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NI 447x Specifications

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ni.com/manuals

This document lists specifications for the NI 447x Dynamic Signal Acquisition (DSA) devices including the NI PXI/PCI-4472 (NI 4472), NI PCI-4474, and NI PXI/PCI-4472B (NI 4472B). These specifications are typical at 25 °C unless otherwise stated. The system must be allowed to warm up for 15 minutes to achieve the rated accuracy. All specifications are subject to change without notice. Visit ni.com/manuals for the most current specifications and product documentation.



Caution The inputs of this sensitive test and measurement product are not protected for electromagnetic interference for functional reasons. As a result, this product may experience reduced measurement accuracy or other temporary performance degradation when cables are attached in an environment with electromagnetic interference present. Refer to the Declaration of Conformity (DoC) for this product for details of the standards applied to assess electromagnetic compatibility performance. To obtain the DoC, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.



Note Keep the filler panels on all unused slots in your chassis or computer to maintain forced air cooling.

Analog Input

Channel Characteristics

Number of channels	Sample rates (f_s), samples-per-second (S/s)
NI 4472/4472B 8, simultaneously sampled	102.4 kS/s down to 1.0 kS/s in 190.7 μ S/s increments for $f_s > 51.2$ kS/s or 95.37 μ S/s increments for $f_s \leq 51.2$ kS/s
NI PCI-4474 4, simultaneously sampled	
Input configuration Pseudodifferential	
Input coupling AC or DC, software-selectable	ADC modulator oversample rate
A/D converter (ADC) resolution 24 bits	1.0 kS/s $\leq f_s \leq 51.2$ kS/s 128 f_s
ADC type Delta-sigma	51.2 kS/s $< f_s \leq 102.4$ kS/s 64 f_s
	Sample Clock Timebase, low-frequency alias rejection disabled (default) ¹
	1.0 kS/s $\leq f_s \leq 51.2$ kS/s 256 f_s
	51.2 kS/s $< f_s \leq 102.4$ kS/s 128 f_s

¹ Low-frequency alias rejection can be enabled at sample rates of 25.6 kS/s and lower for supported NI 447x devices. Refer to the *National Instruments Dynamic Signal Acquisition Help* for supported devices and more information.



Sample Clock Timebase, low-frequency alias rejection enabled

Sample Rate (kS/s)	Sample Clock Timebase
$1.0 \leq f_s \leq 1.6$	$8,192 f_s$
$1.6 < f_s \leq 3.2$	$4,096 f_s$
$3.2 < f_s \leq 6.4$	$2,048 f_s$
$6.4 < f_s \leq 12.8$	$1,024 f_s$
$12.8 < f_s \leq 25.6$	$512 f_s$
$25.6 < f_s \leq 51.2$	$256 f_s$
$51.2 < f_s \leq 102.4$	$128 f_s$

FIFO buffer size1,023 samples

Data transfers.....DMA

Overvoltage protection

Positive input $\pm 42.4 V_{pk}$

Negative input (shield).....Not protected

External triggerNot protected

Frequency accuracy ± 25 ppm

Input signal range..... $\pm 10 V_{pk}$

Transfer Characteristics

DC-coupled offset (residual) ± 3 mV, max

Gain (amplitude accuracy)..... ± 0.1 dB, max, $f_{in} = 1$ kHz

Amplifier Characteristics

Input Impedance (Ground Referenced)	Pseudodifferential Configuration
Between positive input and chassis ground (NI 447x all revisions and NI PXI-4472B revision G and earlier)	$1 M\Omega \parallel 60$ pF
Between positive input and chassis ground (NI PXI-4472B revision H and later)	$10 M\Omega \parallel 60$ pF
Between negative input and chassis ground	$50 \Omega \parallel 0.02$ μ F

Common-mode rejection ratio (CMRR)

