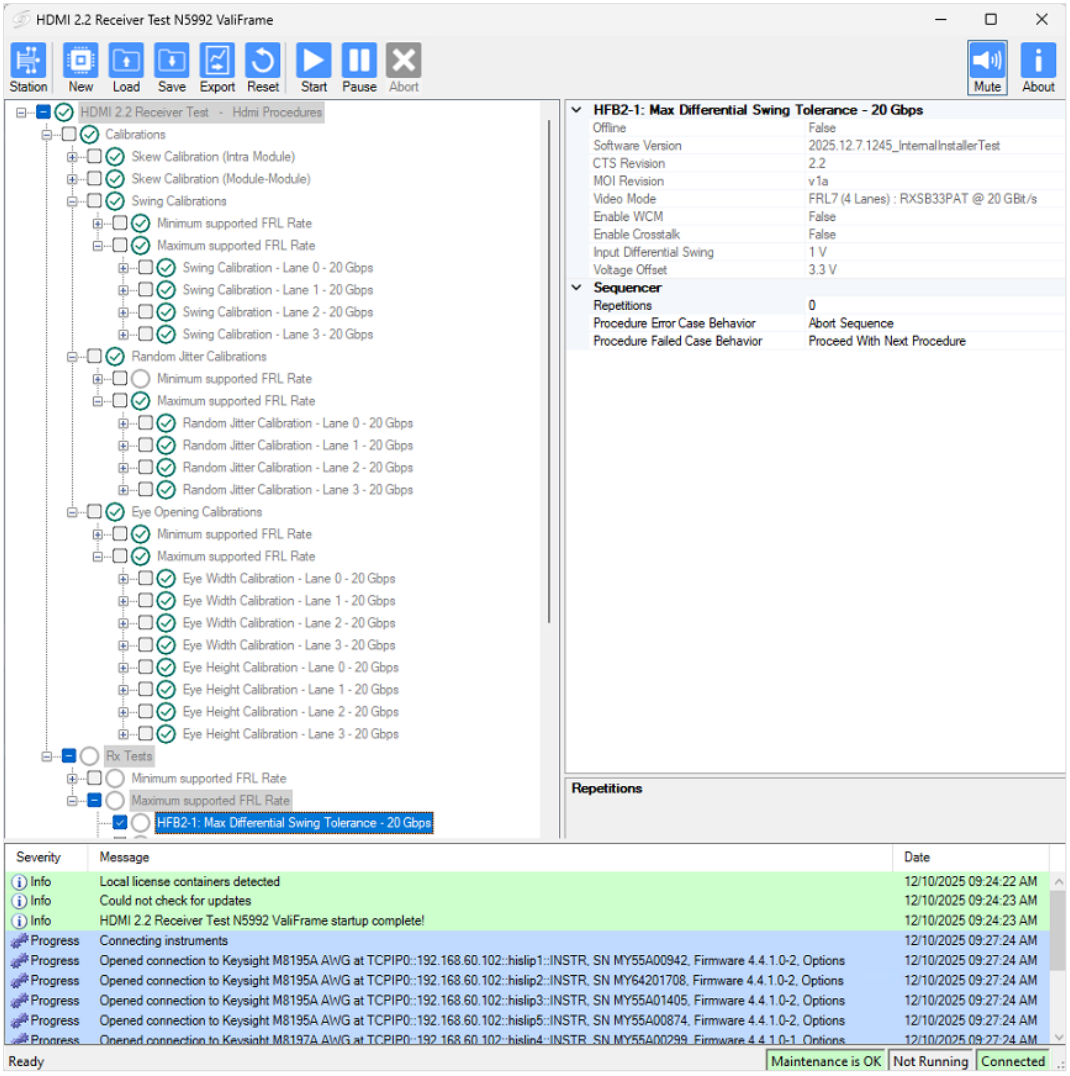
N5992HP2A

HDMI 2.2 Receiver Compliance Test Automation Platform

Introduction

This datasheet outlines the covered HDMI 2.2 receiver compliance tests, instrument requirements, and the PC specifications for running the automated test software.



KEYSIGHT

N5992 Product Line

High-speed digital standards are rapidly evolving to support next-generation technologies such as generative AI, chiplet-based architecture, advanced driver assistance systems (ADAS), edge AI, and 6G research.

