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Find the *National Instruments PXIe-4309* at our website: *Click HERE*

SPECIFICATIONS

PXIe-4309

32 Ch (8 ADC), 2 MS/s, 18 - 28 bit, Flexible Resolution PXI Analog Input Module

Français Deutsch 日本語 한국어 简体中文

ni.com/manuals

This document lists specifications for the PXIe-4309 data acquisition module. All specifications are subject to change without notice. Refer to ni.com/manuals for the most current specifications and product documentation.

Note To maintain forced air cooling in the PXIe system, refer to the *Maintain Forced-Air Cooling Note to Users*.

Terminology

Maximum and *minimum* specifications characterize the warranted performance of the instrument within the recommended calibration interval and under the stated operating conditions. These specifications are subject to production verification or guaranteed by design.

Typical specifications are specifications met by the majority of the instruments within the recommended calibration interval and under the stated operating conditions, based on measurements taken during production verification and/or engineering development. The performance of the instrument is not warranted.

Supplemental specifications describe the basic function and attributes of the instrument established by design and are not subject to production verification. They provide information that is relevant for the adequate use of the instrument that is not included in the previous definitions.

The following specifications are typical at 25 °C, unless otherwise noted.

- T_{extcal} is the device temperature at last external calibration.
- $T_{selfcal}$ is the device temperature at last self-calibration.

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Input Characteristics

Number of ADCs ..... 8 simultaneously sampling ADCs

Number of channels

- Single channel per ADC ..... 8 differential analog input channels
- Multichannel per ADC[1] ..... 32 differential analog input channels

ADC resolution..... 18 bits

Type of ADC ..... SAR

DNL..... No missing codes

INL ..... Refer to *Absolute Accuracy* section

Measurement resolution[2] ..... 18 bits - 28 bits

Maximum sample rate[3, 4]

- Auto zero none
  - Single channel per ADC ..... 2 MS/s
  - Multichannel per ADC ..... 400 kS/s (aggregate)
- Auto zero once
  - Single channel per ADC ..... 2 MS/s
  - Multichannel per ADC ..... 400 kS/s (aggregate)
- Auto zero every sample
  - Single channel per ADC..... 10 kS/s
  - Multichannel per ADC ..... 10 kS/s (aggregate)
- Chopping
  - Single channel per ADC..... 10 kS/s
  - Multichannel per ADC ..... 10 kS/s (aggregate)

Input coupling ..... DC

Input range..... ±0.1 V, ±1.0 V, ±10 V, ±15 V

Input overrange ..... 0.5% of range

Maximum working voltage
(signal + common mode) ..... ±15.5 V of GND

[1] Up to 4 channels per ADC.

[2] Depends on the sample rate. Refer to the *Noise versus Sampling Rate* section for more information.

[3] For multichannel, up to 4 channels per ADC.

[4] Refer to the *PXIe-4309 User Manual* for Maximum Sample Rates in Hardware-Timed Single Point, On-Demand, and External Sample Clock modes.

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Input impedance

Device on, channel idle

AI+ to AI- ..... >10 GΩ in parallel with 100 pF

AI- to GND..... >100 GΩ in parallel with 10 pF

Device on, channel active

AI+ to AI- ..... >10 GΩ in parallel with 200 pF

AI- to GND..... >100 GΩ in parallel with 100 pF

Input bias current

Device on, channel active..... ±4.5 nA

Overvoltage protection

Device on/off..... ±30 V min

Overvoltage protection input current

Device on ..... ±100 µA

Device off..... ±10 µA

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

Data transfers..... Direct memory access (DMA), programmed I/O

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Absolute Accuracy

Auto Zero None

Table 1. DC Voltage Specifications for Auto Zero None

Range	Absolute Accuracy*, **, ††			Temperature Coefficient††
	24 Hour†, ‡ T_{extcal} ± 1 °C $T_{selfcal}$ ± 1 °C	2 Year T_{extcal} ± 5 °C $T_{selfcal}$ ± 1 °C	2 Year T_{extcal} ± 10 °C $T_{selfcal}$ ± 5 °C	0 °C - 55 °C
	± (ppm of reading + µV)			± (ppm of reading + µV) / °C
0.1 V	33 + 3.2	60 + 7.6	165 + 11.6	25 + 1
1.0 V	28 + 7.4	55 + 16.2	140 + 36.2	20 + 5
10 V	23 + 59.6	50 + 155	115 + 355	15 + 50
15 V	28 + 89.0	55 + 307	140 + 607	20 + 75

*Source Impedance ≤50 Ω.
†Relative to External Calibration Source.
‡Assumes Offset Nulling.
**Sample Rate ≤10 S/s.
††Temperature Coefficient is an adder to the Absolute Accuracy values that does not apply unless operating outside of the stated self-calibration temperature intervals. Temperature Coefficient is included in the Absolute Accuracy values over the stated self-calibration temperature intervals.

Table 2. DC Voltage Performance Specifications for Auto Zero None

Range	Residual Offset*, †	Linearity†	Noise*, †, ‡		
			10 S/s	10 kS/s	2 MS/s
	µV	ppm of range	μV_{pk-pk}	μV_{rms}	
0.1 V	5	5	2.2	0.6	6.9
1.0 V			2.4	0.8	11
10 V	50		9.6	5.8	84
15 V	75	10	14	8.7	125

*Source Impedance ≤50 Ω.
†Residual Offset, Linearity and Noise are included in the Absolute Accuracy values in the DC voltage specifications table for Sample Rate ≤10 S/s.
‡Noise for Single Channel per ADC. For Multiple Channel per ADC refer to the *Noise versus Sampling Rate* section.

