24-Bit, 102.4 kS/s, 8- and 4-Channel Dynamic Signal Acquisition

NI 4472 Series, NI PCI-4474

- 24-bit resolution
- 110 dB dynamic range
- 102.4 kS/s maximum sampling rate
- 45 kHz alias-free bandwidth
- ±10 V range
- AC/DC coupling
- IEPE conditioning – software configurable
- Multiple-device synchronization

Operating Systems
- Windows XP/2000/NT
- LabVIEW Real-Time

Recommended Software
- LabVIEW
- Sound and Vibration Toolkit
- Sound and Vibration Measurement Suite
- LabWindows™/CVI
- Measurement Studio

Measurement Services Software (included)
- NI-DAQmx

Overview
The National Instruments PCI-4472 and PXI-4472 are 8-channel dynamic signal acquisition devices for making high-accuracy audio-frequency measurements. The PCI-4474 is a similar 4-channel board.

The vibration-optimized NI PXI-4472B offers a lower AC cutoff frequency of 0.5 Hz. Input channels incorporate Integrated Electronic Piezoelectric (IEPE) signal conditioning for accelerometers and microphones. The input channels of an NI 447x simultaneously digitize input signals over a bandwidth from DC to 45 kHz. You can synchronize multiple NI 447x devices for high-channel-count applications, or with other modules using the PXI star trigger bus or the RTSI bus on PCI. When used with the Sound and Vibration Toolkit or other software analysis tools, an NI 447x can obtain a variety of accurate time and frequency measurements for your application.

Hardware

Analog Inputs
NI 447x devices have four or eight analog inputs with 24-bit resolution ADCs that are simultaneously sampled at a software-programmable rate. The high resolution provides the necessary accuracy to make NI 447x devices well-suited for audio and vibration analysis applications.

You can achieve outstanding measurements with an NI 447x. For example, when sampling at 51.2 kS/s and using a 16 k FFT, you can achieve a dynamic range greater than 110 dB. Using state-of-the-art delta-sigma modulating ADCs, the NI 447x devices deliver low noise and low distortion. Because these ADCs use a 1-bit quantizer oversampled at a multiple of the specified sampling rate, they produce extraordinary linearity. Extremely flat, linear-phase, lowpass digital filters then remove aliases and shape the quantization noise from the band of interest. Using the delta-sigma modulating ADCs, an NI 447x is immune to the DNL distortion associated with conventional data acquisition devices.

Applications
- Noise and vibration diagnostics
- Audio test and measurement
- Machine condition monitoring
- Sound power
- Telecommunications testing
- Structural vibration
- Pass-by noise

Table 1. NI 447x Channel, Speed, and Resolution Specifications

<table>
<thead>
<tr>
<th>Device</th>
<th>Bus</th>
<th>Analog Inputs</th>
<th>Resolution</th>
<th>Input Range</th>
<th>Sampling Rate</th>
<th>AC Cutoff Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 4472</td>
<td>PCI, PXI</td>
<td>8</td>
<td>24 bits</td>
<td>±10 V</td>
<td>102.4 kS/s</td>
<td>3.4 Hz</td>
</tr>
<tr>
<td>NI 4472B</td>
<td>PCI, PXI</td>
<td>8</td>
<td>24 bits</td>
<td>±10 V</td>
<td>102.4 kS/S</td>
<td>0.5 Hz</td>
</tr>
<tr>
<td>NI 4474</td>
<td>PCI</td>
<td>4</td>
<td>24 bits</td>
<td>±10 V</td>
<td>102.4 kS/S</td>
<td>3.4 Hz</td>
</tr>
</tbody>
</table>

Figure 1. The 24-bit architecture of the NI 447x devices delivers more than 110 dB dynamic range and a significantly lower noise floor than 12- and 16-bit and comparable 24-bit products.
Antialiasing
The analog inputs have both analog and real-time digital filters implemented in hardware to prevent aliasing. Input signals are first passed through fixed analog filters to remove any signals with frequency components beyond the range of the ADCs; then digital antialiasing filters automatically adjust their cutoff frequency to remove any frequency components above half the programmed sampling rate. This advanced analog input design frees you from adding more external filters to prevent aliasing.

Multidevice Synchronization
For applications requiring high channel counts, you can synchronize the operation of two or more NI 447x devices. Using the PXI star trigger bus, you can send and receive timing signals between PXI-447x modules. You achieve synchronization by sharing a digital trigger from one device and synchronizing all devices to the same clock. The PXI star trigger bus, as defined by the PXI Specification, ensures synchronization between modules with less than 1 ns of skew, which enables a system to have 0.1 deg phase mismatch for a 1 kHz signal between any two channels across devices in the same chassis. Low phase mismatch is critical in obtaining phase information from cross-channel measurements in many applications. In the 18-slot PXI-1045 chassis, you can synchronize up to 14 PXI-4472 modules to have up to 112 simultaneously sampled analog inputs. Using the RTSI bus, you can synchronize two or more PCI-4472 or PCI-4474 boards as well.

