

HDMI TX APPLICATION



Application Brochure
Version 01.00

ROHDE & SCHWARZ

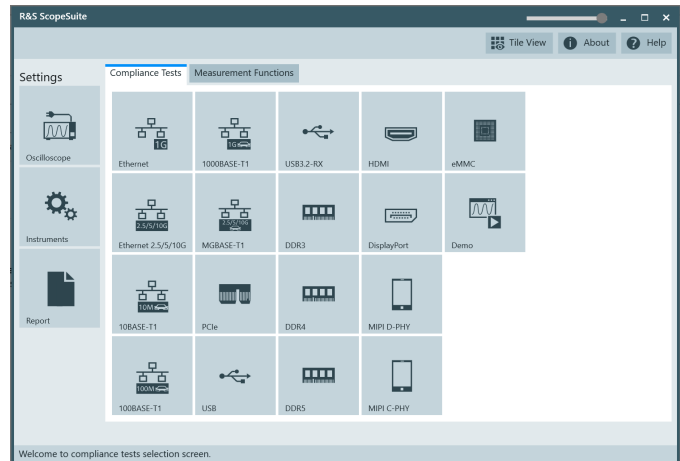
Make ideas real



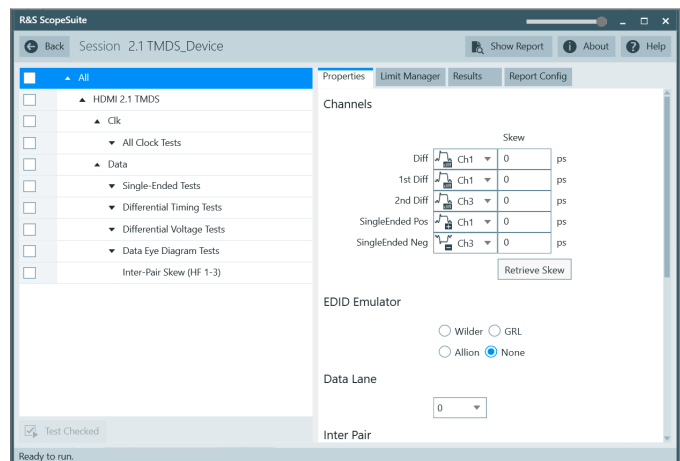
The Rohde & Schwarz HDMI 2.1 TMDs transmitter test solution provides a reliable way to test a device for compliance. Additionally, Rohde & Schwarz has a solution for HDMI 1.4b TX testing. The R&S®ScopeSuite software allows for ease of automating the complex tests per the HDMI Forum Generic Compliance Test Specification (GCTS). The R&S®ScopeSuite solution aids in debugging and characterization of the device under test (DUT), allowing customization of pass/fail criteria, pausing tests and changing various parameters to customize your test session.

R&S®ScopeSuite overview

R&S®ScopeSuite streamlines automation for various digital interface standards, including HDMI 2.1 TMDs and HDMI 1.4b transmitter testing. The HDMI 2.1 TMDs and HDMI 1.4b transmitter test solution encompasses all pertinent test cases. For ease of reference, the software's intuitive homepage conveniently lists all supported and readily available standards.



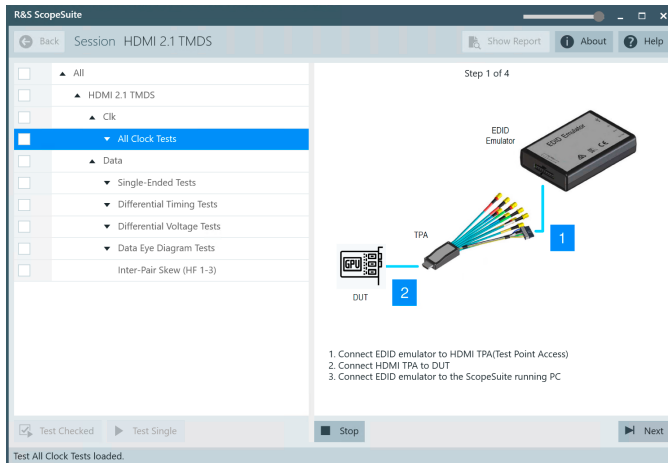
R&S®ScopeSuite software completely controls the connected R&S®RTP high-performance oscilloscope for seamless compliance testing and precise measurements in line with the test specification standards. Selecting test cases may also require additional, specialized instruments such as a vector network analyzer (VNA). R&S®ScopeSuite provides comprehensive control and support for all necessary instruments for a fully integrated, end-to-end compliance test solution.



