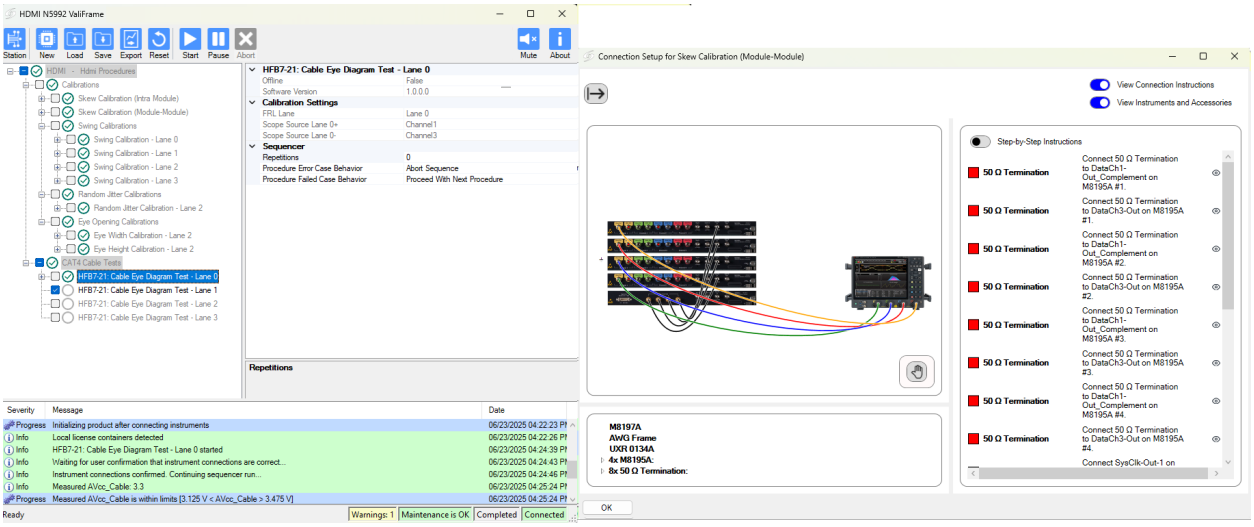
N5992HPCD HDMI 2.2 Cable Test CAT4 Eye Test Solution

Cable conformance test automation software



Unlock the full potential of your HDMI 2.2 CAT4 cable testing with the N5992HPCD – a cutting-edge, automated solution that streamlines compliance validation and ensures high-fidelity signal performance. Designed for efficiency and accuracy, it covers all critical electrical tests including eye diagram, jitter, skew, and impedance, while its automated calibration routines eliminate guesswork and deliver consistent, repeatable results.

Seamlessly integrated with Keysight's industry-leading instruments, the N5992HPCD empowers engineers to accelerate time-to-market with confidence, precision, and ease.

KEYSIGHT

At a Glance

High-speed digital standards are rapidly evolving to keep pace with emerging technologies such as 5G, the Internet of Things (IoT), Artificial Intelligence (AI), Virtual Reality (VR), and autonomous vehicles.

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 software solution anticipates these test challenges, optimizes performance, and accelerates the time-to-market for your high-speed computing interfaces, data center connections, and consumer electronics.

- Supported standards, which include PCIe, SAS, SATA, USB, HDMI, DisplayPort, MIPI M-PHY/MIPI C-PHY/D-PHY. Other standards will be continuously added to 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-lane and multi-lane device testing.

