Sound and Vibration Data Acquisition

NI 9233, NI 9234 *NEW!*

- 24-bit resolution
- 102 dB dynamic range
- 4 simultaneous analog inputs
- ±5 V input range
- Antialiasing filters
- TEDS read/write

Recommended Software

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

Supported Hardware Platforms

- NI CompactDAQ
- CompactRIO
- Hi-Speed USB carrier
- Wi-Fi/Ethernet carrier



Model	Max Sampling Rate	IEPE	Coupling
NI 9233	50 kS/s	Always enabled (2 mA)	AC coupling
NI 9234	51.2 kS/s	Software selectable (0 or 2 mA)	Software selectable AC/DC coupling

Table 1. NI C Series Dynamic Signal Acquisition Selection Guide

Overview

NI 9233 and 9234 are 4-channel dynamic signal acquisition (DSA) modules for making high-accuracy measurements from IEPE sensors. These C Series analog input modules deliver 102 dB of dynamic range and incorporate IEPE (2 mA constant current) signal conditioning for accelerometers and microphones. The four input channels simultaneously acquire at rates from 2 to 50 kHz or, with the NI 9234, up to 51.2 kS/s. In addition, the modules include built-in antialiasing filters that automatically adjust to your sampling rate. NI 9233/9234 modules are ideal for a wide variety of mobile/portable applications such as industrial machine condition monitoring and in-vehicle noise, vibration, and harshness testing.

Hardware

Analysis Capabilities
Power spectra
Zoom FFTs
Fractional-octave analysis
Vibration level measurements
Order spectra
Transient 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. NI 9233/9234 modules feature a voltage range of ±5 V and a dynamic range of more than 100 dB. In addition, the modules include the capability to read and write to transducer electronic data sheet (TEDS) Class 1 smart sensors. NI 9233/9234 modules provide ±30 V of overvoltage protection (with respect to chassis ground) for IEPE sensor connections. The NI 9234 has three software-selectable modes of measurement operation: IEPE-on with AC coupling, IEPE-off with AC coupling, and IEPE-off with DC coupling. IEPE excitation and AC coupling are not software-selectable and are always enabled for the NI 9233.

NI 9233/9234 modules use a method of A/D 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.

NATIONAL INSTRUMENTS™

Wi-Fi/Ethernet Platform *NEW!*

NI Wi-Fi data acquisition (DAQ) devices combine IEEE 802.11 wireless or Ethernet communication; direct sensor connectivity; and the flexibility of NI LabVIEW software for remote monitoring of electrical, physical, mechanical, and acoustical signals. NI Wi-Fi DAQ devices can stream data on each channel at more than 50 kS/s with 24 bits of resolution. In addition, built-in NIST-approved 128-bit AES encryption and advanced network authentication methods offer the highest commercially available network security. With the flexibility of LabVIEW graphical programming and ubiquity of 802.11 network infrastructure, NI Wi-Fi DAQ makes it easy to incorporate wireless connectivity into new or existing PC-based measurement or control systems.



USB Platform

The NI Hi-Speed USB carrier makes portable data acquisition easy. Simply plug an NI 9233/9234 module into the USB carrier and begin acquiring data. Communication to the USB carrier is over Hi-Speed USB, guaranteeing data throughput.



NI CompactDAQ Platform

NI CompactDAQ delivers the simplicity of USB to sensor and electrical measurements on the benchtop, in the field, and on the production line. By combining the ease of use and low cost of a data logger with the performance and flexibility of modular instrumentation, NI CompactDAQ offers fast, accurate measurements in a small, simple, and affordable system. Flexible software options make it easy to use NI CompactDAQ to log data for simple experiments or to develop a fully automated test or control system. The modular design can measure up to 256 channels of electrical, physical, mechanical, or acoustical signals in a single system. In addition, per-channel ADCs and individually isolated modules ensure fast, accurate, and safe measurements.



NI CompactRIO Platform

When used with the small, rugged CompactRIO embedded control and data acquisition system, NI C Series analog input modules connect directly to reconfigurable I/O (RIO) field-programmable gate array (FPGA) hardware to create high-performance embedded systems. The reconfigurable FPGA hardware within CompactRIO provides a variety of options for custom timing, triggering, synchronization, filtering, signal processing, and high-speed decision making for all C Series analog input modules. For instance, with CompactRIO, you can implement custom triggering for any analog sensor type on a per-channel basis using the flexibility and performance of the FPGA and the numerous arithmetic and comparison function blocks built into NI LabVIEW FPGA.



Analysis Software

NI 9233/9234 modules are 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 and LabVIEW analysis VIs (functions) for power spectra, frequency response (FRF), fractional octave analysis, sound-level measurements, order spectra, order maps, order extraction, sensor calibration, human vibration filters, and torsional vibration.

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

Interactive Analysis Environment

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

There are many built-in steps available for immediate use in the Sound and Vibration Assistant. 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
- Report generation – ability to drag and drop signals to Microsoft Excel or export data to Microsoft Word or UFF58 files

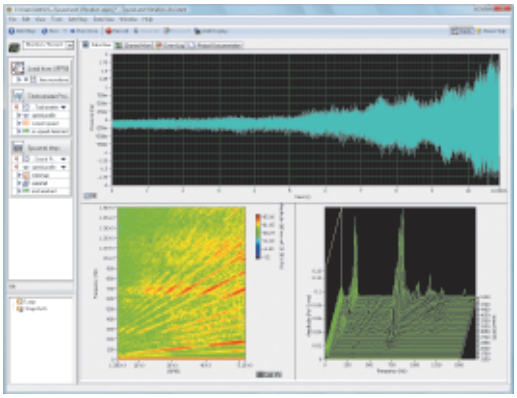


Figure 1. NI Sound and Vibration Assistant Performing Engine Run-Up Test

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
- Baseband, zoom, and subset power spectrum
- Peak search and power in band
- Frequency response (FRF)
- Filtering
- Swept sine
- Distortion analysis (THD, THD+N, IMD)
- Noise measurements (SNR)
- Human vibration weighting filters
- Torsional vibration
- Tachometer signal processing
- Order tracking, spectrum, and order extraction
- Waterfall display for power, octave, and order spectra
- Shaft centerline, orbit, Bode, and polar plot format
- File input and output to UFF58

