SPECIFICATIONS

# PXIe-4481

24-Bit, 6-Channel, 1.25 MS/s/ch PXI Analog Input Module

## Definitions

*Warranted* specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

The following characteristic specifications describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- *Typical* specifications describe the performance met by a majority of models.
- *Nominal* specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are *Typical* unless otherwise noted.

## Conditions

Specifications are valid for the range -40 °C to 70 °C unless otherwise noted.

## Input Characteristics

| | |
|---|---|
| Number of simultaneously sampled input channels | 6 |
| Measurement types | Voltage, each channel independently software-selectable |
| Input configuration | |
| Voltage | Differential or pseudodifferential (50 Ω between negative input and chassis ground), each channel independently software-selectable |
| Input coupling | |
| Voltage | AC or DC, each channel independently software-selectable |

| | |
|---|---|
| A/D converter (ADC) resolution | 24 bits |
| ADC type | Delta-Sigma |
| Sample rates ($f_s$) | |
| Range | 100 Sample/s to 1.25 MSample/s |
| Resolution[1] | ≤1.458 mSample/s |
| ADC modulator sample rate | 20 MSample/s |
| FIFO buffer size | 1,023 samples per task + 8,221 samples per channel in task |
| Data transfers | Direct Memory Access (DMA), Programmed I/O |

## Common-Mode Range (Voltage)

| Input | Configuration | |
|---|---|---|
| | Differential ($V_{pk}$)* | Pseudodifferential ($V_{pk}$)* |
| Positive input (+) | ±10 | ±10 |
| Negative input (-) | ±10 | ±10 |
| * Voltages with respect to chassis ground. | | |

## Signal Range (Voltage)

| Range (V) * | Full-Scale Input, Min | |
|---|---|---|
| | $V_{pk}$ | $V_{rms}$ † |
| 10 | ±10.0‡ | 7.07‡ |
| 5 | ±5.0 | 3.53 |
| 1 | ±1.0 | 0.707 |
| 0.5 | ±0.5 | 0.353 |

* Each input channel range is independently software-selectable.

† Sine input.

‡ Typical.

[1] Dependent on the sample rate. Refer to the *PXIe-4480/4481 User Manual* for more information.

## Overvoltage Protection (Voltage)

| Input | Configuration | |
|---|---|---|
| | Differential ($V_{pk}$)* | Pseudodifferential ($V_{pk}$)* |
| Positive input (+) | ±30 | ±30 |
| Negative input (-) | ±30 | ±10 |
| * Voltages with respect to chassis ground. | | |

## Overvoltage Protection (Unpowered)

| Input | Voltage ($V_{pk}$)* |
|---|---|
| Positive input (+) | ±15 |
| Negative input (-) | ±15 |
| * Voltages with respect to chassis ground. | |

# Transfer Characteristics

## Offset (Residual DC)

| Range (V) | DC-Coupled Offset (±mV)*, Max (Typical) | AC-Coupled Offset (±mV)†, Typical, 25 °C | DC-Coupled Offset (±mV)†, Max, 55 °C |
|---|---|---|---|
| 10 | 5.0 (2.0) | 1.1 | 7.0 |
| 5 | 2.2 (1.0) | 0.6 | 5.0 |
| 1 | 0.8 (0.5) | 0.3 | 4.2 |
| 0.5 | 0.65 (0.4) | 0.3 | 4.2 |

* Source impedance ≤ 50 Ω.

† Applied DC bias ≤ 15 V.

## Gain Amplitude Accuracy

| | |
|---|---|
| Voltage | |
| 1 kHz input tone | ±0.05 dB max, ±0.02 dB typical |

# Amplifier Characteristics

## Input Impedance (Voltage)

| Input Impedance | Configuration | |
|---|---|---|
| | Differential | Pseudodifferential |
| Between positive input and chassis ground | 1.62 MΩ \|\| 200 pF | 1.62 MΩ \|\| 200 pF |
| Between negative input and chassis ground | 1.62 MΩ \|\| 200 pF | 50 Ω |

## Common-Mode Rejection Ratio (CMRR)

| Range (V) | DC-Coupled CMRR (dBc)*, † | AC-Coupled CMRR (dBc)*, ‡ |
|---|---|---|
| 10 | 60 | 60 |
| 5 | 70 | 70 |
| 1 | 85 | 80 |
| 0.5 | 90 | 80 |

* $f_{in} \leq 1$ kHz.

† Differential configuration.

‡ $f_{in}$ = 50 Hz or 60 Hz.

# Dynamic Characteristics

## Bandwidth and Alias Rejection

| | |
|---|---|
| Alias-free bandwidth (BW) (passband) | DC to 0.403 $f_s$ |
| Alias rejection | 120 dBc min, 0.597 $f_s < f_{in} <$ 19.25375 MHz |

## Filter Delay

| | |
|---|---|
| Digital filter delay | Adjustable[2] |

[2] Digital filter delay is compensated to 0 ns by default and adjustable in software.

| Analog filter delay | |
|---|---|
| 10 V range | 31 ns |
| 5 V range | 47 ns |
| 1 V range | 150 ns |
| 0.5 V range | 215 ns |

## AC Coupling (Voltage)

| | |
|---|---|
| -3 dB cutoff frequency | 0.49 Hz |
| -0.1 dB cutoff frequency | 3.2 Hz |