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Auto Zero Once

Table 3. DC Voltage Specifications for Auto Zero Once

Range	Absolute Accuracy*, **, ††			Temperature Coefficient††
	24 Hour†, ‡ T_{extcal} ± 1 °C $T_{selfcal}$ ± 1 °C	2 Year T_{extcal} ± 5 °C $T_{selfcal}$ ± 1 °C	2 Year T_{extcal} ± 10 °C $T_{selfcal}$ ± 5 °C	0 °C - 55 °C
	± (ppm of reading + µV)			± (ppm of reading + µV) / °C
0.1 V	33 + 2.3	60 + 6.7	165 + 7.1	25 + 0.1
1.0 V	28 + 2.5	55 + 11.3	140 + 11.7	20 + 0.1
10 V	23 + 9.7	50 + 104.9	115 + 105.3	15 + 0.1
15 V	28 + 14.1	55 + 232.1	140 + 232.5	20 + 0.1

*Source Impedance ≤50 Ω.
†Relative to External Calibration Source.
‡Assumes Offset Nulling.
**Sample Rate ≤10 S/s.
††Temperature Coefficient is an adder to the Absolute Accuracy values that does not apply unless operating outside of the stated self-calibration temperature intervals. Temperature Coefficient is included in the Absolute Accuracy values over the stated self-calibration temperature intervals.

Table 4. DC Voltage Performance Specifications for Auto Zero Once

Range	Residual Offset*, †	Linearity†	Noise*, †, ‡		
			10 S/s	10 kS/s	2 MS/s
	µV	ppm of range	μV_{pk-pk}	μV_{rms}	
0.1 V	5	5	2.2	0.6	6.9
1.0 V			2.4	0.8	11
10 V	50		9.6	5.8	84
15 V	75	10	14	8.7	125

*Source Impedance ≤50 Ω.
†Residual Offset, Linearity and Noise are included in the Absolute Accuracy values in the DC voltage specifications table for Sample Rate ≤10 S/s.
‡Noise for Single Channel per ADC. For Multiple Channel per ADC refer to the *Noise versus Sampling Rate* section.

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Auto Zero Every Sample

Table 5. DC Voltage Specifications for Auto Zero Every Sample

Range	Absolute Accuracy*, **, ††			Temperature Coefficient††
	24 Hour†, ‡ T_{extcal} ± 1 °C $T_{selfcal}$ ± 1 °C	2 Year T_{extcal} ± 5 °C $T_{selfcal}$ ± 1 °C	2 Year T_{extcal} ± 10 °C $T_{selfcal}$ ± 5 °C	0 °C - 55 °C
	± (ppm of reading + µV)			± (ppm of reading + µV) / °C
0.1 V	33 + 0.3	60 + 4.7	165 + 5.1	25 + 0.1
1.0 V	28 + 0.5	55 + 9.3	140 + 9.7	20 + 0.1
10 V	23 + 2.7	50 + 55.4	115 + 55.8	15 + 0.1
15 V	28 + 4.0	55 + 156.1	140 + 156.5	20 + 0.1

*Source Impedance ≤50 Ω.
†Relative to External Calibration Source.
‡Assumes Offset Nulling.
**Sample Rate ≤10 S/s.
††Temperature Coefficient is an adder to the Absolute Accuracy values that does not apply unless operating outside of the stated self-calibration temperature intervals. Temperature Coefficient is included in the Absolute Accuracy values over the stated self-calibration temperature intervals.

Table 6. DC Voltage Performance Specification for Auto Zero Every Sample

Range	Residual Offset*, †	Linearity†	Noise*, †, ‡	
			10 S/s	10 kS/s
	µV	ppm of range	μV_{pk-pk}	μV_{rms}
0.1 V	4	5	0.2	0.8
1.0 V			0.4	1.1
10 V			2.6	7.4
15 V		10	3.9	11

*Source Impedance ≤50 Ω.
†Residual Offset, Linearity and Noise are included in the Absolute Accuracy values in the DC voltage specifications table for Sample Rate ≤10 S/s.
‡Noise for Single Channel per ADC. For Multiple Channel per ADC refer to the *Noise versus Sampling Rate* section.

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Chopping

Table 7. DC Voltage Specifications for Chopping

Range	Absolute Accuracy*, **, ††			Temperature Coefficient††
	24 Hour†, ‡ T_{extcal} ± 1 °C $T_{selfcal}$ ± 1 °C	2 Year T_{extcal} ± 5 °C $T_{selfcal}$ ± 1 °C	2 Year T_{extcal} ± 10 °C $T_{selfcal}$ ± 5 °C	0 °C - 55 °C
	± (ppm of reading + µV)			± (ppm of reading + µV) / °C
0.1 V	33 + 0.1	60 + 2.6	165 + 2.6	25 +0.01
1.0 V	28 + 0.2	55 + 7.1	140 + 7.2	20 + 0.01
10 V	23 + 1.3	50 + 52.7	115 + 52.7	15 + 0.01
15 V	28 + 2.0	55 + 153.0	140 + 153.1	20 + 0.01

*Source Impedance ≤50 Ω.
†Relative to External Calibration Source.
‡Assumes Offset Nulling.
**Sample Rate ≤10 S/s.
††Temperature Coefficient is an adder to the Absolute Accuracy values that does not apply unless operating outside of the stated self-calibration temperature intervals. Temperature Coefficient is included in the Absolute Accuracy values over the stated self-calibration temperature intervals.

