

# SPECIFICATIONS

# PXI-4070

6½-Digit, ±300 V, Onboard 1.8 MS/s Isolated Digitizer, PXI Digital Multimeter

These specifications apply to the PXI-4070.

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# Definitions

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

*Characteristics* 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 expected performance met by a majority of the models.
- *Nominal* specifications describe parameters and attributes that may be useful in operation.

Specifications are *Warranted* unless otherwise noted.

# Conditions

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Specifications are valid under the following conditions unless otherwise noted.

- Calibration interval of 2 years
- 1 hour of warm-up time

# DC Specifications

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**Table 1.** PXI-4070 DC Speeds, Nominal

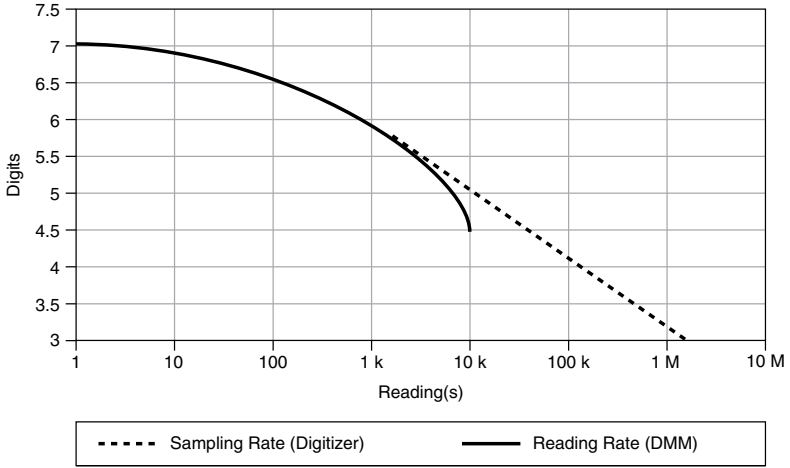
Digits	Bits	Max Sampling Rate <sup>1</sup> (Digitizer)	Reading Rate <sup>2</sup> (DMM)
7	23	5 S/s	5 S/s
6½	22	100 S/s	100 S/s
5½	18	5 kS/s	3 kS/s
4½	15	20 kS/s	7 kS/s
3	10	1.8 MS/s	N/A

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<sup>1</sup> Maximum sampling rates refer to waveform acquisition in digitizer mode.

<sup>2</sup> Auto Zero disabled, except 7 digits, measured on a 10 V and 10 kΩ range.

**Figure 1. DC Voltage Maximum Reading Rate, Nominal**



## DC System Speeds

Range or function change	100/s
Auto Range time, DC V	5 ms
Auto Range time, DC I	5 ms
Auto Range time, resistance	50 ms
Trigger latency	2 $\mu$ s
Maximum trigger rate	6 kHz

## DC Accuracy Specifications



**Note** All DC accuracy specifications apply to 6½-digit resolution ( $\geq 1$  PLC), Auto Zero and ADC calibration enabled.

**Table 2. DC Voltage  $\pm$  (ppm of reading + ppm of range)**

Range	Resolution	Input Resistance	24 Hr <sup>3</sup> T <sub>cal</sub> $\pm$ 1 °C <sup>4</sup>	90 Day <sup>5</sup> T <sub>cal</sub> $\pm$ 5 °C	2 Year <sup>5</sup> T <sub>cal</sub> $\pm$ 5 °C	Tempco/°C (0 °C to 55 °C)	
						Without Self-cal	With Self-cal
100 mV <sup>6</sup>	100 nV	>10 G $\Omega$ 10 M $\Omega$ , nominal	10 + 10	30 + 20	40 + 20	4 + 5	0.3 + 0.3
1 V	1 $\mu$ V	>10 G $\Omega$ 10 M $\Omega$ , nominal	6 + 2	20 + 6	25 + 6	2 + 1	0.3 + 0.3
10 V	10 $\mu$ V	>10 G $\Omega$ 10 M $\Omega$ , nominal	4 + 2	20 + 6	25 + 6	1 + 1	0.3 + 0.3
100 V	100 $\mu$ V	10 M $\Omega$ , nominal	6 + 2	30 + 6	35 + 6	4 + 1	0.3 + 0.3
300 V	1 mV	10 M $\Omega$ , nominal	6 + 6	30 + 20	35 + 20	4 + 3	0.3 + 0.3