**Figure 1.** AC-Coupled Voltage Measurement Magnitude Response vs. Frequency

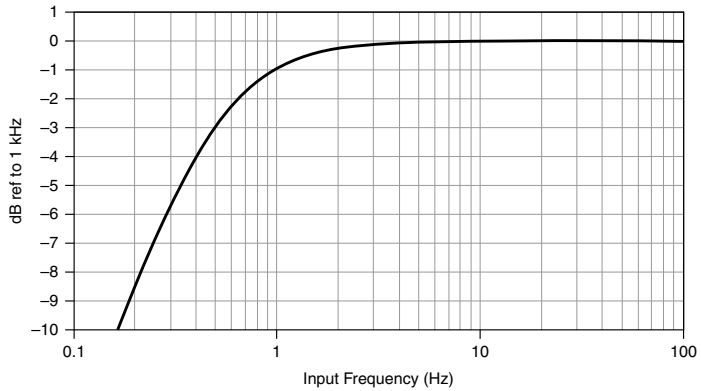
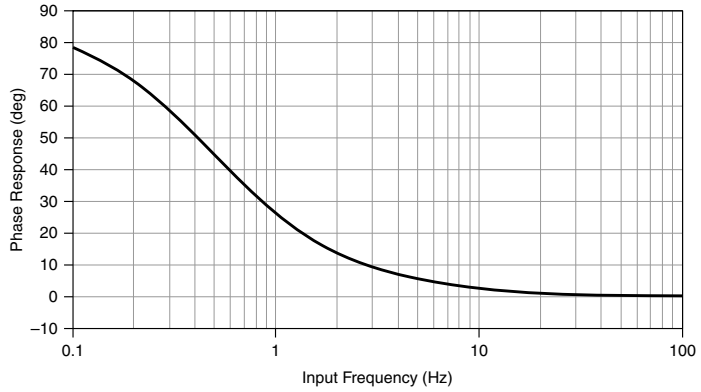



**Figure 2.** AC-Coupled Voltage Measurement Phase Response vs. Frequency



## Gain Flatness (Voltage)

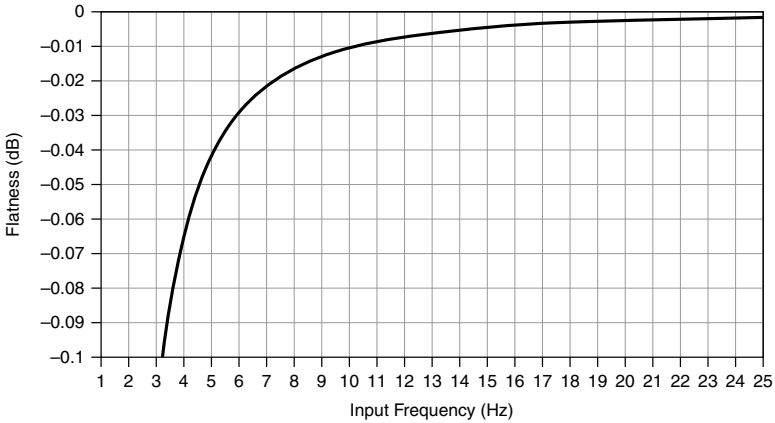
| Range (V) | $f_s$ = 1.25 MSamples/s | | | | |
|---|---|---|---|---|---|
| | DC-Coupled Flatness (dB)*, Max (Typical) | | | | |
| | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ > 20 kHz to 50 kHz | $f_{in}$ > 50 kHz to 100 kHz | $f_{in}$ > 100 kHz to 200 kHz | $f_{in}$ > 200 kHz to 500 kHz |
| 10 | ±0.007 (±0.001) | ±0.013 (±0.003) | ±0.03 (±0.003) | ±0.11 (±0.005) | (±0.025) |
| 5 | ±0.007 (±0.001) | ±0.013 (±0.003) | ±0.03 (±0.0035) | ±0.11 (±0.0055) | (±0.04) |
| 1 | ±0.007 (±0.001) | ±0.016 (±0.004) | ±0.057 (±0.022) | ±0.22 (±0.1) | (±0.6) |
| 0.5 | ±0.008 (±0.002) | ±0.025 (±0.012) | ±0.094 (±0.055) | ±0.36 (±0.23) | (±1.25) |

* Relative to 1 kHz.

| Range (V) | $f_s$ = 1.25 MSamples/s | | | | | |
|---|---|---|---|---|---|---|
| | DC-Coupled Flatness (dB)*, Max (Typical) | | | | | |
| | $f_{in}$ ≤ 25 Hz | $f_{in}$ > 25 Hz to 20 kHz | $f_{in}$ > 20 kHz to 50 kHz | $f_{in}$ > 50 kHz to 100 kHz | $f_{in}$ > 100 kHz to 200 kHz | $f_{in}$ > 200 kHz to 500 kHz |
| 10 | Refer to the following figure. | ±0.007 (±0.001) | ±0.013 (±0.003) | ±0.03 (±0.003) | ±0.11 (±0.005) | (±0.025) |
| 5 | Refer to the following figure. | ±0.007 (±0.001) | ±0.013 (±0.003) | ±0.03 (±0.0035) | ±0.11 (±0.0055) | (±0.04) |
| 1 | Refer to the following figure. | ±0.007 (±0.001) | ±0.016 (±0.004) | ±0.057 (±0.022) | ±0.22 (±0.1) | (±0.6) |
| 0.5 | Refer to the following figure. | ±0.008 (±0.002) | ±0.025 (±0.012) | ±0.094 (±0.055) | ±0.36 (±0.23) | (±1.25) |

* Relative to 1 kHz.

**Figure 3.** Voltage Measurement AC-Coupled Gain Flatness




## Interchannel Gain Mismatch (Voltage)

| Range (V) | AC/DC-Coupled Mismatch (dB)*, Max, (Typical) | | | AC-Coupled Mismatch (dB)*, Max (Typical) | |
|---|---|---|---|---|---|
| | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ > 20 kHz to 50 kHz | $f_{in}$ > 50 kHz to 100 kHz | $f_{in}$ = 5 Hz | $f_{in}$ = 10 Hz |
| 10 | 0.011 (0.005) | 0.011 (0.005) | 0.011 (0.005) | 0.019 (0.009) | 0.015 (0.007) |
| 5 | 0.013 (0.006) | 0.013 (0.006) | 0.013 (0.006) | | |
| 1 | 0.015 (0.007) | 0.015 (0.007) | 0.019 (0.009) | | |
| 0.5 | 0.015 (0.007) | 0.017 (0.008) | 0.034 (0.017) | | |

* Identical channel configurations.

## Interchannel Phase Mismatch (Voltage)

| Range (V) | AC/DC-Coupled Mismatch*, Max, (Typical) | | | AC-Coupled Mismatch*, Max (Typical) | |
|---|---|---|---|---|---|
| | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ > 20 kHz to 50 kHz | $f_{in}$ > 50 kHz to 100 kHz | $f_{in}$ = 5 Hz | $f_{in}$ = 10 Hz |
| 10 | 0.02° (0.01°) | 0.05° (0.025°) | 0.1° (0.05°) | 0.34° (0.17°) | 0.17° (0.09°) |
| 5 | 0.04° (0.02°) | 0.10° (0.05°) | 0.2° (0.1°) | | |
| 1 | 0.24° (0.12°) | 0.60° (0.30°) | 1.2° (0.6°) | | |
| 0.5 | 0.38° (0.19°) | 0.96° (0.48°) | 1.9° (0.95°) | | |

* Identical channel configurations.