Each generational change introduces new test challenges for your digital designs. You need to test your high-speed digital designs across all product development stages, from design and simulation to analysis, debugging, and compliance testing. The N5992 product line anticipates test challenges, optimizes performance, and accelerates time-to-market of your high-speed computing interfaces, data-center connections, and consumer electronics.

Supported standards, which include PCIe, SAS, SATA, USB, HDMI, DisplayPort, and MIPI C-PHY. Other standards will be continuously added with the requirements for higher data-speed testing.

- Guided setup with automated fast stress signal calibration and compliance measurement functions
- Modern look and feel with enhanced functionalities
- System modularity allows the user to enable only required functionalities
- HTML reports
- Node-locked and transportable licenses
- Characterization mode for in-depth testing
- Single- and multi-lane device testing

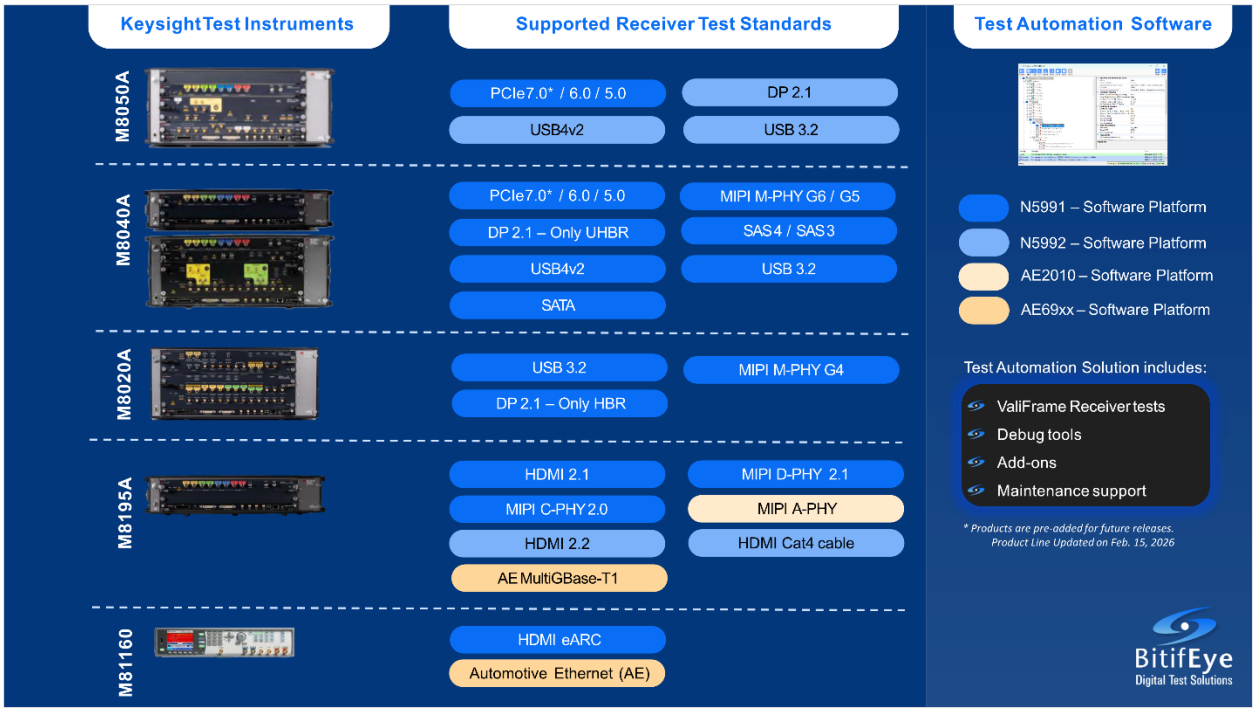


Figure 1. N5992 Software Solution Path

Turn Your Instruments into a Solution

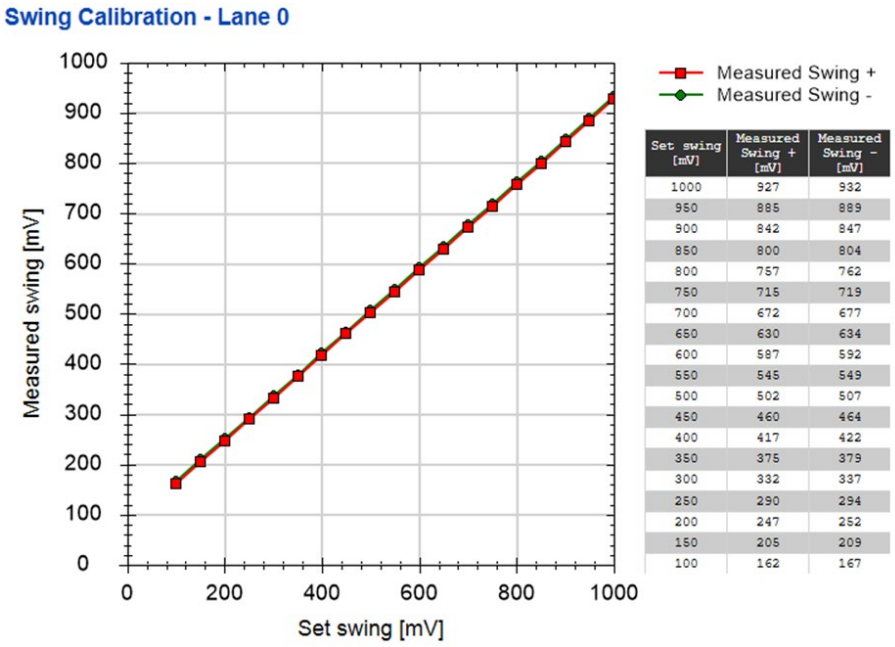
An efficient test strategy is a proven competitive advantage. The Keysight Technologies N5992 is the successor to the well-known industry standard N5990A test automation software platform. It follows the same concept – combining the performance of your instruments with the convenience of your PC. The system's software provides unprecedented test integration, high-throughput, and ease-of-use for a wide range of stimulus and response systems, providing a level of control that transforms a collection of instruments into a universal, user-friendly, and highly productive test solution.

Standardize Your Tests

The N5992 receiver-test options provide dedicated receiver compliance tests for popular and emerging digital buses. The user can choose compliance mode for fast reassurance, or characterization mode for in-depth analysis. The Receiver Test Automation Platform's compliance testing capabilities have been repeatedly proven at interoperability workshops ("plug fests"). The N5992 builds on the success of previous generations to deliver significant gains in productivity. Like its predecessor, the N5991A, the new system makes it easy to test multiple buses by using the same interface for all available standards. It delivers additional gains by using familiar HTML for reporting results.

