

R&S®RTP-K110

HDMI Compliance Test

User Manual



1179319602
Version 02

ROHDE & SCHWARZ
Make ideas real



This document describes the HDMI compliance test procedures of the following option:

- R&S®RTP-K110 (1802.9467.02)

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1179.3196.02 | Version 02 | R&S®RTP-K110

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®ScopeSuite is indicated as R&S ScopeSuite.

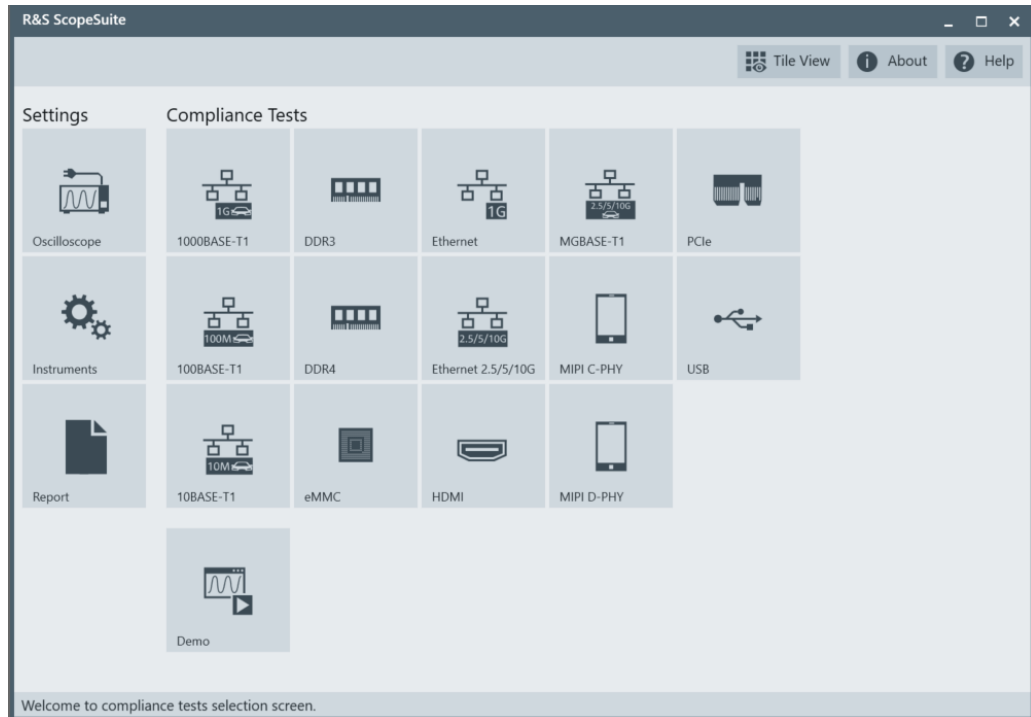
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1 R&S ScopeSuite overview

The R&S ScopeSuite software is used with R&S RTP oscilloscopes. It can be installed on a test computer or directly on the oscilloscope. For system requirements, refer to the Release Notes.



The R&S ScopeSuite main panel has several areas:

- "Settings": connection settings to oscilloscope and other instruments also default report settings
 - "Compliance Tests": selection of the compliance test
 - "Demo": accesses demo test cases that can be used for trying out the software without having a connection to an oscilloscope
 - "Help": opens the help file, containing information about the R&S ScopeSuite configuration
 - "About": gives information about the R&S ScopeSuite software
 - "Tile View": allows a personalization of the compliance test selection
You can configure which tests are visible in the compliance test section and which are hidden, so that only the ones you use are displayed.
- To hide a test from the "Compliance Tests" view, do one of the following:

- a) Right-click on the compliance test you want to hide.
The icon of the test changes, see [Figure 1-1](#). Now with a left click you can hide the test.

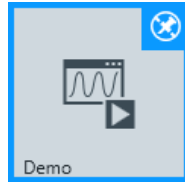


Figure 1-1: Unpin icon

- b) Click on "Title View" to show a list of the available test cases. By clicking a test case in the show list, you can pin/unpin it from the main panel.

2 Preparing the measurements

2.1 Test equipment

For HDMI compliance tests, the following test equipment is needed:

- R&S RTP with 4 channels and minimum 8 GHz bandwidth
- R&S RTP-K110 HDMI compliance test option (required option, installed on the R&S RTP)
- 2 modular probes, R&S ZM160 with 9 GHz bandwidth.
- 2 modular probe tips R&S RT-ZMA40
- HDMI Termination Module and an HDMI TPA adapter
- EDID Emulator
- R&S RTP-K140/-K141 High Speed Serial Triggering 8G/16G is required for:
 - HDMI 2.1 TMDS: Differential Voltage Mask Tests
 - Jitter Mask Tests
 - Inter-Pair Skew
- The free-of-charge R&S ScopeSuite software, which can be installed on a computer or directly on the R&S RTP.

2.2 Installing software and license

The preparation steps are performed only once for each computer and instrument that are used for testing.



Uninstall older versions of the R&S ScopeSuite

If an older version of the R&S ScopeSuite is installed, make sure to uninstall the old version before you install the new one. You can find the version number of the current installation in "Help" menu > "About". To uninstall the R&S ScopeSuite, use the Windows "Control Panel" > "Programs".

For best operation results, we recommend that the installed firmware versions of the R&S ScopeSuite and the oscilloscope are the same.

To install the R&S ScopeSuite

1. Download the latest R&S ScopeSuite software from the "Software" section on the Rohde & Schwarz R&S RTP website:
www.rohde-schwarz.com/product/rtp.html
www.rohde-schwarz.com/product/rto.html
2. Install the R&S ScopeSuite software:

- On the computer that is used for testing, or
- On the R&S RTP.

For system requirements, refer to the Release Notes.

To install the license key on the R&S RTP

- ▶ When you got the license key of the compliance test option, enable it on the oscilloscope using [Setup] > "SW Options".
For a detailed description, refer to the R&S RTP user manual, chapter "Installing Options", or to the online help on the instrument.

2.3 Setting up the network

If the R&S ScopeSuite software runs on a test computer, the computer and the testing oscilloscope require a LAN connection.

There are two ways of connection:

- LAN (local area network): It is recommended that you connect to a LAN with DHCP server. This server uses the Dynamic Host Configuration Protocol (DHCP) to assign all address information automatically.
If no DHCP server is available, assign fixed IP addresses to all devices.
- Direct connection of the instruments and the computer or connection to a switch using LAN cables: Assign fixed IP addresses to the computer and the instruments and reboot all devices.

To set up and test the LAN connection

1. Connect the computer and the instruments to the same LAN.
2. Start all devices.
3. If no DHCP server is available, assign fixed IP addresses to all devices.
4. Ping the instruments to make sure that the connection is established.
5. If VISA is installed, check if VISA can access the instruments.
 - a) Start VISA on the test computer.
 - b) Validate the VISA address string of each device.

See also:

- [Chapter 2.5, "Connecting the R&S RTP"](#), on page 9

2.4 Starting the R&S ScopeSuite

To start the R&S ScopeSuite on the test computer or on the oscilloscope:

- ▶ Double-click the R&S ScopeSuite program icon.

To start the R&S ScopeSuite on the instrument, in the R&S RTP firmware:

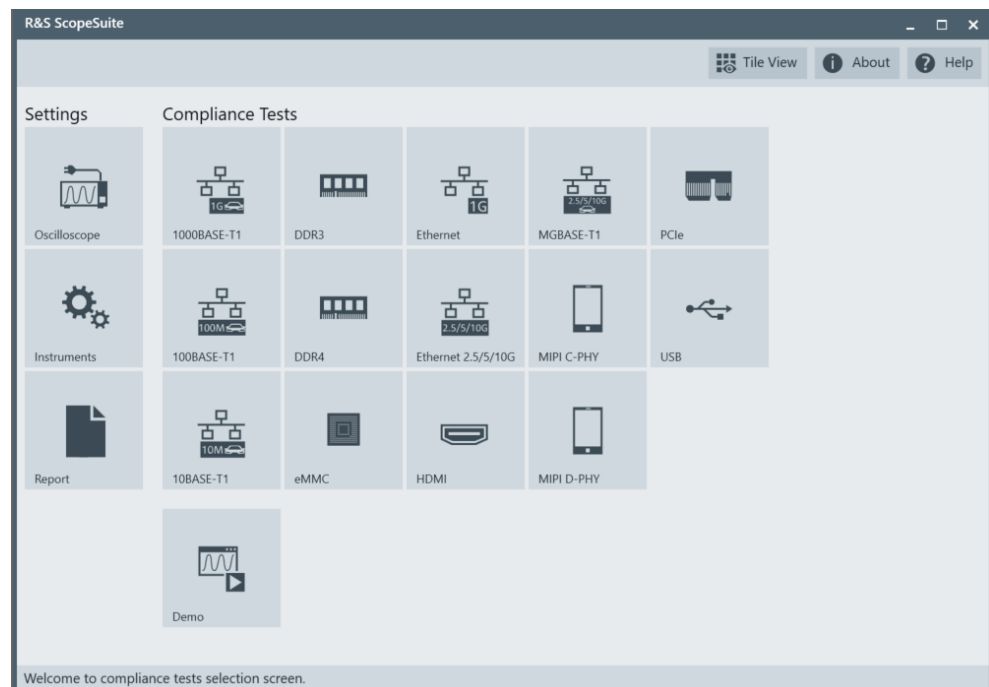
- ▶ In the "Apps" dialog, open the "Compliance" tab.

2.5 Connecting the R&S RTP

If the R&S ScopeSuite is installed directly on the instrument, the software detects the R&S RTP firmware automatically, and the "Oscilloscope" button is not available in the R&S ScopeSuite.

If the R&S ScopeSuite software runs on a test computer, the computer and the testing oscilloscope require a LAN connection, see [Chapter 2.3, "Setting up the network"](#), on page 8. The R&S ScopeSuite software needs the IP address of the oscilloscope to establish connection.