**Note** Listed gain and phase mismatch specifications are valid for measurements made on channels on the same module. For measurements made on channels on different modules, the listed gain and phase mismatch specifications still apply, but are subject to the following conditions:

- For gain matching, all modules must be properly warmed up. Refer to the Environmental section for the specified warm-up time.
- For phase matching, all modules must be synchronized to a common timebase. To the listed specifications, add the following error: $360° \times f_{in} \times clock\ skew$. Refer to the Timing and Synchronization section for the maximum intermodule clock skew.

## Idle Channel Noise (Voltage)

| Range (V) | Idle Channel Noise (µVrms)* | | |
|---|---|---|---|
| | $f_s$ = 51.2 kSample/s | $f_s$ = 204.8 kSample/s | $f_s$ = 1.25 MSample/s |
| 10 | 16 | 32 | 87 |
| 5 | 6.5 | 13 | 35 |
| 1 | 1.8 | 3.6 | 9.1 |
| 0.5 | 1.5 | 3.0 | 7.1 |

* Source impedance ≤ 50 Ω.

## Dynamic Range (Voltage)

| Range (V) | Dynamic Range (dBFS)*, † | | |
|---|---|---|---|
| | $f_s$ = 51.2 kSample/s | $f_s$ = 204.8 kSample/s | $f_s$ = 1.25 MSample/s |
| 10 | 113 | 107 | 98 |
| 5 | 115 | 109 | 100 |
| 1 | 112 | 106 | 98 |
| 0.5 | 107 | 101 | 94 |

* 1 kHz tone, -60 dBFS input amplitude.

† Source impedance ≤ 50 Ω.

## Representative Measurement FFTs (1 kHz)

Test conditions for all FFTs: Unaveraged computation of 1.6 million samples, differential input configuration.