**Table 3. DC Current<sup>7</sup>  $\pm$  (ppm of reading + ppm of range)**

Range	Resolution	Burden Voltage, typical	Noise (ppm of range RMS)	2 Year (0 °C to 55 °C)	Tempco/°C (0 °C to 55 °C)
20 mA	10 nA	<20 mV	20	400 + 150	8 + 1
200 mA	100 nA	<200 mV	3	400 + 20	8 + 0.2
1 A	1 $\mu$ A	<800 mV	3	500 + 50	8 + 0.4

<sup>3</sup> Relative to external calibration source.

<sup>4</sup> T<sub>cal</sub> is the temperature at which the last self-calibration or external calibration was performed.

<sup>5</sup> Using internal self-calibration; specifications valid over the entire operating temperature range.

<sup>6</sup> With offset nulling and 100 ms aperture.

<sup>7</sup> Typical 24 hour accuracy (23 °C  $\pm$ 1 °C) is  $\pm$ (50 ppm of reading + 5 ppm of range).

**Table 4.** Resistance (4-Wire and 2-Wire<sup>8</sup>) ± (ppm of reading + ppm of range)

Range	Test Current <sup>9</sup>	Max Test Voltage	24 Hr <sup>10</sup> T <sub>cal</sub> ±1 °C <sup>11</sup>	90 Day <sup>12</sup> T <sub>cal</sub> ±5 °C	2 Year <sup>12</sup> T <sub>cal</sub> ±5 °C	Tempco/°C (0 °C to 55 °C)	
						Without Self-cal	With Self-cal
100 Ω <sup>13</sup>	1 mA	100 mV	15 + 10	50 + 10	80 + 10	8 + 1	0.8 + 1
1 kΩ <sup>13</sup>	1 mA	1 V	12 + 2	50 + 3	80 + 3	8 + 0.1	0.8 + 0.1
10 kΩ <sup>13</sup>	100 μA	1 V	12 + 2	50 + 3	80 + 3	8 + 0.1	0.8 + 0.1
100 kΩ	10 μA	1 V	15 + 2	50 + 6	80 + 6	8 + 0.5	0.8 + 0.5
1 MΩ	10 μA	10 V	20 + 2	60 + 10	90 + 10	8 + 1	0.8 + 1
10 MΩ	1 μA	10 V	100 + 2	200 + 10	400 + 10	30 + 3	30 + 3
100 MΩ <sup>14</sup>	1 μA   10 MΩ	10 V	900 + 20	5,500 + 40	6,000 + 40	200 + 10	200 + 10

**Table 5.** Diode Test

Range	Resolution	Test Current <sup>15</sup>	Accuracy
10 V	10 μV	1 μA, 10 μA, 100 μA, 1 mA <sup>16</sup>	Add 20 ppm of reading to 10 VDC voltage specifications.

<sup>8</sup> Perform offset nulling or add 200 mΩ to reading.

<sup>9</sup> -10% to 0% tolerance.

<sup>10</sup> Relative to external calibration source.

<sup>11</sup> T<sub>cal</sub> is the temperature at which the last self-calibration or external calibration was performed.

<sup>12</sup> Using internal self-calibration; specifications valid over the entire operating temperature range.

<sup>13</sup> With offset compensated ohms enabled.

<sup>14</sup> 2-wire resistance measurement only. Typical accuracy is 5% between 105 MΩ and 1.05 GΩ. Use tempco outside 18 °C to 28 °C.

