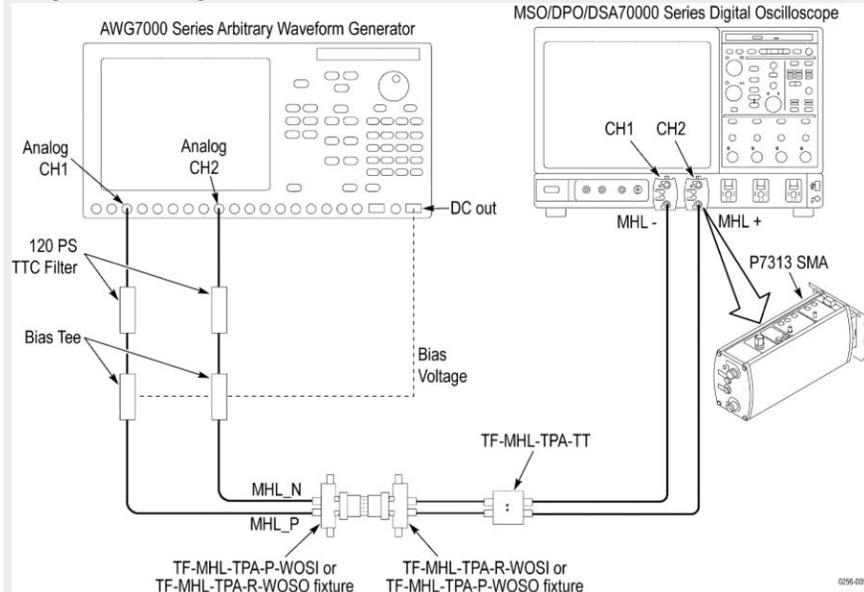
**Measurement algorithm**

The below procedure is fully automated by Tektronix MHL Compliance Software (Option MHD).

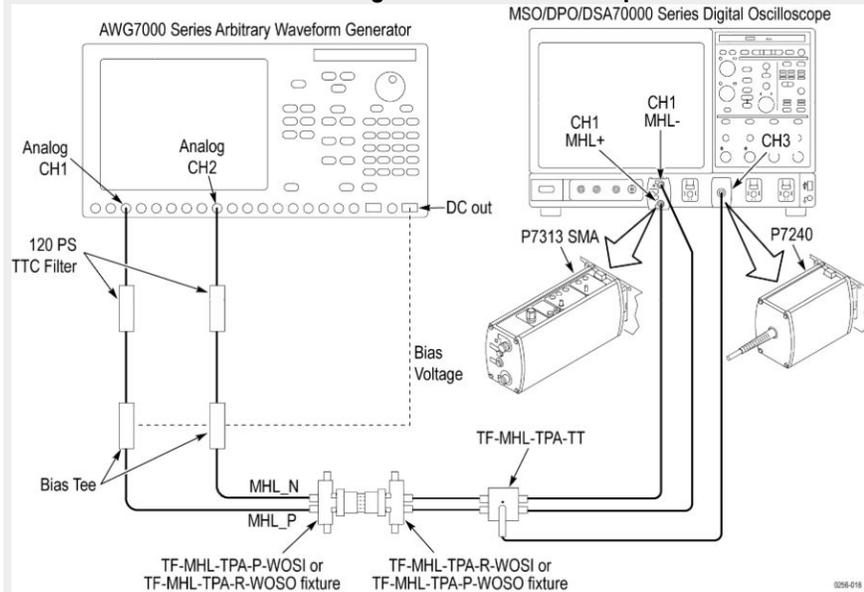
1. Connect the equipment as shown in single-ended signals calibration setup for dongle tests and as shown in differential & common-mode signals calibration setup for dongle tests. Set  $V_{\text{TERM}} = 3.3\text{V}$ , AWG Ch1 transmitting MHL+ and AWG Ch2 transmitting MHL- signals. Ensure the Bias Tees are used at the output of the AWG channels along with 120ps filters.
2. Calibrate the MHL Signal Generator AWG7122C output for the following settings. (Calibration of differential and common-mode signals).
  - a. Frequency: Highest frequency supported by the Dongle DUT
  - b. Pattern: MHL Gray Ramp data streams
  - c. Rise/fall times:
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
    - Less than or equal to 2.25Gbps  
Differential signal 200ps (20% - 80%),  
Common-mode signal 600ps (20% - 80%)
  - d. Swing voltages: Differential signal 800mV, Common-mode signal 540mV e.
1. Adjust the DC level of the MHL Signal Generator AWG7122C so that  $V_{\text{SE\_HIGH}} = V_{\text{TERM}} + 10\text{ mV}$ ,  $V_{\text{SE\_HIGH}} = V_{\text{TERM}} - 540\text{ mV}$ ,  $V_{\text{SE\_LOW}} = V_{\text{TERM}} - 700\text{ mV}$  and  $V_{\text{SE\_LOW}} = V_{\text{TERM}} - 1760\text{ mV}$ . Record the DC level setting for each single-ended value setting. (Calibration of single-ended signals)
2. Connect the equipment as shown in dongle – input signal single-ended voltage level tolerance test with CBus Source board connected to Tektronix fixture CBus port. Provide VBus if DUT is unpowered dongle. Do not provide VBus if DUT is powered dongle.
3. Turn on the DUT and enable the MHL mode through Device Discovery and CBUS Information Exchange with the CBUS Source board.
4. Adjust the DC level of the MHL Signal Generator AWG7122C output so that  $V_{\text{SE\_HIGH}} = V_{\text{TERM}} + 10\text{ mV}$ .
5. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{\text{TERM}}$ , frequency and single-ended voltage.
1. Adjust the DC level of the output so that  $V_{\text{SE\_HIGH}} = V_{\text{TERM}} - 540\text{ mV}$ .
2. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{\text{TERM}}$ , frequency and single-ended voltage.
3. Adjust the DC level of the output so that  $V_{\text{SE\_LOW}} = V_{\text{TERM}} - 700\text{ mV}$ .
4. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{\text{TERM}}$ , frequency and single-ended voltage.