Select Tests and Test Results

The test automation software platform lets you select tests from an intuitive tree structure with multiple levels of detail. Select the tests you want to run, together with the number of repetitions. Test results are provided in HTML format. When you measure a parameter range, it delivers a specific graph and a related data table, as shown in Figure 2.



Set swing [mV]	Measured Swing + [mV]	Measured Swing - [mV]
1000	927	932
950	885	889
900	842	847
850	800	804
800	757	762
750	715	719
700	672	677
650	630	634
600	587	592
550	545	549
500	502	507
450	460	464
400	417	422
350	375	379
300	332	337
250	290	294
200	247	252
150	205	209
100	162	167

Figure 2. N5992 calibration report on graph format and a related data table

N5992HP2A HDMI 2.2 Receiver Tests

The **N5992HP2A HDMI 2.2 Receiver Test** software is a purpose-built, automated solution for validating the electrical performance and compliance of HDMI 2.2 sink devices in accordance with HDMI Forum specifications. It provides a guided, end-to-end test environment that supports both receiver characterization in R&D and formal compliance validation.

The software automates all required HDMI 2.2 receiver tests, delivering comprehensive signal integrity validation including jitter analysis, skew characterization, impedance verification, and high-speed TMDS channel performance testing. An intuitive GUI, built-in calibration routines, and automated workflows simplify setup, improve measurement repeatability, and reduce human error.

The N5992HP2A integrates seamlessly with Keysight high-performance oscilloscopes, Arbitrary Waveform Generators (AWGs), and signal conditioning accessories, ensuring accurate, repeatable measurements. Automated pass/fail reporting accelerates decision-making and shortens time-to-market, enabling confident qualification and interoperability of next-generation HDMI receivers.

