USB-6363 Specifications

2022-10-07

Contents

USB-6363 Specifications

These specifications apply to the USB-6363 BNC, USB-6363 Mass Termination, and USB-6363 Spring Terminal.

Definitions

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 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

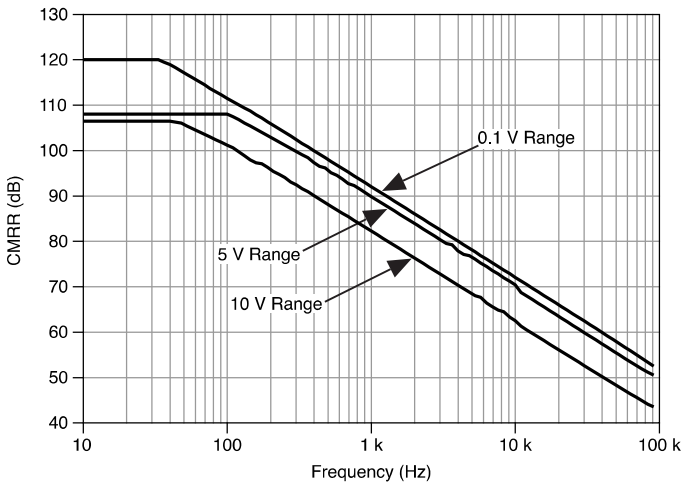
Specifications are valid at 25 °C unless otherwise noted.

Analog Input

Number of channels	32 single-ended or 16 differential
ADC resolution	16 bits
DNL	No missing codes guaranteed

INL	Refer to **AI Absolute Accuracy**.
Sample rate	
Single channel maximum	2.00 MSample/s
Multichannel maximum (aggregate)	1.00 MSample/s
Minimum	No minimum
Timing resolution	10 ns
Timing accuracy	50 ppm of sample rate
Input coupling	DC
Input range	±0.1 V, ±0.2 V, ±0.5 V, ±1 V, ±2 V, ±5 V, ±10 V
Maximum working voltage for analog inputs (signal + common mode)	±11 V of AI GND
CMRR (DC to 60 Hz)	100 dB

Figure 1. AI <0..31> CMRR



Input impedance

Device on

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

Device off

AI+ to AI GND	820 Ω
AI- to AI GND	820 Ω

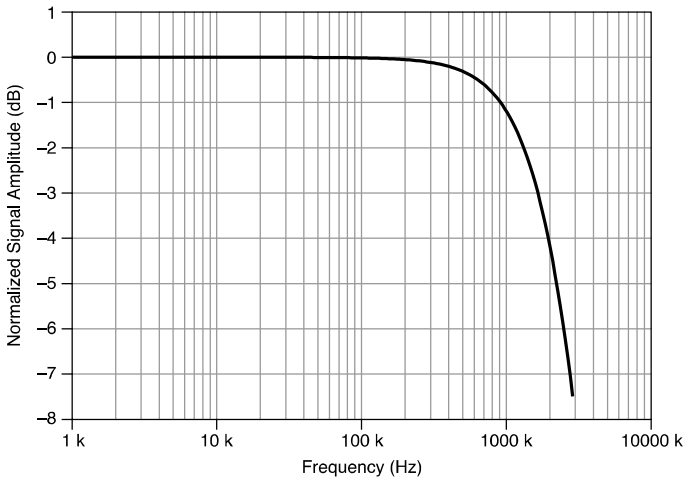
Input bias current	±100 pA

Crosstalk (at 100 kHz)

Adjacent channels	-75 dB
Non-adjacent channels	-95 dB

Small signal bandwidth (-3 dB)	1.7 MHz

Figure 2. AI <0..31> Small Signal Bandwidth



Input FIFO size	2,047 samples
Scan list memory	4,095 entries
Data transfers	USB Signal Stream, programmed I/O

