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USB-6363

SPECIFICATIONS

USB-6363

32 AI (16-Bit, 2 MS/s), 4 AO (2.86 MS/s), 48 DIO USB Multifunction I/O Device

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.

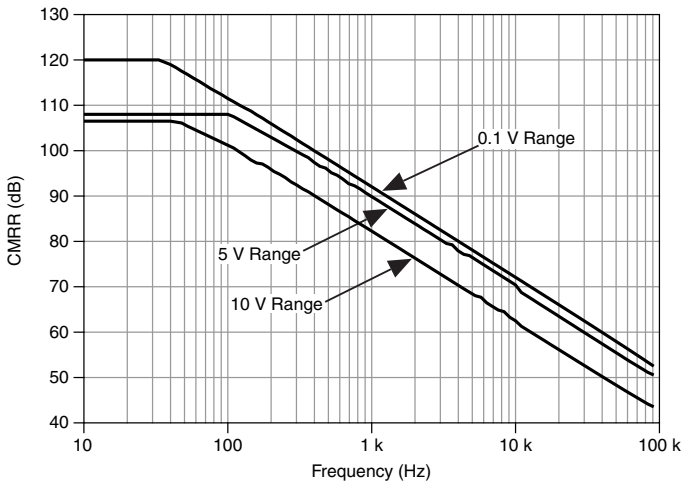
Analog Input

| | |
|--------------------|--|
| Number of channels | 32 single-ended or 16 differential |
| ADC resolution | 16 bits |
| DNL | No missing codes guaranteed |
| INL | Refer to <i>AI Absolute Accuracy</i> . |

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



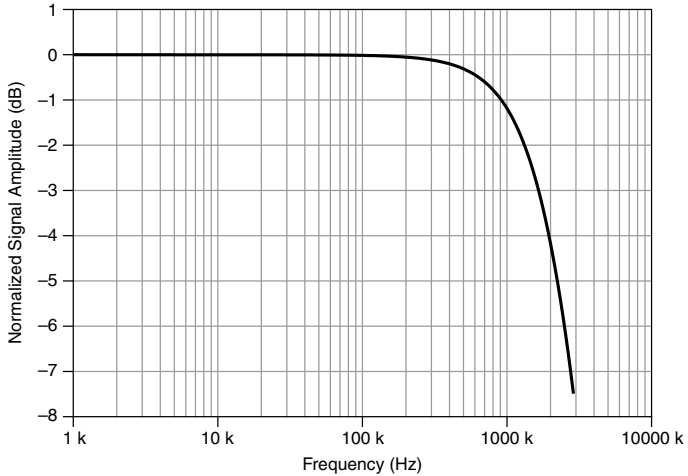
Input impedance

| | |
|--------------------|--|
| Device on | |
| AI+ to AI GND | >10 G Ω in parallel with 100 pF |
| AI- to AI GND | >10 G Ω 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

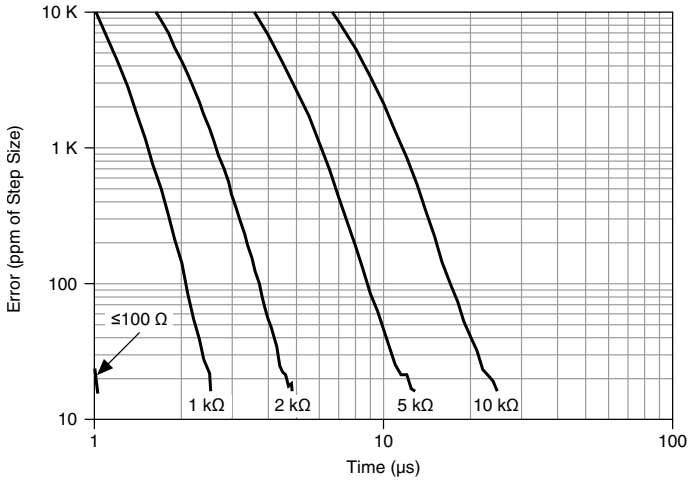


| | |
|--|-----------------------------------|
| Input FIFO size | 2,047 samples |
| Scan list memory | 4,095 entries |
| Data transfers | USB Signal Stream, programmed I/O |
| Overvoltage protection for all analog input and sense channels | |
| Device on | ±25 V for up to two AI pins |
| Device off | ±15 V for up to two AI pins |
| Input current during overvoltage condition | ±20 mA max/AI pin |

Table 1. Settling Time for Multichannel Measurements

| 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 |
| ±0.2 V, ±0.1 V | 2 μs | 8 μs |