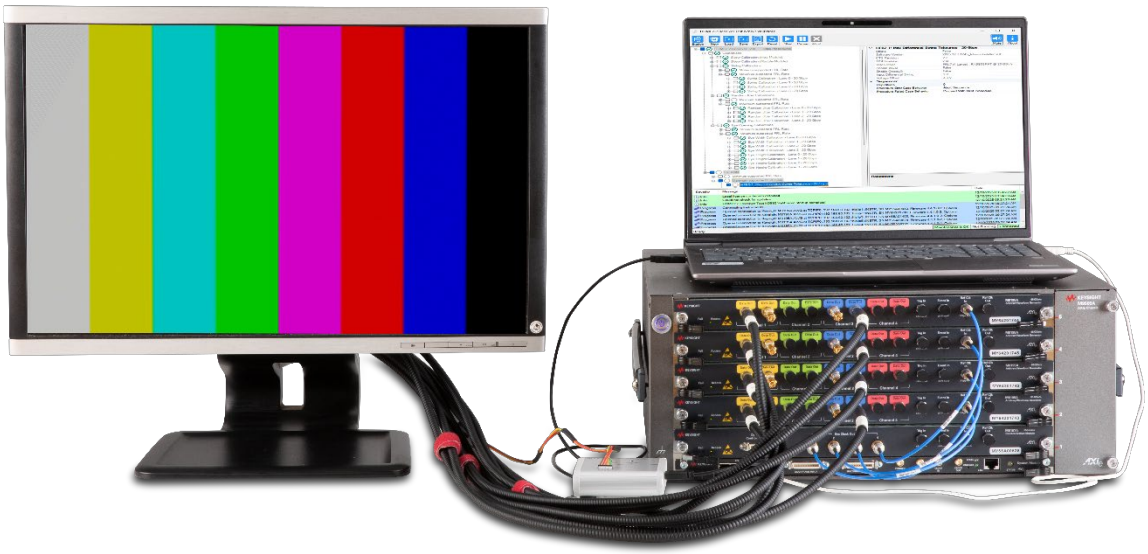


Figure 3. HDMI Receiver Test Setup based on M8195A

Calibrations

The HDMI Receiver testing supports automatic control of the Keysight Technologies M8195A AWG. It calibrates stress conditions and controls all electronic test equipment for automated tests. The N5992HP2A implements the tests according to the requirements of the Compliance Test Specification for Sink Devices of HDMI version 2.2.