**Figure 4.** -3 dBFS, 1 kHz Tone Acquired at 1.25 MSample/s, 10 V Range (Full Bandwidth)

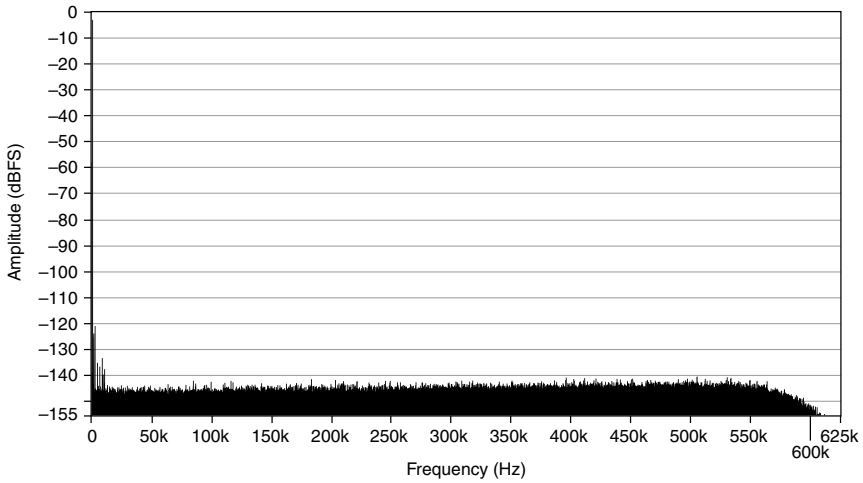


**Figure 5.** -3 dBFS, 1 kHz Tone Acquired at 1.25 MSample/s, 10 V Range (20 kHz Bandwidth)

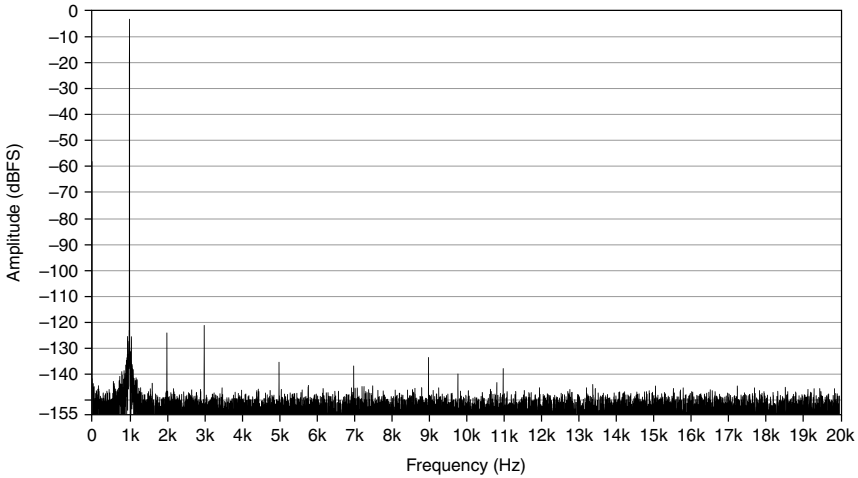



**Figure 6.** -3 dBFS, 1 kHz Tone Acquired at 1.25 MSample/s, 5 V Range (Full Bandwidth)

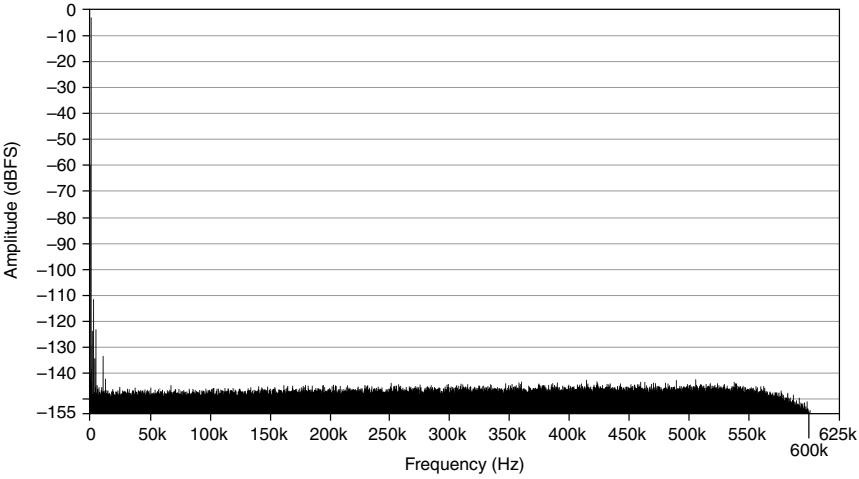


**Figure 7.** -3 dBFS, 1 kHz Tone Acquired at 1.25 MSample/s, 5 V Range (20 kHz Bandwidth)

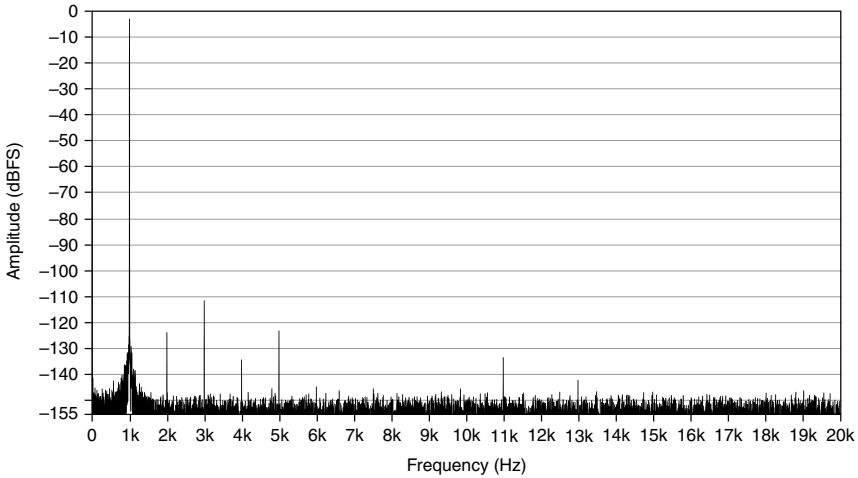



**Figure 8.** -3 dBFS, 1 kHz Tone Acquired at 1.25 MSample/s, 1 V Range (Full Bandwidth)

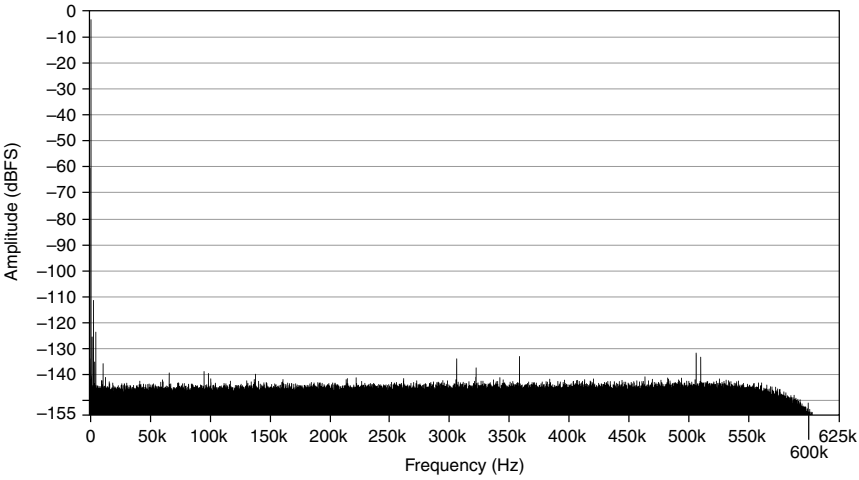


