

DisplayPort 2.1 (HBRx) AND eDisplayPort 2.0 (HBRx) TX APPLICATION



Application Brochure
Version 01.00

ROHDE & SCHWARZ

Make ideas real



The Rohde & Schwarz DisplayPort 2.1 (HBRx) transmitter (TX) test solution is VESA approved and reliably tests devices for compliance.

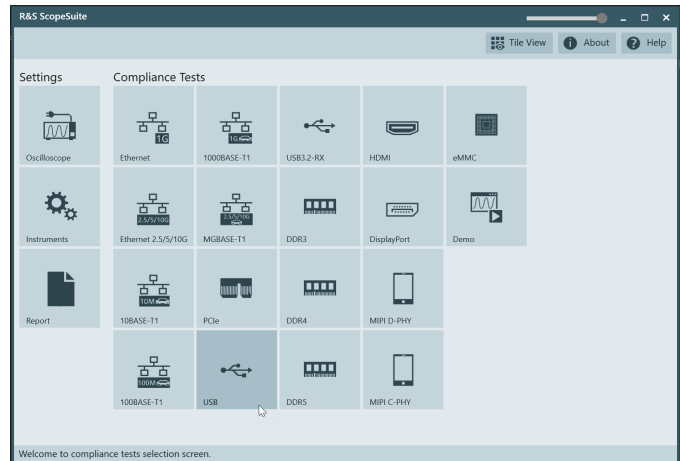
Additionally, Rohde & Schwarz offers a solution for embedded DisplayPort 2.0 (HBRx) transmitter conformance testing. The R&S®RTP-K114 (DP2.1 (HBRx) TX) and R&S®RTP-K115 (eDP2.0 (HBRx) TX) test options included in the R&S®ScopeSuite compliance test software make it easy to automate the complex tests in line with the VESA Compliance Test Specification (CTS). Furthermore, the R&S®ScopeSuite solution aids in debugging and characterizing devices under test (DUTs) by enabling pass/fail criteria customization, pausing tests and changing various parameters to customize your test session.

Key facts

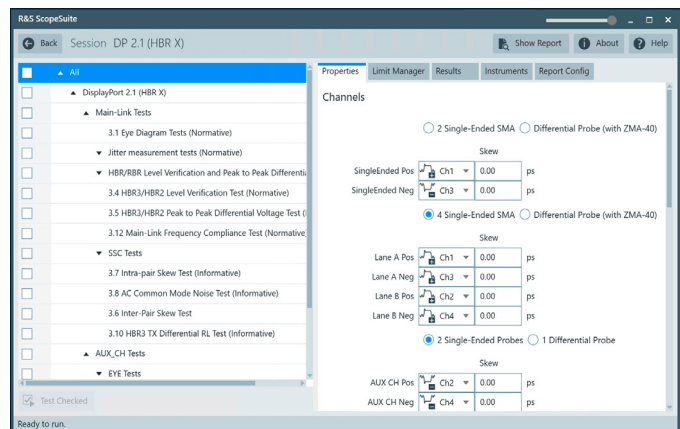
- ▶ VESA approved solution
- ▶ Capable of DP2.1 (HBRx) compliance testing
- ▶ Automated testing with R&S®ScopeSuite compliance test software
- ▶ Detailed test reporting
- ▶ Capable of testing with full-size DP, mini DP and USB Type-C connectors

R&S®ScopeSuite overview

R&S®ScopeSuite streamlines automation for various digital interface standards, including the DisplayPort 2.1 (HBRx) transmitter test. The DP2.1 (HBRx) 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 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.



COVERED TESTS

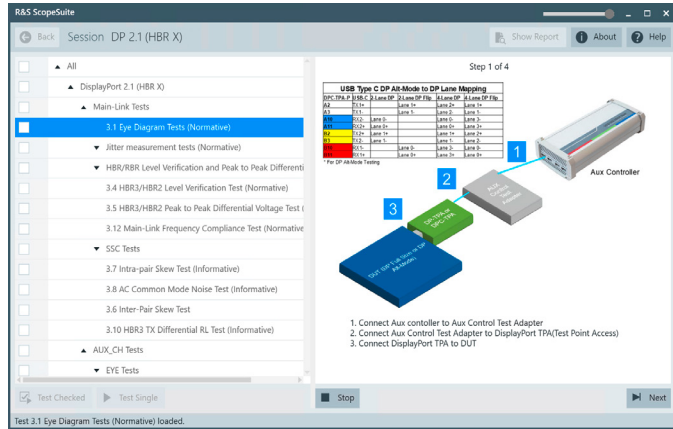
DisplayPort 2.1 (HBRx)

