PXIe-6376

User Manual

Authorized Distributor

Integration Partner

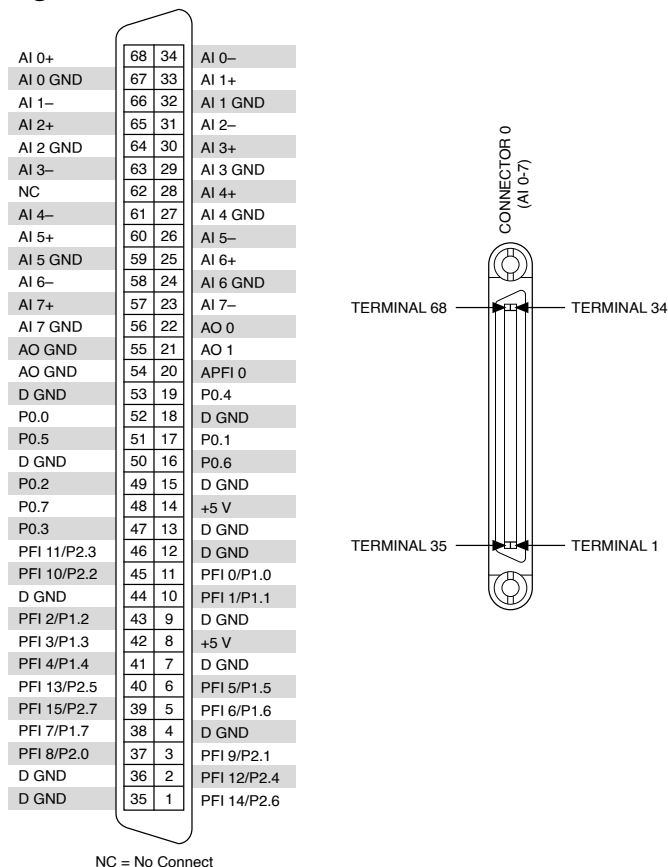# Contents

NI 6376 Specifications

NI 6376 Specifications

The following specifications are typical at 25 °C, unless otherwise noted. For more information about the NI 6376, refer to the **X Series User Manual** available from ni.com/manuals.

Worldwide Support and Services

NI corporate headquarters is located at 11500 N Mopac Expwy, Austin, TX, 78759-3504, USA.

Device Pinout

Figure 1. NI PXIe-6376 Pinout

AI 0+	68	34	AI 0–
AI 0 GND	67	33	AI 1+
AI 1–	66	32	AI 1 GND
AI 2+	65	31	AI 2–
AI 2 GND	64	30	AI 3+
AI 3–	63	29	AI 3 GND
NC	62	28	AI 4+
AI 4–	61	27	AI 4 GND
AI 5+	60	26	AI 5–
AI 5 GND	59	25	AI 6+
AI 6–	58	24	AI 6 GND
AI 7+	57	23	AI 7–
AI 7 GND	56	22	AO 0
AO GND	55	21	AO 1
AO GND	54	20	APFI 0
D GND	53	19	P0.4
P0.0	52	18	D GND
P0.5	51	17	P0.1
D GND	50	16	P0.6
P0.2	49	15	D GND
P0.7	48	14	+5 V
P0.3	47	13	D GND
PFI 11/P2.3	46	12	D GND
PFI 10/P2.2	45	11	PFI 0/P1.0
D GND	44	10	PFI 1/P1.1
PFI 2/P1.2	43	9	D GND
PFI 3/P1.3	42	8	+5 V
PFI 4/P1.4	41	7	D GND
PFI 13/P2.5	40	6	PFI 5/P1.5
PFI 15/P2.7	39	5	PFI 6/P1.6
PFI 7/P1.7	38	4	D GND
PFI 8/P2.0	37	3	PFI 9/P2.1
D GND	36	2	PFI 12/P2.4
D GND	35	1	PFI 14/P2.6

NC = No Connect

CONNECTOR 0 (AI 0-7)

TERMINAL 68 — TERMINAL 34

TERMINAL 35 — TERMINAL 1

Analog Input

Number of channels	8 differential
ADC resolution	16 bits
DNL	No missing codes guaranteed
INL	Refer to the AI Absolute Accuracy section.

