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Requirements and Compatibility | Ordering Information

For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

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NI Digital Video Analyzer

HDMI 1.4 Protocol, Audio, Video, and Picture Quality Analysis



- Support for 1080p60Hz, HDCP-encrypted content including 3D
- HDMI 1.4 Protocol Analysis including InfoFrame analysis, CEC messaging, programmable EDID, and HPD events
- Real-time measurements for total picture quality with NI Picture Quality Analysis (NI PQA) software
- Configurable test steps within NI TestStand designed for automated applications
- Included NI PXIe-6545 200 MS/s high-speed digital module and NI PXI-2172 deserializer/decryption module
- Included NI PXI-7813R reconfigurable I/O module for HDMI Audio and SPDIF Audio acquisition

Overview

The NI Digital Video Analyzer is a flexible, high-performance solution for the validation and production test of HDCP-encrypted HDMI devices. It incorporates the functionality of a protocol analyzer, audio analyzer, video analyzer, and picture quality analyzer into a single solution. The analyzer combines modular instruments based on PXI Express technology with audio and video analysis software to automate measurements. Using software-defined test solutions based on PXI, you can include analyzers for CVBS, CAV, HDMI, SPDIF, and Stereo audio in a single system that is optimized for parallel test. The NI Digital Video Analyzer is made up of an NI PXIe-6545 high-speed digital waveform analyzer/generator, an NI PXI-2172 deserializer and decryption module, and NI Video Measurement Suite (NI VMS) software, which provides easy-to-use graphical user interfaces, more than 250 analog and digital video measurements optimized for automated test, and seamless integration with NI TestStand test management software for automated applications.

The NI Digital Video Analyzer is an extension of the NI Analog Video Analyzer for composite, S-video, component, and VGA video analysis. The analyzer measures video characteristics such as line timing, color levels, system noise, frequency response, and other linear and nonlinear distortions. These measurements are complemented with HDMI audio analysis using common measurements such as THD and frequency response, and protocol analysis of InfoFrame content, CEC messaging, and EDID emulation to simulate high-definition display settings. Both analyzers use the same NI VMS software, so you can develop video test applications of integrated devices more efficiently.

Many video test engineering challenges involve measuring perceptual quality or identifying defects such as stuck video, dropped audio, macroblocking, and pixelation. NI Picture Quality Analysis (NI PQA) software is an add-on to the NI Digital Video Analyzer that provides real-time, objective measurements to identify these artifacts and many more. NI PQA also includes total picture quality measurements such as PSNR and CW-SSIM to give objective scores for perceived quality.

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Requirements and Compatibility

OS Information

- Windows 7
- Windows XP

Driver Information

- NI-DAQmx
- NI-HSDIO
- NI-RIO
- NI-SWITCH

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Application and Technology

HDMI Video Signal Measurements With NI VMS

When used with NI VMS software, the NI Digital Video Analyzer acts as a waveform analyzer. You can acquire a single video containing common test patterns such as colorbars, ramps, multibursts, and sweeps and then analyze the horizontal lines using advanced signal processing algorithms included in NI VMS software. To ensure optimal execution speed, the system acquires one frame of video and takes several measurements on the acquired frame on lines or patterns defined by the user. Measurement time thus becomes a function of computation time and not the acquisition time, creating a system that benefits from multicore computing.

Easy-to-Use Software Interfaces for Fast Development

NI VMS software provides three different ways to develop an application for HDMI test:

1. Interactive stand-alone application (.exe) for debugging and nonautomated applications
2. Custom step types for NI TestStand for quickly configuring automated measurements and limits
3. LabVIEW API for creating custom applications

The analyzer supports Full High-Definition (1080p60) video, including 3D and HDCP-encrypted content, and deep color (36-bit/pixel) content.

