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# PXle-7865

# Specifications

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# PXIe-7865 Specifications

## Conditions

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

## Pinout

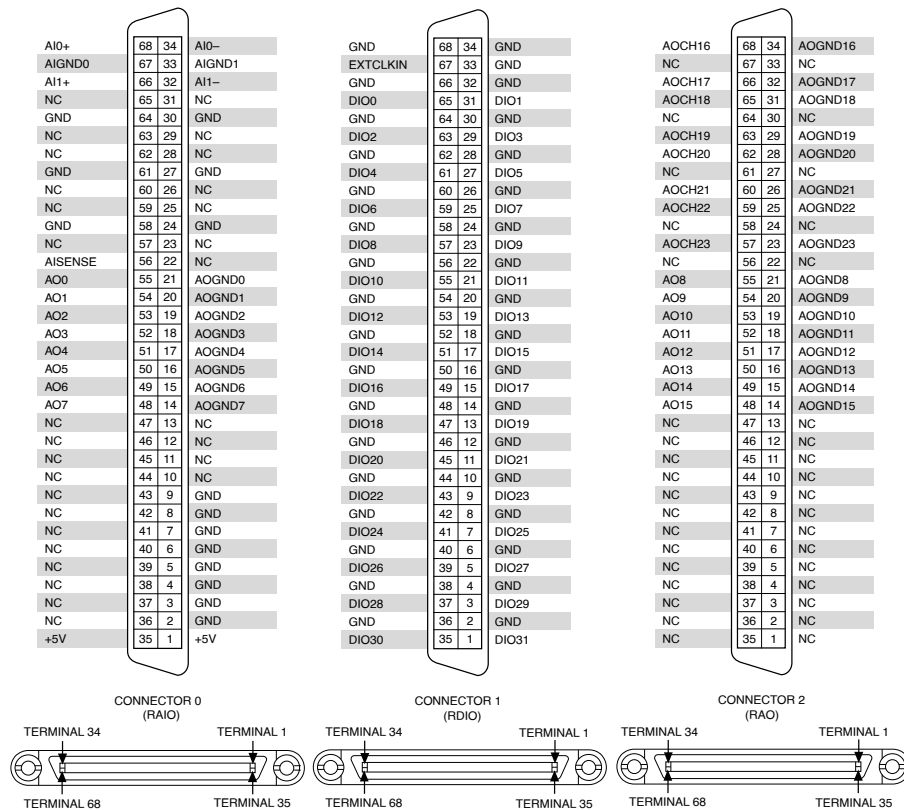


Table 1. PXIe-7865 Signal Descriptions

Signal	Description
AI+	Positive analog input signal connection
AI-	Negative analog input signal connection
AISENSE	Reference connection for NRSE measurements
AIGND	Ground reference for the analog input signal

Signal	Description
AO	Analog output signal connection
AOGND	Ground reference for the analog output signal
DIO	Digital input/output signal connection
EXTCLKIN	External clock input source that can be used for source synchronous acquisitions. The provided clock source must be stable and glitch-free.
GND	Ground connection
Supply (+5 V <sub>out</sub> )	5 V power output connection for external devices
NC	No connection

The PXIe-7865 is protected from overvoltage and overcurrent conditions.



**Note** The pinout label on the lid of the SCB-68A accessory is incompatible with the NI PXIe-7865. Refer to the **NI 78xxR Pinout Labels for the SCB-68A**, available at [ni.com/manuals](https://ni.com/manuals) for the compatible pinout labels.

## Analog Input

Number of channels	2
Input modes (software-selectable; selection applies to all channels)	DIFF, NRSE <sup>1</sup> , RSE
Type of ADC	Successive approximation register (SAR)
Resolution	16 bits

- Operating channels in NRSE input mode while outside of the specified voltage range may impact accuracy of other channels.

