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NI 447*x* Specifications

Français Deutsch 日本語 한국어 简体中文

ni.com/manuals

This document lists specifications for the NI 447*x* 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

- NI 4472/4472B ..... 8, simultaneously sampled
- NI PCI-4474 ..... 4, simultaneously sampled

Input configuration ..... Pseudodifferential

Input coupling ..... AC or DC, software-selectable

A/D converter (ADC) resolution .... 24 bits

ADC type ..... Delta-sigma

Sample rates (f_s), samples-per-second (S/s)..... 102.4 kS/s down to 1.0 kS/s in 190.7 µS/s increments for f_s > 51.2 kS/s or 95.37 µS/s increments for $f_s \leq$ 51.2 kS/s

ADC modulator oversample rate

- 1.0 kS/s ≤ f_s ≤ 51.2 kS/s ..... 128 f_s
- 51.2 kS/s < f_s ≤ 102.4 kS/s ..... 64 f_s

Sample Clock Timebase, low-frequency alias rejection disabled (default)[1]

- 1.0 kS/s ≤ f_s ≤ 51.2 kS/s ..... 256 f_s
- 51.2 kS/s < f_s ≤ 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 447*x* devices. Refer to the *National Instruments Dynamic Signal Acquisition Help* for supported devices and more information.

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Sample Clock Timebase, low-frequency alias rejection enabled

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

FIFO buffer size .....1,023 samples

Data transfers.....DMA

Overvoltage protection

Positive input .....±42.4 V_{pk}

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

External trigger .....Not protected

Frequency accuracy ..... ±25 ppm

Input signal range..... ±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 MΩ ‖ 60 pF
Between positive input and chassis ground (NI PXI-4472B revision H and later)	10 MΩ ‖ 60 pF
Between negative input and chassis ground	50 Ω ‖ 0.02 µF

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 < input frequency < 127.4535 f_s, where 1.0 kS/s ≤ f_s ≤ 51.2 kS/s 0.5465 f_s < input frequency < 63.4535 f_s, where 51.2 kS/s < f_s ≤ 102.4 kS/s	Input frequency > 0.6 f_s
–3 dB BW	0.491 f_s	0.4863 f_s

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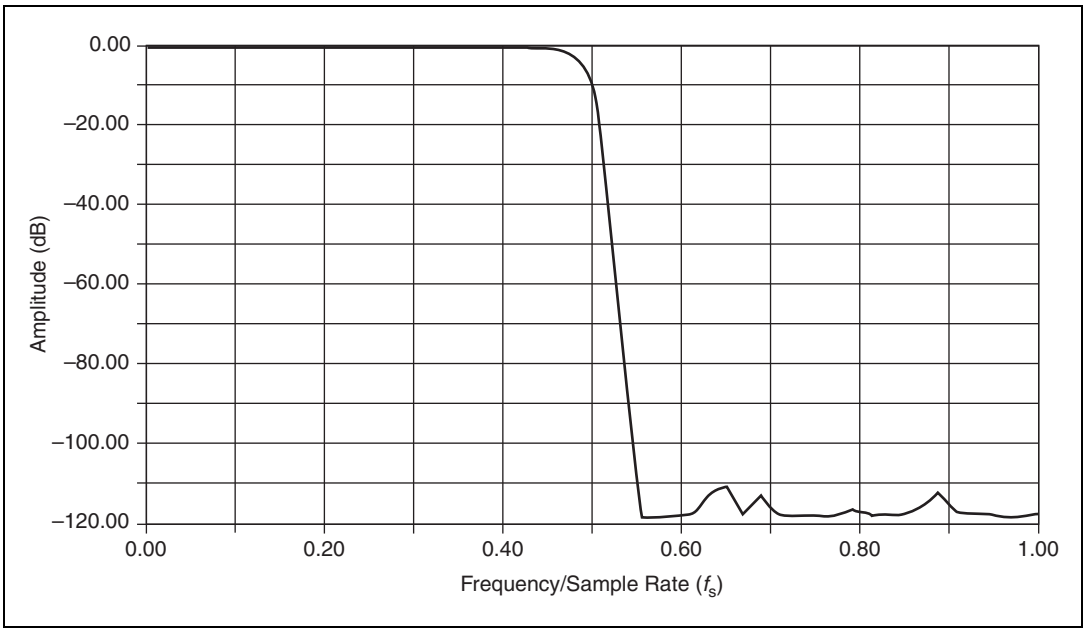


Figure 1. Digital Filter Input Frequency Response

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.