Table 8. DC Voltage Performance Specifications for Chopping

Range	Residual Offset*, †	Linearity†	Noise*, †, ‡	
			10 S/s	10 kS/s
	µV	ppm of range	μV_{pk-pk}	μV_{rms}
0.1 V	2	5	0.1	0.5
1.0 V			0.2	0.8
10 V			1.3	6.2
15 V		10	2	9.2

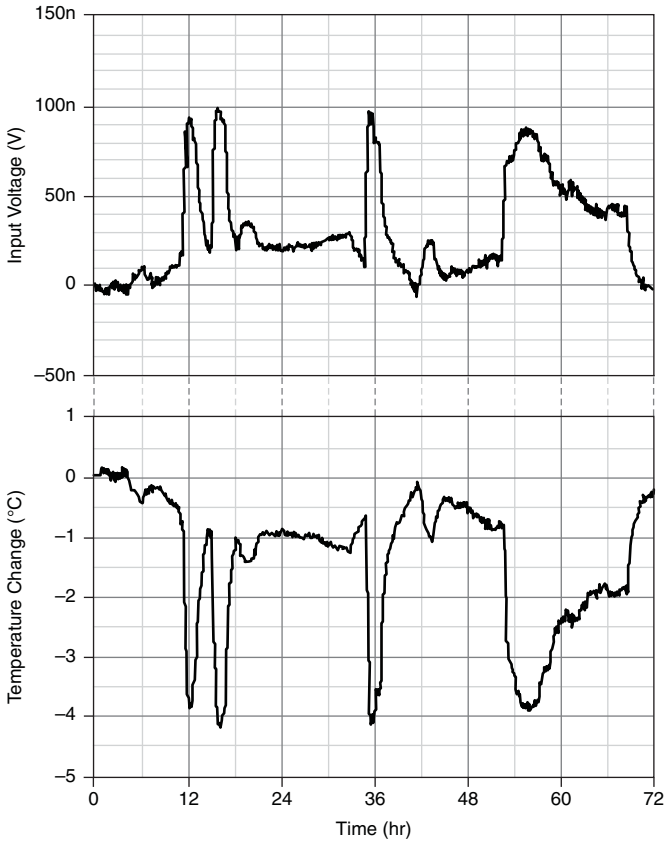
*Source Impedance ≤50 Ω.
†Residual Offset, Linearity and Noise are included in the Absolute Accuracy values in the DC voltage specifications table for Sample Rate ≤10 S/s.
‡Noise for Single Channel per ADC. For Multiple Channel per ADC refer to the *Noise versus Sampling Rate* section.

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Offset Cancellation Long Term Stability Performance

TB-4309 (ST), analog inputs shorted at the terminal block screw terminals
Continuous Acquisition, 0.1 V Range, Auto Zero Every Sample, 2 S/s
Offset Nulling: 2 samples prior to continuous acquisition
Waveform Filter: Average and Decimate by 720 (10 S/hr)

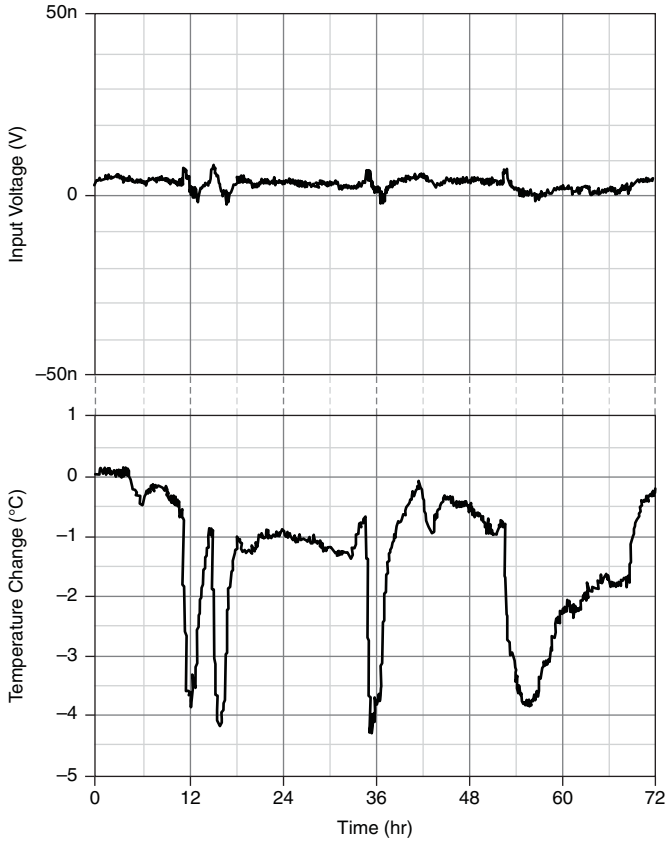
Figure 1. Auto Zero Every Sample Offset Cancellation Stability



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TB-4309 (ST), analog inputs shorted at the terminal block screw terminals
Continuous Acquisition, 0.1 V Range, Chopping, 2 S/s
Offset Nulling: 2 samples prior to continuous acquisition
Waveform Filter: Average and Decimate by 720 (10 S/hr)

Figure 2. Chopping Offset Cancellation Stability

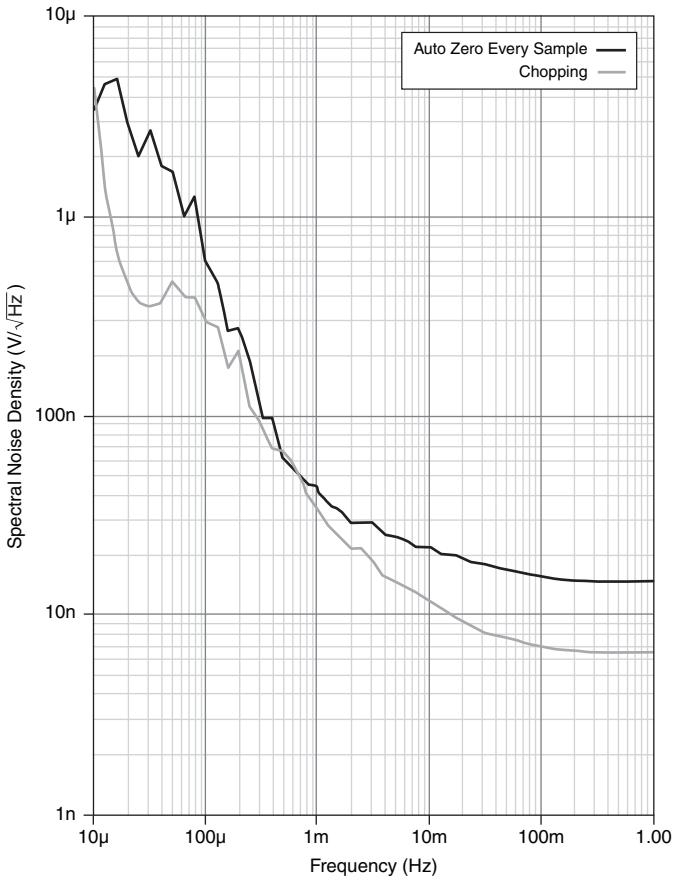


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Offset Cancellation Spectral Noise Density Performance