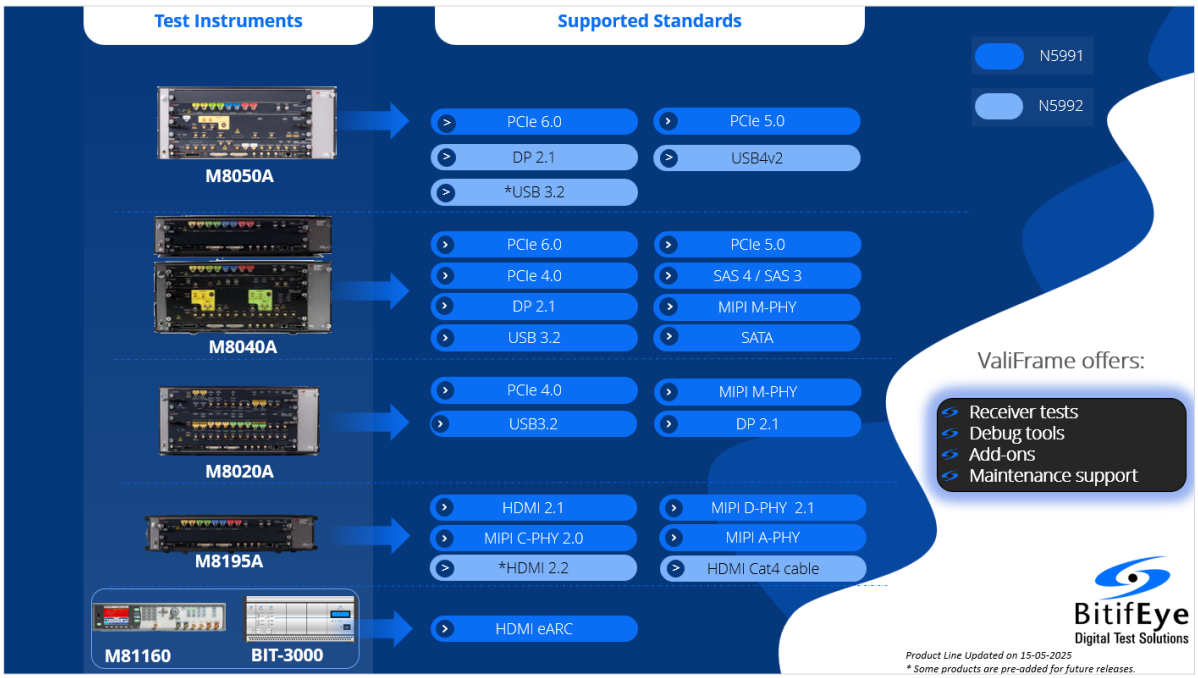


Figure 1. N5992 software solution path

Maximize Your Testing Efficiency

Turn your instruments into a solution

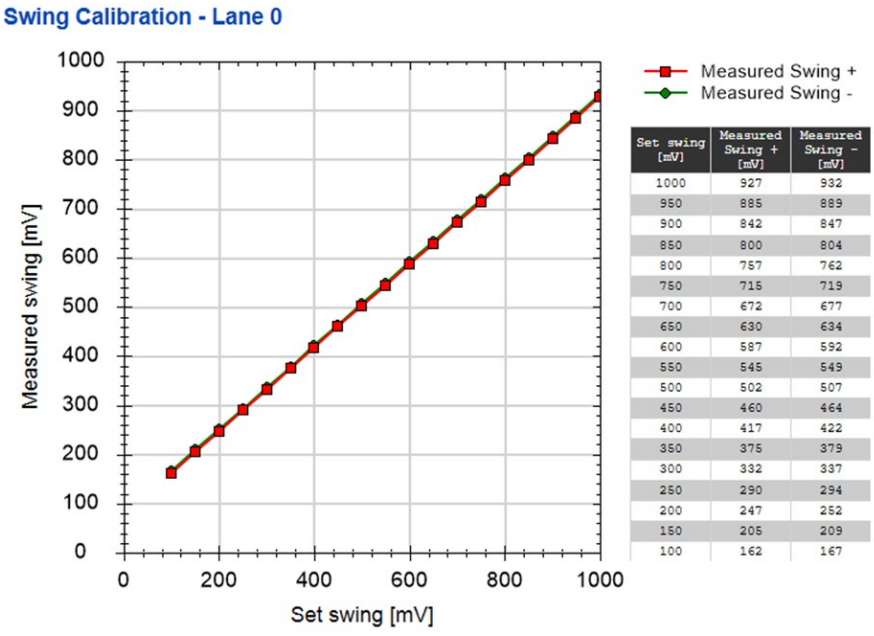
An efficient test strategy is a proven competitive advantage. Keysight's N5992 test automation software platform combines the performance of your instruments with the convenience of your PC. The system's software provides unprecedented test integration, high-throughput, and ease-of-use for a wide range 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 offer specialized compliance tests for both established and emerging digital buses. You can select compliance mode for quick validation or characterization mode for in-depth analysis. The Receiver Test Automation Platform's compliance testing capabilities have consistently demonstrated its effectiveness at interoperability workshops ("plug fests"). The N5992 builds on the success of previous generations to deliver significant gains in productivity. Like its predecessor, the N5991, the new system makes it easy to test multiple buses by utilizing the same interface for all available standards. It delivers additional gains by using HTML for reporting results.