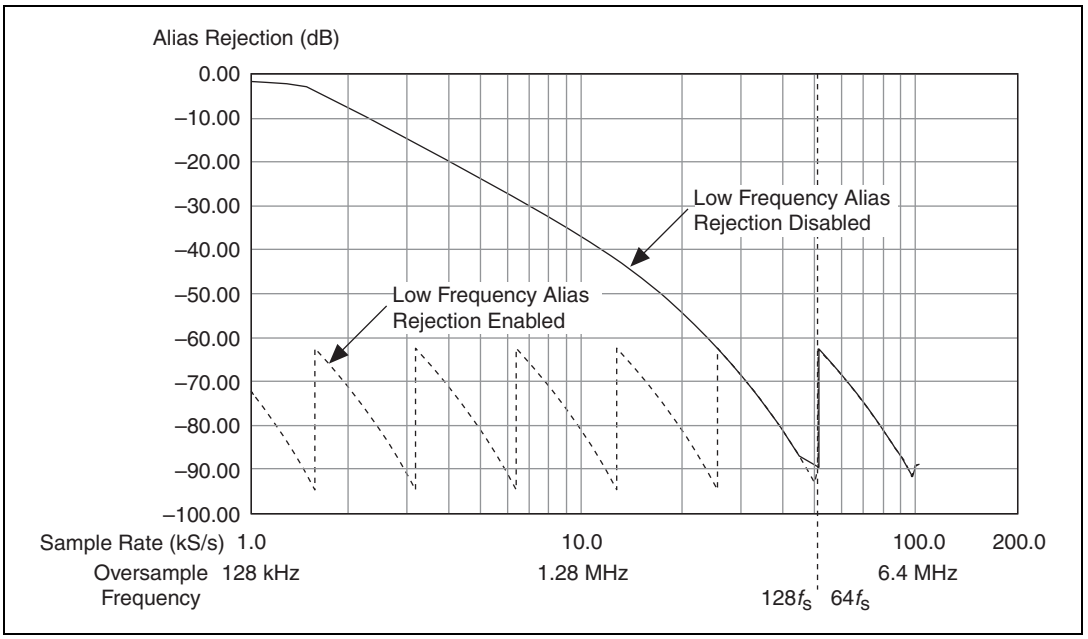


Figure 2. Analog Filter Alias Rejection at Oversample Rates

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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)**
$1.0 \le f_s \le 1.6$	38.7	$1.0 \le f_s \le 1.6$	32
$1.6 < f_s \le 3.2$		$1.6 < f_s \le 3.2$	32
$3.2 < f_s \le 6.4$		$3.2 < f_s \le 6.4$	32
$6.4 < f_s \le 12.8$		$6.4 < f_s \le 12.8$	33.675
$12.8 < f_s \le 25.6$		$12.8 < f_s \le 25.6$	35.35
$25.6 < f_s \le 102.4$		$25.6 < f_s \le 102.4$	38.7