<sup>15</sup> -10% to 0% tolerance.

<sup>16</sup> Up to 4.5 V measurement for 1 mA test current.

**Table 6.** Additional Noise Errors for DC Voltage, Current, Resistance

Resolution	Additional Noise Error
5½ digits	10 ppm of range
5 digits	30 ppm of range
4½ digits	100 ppm of range

## DC Functions General Specifications

Effective CMRR (1 kΩ resistance in LO lead)	>140 dB (DC), 100 ms aperture; >170 dB (>46 Hz) with high-order DC noise rejection, 100 ms aperture
Maximum 4-wire lead resistance	Use the lesser of 10% of range or 1 kΩ
Overrange	105% of range except 300 V and 1 A range
DC voltage input bias current	<30 pA at 23 °C, typical

**Table 7.** Normal-Mode Rejection Ratio (NMRR)

Readings/s	NMRR	Conditions
10	>100 dB <sup>17</sup>	All noise sources >46 Hz
50 (60)	>60 dB <sup>18</sup>	50 (60) Hz ±0.1%

## AC Specifications



**Note** All AC speed specifications apply with Auto Zero disabled.

**Table 8.** PXI-4070 AC Bandwidth

Digits	Reading Rate	Bandwidth
6½	0.25 S/s	1 Hz to 300 kHz
6½	2.5 S/s	10 Hz to 300 kHz
6½	25 S/s	100 Hz to 300 kHz

<sup>17</sup> With high-order DC noise rejection; 100 ms aperture.

<sup>18</sup> With normal DC noise rejection; 20 ms (16.67 ms) aperture.

**Table 8. PXI-4070 AC Bandwidth (Continued)**

Digits	Reading Rate	Bandwidth
6½	100.0 S/s	400 Hz to 300 kHz
5½	1.0 kS/s	20 kHz to 300 kHz

## AC System Speeds

Range or function change	10/s
Auto Range time, AC V and AC I	250 ms
Trigger latency	2 µs
Maximum trigger rate	1 kHz

## AC Accuracy Specifications



**Note** All AC accuracy specifications apply to 6½ digit resolution, signal amplitudes greater than 1% of range, and Auto Zero enabled.

**Table 9. AC Voltage<sup>19</sup> 2 Year ± (% of reading + % of range), 23 °C ± 10 °C**

Range (RMS)	Peak Voltage	Resolution	1 Hz to 40 Hz <sup>20</sup>	>40 Hz to 20 kHz	>20 kHz to 50 kHz	>50 kHz to 100 kHz <sup>21</sup>	>100 kHz to 300 kHz <sup>21</sup>
50 mV <sup>22</sup>	±105 mV	100 nV	0.1 + 0.04	0.05 + 0.04	0.09 + 0.04	0.5 + 0.08	3 + 0.1
500 mV	±1.05 V	1 µV	0.1 + 0.01	0.05 + 0.02	0.09 + 0.02	0.5 + 0.02	3 + 0.05
5 V	±10.5 V	10 µV					
50 V	±105 V	100 µV					
300 V	±450 V	1 mV					
Tempco/°C (0 °C to 55 °C)			0.001 + 0.001	0.001 + 0.001	0.001 + 0.001	0.001 + 0.001	0.01 + 0.01

<sup>19</sup> After self-calibration. Measurement aperture greater than  $4/f_L$ , where  $f_L$  is the lowest frequency component of the signal being measured.

<sup>20</sup> Specification applies for DC coupling.

<sup>21</sup> Above 150 V with V-Hz above  $1.5 \times 10^7$ , specifications are typical.

<sup>22</sup> Applies to signals >2 mV.