Triggering
NI 447x devices have two trigger modes for acquiring signals. Pretrigger mode digitizes signals before and after a trigger condition occurs. Posttrigger mode digitizes signals after a trigger condition occurs. The source of the trigger can come from any analog input channel, the external digital trigger input, the PXI trigger bus or RTSI bus, or through software. The external digital trigger is 5 V TTL/CMOS-compatible and is activated by a choice of rising or falling edge. Triggering is needed in applications such as those that acquire transient signals. For example, when measuring transient vibrations resulting from striking a mechanical structure with a hammer, acquisition of accelerometer signals is triggered by hammer impact.

Calibration
The offset voltage and gain accuracy of the analog input are calibrated by National Instruments. An onboard precision voltage reference is used for internal calibration to ensure stable, accurate DC specifications. NIST-traceable and ISO-9002-certified calibration certificates are available online.

PXI/PCI Interface
NI 447x devices use the PCI mini-MITE to deliver full DMA bus-master data transfer rates of 20 to 30 MB/s and burst rates up to 132 MB/s. A 1,024-sample, analog input FIFO prevents data loss if DMA or interrupt service latency is long.

Measurement Services Software
NI 447x devices use NI-DAQmx as the hardware and operating system interface. You can build automated test systems or integrate an NI 447x with other hardware, including multifunction DAQ products, through NI-DAQ function calls for NI LabVIEW, LabWindows/CVI, and Measurement Studio software. Because of bandwidth, NI 447x devices are well-suited for applications in audio and vibration analysis. These applications are specifically addressed in the NI Sound and Vibration Toolkit and the NI Sound and Vibration Measurement Suite. Using these toolkits with NI 447x devices, you can produce power spectra, frequency responses, fractional-octave analysis, sound-level measurements, order spectra, order maps, and order extraction. A typical setup for an environmental noise and vibration measurement application would use one or more PXI-4472 modules, a PXI chassis and controller, LabVIEW, and the Sound and Vibration Toolkit.
24-Bit, 102.4 kS/s, 8- and 4-Channel Dynamic Signal Acquisition

### Ordering Information

<table>
<thead>
<tr>
<th>Model</th>
<th>Ordering Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI PCI-4472</td>
<td>778348-01</td>
</tr>
<tr>
<td>NI PCI-4472 with Sound and Vibration Toolkit</td>
<td>778663-01</td>
</tr>
<tr>
<td>NI PCI-4472B</td>
<td>779682-01</td>
</tr>
<tr>
<td>NI PCI-4472B with Sound and Vibration Toolkit</td>
<td>779683-01</td>
</tr>
<tr>
<td>NI PCI-4474</td>
<td>778729-01</td>
</tr>
<tr>
<td>NI PCI-4474 with Sound and Vibration Toolkit</td>
<td>778778-01</td>
</tr>
<tr>
<td>NI PXI-4472</td>
<td>778279-01</td>
</tr>
<tr>
<td>NI PXI-4472 with Sound and Vibration Toolkit</td>
<td>778664-01</td>
</tr>
<tr>
<td>NI PXI-4472B</td>
<td>778279-02</td>
</tr>
<tr>
<td>NI PXI-4472B with Sound and Vibration Toolkit</td>
<td>778664-02</td>
</tr>
</tbody>
</table>

Includes NI-DAQ software.

### Accessories

<table>
<thead>
<tr>
<th>Model</th>
<th>Quantity</th>
<th>Ordering Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMB100, SMB female to BNC female</td>
<td>Qty 1</td>
<td>763389-01</td>
</tr>
<tr>
<td></td>
<td>Qty 8</td>
<td>778415-01</td>
</tr>
<tr>
<td>SMB110, SMB female to BNC male</td>
<td>Qty 1</td>
<td>763405-01</td>
</tr>
<tr>
<td></td>
<td>Qty 8</td>
<td>778414-01</td>
</tr>
</tbody>
</table>

**BUY NOW!**

For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to ni.com/soundandvibration.
24-Bit, 102.4 kS/s, 8- and 4-Channel Dynamic Signal Acquisition

Specifications
Typical for 25 °C unless otherwise noted.