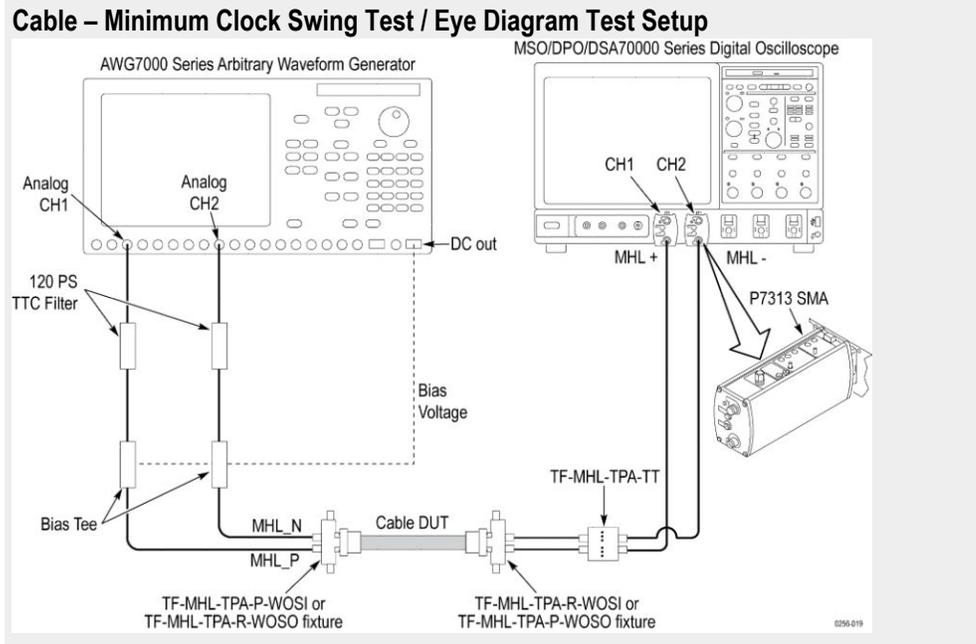
5. Adjust the DC level of the output so that  $V_{SE\_LOW} = V_{TERM} - 1760 \text{ mV}$ .
6. Examine the output of the Dongle DUT on the Display.
  - Record errors on the display if any for the given  $V_{TERM}$ , frequency and single-ended voltage.
7. If there is no error on the display in all recorded results, then PASS. Otherwise FAIL.