Recommended Hardware

The Sound and Vibration Measurement Suite includes more than 50 examples that work with both 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 to 20 dB	DC	–	–
NI 4496	PXI, PXIe	24	114	204.8 kS/s	16	±10 to 1 V	0 to 20 dB	AC	✓	–
NI 4498	PXI, PXIe	24	114	204.8 kS/s	16	±10 V to 316 mV	0 to 20 dB	AC	✓	–
Low Cost										
NI 4472	PXI, PCI	24	110	102.4 kS/s	8	±10 V	–	AC/DC	–	–
NI 4474	PCI	24	110	102.4 kS/s	4	±10 V	–	AC/DC	–	–
Ultraportable										
NI 9233	USB	24	102	50 kS/s	4	±5 V	–	AC	✓	–
NI 9234	USB, Wi-Fi	24	102	51.2 kS/s	4	±5 V	–	AC/DC	✓	–

Table 2. Additional NI Dynamic Signal Acquisition Devices

Ordering Information

NI 9234 779680-01
NI 9234 with Sound and Vibration Measurement Suite 779680-02
NI USB-9234 780235-01
NI USB-9234 with Sound and Vibration Measurement Suite 780235-02
NI WLS-9234 780507-01
NI WLS-9234 with Sound and Vibration Measurement Suite 780507-02
NI ENET-9234 780508-01
NI ENET-9234 with Sound and Vibration Measurement Suite 780508-02

NI 9233 779015-01
NI 9233 with Sound and Vibration Measurement Suite 779015-02
NI USB-9233 with USB carrier 779365-01
NI USB-9233 with Sound and Vibration Measurement Suite 779366-01

BUY NOW!

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

NI 9233 Specifications

>>For complete specifications, see the **NI 9233 Operating Instructions and Specifications** *at* **ni.com/manuals**.

The following specifications are typical for the range 0 to 60 °C unless otherwise noted.

Input Characteristics

Number of channels ..... 4 analog input
ADC resolution ..... 24 bits
Type of ADC ..... Delta-sigma (with analog prefiltering)
Data rate (fs)
  Minimum ..... 2 kS/s
  Maximum ..... 50 kS/s
Master timebase (internal)
  Frequency ..... 12.8 MHz
  Accuracy ..... ±100 ppm max
  Input coupling ..... AC
AC cutoff frequency
  -3 dB ..... 0.5 Hz typ
  -0.1 dB ..... 4.2 Hz max
AC voltage full-scale range
  Typical ..... 5.4 V_{pk}
  Minimum ..... 5 V_{pk}
  Maximum ..... 5.8 V_{pk}
Common-mode voltage (AI- to earth ground) ..... ±2 V
IEPE excitation current
  Minimum ..... 2.0 mA
  Typical ..... 2.2 mA
  IEPE compliance voltage ..... 19 V max
Overvoltage protection (with respect to chassis ground)
  For an IEPE sensor connected to AI+ and AI- ..... ±30 V
  For a low-impedance source connected to AI+ and AI- ..... -6 to 30 V

Accuracy (0 to 60 °C)

Error	Accuracy
Calibrated max	±0.3 dB
Calibrated typ	±0.1 dB
Uncalibrated max	±0.6 dB

NI 9234 Specifications

>>For complete specifications, see the **NI 9234 Operating Instructions and Specifications** *at* **ni.com/manuals**.

The following specifications are typical for the range 0 to 60 °C unless otherwise noted.

Input Characteristics

Number of channels ..... 4 analog input
ADC resolution ..... 24 bits
Type of ADC ..... Delta-sigma (with analog prefiltering)
Data rate (fs)
  Minimum ..... 1.65 kS/s
  Maximum ..... 51.2 kS/s
Master timebase (internal)
  Frequency ..... 13.1 MHz
  Accuracy ..... ±50 ppm max
Input coupling ..... Software-selectable AC/DC
AC cutoff frequency
  -3 dB ..... 0.5 Hz typ
  -0.1 dB ..... 4.6 Hz max
AC voltage full-scale range
  Typical ..... 5.1 V_{pk}
  Minimum ..... 5 V_{pk}
  Maximum ..... 5.2 V_{pk}
Common-mode voltage (AI- to earth ground) ..... ±2 V
IEPE excitation current
  Minimum ..... 2.0 mA
  Typical ..... 2.1 mA
IEPE compliance voltage ..... 19 V max
Overvoltage protection (with respect to chassis ground)
  For an IEPE sensor connected to AI+ and AI- ..... ±30 V
  For a low-impedance source connected to AI+ and AI- ..... -6 to 30 V

Accuracy (0 to 60 °C)

Error	Accuracy
Calibrated max	±0.3 dB
Calibrated typ	±0.002 dB
Uncalibrated max	±0.16 dB

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

NI Factory Installation Services

NI Factory Installation Services (FIS) is the fastest and easiest way to use your PXI or PXI/SCXI combination systems right out of the box. Trained NI technicians install the software and hardware and configure the system to your specifications. NI extends the standard warranty by one year on hardware components (controllers, chassis, modules) purchased with FIS. To use FIS, simply configure your system online with **ni.com/pxiadvisor**.

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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