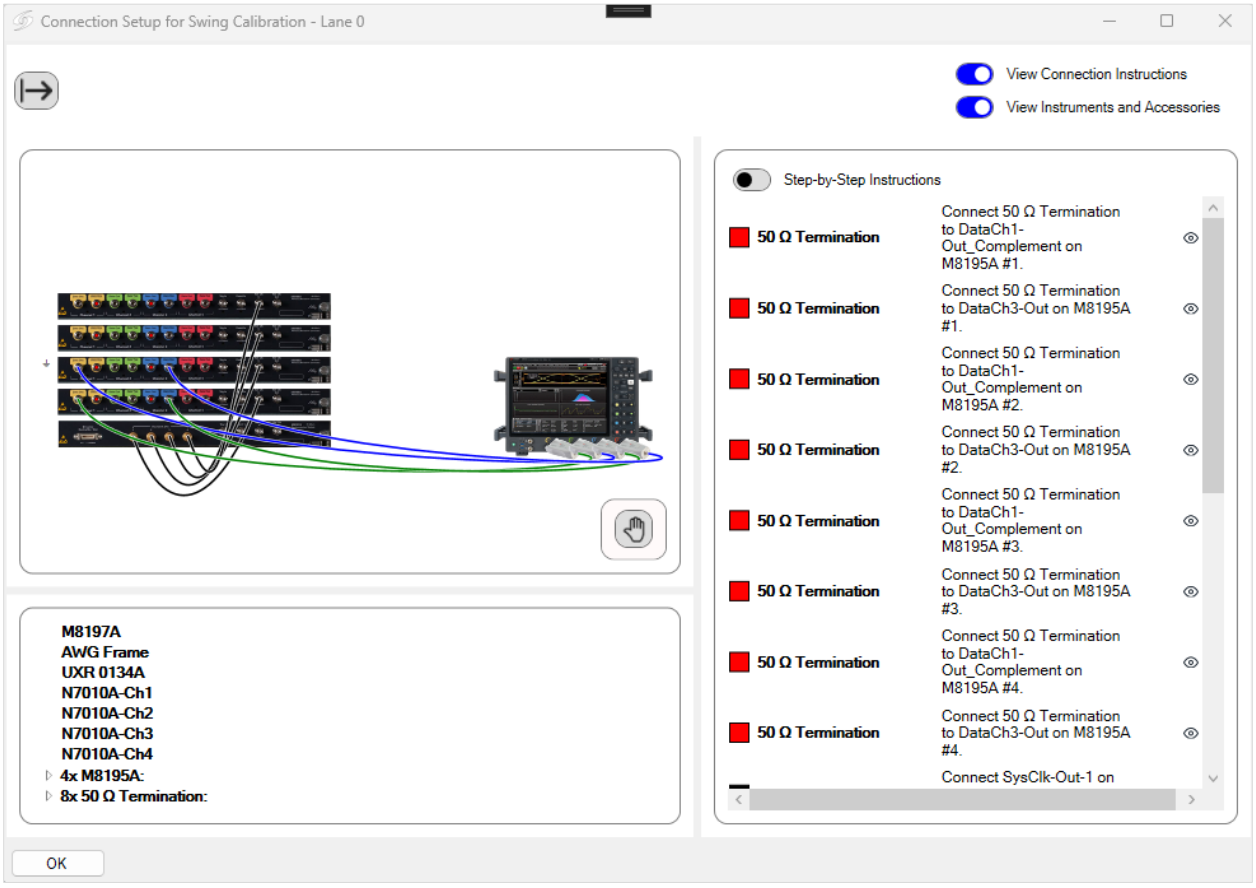


Figure 4. N5992 calibration setup

The calibration procedures calibrate signal generator levels and timings. The order of the procedures is mainly driven by the dependencies of the calibrations. The results of each calibration will be stored in the Calibration folder of ValiFrame, so that it can be further used in another calibrations or tests.

Jitter calibrations are required for each data rate as specified in the HDMI Specification. ValiFrame automation helps to automatically determine the required calibrations to run tests.

SkewCalibration(IntraModule)

----General----	
Offline	False
Software Version	1.0.0.0_InternalInstallerTest
Spec Deviations	
Comments	
FW Compatibility	False
Probe Amplifier	N7010A
Probe Head	None
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8195A AWG ; Company: Keysight Technologies ; Model: M8195A ; SN: Unknown ; FW rev.: Unknown ; Description: M8195A Module 1 ; Firmware Version Supported: False ; Calibrated Instrument
Calibrated Instrument 2	Name: Keysight M8195A AWG ; Company: Keysight Technologies ; Model: M8195A ; SN: Unknown ; FW rev.: Unknown ; Description: M8195A Module 2 ; Firmware Version Supported: False ; Calibrated Instrument
Calibrated Instrument 3	Name: Keysight M8195A AWG ; Company: Keysight Technologies ; Model: M8195A ; SN: Unknown ; FW rev.: Unknown ; Description: M8195A Module 3 ; Firmware Version Supported: False ; Calibrated Instrument
Calibrated Instrument 4	Name: Keysight M8195A AWG ; Company: Keysight Technologies ; Model: M8195A ; SN: Unknown ; FW rev.: Unknown ; Description: M8195A Module 4 ; Firmware Version Supported: False ; Calibrated Instrument
Calibrated Instrument 5	Name: Keysight DSO ; Company: Keysight Technologies ; Model: DSO Infiniium Series ; SN: Unknown ; FW rev.: Unknown ; Description: Real-Time Oscilloscope ; Firmware Version Supported: False ; Calibrated Instrument
Measurement Instrument 1	Name: Keysight M8197A AWG ; Company: Keysight Technologies ; Model: M8197A ; SN: Unknown ; FW rev.: Unknown ; Description: AWG Sync module ; Firmware Version Supported: False ; Measurement Instrument

Skew on FRL Lane0 module [ns]	Skew on FRL Lane1 module [ns]	Skew on FRL Lane2 module [ns]	Skew on FRL Lane3 module [ns]
0.400	0.500	0.300	0.400

Figure 5. Example of a skew calibration test result

Receiver Tests

HDMI Receiver testing ensures signal integrity by verifying that the Receiver meets the stringent requirements defined by the HDMI 2.2 specification. It is conducted by applying a stressed signal, performing the loopback training and reading automatically the errors with the SCDC Controller. FRL tests must be conducted for the highest and the lowest supported data rate.