Analog Input
Channel Characteristics
Number of channels
NI 4472 Series ......................... 8, simultaneously sampled
NI 4474 Series ......................... 4, simultaneously sampled
Input configuration ................. Unbalanced differential
Resolution ............................... 24 bits, nominal
Type of ADC .......................... Delta-sigma
Oversampling, for sample rate (fs):
1.0 kS/s ≤ fs ≤ 51.2 kS/s ............ 128 fs
51.2 kS/s < fs ≤ 102.4 kS/s .......... 64 fs
Sample rates (fs) ................. 1.0 to 102.4 kS/s in 190.7 µs/s increments
for fs > 51.2 kS/s
Frequency accuracy ............... ±25 ppm
Input signal range ................. ±10 V peak
FIFO buffer size ..................... 1,024 samples
Data transfers ....................... DMA

Transfer Characteristics
Offset (residual DC) ............... ±3 mV, max
Gain (amplitude accuracy) ........ ±0.1 dB, max, fi = 1 kHz

Amplifier Characteristics
Input impedance (ground referenced)
Positive input .......................... 1 MΩ in parallel with 60 pF
Negative input (shield) ............. 50 Ω in parallel with 0.02 µF
Flatness (relative to 1 kHz) ......... ±0.1 dB, DC to 0.4535 fs, max,
DC-coupled
-3 dB bandwidth .................... 0.4863 fs
Input coupling ....................... AC or DC, software-selectable
AC-3 dB cutoff frequency
NI 4472, NI 4474 ..................... 3.4 Hz
NI 4472B ............................. 0.5 Hz
Overvoltage protection
Positive input .......................... ±42.4 V
Positive inputs protected ........ CH<0..7>
Negative input (shield) .......... Not protected, rated at ±2.5 V
Common-mode rejection ratio (CMRR)
fs < 1 kHz ................................ >60 dB, minimum

Dynamic Characteristics
Alias-free bandwidth (passband) .... DC (0 Hz) to 0.4535 fs
Stop band ............................ fs
Alias rejection ....................... 51.2 kS/s
Spurious-free dynamic range ......... 118 dB, 51.2 kS/s ≤ fs ≤ 102.4 kS/s THD, fn = 1 kHz
0 dBFS input .......................... <90 dB
20 dBFS input .......................... <100 dB
60 dBFS input .......................... <60 dB
IMD .................................... <100 dB (CCIF 14 kHz + 15 kHz)
Crosstalk1 (channel separation), fn = 0 to 51.2 kHz
Between channels 0 and 1, 2 and 3, 4 and 5, or 6 and 7
Shorted input .......................... <90 dB
1 kΩ load ............................. <80 dB
Other channel combinations
Shorted input .......................... <100 dB
1 kΩ load ............................. <90 dB
Phase linearity ....................... <±0.5 deg
Interchannel phase mismatch ...... <fn (in kHz) x 0.018 deg + 0.082 deg
Interchannel gain mismatch ......... ±0.1 dB
Filter delay through ADC .......... 38.8 sample periods

Onboard Calibration Reference
DC level ................................ 5,000 V ±2.5 mV
Temperature coefficient ............ ±5 ppm/°C maximum
Long-term stability .................. ±20 ppm/µs, 1,000 h

Signal Conditioning
Constant current source (software-controlled)
Current .............................. 4 mA, ±5% Compliance ................. 24 V
Output impedance ................... >250 kΩ at 1 kHz
Current noise ....................... <500 pA/V

Triggers
Analog Trigger
Source .................. CH<0..7>
Level .................. -10 to +10 V, full scale, programmable
Slope .................. Positive or negative (software-selectable)
Resolution ................... Positive or negative (software-selectable)
Hysteresis ....................... Programmable

Digital Trigger
Compatibility ................. 5 V TTL/CMOS
Response .................. Rising or falling edge
Pulse width ................... 10 ns, minimum
Bus Interface
Type .......................... Master, slave

Power Requirements
+3.3 VDC ....................... 400 mA, maximum
+5 VDC ....................... 2.6 A, maximum
+12 VDC ....................... 120 mA, maximum
-12 VDC ....................... 120 mA, maximum

[1] Crosstalk between channels
24-Bit, 102.4 kS/s, 8- and 4-Channel Dynamic Signal Acquisition

Physical

Dimensions (not including connectors)
- PCI: 17.5 by 10.7 cm (6.9 by 4.2 in.)
- PXI: 16.0 by 9.9 cm (6.3 by 3.9 in.)
  (1 slot)
Analog I/O connectors: SMB male
Digital trigger connector: SMB male

Maximum Working Voltage

Maximum working voltage refers to the signal voltage plus the common-mode voltage.
- Channel-to-earth: 10 V, installation category I
- Channel-to-channel: 10 V, installation category I

Environmental

Operating temperature: 0 to 50 °C
Storage temperature: -20 to 70 °C
Relative humidity: 10 to 90%, noncondensing
Maximum altitude: 2,000 m
Pollution degree (indoor use only): 2

Calibration

Internal — On software command; computes gain and offset corrections
  
  Interval: Whenever temperature is different from temperature at last internal calibration by more than ±5 °C

External — Internal voltage reference read and stored in nonvolatile memory
  
  Interval: 1 year
  Warm-up time: 15 minutes

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](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:
- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note: For EMC compliance, operate this device according to product 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](http://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](http://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.

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.

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.

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.

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.