1. Start the R&S RTP.
2. Start the R&S ScopeSuite software.
3. Click "Settings" > "Oscilloscope".

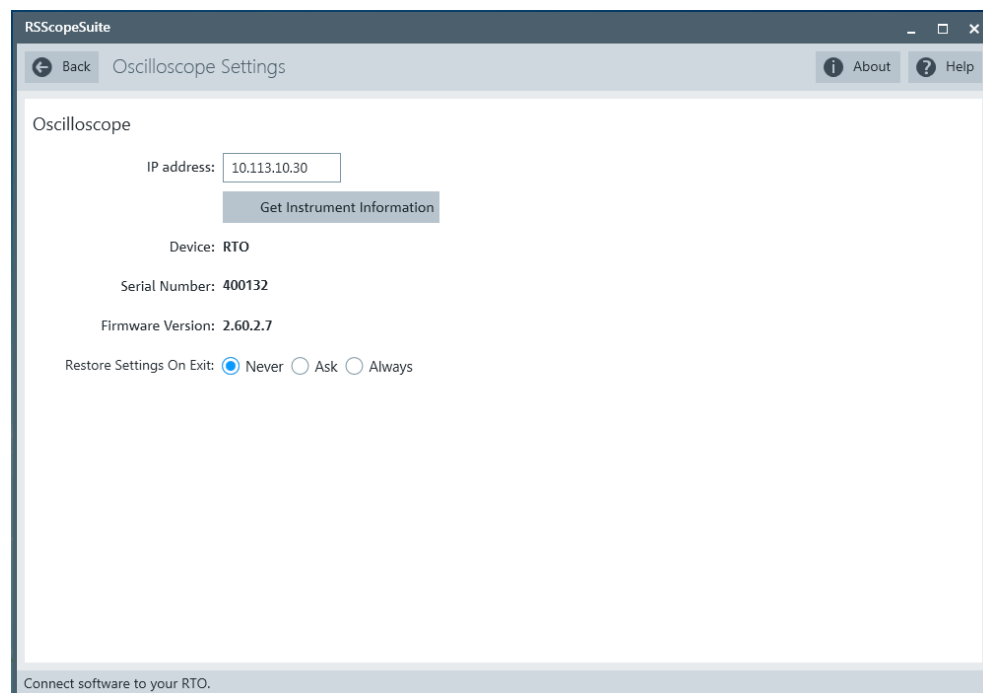


4. Enter the IP address of the oscilloscope.

To obtain the IP address: press the Rohde & Schwarz logo at the top-right corner of the oscilloscope's display.

5. Click "Get Instrument Information".

The computer connects with the instrument and gets the instrument data.

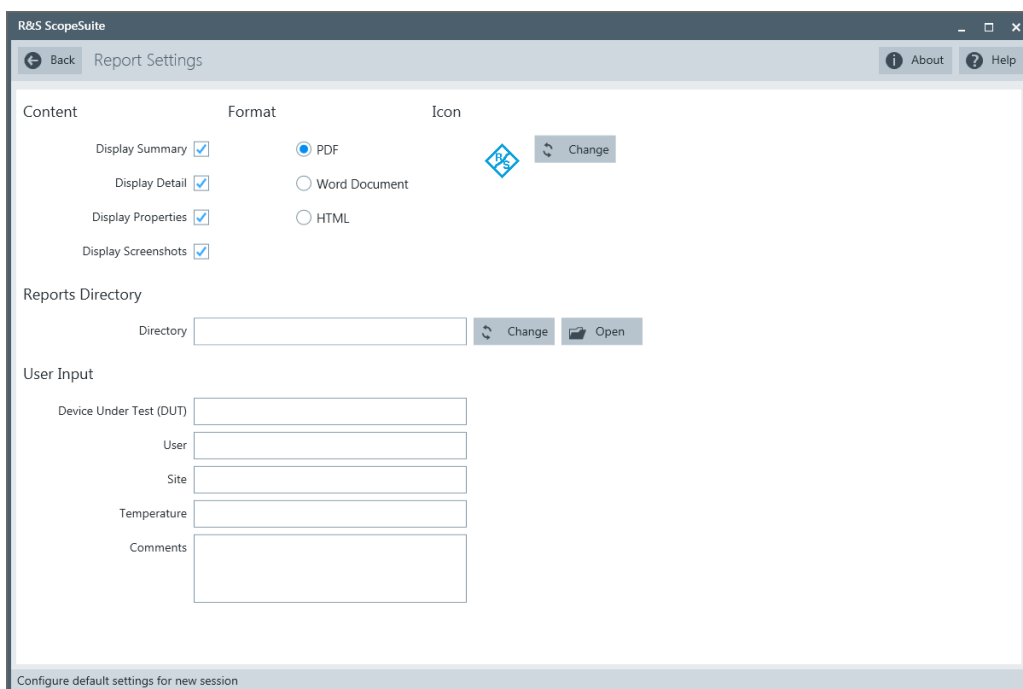


If the connection fails, an error message is shown.

2.6 Report configuration

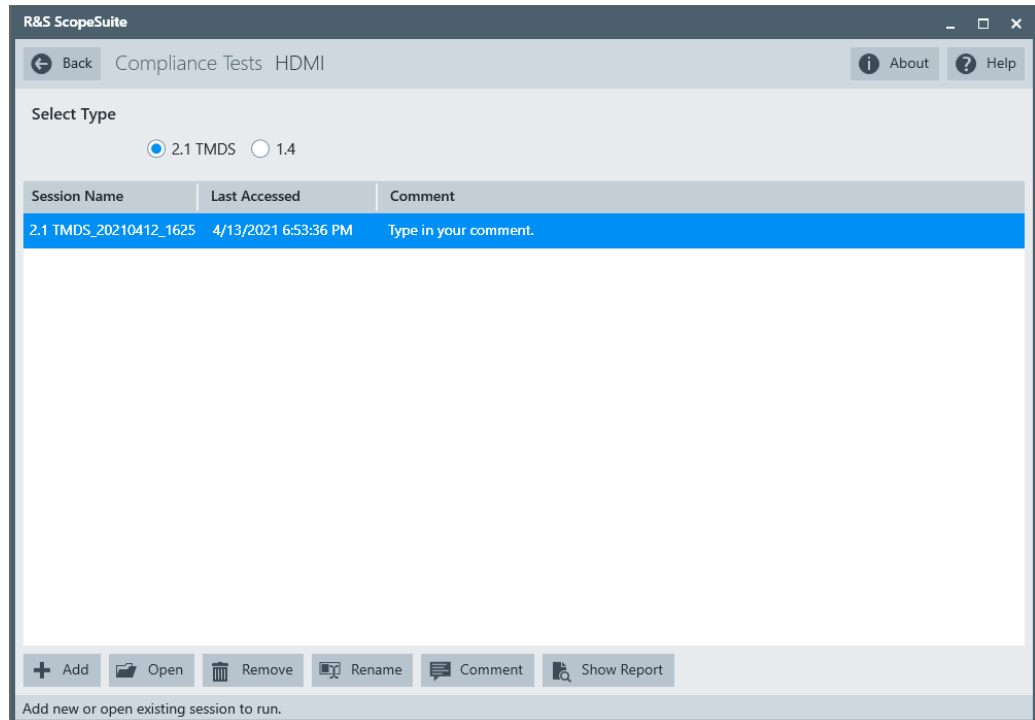
In the "Report Configuration" menu, you can select the format of the report and the details to be included in the report. You can also select an icon that is displayed in the upper left corner of the report.

Also, you can enter common information on the test that is written in the "General Information" section of the test report.



3 Performing tests

3.1 Starting a test session



After you open a compliance test, the "Session Selection" dialog appears. In this dialog, you can create new sessions, open or view existing report.

The following functions are available for handling test sessions:

Function	Description
"Add"	Adds a new session
"Open"	Opens the selected session
"Remove"	Removes the selected session
"Rename"	Changes the "Session Name"
"Comment"	Adds a comment
"Show report"	Generates a report for the selected session

To add a test session

1. In the R&S ScopeSuite window, select the compliance test.
2. In the "Session Selection" dialog press "Add".
3. If necessary change the "Session Name"

To open a test session

1. In the R&S ScopeSuite window, select the compliance test.
2. In the "Session Selection" dialog, select the session you want to open and double click on it.
Alternatively, select the session and press "Open".

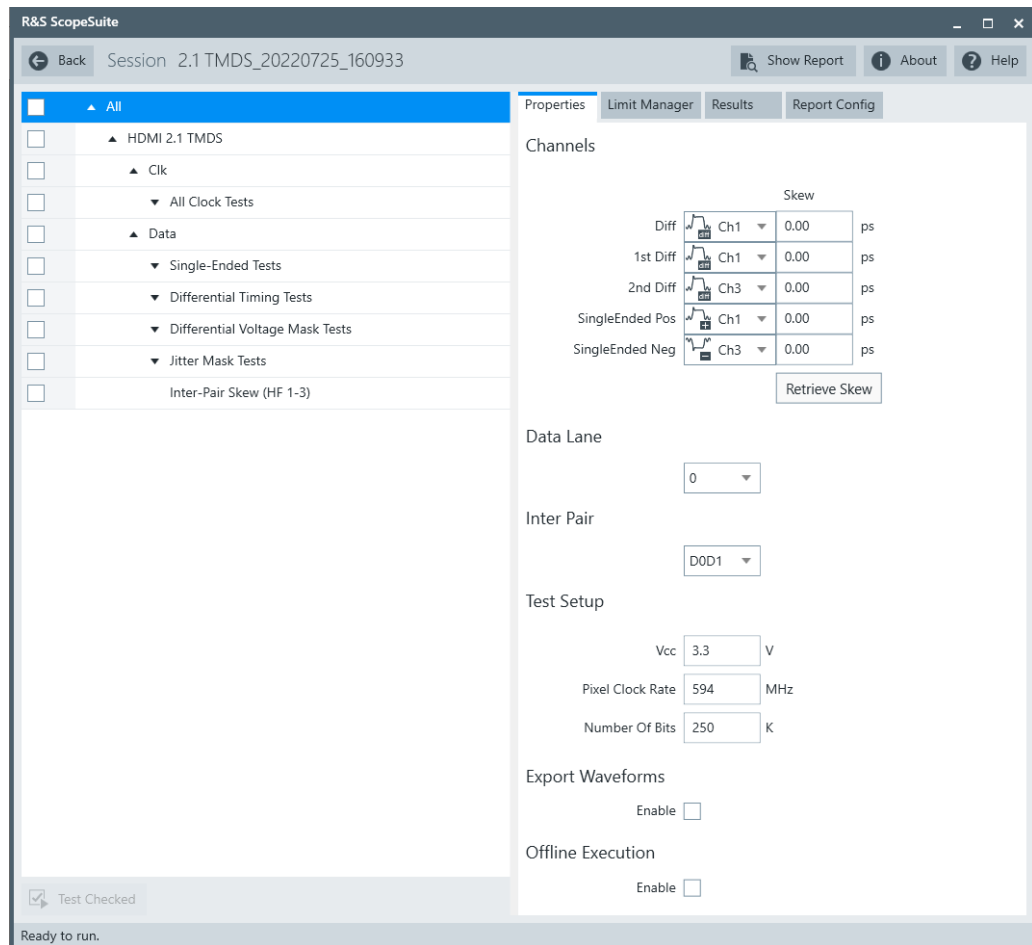
To show a report for a test session

1. In the R&S ScopeSuite window, select the compliance test.
2. In the "Session Selection" dialog, select the session you want the report for and press "Show report".