Sample rate		
Single channel maximum		3.571 MS/s
Minimum		No minimum
Timing resolution	10 ns	
Timing accuracy	50 ppm of sample rate	
Input coupling	DC	
Input range	±1 V, ±2 V, ±5 V, ±10 V	

Maximum working voltage for all analog inputs	
Positive input (AI+)	±11 V for all ranges, Measurement Category I

Negative input (AI-)	±11 V for all ranges, Measurement Category I

⚠️ **Caution** Do not use for measurements within Categories II, III, and IV.

✏️ **Note** Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are for other circuits not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

CMRR (at 60 Hz)	75 dB	
Bandwidth	1 MHz	
THD	-80 dBFS	
Input impedance		
Device on		
AI+ to AI GND	>100 GΩ in parallel with 100 pF	
AI- to AI GND	>100 GΩ in parallel with 100 pF	
Device off		
AI+ to AI GND		2 kΩ
AI- to AI GND		2 kΩ

Input bias current	±10 pA
Crosstalk (at 100 kHz)	

Adjacent channels	-80 dB

Non-adjacent channels	-100 dB

Input FIFO size	8,182 samples shared among channels used
Data transfers	DMA (scatter-gather), programmed I/O
Overvoltage protection for all analog input channels	

Device on	±36 V

Device off	±15 V

Input current during overvoltage conditions	±20 mA max/AI pin

Analog Triggers

Number of triggers	1
Source	AI <0..7>, APFI 0

Functions	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Source level	
AI <0..7>	±Full scale
APFI 0	±10 V
Resolution	16 bits
Modes	Analog edge triggering, analog edge triggering with hysteresis, and analog window triggering
Bandwidth (-3 dB)	
AI <0..7>	3.4 MHz
APFI 0	3.9 MHz
Accuracy	±1% of range
APFI 0 characteristics	
Input impedance	10 kΩ
Coupling	DC
Protection, power on	±30 V

Protection, power off	±15 V

AI Absolute Accuracy

Table 1. AI Absolute Accuracy

Nominal Range Positive Full Scale	Nominal Range Negative Full Scale	Residual Gain Error (ppm of Reading)	Offset Tempco (ppm of Range/°C)	Random Noise, σ (μVrms)	Absolute Accuracy at Full Scale (μV)
10	-10	114	35	252	2,688
5	-5	120	36	134	1,379
2	-2	120	42	71	564
1	-1	138	50	61	313

Note For more information about absolute accuracy at full scale, refer to the AI Absolute Accuracy Example section.

Gain tempco	8 ppm/°C
Reference tempco	5 ppm/°C
Residual offset error	15 ppm of range
INL error	46 ppm of range

Note Accuracies listed are valid for up to two years from the device external calibration.

AI Absolute Accuracy Equation

AbsoluteAccuracy *=* ***Reading*** *· (****GainError****) +* ***Range*** *· (****OffsetError****) +* ***NoiseUncertainty***

- ***GainError*** *=* ***ResidualAIGainError*** *+* ***GainTempco*** *· (****TempChangeFromLastInternalCal****) +* ***ReferenceTempco*** *· (****TempChangeFromLastExternalCal****)*
- ***OffsetError*** *=* ***ResidualAIOffsetError*** *+* ***OffsetTempco*** *· (****TempChangeFromLastInternalCal****) +* ***INLError***
- ***NoiseUncertainty*** *=*
$$\frac{Random\ Noise\ \cdot\ 3}{\sqrt{100}}$$
for a coverage factor of 3 σ and averaging 100 points.