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 $\pm 30\text{ V}$

Power off $\pm 15\text{ V}$

AI Absolute Accuracy (Warranted)

Table 2. AI Absolute Accuracy

| 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 |
| 0.1 | -0.1 | 108 | 45 | 90 | 17 | 33 |



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

- $\text{TempChangeFromLastExternalCal} = 10\text{ }^\circ\text{C}$
- $\text{TempChangeFromLastInternalCal} = 1\text{ }^\circ\text{C}$
- $\text{NumberOfReadings} = 10,000$
- $\text{CoverageFactor} = 3\sigma$



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

Gain tempco $13\text{ ppm}/^\circ\text{C}$

Reference tempco $1\text{ ppm}/^\circ\text{C}$

INL error 60 ppm of range

AI Absolute Accuracy Equation

$\text{AbsoluteAccuracy} = \text{Reading} \cdot (\text{GainError}) + \text{Range} \cdot (\text{OffsetError}) + \text{NoiseUncertainty}$

$\text{GainError} = \text{ResidualGainError} + \text{GainTempco} \cdot (\text{TempChangeFromLastInternalCal}) + \text{ReferenceTempco} \cdot (\text{TempChangeFromLastExternalCal})$

OffsetError = ResidualOffsetError + OffsetTempco · (TempChangeFromLastInternalCal)
+ INLError

NoiseUncertainty = $\frac{\text{Random Noise} \cdot 3}{\sqrt{10,000}}$ 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: $\frac{315 \mu\text{V} \cdot 3}{\sqrt{10,000}} = 9.4 \mu\text{V}$

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 μ s |
| Slew rate | 20 V/ μ s |
| Glitch energy at midscale transition, ± 10 V range | 10 nV \cdot s |

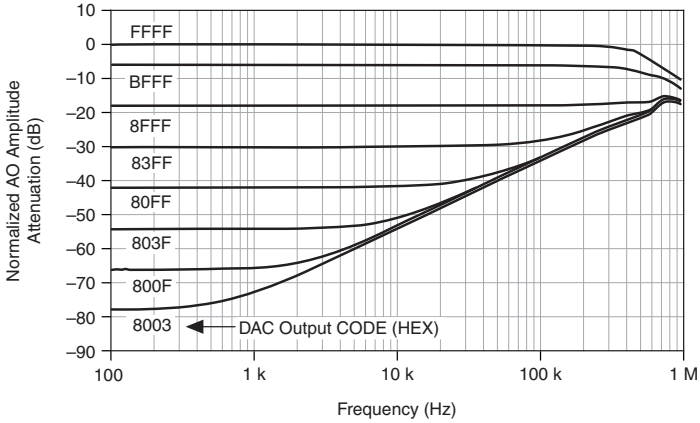
External Reference

APFI <0,1> characteristics

| | |
|------------------------|---------------|
| Input impedance | 10 k Ω |
| Coupling | DC |
| Protection, device on | ± 30 V |
| Protection, device off | ± 15 V |
| Range | ± 11 V |
| Slew rate | 20 V/ μ s |

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

Figure 4. AO <0..3> External Reference Bandwidth



AO Absolute Accuracy (Warranted)

Table 3. AO Absolute Accuracy

| 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 |



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

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

$GainError = ResidualGainError + GainTempco \cdot (TempChangeFromLastInternalCal) + ReferenceTempco \cdot (TempChangeFromLastExternalCal)$

$OffsetError = ResidualOffsetError + OffsetTempco \cdot (TempChangeFromLastInternalCal) + INLError$

Digital I/O/PFI

Static Characteristics

| | |
|--------------------------|--|
| Number of channels | 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 k Ω |
| Minimum | 20 k Ω |
| 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 μ s, 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 μ s, 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 (V_{T+}) | 2.2 V maximum |
| Negative-going threshold (V_{T-}) | 0.8 V minimum |
| Delta VT hysteresis ($V_{T+} - V_{T-}$) | 0.2 V minimum |
| I_{IL} input low current ($V_{IN} = 0$ V) | -10 μ A maximum |
| I_{IH} input high current ($V_{IN} = 5$ V) | 250 μ A maximum |