**Figure 9.** -3 dBFS, 1 kHz Tone Acquired at 1.25 MSample/s, 1 V Range (20 kHz Bandwidth)

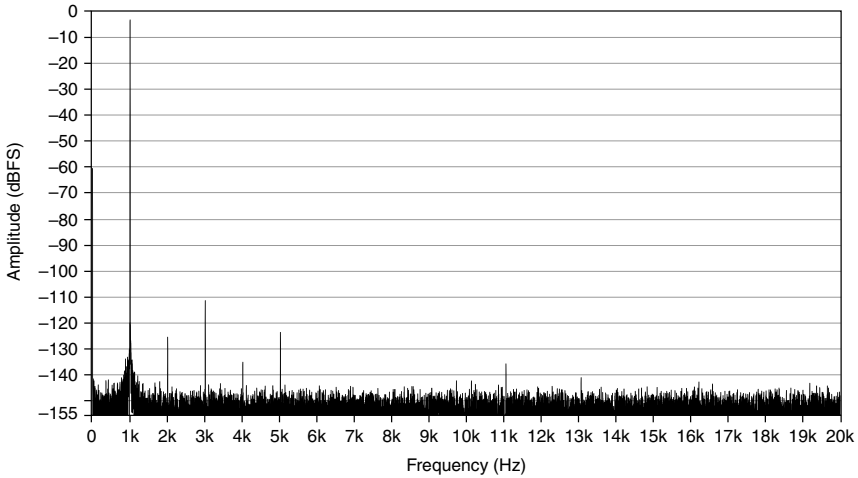



**Figure 10.** -3 dBFS, 1 kHz Tone Acquired at 1.25 MSample/s, 0.5 V Range (Full Bandwidth)

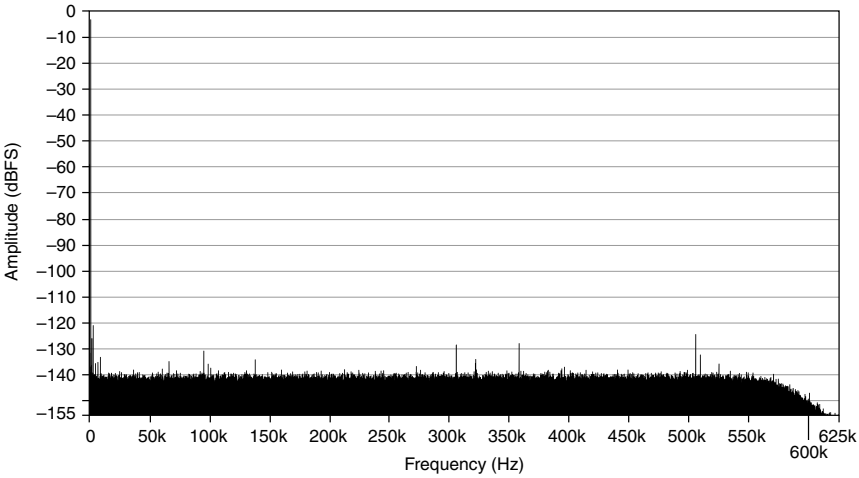
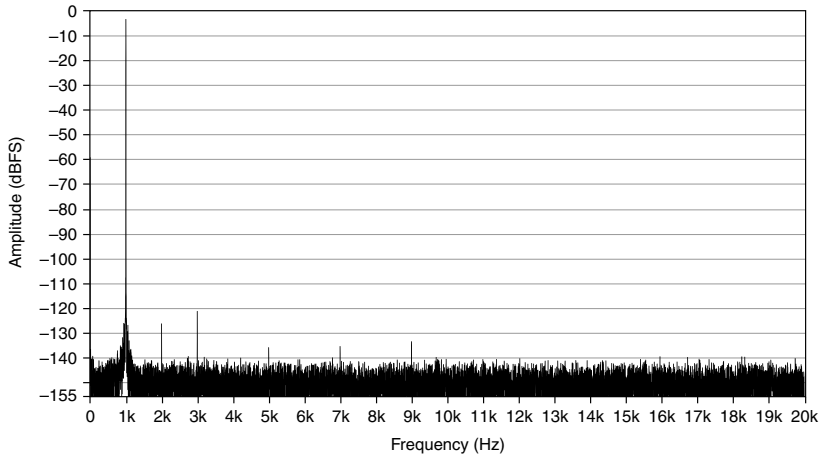


**Figure 11.** -3 dBFS, 1 kHz Tone Acquired at 1.25 MSample/s, 0.5 V Range (20 kHz Bandwidth)




## Representative Measurement FFTs (10 kHz)

Test conditions for all FFTs: Unaveraged computation of 1.6 million samples, differential input configuration.