TB-4309 (ST), analog inputs shorted at the terminal block screw terminals
Continuous Acquisition, 0.1 V Range, 518400 Samples acquired at 2 S/s

Figure 3. Offset Cancellation Spectral Noise Density



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Noise versus Sampling Rate

Auto Zero None and Auto Zero Once

Figure 4. Noise versus Sample Rate (Single channel per ADC)

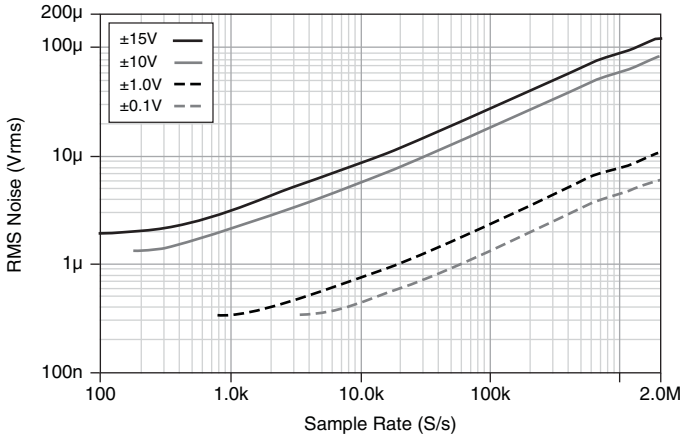
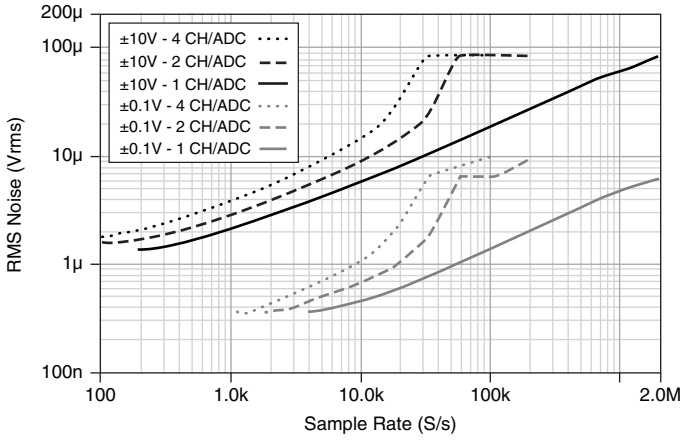


Figure 5. Noise versus Sample Rate (Multichannel per ADC)



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Auto Zero Every Sample

Figure 6. Noise versus Sample Rate (Single channel per ADC)

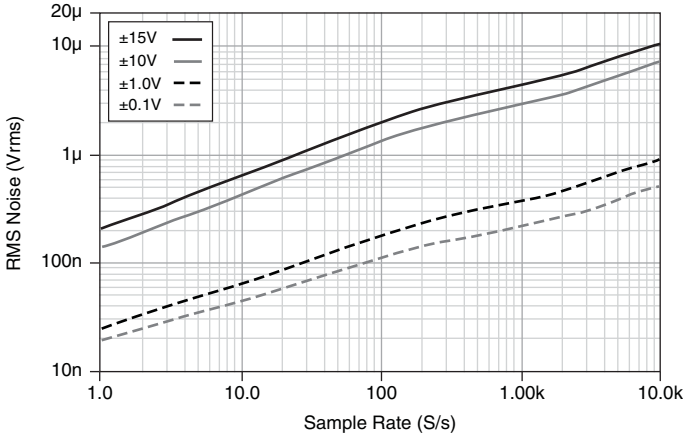
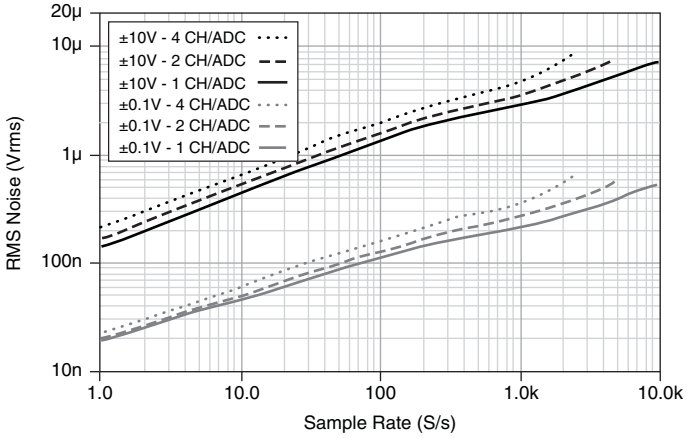


Figure 7. Noise versus Sample Rate (Multichannel per ADC)



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Chopping

Figure 8. Noise versus Sample Rate (Single channel per ADC)