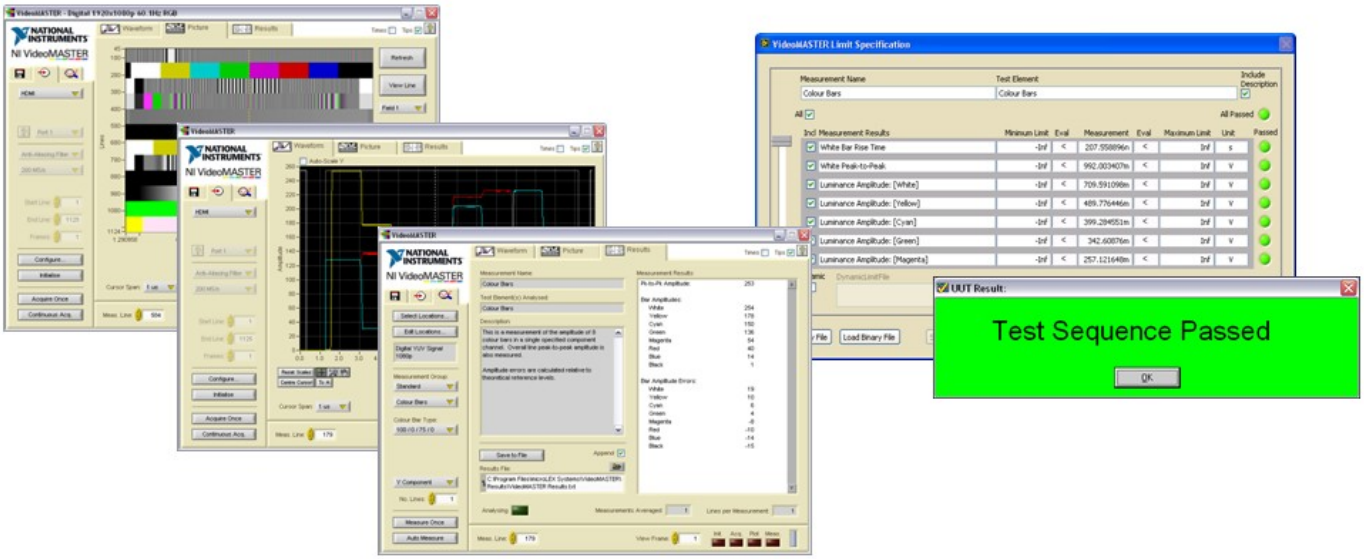


Figure 1. NI VMS software provides several ways of viewing video signal information such as the active picture (top), horizontal line waveform (middle), and measurement results (bottom). Also included is a Limits Editor (right) to create pass/fail tests for all measurements.

NI VMS offers a complete set of video measurements for analyzing high-definition HDMI video:

Amplitude and Timing	
Channel delay	Delays between the 3 channels
Color bars	Bar amplitudes and errors
Edge finder	Number of edges found Low and high levels Amplitude and center Bar width Rise and fall times
Group delay and frequency response (SinX)/X	Group delay gain

Horizontal timing	Sync width, start and end Sync polarity: H and V Active video: start and end Active line interval Total line interval
K-factor	K 2T K-pulse bar Pulse/bar ratio and error Pulse amplitude Pulse width (HAD)
Level meter (single point/two point differential)	Amplitude levels: Y, U, V or R,G,B Frequency Location/time
Line frequency	Line frequency Line period Frame frequency Sample frequency
Noise Spectrum	
Noise spectrum	Noise level, dB_{rms} and mV_{rms} Peak noise level and frequency Noise band start and stop
Linear Distortion	
Multiburst	Flag amplitude Packet amplitudes Packet frequencies Amplitude difference
Sweep	Amplitudes Frequencies Amplitude difference
Short-time distortion	Bar amplitude and width Rise time, preshoot, overshoot, settling time Fall time, preshoot, undershoot, settling time
Nonlinear Distortion	
Nonlinearity	Nonlinearity Step nonlinearity errors
Signal Information	
Signal information	Frame rate Pixel width and height Progressive or interlaced Bits per pixel RGB or YUV 4:4:4 or 4:2:2 Encryption or not

Table 1. NI VMS offers a complete set of video measurements for analyzing high-definition HDMI video.

HDMI Audio Signal Measurements With NI AudioMASTER

The NI Digital Audio Analyzer is an add-on to the NI Digital Video Analyzer that includes an NI PXI-7813R reconfigurable I/O module, HDMI audio cable, and NI AudioMASTER software. The PXI-7813R connects directly to the PXI-2172 (shown in Figure 2) to acquire 2- to 8-channel embedded audio at sample rates up to 192 kHz including HDCP-encrypted audio.