Input frequency (f_{in}) < 1 kHz..... 60 dB

Dynamic Characteristics

Specification	Low-Frequency Alias Rejection Disabled (Default)	Low-Frequency Alias Rejection Enabled
Alias-free bandwidth (BW) (passband)	DC to $0.4535 f_s$	DC to $0.4 f_s$
Alias rejection, minimum	110 dBc	104 dBc
Alias rejection by frequency	$0.5465 f_s < \text{input frequency} < 127.4535 f_s$, where $1.0 \text{ kS/s} \leq f_s \leq 51.2 \text{ kS/s}$ $0.5465 f_s < \text{input frequency} < 63.4535 f_s$, where $51.2 \text{ kS/s} < f_s \leq 102.4 \text{ kS/s}$	Input frequency > $0.6 f_s$
-3 dB BW	$0.491 f_s$	$0.4863 f_s$

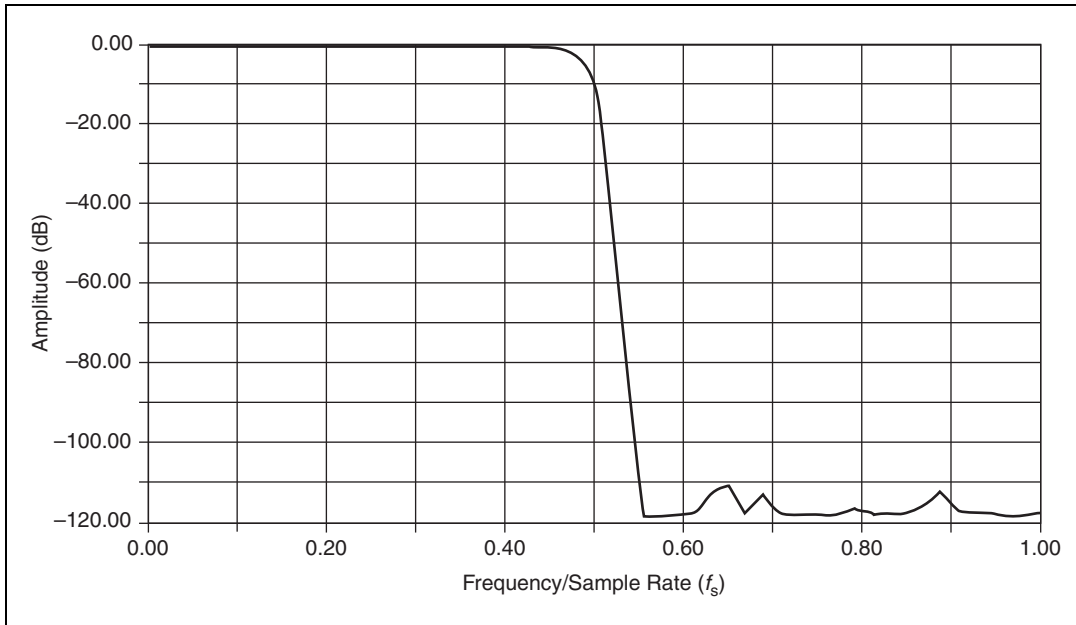


Figure 1. Digital Filter Input Frequency Response

Aliasing can occur for frequencies around multiples of 128 or 64 f_s with low-frequency alias rejection disabled. In Figure 2, the solid line shows the amount of rejection for signals that appear in the f_s -wide windows around multiples of 128 or 64 f_s .

The dashed line shows the improvement achieved with low-frequency alias rejection enabled. Refer to the *National Instruments Dynamic Signal Acquisition Help* for more information.