**Table 10. AC Current<sup>23</sup> 2 Year ± (% of reading + % of range), 0 °C ± 55 °C**

Range (RMS)	Peak Current	Resolution	Burden Voltage (RMS)	1 Hz to 20 kHz <sup>24</sup>	Tempco/°C (0 °C to 55 °C)
10 mA <sup>25</sup>	±20 mA	10 nA	<10 mV	0.04 + 0.02	0.001 + 0.0001
100 mA	±200 mA	100 nA	<100 mV	0.04 + 0.02	0.001 + 0.0001
1 A	±2 A	1 µA	<800 mV	0.1 + 0.02	0.001 + 0.0001



**Note** No degradation in accuracy occurs due to crest factor for signals up to the rated peak voltage/current or bandwidth. For high crest factor signals, increase range. For example, for a 500 mVrms signal with a crest factor between 2 and 20, use the 5 V range.

## AC Functions General Specifications

Input impedance	1 MΩ in parallel with 150 pF, nominal
Input coupling	AC or DC coupling
Overrange	105% of range except 300 V, 1 A range
Maximum Volt-Hertz product	$>8 \times 10^7$ V-Hz
Maximum DC voltage component	250 V
CMRR (1 kΩ resistance in LO lead)	>70 dB (DC to 60 Hz)

## Frequency and Period

**Table 11. PXI-4070 Frequency and Period<sup>26</sup>**

Input Range	Frequency Range	Period Range	Resolution	2-Year Accuracy <sup>27</sup> 0 °C to 55 °C ± % of reading
50 mV to 300 V	1 Hz to 500 kHz	1 s to 2 µs	6½ digits	0.01

<sup>23</sup> Measurement aperture greater than  $4/f_L$ , where  $f_L$  is the lowest frequency component of the signal being measured.

<sup>24</sup> Specification is typical for the 5 kHz to 20 kHz frequency range.

<sup>25</sup> Applies to signals  $>200$  µA.

<sup>26</sup> 2 second gate time; input signal must be  $>10\%$  of AC voltage input range.

<sup>27</sup> 0.00025% of reading, typical.

# Temperature Accuracy Specifications (°C)

**Table 12.** Thermocouple Temperature Accuracy Specifications (°C)<sup>28</sup>

Type	Range	2 Year T <sub>cal</sub> ±5 °C		Tempco/°C <sup>29</sup>	Resolution
		With Simulated Ref. Junction <sup>30</sup>	With PXI-2527 <sup>31</sup>		
J	-150 to 1200	0.3	1.0	0.03	0.1
	-210 to -150	0.4	1.2	0.03	0.1
K	-100 to 1200	0.4	1.0	0.03	0.1
	-200 to -100	0.4	1.5	0.03	0.1
N	-100 to 1300	0.3	1.0	0.03	0.1
	-200 to -100	0.6	1.5	0.03	0.1
T	-100 to 400	0.3	1.0	0.03	0.1
	-200 to -100	0.4	1.5	0.03	0.1
E	-150 to 1000	0.2	1.0	0.03	0.1
	-200 to -150	0.3	1.5	0.03	0.1
R	300 to 1760	0.6	1.8	0.06	0.1
	-50 to 300	1.4	1.9	0.06	0.1
S	400 to 1760	0.7	1.8	0.06	0.1
	-50 to 400	1.3	1.8	0.06	0.1
B	1100 to 1820	0.6	1.8	0.09	0.1
	400 to 1100	1.4	1.9	0.09	0.1

<sup>28</sup> T<sub>cal</sub> is the temperature at which the last external calibration was performed. For total measurement accuracy, add temperature probe error.

<sup>29</sup> Tempco is the temperature coefficient, expressed in degrees of measurement uncertainty per degree change in DMM instrument operating temperature.

<sup>30</sup> Using simulated reference junction.

<sup>31</sup> Includes PXI-2527 with TB-2627 with a typical 0.5 °C CJC error and a typical thermal EMF offset of 2.5 µV for CJC temperatures between 15 °C and 35 °C. Add an additional 0.5 °C uncertainty when CJC is in the range 0-15 °C or 35-50 °C.