Easy-to-Use Software Interfaces

NI AudioMASTER software provides an easy-to-use software interface to quickly configure HDMI audio measurements. With the NI AudioMASTER custom test step in NI TestStand, you can select measurements, configure limits, and process HDMI audio signals.

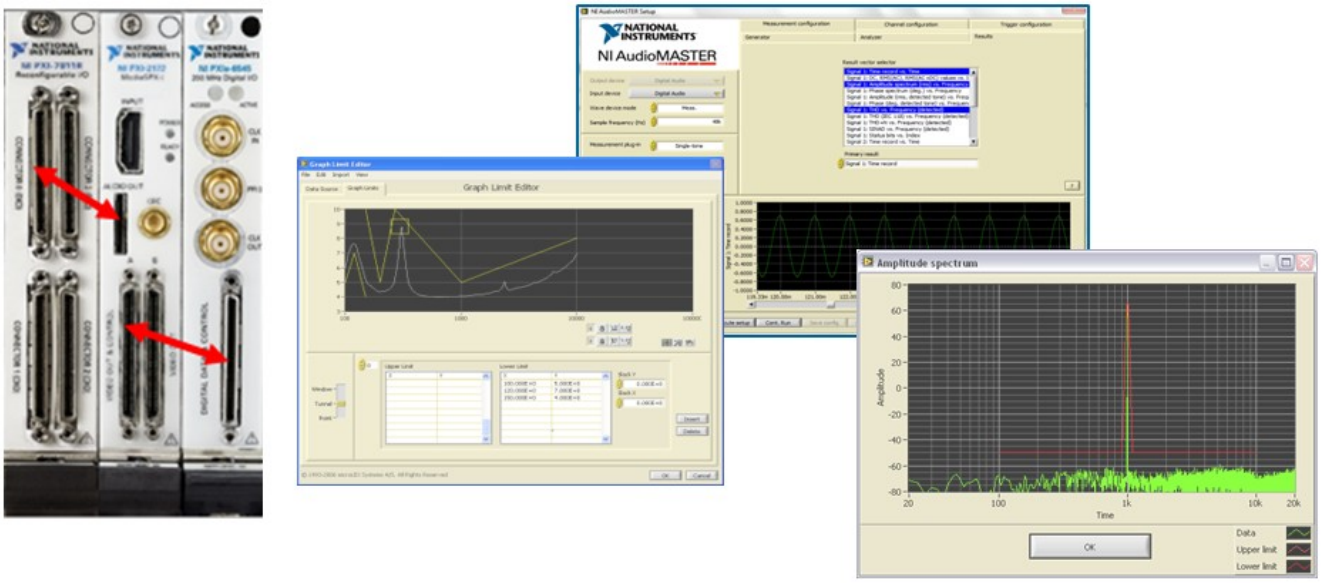


Figure 2. Using the NI Digital Audio Analyzer, you can analyze all embedded channels in the HDMI signal. NI AudioMASTER software has high-performance measurements for analyzing single tones, multitones, amplitude sweeps, frequency sweeps, and more to test not only functionality but also audio quality.

NI AudioMASTER provides a complete set of audio measurements for analyzing HDCP-encrypted HDMI embedded audio. Any set of measurements can be applied to all channels of the embedded audio.

HDMI Signal Type
Amplitude Sweep
Coherent Sweep
Multiple Pure Tones
Multi-Tone
Polarity
Single-Tone
Step Response
Waveform Analyzer

HDMI Signal Measurements
Tone Frequency (Hz)
Tone Amplitude
Tone Phase (Deg)
DC
Broadband RMS
THD
THD+N
SINAD
Dynamic Range (SNR)
Spectrum (RMS)
Amplitude Spectrum (RMS)
Phase Spectrum (Deg)
Status Bits
Octave Band (1/n) RMS
Time Record
Channel Phase Difference
Channel Amplitude Difference
Crosstalk

Table 2. NI AudioMASTER provides a complete set of audio measurements for analyzing HDCP-encrypted

HDMI embedded audio.

HDMI 1.4 Protocol Analysis: InfoFrames, CEC, DDC, and HPD

The NI Digital Video Analyzer can also be used to test HDMI 1.4 protocols including InfoFrames, CEC messaging, EDID emulation, and HPD events to ensure successful interoperability with other HDMI devices.