AI Absolute Accuracy Example

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

- ***TempChangeFromLastExternalCal*** *=* 10 °C
- ***TempChangeFromLastInternalCal*** *=* 1 °C
- ***number_of_readings*** *=* 10,000
- ***CoverageFactor*** *=* 3 σ

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

- ***GainError*** *=* 114 ppm + 8 ppm · 1 + 5 ppm · 10 = 172 ppm
- ***OffsetError*** *=* 15 ppm + 35 ppm ·1 + 46 ppm = 96 ppm
- ***Noise Uncertainty*** *=*
$$\frac{252\ \mu V\ \cdot\ 3}{\sqrt{10,\ 000}}$$
= 7.6 µV
- ***AbsoluteAccuracy*** *=* 10 V · (***GainError***) + 10 V · (***OffsetError***) + ***NoiseUncertainty*** = 2688 µV

Analog Output

Number of channels	2
DAC resolution	16 bits
DNL	±1 LSB, max
Monotonicity	16 bit guaranteed
Accuracy	Refer to the AO Absolute Accuracy section.

Maximum update rate (simultaneous)	
1 channel	3.3 MS/s
2 channels	3.3 MS/s

|	
Minimum update rate	No minimum
Timing accuracy	50 ppm of sample rate
Timing resolution	10 ns
Output range	±10 V, ±5 V, ±external reference on APFI 0

Output coupling	DC
Output impedance	0.4 Ω
Output current drive	±5 mA
Overdrive protection	±25 V
Overdrive current	10 mA
Power-on state	±5 mV
Power-on/off glitch	1.5 V peak for 200 ms
Output FIFO size	8,191 samples shared among channels used
Data transfers	DMA (scatter-gather), programmed I/O
AO waveform modes	Non-periodic waveform, periodic waveform regeneration mode from onboard FIFO, periodic waveform regeneration from host buffer including dynamic update
Settling time, full-scale step, 15 ppm (1 LSB)	2 µs
Slew rate	20 V/µs

Glitch energy at midscale transition, ±10 V range	6 nV · s

External Reference

APFI 0 characteristics	
Input impedance	10 kΩ
Coupling	DC
Protection, device on	±30 V
Protection, device off	± 15 V
Range	±11 V
Slew rate	±20 V/µs

Figure 2. Analog Output External Reference Bandwidth
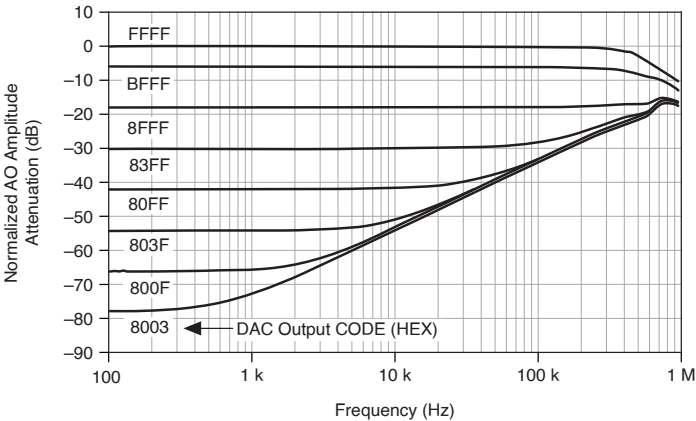
AO Absolute Accuracy

Absolute accuracy at full-scale numbers is valid immediately following self calibration and assumes the device is operating within 10 °C of the last external calibration.

Table 2. AO Absolute Accuracy

Nominal Range Positive Full Scale	Nominal Range Negative Full Scale	Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco (ppm/°C)	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	INL Error (ppm of Range)	Absolute Accuracy at Full Scale (µV)
10	-10	129	17	5	65	1	64	3,256
5	-5	135	8	5	65	1	64	1,616

Note Accuracies listed are valid for up to two years from the device external calibration.

AO Absolute Accuracy Equation

$$AbsoluteAccuracy = OutputValue \cdot (GainError) + Range \cdot (OffsetError)$$

- $GainError = ResidualGainError + GainTempco \cdot (TempChangeFromLastInternalCal) + ReferenceTempco \cdot (TempChangeFromLastExternalCal)$
- $OffsetError = ResidualOffsetError + OffsetTempco \cdot (TempChangeFromLastInternalCal) + INLError$

Digital I/O/PFI

Static Characteristics

Number of channels	24 total, 8 (P0.<0..7>), 16 (PFI <0..7>/P1, PFI <8..15>/P2)

Ground reference	D GND
Direction control	Each terminal individually programmable as input or output
Pull-down resistor	50 kΩ typical, 20 kΩ minimum
Input voltage protection	±20 V on up to two pins

> ⚠ **Caution** Stresses beyond those listed under the *Input voltage protection* specification may cause permanent damage to the device.