**Figure 12.** -3 dBFS, 10 kHz Tone Acquired at 1.25 MSample/s, 10 V Range (Full Bandwidth)

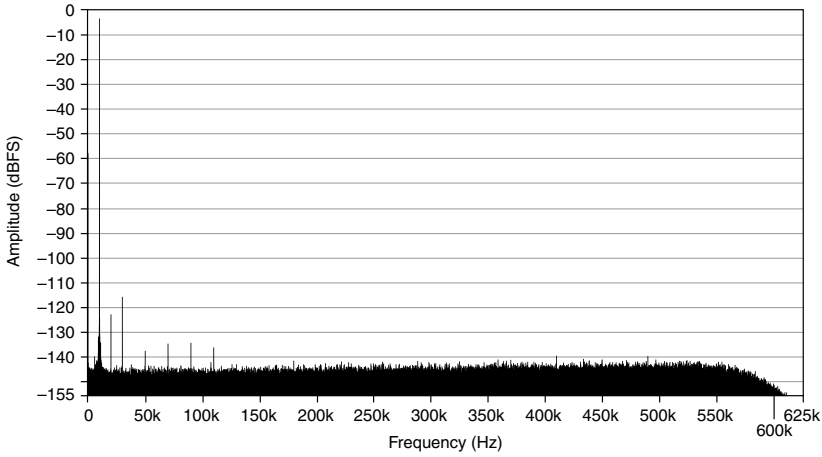


**Figure 13.** -3 dBFS, 10 kHz Tone Acquired at 1.25 MSample/s, 10 V Range (150 kHz Bandwidth)

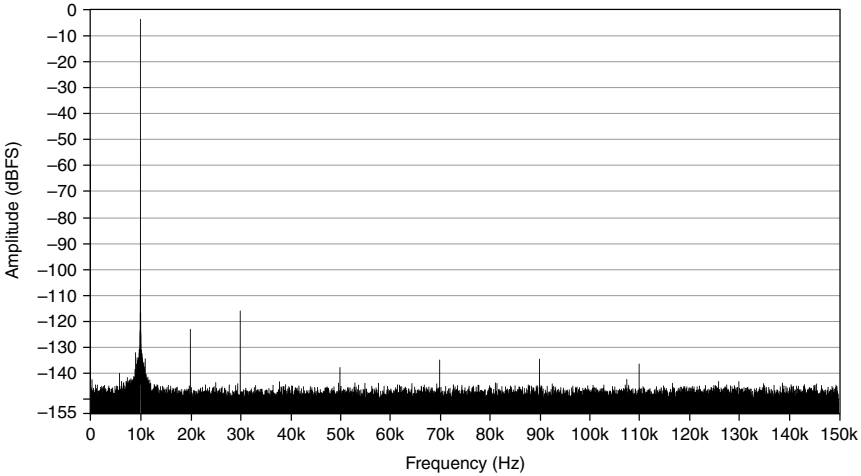



**Figure 14.** -3 dBFS, 10 kHz Tone Acquired at 1.25 MSample/s, 5 V Range (Full Bandwidth)

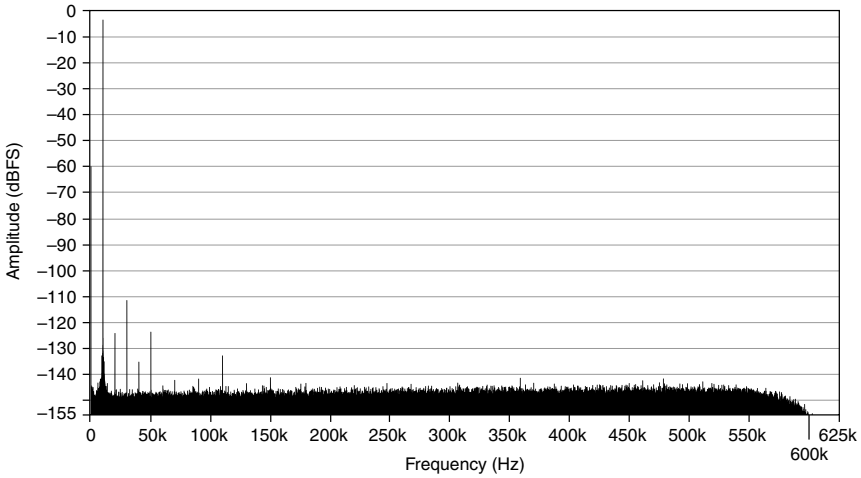


**Figure 15.** -3 dBFS, 10 kHz Tone Acquired at 1.25 MSample/s, 5 V Range (150 kHz Bandwidth)

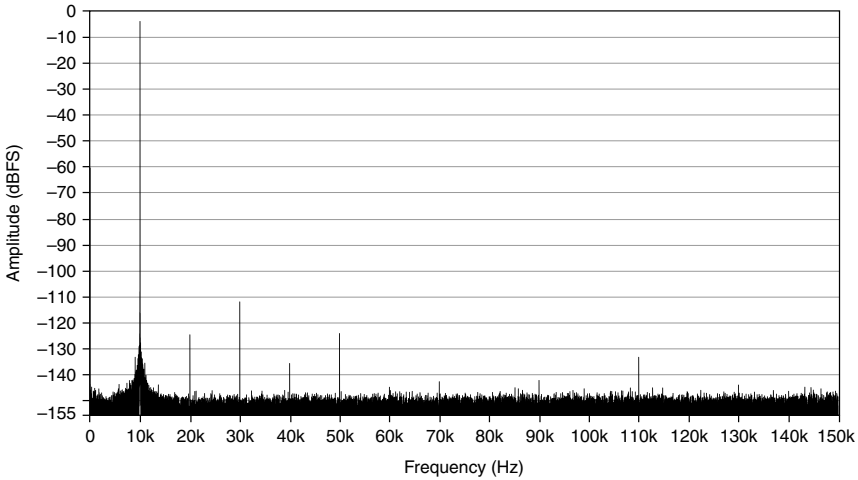



**Figure 16.** -3 dBFS, 10 kHz Tone Acquired at 1.25 MSample/s, 1 V Range (Full Bandwidth)

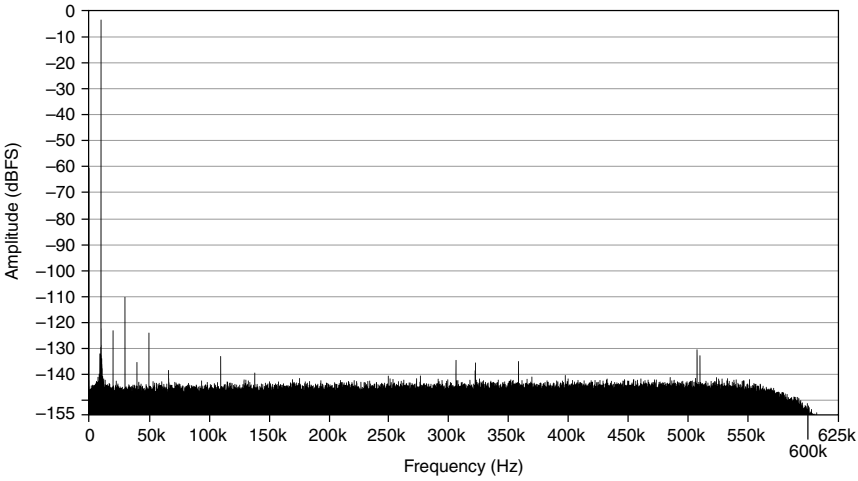


**Figure 17.** -3 dBFS, 10 kHz Tone Acquired at 1.25 MSample/s, 1 V Range (150 kHz Bandwidth)

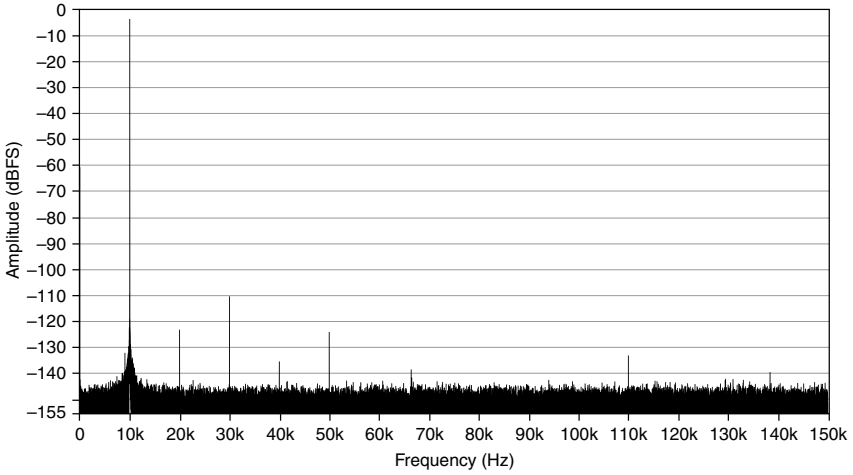



**Figure 18.** -3 dBFS, 10 kHz Tone Acquired at 1.25 MSample/s, 0.5 V Range (Full Bandwidth)

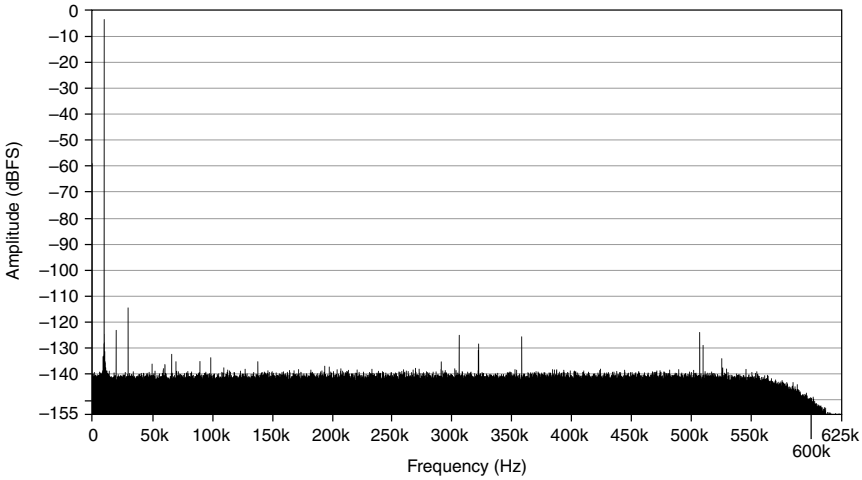
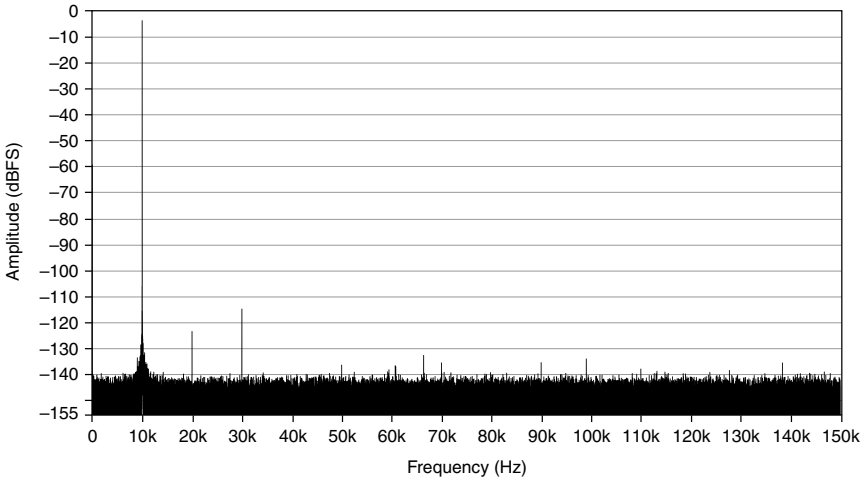


**Figure 19.** -3 dBFS, 10 kHz Tone Acquired at 1.25 MSample/s, 0.5 V Range (150 kHz Bandwidth)




## Spurious Free Dynamic Range (Voltage)

| Range (V) | SFDR (dBC)*, †, ‡ | | |
|---|---|---|---|
| | $f_s$ = 51.2 kSample/s | $f_s$ = 204.8 kSample/s | $f_s$ = 1.25 MSample/s |
| 10 | 100 | 100 | 100 |
| 5 | 100 | 100 | 100 |
| 1 | 100 | 100 | 94 |
| 0.5 | 100 | 100 | 88 |

* 1 kHz input tone, input amplitude is -3 dBFS.

† Differential configuration.

‡ Evaluation BW = 10 Hz to 0.4 $f_s$

## Total Harmonic Distortion (THD), Balanced Source

| Range (V) | THD (dBC)*, † | | | | |
|---|---|---|---|---|---|
| | $f_s$ = 51.2 kSample/s | | $f_s$ = 204.8 kSample/s | | |
| | $f_{in}$ = 1 kHz | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ = 1 kHz | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ > 20 kHz to 80 kHz |
| 10, 5, 1, 0.5 | -100 | -100 | -100 | -98 | -96 |

* Input amplitude is -3 dBFS.

† Differential configuration.

| Range (V) | THD (dBC)*, † | | | | |
|---|---|---|---|---|---|
| | $f_s$ = 1.25 MSample/s | | | | |
| | $f_{in}$ = 1 kHz | $f_{in}$ = 10 kHz | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ > 20 kHz to 50 kHz | $f_{in}$ > 50 kHz to 100 kHz |
| 10, 5, 1, 0.5 | -100 | -99 | -98 | -95 | -90 |

* Input amplitude is -3 dBFS.

† Differential configuration.

## Total Harmonic Distortion (THD), Unbalanced Source

| Range (V) | THD (dBC)*, † | | | | |
|---|---|---|---|---|---|
| | $f_s$ = 51.2 kSample/s | | $f_s$ = 204.8 kSample/s | | |