3.2 Configuring the test

1. In the R&S ScopeSuite window, select the compliance test to be performed:
 - "HDMI"
2. Open a test session, see [Chapter 3.1, "Starting a test session"](#), on page 12.
3. Adjust the "Properties" settings for the test cases you want to perform.
4. Click "Limit Manager" and edit the limit criteria, see [Chapter 3.2.1.1, "Limit manager"](#), on page 15.
5. If you want to use special report settings the "Report Config" tab to define the format and contents of the report. Otherwise the settings defined in "RSScopeSuite" > "Settings" > "Report" are used. See [Chapter 2.6, "Report configuration"](#), on page 10.
6. Click "Test Checked"/"Test Single" and proceed as described in the relevant test case chapter.

3.2.1 General test settings



Each session dialog is divided into several sections:

- "Properties": shows the settings that can be made for the test case selected on the left side of the dialog. You can differentiate between the "All" and the sub test properties
In the "All" > "Properties" tab you can configure the settings for all test cases in the current session. Once you change and save a setting in this tab, the changes will be done for all test in the sessions. At the same time, there will be a special marking for the functions that have different settings for different sub tests.
- "Limit Manager": sets the measurement limits that are used for compliance testing, see [Chapter 3.2.1.1, "Limit manager"](#), on page 15.
- "Results": shows an overview of the available test results for this session.
- "Instruments": defines instruments settings for connecting to external devices, that are specific for this test session.
When a session is first created the global settings ("RScopeSuite" > "Settings" > "Instruments") are copied to the session. This "Instruments" tab can be used to change those copied defaults.
- "Report Config": defines the format and contents of the report for this session.

When a session is first created the global settings ("RSScopeSuite" > "Settings" > "Report") are copied to the session. This "Report Config" tab can be used to change those copied defaults.

- "Test Checked"/ "Test Single": starts the selected test group.

3.2.1.1 Limit manager

The "Limit Manager" shows the measurement limits that are used for compliance testing.

Each limit comprises the comparison criterion, the unit, the limit value A, and a second limit value B if the criterion requires two limits.

You can set the values to defaults, change the values in the table, export the table in xml format, or import xml files with limit settings.

- ▶ Check and adjust the measurement limits.

Measurement	Criteria	Unit	A	B
Clock Duty Cycle Maximum	x<=A	%	60	
Clock Duty Cycle Minimum	x>=A	%	40	
Clock Fall Time	x>=A	s	7.5E-11	
Clock Intra-Pair Skew	x<=A	%	15	
Clock Jitter	x<=A	%	30	
Clock Rate	A<x<B	Hz	8.5E+07	1.5E+08
Clock Rise Time	x>=A	s	7.5E-11	
Clock VI Negative	A<=x<=B	V	2.3	3.1
Clock VI Positive	A<=x<=B	V	2.3	3.1
Clock Vh Negative	A<=x<=B	V	2.9	3.31
Clock Vh Positive	A<=x<=B	V	2.9	3.31
Clock Vswing Negative	A<=x<=B	V	0.2	0.6
Clock Vswing Positive	A<=x<=B	V	0.2	0.6
Clock Vswing TP1	A<=x<=B	V	0.4	1.2
Data Fall Time	x>=A	s	4.25E-11	
Data Inter-Pair Skew	x<=A	%	20	
Data Intra-Pair Skew	x<=A	%	15	
Data Mask Test	Ignore			
Data Maximum Differential Voltage	x<=A	V	0.78	
Data Minimum Differential Voltage	x>=A	V	-0.78	
Data Rise Time	x>=A	s	4.25E-11	
Data VI Negative	x>=A	V	2.3	
Data VI Positive	x<=A	V	2.9	
Data Vswing Negative	x>=A	V	0.4	
Data Vswing Positive	x<=A	V	0.6	

3.3 Initiating the test

To perform compliance tests, the device under test is connected to the test board in a test-specific way. Using a probe, the test board is connected with the R&S RTP. The probe connections are test-specific. The R&S ScopeSuite guides you step-by-step through the connection setup and the test sequence.

1. Set the test setup on a nonconductive, static-approved work surface.
2. In the R&S ScopeSuite window, select the compliance test.
3. Open a test session, see [Chapter 3.1, "Starting a test session"](#), on page 12.
4. Check the test configuration settings and adjust, if necessary. See: [Chapter 3.2, "Configuring the test"](#), on page 13.
5. Click "Test Checked" for starting all checked test cases or "Test Single" for starting only the selected test case.

The R&S ScopeSuite test wizard explains the following individual setup steps. A detailed test description can be found in the following chapters:

- [Chapter 4, "HDMI 1.4 tests"](#), on page 20
- [Chapter 5, "HDMI 2.1 TMDS tests"](#), on page 30

3.4 Getting test results

If you resume an existing session, new measurements are appended to the report, new diagrams and waveform files are added to the session folder. Existing files are not deleted or replaced. Sessions data remain until you delete them in the "Results" tab of the session.

The report format can be defined in "RSScopeSuite" > "Settings" > "Report" for all compliance tests (see also [Chapter 2.6, "Report configuration"](#), on page 10). If you want to use special report settings for a session, you can define the format and contents of the report in the "Report Config" tab of the session.

All test results are listed in the "Results" tab. Reports can be provided in PDF, MSWord, or HTML format. To view and print PDF reports, you need a PDF viewer, for example, the Acrobat Reader.

The test report file can be created at the end of the test, or later in the "Session Selection" dialog.

To show a test report

1. In the R&S ScopeSuite window, select the compliance test to be performed.
2. Select the session name in the "Session Selection" dialog and click "Show report".
The report opens in a separate application window, depending on the file format. You can check the test results and print the report.

To delete the results, diagrams and waveform files of a session

1. In the "Session Selection" dialog select the session and open it.
2. In the "Results" tab, select the result to be deleted.
3. Click "Remove".

3.5 Starting HDMI tests

Before you run the test, complete the following actions:

- LAN connection of the oscilloscope and the computer running the R&S ScopeSuite, see [Chapter 2.5, "Connecting the R&S RTP"](#), on page 9
1. Select "HDMI" in the R&S ScopeSuite start window.
 2. In the "Session Selection" dialog, set the "Select Type" standard. The following "Types" are available:
 - "2.1 TDMS":
 - "1.4":
 3. Add a new test session.
 4. Open the session. For details, see [Chapter 3.1, "Starting a test session"](#), on page 12.
 5. Check the test configuration settings. Adjust, if necessary. See:
 - [Chapter 3.6, "Test configuration for HDMI"](#), on page 17
 - [Chapter 3.2.1.1, "Limit manager"](#), on page 15
 6. Select/check the test cases you want to run and click "Test Single"/"Test checked".
 7. A step-by step guide explains the following individual setup steps. When you have finished all steps of the step-by-step guide, the compliance test runs automatically.

3.6 Test configuration for HDMI

The test configuration consists of some test-specific configuration settings. The values for the settings in this tab depend on the selected version of the standard.

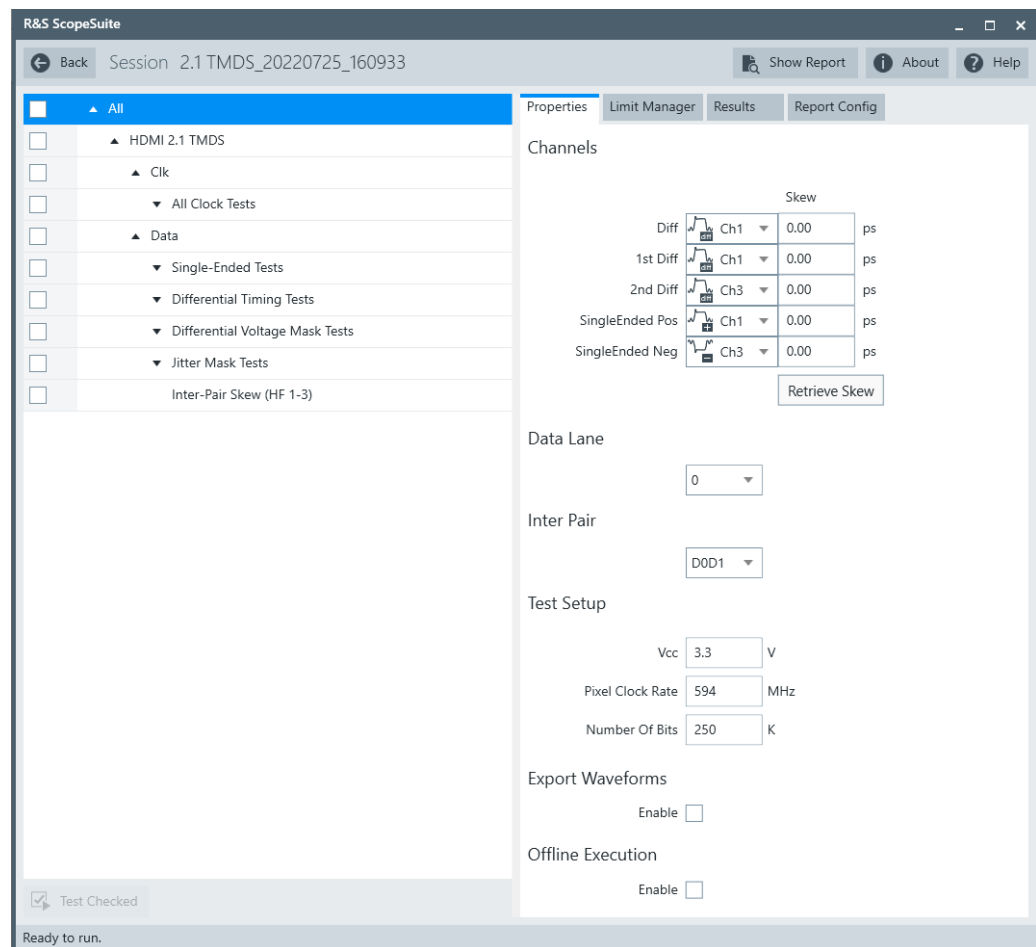


Figure 3-1: Configuration for HDMI compliance tests

Channels

In the "Channels" section you can select the channel of the probes used for the test setup and set the skew for each channel.

The skew compensates signal propagation differences between channels caused by the different length of cables, probes, and other sources.

You can set a fixed value or retrieve the skew value from the oscilloscope.

Data Lane

Selects the data lane that is tested.

Inter Pair

Selects the used inter pair skew. You can select "D0/D1", "D1/D2", "D0/D2".