**Table 13. RTD<sup>32</sup> Temperature Accuracy Specifications (°C)**

Range	2 year $T_{cal} \pm 5 \text{ }^{\circ}\text{C}^{30}$	Tempco/ $^{\circ}\text{C}^{29}$	Resolution
-200 to 600	0.14	0.011	0.01

**Table 14. Thermistor Temperature Accuracy Specifications (°C)<sup>33</sup>**

Range	2 year $T_{cal} \pm 5 \text{ }^{\circ}\text{C}^{30}$	Tempco/ $^{\circ}\text{C}^{29}$	Resolution
-80 to 150	0.08	0.002	0.01

## Isolated Digitizer Specifications



**Note** All digitizer accuracy specifications apply to Auto Zero enabled, DC coupling, after self-calibration, and 1.8 MS/s sampling rate. For basic DC accuracy, refer to the DC voltage specifications and DC current specifications in the DC Specifications section.

**Table 15. Voltage Mode**

Range	Input Impedance <sup>34</sup>	Flatness Error 20 kHz, Typical	Bandwidth (-3 dB), Typical <sup>35</sup>	THD 1 kHz signal, -1 dBfs, Typical	THD 20 kHz signal, -1 dBfs, Typical
100 mV	>10 G $\Omega$ , 1 M $\Omega$	-0.03 dB	300 kHz	-104 dB	-78 dB
1 V	>10 G $\Omega$ , 1 M $\Omega$	-0.03 dB	300 kHz	-109 dB	-83 dB
10 V	>10 G $\Omega$ , 1 M $\Omega$	-0.03 dB	300 kHz	-96 dB	-70 dB
100 V	1 M $\Omega$	-0.03 dB	300 kHz	-96 dB	-70 dB
300 V	1 M $\Omega$	-0.03 dB	300 kHz	-98 dB	-72 dB

<sup>32</sup> Based on RTD with  $R_O = 100 \text{ } \Omega$  Pt3851 RTD in a 4-wire configuration, using lowest possible resistance range for each temperature. For total measurement accuracy, add temperature probe error.

<sup>33</sup> For total measurement accuracy, add temperature probe error.

<sup>34</sup> In parallel with 150 pF.

<sup>35</sup> The AC coupling low frequency (-3 dB) point is 0.8 Hz.

**Table 16.** Current Mode

Range	Resolution	Burden Voltage, Typical	Flatness Error 20 kHz, Typical	Bandwidth (-3 dB), Typical
20 mA	10 nA	<20 mV	±0.01 dB	430 kHz
200 mA	100 nA	<200 mV	±0.01 dB	430 kHz
1 A	1 µA	<800 mV	±0.01 dB	400 kHz

## Acquisition System

### Sampling rate and record duration

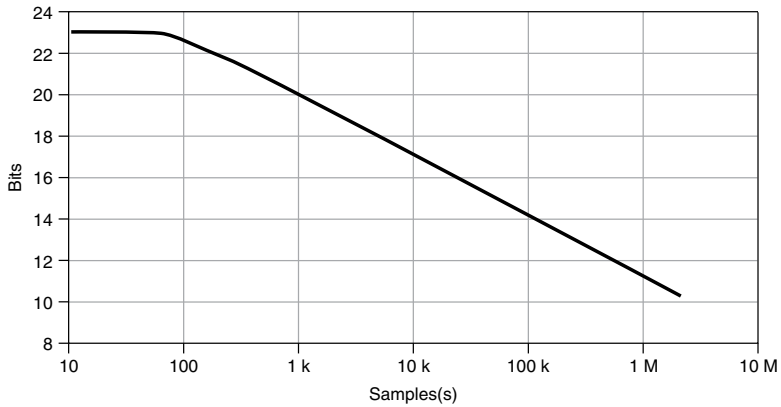
Available sampling rates	$r = \frac{1.8 MS/s}{y}$ , where $y = 1, 2, 3, \dots, 1.8 \times 10^5$
Minimum record duration	8.89 µs
Maximum record duration	149 s
Record duration	$n/r$ , where $n$ = number of samples, $r$ = sampling rate
Variable resolution	10-23 bits; refer to Digitizer Maximum Sampling Rate graph
Available functions	Voltage and current
Voltage ranges	±100 mV to ±300 V (DC or AC coupled)
Current ranges	±20 mA to ±1 A
Timebase accuracy	25 ppm
Input trigger	
Latency <sup>36</sup>	1.8 µs
Jitter	<600 ns