| | $f_{in}$ = 1 kHz | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ = 1 kHz | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ > 20 kHz to 80 kHz |
| 10 | -100 | -97 | -100 | -90 | -85 |
| 5, 1, 0.5 | -100 | -100 | -100 | -97 | -96 |

* Input amplitude is -3 dBFS.

† Pseudodifferential configuration.

| Range (V) | THD (dBC)*, † | | | | |
|---|---|---|---|---|---|
| | $f_s$ = 1.25 MSample/s | | | | |
| | $f_{in}$ = 1 kHz | $f_{in}$ = 10 kHz | $f_{in}$ = 20 Hz to 20 kHz | $f_{in}$ > 20 kHz to 50 kHz | $f_{in}$ > 50 kHz to 100 kHz |
| 10 | -100 | -95 | -90 | -81 | -74 |
| 5, 1, 0.5 | -100 | -98 | -97 | -92 | -81 |

* Input amplitude is -3 dBFS.

† Pseudodifferential configuration.

## Crosstalk, Input Channel Separation

| Range (V) | Crosstalk (dBC)*, † | |
|---|---|---|
| | $f_{in}$ = 1 kHz | $f_{in}$ = 100 kHz |
| 10, 5, 1, 0.5 | -140 | -100 |

* Input amplitude is -1 dBFS.

† Source impedance is ≤ 50 Ω

## Voltage Reference

| | |
|---|---|
| DC level | 4,096 V |
| Temperature coefficient | 5 ppm/°C max |
| Time stability | 20 ppm/1,000 hr |

## Frequency Timebase Characteristics

| | |
|---|---|
| Accuracy | |
| Using internal VCXO timebase | ±50 ppm max |
| Using external timebase | Equal to accuracy of external timebase |

## Timing and Synchronization

| | |
|---|---|
| Number of timing engines[3] | 3 |
| Reference clock source | Onboard clock, backplane PXIe_CLK100 |
| Intermodule ADC clock skew[4] | |
| $T_{tb}$ ±5 °C | 11 ns max (Listed accuracy is valid for 30 days following a timebase change. $T_{tb}$ = ambient temperature at which the timebase source was last changed.) |
| Over full operating temperature range | 20 ns max |

## Triggers

| | |
|---|---|
| Analog trigger | |
| Purpose | Reference trigger only |
| Source | Any channel |
| Level | Full scale, programmable |
| Mode | Rising-edge or falling-edge with hysteresis, entering or leaving window |
| Resolution | 24 bits |
| Digital trigger | |
| Purpose | Start or reference trigger |
| Source | PFI0, PXI_Trig<0..7>, PXI_Star, PXIe_DStar<A..B> |
| Polarity | Rising or falling edge, software-selectable |
| Minimum pulse width | 100 ns for PXI_Trig<0..7>, 20 ns for others |

[3] Channels can be arbitrarily grouped and assigned to timing engines. Timing engines can be independently synchronized, started, and stopped. Each timing engine can be utilized in frequency domain mode or time domain mode, but not both types simultaneously. All timing engines must use the same reference clock source. Refer to the *PXIe-4480/4481 User Manual* for more details on the assignment of timing engines.