V_{cc}

Voltage of the common collector.

Pixel Clock Rate

Sets the pixel clock rate. The pixel clock rate is a set of predefined values depending on the DUT settings.

For available pixel clock rates, refer to HDMI compliance test specification.

Number of Bits

Sets the number of bits.

Export Waveforms

Enables you to export a waveform. You can later load the waveforms to run the tests in the offline mode, see [Offline Execution](#).

You can define an export directory, or use the default one:

```
MyDocuments\Rohde-Schwarz\RSScopeSuite\<<Version>\Waveforms\  
<ComplianceTest>\<SubTest>\<Speed>\<SessionName>
```

For example:

```
MyDocuments\Rohde-Schwarz\RSScopeSuite\5.00.0\Waveforms\HDMI\  
2.1 TMDS\HDMI_21_20210114_144116
```

Offline Execution

If enabled, allows you to use exported waveforms as a source for the execution of the compliance test.

You can select one waveform for each needed signal.

4 HDMI 1.4 tests

4.1 Test equipment

The following equipment is needed for performing HDMI 1.4 compliance tests.

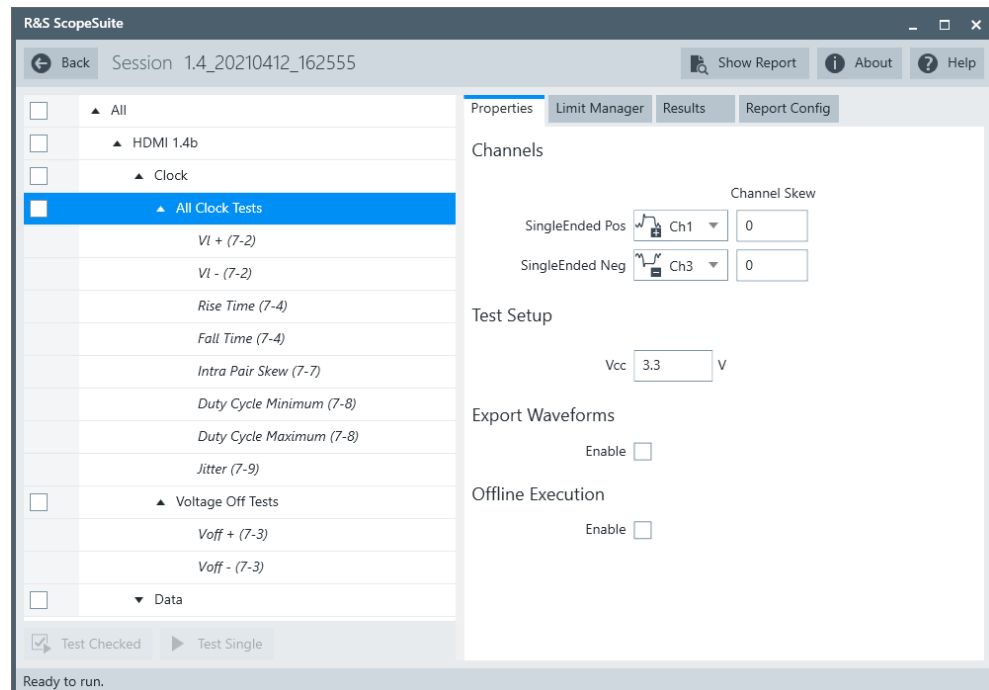
Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTP with 4 channels and minimum bandwidth 8 GHz	1
Modular probes	R&S ZM160	2
Modular probe tips	R&S RT-ZMA40	2
HDMI TPA adapter	-	1
HDMI termination module	-	1
EDID emulator	-	1
DUT	HDMI 1.4 device that supports the selected type	1
Option R&S RTP-K140/-K141	Required for the following tests: Jitter Mask Tests Inter-Pair Skew (7-6)	1

4.2 Clock tests

4.2.1 All clock tests

4.2.1.1 Performing the tests

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "1.4" > "Clock" > "All Clock Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.
6. You can also run the test in offline mode, using downloaded waveforms. For details, see ["Offline Execution"](#) on page 19.

4.2.1.2 Measurements

The measurements in the following chapter verify, if the measured values are within the limits defined in HDMI CTSv1.4b.

The "All Clock Tests" include the following measurements:

VI + (7-2)

The VL Clock+ test verifies that the DC voltage levels for each TMDS clock signal on the HDMI link are within the limits. The test is passed, if the maximum VI+ is below 2.9 V.

VI - (7-2)

The VL Clock-test verifies that the DC voltage levels for each TMDS clock signal on the HDMI link are within the limits.

Rise Time/Fall Time

The test verifies that the rise times on the TMDS differential signals are within the limits:

Table 4-1: Rise Time/Fall Time

Symbol	Min
T_{rise}	75 ps
T_{fall}	75 ps

Intra Pair Skew (7-7)

The Intra-Pair Skew for Data Lane x Test verifies that any skew within any one differential pair in the TMDS portion of the HDMI link does not exceed the limits.

Duty Cycle Minimum / Maximum (7-8)

The clock duty cycle tests verify that the minimum /maximum duty cycle of the differential TMDS clock does not exceed the limits.

Table 4-2: Duty cycle

Symbol	Min	Max
$T_{\text{duty-max}}$	40%	
$T_{\text{duty-min}}$		60%

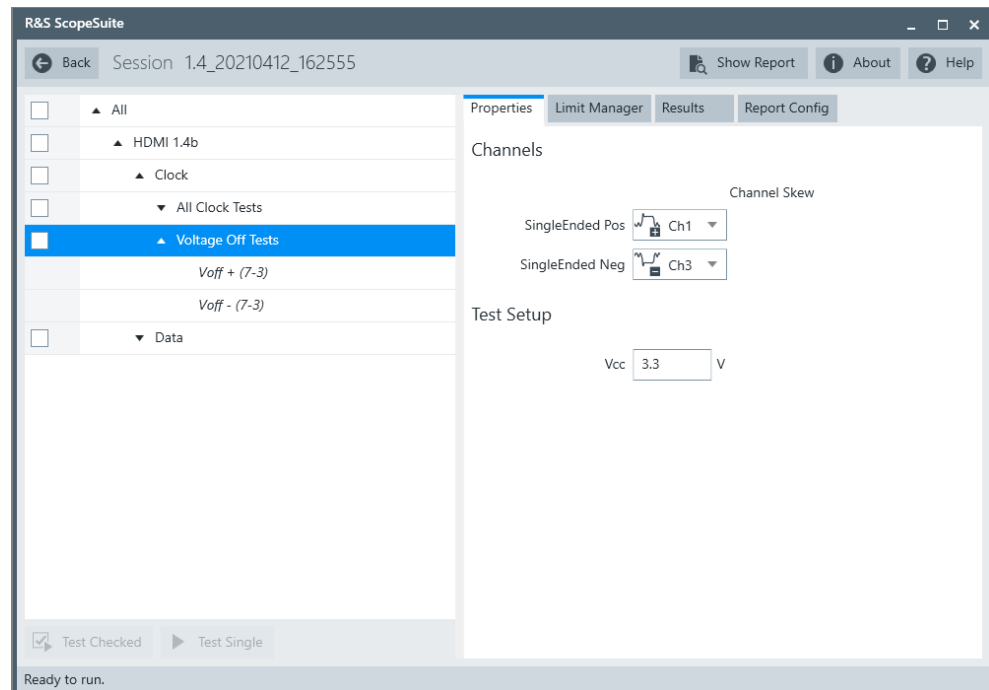
Jitter (7-9)

The clock jitter test verifies that the TMDS clock does not carry more excessive jitter than $0.25T_{\text{bit}}$.

4.2.2 Voltage off tests

4.2.2.1 Performing the tests

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "1.4" > "Clock" > "Voltage Off Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.

4.2.2.2 Measurements

The test measures the following:

$$V_{\text{off}^+} (7-3) / V_{\text{off}^-} (7-3)$$

The V_{off} clock-test verifies that a disabled TMDS link only allows leakage currents that are within the limits defined in HDMI CTSv1.4b.

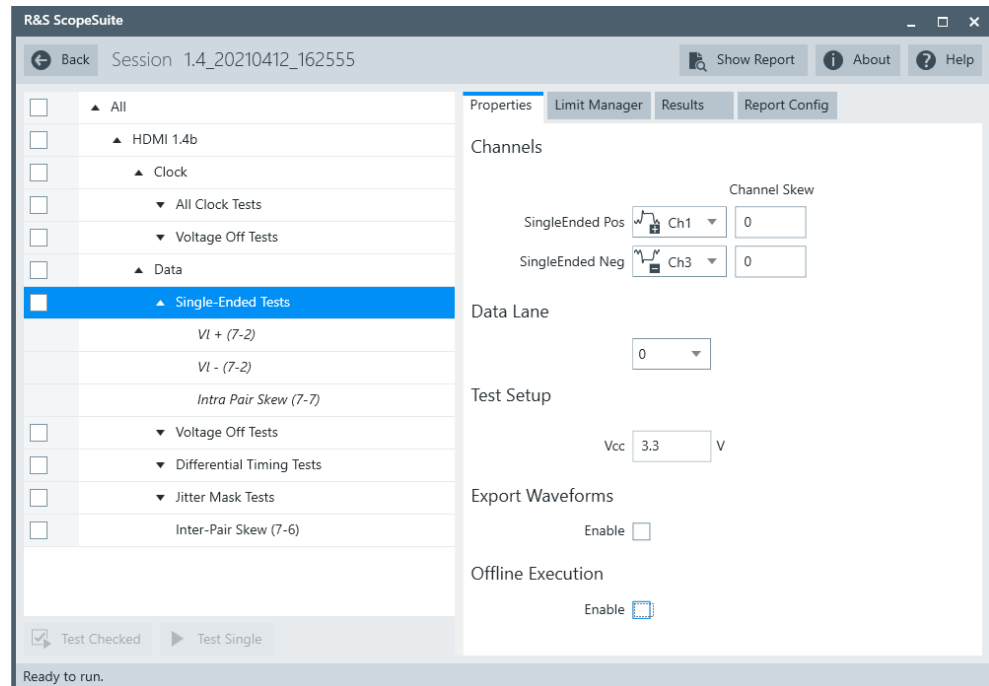
4.3 Data tests

4.3.1 Single-ended tests

4.3.1.1 Performing the tests

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.

2. Select "1.4" > "Data" > "Single-Ended Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.
6. You can also run the test in offline mode, using downloaded waveforms. For details, see ["Offline Execution"](#) on page 19.

4.3.1.2 Measurements

The test measures the following:

VI+ (7-2)

The VL Clock+ test verifies that the DC voltage levels for each TMDS clock signal on the HDMI link are within the limits. The test is passed, if the maximum VI+ < 2.9 V.