AC –3 dB cut-off frequency

NI 447x .....3.4 Hz

NI 4472B.....0.5 Hz

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

1.0 kS/s $\le f_s \le$ 51.2 kS/s..... ±0.03 dB, max

51.2 kS/s $< f_s \le$ 102.4 kS/s..... ±0.1 dB, max

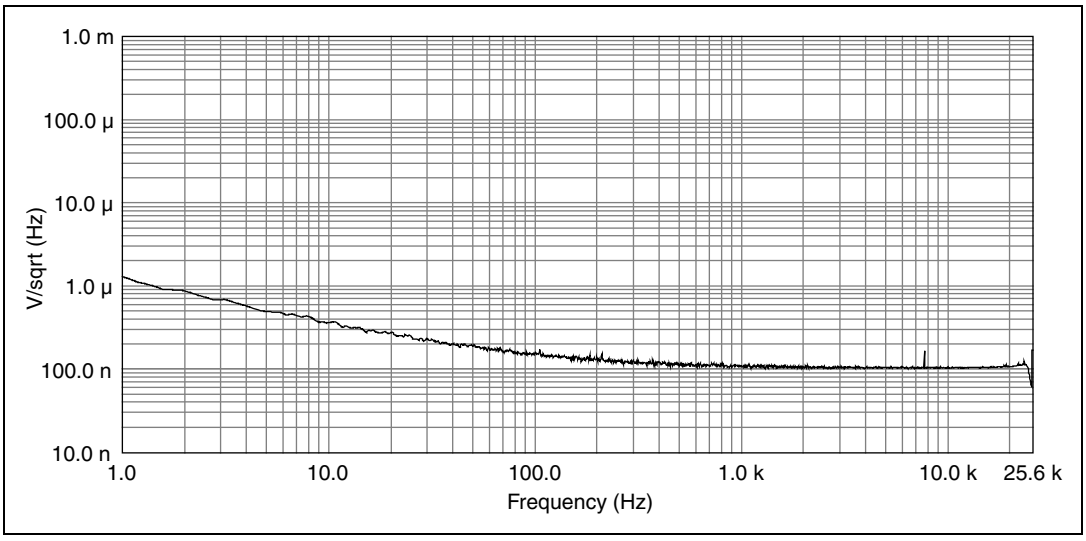


Figure 3. Input Noise Spectral Density at 128-Times Oversampling (50 Ω Connected at Input)

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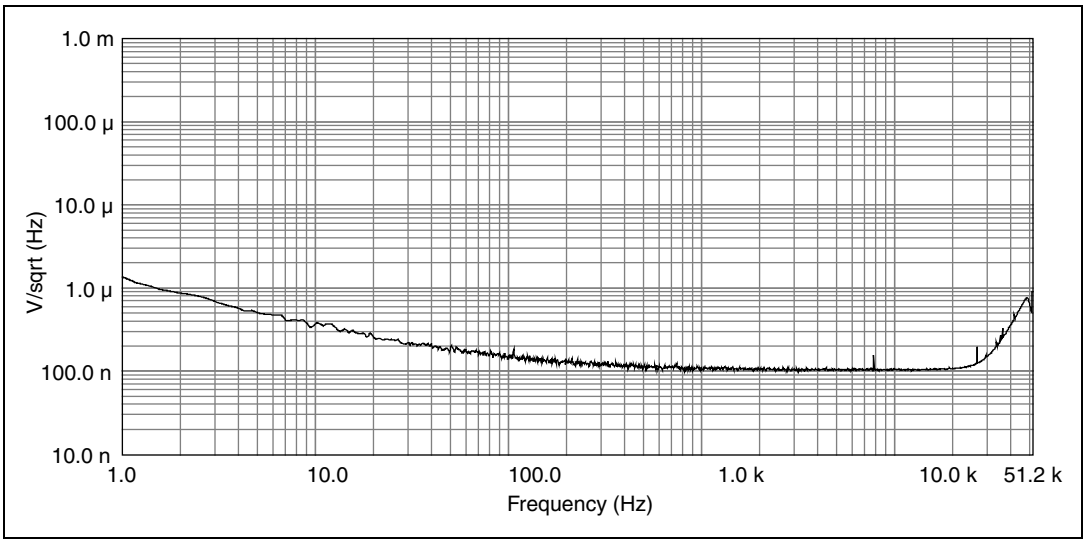


Figure 4. Input Noise Spectral Density at 64-Times Oversampling (50 Ω Connected at Input)

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}

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Spurious free dynamic range[1,2] .....104 dB