Select the tests and results you want

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, as well as 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.



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 test results in graph format and a related data table

N5992HPCD HDMI 2.2 Cat4 Cable Eye Test

The N5992HPCD software is a purpose-built, automated test solution for performing HDMI 2.2 Category 4 (CAT4) cable eye diagram compliance testing in accordance with HDMI Forum electrical specifications. It enables comprehensive signal integrity validation by executing precise eye diagram measurements, jitter analysis, skew characterization, and impedance verification across all high-speed TMDS channels.

The software integrates seamlessly with Keysight's high-performance oscilloscopes, Bit Error Rate Testers (BERTs), and signal conditioning accessories to ensure accurate and repeatable results. Built-in calibration routines and automated workflows reduce setup complexity and human error, while detailed test reports with pass/fail criteria ensure fast decision-making. Designed for use in both R&D and compliance validation environments, the N5992HPCD accelerates the qualification of HDMI CAT4 cables, ensuring interoperability and performance across the HDMI ecosystem.

Calibrations

The HDMI Receiver testing supports automatic control of the Keysight Technologies M8195A AWG (Arbitrary Waveform Generator). It calibrates stress conditions and controls all electronic test equipment for automated tests. The N5992 implements the tests according to the requirements of the Compliance Test Specification for Sink Devices of HDMI version 2.2.

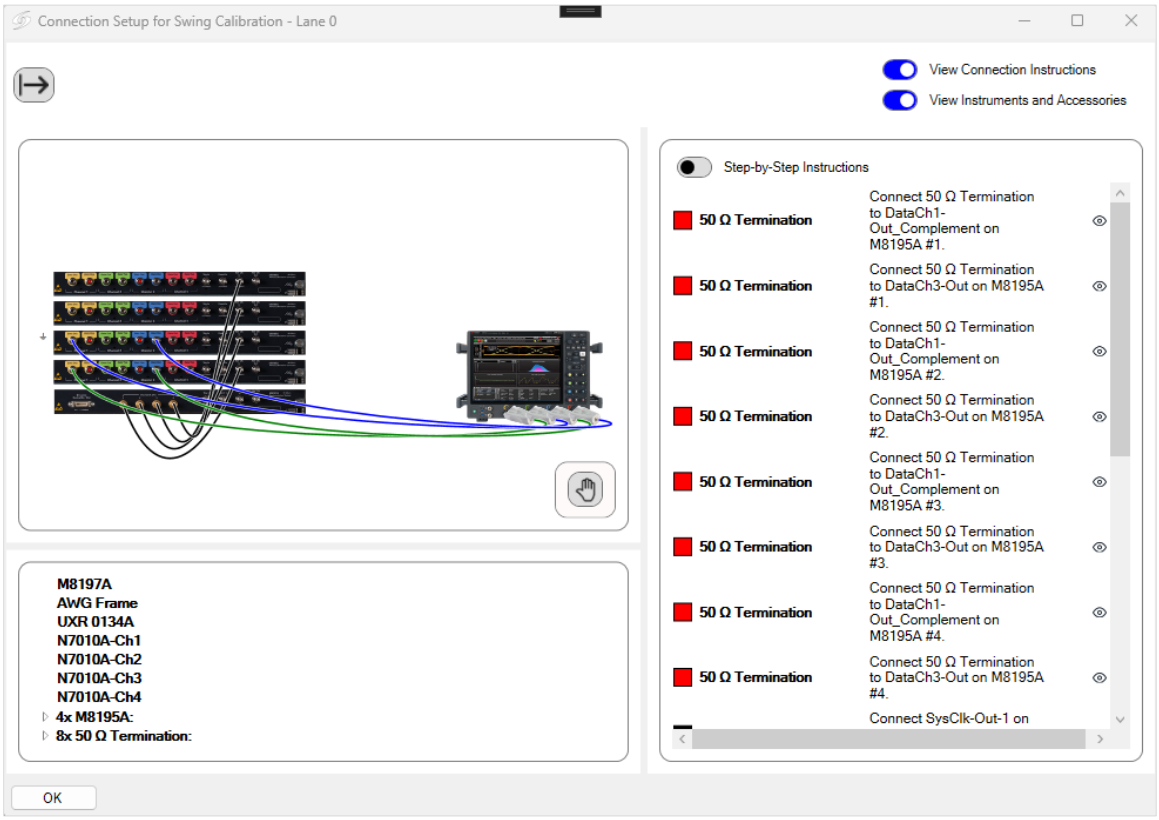


Figure 3. N5992 calibration setup

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 4. Example of a skew calibration test result