### Single-Ended Signals Calibration Setup for Cable Tests



### Differential & Common-Mode Signals Calibration Setup for Cable Tests



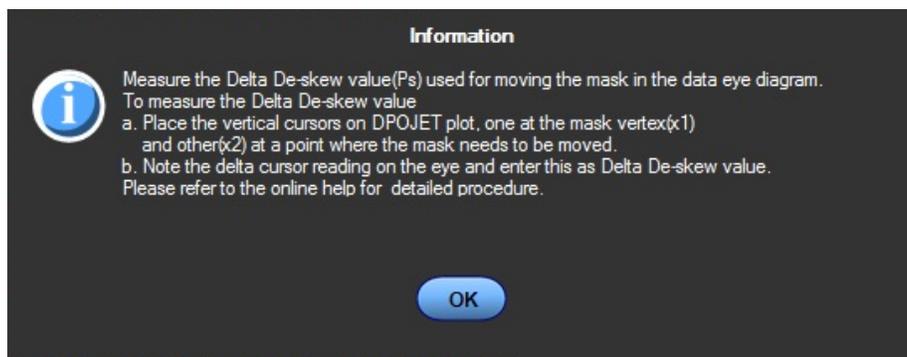


# Reference

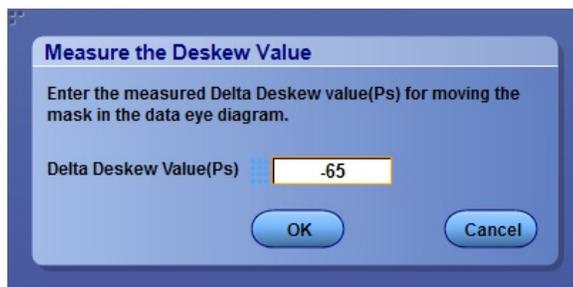
## MHL data eye diagram test - mask movement

When performing the MHL Data Eye Diagram test (Transmitter), if the test fails due to mask hits, you are presented with a dialog box to enter a timing value that will be used to shift the Mask horizontally, thus allowing the test to pass. You will have up to three opportunities to adjust the mask position. If after three attempts, and the test still fails due to any mask hits, the test will stop and report the test as failed.

The first message you see when the Eye Diagram tests fails due to mask hits provides a short description of what you need to adjust the mask position.



After you select OK, the Measure the Deskew Value pop-up dialog box displays. Once you determine how the amount of time (in pico seconds) to shift the mask horizontally, enter the value here. To determine the amount of deskew time, use the procedure [Moving the Mask](#).

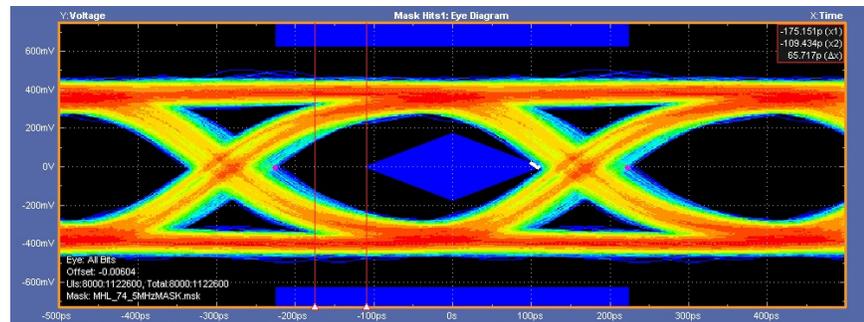


## Moving the Mask

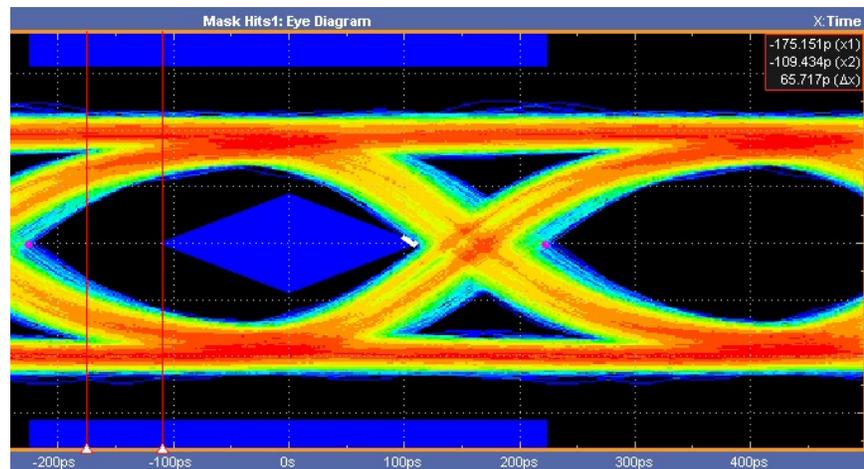
Before you enter a value in the Delta Deskew Value pop-up dialog box, you first need to measure the amount of timing shift required to move the mask horizontally.

