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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



Applications

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

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.

| Device | Bus | Analog Inputs | Resolution | Sampling Rate | Input Range | Triggering | AC Cutoff Frequency |
|----------|----------|---------------|------------|---------------|-------------|--------------------|---------------------|
| NI 4472 | PCI, PXI | 8 | 24 bits | 102.4 kS/s | ±10 V | Analog and digital | 3.4 Hz |
| NI 4472B | PCI, PXI | 8 | 24 bits | 102.4 kS/s | ±10 V | Analog and digital | 0.5 Hz |
| NI 4474 | PCI | 4 | 24 bits | 102.4 kS/s | ±10 V | Analog and digital | 3.4 Hz |

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

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.

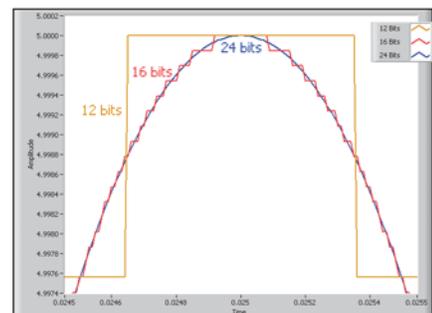


Figure 1. The 24-bit architecture of the NI 447x devices delivers more than 110 dB dynamic range and a significantly lower noise floor than 12- and 16-bit and comparable 24-bit products.



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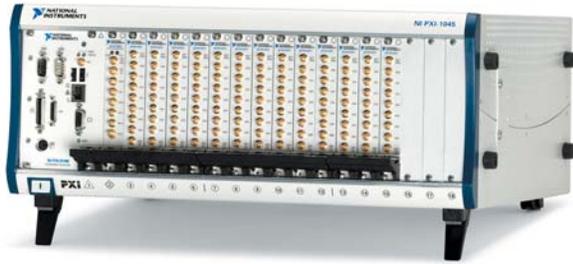


Figure 2. In an 18-slot PXI chassis with 14 PXI-4472 modules, you can have up to 112 simultaneously sampled analog inputs.

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.

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Ordering Information

| | |
|---|-----------|
| NI PCI-4472..... | 778348-01 |
| NI PCI-4472 with Sound and Vibration Toolkit | 778663-01 |
| NI PCI-4472B | 779682-01 |
| NI PCI-4472B with Sound and Vibration Toolkit | 779683-01 |
| NI PCI-4474..... | 778729-01 |
| NI PCI-4474 with Sound and Vibration Toolkit | 778778-01 |
| NI PXI-4472..... | 778279-01 |
| NI PXI-4472 with Sound and Vibration Toolkit | 778664-01 |
| NI PXI-4472B | 778279-02 |
| NI PXI-4472B with Sound and Vibration Toolkit | 778664-02 |

Includes NI-DAQ software.

Accessories

SMB100, SMB female to BNC female

Qty 1763389-01

Qty 8778415-01

SMB110, SMB female to BNC male

Qty 1763405-01

Qty 8778414-01

BUY NOW!

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

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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 (f_s): | |
| 1.0 kS/s $\leq f_s \leq$ 51.2 kS/s | 128 f_s |
| 51.2 kS/s $< f_s \leq$ 102.4 kS/s | 64 f_s |
| Sample rates (f_s) | 1.0 to 102.4 kS/s in 190.7 μ S/s increments for $f_s >$ 51.2 kS/s or 95.36 μ S/s increments for $f_s \leq$ 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, $f_{in} = 1$ kHz |

Amplifier Characteristics

| | |
|-------------------------------------|--|
| Input impedance (ground referenced) | |
| Positive input | 1 M Ω in parallel with 60 pF |
| Negative input (shield) | 50 Ω in parallel with 0.02 μ F |
| Flatness (relative to 1 kHz) | ± 0.1 dB, DC to 0.4535 f_s , max, DC-coupled |
| -3 dB bandwidth | 0.4863 f_s |
| 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) | |
| $f_{in} <$ 1 kHz | > 60 dB, minimum |

Dynamic Characteristics

| | |
|---------------------------------|--|
| Alias-free bandwidth (passband) | DC (0 Hz) to 0.4535 f_s |
| Stop band | 0.5465 f_s |
| Alias rejection | 110 dB |
| Spurious-free dynamic range | 130 dB, 1.0 kS/s $\leq f_s \leq$ 51.2 kS/s |

| | |
|---|---|
| 118 dB, 51.2 kS/s $< f_s \leq$ 102.4 kS/s THD, $f_{in} = 1$ kHz | |
| 0 dBFS input | < -90 dB |
| 20 dBFS input | < -100 dB |
| 60 dBFS input | < -60 dB |
| IMD | < -100 dB (CCIF 14 kHz + 15 kHz) |
| Crosstalk ¹ (channel separation), $f_{in} = 0$ to 51.2 kHz | |
| Between channels 0 and 1, 2 and 3, 4 and 5, or 6 and 7 | |
| Shorted input | < -90 dB |
| 1 k Ω load | < -80 dB |
| Other channel combinations | |
| Shorted input | < -100 dB |
| 1 k Ω load | < -90 dB |
| Phase linearity | ± 0.5 deg |
| Interchannel phase mismatch | $< f_{in}$ (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/ $^{\circ}$ C maximum |
| Long-term stability | ± 20 ppm/ $\sqrt{1,000}$ h |

Signal Conditioning

| | |
|---|--------------------------------|
| Constant current source (software-controlled) | |
| Current | 4 mA, $\pm 5\%$ |
| Compliance | 24 V |
| Output impedance | > 250 k Ω at 1 kHz |
| Current noise | < 500 pA/ $\sqrt{\text{Hz}}$ |

Triggers

Analog Trigger

| | |
|------------|--|
| Source | CH<0..7> |
| Level | -10 to +10 V, full scale, programmable |
| Slope | Positive or negative (software-selectable) |
| Resolution | 24 bits, nominal |
| 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 | |
| PXI | 400 mA, maximum |
| +5 VDC | |
| PCI | 2.6 A, maximum |
| PXI | 2.2 A, maximum |
| +12 VDC | 120 mA, maximum |
| -12 VDC | 120 mA, maximum |

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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 |

¹Measured with full-scale (± 10 V) input.

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 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, search by model number or product line, and click the appropriate link in the Certification column.

Waste Electrical and Electronic Equipment (WEEE)

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