Key facts

- ▶ Automated testing with R&S®ScopeSuite
- ▶ Detailed test reporting
- ▶ Follows HDMI gCTS for TMDs TX testing

Detailed, image based instructions let users effortlessly and correctly configure setups with an oscilloscope, its accompanying probes, the designated test fixtures and the device under test. This user-friendly approach significantly minimizes the likelihood of setup-related errors.



All test results are fully documented in a PDF report. This report can include only specific test cases, numerical result data or instrument screenshots based on user preferences.

Result	Test	Description	Run
✓	VI/Vswing + (HF 1-1)	Voltage Low/Swing Positive	1
✓	VI/Vswing - (HF 1-1)	Voltage Low/Swing Negative	1
✓	Rise Time (HF 1-2)	Rise Time	1
✓	Fall Time (HF 1-2)	Fall Time	1
✓	Intra Pair Skew (HF 1-4)	Intra Pair Skew : Common Skew Time / UI	1
✓	Rate (HF 1-6)	Average Clock Rate	1
✓	Duty Cycle Maximum (HF 1-6)	Duty Cycle Max	1
✓	Duty Cycle Minimum (HF 1-6)	Duty Cycle Min	1
✓	Vswing TP1 (HF 1-7)	Vswing TP1	1
✓	Jitter at TP2_EQ(HF 1-7)	TP2_EQ Test of Jitter	1

Result	Test	Description	Run
✓	VI/Vswing + (HF 1-1)	Data Vlow/Vswing Positive	1
✓	VI/Vswing - (HF 1-1)	Data Vlow/Vswing Negative	1
✓	Intra Pair Skew (HF 1-4)	Data Intra Pair Skew : Common Skew Time / UI	1

Result	Test	Description	Run
✓	Rise Time (HF 1-2)	Data Rise Time	1
✓	Fall Time (HF 1-2)	Data Fall Time	1

Result	Test	Description	Run
✓	Maximum/Minimum Differential Voltage (HF 1-5)	This test confirms that the differential signal on each TMDS differential data pair does not exceed the Maximum/Minimum Differential Voltage.	1

Result	Test	Description	Run
✓	Data Eye Diagram Test TP2 (HF 1-8)	This test confirms that the differential signal on each TMDS differential data pair has an "eye opening" (region of valid data) that meets or exceeds the limits on eye opening in the specification.	1

COVERED TESTS

HDMI 2.1 TMDS

- ▶ HF 1-1 V_L and V_{Swing}
- ▶ HF 1-2 T_{RISE} and T_{FALL}
- ▶ HF 1-3 Inter-Pair Skew
- ▶ HF 1-4 Intra-Pair Skew
- ▶ HF 1-5 Differential Voltage
- ▶ HF 1-6 Clock Duty Cycle and Clock Rate
- ▶ HF 1-7 Clock Jitter
- ▶ HF 1-8 Data Eye Diagram

