Sound and Vibration Data Acquisition

NI USB-4432 *NEW!*

- 24-bit resolution
- 101 dB dynamic range
- 5 simultaneous analog inputs
- ±40 V input range
- Antialiasing filters
- TEDS read/write
- Software-selectable AC/DC coupling (0.1 Hz HPF)

Recommended Software

- LabVIEW
- Sound and Vibration Toolkit
- Sound and Vibration Measurement Suite

Model	Max Sampling Rate	IEPE	Coupling
USB-4432	102.4 kS/s	Software-selectable (0 or 2.1 mA)	Software-selectable AC/DC

Table 1. NI C Series Dynamic Signal Acquisition Selection Guide

Overview

The NI USB-4432 is a five-channel dynamic signal acquisition module for making high-accuracy measurements from IEPE sensors. The USB-4432 delivers 101 dB of dynamic range and incorporates software-selectable IEPE (2.1 mA constant current) signal conditioning for accelerometers and microphones. The five channels simultaneously acquire at rates from 1 to 102.4 kS/s. In addition, the module includes built-in antialiasing filters that automatically adjust to your sampling rate. The USB-4432 is ideal for a wide variety of mobile/portable applications such as industrial machine condition monitoring; in-vehicle noise, vibration, and harshness; and audio test systems.

Hardware

Analysis Capabilities

- Power spectra
- Zoom FFTs
- Fractional-octave analysis
- Vibration-level measurements
- Order spectra
- Transient analysis
- Psychoacoustic analysis

Each simultaneous signal is buffered, analog prefiltered, and sampled by a 24-bit delta-sigma analog-to-digital converter (ADC) that performs digital filtering with a cutoff frequency that automatically adjusts to your data rate. The USB-4432 features a voltage range of ±40 V and a dynamic range of 101 dB. In addition, the modules include the capability to read and write to transducer electronic data sheet (TEDS) Class 1 smart sensors. The USB-4432 provides ±60 V of overvoltage protection for IEPE sensor connections. It has three software-selectable modes of measurement operation: IEPE-on with AC coupling, IEPE-off with AC coupling, and IEPE-off with DC coupling.

The USB-4432 uses a method of analog-to-digital conversion known as delta-sigma modulation. If, for example, the data rate is 25 kS/s, then each ADC actually samples its input signal at 3.2 MS/s (128 times the data rate) and produces samples that are applied to a digital filter. This filter then expands the data to 24 bits, rejects signal components greater than 12.5 kHz (the Nyquist frequency), and digitally resamples the data at the chosen data rate of 25 kS/s. This combination of analog and digital filtering provides an accurate representation of desirable signals while rejecting out-of-band signals. The built-in antialiasing filters automatically adjust themselves to discriminate between signals based on the frequency range, or bandwidth, of the signal.

Analysis Software

The USB-4432 is well-suited for noise and vibration analysis applications. The NI Sound and Vibration Measurement Suite, which specifically addresses these applications, has two components: the NI Sound and Vibration Assistant, for quick and easy configuration, and LabVIEW analysis VIs for development of customized test and control systems.

NI Sound and Vibration Assistant

The Sound and Vibration Assistant is interactive software designed to simplify the process of acquiring and analyzing noise and vibration signals by offering:

- A drag-and-drop, interactive analysis and acquisition environment
- Rapid measurement configuration
- Extended functionality through LabVIEW

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Interactive Analysis Environment

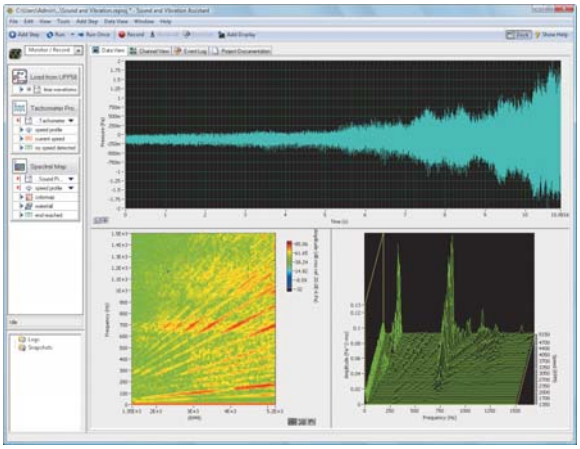

Figure 1. Engine Noise Run-Up in the Sound and Vibration Assistant

The Sound and Vibration Assistant introduces an innovative approach to configuring your measurements using intuitive drag-and-drop steps. Combining the functionality of traditional noise and vibration analysis software with the flexibility to customize and automate routines, the Sound and Vibration Assistant can help you streamline your application.