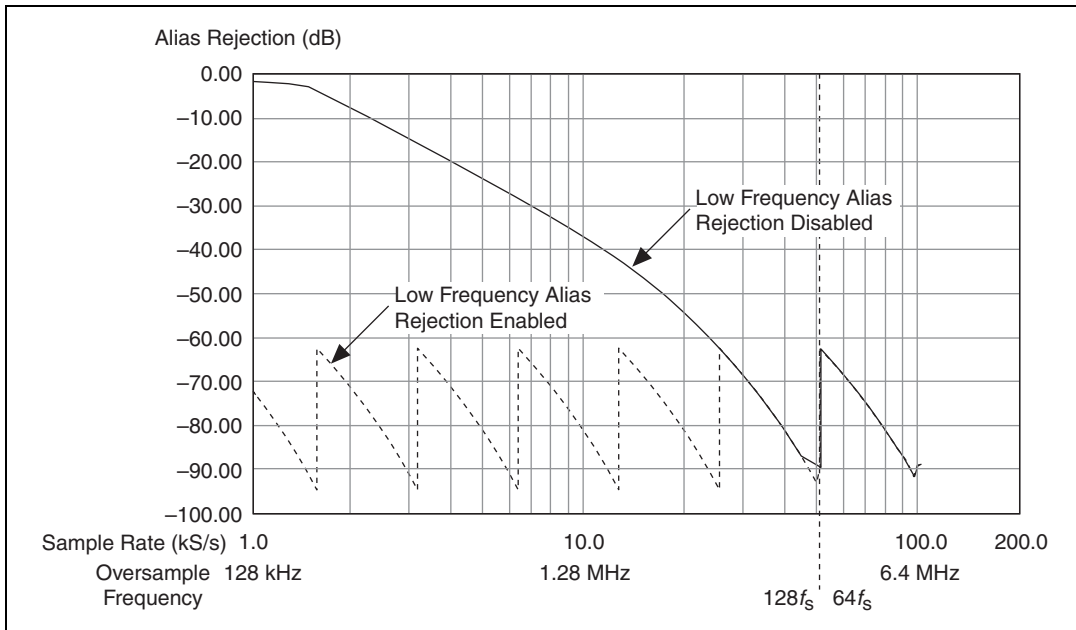


Figure 2. Analog Filter Alias Rejection at Oversample Rates

ADC Filter Delay

Low-Frequency Alias Rejection Disabled (Default)		Low-Frequency Alias Rejection Enabled	
Sample Rate (kS/s)	Filter Delay (Samples)	Sample Rate (kS/s)	Filter Delay (Samples)
$1.0 \leq f_s \leq 1.6$	38.7	$1.0 \leq f_s \leq 1.6$	32
$1.6 < f_s \leq 3.2$		$1.6 < f_s \leq 3.2$	32
$3.2 < f_s \leq 6.4$		$3.2 < f_s \leq 6.4$	32
$6.4 < f_s \leq 12.8$		$6.4 < f_s \leq 12.8$	33.675
$12.8 < f_s \leq 25.6$		$12.8 < f_s \leq 25.6$	35.35
$25.6 < f_s \leq 102.4$		$25.6 < f_s \leq 102.4$	38.7