Overvoltage protection for all analog input and sense channels

Device on	±25 V for up to two AI pins
Device off	±15 V for up to two AI pins

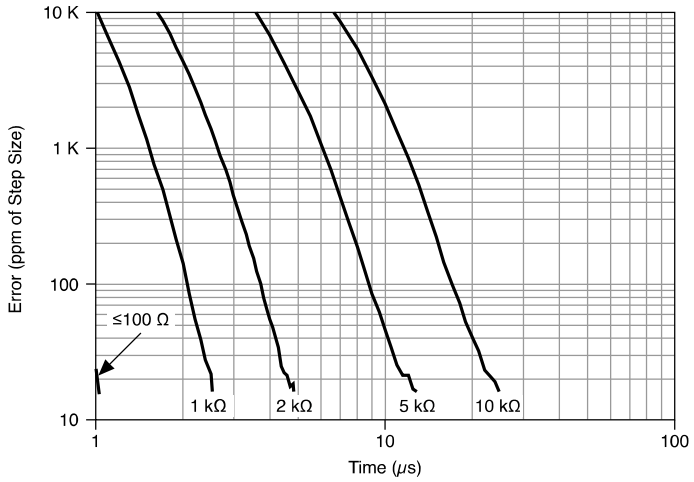
Input current during overvoltage condition	±20 mA max/AI pin

Range	±60 ppm of Step (±4 LSB for Full-Scale Step)	±15 ppm of Step (±1 LSB for Full-Scale Step)
± 10 V, ±5 V, ±2 V, ±1 V	1 µs	1.5 µs
±0.5 V	1.5 µs	2 µs

Range	±60 ppm of Step (±4 LSB for Full-Scale Step)	±15 ppm of Step (±1 LSB for Full-Scale Step)
±0.2 V, ±0.1 V	2 µs	8 µs

Table 1. Settling Time for Multichannel Measurements

Figure 3. Settling Error versus Time for Different Source Impedances



Analog Triggers

Number of triggers	1
Source	AI <0..31>, APFI <0,1>
Functions	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Convert Clock, Sample Clock Timebase
Source level	
AI <0..31>	±Full scale
APFI <0,1>	±10 V
Resolution	16 bits

Modes	Analog edge triggering, analog edge triggering with hysteresis, analog window triggering

Bandwidth (-3 dB)

AI <0..31>	3.4 MHz
APFI <0,1>	3.9 MHz

Accuracy	±1% of range

APFI <0,1> characteristics

Input impedance	10 kΩ
Coupling	DC

Protection

Power on	±30 V
Power off	±15 V

AI Absolute Accuracy (Warranted)

Nominal Range Positive Full Scale (V)	Nominal Range Negative Full Scale (V)	Residual Gain Error (ppm of Reading)	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	Random Noise, σ (µVrms)	Absolute Accuracy at Full Scale (µV)
10	-10	48	13	21	315	1,660
5	-5	55	13	21	157	870
2	-2	55	13	24	64	350
1	-1	65	17	27	38	190
0.5	-0.5	68	17	34	27	100
0.2	-0.2	95	27	55	21	53

Nominal Range Positive Full Scale (V)	Nominal Range Negative Full Scale (V)	Residual Gain Error (ppm of Reading)	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	Random Noise, σ (µVrms)	Absolute Accuracy at Full Scale (µV)
0.1	-0.1	108	45	90	17	33

Table 2. AI Absolute Accuracy

Note **Absolute Accuracy at Full Scale** is determined using the following assumptions:

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

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

Gain tempco	13 ppm/°C
Reference tempco	1 ppm/°C
INL error	60 ppm of range

AI Absolute Accuracy Equation

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

- GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)
- OffsetError = ResidualOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INLError

- NoiseUncertainty = $\frac{\text{Random Noise} \quad 3}{\sqrt{10,000}}$ for a coverage factor of 3 σ and averaging 10,000 points.