Rapid Measurement Configuration

The Sound and Vibration Assistant features many built-in steps that you can use immediately. You can instantly configure a measurement and analysis application with:

- Hardware I/O – generation and acquisition of signals from a variety of devices, including data acquisition devices and modular instruments
- Signal processing – filtering, windowing, and averaging
- Time-domain analysis – sound- and vibration-level measurements
- ANSI and IEC fractional-octave analysis
- Frequency-domain analysis – power spectrum, frequency response, power-in-band, peak search, and distortion
- Order analysis – tachometer processing, order power spectrum, order tracking, and order extraction
- Sound quality – sharpness, loudness, and roughness measurements
- Report generation – ability to drag and drop signals to Microsoft Excel or export data to Microsoft Word or UFF58 files

Extended Functionality through LabVIEW

Reuse your measurement applications developed with the Sound and Vibration Assistant in LabVIEW by converting projects into LabVIEW block diagrams. With the LabVIEW full-featured graphical programming environment, you can further automate your application or customize your analysis.

Sound and Vibration Analysis VIs for LabVIEW

With the sound and vibration analysis VIs in LabVIEW, you can develop a variety of custom audio, acoustic, and vibration applications. Functionality includes:

- Full, 1/3, 1/6, 1/12, and 1/24 octave analysis with linear A-, B-, or C-weighting
- Vibration level with single or double integration
- Sound level with linear A-, B-, or C-weighting
- Baseband, zoom, and subset power spectrum
- Peak search
- Power-in-band
- Frequency response (FRF)
- Filtering
- Swept sine
- Distortion analysis (THD, THD+N, IMD)
- Noise measurements (SNR)
- Human vibration weighting filters
- Torsional vibration
- Sound quality analysis
- Tachometer signal processing
- Order tracking
- Order spectrum
- Order extraction
- Spectral map
- Waterfall display for power, octave, and order spectra
- Data presentation in cascade, shaft centerline, orbit, Bode, or polar plot format
- Shock response spectrum
- File input and output to UFF58

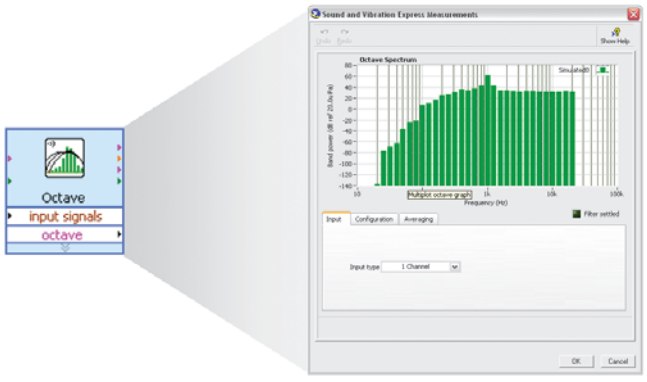

Figure 2. The NI Sound and Vibration Measurement Suite features more than 30 Express VIs for signal processing including octave analysis.

Recommended Hardware

The Sound and Vibration Measurement Suite includes more than 50 examples that work with both dynamic signal acquisition (DSA) and multifunction data acquisition devices. For sound and vibration data acquisition, National Instruments recommends DSA devices. With 24-bit ADCs and digital-to-analog converters (DACs) and integrated antialiasing filters, DSA devices are ideal for acoustic, noise, and vibration measurements.

There are numerous system requirements to consider when selecting data acquisition hardware for measuring or generating sound and vibration signals. From IEPE signal conditioning for accelerometers and microphones to high dynamic range (up to 118 dB) and multichannel synchronization (up to 13,000 channels), National Instruments offers a wide range of hardware products for your applications.