AC -3 dB cut-off frequency

NI 447x3.4 Hz

NI 4472B.....0.5 Hz

Flatness, relative to 1 kHz, DC coupled, for sample rate

$1.0 \text{ kS/s} \leq f_s \leq 51.2 \text{ kS/s}$ $\pm 0.03 \text{ dB}$, max

$51.2 \text{ kS/s} < f_s \leq 102.4 \text{ kS/s}$ $\pm 0.1 \text{ dB}$, max

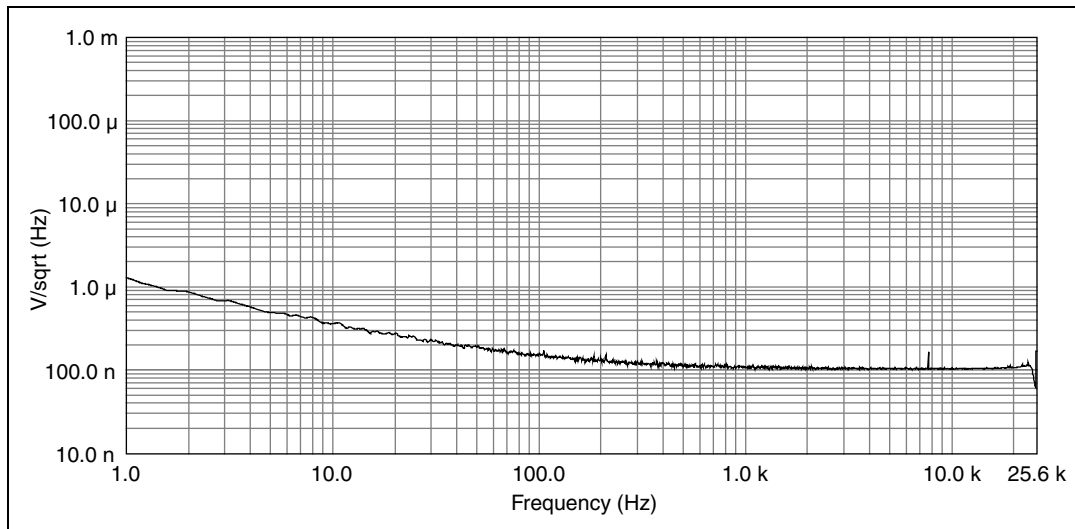


Figure 3. Input Noise Spectral Density at 128-Times Oversampling (50 Ω Connected at Input)

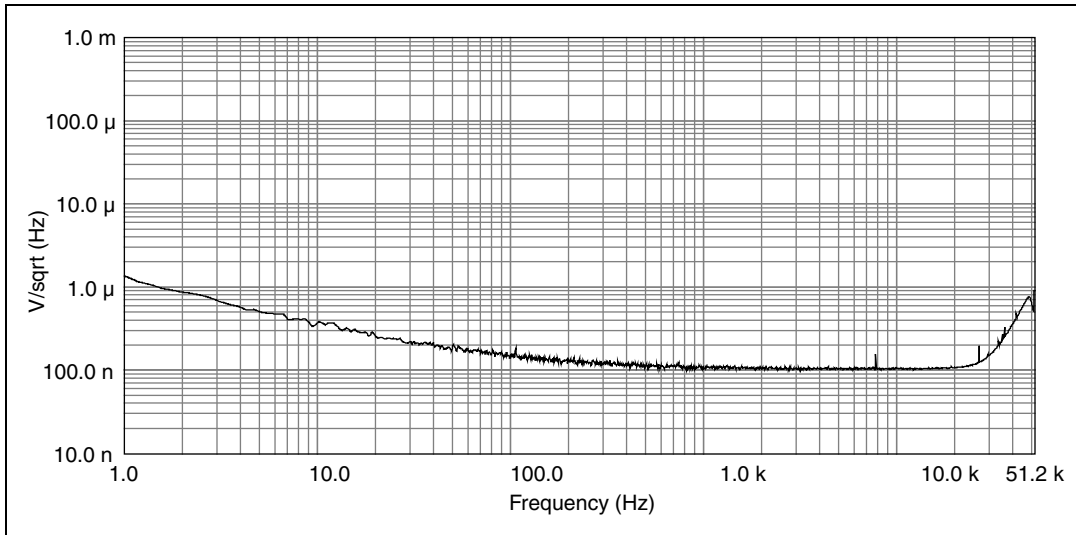


Figure 4. Input Noise Spectral Density at 64-Times Oversampling (50 Ω Connected at Input)

Idle channel noise, for sample rate

$f_s = 51.2$ kS/s,
bandwidth = 25.6 kHz -94 dBV_{rms}
 $f_s = 102.4$ kS/s,
bandwidth = 51.2 kHz -81 dBV_{rms}