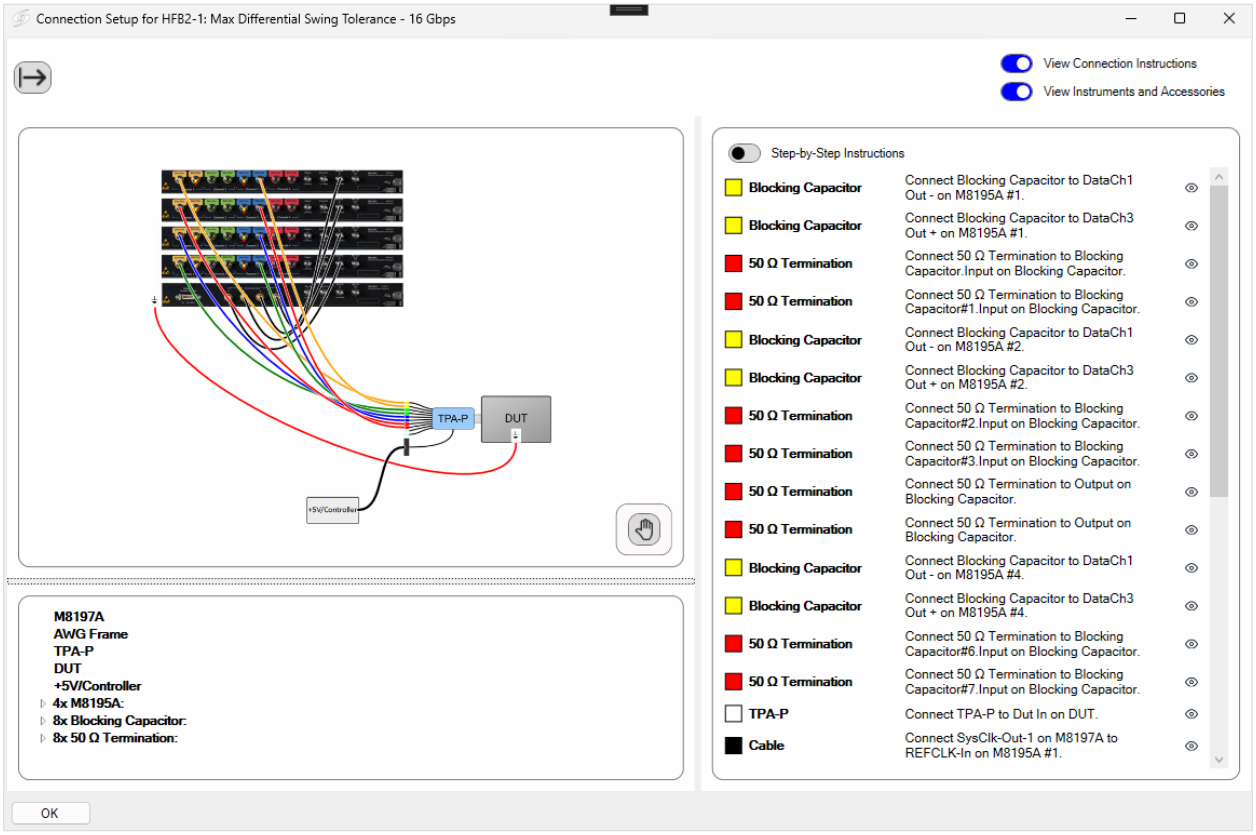
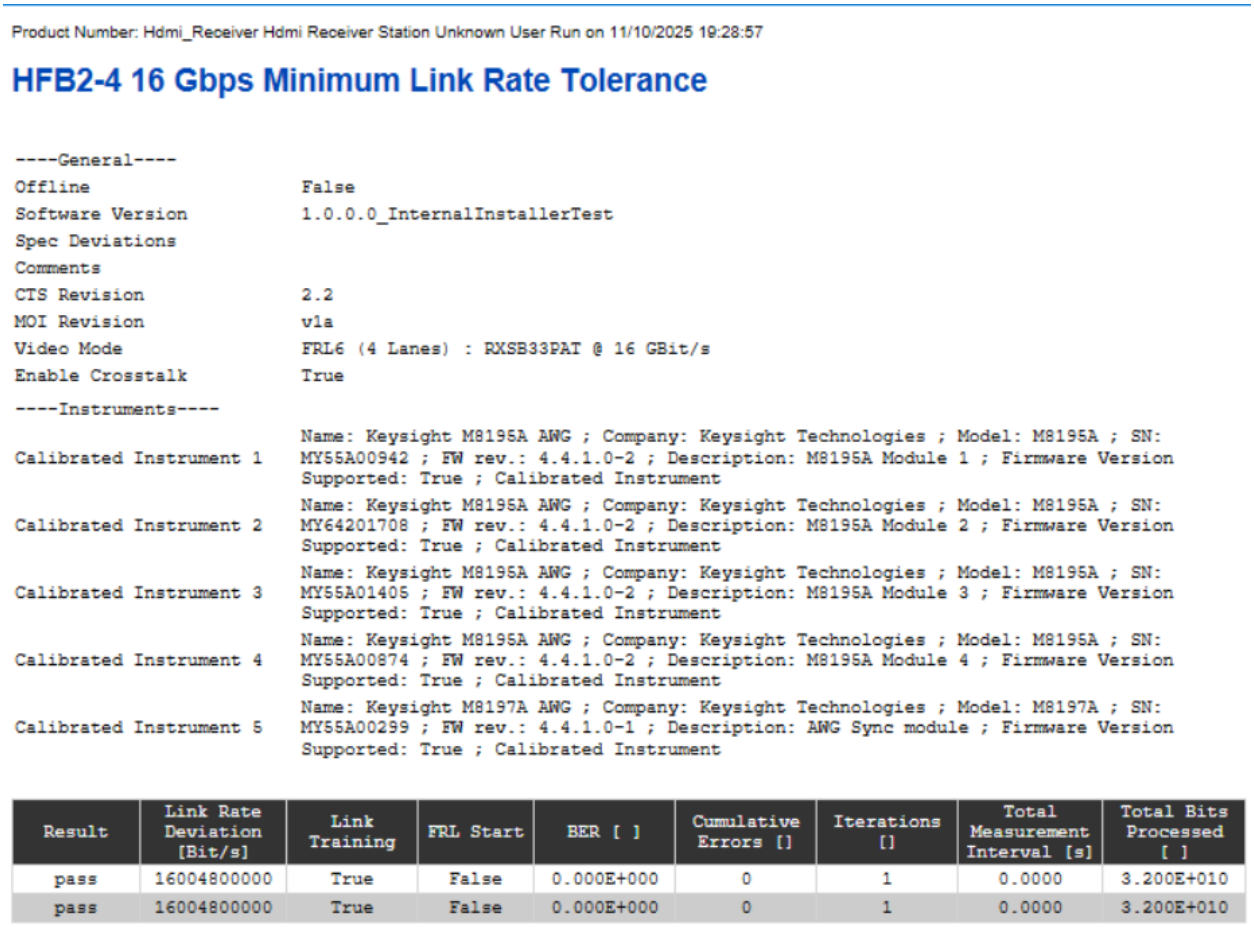