**Note** Refer to *Trigger Specifications* for additional input trigger specifications.

<sup>36</sup> The latency specification value actually reflects negative latency due to sampling before the trigger. Can be reduced to near zero (with the jitter specification) or made positive in software by adding a trigger delay.

**Figure 2. Digitizer Maximum Sampling Rate, Nominal**



## General Specifications

Warm-up	1 hour to rated accuracy
Self-calibration	Calibrates the FlexDMM relative to high-precision internal voltage and resistance standards. No external calibration equipment required.
External calibration interval	2 year recommended
Measurement category	II



**Caution** Do not use this device for connection to signals or for measurements within Measurement Categories III or IV.

### Input protection

Resistance, diode	Up to 300 VDC
DC V, AC V	Up to 300 VDC or AC <sub>rms</sub> , 450 V AC peak
DC I and AC I	F 1.25 A 250 V fast-acting user-replaceable fuse
Maximum common-mode voltage	300 VDC or AC <sub>rms</sub>



**Fuse** When this fuse symbol is marked on a device, take proper precautions.



**Hazardous Voltage** This icon denotes a warning advising you to take precautions to avoid electrical shock.

# Trigger Specifications

Measurement complete trigger pulse width	3 $\mu$ s
Input trigger pulse width	1 $\mu$ s, with <2 m cable
Trigger voltage levels	
Vin High	2.0 V min
Vin Low	0.8 V max
Vout High	2.4 V min
Vout Low	0.4 V max
Trigger voltage level absolute maximums	
Vin High	5.5 V
Vin Low	-0.5 V



**Note** Triggers are LVTTTL/TTL compatible.



**Caution** The AUX I/O connector on the PXI-4070 is not isolated. This connector is not referenced to the measurement circuit but is referenced to the ground of the PXI chassis. Do not operate the digital signal of this connector beyond -0.5 V to 5.5 V of the PXI chassis ground.

## Power Requirements



**Caution** You can impair the protection provided by the PXI-4070 if you use it in a manner not described in this document.

Power consumption	<12 W from PXI backplane
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## Physical Characteristics

Dimensions	3U, one-slot, PXI/cPCI module 2.0 cm $\times$ 13.0 cm $\times$ 21.6 cm (0.8 in. $\times$ 5.1 in. $\times$ 8.5 in.), nominal
Weight	340 g (12 oz), nominal



**Note** If you need to clean the device, wipe it with a dry towel.

# Environment

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Maximum altitude	2,000 m (at 25 °C ambient temperature)
Pollution Degree	2

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Indoor use only.

## 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	Up to 95% at 40 °C

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## Storage Environment

Ambient temperature range	-40 °C 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

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 <sub>rms</sub> (Tested in accordance with IEC 60068-2-64.)
Nonoperating	5 Hz to 500 Hz, 2.4 g <sub>rms</sub> (Tested in accordance with IEC 60068-2-64. Test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

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# Compliance and Certifications

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## 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; 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



**Caution** To ensure the specified EMC performance, operate this product only with shielded cables and accessories.



**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, certifications, and additional information, refer to the [Online Product Certification](#) section.

# CE Compliance

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](http://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](http://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](http://ni.com/environment/weee).

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