Spurious free dynamic range^{1,2}104 dB

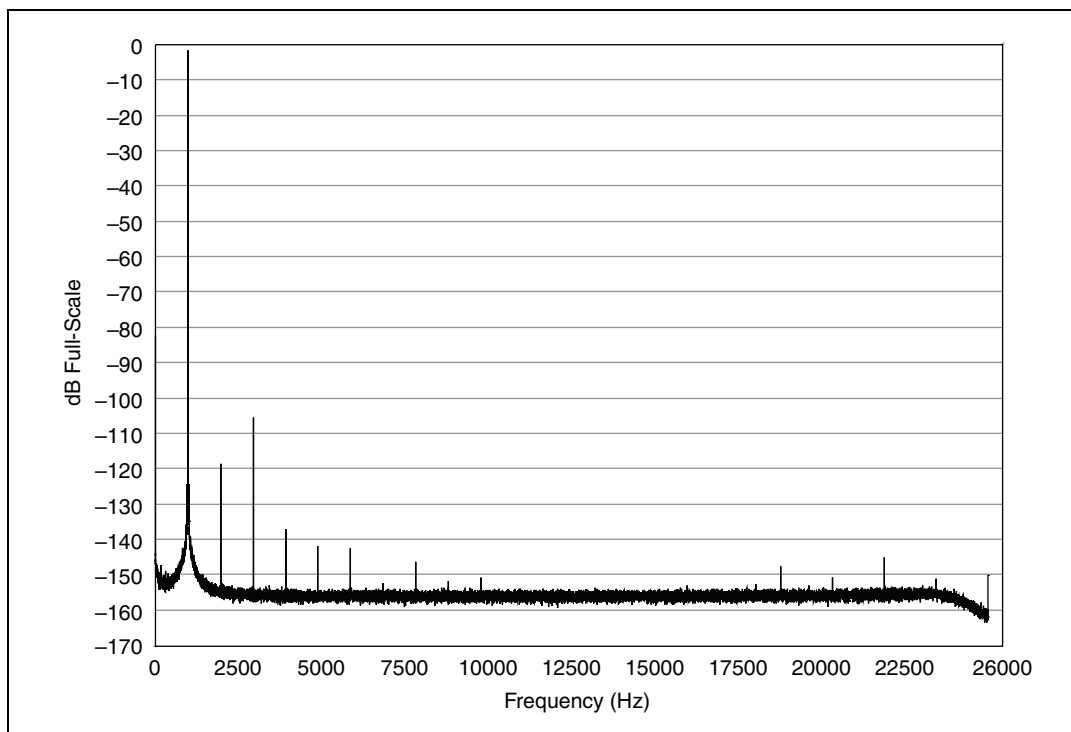


Figure 5. SFDR 51.2 kS/s (-1 dBFS, 1 kHz Sine Wave Input, FFT Size 131,072 Samples, Five Averages)

¹ Measurement includes all harmonics.

² 1 kHz input tone, input amplitude is -1 dBFS or 8.91 V_{pk}.