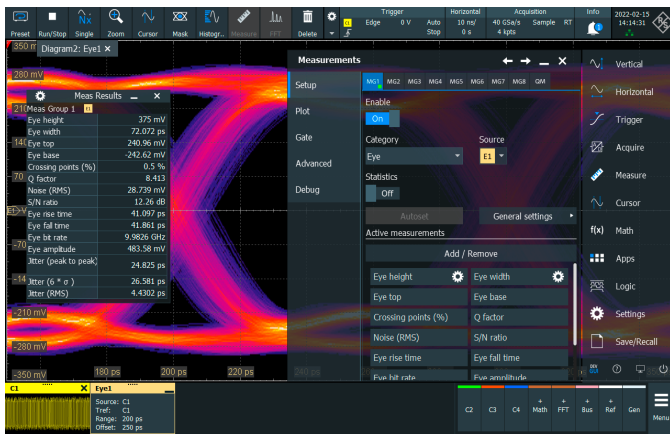
HDMI 1.4b

- ▶ 7-2 Low Level Output Voltage
- ▶ 7-3 Voltage Offset
- ▶ 7-4 Rise/Fall Time
- ▶ 7-5 Overshoot/Undershoot
- ▶ 7-6 Inter-Pair Skew
- ▶ 7-7 Intra-Pair Skew
- ▶ 7-8 Clock Duty Cycle
- ▶ 7-9 Clock Jitter
- ▶ 7-10 Data Eye Diagram

Debugging methods and options

When an issue with compliance testing arises, the R&S®RTP oscilloscope offers powerful debugging tools.

The R&S®RTP-K136 advanced eye analysis (8 Gbit/s CDR) and R&S®RTP-K137 advanced eye analysis (16 Gbit/s CDR) options offer a unique hardware implemented clock data recovery (HW-CDR) to bit slice a serial data stream with an embedded clock. You can configure the nominal bit rate (between 21 kbit/s and 16 Gbit/s) as well as the tracking bandwidth or the relative bandwidth. The hardware CDR in the R&S®RTP continuously follows the drift of the input signal. Traditional eye diagrams use software CDR functions in postprocessing. This is time-consuming and requires a PLL settling time per waveform acquisition, leading to more time between you and the results.

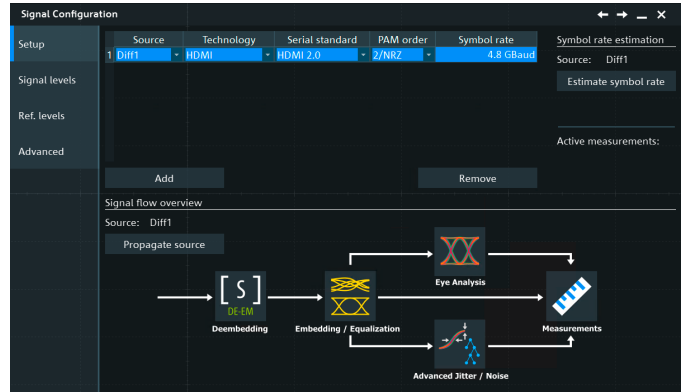


The R&S®RTP-K133 jitter decomposition and R&S®RTP-K134 jitter and noise decomposition options provide new functions to gain more insights into the signal characteristic and root causes of failures. This allows users to reconstruct synthetic eye diagrams including periodic and data-dependent components. You can also calculate and display BER bathtub curves for selected jitter and noise components. Additionally, the options calculate and display the system characteristic step response. As a matter of course, the individual jitter and noise components can be displayed as histogram, track or in spectrum view.

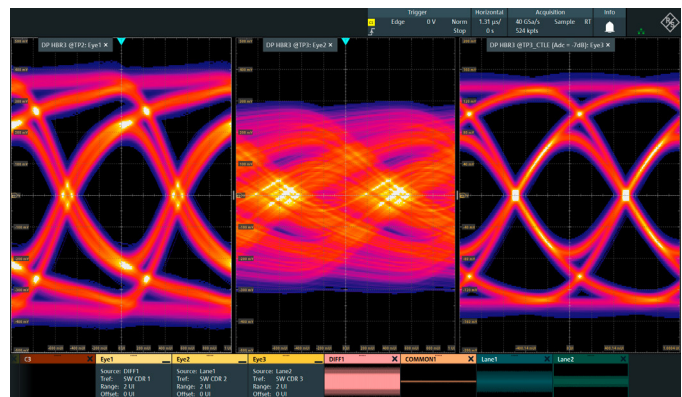


The R&S®RTP-K122 deembedding, real-time extension option allows waveform correction based on S-parameters of the involved measurement blocks. The correction parameters of a cable or a modified probe can also be determined by using a proven cable or proven probe.

