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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

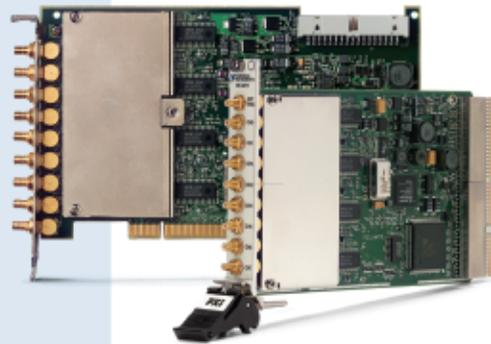
- Windows 2000/NT/XP
- LabVIEW Real-Time
- Mac OS X

Recommended Software

- LabVIEW
- LabVIEW Sound and Vibration Analysis Toolkit
- LabVIEW Order Analysis Toolkit
- LabWindows/CVI
- Measurement Studio

Measurement Services Software (included)

- NI-DAQmx



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	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

Overview

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

Outstanding measurements can be achieved with an NI 447x. For example, when sampling at 51.2 kS/s and using a 16 k FFT, a

dynamic range greater than 110 dB can be achieved. Using state-of-the-art delta-sigma modulating ADCs, the NI 447x devices achieve 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

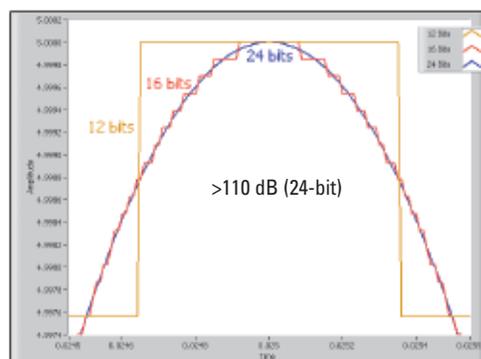


Figure 1. The 24-bit architecture of the NI 447x devices deliver more than 110 dB dynamic range and a significantly lower noise floor than 12, 16, and comparable 24-bit products.

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



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

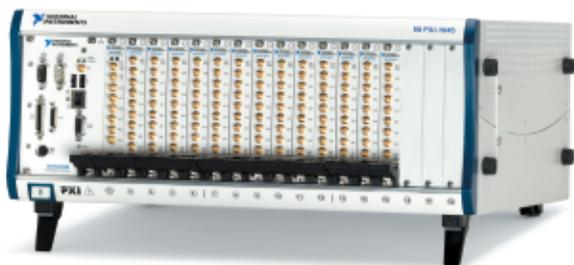


Figure 2. In an 18-slot PXI chassis with 14 PXI-4472 modules, you can have up to 112 simultaneously sampled analog inputs.

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 additional 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. Synchronization is achieved 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, two or more PCI-4472 or PCI-4474 boards can be synchronized 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 LabVIEW, LabWindows/CVI, and Measurement Studio.

Because of bandwidth, NI 447x devices are well suited for applications in audio and vibration analysis. These applications are specifically addressed in the Sound and Vibration Toolkit and the Order Analysis Toolkit for LabVIEW. Using these toolkits in conjunction 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.

Ordering Information

NI PCI-4472	778348-01
NI PCI-4472 with Sound and Vibration Toolkit	778663-01
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 1	763389-01
Qty 8	778415-01
SMB110, SMB female to BNC male	
Qty 1	763405-01
Qty 8	778414-01

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24-Bit, 8-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 (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	$\leq \pm 0.5$ deg
Interchannel phase mismatch	$< f_{in}$ (in kHz) \times 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
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Power Requirements

+3.3 VDC	
PXI	400 mA, maximum
+5 VDC	
PXI	2.6 A, maximum
PXI	2.2 A, maximum
+12 VDC	120 mA, maximum
-12 VDC	120 mA, maximum

Physical

Dimensions (not including connectors)	
PXI	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 $^{\circ}$ C
Storage temperature	-20 to 70 $^{\circ}$ 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 $^{\circ}$ C
External – Internal voltage reference read and stored in nonvolatile memory	
Interval	1 year
Warm-up time	15 minutes

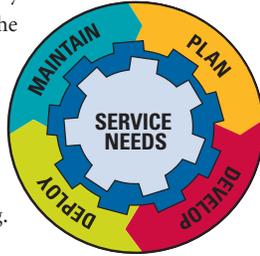
Certifications and Compliances

CE Mark Compliance **CE**

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

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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.

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