- ▶ 3.1 Eye Diagram Tests (Normative)
- ▶ 3.2 HBR/RBR Non-PE Level Verification Test (Normative)
- ▶ 3.3 HBR/RBR Level Verification and Peak to Peak Differential Voltage Test (Normative)
- ▶ 3.4 HBR3/HBR2 Level Verification Test (Normative)
- ▶ 3.5 HBR3/HBR2 Peak to Peak Differential Voltage Test (Normative)
- ▶ 3.6 Inter-Pair Skew Test (Informative)
- ▶ 3.7 Intra-Pair Skew Test (Informative)
- ▶ 3.8 AC Common Mode Noise Test (Informative)
- ▶ 3.9 Non-ISI Jitter Measurement Tests (Normative)
- ▶ 3.10 HBR3 Tx Differential Return Loss Test (Informative)
- ▶ 3.11 TJ/RJ/DJ Measurement Tests (Normative)
- ▶ 3.12 Main-Link Frequency Compliance Test (Normative)
- ▶ 11.1 AUX_CH (Manchester-II) EYE Test (Normative)
- ▶ 11.2 AUX_CH (Manchester-II) Sensitivity Test (Normative)
- ▶ 11.3 AUX_CH_N Termination DC Test (Normative)
- ▶ 11.4 AUX_CH_P Termination DC Test (Normative)
- ▶ 11.5 AUX_CH Slew Rate Test (Normative)
- ▶ 11.6 Inrush (Normative) and Outrush (Informative) Test

Embedded DisplayPort 2.0 (HBRx)

- ▶ Eye Diagram Test
- ▶ Jitter Tests
 - Non ISI jitter
 - Total jitter
 - Random jitter
 - Deterministic jitter
- ▶ Differential Voltage Test
- ▶ Main-Link Frequency Compliance Test
- ▶ SSC Tests
 - Modulation frequency
 - Modulation deviation
 - dF/dT spread-spectrum deviation high-frequency variation
- ▶ Intra-Pair Tests
 - AC common mode noise
 - Intra-pair skew
 - Rise and fall time mismatch
- ▶ Inter-Pair Skew Test
- ▶ AUX Channel Tests
 - Eye tests
 - Mask test
 - Peak-to-peak voltage
 - Unit interval
 - Sensitivity test

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. The report can include only specific test cases, numerical result data or instrument screenshots based on user preferences.

DisplayPort DP 2.1 (HBR X) Test Report

Additional Information

Measurement	Value	Limits
TestPoint	TP2	Test Pattern: CP2520 Pattern 3 (TPS4)
Total Jitter (TJ)	162.503 mUI	Informative Only
Estimated TJ@BER 10e-6	163.183 mUI	Informative Only
ISI Jitter (ISI)	56.684 mUI	Informative Only
Non-ISI Jitter (NonISI)	105.819 mUI	x <= 230 m

DisplayPort 1.4a All Jitter Tests - 3.9 Non-ISI Measurement Tests (Normative) - Total Jitter (TJ)

DisplayPort 1.4a All Jitter Tests - 3.11 TJ/RJ/DJ Measurement Tests (Normative)

Description	TJ is estimated as $TJ = DJ_{dd} + n \cdot R_{jms}$, where for $n=9.5$ (HBR3, BER=10e-6) & $n=12$ (RBR/HBR/HBR2, BER=10-9)
Run	1
Result	Pass
Time	09/23/2025 18:27:23
Comment	

Connectivity and device control

For testing, the oscilloscope connects to the DisplayPort outputs via dedicated test fixtures available from Wilder Technologies and Luxshare-ICT for the various DisplayPort connectors and USB Type-C for DP Alt Mode.

Additionally, we integrated the Unigraf UCD323 AUX Controller into our R&S®ScopeSuite test automation tool for DisplayPort and Embedded DisplayPort testing to enable easy test automation with this industry leading tool. R&S®ScopeSuite can be used with another AUX controller or no AUX controller if the DUT does not require one. The R&S®ScopeSuite tool includes an option to select manual operation of the AUX controller.

Debugging methods and options

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

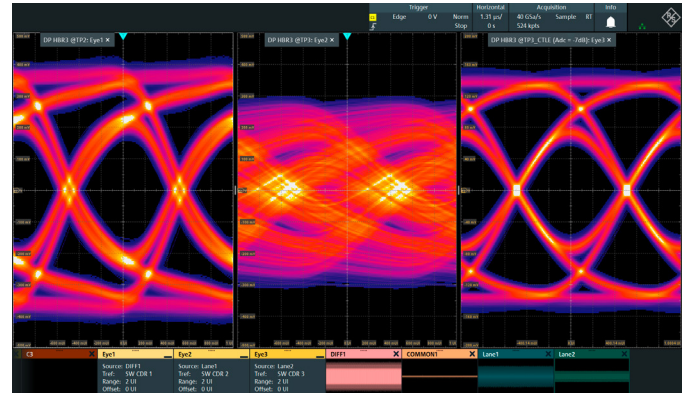
The R&S®RTP-K136 advanced eye analysis (8 Gbps CDR) and R&S®RTP-K137 advanced eye analysis (16 Gbps CDR) options offer a unique hardware implemented clock data recovery (HW-CDR) to bit slice a serial data stream with an embedded clock. You can configure the nominal bit rate (between 21 kbps and 16 Gbps) 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 both time consuming and requires a PLL settling time for each waveform acquisition, increasing the time it takes to get your 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 enables users to reconstruct synthetic eye diagrams, including periodic and data-dependent components, as well as calculate and display BER bathtub curves for selected jitter and noise components. The options also calculate and display the system characteristic step response. The individual jitter and noise components can be displayed as a histogram, a track or in spectrum view.