InfoFrame Measurements, CEC Messaging, EDID Emulation, and HPD Events

NI VMS software provides built-in measurements to verify that InfoFrame content is being generated correctly by the device under test (DUT). Supported InfoFrames include Audio InfoFrame, AVI InfoFrame, HDMI InfoFrame, MPEG InfoFrame, SPD InfoFrame, VBI InfoFrame, and General Parameters.

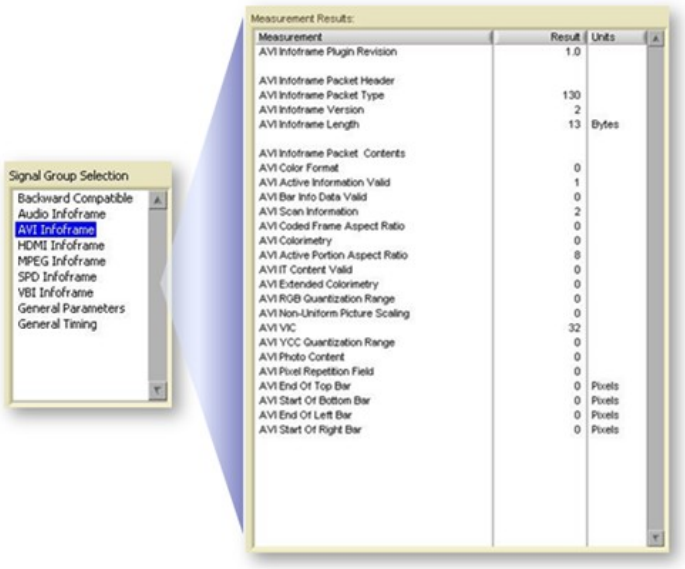


Figure 3. The NI Digital Video Analyzer measures InfoFrame packet bytes.

The NI CEC Analyzer utility is included with the NI Digital Video Analyzer to send and receive CEC messages from the DUT. The utility supports CEC Version 1.3 and 1.4 messaging protocols and can be used to force a DUT into specific action states, query current states, or analyze CEC implementation. The NI CEC Analyzer utility comes as a stand-alone application (.exe) and includes a LabVIEW API for automated measurements.

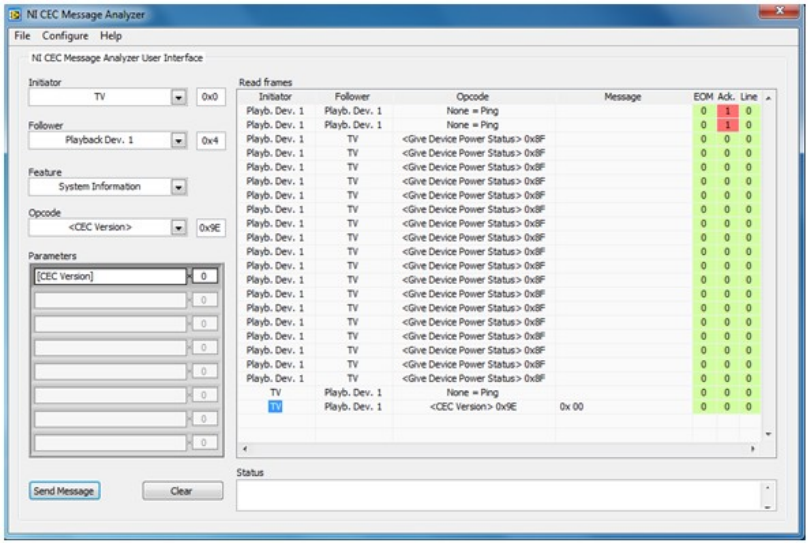


Figure 4. The NI CEC Analyzer utility generates CEC messages and receives and analyzes responses from the DUT.

The NI EDID Update utility is also included with the NI Digital Video Analyzer to programmatically load new EDID tables onto the analyzer, allowing it to simulate different models of HDTVs or other displays. With EDID emulation, you can better guarantee interoperability with nearly any HDMI-capable device.

One of the most well-known features of HDMI 1.4 is 3D video, which requires in-depth testing on EDID negotiations and InfoFrames to ensure 3D capabilities are negotiated properly. The NI Digital Video Analyzer supports a variety of 3D formats including Frame Packing, Side-by-Side Full, and Side-by-Side Half. For other 3D implementations, NI can work with you to ensure the NI Digital Video Analyzer supports your application.