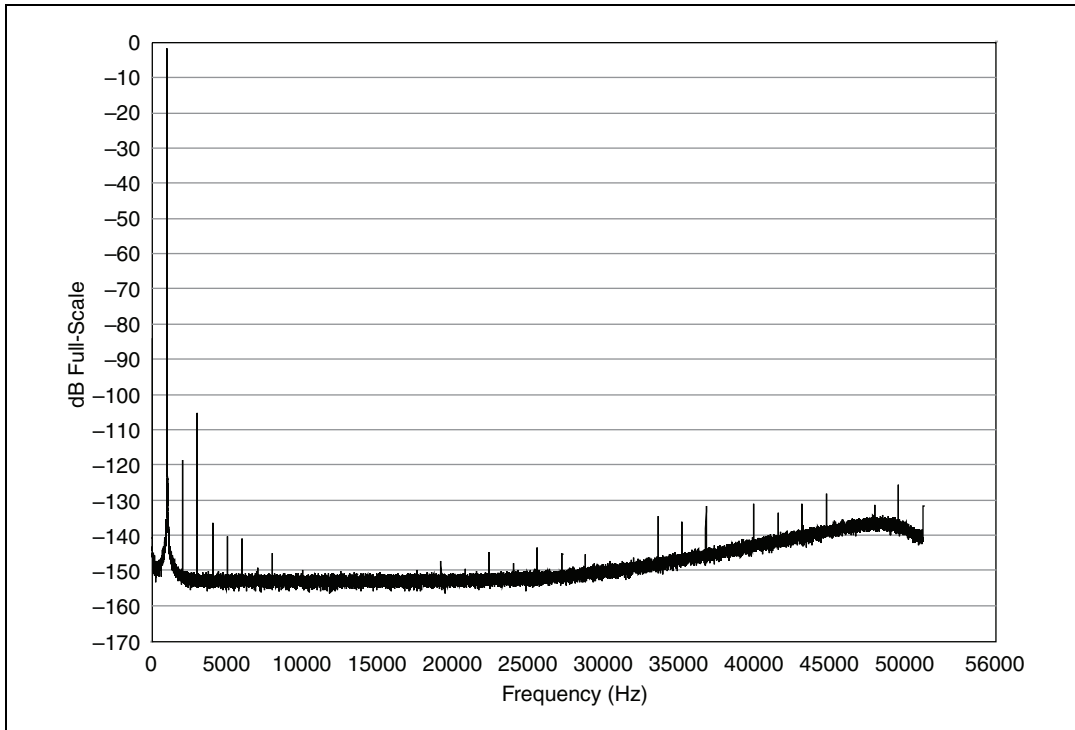


Figure 6. SFDR 102.4 kS/s (-1 dBFS, 1 kHz Sine Wave Input, FFT Size 131,072 Samples, Five Averages)

Dynamic range,^{1,2} for sample rate

1.0 kS/s $\leq f_s \leq 51.2$ kS/s..... 111 dB

51.2 kS/s $< f_s \leq 102.4$ kS/s..... 99 dB

¹ Bandwidth equals $0.4535 f_s$ starting from 20 Hz.

² 1 kHz input tone, input amplitude is -60 dBFS.

Total harmonic distortion (THD)¹-102 dBc

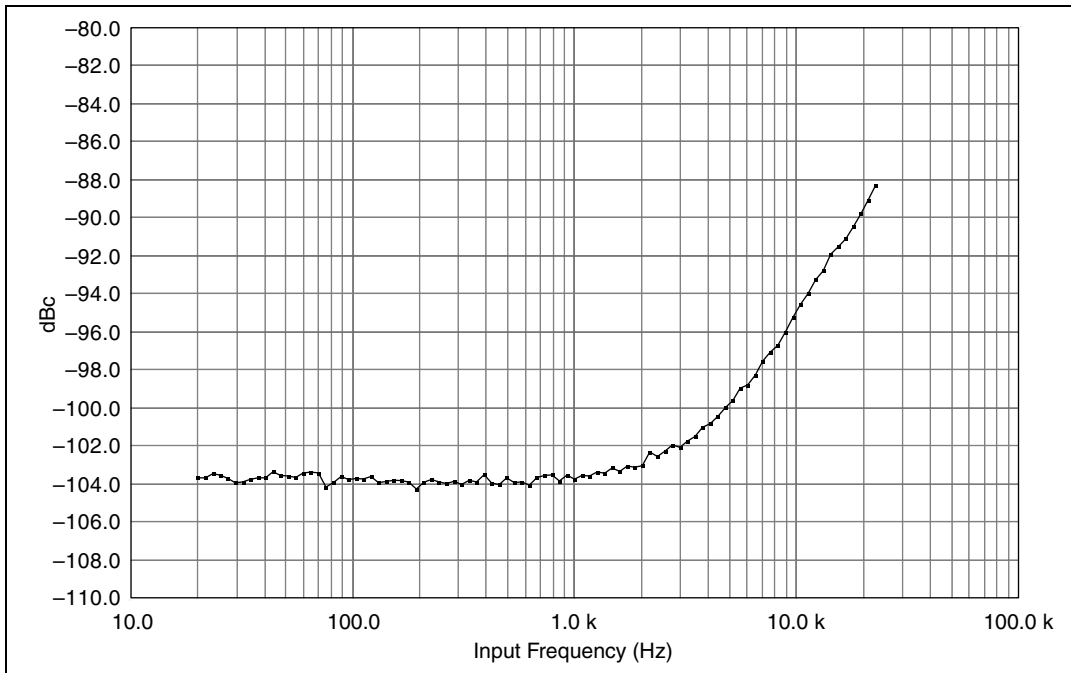


Figure 7. THD (Unbalanced Source, 102.4 kS/s),
-1 dBFS Input Sine Wave, DC Coupled

THD+N² -97 dBc
IMD-100 dBc
(CCIF 14 kHz + 15 kHz)