Conversion time	1 $\mu$ s
Maximum sampling rate (per channel)	1 MS/s
<b>Input impedance</b>	
Powered on	1.25 G $\Omega$    2 pF
Powered off/overload	4 k $\Omega$ minimum

Input signal range (software-selectable)	$\pm 1$ V, $\pm 2$ V, $\pm 5$ V, $\pm 10$ V
Input bias current	$\pm 5$ nA
Input offset current	$\pm 5$ nA
Input coupling	DC

<b>Overvoltage protection</b>	
Powered on	$\pm 42$ V maximum
Powered off	$\pm 35$ V maximum

Table 2. AI Operating Voltage Ranges Over Temperature

Range (V)	Measurement Voltage, AI+ to AI-			Maximum Working Voltage (Signal + Common Mode)
	Minimum (V) <sup>2</sup>	Typical (V)	Maximum (V)	
$\pm 10$	$\pm 10.37$	$\pm 10.5$	$\pm 10.63$	$\pm 12$ V of ground
$\pm 5$	$\pm 5.18$	$\pm 5.25$	$\pm 5.32$	$\pm 10$ V of ground

2. The minimum measurement voltage range is the largest voltage the NI PXIe-7865 is guaranteed to accurately measure.

Range (V)	Measurement Voltage, AI+ to AI-			Maximum Working Voltage (Signal + Common Mode)
	Minimum (V)	Typical (V)	Maximum (V)	
±2	±2.07	±2.1	±2.13	±8.5 V of ground
±1	±1.03	±1.05	±1.06	±8 V of ground

## AI Absolute Accuracy

Absolute accuracy at full scale numbers is valid immediately following internal calibration and assumes the device is operating within 10 °C of the last external calibration. Accuracies listed are valid for up to one year from the device external calibration.

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  $\sigma$

Table 3. AI Absolute Accuracy (Calibrated)

Specifications	Range			
	±10 V	±5 V	±2 V	±1 V
Residual Gain Error (ppm of Reading)	104.4	105.9	110.6	118.4
Gain Tempco (ppm/°C)	20	20	20	20
Reference Tempco (ppm/°C)	4	4	4	4
Residual Offset Error (ppm of Range)	16.4	16.4	16.4	16.4
Offset Tempco (ppm of Range/°C)	4.18	4.17	4.41	4.63
INL Error (ppm of range)	42.52	46.52	46.52	50.52
Random Noise, $\sigma$ ( $\mu\text{V}_{\text{rms}}$ )	263	156	90	74
Absolute Accuracy at Full Scale ( $\mu\text{V}$ )	2,283	1,170	479	252

Table 4. AI Absolute Accuracy (Uncalibrated)

Specifications	Range			
	±10 V	±5 V	±2 V	±1 V
Residual Gain Error (ppm of Reading)	2,921	3,021	3,021	3,021
Gain Tempco (ppm/°C)	20	20	20	20
Reference Tempco (ppm/°C)	4	4	4	4
Residual Offset Error (ppm of Range)	661	671	700	631
Offset Tempco (ppm of Range/°C)	4.18	4.17	4.41	4.63
INL Error (ppm of range)	42.52	46.52	46.52	50.52
Random Noise, $\sigma$ ( $\mu\text{V}_{\text{rms}}$ )	263	156	90	74
Absolute Accuracy at Full Scale ( $\mu\text{V}$ )	36,895	19,018	7,667	3,769

### Calculating Absolute Accuracy

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

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

$$\text{OffsetError} = \text{ResidualOffsetError} + \text{OffsetTempco} \times (\text{TempChangeFromLastInternalCal}) + \text{INL\_Error}$$

$$\text{NoiseUncertainty} = \frac{\text{RandomNoise} \times \text{CoverageFactor}}{\sqrt{\text{number\_of\_readings}}}$$

Refer to the following equation for an example of calculating absolute accuracy for a 10 V reading.

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  $\sigma$

$$\text{GainError} = 104.4 \text{ ppm} + 20 \text{ ppm} \times 1 + 4 \text{ ppm} \times 10$$

$$\text{GainError} = 164.4 \text{ ppm}$$

$$\text{OffsetError} = 16.4 \text{ ppm} + 4.18 \text{ ppm} \times 1 + 42.52 \text{ ppm}$$

$$\text{OffsetError} = 63.1 \text{ ppm}$$

$$\text{NoiseUncertainty} = \frac{263 \mu\text{V} \times 3}{\sqrt{10,000}}$$
$$\text{NoiseUncertainty} = 7.89 \mu\text{V}$$
$$\text{AbsoluteAccuracy} = 10 \text{ V} \times (\text{GainError}) + 10 \text{ V} \times (\text{OffsetError}) + \text{NoiseUncertainty}$$
$$\text{AbsoluteAccuracy} = 2,283 \mu\text{V}$$