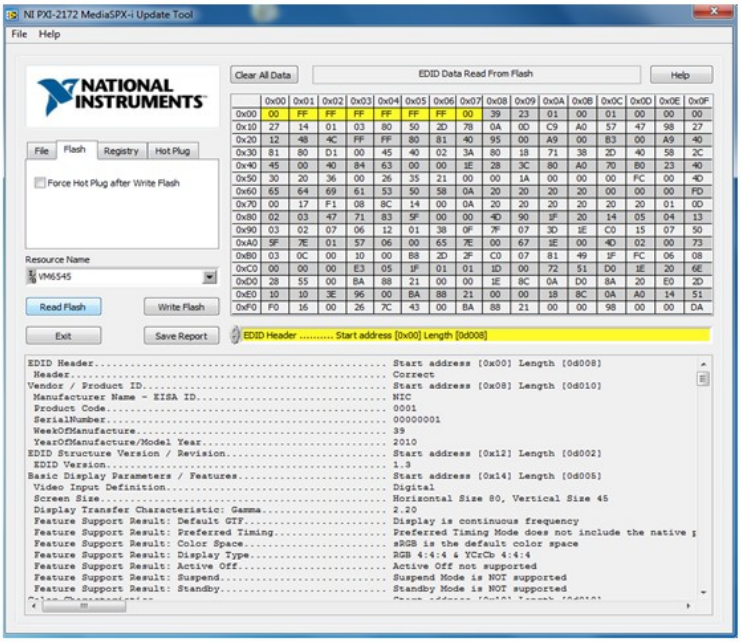


Figure 5. With the NI EDID Update utility, you can load new EDID tables to the NI Digital Video Analyzer to simulate various display settings or force negotiation errors.

Picture Quality Analysis

NI Picture Quality Analysis (NI PQA) software is an add-on to the NI Digital Video Analyzer that analyzes HDMI video and audio streams for overall quality. Using high-performance reference tests, you can remove the doubt of operator inspection and test products in a fraction of the time.

Referenced Versus Nonreferenced Tests and Triggering

NI PQA can perform referenced or nonreferenced measurements. For referenced tests, you can acquire a reference stream from a "golden" device and either compare measurement results (known as **reduced-reference**) or perform a pixel-to-pixel comparison between reference and test streams (known as **full-reference**). NI PQA provides multiple triggering to synchronize the reference and test streams including region of interest (RoI) intensity, optical character recognition (OCR), pattern matching, or a user-defined trigger VI, which you can use for hardware triggering or other custom triggering.