Waveform Characteristics (Port 0 Only)

Terminals used	Port 0 (P0.<0..7>)
Port/sample size	Up to 8 bits
Waveform generation (DO) FIFO	2,047 samples
Waveform acquisition (DI) FIFO	255 samples
DI Sample Clock frequency	0 to 10 MHz, system and bus activity dependent
DO Sample Clock frequency	
Regenerate from FIFO	0 MHz to 10 MHz

Streaming from memory	0 MHz to 10 MHz, system and bus activity dependent
Data transfers	DMA (scatter-gather), programmed I/O
Digital line filter settings	160 ns, 10.24 µs, 5.12 ms, disable

PFI/Port 1/Port 2 Functionality

Functionality	Static digital input, static digital output, timing input, timing output
Timing output sources	Many AI, AO, counter, DI, DO timing signals
Debounce filter settings	90 ns, 5.12 µs, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input

Recommended Operating Conditions

Input high voltage (V_{IH})	
Minimum	2.2 V
Maximum	5.25 V
Input low voltage (V_{IL})	
Minimum	0 V

Maximum	0.8 V
Output high current (I_{OH})	
P0.<0..7>	-24 mA maximum
PFI <0..15>/P1/P2	-16 mA maximum
Output low current (I_{OL})	
P0.<0..7>	24 mA maximum
PFI <0..15>/P1/P2	16 mA maximum

Digital I/O Characteristics

Positive-going threshold (VT+)	2.2 V maximum
Negative-going threshold (VT-)	0.8 V minimum
Delta VT hysteresis (VT+ - VT-)	0.2 V minimum
I_{IL} input low current ($V_{IN} = 0$ V)	-10 µA maximum
I_{IH} input high current ($V_{IN} = 5$ V)	250 µA maximum