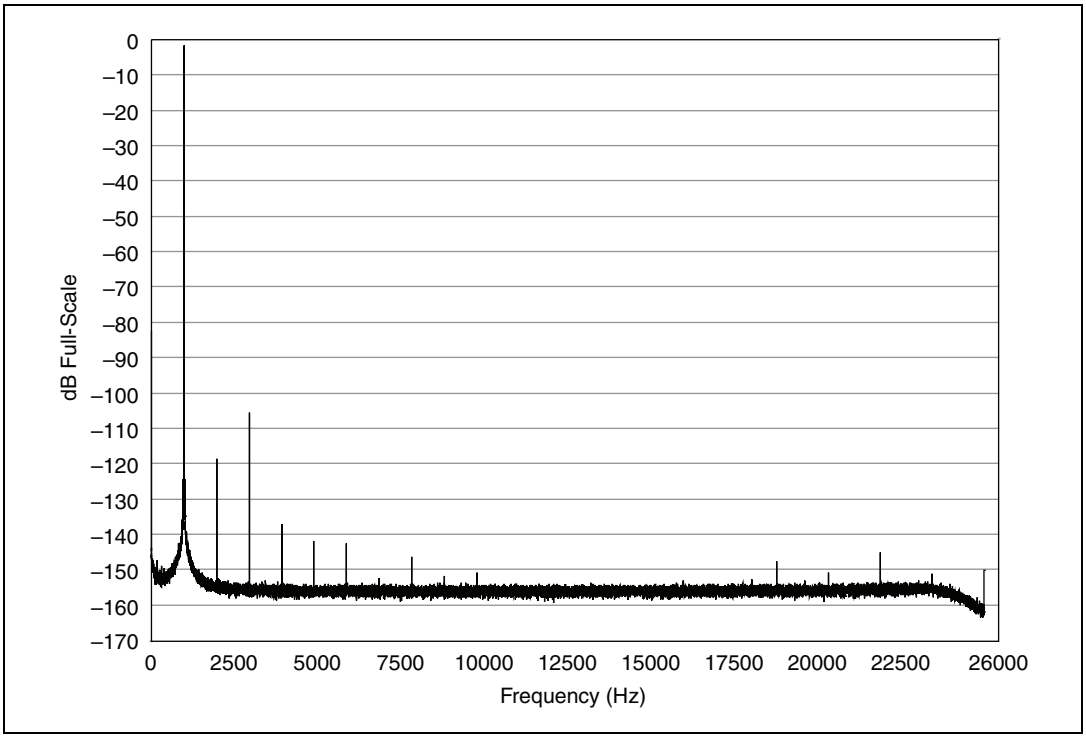


Figure 5. SFDR 51.2 kS/s (–1 dBFS, 1 kHz Sine Wave Input, FFT Size 131,072 Samples, Five Averages)

[1] Measurement includes all harmonics.

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

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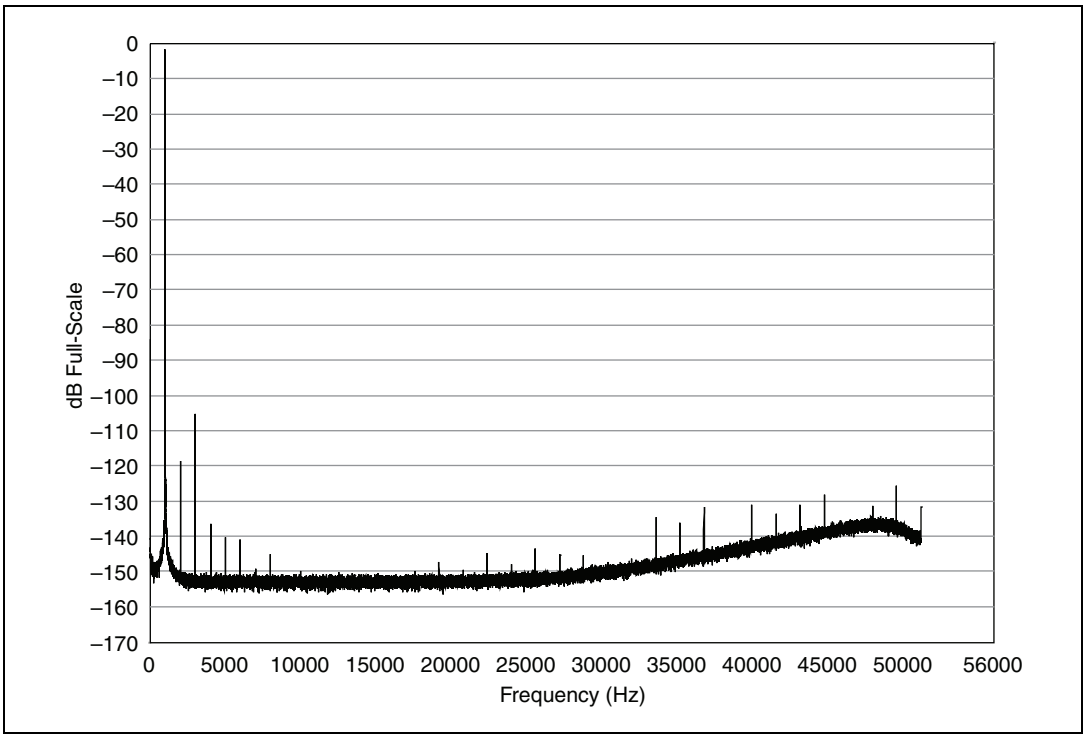


Figure 6. SFDR 102.4 kS/s (–1 dBFS, 1 kHz Sine Wave Input, FFT Size 131,072 Samples, Five Averages)

Dynamic range,[1,2] for sample rate

1.0 kS/s ≤ f_s ≤ 51.2 kS/s..... 111 dB

51.2 kS/s < f_s ≤ 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.