Figure 5. P0.<0..31>: I_{OH} versus V_{OH}

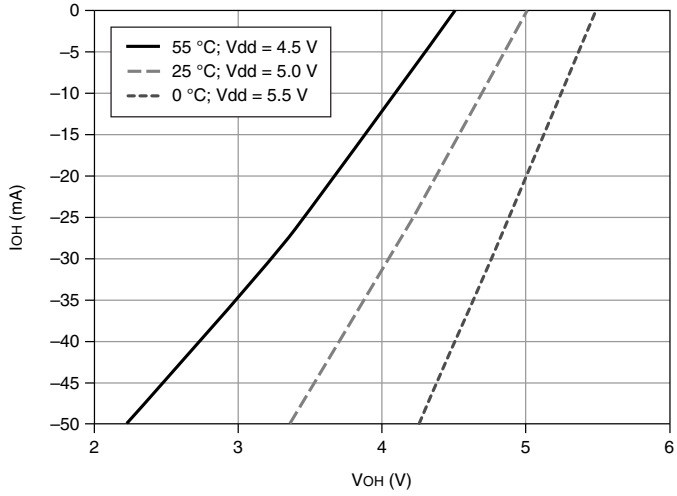


Figure 6. P0.<0..31>: I_{OL} versus V_{OL}

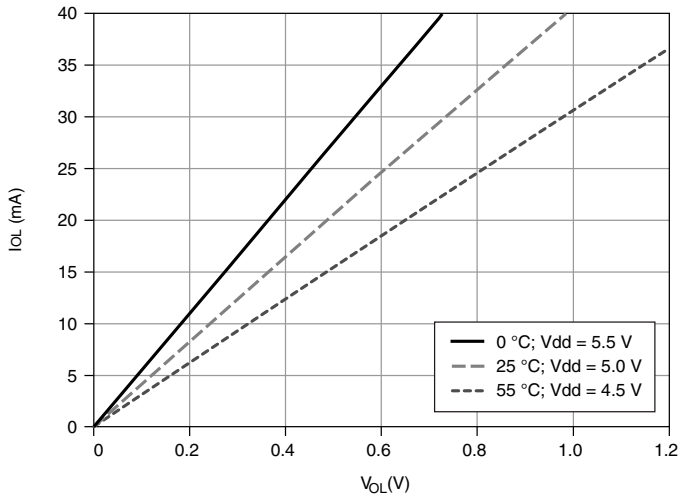


Figure 7. PFI <0..15>/P1/P2: I_{OH} versus V_{OH}

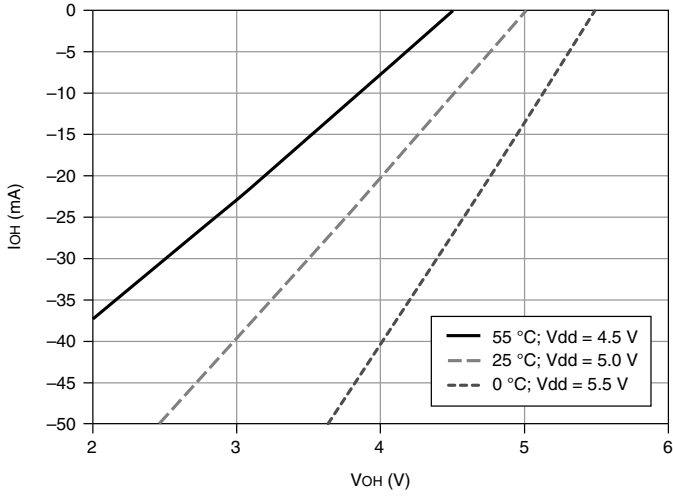
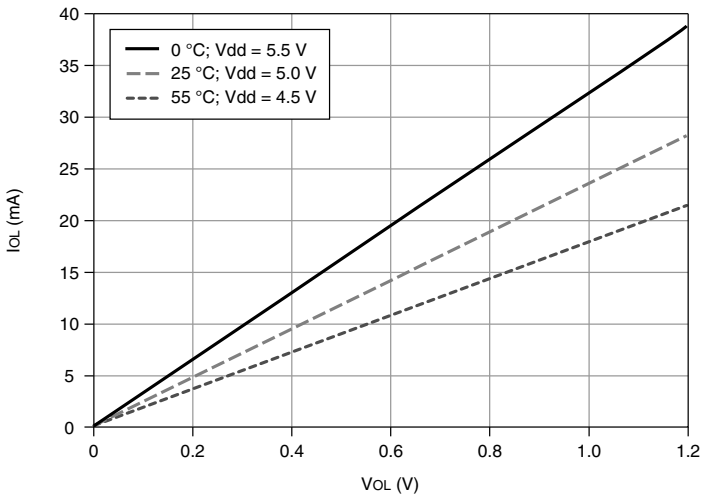


Figure 8. PFI <0..15>/P1/P2: I_{OL} versus V_{OL}



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 |

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

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 lb 15 oz) |
| Mass termination | 971 g (2 lb 2.2 oz) |
| Screw terminal | 1.459 kg (3 lb 3.4 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-*) |

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

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 UL and other 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

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/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.

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