Figure 3. P0.<0..7>: I$_{OH}$ versus V$_{OH}$
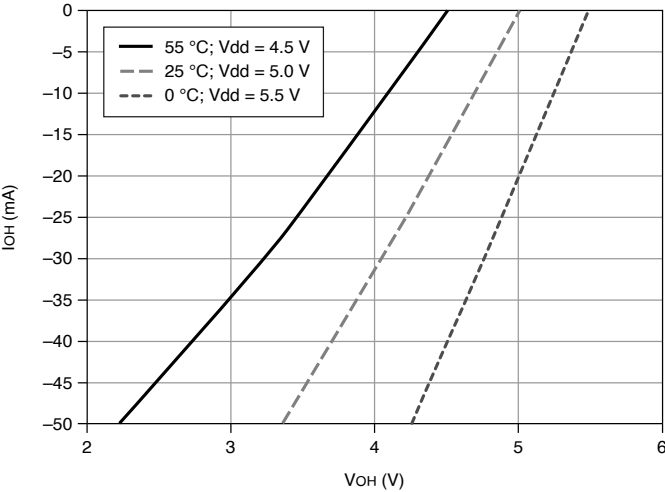
Figure 4. P0.<0..7>: I$_{OL}$ versus V$_{OL}$
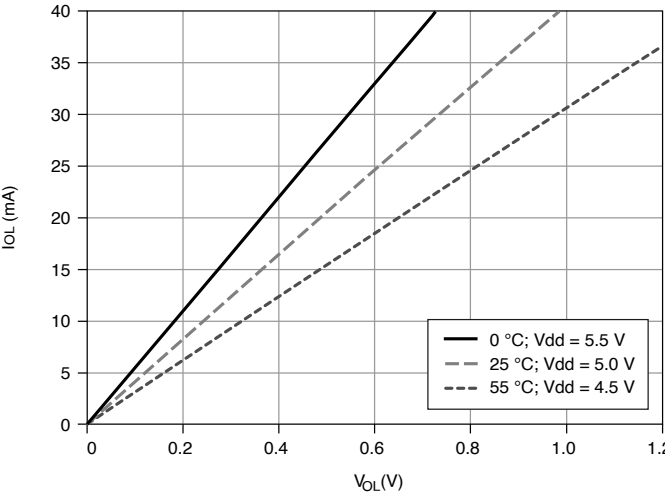
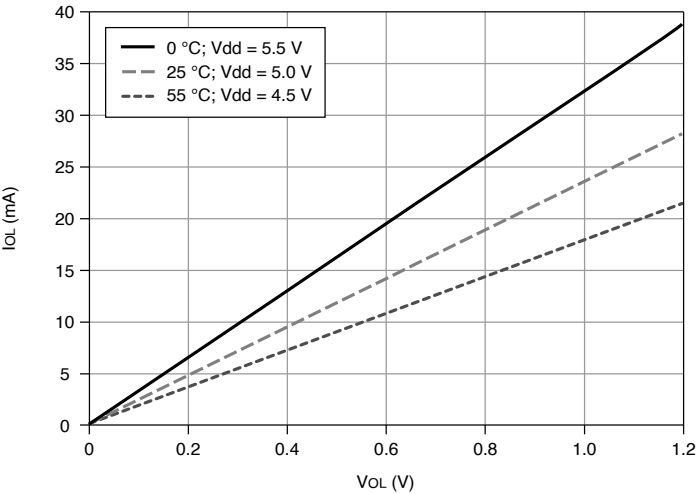Figure 5. PFI <0..15>/P1/P2: I$_{OH}$ versus V$_{OH}$
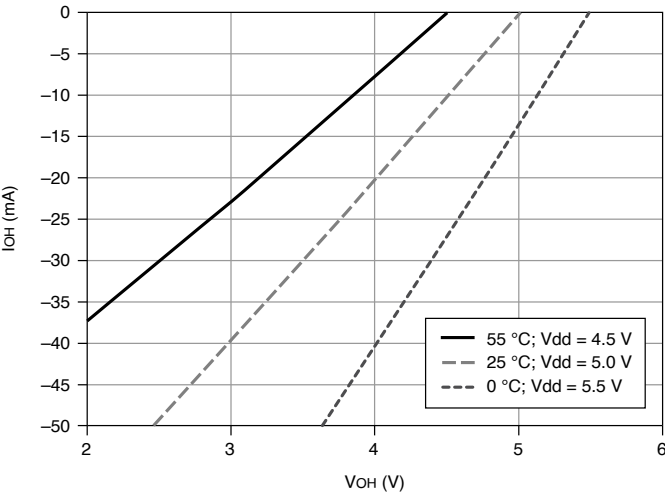
Figure 6. PFI <0..15>/P1/P2: I_{OL} versus V_{OL}

General-Purpose Counters

Number of counter/timers	4
Resolution	32 bits
Counter measurements	Edge counting, pulse, pulse width, semi-period, period, two-edge separation
Position measurements	X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding
Output applications	Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling
Internal base clocks	100 MHz, 20 MHz, 100 kHz
External base clock	0 MHz to 25 MHz; 0 MHz to 100 MHz on PXIe_DSTAR<A,B>

frequency	
Base clock accuracy	50 ppm
Inputs	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock
Routing options for inputs	Any PFI, PXIe_DSTAR<A,B>, PXI_TRIG, PXI_STAR, analog trigger, many internal triggers
FIFO	127 samples per counter
Data transfers	Dedicated scatter-gather DMA controller for each counter/timer, programmed I/O

Frequency Generator

Number of channels	1
Base clocks	20 MHz, 10 MHz, 100 kHz
Divisors	1 to 16
Base clock accuracy	50 ppm

Output can be available on any PFI terminal.