Product	Bus	Input Resolution (bits)	Dynamic Range (dB)	Sampling Rate per Channel	Analog Inputs	Input Range	Gain Settings	Coupling	TEDS Support	Analog Outputs
High Performance										
NI 4461	PXI, PCI	24	118	204.8 kS/s	2	±42 V to 316 mV	-20 to 30 dB in 10 dB increments	AC/DC	✔	2
NI 4462	PXI, PCI	24	118	204.8 kS/s	4	±42 V to 316 mV	-20 to 30 dB in 10 dB increments	AC/DC	✔	–
High Density										
NI 4495	PXI	24	114	204.8 kS/s	16	±10 to 1 V	0 and 20 dB	DC	–	–
NI 4496	PXI, PXI Express	24	114	204.8 kS/s	16	±10 to 1 V	0 and 20 dB	AC	✔	–
NI 4498	PXI, PXI Express	24	114	204.8 kS/s	16	±10 V to 316 mV	0 to 30 dB in 10 dB increments	AC	✔	–
Low Cost										
NI 4472	PXI, PCI	24	110	102.4 kS/s	8	±10 V	N/A	AC/DC	–	–
NI 4474	PCI	24	110	102.4 kS/s	4	±10 V	N/A	AC/DC	–	–
Portable/Compact										
NI 9233	USB	24	102	50 kS/s	4	±5 V	N/A	AC	✔	–
NI 9234	USB, Wi-Fi	24	102	51.2 kS/s	4	±5 V	N/A	AC/DC	✔	–
NI 4432	USB	24	101	102.4 kS/s	5	±40 V	N/A	AC/DC	✔	–

Table 2. Additional NI Dynamic Signal Acquisition Devices

Ordering Information

NI USB-4432 779680-01

NI USB-4432 with Sound and Vibration Measurement Suite 779680-02

BUY NOW!

For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to **ni.com/soundandvibration**.

Specifications

>> For complete specifications, see the *NI USB-4432 Specifications* manual at **ni.com/manuals**.

Analog Input

Input channels	5
Input connector	1 BNC per channel
ADC resolution	24 bits
ADC type	Delta-sigma
Sampling mode	Simultaneous
Sample rates (f_s)	1 to 102.4 kS/s
Sample rate accuracy	±100 ppm max
Input range	±40 V_{pk}
Input protection	±60 V max
Input coupling	AC or DC, each channel independently software selectable

Frequency Response

Amplitude flatness

Input Signal Frequency (f_{in})	Flatness[1]
20 Hz to 20 kHz	±0.01 dB typ
	±0.02 dB max
20 Hz to 46.4 kHz	±0.02 dB typ
	±0.05 dB max

[1]Relative to 1 kHz

Phase linearity	
f_{in} = 20 Hz to 20 kHz	±0.01°
f_{in} = 20 Hz to 46.4 kHz	±0.05°
Interchannel phase mismatch	
(f_{in} ≥ 100 Hz)	0.015°/kHz · f_{in} typ 0.03°/kHz · f_{in} max
-3 dB bandwidth	0.49 · f_s
AC coupling	
-3 dB cutoff frequency	0.1 Hz
-0.1 dB cutoff frequency	0.7 Hz
ADC filter delay (nominal)	38 samples

Safety and Compliance

Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note: For UL and other safety certifications, refer to the product label or visit **ni.com/certification**, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note: For EMC compliance, operate this product according to the documentation.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Note: Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit **ni.com/certification**, search by model number or product line, and click the appropriate link in the Certification column.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers: At the end of their life cycle, all products must be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit **ni.com/environment/weee.htm**.

NI Services and Support

NI has the services and support to meet your needs around the globe and through the application life cycle – from planning and development through deployment and ongoing maintenance. We offer services and service levels to meet customer requirements in research, design, validation, and manufacturing. Visit **ni.com/services**.

Training and Certification

NI training is the fastest, most certain route to productivity with our products. NI training can shorten your learning curve, save development time, and reduce maintenance costs over the application life cycle. We schedule instructor-led courses in cities worldwide, or we can hold a course at your facility. We also offer a professional certification program that identifies individuals who have high levels of skill and knowledge on using NI products. Visit **ni.com/training**.

Professional Services

Our NI Professional Services team is composed of NI applications and systems engineers and a worldwide National Instruments Alliance Partner program of more than 600 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit **ni.com/alliance**.

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OEM Support

We offer design-in consulting and product integration assistance if you want to use our products for OEM applications. For information about special pricing and services for OEM customers, visit **ni.com/oem**.

Local Sales and Technical Support

In offices worldwide, our staff is local to the country, giving you access to engineers who speak your language. NI delivers industry-leading technical support through online knowledge bases, our applications engineers, and access to 14,000 measurement and automation professionals within NI Developer Exchange forums. Find immediate answers to your questions at **ni.com/support**.

We also offer service programs that provide automatic upgrades to your application development environment and higher levels of technical support. Visit **ni.com/ssp**.

Hardware 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 Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit **ni.com/calibration**.

Repair and Extended Warranty

NI provides complete repair services for our products. Express repair and advance replacement services are also available. We offer extended warranties to help you meet project life-cycle requirements. Visit **ni.com/services**.

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