DC Transfer Characteristics

INL	Refer to the AI Accuracy Table
DNL	±0.4 LSB typical, ±0.9 LSB maximum
No missing codes	16 bits guaranteed
CMRR, DC to 60 Hz	-100 dB

Dynamic Characteristics

Bandwidth	
Small signal	1 MHz
Large signal	500 kHz

Table 5. Settling Time

Range (V)	Step Size (V)	Accuracy		
		±16 LSB	±4 LSB	±2 LSB
±10	±20.0	1.50 μs	4.00 μs	7.00 μs
	±2.0	0.50 μs	0.50 μs	1.00 μs
	±0.2	0.50 μs	0.50 μs	0.50 μs



Range (V)	Step Size (V)	Accuracy		
		$\pm 16$ LSB	$\pm 4$ LSB	$\pm 2$ LSB
$\pm 5$	$\pm 10$	1.50 $\mu$ s	3.50 $\mu$ s	7.50 $\mu$ s
	$\pm 1$	0.50 $\mu$ s	0.50 $\mu$ s	1.00 $\mu$ s
	$\pm 0.1$	0.50 $\mu$ s	0.50 $\mu$ s	0.50 $\mu$ s
$\pm 2$	$\pm 4$	1.00 $\mu$ s	3.50 $\mu$ s	8.00 $\mu$ s
	$\pm 0.4$	0.50 $\mu$ s	0.50 $\mu$ s	1.00 $\mu$ s
	$\pm 0.04$	0.50 $\mu$ s	0.50 $\mu$ s	0.50 $\mu$ s
$\pm 1$	$\pm 2$	1.00 $\mu$ s	3.50 $\mu$ s	12.00 $\mu$ s
	$\pm 0.2$	0.50 $\mu$ s	0.50 $\mu$ s	2.00 $\mu$ s
	$\pm 0.02$	0.50 $\mu$ s	0.50 $\mu$ s	0.50 $\mu$ s

Crosstalk	-80 dB, DC to 100 kHz, at 50 $\Omega$
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## Analog Output

Output type	Single-ended, voltage output
Number of channels	24
Resolution	16 bits
Update time	1 $\mu$ s
Maximum update rate	1 MS/s

Type of DAC	Enhanced R-2R
Range	$\pm 10$ V
Output coupling	DC
Output impedance	$0.5 \Omega$
Current drive	$\pm 2.5$ mA
Protection	Short circuit to ground
<b>Overvoltage protection</b>	
Powered on	$\pm 15$ V maximum
Powered off	$\pm 10$ V maximum

Power-on state	User-configurable
Power-on glitch	1.6 V for 2 $\mu$ s
Power-down glitch	0.4 V peak, decays to 0 V in 200 ms

Table 6. AO Operating Voltage Ranges for Over Temperature

Range (V)	Measurement Voltage, AO+ to AO GND		
	Minimum (V) <sup>3</sup>	Typical (V)	Maximum (V)
$\pm 10$	$\pm 10.1$	$\pm 10.16$	$\pm 10.22$

3. The minimum measurement voltage range is the largest voltage the NI PXIe-7865 is guaranteed to accurately measure.

## AO Absolute Accuracy

Absolute accuracy at full scale numbers is valid immediately following internal calibration and assumes the device is operating within 10 °C of the last external calibration. Accuracies listed are valid for up to one year from the device external calibration.

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

- TempChangeFromLastExternalCal = 10 °C
- TempChangeFromLastInternalCal = 1 °C

Table 7. AO Absolute Accuracy (Calibrated)

Specifications	±10 V Range
Residual Gain Error (ppm of Reading)	87.3
Gain Tempco (ppm/°C)	12.6
Reference Tempco (ppm/°C)	4
Residual Offset Error (ppm of Range)	41.1
Offset Tempco (ppm of Range/°C)	7.8
INL Error (ppm of range)	61
Absolute Accuracy at Full Scale (μV)	2,498

Table 8. AO Absolute Accuracy (Uncalibrated)

Specifications	±10 V Range
Residual Gain Error (ppm of Reading)	2,968.6
Gain Tempco (ppm/°C)	12.6
Reference Tempco (ppm/°C)	4
Residual Offset Error (ppm of Range)	1,004.1
Offset Tempco (ppm of Range/°C)	7.8
INL Error (ppm of range)	61
Absolute Accuracy at Full Scale (μV)	40,941

Calculating Absolute Accuracy

$$\text{AbsoluteAccuracy} = \text{OutputValue} \times (\text{GainError}) + \text{Range} \times (\text{OffsetError})$$

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

$$\text{OffsetError} = \text{ResidualGainError} + \text{AOOffsetTempco} \times (\text{TempChangeFromLastInternalCal}) + \text{INL\_Error}$$

Refer to the following equation for an example of calculating absolute accuracy for a 10 V reading.