Figure 6. Connection setup, detailing components, and interconnections

The following figure illustrates the report of a Minimum Link Rate Tolerance Test generated by ValiFrame. Besides the test result it displays additional details as well. This test is one of the crucial tests for validating HDMI Receiver performance, ensuring minimal signal degradation, robust high-speed transmission, and interoperability across devices. It is integrated into automated test workflows.



Product Number: Hdmi_Receiver Hdmi Receiver Station Unknown User Run on 11/10/2025 19:28:57

HFB2-4 16 Gbps Minimum Link Rate Tolerance

----General----	
Offline	False
Software Version	1.0.0.0_InternalInstallerTest
Spec Deviations	
Comments	
CTS Revision	2.2
MOI Revision	v1a
Video Mode	FRL6 (4 Lanes) : RXSB33PAT @ 16 GBit/s
Enable Crosstalk	True
----Instruments----	
Calibrated Instrument 1	Name: Keysight M8195A AWG ; Company: Keysight Technologies ; Model: M8195A ; SN: MY55A00942 ; FW rev.: 4.4.1.0-2 ; Description: M8195A Module 1 ; Firmware Version Supported: True ; Calibrated Instrument
Calibrated Instrument 2	Name: Keysight M8195A AWG ; Company: Keysight Technologies ; Model: M8195A ; SN: MY64201708 ; FW rev.: 4.4.1.0-2 ; Description: M8195A Module 2 ; Firmware Version Supported: True ; Calibrated Instrument
Calibrated Instrument 3	Name: Keysight M8195A AWG ; Company: Keysight Technologies ; Model: M8195A ; SN: MY55A01405 ; FW rev.: 4.4.1.0-2 ; Description: M8195A Module 3 ; Firmware Version Supported: True ; Calibrated Instrument
Calibrated Instrument 4	Name: Keysight M8195A AWG ; Company: Keysight Technologies ; Model: M8195A ; SN: MY55A00874 ; FW rev.: 4.4.1.0-2 ; Description: M8195A Module 4 ; Firmware Version Supported: True ; Calibrated Instrument
Calibrated Instrument 5	Name: Keysight M8197A AWG ; Company: Keysight Technologies ; Model: M8197A ; SN: MY55A00299 ; FW rev.: 4.4.1.0-1 ; Description: AWG Sync module ; Firmware Version Supported: True ; Calibrated Instrument