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Total harmonic distortion (THD)[1] ....–102 dBc

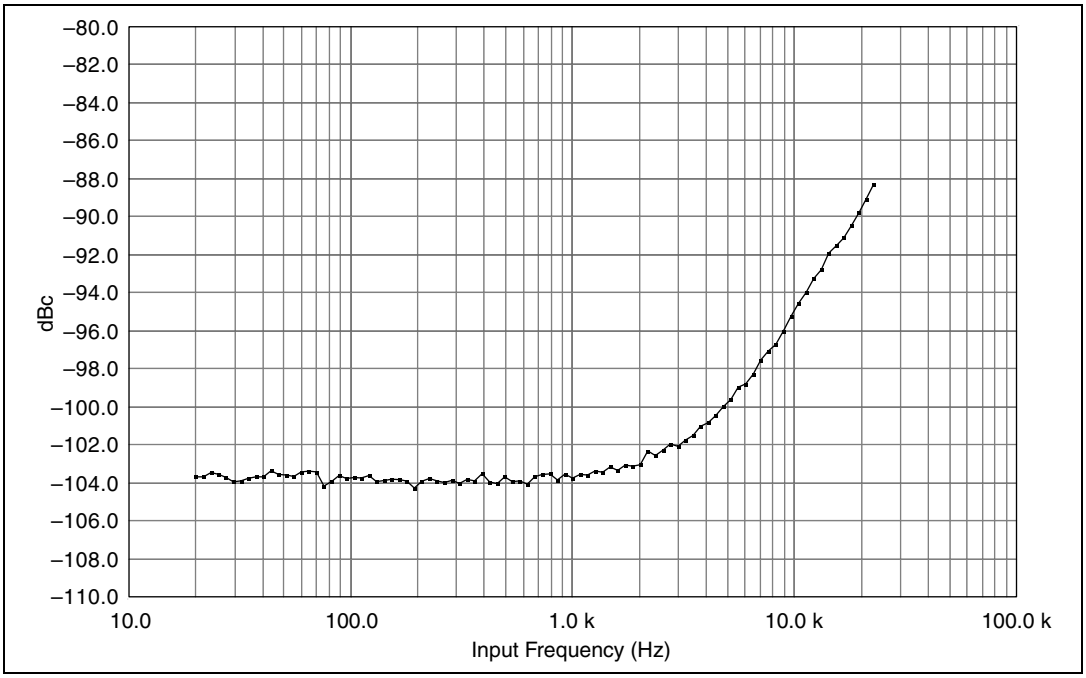


Figure 7. THD (Unbalanced Source, 102.4 kS/s), –1 dBFS Input Sine Wave, DC Coupled

THD+N[2] ..... –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°

Onboard Calibration Reference

DC level ..... 5.000 V ±2.5 mV

Temperature coefficient..... ±5 ppm/°C max

Long-term stability ..... ±20 ppm/$\sqrt{1{,}000\ \text{h}}$

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/$\sqrt{\text{Hz}}$

[1] 1 kHz input tone, input amplitude is –1 dBFS.

[2] 1 kHz input tone, –1 dBFS, 50 kHz measurement bandwidth.

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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

PCI

- RTSI ..... Up to 5 devices across ribbon cable

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 ..... 120 mA, max

–12 VDC ..... 120 mA, max

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 ..... SMB male

Digital trigger connector ..... SMB male

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 ..... 10 to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Altitude ..... 2,000 m (at 25 °C ambient temperature)

Pollution Degree (indoor use only) 2

Storage Environment

Ambient temperature range ..... –20 to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

Relative humidity range ..... 5 to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

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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

Operating .....5 to 500 Hz, 0.3 g_{rms}

Nonoperating .....5 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 CE

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.

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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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