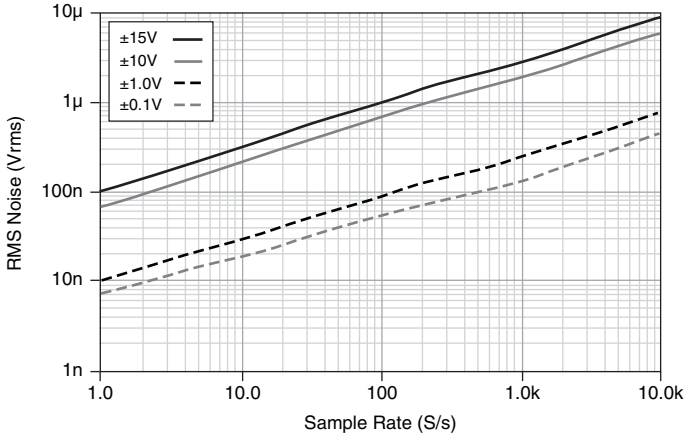
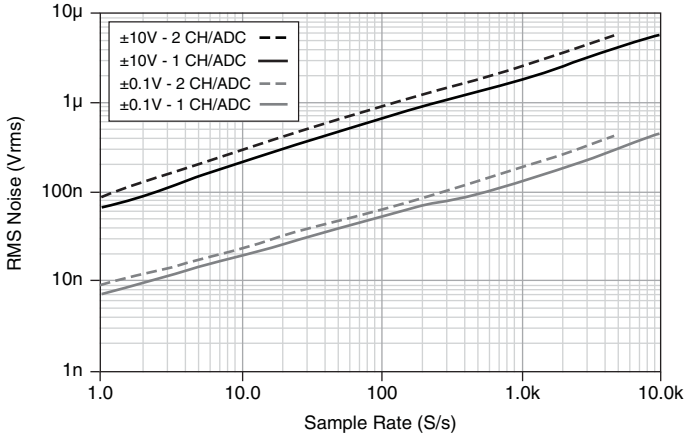


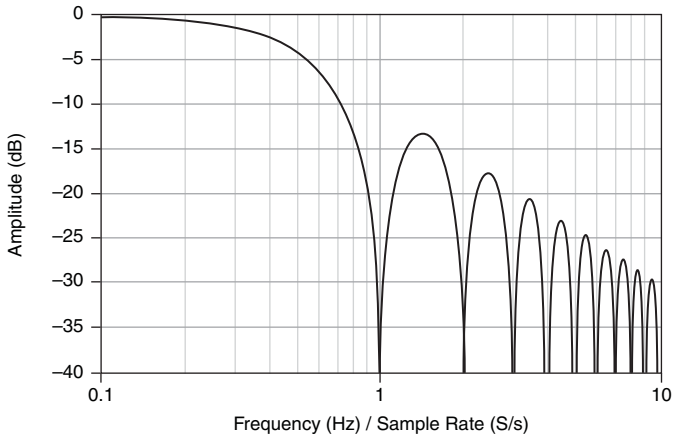
Figure 9. Noise versus Sample Rate (Multichannel per ADC)



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Digital Filter Frequency Response[1, 2, 3]

Figure 10. Digital Filter Frequency Response



[1] Applies to sampling rates ≤ 1 MS/s for all configurations that use a single channel per ADC.

[2] Applies to sampling rates ≤ 200 kS/s (aggregate) for all configurations that use multiple channels per ADC.

[3] Does not apply to Hardware-Timed Single Point, On-Demand, and External Sample Clock modes.

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Dynamic Characteristics

Spectral Noise Density

Input voltage noise density at 1 kHz

0.1 V ..... 6.2 nV/$\sqrt{\text{Hz}}$

1.0 V ..... 12 nV/$\sqrt{\text{Hz}}$

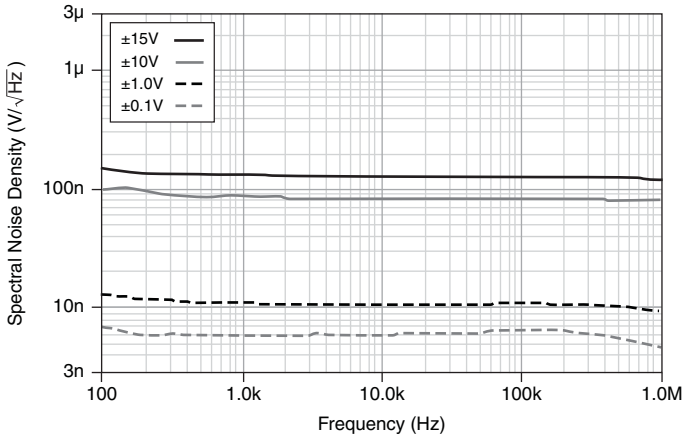
10 V ..... 94 nV/$\sqrt{\text{Hz}}$

15 V ..... 136 nV/$\sqrt{\text{Hz}}$

Input current noise density at 1 k Hz..... 0.5 pA/$\sqrt{\text{Hz}}$

Auto Zero None and Auto Zero Once

Figure 11. 2 MS/s Spectral Noise Density (Single channel per ADC)



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Figure 12. 20 kS/s Spectral Noise Density (Single channel per ADC)

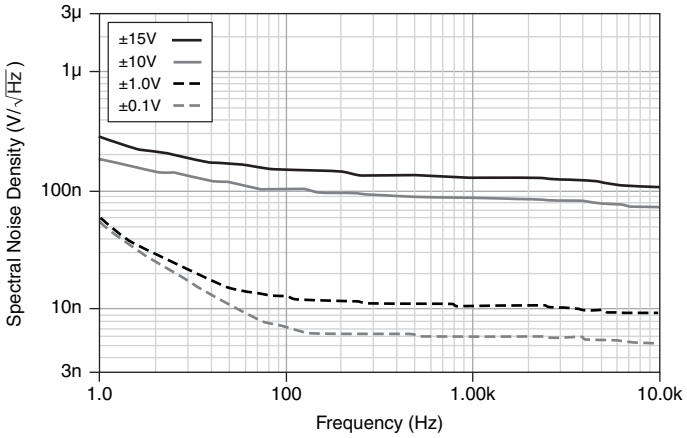
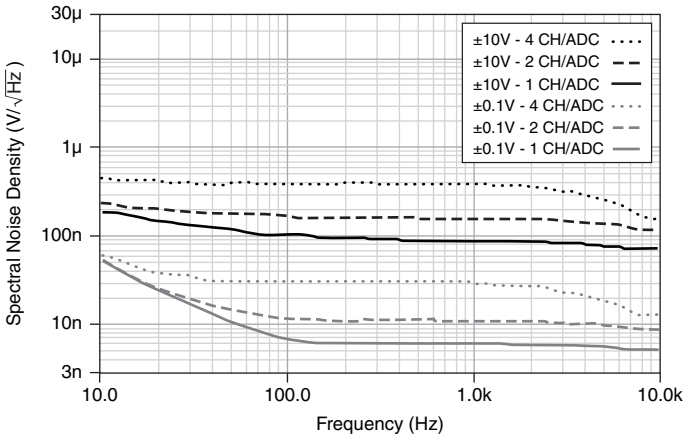