Cable tests

HDMI cable electrical compliance testing ensures signal integrity by verifying that cables meet the stringent requirements defined by the HDMI 2.2 specification. During this process, a stressed signal – incorporating worst-case jitter conditions – is transmitted through the cable under test, and the resulting waveform is captured using a high-bandwidth real-time digital oscilloscope. The key test case is the Cable Eye Mask test, which evaluates the eye diagram opening at multiple Fixed Rate Link (FRL) data rates of 16 Gbps, 20 Gbps, and 24 Gbps, across all four TMDS lanes.

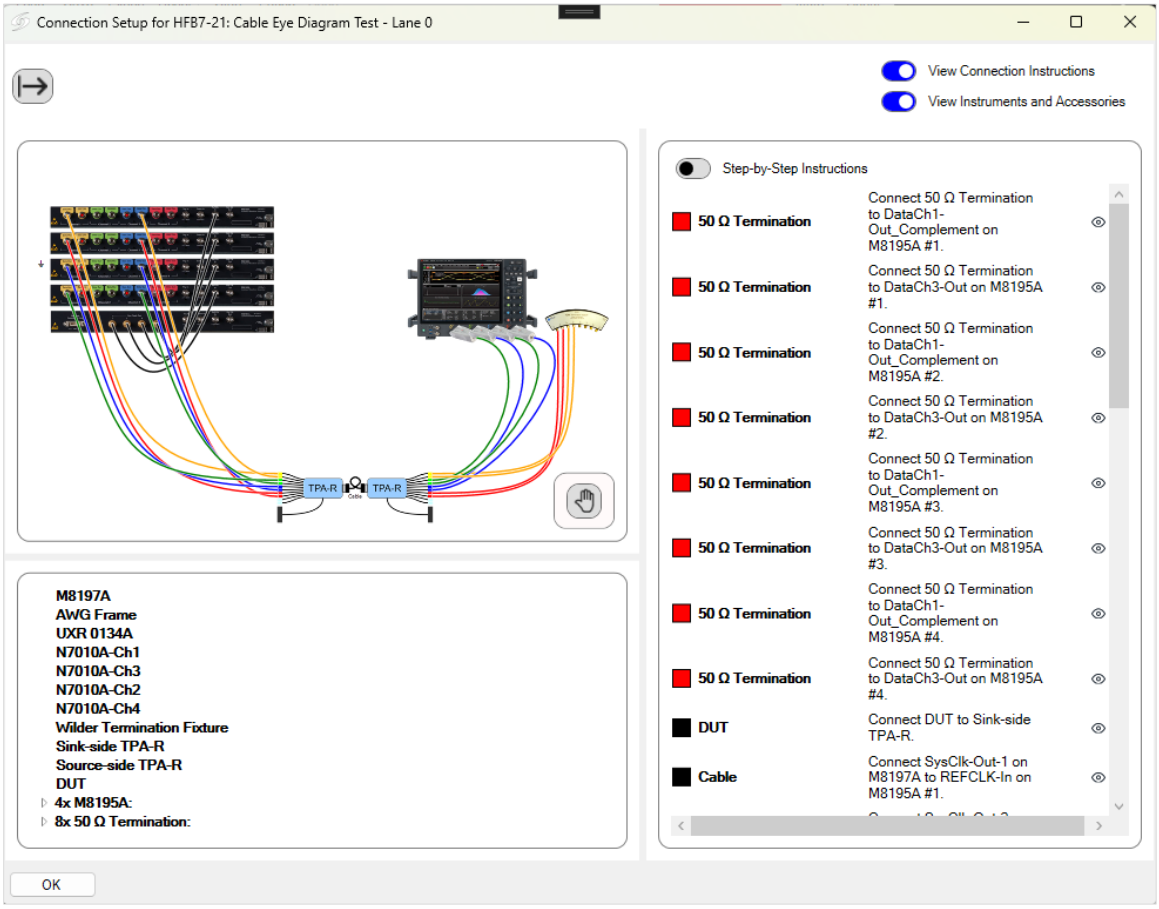


Figure 5. Connection setup, detailing components and interconnections

Figure 6 illustrates the Lane 0 eye diagram generated by Keysight's Infiniium oscilloscope, displaying precise eye height (118.3 mV) and eye width (14.512 ps) values, with over 1.9 million unit intervals (UIs) accumulated. The waveform successfully passes the absolute eye mask with 0 failed UIs, confirming full compliance under worst-case jitter stress.

