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# NI PXIe-7847R Specifications

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# Contents

PXIe-7847R Specifications..... 3

# PXIe-7847R Specifications

## NI PXIe-7847R Specifications

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

### Analog Input

Number of channels	8
Input modes (software-selectable; selection applies to all channels)	DIFF, NRSE, RSE
Type of ADC	Successive approximation register (SAR)
Resolution	16 bits
Conversion time	2 $\mu$ s
Maximum sampling rate (per channel)	500 kS/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	±42 V maximum
Powered off	±35 V maximum

**Table 1.** AI Operating Voltage Ranges Over Temperature

Range (V)	Measurement Voltage, AI+ to AI-			Maximum Working Voltage (Signal + Common Mode)
	Minimum (V) <sup>[1]</sup>	Typical (V)	Maximum (V)	
±10	±10.37	±10.5	±10.63	±12 V of ground
±5	±5.18	± 5.25	±5.32	±10 V of ground
±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 2.** AI Absolute Accuracy (Calibrated)

Specifications	Range				
	±20 V	±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 3.** AI Absolute Accuracy (Uncalibrated)

Specifications	Range				
	±20 V	±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

Specifications	Range				
	±20 V	±10 V	±5 V	±2 V	±1 V
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:

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

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

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

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

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

$$\text{NoiseUncertainty} = \frac{263 \mu\text{V} \times 3}{\sqrt{10,000}}$$

$$\text{NoiseUncertainty} = 7.89 \mu\text{V}$$

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

$$\text{AbsoluteAccuracy} = 2,283 \mu\text{V}$$

## 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

<b>Bandwidth</b>	
Small signal	1 MHz
Large signal	500 kHz

**Table 4.** Settling Time

Range (V)	Step Size (V)	Accuracy		
		±16 LSB	±4 LSB	±2 LSB
±20				
±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
±5	±10	1.50 μs	3.50 μs	7.50 μs
	±1	0.50 μs	0.50 μs	1.00 μs

Range (V)	Step Size (V)	Accuracy		
		$\pm 16$ LSB	$\pm 4$ LSB	$\pm 2$ LSB
	$\pm 0.1$	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 $\Omega$		

## Analog Output

Output type	Single-ended, voltage output
Number of channels	8
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	±2.5 mA
Protection	Short circuit to ground
<b>Overvoltage protection</b>	
Powered on	±15 V maximum
Powered off	±10 V maximum
Power-on state	User-configurable
Power-on glitch	1 V for 1 μs

**Table 5.** AO Operating Voltage Ranges for Over Temperature

Range (V)	Measurement Voltage, AO+ to AO GND		
	Minimum (V) <sup>[2]</sup>	Typical (V)	Maximum (V)
±10	±10.1	±10.16	±10.22

### 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 6.** AO Absolute Accuracy (Calibrated)

Specifications	±10 V Range
Residual Gain Error (ppm of Reading)	87.3

Specifications	±10 V Range
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 7.** 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:

- $\text{TempChangeFromLastExternalCal} = 10\text{ }^\circ\text{C}$
- $\text{TempChangeFromLastInternalCal} = 1\text{ }^\circ\text{C}$

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

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

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

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

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

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

## 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 8.** Settling Time

Step Size (V)	Accuracy		
	±16 LSB	±4 LSB	±2 LSB
±20.0	5.3 μs	6.5 μs	7.8 μs
±2.0	3.2 μs	3.9 μs	4.4 μs
±0.2	1.8 μs	2.8 μs	3.8 μs
Slew rate	10 V/μs		
Noise	250 μV RMS, DC to 1 MHz		
Glitch energy at midscale transition	±10 mV for 3 μs		

## 5V Output

Output voltage	4.75 V to 5.1 V
Output current	0.5 A maximum

Overvoltage protection	±30 V
Overcurrent protection	650 mA

## Digital I/O

**Table 9.** Channel Frequency

Connector	Number of Channels	Maximum Frequency
Connector 0	16	10 MHz
Connector 1	32	80 MHz
Compatibility	LVTTTL, LVCMOS	
Logic family	Software-selectable	
Default software setting	3.3 V	