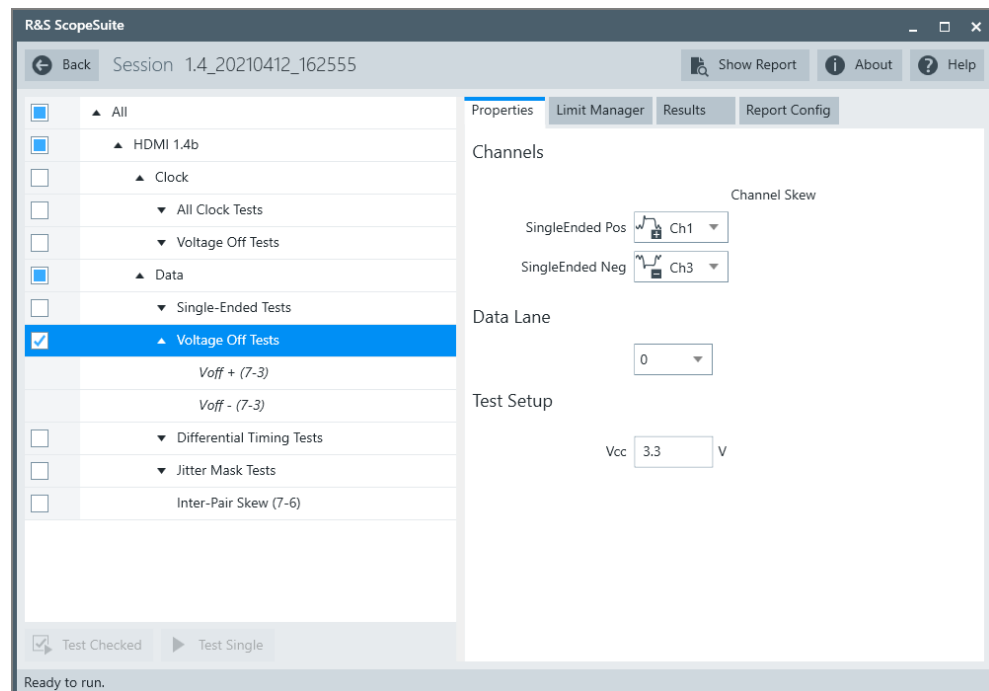
VI- (7-2)

The VL Clock-test verifies that the DC voltage levels for each TMDS clock signal on the HDMI link are within the limits.

4.3.2 Voltage off tests

4.3.2.1 Performing the tests

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "1.4" > "Data" > "Voltage Off Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.

4.3.2.2 Measurements

The test measures the following:

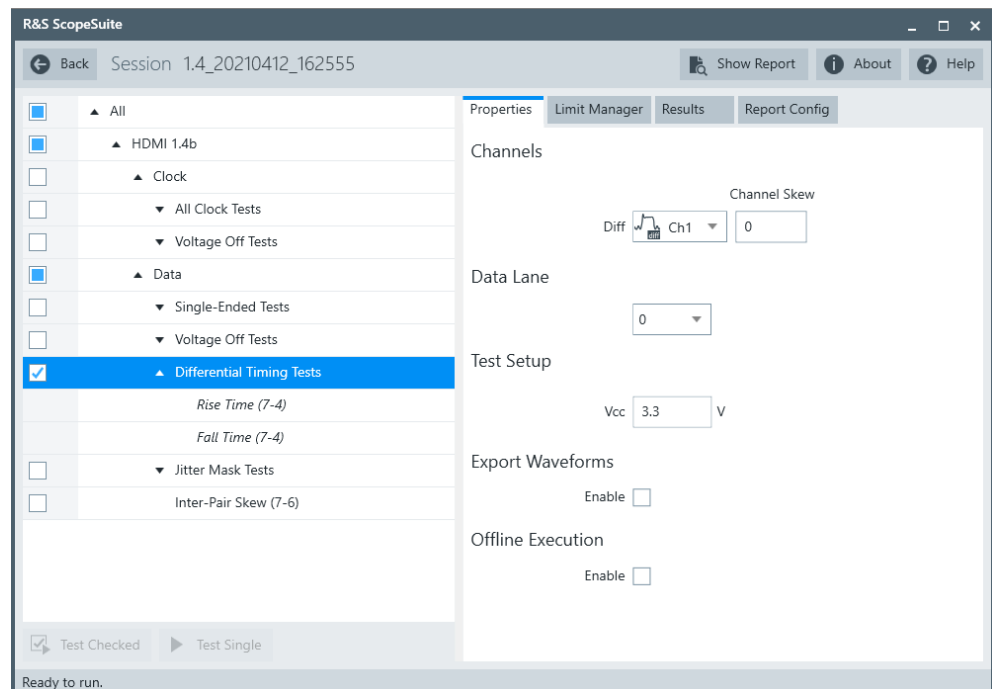
$$V_{\text{off}^+} (7-3) / V_{\text{off}^-} (7-3)$$

The V_{Off} clock-test verifies that a disabled TMDS link only allows leakage currents that are within the limits defined in HDMI CTSv1.4b.

4.3.3 Differential timing tests

4.3.3.1 Performing the tests

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "1.4" > "Data" > "Differential Timing Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.
6. You can also run the test in offline mode, using downloaded waveforms. For details, see ["Offline Execution"](#) on page 19.

4.3.3.2 Measurements

The test measures the following:

Rise Time (7-4)/Fall Time (7-4)

The rise time T_{rise} data test verifies that the time is within the limits defined in HDMI CTSv1.4b.

The test is considered as pass, if $T_{rise} > 75$ ps.

Fall Time (7-4)

The fall time T_{fall} data test verifies that the time is within the limits defined in HDMI CTSv1.4b.

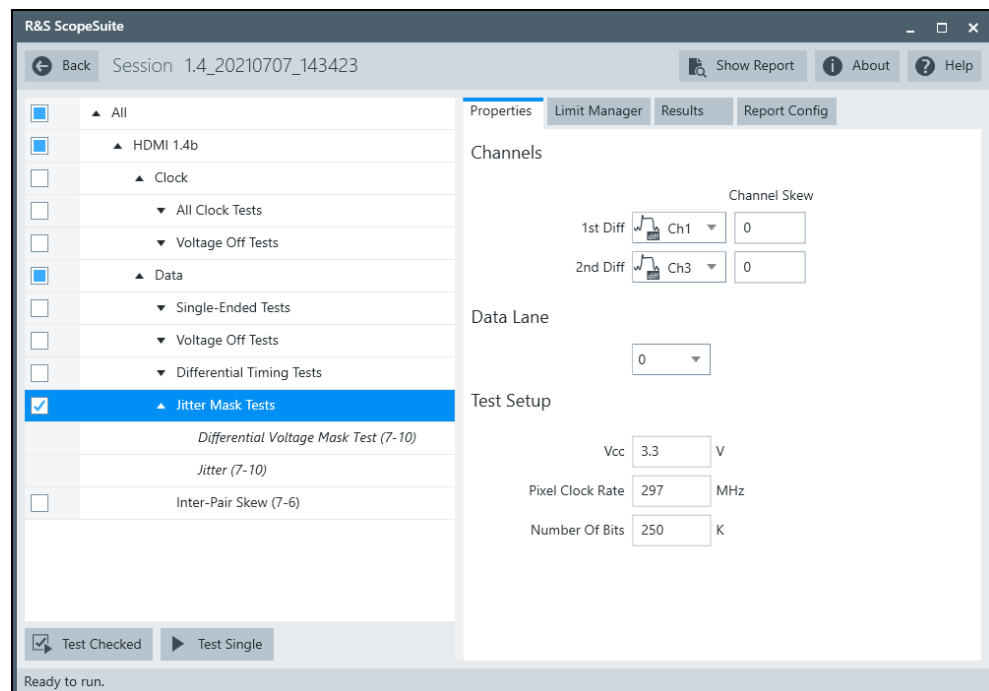
The test is considered as pass, if $T_{fall} > 75$ ps.

4.3.4 Jitter mask tests

4.3.4.1 Performing the tests

Requires option R&S RTP-K140/-K141 High-speed serial triggering 8G/16G.

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "1.4" > "Data" > "Jitter Mask Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.

4.3.4.2 Measurements

The test measures the following:

Differential Voltage Mask Test (7-10)

The differential mask test confirms that the differential signal on the TMDS differential pair Dx has a region of valid data that meets or exceeds the limits of the eye opening as defined in HDMI CTSv1.4b. This means that no part of the waveform touches or crosses into the data eye.

Jitter (7-10)

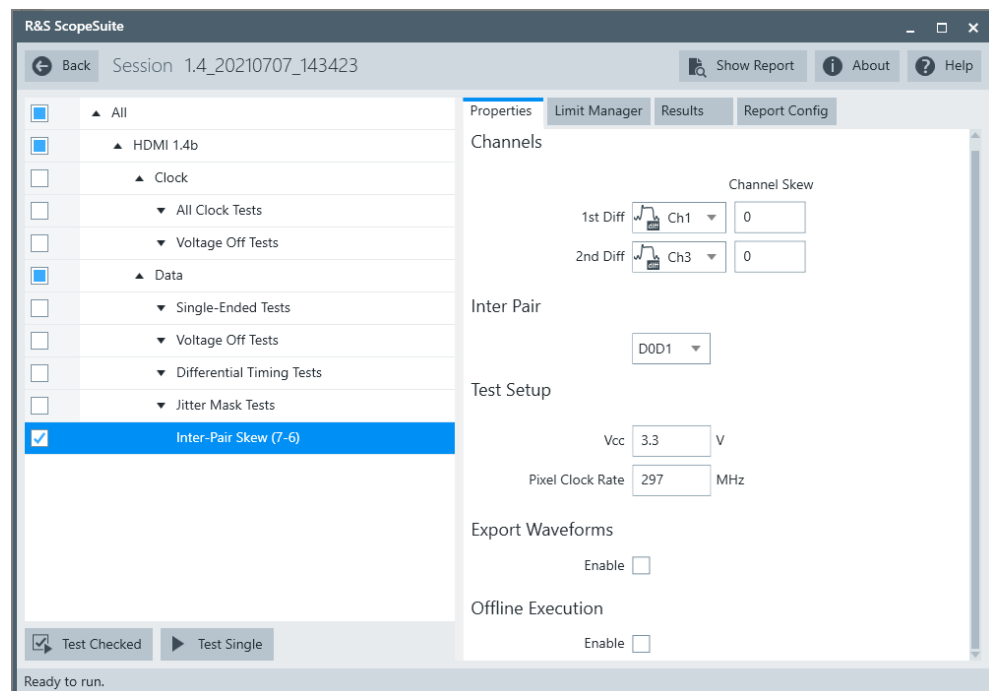
The test verifies that the data jitter on the eye opening for the TMDS differential pair Dx is within the limits defined in HDMI CTSv1.4b.