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

- TempChangeFromLastExternalCal = 10 °C
- TempChangeFromLastInternalCal = 1 °C

$$\text{GainError} = 87.3 \text{ ppm} + 12.6 \text{ ppm} \times 1 + 4 \text{ ppm} \times 10$$

$$\text{GainError} = 139.9 \text{ ppm}$$

$$\text{OffsetError} = 41.1 \text{ ppm} + 7.8 \text{ ppm} \times 1 + 61 \text{ ppm}$$

$$\text{OffsetError} = 109.9 \text{ ppm}$$

$$\text{AbsoluteAccuracy} = 10 \text{ V} \times (\text{GainError}) + 10 \text{ V} \times (\text{OffsetError})$$

$$\text{AbsoluteAccuracy} = 2,498 \text{ }\mu\text{V}$$

DC Transfer Characteristics

INL	Refer to the AO Accuracy Table
DNL	±0.5 LSB typical, ±1 LSB maximum
Monotonicity	16 bits, guaranteed

## Dynamic Characteristics

Table 9. Settling Time

Step Size (V)	Accuracy		
	$\pm 16$ LSB	$\pm 4$ LSB	$\pm 2$ LSB
$\pm 20.0$	5.3 $\mu$ s	6.5 $\mu$ s	7.8 $\mu$ s
$\pm 2.0$	3.2 $\mu$ s	3.9 $\mu$ s	4.4 $\mu$ s
$\pm 0.2$	1.8 $\mu$ s	2.8 $\mu$ s	3.8 $\mu$ s

Slew rate	10 V/ $\mu$ s
Noise	250 $\mu$ V RMS, DC to 1 MHz
Glitch energy at midscale transition	$\pm 10$ mV for 3 $\mu$ s

## 5V Output

Output voltage	4.75 V to 5.1 V
Output current	0.5 A maximum
Overvoltage protection	$\pm 30$ V
Overcurrent protection	650 mA

# Digital I/O

Table 10. Channel Frequency

Connector	Number of Channels	Maximum Frequency
Connector 1	32	20 MHz

Compatibility	TTL, LVTTTL, LVCMOS
Logic family	Fixed
<b>Voltage level</b>	
Digital input	5 V, 3.3 V
Digital output	3.3V

Table 11. Digital Input Logic Levels

Logic Level	Input Low Voltage ( $V_{IL}$ ) Maximum	Input High Voltage ( $V_{IH}$ ) Minimum
5 V	0.80 V	2.00 V
3.3 V	0.80 V	2.00 V

Minimum input	-0.2 V
Maximum input	5.5 V
Input leakage current	$\pm 85 \mu\text{A}$ maximum

Input impedance	
5 V input	74 k $\Omega$ typical, pull-down
3.3 V input	50 k $\Omega$ typical, pull-down

Table 12. Digital Output Logic Levels

Logic Level	Current	Output Low Voltage (V <sub>OL</sub> ) Maximum	Output High Voltage (V <sub>OH</sub> ) Minimum
3.3 V	100 $\mu$ A	0.20 V	3.00 V
	4 mA	0.40 V	2.40 V

Maximum DC output current per channel	
Source	4.0 mA
Sink	4.0 mA

Output impedance	50 $\Omega$
Power-on state <sup>4</sup>	Programmable, by line
Protection <sup>5</sup>	$\pm 15$ V, per line
Direction control of digital I/O channels	Per channel
Minimum I/O pulse width	25 ns
Minimum sampling period	5 ns

4. Tristate by default.
5. Only protects up to 20 lines simultaneously. NI recommends minimizing long-term over/under-voltage exposure to the Digital I/O. Prolonged DC voltage stresses that violate the maximum and minimum digital input voltage ratings may reduce device longevity. Over/under-voltage stresses are considered prolonged if the cumulative time in the abnormal condition exceeds 1 year.