**Table 10.** Digital Input Logic Levels

Logic Family	Input Low Voltage ( $V_{IL}$ ) Maximum	Input High Voltage ( $V_{IH}$ ) Minimum
1.2 V	0.42 V	0.84 V
1.5 V	0.51 V	1.01 V
1.8 V	0.61 V	1.21 V
2.5 V	0.70 V	1.60 V
3.3 V	0.80 V	2.00 V
Minimum input	-0.3 V	
Maximum input	3.6 V	
Input leakage current	±15 $\mu$ A maximum	

Input impedance	50 k $\Omega$ typical, pull-down
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**Table 11.** Digital Output Logic Levels

Logic Family	Current	Output Low Voltage (V <sub>OL</sub> ) Maximum	Output High Voltage (V <sub>OH</sub> ) Minimum
1.2 V	100 $\mu$ A	0.20 V	1.00 V
1.5 V	100 $\mu$ A	0.20 V	1.25 V
1.8 V	100 $\mu$ A	0.20 V	1.54 V
2.5 V	100 $\mu$ A	0.20 V	2.22 V
3.3 V	100 $\mu$ A	0.20 V	3.00 V
	4 mA	0.40 V	2.40 V

<b>Maximum DC output current per channel</b>	
Source	4.0 mA
Sink	4.0 mA
Output impedance	50 $\Omega$
Power-on state	Programmable, by line
Protection	$\pm$ 20 V, single line <sup>[3]</sup>
Digital I/O voltage selection	Programmable, per connector, and defined at compilation (not run-time configurable)
Direction control of digital I/O channels	Per channel
Minimum I/O pulse width	6.25 ns
Minimum sampling period	5 ns

## External Clock

Direction	Input into device
Maximum input leakage	$\pm 15 \mu\text{A}$
Characteristic impedance	50 $\Omega$
Power-on state	Tristated
Minimum input	
Maximum input	
Logic level	Inherited from programmed digital voltage selection per connector
Maximum input frequency	80 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	$\pm 100$ 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>
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	3 A
+12 V	2 A

## Physical Characteristics



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

Dimensions	18.5 cm × 17.3 cm × 3.6 cm(7.3 in. × 6.8 in. × 1.4 in.)
Weight	171.2 g (6.04 oz)
I/O connectors	2 × 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-7847R to signals or use for measurements within Measurement Categories II, III, or IV.



**Attention** Ne connectez pas le NI PXIe-7847R 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

## 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)
- 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](http://ni.com/product-certifications), search by model number, and click the appropriate link.

## Shock and Vibration

Operational shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
<b>Random vibration</b>	
Operating	5 Hz to 500 Hz, 0.3 g <sub>rms</sub>
Non-operating	.5 Hz to 500 Hz, 2.4 g <sub>rms</sub> (Tested in accordance with IEC 60068-2-64. Meets MIL-PRF-28800F Class 3.)

## Environmental

Refer to the manual for the chassis you are using for more information about meeting these specifications.

Operating temperature (IEC 60068-2-1, IEC 60068-2-2)	0 °C to 55 °C
Storage temperature (IEC 60068-2-1, IEC 60068-2-2)	-40 °C to 71 °C
Operating humidity (IEC 60068-2-78)	10% RH to 90% RH, noncondensing
Storage humidity (IEC 60068-2-78)	5% RH to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m


Indoor use only.

## 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](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.

## 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](http://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](http://ni.com/environment/rohs_china)。(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](http://ni.com/environment/rohs_china).)

## Calibration

Recommended warm-up time	15 minutes
Calibration interval	1 year
<b>Onboard calibration reference</b>	
DC level <sup>[4]</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](http://ni.com/calibration) to generate a calibration certificate for the NI PXIe-7847R

## NI Services

Visit [ni.com/support](https://ni.com/support) to find support resources including documentation, downloads, and troubleshooting and application development self-help such as tutorials and examples.

Visit [ni.com/services](https://ni.com/services) to learn about NI service offerings such as calibration options, repair, and replacement.

Visit [ni.com/register](https://ni.com/register) to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

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