Crosstalk (Channel Separation)*, †	Shorted Input	1 kΩ Load
Adjacent channels	<-90 dB	<-80 dB
Other channel combinations	<-100 dB	<-90 dB

* Measured with full-scale (±10 V) input.
† $f_{in} = 0$ to 51.2 kHz

Interchannel gain mismatch, for sample rate
1.0 kS/s ≤ f_s ≤ 51.2 kS/s±0.06 dB, max
51.2 kS/s < f_s ≤ 102.4 kS/s±0.2 dB, max
Interchannel phase mismatch< f_{in} (in kHz) × 0.018° +
0.082°
Phase linearity<±0.5°

¹ 1 kHz input tone, input amplitude is -1 dBFS.
² 1 kHz input tone, -1 dBFS, 50 kHz measurement bandwidth.

Onboard Calibration Reference

DC level 5.000 V ±2.5 mV
Temperature coefficient ±5 ppm/°C max
Long-term stability ±20 ppm/√1,000 h

Integrated Electronic Piezoelectric (IEPE)

Current 0 or 4 mA, ±5%, each
channel independently
software selectable
Compliance 24 V
Output impedance >250 kΩ at 1 kHz
Current noise <500 pA/√Hz

Triggers

Analog trigger

Purpose	Start trigger or reference
Source	
NI 4472/4472B	CH<0..7>
NI PCI-4474	CH<0..3>
Level	Full scale, programmable
Slope	Positive (rising) or negative (falling), software-selectable
Resolution	24 bits
Hysteresis	Programmable

Digital trigger

Purpose	Start or reference trigger
Compatibility	5 V TTL/CMOS
Polarity	Rising or falling edge
Minimum pulse width	100 ns

General Specifications

Bus Interface

PCI or PXI	3.3 V or 5 V signal environment
DMA channels	1, analog input

Synchronization

PXI

PXI_STAR	Up to 14 devices per chassis
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PCI

RTSI	Up to 5 devices across ribbon cable
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Power Requirements

+3.3 VDC

NI PCI-4472/4472B/4474	0 mA
NI PXI-4472/4472B	400 mA, max

+5 VDC

NI PCI-4472/4472B	2,600 mA, max
NI PCI-4474	2,000 mA, max
NI PXI-4472/4472B	2,000 mA, max

+12 VDC

-12 VDC

Physical

Dimensions (not including connectors)

NI PCI-4472/4472B/4474	17.5 × 10.7 cm (6.9 × 4.2 in.)
NI PXI-4472/4472B	16.0 × 9.9 cm (6.3 × 3.9 in.) (1 3U CompactPCI slot)

Weight

NI PCI-4472/4472B	198 g (7 oz)
NI PCI-4474	184 g (6.5 oz)
NI PXI-4472/4472B	241 g (8.5 oz)

Analog I/O connectors

Digital trigger connector

Environmental

Operating Environment

Ambient temperature range

PXI-447x	0 to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
PCI-447x	0 to 50 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

Relative humidity range

Altitude

Pollution Degree
(indoor use only)

Storage Environment

Ambient temperature range

Relative humidity range

Shock and Vibration (PXI Only)

Operational shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)
Random vibration	
Operating5 to 500 Hz, 0.3 g _{rms}
Nonoperating5 to 500 Hz, 2.4 g _{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Calibration

Self-calibration	On software command, the device computes gain and offset corrections relative to high-precision internal reference
Interval	Recommended whenever ambient temperature differs from T _{cal} by more than ±5 °C
External calibration interval	1 year
Warm-up time	15 minutes

Maximum Working Voltage

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Channel-to-earth	42 V _{pk} , Measurement Category I
Channel-to-channel	42 V _{pk} , Measurement Category I



Caution Do *not* use the NI 447x for connections to signals or for measurements within Categories II, III, or IV.

Safety

This product meets 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 the *Online Product Certification* section.

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 the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.



Note For EMC compliance, operate this device with shielded cables.



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

CE Compliance

This product meets the essential requirements of applicable European Directives as follows:

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

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and 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.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of the 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.

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