Figure 13. 20 kS/s Spectral Noise Density (Multichannel per ADC)



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Figure 14. 2 kS/s Spectral Noise Density (Single channel per ADC)

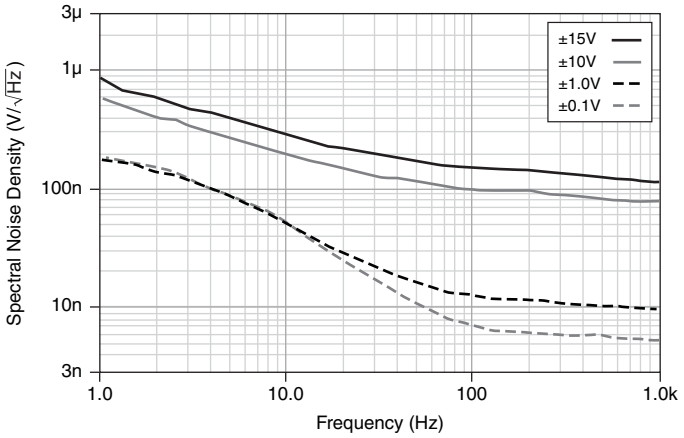
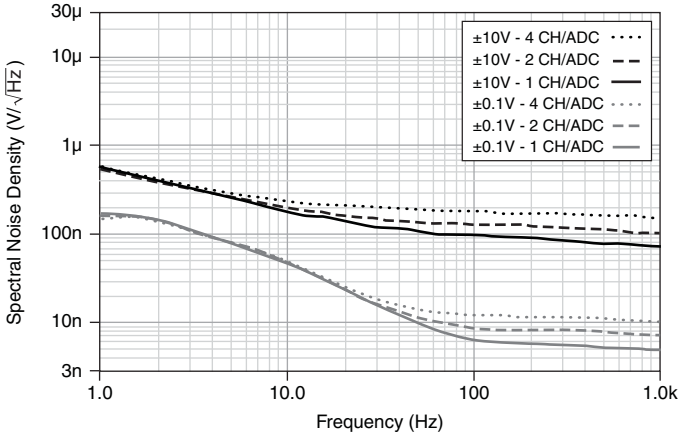


Figure 15. 2 kS/s Spectral Noise Density (Multichannel per ADC)



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Auto Zero Every Sample

Figure 16. 2 kS/s Spectral Noise Density (Single channel per ADC)

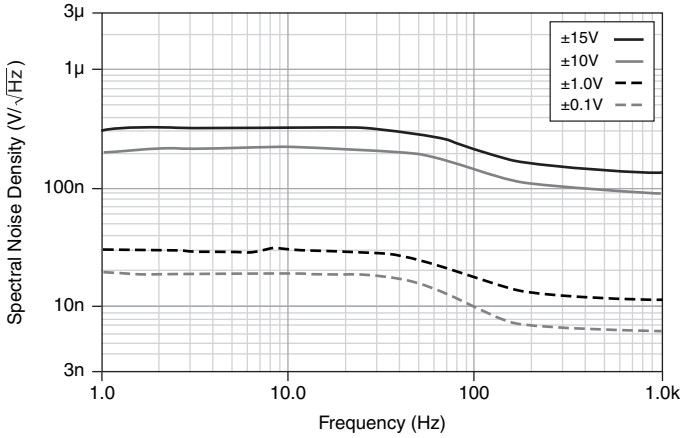
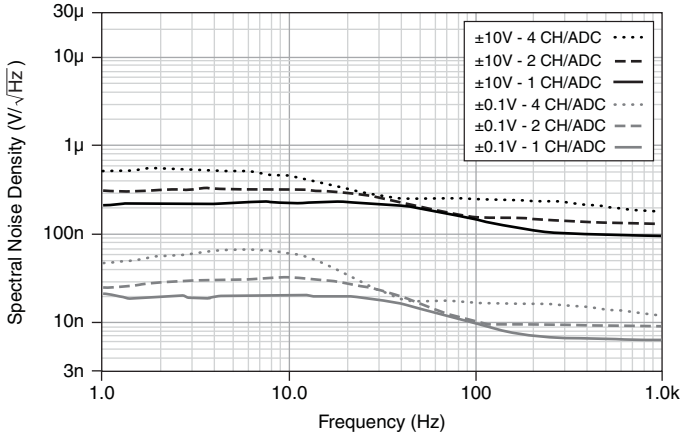


Figure 17. 2 kS/s Spectral Noise Density (Multichannel per ADC)



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Chopping

Figure 18. 2 kS/s Spectral Noise Density (Single channel per ADC)