AI Absolute Accuracy Example

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

- GainError: 48 ppm + 13 ppm · 1 + 1 ppm · 10 = 71 ppm
- OffsetError: 13 ppm + 21 ppm · 1 + 60 ppm = 94 ppm
- NoiseUncertainty: $\frac{315\,\mu V \quad 3}{\sqrt{10,000}}$ = 9.4 µV
- AbsoluteAccuracy: 10 V · (GainError) + 10 V · (OffsetError) + NoiseUncertainty = 1,660 µV

Analog Output

Number of channels	4
DAC resolution	16 bits
DNL	±1 LSB
Monotonicity	16 bit guaranteed
Maximum update rate (simultaneous)	
1 channel	2.86 MSample/s
2 channels	2.00 MSample/s
3 channels	1.54 MSample/s

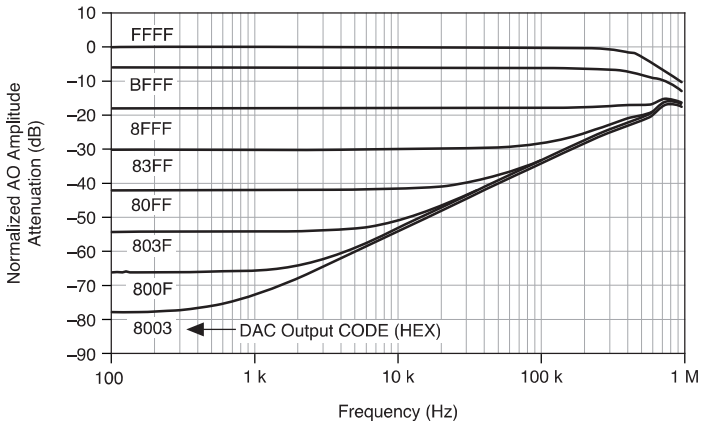
4 channels	1.25 MSample/s
Timing accuracy	50 ppm of sample rate
Timing resolution	10 ns
Output range	±10 V, ±5 V, ±external reference on APFI <0,1>
Output coupling	DC
Output impedance	0.2 Ω
Output current drive	±5 mA
Overdrive protection	±25 V
Overdrive current	26 mA
Power-on state	±5 mV
Power-on/off glitch	1.5 V peak for 1.2 s[1]
Output FIFO size	8,191 samples shared among channels used
Data transfers	USB Signal Stream, 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	10 nV · s

External Reference

APFI <0,1> 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 4. AO <0..3> External Reference Bandwidth



AO Absolute Accuracy (Warranted)

Nominal Range Positive Full Scale (V)	Nominal Range Negative Full Scale (V)	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	63	17	1	33	2	64	1,890
5	-5	70	8	1	33	2	64	935

Table 3. AO Absolute Accuracy

> **Note** **Absolute Accuracy at Full Scale** numbers are valid immediately following self calibration and assumes the device is operating within 10 °C of the last external calibration.

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

AO Absolute Accuracy Equation

AbsoluteAccuracy = OutputValue · (GainError) + Range · (OffsetError)

- GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)
- OffsetError = ResidualOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INLError

Digital I/O/PFI

Static Characteristics

Number of channels	48 total, 32 (P0.<0..31>),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	
Typical	50 kΩ
Minimum	20 kΩ
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..31>)
Port/sample size	Up to 32 bits
Waveform generation (DO) FIFO	2,047 samples
Waveform acquisition (DI) FIFO	255 samples
DI Sample Clock frequency	0 MHz to 1 MHz, system and bus activity dependent
DO Sample Clock frequency	
Regenerate from FIFO	0 MHz to 10 MHz
Streaming from memory	0 MHz to 1 MHz, system and bus activity dependent

Data transfers	USB Signal Stream, programmed I/O
Digital line filter settings	160 ns, 10.24 µs, 5.12 ms, disable

PFI/Port1/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..31>	-24 mA maximum
PFI <0..15>/P1/P2	-16 mA maximum

Output low current (I_{OL})	
P0.<0..31>	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 5. P0.<0..31>: I_{OH} versus V_{OH}