[4] Valid between PXIe-4480/4481 modules installed in the same chassis. Between PXIe-4480/4481 modules in different chassis, add the potential skew in the PXI_CLK10 clock distribution. Refer to the appropriate chassis documentation for its clock skew specifications.

## Output Timing Signals

| | |
|---|---|
| Sources | Start Trigger Out, Reference Trigger Out, Sync Pulse Out |
| Destinations | PFI0, PXI_Trig<0..7>, PXIe_DStarC |
| Polarity | Software-selectable except for Sync Pulse Out (always active low) |

## PFI0 (Front Panel Digital Trigger)

| | |
|---|---|
| Input | |
| Logic compatibility | 3.3 V or 5 V |
| Input range | 0 V to 5.5 V |
| $V_{IL}$ | 0.95 V max |
| $V_{IH}$ | 2.4 V min |
| Input impedance | 10 kΩ |
| Overvoltage protection | ±10 $V_{pk}$ |
| Output | |
| Output range | 0 V to 3.45 V |
| $V_{OL}$ | 0.33 V max at 5 mA |
| $V_{OH}$ | 2.8 V min at 5 mA |
| Output impedance | 50 Ω |
| Output current | ±5 mA max |

## Time Domain Mode

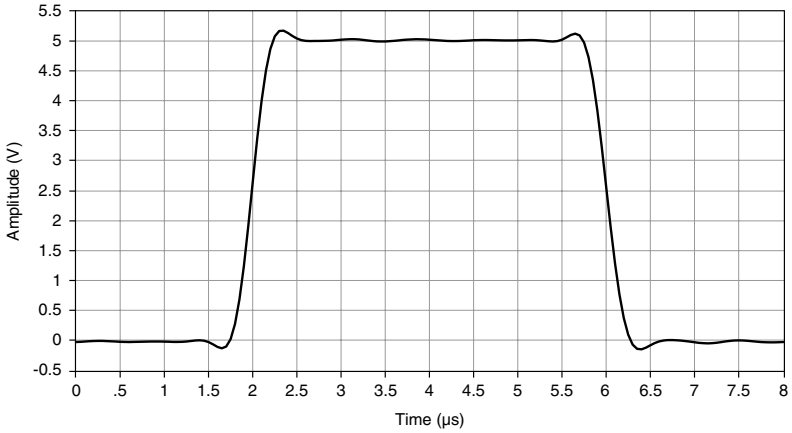
| | |
|---|---|
| Base sample rate | 20 MSample/s |
| Sample rate decimation[5] | Base sample rate divided by integers 1 to 15 |
| Default FIR filter[6] | |
| Type | Equiripple low pass |
| Number of taps | 35 |

[5] Time domain mode always operates and filters at the base sample rate of 20 MSample/s. Users may request a slower sample rate that the module will create by dropping samples to decimate down to the requested rate.

[6] Digital filter is user-programmable. Refer to the *PXIe-4480/4481 User Manual* for more details.

| | |
|---|---|
| Passband ripple | ±5 mdB (DC to 800 kHz) |
| Stopband attenuation | ≥ 120 dB, $f_{in}$ ≥ 3.9 MHz |
| Effective number of bits (ENOB) | |
| 10 V range | 13.2 |
| 5 V range | 13.5 |
| 1 V range | 13.5 |
| 0.5 V range | 13.1 |

**Figure 20.** Time Domain Step Response, 5 V Range, Sampled at 20 MSample/s




**Note** The measured step response is affected by both the fixed anti-aliasing analog filtering and the digital filter used. Signal measured for step response had a rise/fall time of less than 15 ns.

# General Specifications

This section lists general specification information for the PXIe-4481.

## Bus Interface

| | |
|---|---|
| Form factor | x4 PXI Express peripheral module, Specification rev. 1.0 compliant |
| Slot compatibility | PXI Express or PXI Express hybrid slots |
| DMA channels | 3, analog input |

## Power Requirements

| Voltage (V) | Current (A), Max (Typical) |
|---|---|
| +3.3 | 2.0 (1.5) |
| +12 | 3.0 (2.5) |

## Physical

| | |
|---|---|
| Dimensions (not including connectors) | 16 cm x 10 cm (6.3 in. x 3.9 in.) 3U CompactPCI slot |
| Analog input connector | InfiniBand 12x |
| Digital trigger connector (PFI0) | SMB male |
| Front-panel LEDs | 2 (Access, Active) |
| Weight | 264 g (9.3 oz) |
| Measurement Category | 1[7] |

**Caution** Do not use the PXIe-4481 for connections to signals or for measurements within Categories II, III, or IV.

**Caution** The protection provided by the PXIe-4481 can be impaired if it is used in a manner not described in this document.

**Caution** Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

# Environmental

## Operating Environment

| | |
|---|---|
| Ambient temperature range | 0 °C to 55 °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 (800 mbar) |
| Pollution degree | 2 |

[7] Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connections to the MAINS building installations of Measurement Categories CAT II, CAT III, CAT IV.

Indoor use only.

## Storage Environment

| | |
|---|---|
| Ambient temperature range | -40 °C to 71 °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.) |

## Shock and Vibration

| | |
|---|---|
| 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 Hz to 500 Hz, 0.3 $g_{rms}$ |
| Nonoperating | 5 Hz to 500 Hz, 2.4 $g_{rms}$ (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-288800F, Class 3.) |

# Calibration

| | |
|---|---|
| External calibration interval | 2 years |
| Warm-up time | 15 minutes |

# Safety

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 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 61326-1 (IEC 61326-1): Class A emissions; Controlled immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

**Note** Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

**Note** In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

**Note** For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

# CE Compliance CE

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

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; 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 *Minimize Our Environmental Impact* 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 product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit *ni.com/environment/weee*.

## 电子信息产品污染控制管理办法（中国 RoHS）

**中国客户** National Instruments 符合中国电子信息产品中限制使用某些有害物质指令(RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)