This test is crucial for validating HDMI CAT4 cable performance, ensuring minimal signal degradation, robust high-speed transmission, and interoperability across devices. It is integrated into automated test workflows.

Figure 6. Eye diagram generated by the Infiniium oscilloscope

Recommended instruments and hardware for HDMI 2.2 CAT4 cable eye diagram testing

To perform accurate and repeatable HDMI 2.2 Cable Test CAT4 eye diagram testing, the following equipment is required:

- Infiniium UXR-Series Oscilloscopes
- N7010A Active Termination Adapter
- M8195A 65GSa/s Arbitrary Waveform Generator
- M8197A Multi-Channel Synchronization Module
- TPA-P test adapter BIT-1010-0520-0
- TPA-R test adapter BIT-1010-0521-0
- HDMI 2.2 test automation kit for M8195A (BIT-1014-0011-1)

System Requirements

Visit BitifEye Download Hub and read the changelog of the current software release for detailed information on software and hardware requirements.

Software

Requirements

- OS: Windows 10
- Microsoft .NET
- Keysight IO Libraries Suite
- Exact versions of software requirements are listed in the respective changelog file.

Recommendation

- Microsoft Office Excel, English version

Hardware

Requirement

- Connectivity hardware for instrumentation, depending on configuration e.g. USB3, Ethernet

Recommendations

- Multicore processor with 12 logical processors or more
- 32 GB RAM or higher

Application Programming Interface (API)

The N5992 ValiFrame remote interface enables access to ValiFrame functionalities, such as test setup information, calibration, test procedures, and results, from external programming environments. This remote interface is included in the base product of specific standards and does not require a special license. Consequently, the remote interface can be used to control the N5992 with external software.

In standard applications, a top-level external test sequencer utilizes the ValiFrame functionality.

Ordering Information

Software

HDMI 2.2 Cat4 Cable Eye solution

N5992HPCD	HDMI 2.2 Cat4 Cable Eye Test Software

License

Licensing options for cable conformance test software

-1FP	Perpetual node-locked license
-1TP	Perpetual transportable single license
-SFM	SW maintenance, 1-year, for -1FP license
-STM	SW maintenance, 1-year, for -1TP license

License type

Node locked: The license can be used on one specified computer.

Transportable: The license can be used on one computer at a time but may be transferred to another using the BitifEye License Manager.

Software maintenance

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

A software maintenance license is always valid for the respective RX test or Debug Tool, e.g. the Link Training Suite or Frame Generator product.

Software maintenance includes updates to newer instrument firmware, as well as changes to procedures and test limits for the test specifications associated with the products covered by the software maintenance license. However, upgrades to a different test specification are not included.

Products without a software maintenance offering and not an Add-On cannot be updated but will remain operational using the last version for which software maintenance was available.

Software without any additional software maintenance product associated with it will have a maintenance expiration date of the license issue date plus 14 days. The software itself will continue to function even if the maintenance has expired.

If software maintenance has expired, a new software maintenance license can be purchased for the product. However, the new software maintenance will not provide coverage starting from the purchase date but from the expiry date of the previous software maintenance coverage. For example, if the software maintenance expired on April 30th, 2024, and a new 1-year software maintenance is purchased on August 1st, 2025, the purchased coverage will start from May 1st, 2024, and end on April 30th, 2025.

Related Products

Explore our range of advanced testing solutions designed to enhance your measurement capabilities and ensure compliance with industry standards. Keysight products include cutting-edge devices and compliance test software, engineered to deliver precise and reliable results.

- D9021HDMC HDMI Electrical Performance, Validation, and Compliance Test Software
- N5991HP1A HDMI 2.1 Receiver Compliance Test Software
- N5991HE1A HDMI eARC Receiver Compliance Test Software
- M8195A 65 GSa/s Arbitrary Waveform Generator
- M8197A Multi-Channel Synchronization Module for M8195A
- Infiniium UXR-B Series Oscilloscopes
- M8040A 64 GBaud High-Performance BERT
- M8020A J-BERT High-Performance BERTs