Phase-Locked Loop (PLL)

Number of PLLs	1

Table 3. Reference Clock Locking Frequencies

Reference Signal	PXI Express Locking Input Frequency (MHz)
PXIe_DSTAR<A,B>	10, 20, 100
PXI_STAR	10, 20
PXIe_CLK100	100
PXI_TRIG <0..7>	10, 20
PFI <0..15>	10, 20

Output of PLL	100 MHz Timebase; other signals derived from 100 MHz Timebase including 20 MHz and 100 kHz Timebases

External Digital Triggers

Source	Any PFI, PXIe_DSTAR<A,B>, PXI_TRIG, PXI_STAR
Polarity	Software-selectable for most signals
Analog input function	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Convert Clock, Sample Clock Timebase
Analog output function	Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase

Counter/timer functions	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock
Digital waveform generation (DO) function	Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Digital waveform acquisition (DI) function	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase

Device-to-Device Trigger Bus

Input source	PXI_TRIG <0..7>, PXI_STAR, PXIe_DSTAR<A,B>
Output destination	PXI_TRIG <0..7>, PXIe_DSTARC
Output selections	10 MHz Clock, frequency generator output, many internal signals
Debounce filter settings	90 ns, 5.12 µs, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input

Bus Interface

Form factor	x1 PXI Express peripheral module, specification rev 1.0 compliant
Slot compatibility	x1 and x4 PXI Express or PXI Express hybrid slots

DMA channels	8, can be used for analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1, counter/timer 2, counter/timer 3

All PXIe devices may be installed in PXI Express slots or PXI Express hybrid slots.

Power Requirements

⚠️ **Caution** The protection provided by the device can be impaired if the device is used in a manner not described in the *X Series User Manual*.

+3.3 V	4.75 W
+12 V	15.6 W

Current Limits

⚠️ **Caution** Exceeding the current limits may cause unpredictable behavior by the device and/or PC/chassis.

+5 V terminal (connector 0)	1 A max[1]
P0/PFI/P1/P2 and +5 V terminals combined	1.7 A max

Physical Characteristics

PXIe printed circuit board dimensions	Standard 3U PXI

1. Has a self-resetting fuse that opens when current exceeds this specification.

Weight	168 g (5.9 oz)
I/O connector	1 68-pin VHDCI

Table 4. PXIe Mating Connectors

Manufacturer, Part Number	Description
MOLEX 71430-0011	68-Pos Right Angle Single Stack PCB-Mount VHDCI (Receptacle)
MOLEX 74337-0016	68-Pos Right Angle Dual Stack PCB-Mount VHDCI (Receptacle)
MOLEX 71425-3001	68-Pos Offset IDC Cable Connector (Plug) (SHC68-*)

⚠ **Caution** If you need to clean the module, wipe it with a dry towel.

Calibration

Recommended warm-up time	15 minutes
Calibration interval	2 years

Maximum Working Voltage

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

Channel to earth	11 V, Measurement Category I

> ⚠️ **Caution** Do not use for measurements within Categories II, III, or IV.

> ✎ **Note** Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are for other circuits not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

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 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.)

Environmental

Operating temperature	0 to 55 °C
Storage temperature	-40 to 70 °C
Operating humidity	10 to 90% RH, noncondensing

Storage humidity	5 to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m

Indoor use only.

Safety Compliance Standards

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 safety certifications, refer to the product label or the Product Certifications and Declarations section.

EMC Standards

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
- AS/NZS CISPR 11: Group 1, Class A emissions
- ICES-001: Class A emissions

> **Note** Group 1 equipment 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 Europe, Australia, New Zealand, and Canada (per CISPR 11) Class A equipment is intended for use in non-residential locations.

CE Compliance $\mathsf{C} \, \mathsf{E}$

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)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)
- 2014/53/EU; Radio Equipment Directive (RED)
- 2014/34/EU; Potentially Explosive Atmospheres (ATEX)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

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 **Engineering a Healthy Planet** 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.

EU and UK Customers

- ⌦ **Waste Electrical and Electronic Equipment (WEEE)**—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）

- ⓔⓢ⑩ **中国RoHS**— NI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NI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`.)