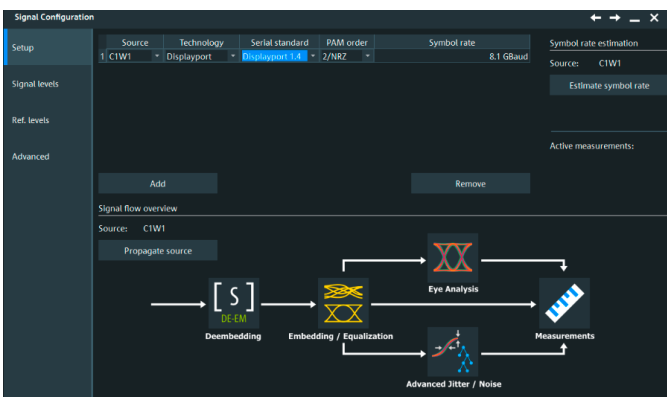
The R&S®RTP-K126 embedding and equalization option enables emulation of predistortion (also called preemphasis or deemphasis) at the transmitter side, the emulation of a lossy channel (e.g. embedding transmission loss of a PCB trace or long cable) and the emulation of various equalizer types at the receiver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



DisplayPort eye with nothing applied to it (left); lossy channel embedded (middle); and CTLE applied to bring back the eye (right)

The R&S®RTP-K122 deembedding, real-time extension option enables waveform correction based on the 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 and supports interface standards based on configurations such as symbol rate, PAM order, CDR settings and equalizer coefficients. Just select an input channel as the source, the applicable standard, and configure deembedding, embedding and equalization before starting an in-depth analysis with automated measurements, eye, jitter and noise tools.



Transmitter test configurations

DP 2.1 (HBRx)		
Remarks	Reference configuration	
	Product	Quantity
Oscilloscope, 13 GHz bandwidth	R&S®RTP134B	1
DisplayPort (DP) 1.4a	R&S®RTP-K114	1
Advanced eye analysis (16 Gbps CDR)	R&S®RTP-K137	1
High-speed serial pattern trigger (16 Gbps CDR)	R&S®RTP-K141	1
High-precision and low-loss matched cable pair	R&S®RT-ZA17	2 (1 for TX, 1 for RX)
Probe amplifier module for inter-pair-skew testing	R&S®RT-ZM130 +	2
SMA module	R&S®RT-ZMA40	
Active probes for AUX_CH testing	R&S®RT-ZS10	2
Plug adapter (purchased via Wilder Technologies: www.wilder-tech.com)	DP-TPA-P	1
AUX control adapter (purchased via Wilder Technologies: www.wilder-tech.com)	DP-TPA-A	1
DP emulator (purchased via Unigraf: www.unigraf.fi)	Unigraf UCD-323 (automation supported by R&S®ScopeSuite)	1

eDP 2.0 (HBRx)		
Remarks	Reference configuration	
	Product	Quantity
Oscilloscope, 16 GHz bandwidth	R&S®RTP164B	1
Embedded DisplayPort (eDP) 1.4b/1.5	R&S®RTP-K115	1
Advanced eye analysis (16 Gbps CDR)	R&S®RTP-K137	1
High-speed serial pattern trigger (16 Gbps CDR)	R&S®RTP-K141	1
High-precision and low-loss matched cable pair	R&S®RT-ZA17	2 (1 for TX, 1 for RX)
Probe amplifier module for inter-pair-skew testing	R&S®RT-ZM130 +	2
SMA module	R&S®RT-ZMA40	
Active probes for AUX_CH testing	R&S®RT-ZS10	2
Plug adapter (purchased via Wilder Technologies: www.wilder-tech.com)	EDP-TPA40L-P	1
AUX control adapter (purchased via Wilder Technologies: www.wilder-tech.com)	eDP-TPA-A	1
DP Emulator (purchased via Unigraf: www.unigraf.fi)	Unigraf UCD-323 (automation supported by R&S®ScopeSuite)	1

Optional: For signal integrity debugging		
Remarks	Reference configuration	
	Product	Quantity
Deembedding or Deembedding, real-time extension	R&S®RTP-K121 or R&S®RTP-K122	1
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

MORE INFORMATION

- ▶ www.rohde-schwarz.com/manual/rtp/
- ▶ [R&S®RTP high-performance oscilloscope](#) product brochure (PD 3683.5616.12)
- ▶ [Signal model based approach to joint jitter and noise decomposition](#) white paper, PD 3608.5241.52

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