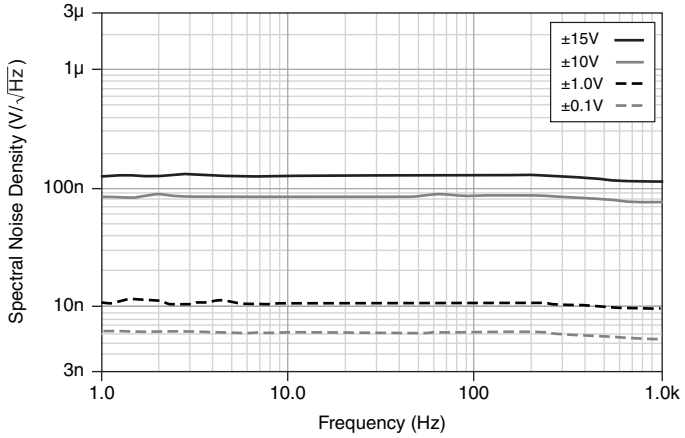
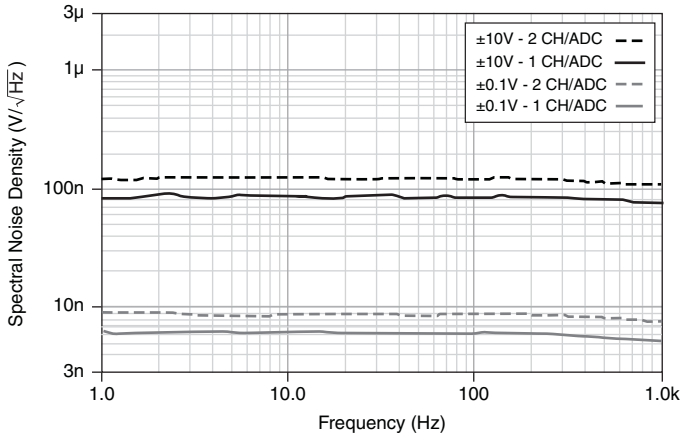


Figure 19. 2 kS/s Spectral Noise Density (Multichannel per ADC)



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Common-Mode Rejection Ratio (CMRR)

DC ..... >160 dBc

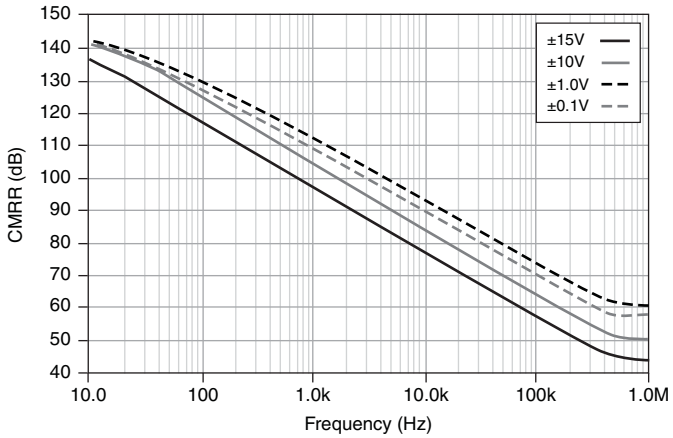
DC - 100 Hz

0.1 V, 1.0 V ..... >126 dBc

10 V ..... >120 dBc

15 V ..... >114 dBc

Figure 20. Common-Mode Rejection Ratio



Crosstalk, Input Channel Separation[1]

TB-4309 (ST)[2] and TB-4309 (MT)[3]

1 kHz ..... Typically ≤ -120 dBc

10 kHz ..... Typically ≤ -100 dBc

100 kHz ..... Typically ≤ -80 dBc

500 kHz ..... Typically ≤ -70 dBc

[1] To maintain crosstalk performance use separation and/or shielding between signal cables.

[2] Inputs shorted at terminal block screw terminals.

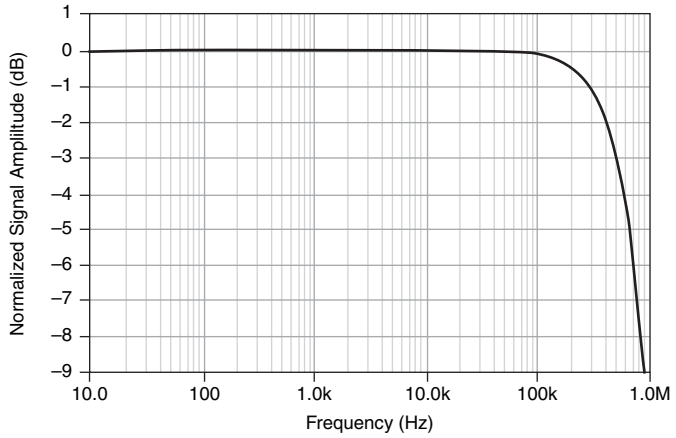
[3] Inputs shorted at SCB-68 screw terminals using 2 m, 68-pin cable.

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Bandwidth

-3.0 dB bandwidth ..... 500 kHz

Figure 21. Magnitude Response

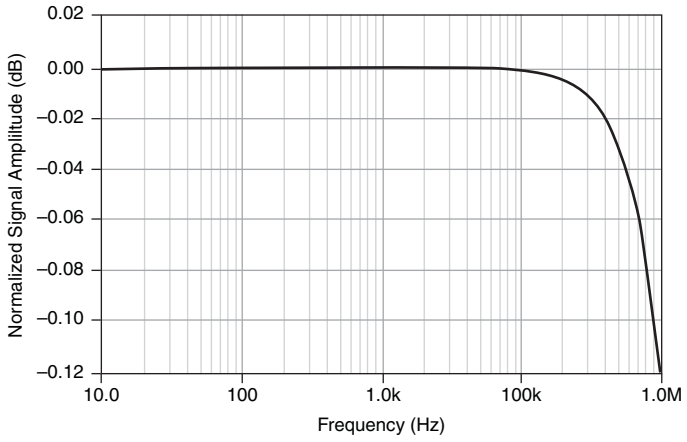


Flatness

DC - 20 kHz..... -6.5 mdB

DC - 80 kHz..... -100 mdB

Figure 22. Flatness



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Source Impedance Error

Figure 23. Source Impedance Reading Error[1]