## External Clock

Direction	Input into device
Maximum input leakage	$\pm 85 \mu\text{A}$
Characteristic impedance	50 $\Omega$
Power-on state	Tristated
Minimum input	-0.2 V
Maximum input	5.5 V
Logic level	5 V, 3.3 V
Maximum input frequency	20 MHz

## Reconfigurable FPGA

FPGA type	Kintex-7 160T
Number of flip-flops	202,800
Number of LUTs	101,400



Embedded Block RAM	11,700 kbits
Number of DSP48 slices	600
Timebase	40 MHz, 80 MHz, 120 MHz, 160 MHz, or 200 MHz
Default timebase	40 MHz
Timebase reference source	Onboard clock, phase-locked to PXI Express 100 MHz (PXIe_CLK100)
Onboard clock timebase accuracy	±100 ppm, 250 ps peak-to-peak jitter
Data transfers	DMA, interrupts, programmed I/O

## Onboard DRAM

Memory size	1 Bank; 512 MB
Maximum theoretical data rate	800 MB/s streaming

## Synchronization Resources

Input/output source	PXI_Trig<0..7>
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Input source	PXI_Star, PXIe_DStarA, PXIe_DStarB, PXI_Clk10, PXIe_Clk100, External Clock 1
Output source	PXIe_DStarC

## Bus Interface

Form factor	x4 PXI Express, specification v1.0 compliant
Slot compatibility	x4, x8, and x16 PXI Express or PXI Express hybrid slots
Data transfers	DMA, interrupts, programmed I/O
Number of DMA channels	16

## Power Requirements

Power requirements are dependent on the digital output loads and configuration of the LabVIEW FPGA VI used in your application.

+3.3 V	2.25 A
+12 V	1.65 A

## Physical Characteristics

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



**Tip** For two-dimensional drawings and three-dimensional models of the device and connectors, visit [ni.com/dimensions](https://ni.com/dimensions) and search by model number.

Dimensions	21.4 cm × 13.0 cm × 2.1 cm (8.43 in. × 5.12 in. × 0.83 in.)
Weight	177.6 g (6.26 oz)
I/O connectors	3 × 68-pin VHDCI

## Safety Voltages

Connect only voltages that are below these limits.

Channel-to-earth	±12 V, Measurement Category I
Channel-to-channel	±24 V, Measurement Category I



**Caution** Do not connect the NI PXIe-7865 to signals or use for measurements within Measurement Categories II, III, or IV.



**Attention** Ne connectez pas le NI PXIe-7865 à des signaux et ne l'utilisez pas pour effectuer des mesures dans les catégories de mesure II, III ou IV.

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.



**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.

## 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



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

## Environmental Characteristics

Temperature	
Operating	0 °C to 55 °C
Storage	-40 °C to 71 °C
Humidity	
Operating	10% RH to 90% RH, noncondensing
Storage	5% RH to 95% RH, noncondensing

Pollution Degree	2
Maximum altitude	2,000 m

Shock and Vibration	
Operating vibration	5 Hz to 500 Hz, 0.3 g RMS
Non-operating vibration	5 Hz to 500 Hz, 2.4 g RMS


Operating shock	30 g, half-sine, 11 ms pulse
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## 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](https://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](https://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](https://ni.com/environment/rohs_china)。(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](https://ni.com/environment/rohs_china).)

## 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 60068-2-78 Damp heat (steady state)
- IEC 60068-2-64 Random operating vibration
- IEC 60068-2-27 Operating shock



**Note** To verify marine approval certification for a product, refer to the product label or visit [ni.com/certification](https://ni.com/certification) and search for the certificate.

## 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)
- 2015/863/EU; Restriction of Hazardous Substances (RoHS)

## Calibration

Recommended warm-up time		15 minutes
Calibration interval		1 year
<b>Onboard calibration reference</b>		
DC level <sup>6</sup>	5.000 V ( $\pm 2$ mV)	
Temperature coefficient	$\pm 4$ ppm/ $^{\circ}$ C maximum	
Long-term stability	$\pm 25$ ppm/1,000 h	



**Note** Refer to Calibration Certifications at [ni.com/calibration](https://ni.com/calibration) to generate a calibration certificate for the NI PXIe-7865

6. Actual value stored in Flash memory