Result	Link Rate Deviation [Bit/s]	Link Training	FRL Start	BER [ ]	Cumulative Errors []	Iterations []	Total Measurement Interval [s]	Total Bits Processed [ ]
pass	16004800000	True	False	0.000E+000	0	1	0.0000	3.200E+010
pass	16004800000	True	False	0.000E+000	0	1	0.0000	3.200E+010

Figure 7. Minimum Link Rate Tolerance Test report

Instrument Requirements for HDMI 2.2 Receiver Testing

The N5992HP2A Receiver Test Automation for HDMI requires the following hardware:

- One (1) M9505A AXIe chassis with suitable USB or PCIe connectivity to the external controller
- Four (4) M8195A AWGs
- One (1) M8197A sync module
- One (1) external controller, PC with suitable USB or PCIe connectivity to the M9505A AXIe chassis

Periodic calibration with a UXR 33 GHz scope is strongly recommended.

Please ask for a complete configuration for details on instrument options, accessories, and additional software.

System Requirements

Visit https://downloads.bitifeye.com/ and read the changelog of the current software release for detailed information on software and hardware requirements.

Software

Requirements*

- OS: Windows 11, English version
- Microsoft .NET Framework
- Keysight IO Libraries Suite

Exact versions of software requirements are listed in the respective changelog file.

*Compatibility of N5992HP2A software releases may be subject to Microsoft operating system life cycles for Customer controller hardware. Customer is responsible for confirming controller compatibility prior to updating. Upward compatibility may require additional purchase.

Hardware

Requirements

- Connectivity hardware for instrumentation, depending on configuration e.g., Ethernet
- Multicore processor with 12 logical processors or more
- 16 GB RAM or higher

Application Programming Interface (API)

The N5992 ValiFrame API allows ValiFrame functionality (such as test setup information, calibration and test procedures, and also results) to be accessed from external programming environments. API does not need a special license to be used. It is included in the base product of particular standards. The API can thus be used to control the N5992 with external software.

In typical use, a top-level external test sequencer takes advantage of ValiFrame functionality.

Software Maintenance Extension

The purchase of one -SFM maintenance extension license for -1FP product licenses or one -STM maintenance extension license for -1TP product licenses provides the ability to install updates for one year.

A software maintenance extension license is always valid for the respective RX test or Debug Tool/Link Training Suite or Frame Generator product only.

Software maintenance extension includes updates to newer instrument firmware as well as procedure and test limit changes for the test specifications covered by the products the software maintenance extension license belongs to. Upgrades to a different test specification are not covered.

Products that do not have a software maintenance extension license and are not an Add-On will not be updated but are still operational.

Software without any extra software maintenance extension product associated with it will have a maintenance expiration date of the license issue date +14 days as a starting point. The software itself will still work, even if the maintenance is expired. If software maintenance extension has expired, a new software maintenance extension license can be purchased for this product. However, the new software maintenance extension will not grant coverage starting from the purchase date but from the date the previous software maintenance extension coverage expired.

For example, if the software maintenance extension expired on April 30th, 2025, and a new 1-year software maintenance extension was purchased on August 1st, 2025, the purchased coverage would begin on May 1st, 2025, and would end on April 30th, 2026.

Ordering Information for HDMI 2.2 Software Products

N5992HP2A HDMI 2.2 Receiver Test

Unit	Description
N5992HP2A-1FP	HDMI 2.2 Receiver Tests, Perpetual node-locked license
N5992HP2A-1TP	HDMI 2.2 Receiver Tests, Perpetual transportable single license
N5992HP2A-SFM	HDMI 2.2 Receiver Tests, SW maintenance, 12 Months, Node-locked License
N5992HP2A-STM	HDMI 2.2 Receiver Tests, SW maintenance, 12 Months, Transportable License

Related Products

- D9021HDMC – HDMI Electrical Performance, Validation, and Compliance Test Software
- N5991HE1A – HDMI eARC and HEAC Receiver Compliance Test Automation Platform
- N5992HPCD – CAT4 Cable Eye Test Software for HDMI