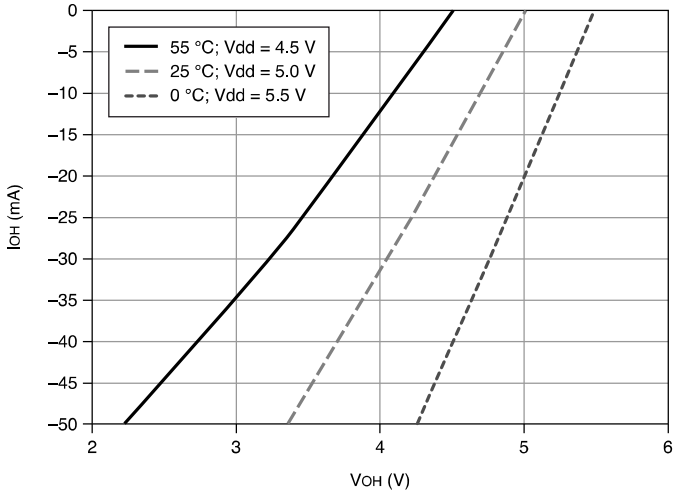


Figure 6. P0.<0..31>: I_{OL} versus V_{OL}

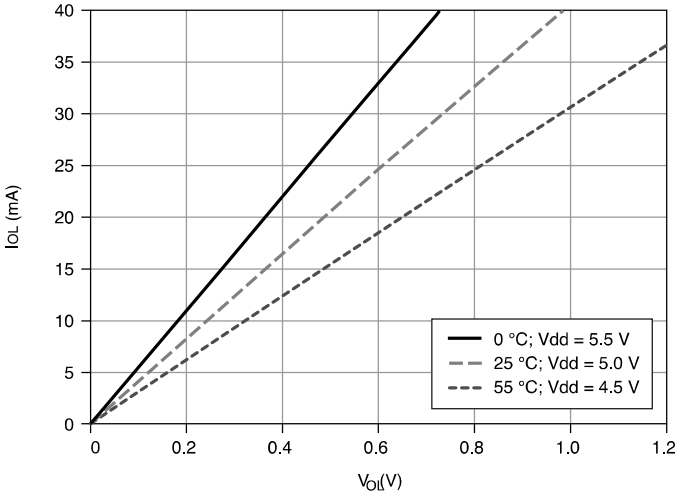


Figure 7. PFI <0..15>/P1/P2: I_{OH} versus V_{OH}

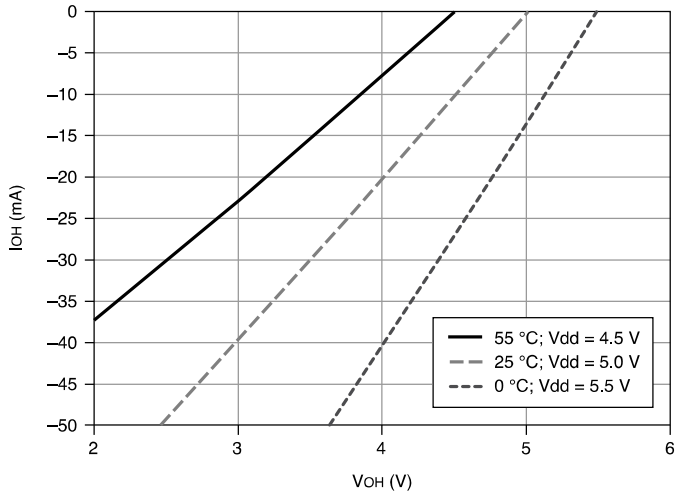
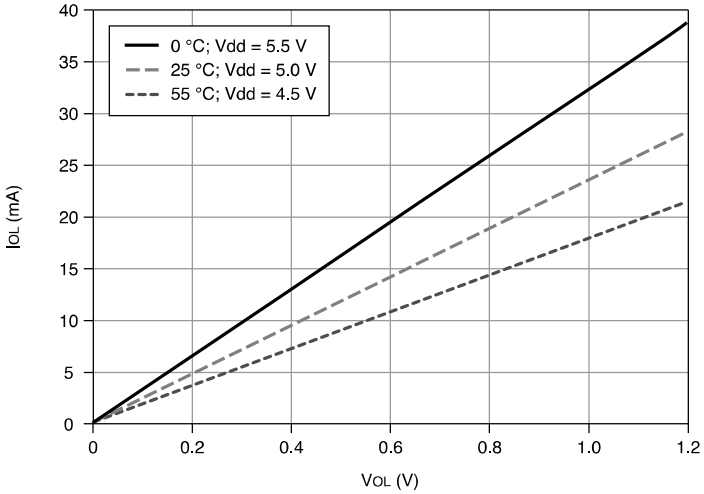