1. Observe the eye diagram plot and locate the mask hits.

In the example, you can see the mask hits. You can move the mask towards the right or left horizontally by entering the positive or negative de-skew values appropriately.

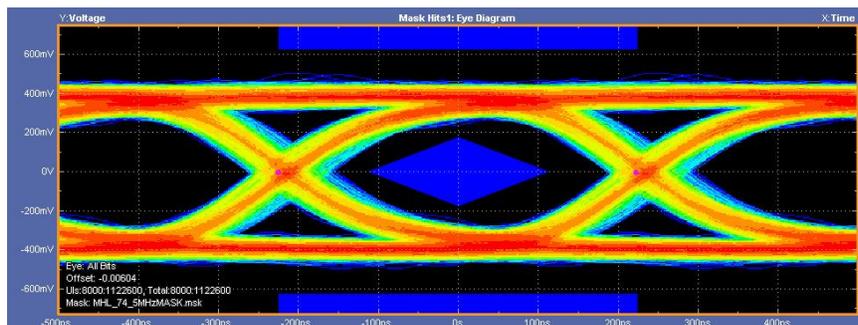


2. Using the delta cursors, measure the amount of time you want to shift the mask. In the example, we've measured that we want to shift the mask -65 ps.



- Enter the Delta Deskew Value in the pop-up dialog box and click OK. This causes the MHL TekExpress solution to perform the test again.

Observe that the Eye Diagram is rendered again after shifting the mask. You can see that there are no mask hits.



**NOTE.** If the test fails again due to mask hits, you will have two more attempts (three total) to adjust the position of the mask.

- Viewing the Results screen shows that the MHL Data Eye Diagram test now passes.

TekExpress MHL - (Untitled)\*

Options

Setup Status Results Reports

Overall Test Result

Test Name	Pass/Fail	Details	TBit	VTerm	Value	Margin
3.1.1.12 MHL Data Eye Diagram	Pass	Data Jitter at VTerm(Min) at 74.25	448.93 ps	3.135 V	125.0884	98.4721
3.1.1.12 MHL Data Eye Diagram	Pass	Mask hits at VTerm(Min) at 74.25	448.93 ps	3.135 V	0	0

Stop Pause Clear

See also [3. 1. 1. 12: MHL Data Eye Diagram Test](#)

## Map the My TekExpress folder

Map the shared My TekExpress folder as X: (X drive) on all instruments used in test setup running Microsoft Windows Operating System. The My TekExpress folder has the shared name format <domain><user ID>My TekExpress. Or, if the instrument is not connected to a domain, then the share name format is <instrument name><user ID> My TekExpress. This shared folder is used to save the waveform files and is used during any other file transfer operations.

To map the My TekExpress folder on the instruments, follow these steps:

1. Open Windows Explorer.
2. From the Windows Explorer menu, click **Computer**.
3. In the menu bar, click **Map network drive**.
4. Select the Drive letter as **X:** (if there is any previous connection on X:, disconnect it first through **Tools > Disconnect Network drive** menu of Windows Explorer. Windows 7 users: if you do not see the Tools menu, press the **Alt** key).
5. In the Folder field, enter the remote My TekExpress folder path (for example, \\192.158.97.65\My TekExpress)
6. Click **Finish**.

To determine the IP address of the instrument where the My TekExpress folder exists, do the following:

1. On the instrument where the My TekExpress folder exists, click **Start** and select **Run**.
2. Type “cmd” and then press **Enter**.
3. At the command prompt, type “ipconfig” and then press **Enter**.

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