4.3.5 Inter-pair skew

4.3.5.1 Performing the tests

Requires option R&S RTP-K140/-K141 High-speed serial triggering 8G/16G.

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "1.4" > "Data" > "Inter-Pair Skew (7-6)".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.

6. You can also run the test in offline mode, using downloaded waveforms. For details, see "[Offline Execution](#)" on page 19.

4.3.5.2 Measurements

The Inter-Pair Skew test for D0/D1, D1/D2, D0/D2 verifies that any skew between the differential pairs in the TMDS portion of the HDMI link does not exceed the limits defined in HDMI CTSv1.4b.

You can select the inter-pair that you want to test.

5 HDMI 2.1 TMDS tests

5.1 Test equipment

The following equipment is needed for performing HDMI 2.1 compliance tests.

Item	Description, model	Quantity
Rohde & Schwarz oscilloscope	R&S RTP with 4 channels and minimum bandwidth 8 GHz	1
Modular probes	R&S ZM160	2
Modular probe tips	R&S RT-ZMA40	2
HDMI TPA adapter	-	1
HDMI termination module	-	1
EDID emulator	-	1
DUT	HDMI 2.1 device that supports the selected type	1
Option R&S RTP-K140/-K141	Required for the following tests: Differential Voltage Mask Tests Jitter Mask Tests Inter-Pair Skew (HF 1-3)	1

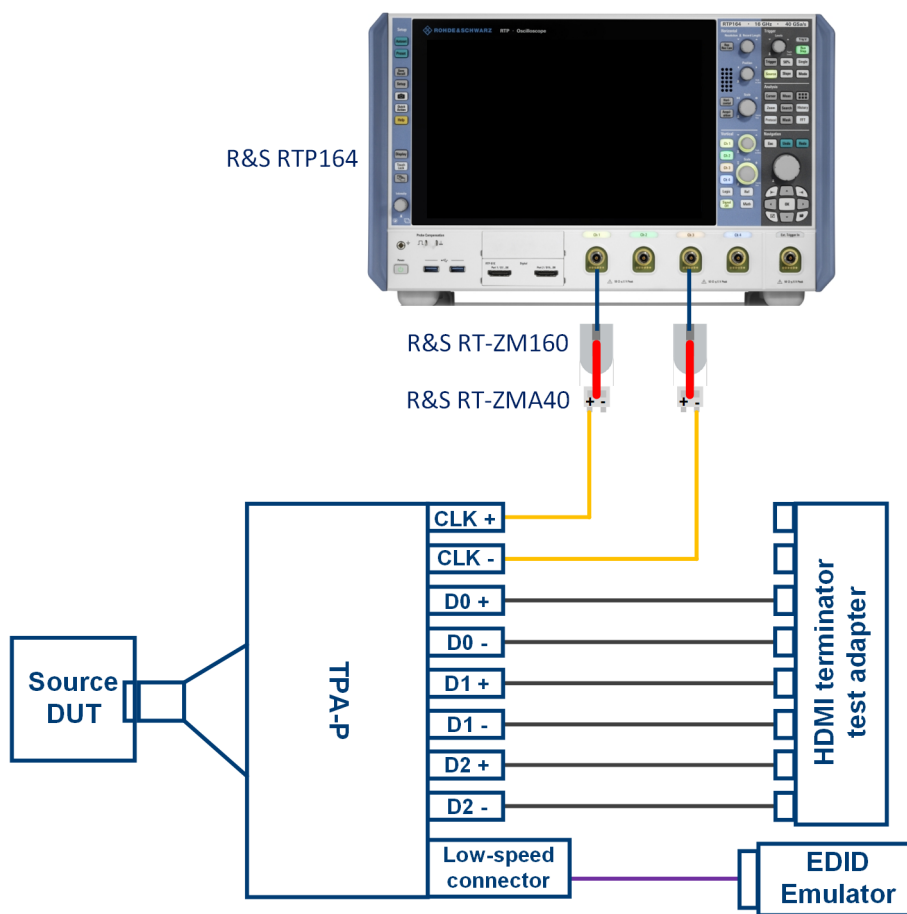


Figure 5-1: Test setup HDMI 2.1 Clock tests

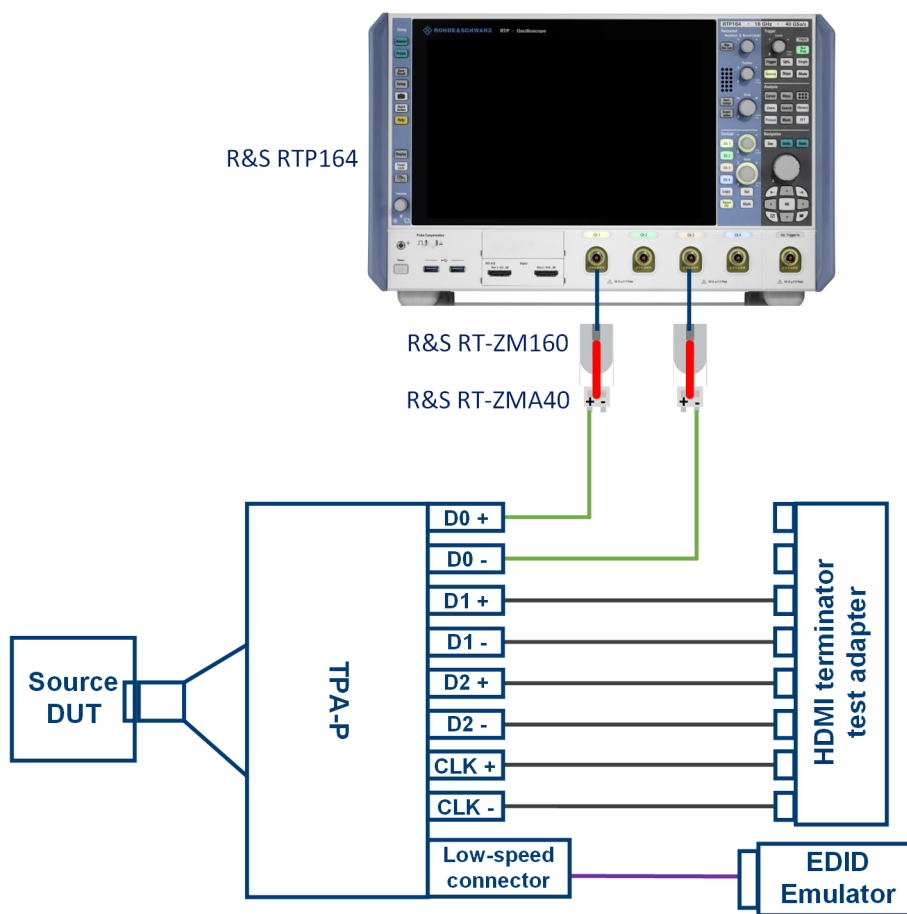


Figure 5-2: Test setup HDMI 2.1 Single-Ended tests

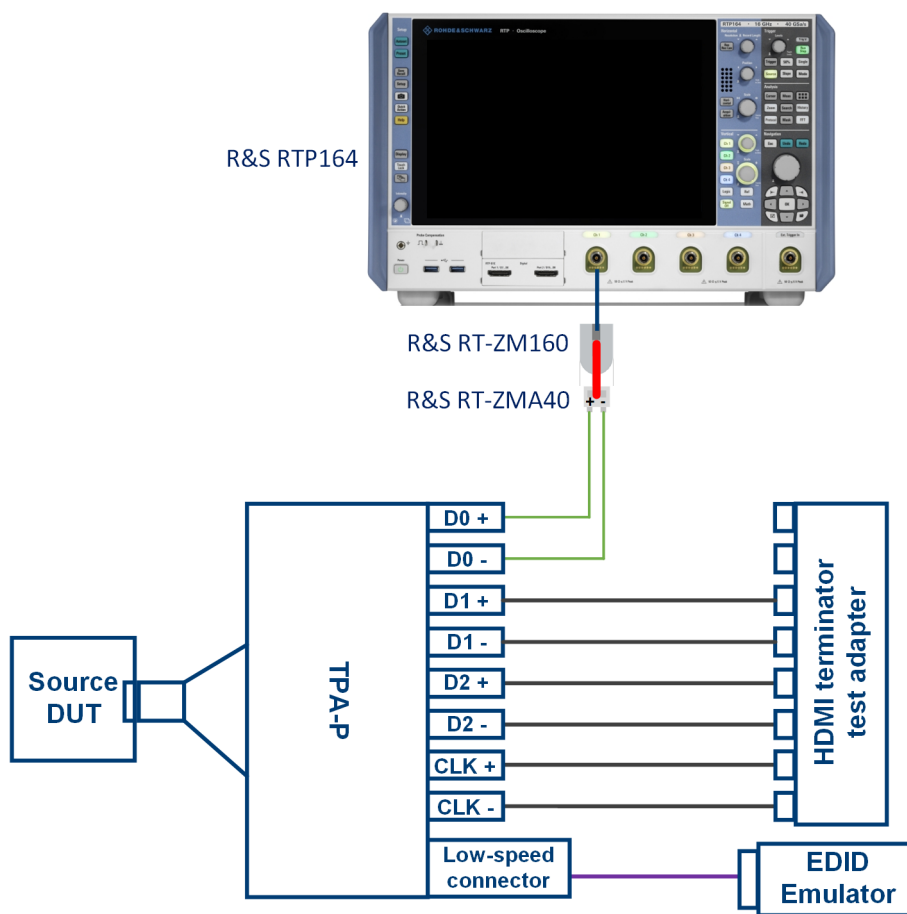


Figure 5-3: Test setup HDMI 2.1 Differential Voltage Mask Tests (HF 1-5)