Figure 8. PFI <0..15>/P1/P2: I_{OL} versus V_{OL}



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 frequency	0 MHz to 25 MHz
Base clock accuracy	50 ppm

Inputs	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock
Routing options for inputs	Any PFI, analog trigger, many internal signals
FIFO	127 samples per counter
Data transfers	USB Signal Stream, 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

Phase-Locked Loop (PLL)

Number of PLLs	1
PFI <0..15> reference clock locking frequency	10 MHz
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
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

Bus Interface

USB compatibility	USB 2.0 Hi-Speed or full-speed[2]
USB Signal Stream	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

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**.

> **Caution** The USB device must be powered with an NI offered AC adapter or a National Electric Code (NEC) Class 2 DC source that meets the power requirements for the device and has appropriate safety certification marks for country of use.

Power supply requirements	11 VDC to 30 VDC, 30 W, 2 positions 3.5 mm pitch pluggable screw terminal with screw locks similar to Phoenix Contact MC 1,5/2-STF-3,5 BK
Power input mating connector	Phoenix Contact MC 1,5/2-GF-3,5 BK or equivalent

Current Limits

> **Caution** Exceeding the current limits may cause unpredictable device behavior.

+5 V terminal	1 A maximum[3]
P0/PFI/P1/P2 and +5 V terminals combined	2 A maximum

Physical Characteristics

Enclosure dimensions (includes connectors)	
BNC	20.3 cm × 18.5 cm × 6.8 cm(8.0 in. × 7.3 in. × 2.7 in.)
Mass termination	18.5 cm × 17.3 cm × 3.6 cm(7.3 in. × 6.8 in. × 1.4 in.)
Screw terminal	26.4 cm × 17.3 cm × 3.6 cm(10.4 in. × 6.8 in. × 1.4 in.)
Weight	

BNC	1.803 kg (3 lb15 oz))
Mass termination	971 g (2 lb2.2 oz)
Screw terminal	1.459 kg (3 lb3.4 oz)

I/O connectors

BNC

Device connector	30 BNCs and 60 screw terminals
Screw terminal wiring gauge	0.2047 mm^2 to 1.3087 mm^2(16 AWG to 24 AWG)

Mass termination

Device connector	2 68-Pos Right Angle Single Stack PCB-Mount VHDCI (Receptacle)
Cable connector	68-Pos Offset IDC Cable Connector (Plug) (SHC68-*)

Screw terminal

Device connector	128 screw terminals
Screw terminal wiring gauge	0.2047 mm^2 to 1.3087 mm^2(16 AWG to 24 AWG)

Note For more information about the connectors used for DAQ devices, refer to the document, **NI DAQ Device Custom Cables, Replacement Connectors, and Screws**, by going to ni.com/info and entering the Info Code rdspmb.

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

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as **MAINS** voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

> **Caution** Do not connect the system to signals or use for measurements within Measurement 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.

Environmental

Temperature

Operating	0 °C to 45 °C
Storage	-40 °C to 70 °C
Humidity	
Operating	10% to 90% RH, noncondensing
Storage	5% to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m

Indoor use only.

Environmental Standards

This product meets the requirements of the following environmental standards for electrical equipment.

- IEC 60068-2-1 Cold
- IEC 60068-2-2 Dry heat
- IEC 60068-2-56 Damp heat (steady state)

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.

Electromagnetic Compatibility 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
- 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.

Notice For EMC declarations and certifications, and additional information, refer to the Product Certifications and Declarations 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)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

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）

- **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.)

[1] Typical behavior. Time period may be longer due to host system USB performance. Time period is longer during firmware updates.

[2] Operating on a full-speed bus results in lower performance, and you might not be able to achieve maximum sampling/update rates.

[3] Has self-resetting fuse that opens when current exceeds this specification.