The signal configurator is a tool built into the base oscilloscope firmware. It is the central entry point for signal integrity analysis. Interface standards based on configurations, such as symbol rate, PAM order, CDR settings and equalizer coefficients are supported. Just select an input channel as source, the appropriate standard and configure deembedding, embedding and equalization, before starting an in-depth analysis with automated measurements, eye, jitter and noise tools.



The R&S®RTP-K126 embedding and equalization option enables emulation of predistortion (also called preemphasis or deemphasis) at the transmitter side, the emulation of a lossy channel (e.g. embedding transmission loss of a PCB trace or long cable) and the emulation of various equalizer types at the receiver side. You can build your individual cascade of deembedding, TX equalizer, signal channel embedding and finally RX equalization.



Connectivity for HDMI testing

For testing, the oscilloscopes connect to the HDMI outputs via dedicated test fixtures. We work with Wilder Technologies for the test point adapters (TPAs) and termination module for the unused lanes during test.

Additionally, we integrated the Allion, Wilder Technologies and GRL EDID Emulator into the R&S®ScopeSuite test automation tool for HDMI transmitter testing. This allows for easy test automation and flexibility for you to choose which emulator works best for you. Within R&S®ScopeSuite, select manual operation of the EDID emulator to gain complete control of the DUT.

Recommended test configurations

HDMI 2.1 TMDS (6 Gbit/s)		
	Reference configuration	
Remarks	Product	Quantity
Oscilloscope, 16 GHz bandwidth	R&S®RTP164B	1
HDMI 1.4/2.0/2.1	R&S®RTP-K110	1
Probe amplifier module	R&S®RT-ZM160	2
SMA module	R&S®RT-ZMA40	2
(Plug or receptacle) Adapter (purchased via Wilder Technologies: www.wilder-tech.com)	HDMIA2.1-TPA-x	1
Emulator module (purchased via Wilder Technologies: www.wilder-tech.com)	HDMI-EDID-EMMS	1
Termination module (purchased via Wilder Technologies: www.wilder-tech.com)	HDMI-TPA-T	1
Advanced eye analysis (8 Gbit/s CDR) or Advanced eye analysis (16 Gbit/s CDR)	R&S®RTP-K136 or R&S®RTP-K137	1
High-speed serial pattern trigger (8 Gbit/s CDR) or High-speed serial pattern trigger (16 Gbit/s CDR)	R&S®RTP-K140 or R&S®RTP-K141	1

HDMI 1.4b (3.4 Gbit/s)		
	Reference configuration	
Remarks	Product	Quantity
Oscilloscope, 8 GHz bandwidth, for 3.4 Gbit/s data rate	R&S®RTP084B	1
HDMI 1.4/2.0/2.1	R&S®RTP-K110	1
Probe amplifier module	R&S®RT-ZM90	2
SMA module	R&S®RT-ZMA40	2
(Plug or receptacle) Adapter (purchased via Wilder Technologies: www.wilder-tech.com)	HDMIA2.1-TPA-x	1
Emulator module (purchased via Wilder Technologies: www.wilder-tech.com)	HDMI-EDID-EMMS	1
Termination module (purchased via Wilder Technologies: www.wilder-tech.com)	HDMI-TPA-T	1
Advanced eye analysis (8 Gbit/s CDR) or Advanced eye analysis (16 Gbit/s CDR)	R&S®RTP-K136 or R&S®RTP-K137	1
High-speed serial pattern trigger (8 Gbit/s CDR) or High-speed serial pattern trigger (16 Gbit/s CDR)	R&S®RTP-K140 or R&S®RTP-K141	1

Optional: For signal integrity debugging		
	Reference configuration	
Remarks	Product	Quantity
Embedding and equalization	R&S®RTP-K126	1
Jitter decomposition or Jitter and noise decomposition	R&S®RTP-K133 or R&S®RTP-K134	1

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