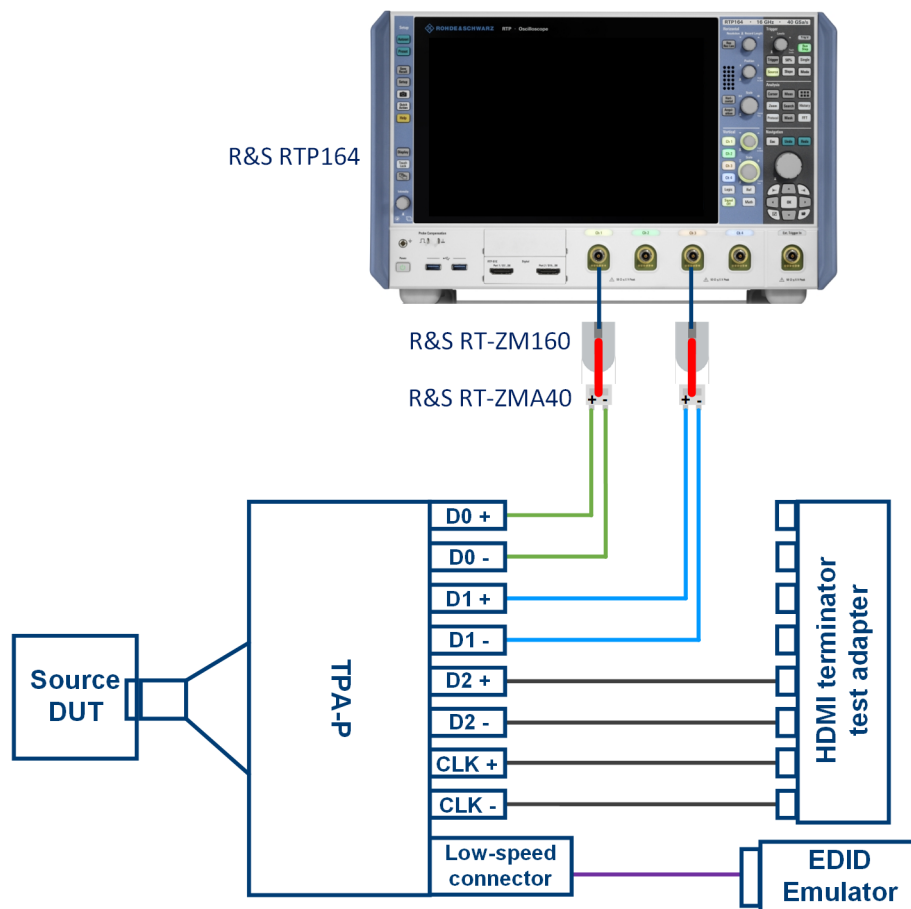


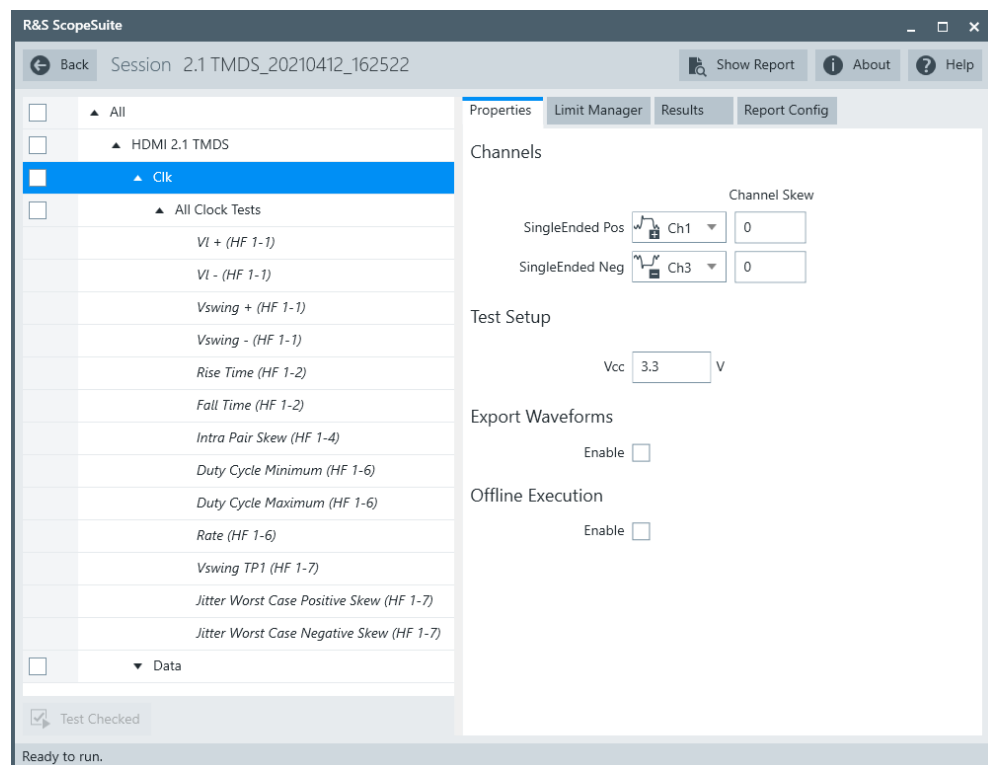
Figure 5-4: Test setup HDMI 2.1 Inter-Pair Skew (HF 1-3)

5.2 Clock tests

5.2.1 All clock tests

5.2.1.1 Performing the tests

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "HDMI 2.1 TMDS" > "Clock" > "All Clock Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.
6. You can also run the test in offline mode, using downloaded waveforms. For details, see ["Offline Execution"](#) on page 19.

5.2.2 Measurements

The measurements in the following chapter verify, if the measured values are within the limits defined in HDMI CTSv2.1.

The "All Clock Tests" include the following measurements:

VI + (HF 1-1)

The VL Clock+ test verifies that the DC voltage levels for each TMDS clock signal on the HDMI link are within the limits defined in the specification. The test is passed, if the maximum VI+ > 2.9 V.

VI - (HF 1-1)

The VL Clock- test verifies that the DC voltage levels for each TMDS clock signal on the HDMI link are within the limits defined in the specification. The test is passed, if the maximum VI+ is < 2.3V.

$V_{\text{swing}+}$

The $V_{\text{swing}+}$ test verifies that the DC voltage levels for each TMDS clock signal on the HDMI link are within the limits defined in the specification.

The test is passed, if $\text{Clock}+ V_{\text{swing}} < 600\text{mV}$.

 $V_{\text{swing}-}$ **Clock rise time/ fall time**

The clock rise/fall time test confirms that the rise/fall times on the TMDS signals are within the limits defined in the specification.

Table 5-1: Rise Time/Fall Time for 3.4 Gbps < R_{bit} < 6.0 Gbps at TP1

Symbol	Min
T_{rise}	75 ps
T_{fall}	75 ps

Intra Pair Skew (HF 1-4)

The Intra-Pair Skew for clock verifies that any skew within any one differential pair in the TMDS portion of the HDMI link does not exceed the limits defined in the specification.

Duty Cycle Minimum / Maximum (HF1-6)

The clock duty cycle tests confirm that the minimum /maximum duty cycle of the differential TMDS clock does not exceed the limits defined in the specification.

Table 5-2: Duty cycle for 3.4 Gbps < R_{bit} < 6.0 Gbps at TP1

Symbol	Min	Max
$T_{\text{duty-max}}$	40%	
$T_{\text{duty-min}}$		60%

Jitter Worst Case Positive Skew (HF 1-7)

The test verifies that the TMDS Clock does not carry excessive jitter more than defined in HDMI CTSv2.1.

Jitter Worst Case Negative Skew (HF 1-7)

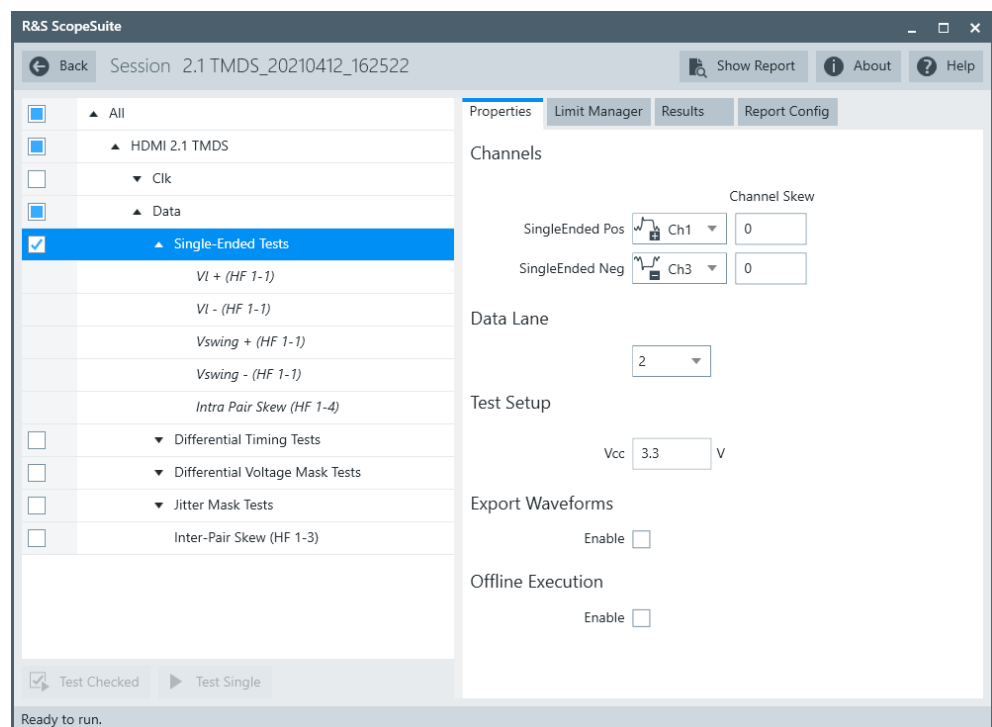
The test verifies that the TMDS clock does not carry excessive jitter more than defined in HDMI CTSv2.1.

5.3 Data tests

5.3.1 Single-Ended tests

5.3.1.1 Performing the tests

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "HDMI 2.1 TMDS" > "Data" > "Single-Ended Tests".