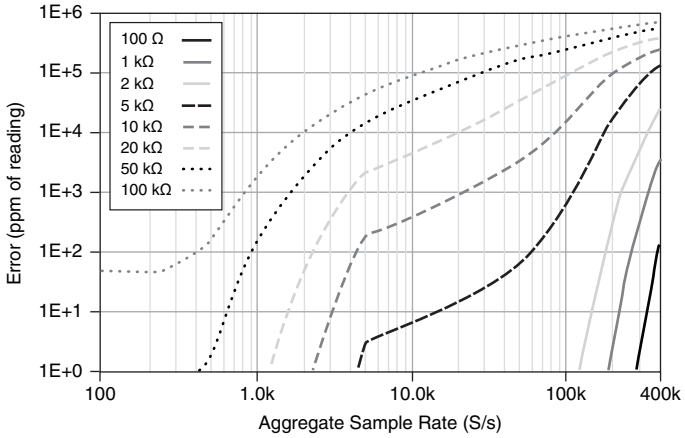
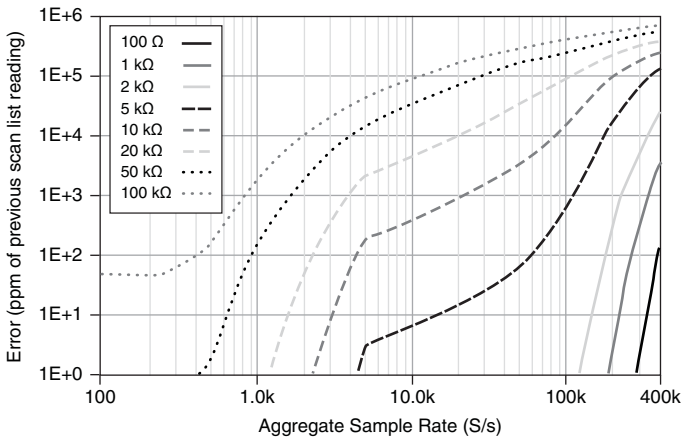


Figure 24. Source Impedance Ghosting Error[2]



[1] Applies to all configurations that use multiple channels per ADC, Auto Zero Every Sample or Chopping.

[2] Applies to all configurations that use multiple channels per ADC.

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Onboard Calibration Reference

Voltage

Output voltage range ..... 6.741 V – 7.298 V

Output current drive ..... ±1 µA

Temperature coefficient ..... ±1 ppm/°C

Overvoltage protection ..... ±30 V min

Frequency Timebase Characteristics

Resolution ..... 10 ns

Accuracy

- Using internal timebase ..... ±50 ppm
- Using external timebase ..... Equal to accuracy of external timebase

Timing and Synchronization

Number of timing engines 1

Reference clock source ..... Onboard clock, backplane PXIe_CLK100

Digital Triggers

Purpose ..... Start trigger, reference trigger, pause trigger

Source ..... PFI 0, PFI 1, PXI_Trig <0..7>, PXI_Star, PXIe_DStar A, PXIe_DStar B

Polarity ..... Software-selectable

Debounce filter settings ..... Disable, 90 ns, 5.12 µs, custom interval

Output Timing Signals

Source ..... Start trigger, reference trigger, pause trigger, sample clock

Destination ..... PFI 0, PFI 1, PXI_Trig <0..7>, PXIe_DStarC

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PFI 0 and PFI 1 (Front Panel Digital Triggers)

Input

- Logic compatibility ..... 3.3 V or 5 V
- High, VIH ..... 2.40 V min
- Low, VIL ..... 0.95 V max
- Input impedance ..... 10 kΩ
- Input current (0 V ≤ Vin ≤ 5 V) ..... ≤ 500 µA
- Overvoltage protection ..... ±30 V min

Output

- High, VOH ..... 3.43 V max
  - Sourcing 5 mA ..... 2.88 V min
- Low, VOL
  - Sinking 5 mA ..... 0.33 V max
- Output impedance ..... 50 Ω
- Output current ..... ±30 mA min
- Overvoltage protection ..... ±30 V min

General Specifications

Bus Interface

Form factor ..... x1 PXI Express peripheral module, specification rev 1.0 compliant

Slot compatibility ..... PXI Express or PXI Express hybrid slots

DMA channels ..... 1, analog input

Power Requirements

+12 V ..... 2 A max

+3.3 V ..... 1 A max

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Physical

Dimensions..... 16 cm × 10 cm
(6.3 in. × 3.9 in.)
3U CompactPCI slot

Weight ..... 238 g (8.4 oz)

I/O connector..... 96-pin male DIN 41612/IEC 60603-2 connector

Measurement Category[1] I

Caution Do *not* use the PXIe-4309 for connections to signals or for measurements within Categories II, III, or IV.

Caution The protection provided by the PXIe-4309 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 Specifications

Operating Environment

Ambient temperature range..... 0 °C to 55 °C
(Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)

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

Maximum altitude..... 2,000 m (800 mbar)

Pollution Degree 2

Indoor use only.

[1] 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.

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Storage Environment

Ambient temperature range ..... -40 °C to 71 °C
(Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)

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

Shock and Vibration

Operating shock ..... 30 g peak, half-sine, 11 ms pulse
(Tested in accordance with IEC 60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)

Random vibration

- Operating ..... 5 Hz to 500 Hz, 0.3 g_{rms}
- Non-operating ..... 5 Hz to 500 Hz, 2.4 g_{rms}
  (Tested in accordance with IEC 60068-2-64. Non-operating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Calibration

You can obtain the calibration certificate and information about calibration services for the PXIe-4309 at ni.com/calibration.

Self-calibration ..... On software command, the module computes gain, offset, and linearity corrections relative to the high-precision internal voltage reference.

Self-calibration interval ..... Depending on required absolute accuracy, self-calibration is recommended whenever the current device temperature differs by more than the specified temperature range from the device temperature at which the last self-calibration was performed.

Calibration interval ..... 2 years

Warm-up time ..... 15 minutes

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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 61326-1 (IEC 61326-1): Class A emissions; Basic 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 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 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 For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

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

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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 products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit ni.com/environment/weee.

电子信息产品污染控制管理办法 （中国 RoHS）



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Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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