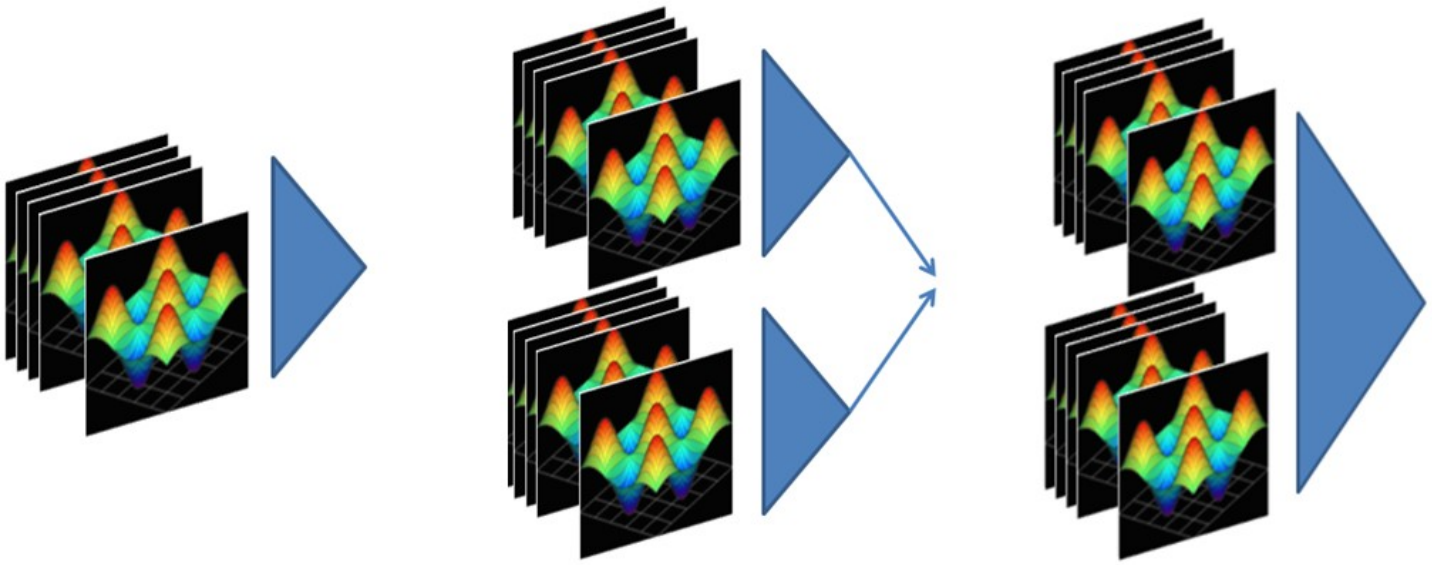


Figure 6. You can perform picture quality analysis with three methods: 1. nonreferenced test where the video stream is unknown or unrepeatable (left), 2. reduced reference test where measurements made on a reference stream are compared to measurements made on a test stream (middle), and 3. pixel-to-pixel comparison between test and reference streams, known as a Full Reference test (right).

Types of Measurements

NI PQA offers three types of measurements to cover any variety of application requirements:

1. **Defect-specific** measurements identify key defects in audio or video quality such as blockiness, audio drops, and stuck frames. (See a full list of measurements in Table 3.)

2. **Total picture quality**, or perceptual video quality, measurements perform a full-reference measurement to create an overall score for the video quality. The most common total picture quality measurement is peak signal-to-noise ratio, or PSNR, which uses the mean-squared error (MSE) calculation. NI PQA also provides a differential mean opinion score (DMOS) based on the complex wavelet-structural similarity (CW-SSIM)

index developed by Dr. Albert Bovik and the team at the University of Texas Laboratory for Image and Video Engineering (LIVE). CW-SSIM has proven to have high correlation with perceived quality, making it a strong alternative to operator inspection.

3. The **user-defined** measurement helps you apply custom analysis algorithms to the acquired audio/video signals. This measurement is supported only for non-HDCP encrypted video signals due to HDCP regulations.

NI PQA Measurements
Blockiness
MTF Contrast
Dropped / Stuck Frames
Checkers
Gradient
Color Levels
Pattern Match
Test Delay
Audio Sound Pressure Level (SPL)
Single Tone FRF and THD
Audio / Video Sync
Rubb & Buzz
Peak Signal-to-Noise Ratio (PSNR)
Structural Similarity (SSIM)
User-Defined

Table 3.. The NI PQA software offers multiple ways of measuring dynamic audio and video quality, allowing you to customize the measurements needed for your application.

Processor Recommendations

When analyzing high-definition audio/video signals such as 1080p60, measurements must be performed as fast as possible since high-definition content can quickly fill any buffer. The NI PQA measurements use NI LabVIEW multicore computing to optimize computational performance.

For applications that require 1080p 24Hz (or similar bandwidth such as 1080i60 or 720p60), National Instruments recommends the NI PXIe-8133 quad-core embedded controller.

For applications that require 1080p 60Hz analysis, NI recommends using an external PC based on the Intel i7 980x processor with the NI PXIe-PCIe8371 (or NI PXIe-PCIe8372 if using a RAID system) for real-time tests. The 1080p 60Hz applications that require only a few seconds of analysis, such as production test, can use the NI PXIe-8133 quad-core embedded controller. NI experts can help you design the best configuration for your application by reviewing test requirements or application goals.

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Ordering Information

For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI Digital Video Analyzer Add-Ons			
NI Picture Quality Analysis (NI PQA) software	781810-01	No accessories required.	
NI AudioMASTER for HDMI Audio Analysis	781006-02	No accessories required.	
NI Digital Video Analyzer			
NI Digital Video Analyzer (PXIe)	780950-01	No accessories required.	

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Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

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