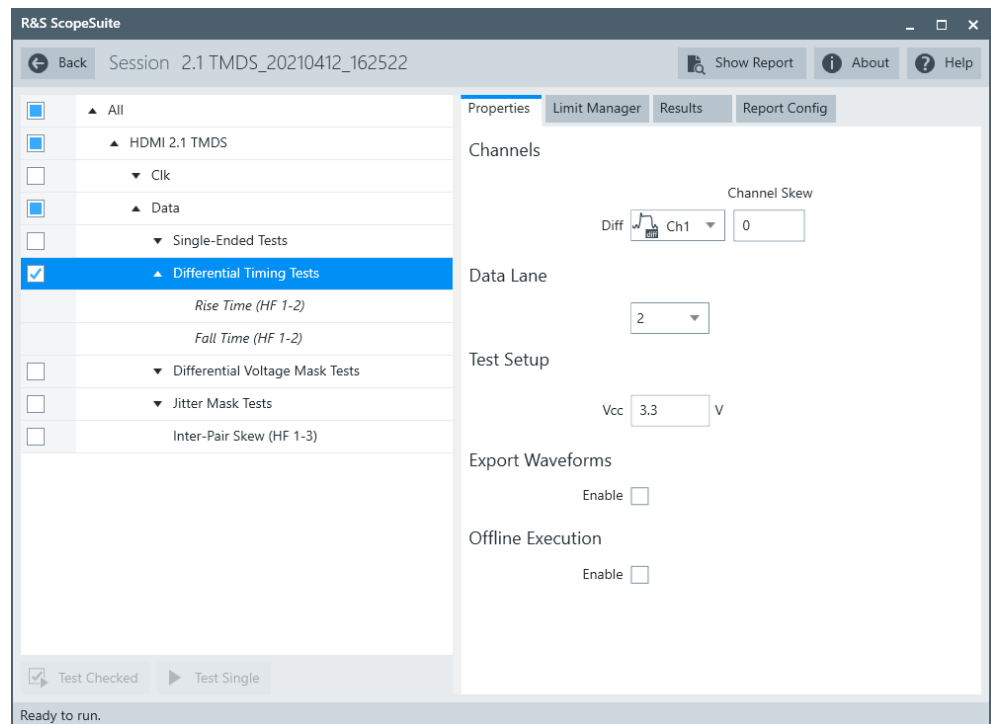


3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.
6. You can also run the test in offline mode, using downloaded waveforms. For details, see ["Offline Execution"](#) on page 19.

5.3.2 Differential timing tests

5.3.2.1 Performing the tests

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "HDMI 2.1 TMDS" > "Data" > "Differential Timing Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.
6. You can also run the test in offline mode, using downloaded waveforms. For details, see ["Offline Execution"](#) on page 19.

5.3.2.2 Measurements

Rise time/fall time

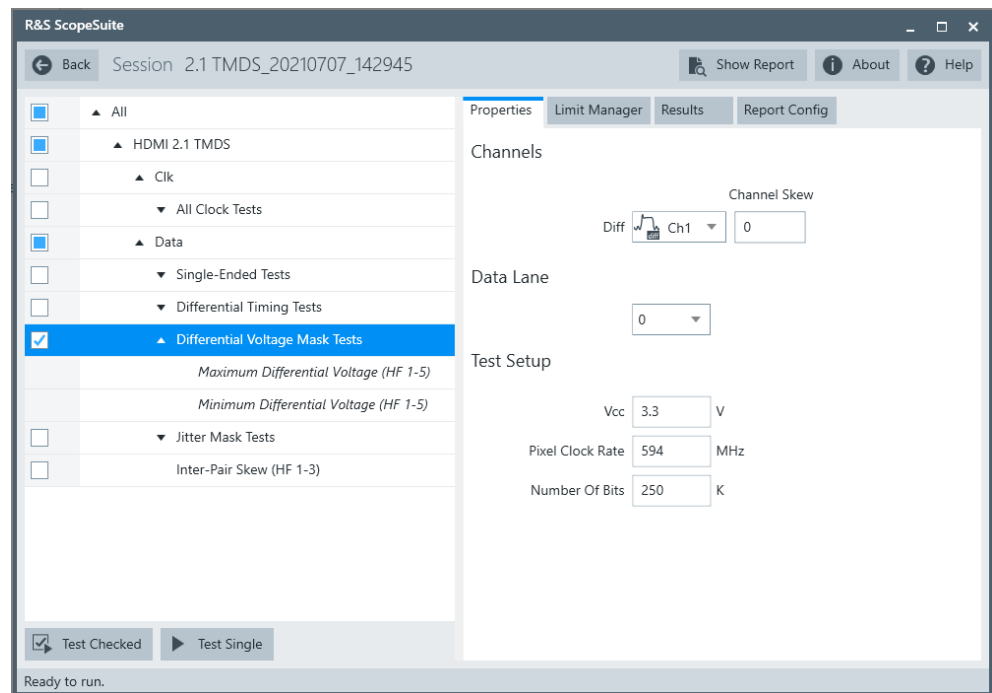
The data rise/fall time test verifies that the rise/fall times on the TMDS signals are within the limits defined in HDMI CTSv2.1.

5.3.3 Differential voltage mask tests

5.3.3.1 Performing the tests

Requires option R&S RTP-K140/-K141 High-speed serial triggering 8G/16G.

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "HDMI 2.1 TMDS" > "Data" > "Differential Voltage Mask Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.

5.3.3.2 Measurements

The test measures the following:

Maximum Differential Voltage (HF 1-5)

The test verifies that the signal on each TMDS differential data pair does not exceed the limits defined in HDMI CTSv2.1.

The test is passed, if no part of the waveform exceeds the maximum differential voltage (+780mV).

Minimum Differential Voltage (HF 1-5)

The test verifies that the signal on each TMDS differential data pair does not exceed the limits defined in HDMI CTSv2.1.

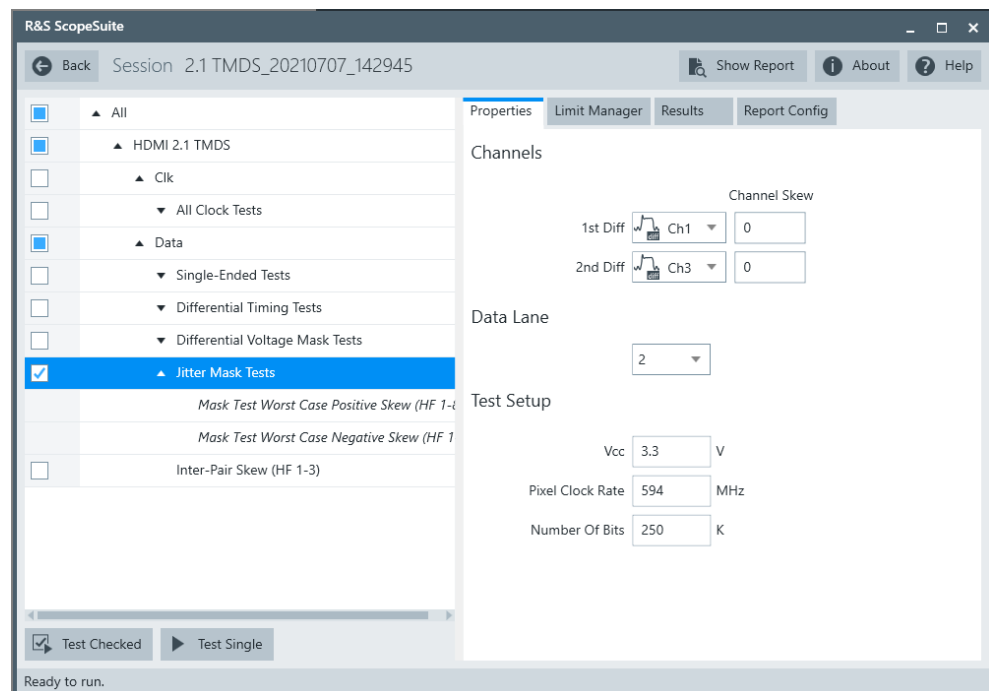
The test is passed, if no part of the waveform exceeds the minimum differential voltage (-780mV).

5.3.4 Jitter mask tests

5.3.4.1 Performing the tests

Requires option R&S RTP-K140/-K141 High-speed serial triggering 8G/16G.

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "HDMI 2.1 TMDS" > "Data" > "Jitter Mask Tests".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.

5.3.4.2 Measurements

The test measures the following:

Mask Test Worst Case Positive Skew (HF 1-8)

The test verifies that the signal on the TMDS differential data pair Dx has a region of valid data that meets or exceeds the limits on eye opening defined in HDMI CTSv2.1.

Mask Test Worst Case Negative Skew (HF 1-8)

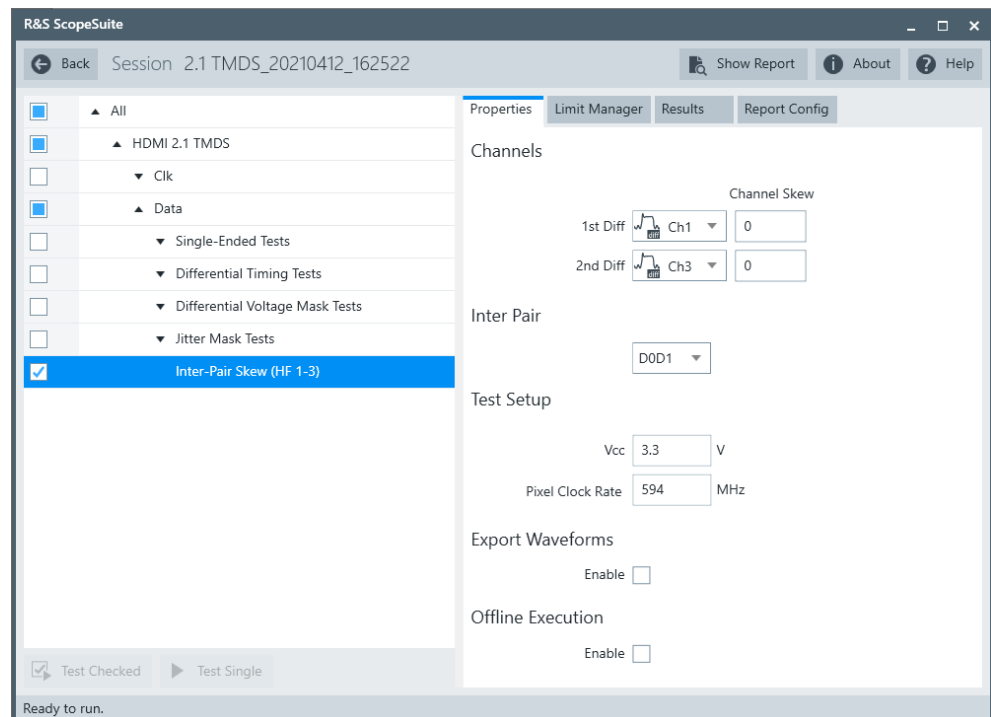
The test verifies that the signal on the TMDS differential data pair Dx has a region of valid data that meets or exceeds the limits on eye opening defined in HDMI CTSv2.1.

5.3.5 Inter-pair skew

5.3.5.1 Performing the tests

Requires option R&S RTP-K140/-K141 High-speed serial triggering 8G/16G.

1. Start the test as described in [Chapter 3.5, "Starting HDMI tests"](#), on page 17.
2. Select "HDMI 2.1 TMDS" > "Data" > "Inter-Pair Skew (HF 1-3)".



3. Enable the tests that you want to run.
4. Click "Test Single".
5. Follow the instructions of the step-by step guide.
When you have finished all steps, the compliance test runs automatically.

6. You can also run the test in offline mode, using downloaded waveforms. For details, see "[Offline Execution](#)" on page 19.