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# PXle-4147 Specifications

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# PXIe-4147 Specifications

## 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.
- **Measured** specifications describe the measured performance of a representative model.

Specifications are **Warranted** unless otherwise noted.

## Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature<sup>1</sup> of 23 °C ± 5 °C
- Relative humidity between 10% and 70%, noncondensing. See [Programming and Measurement Accuracy/Resolution](#) for additional performance derating when operating above 70% relative humidity.
- Chassis with slot cooling capacity ≥38 W<sup>2</sup>
  - For chassis with slot cooling capacity = 38 W, fan speed set to HIGH

<sup>1</sup> The ambient temperature of a PXI system is defined as the temperature at the chassis fan inlet (air intake).

<sup>2</sup> For increased capability, NI recommends installing the PXIe-4147 in a chassis with slot cooling capacity ≥58 W.

- Calibration interval of 1 year
- 30 minutes warm-up time
- Self-calibration performed within the last 24 hours
- niDCPower Aperture Time property or NIDCPOWER\_ATTR\_APERTURE\_TIME attribute set to 2 power-line cycles (PLC)

## Block Diagrams

Figure 1. PXIe-4147 Block Diagram

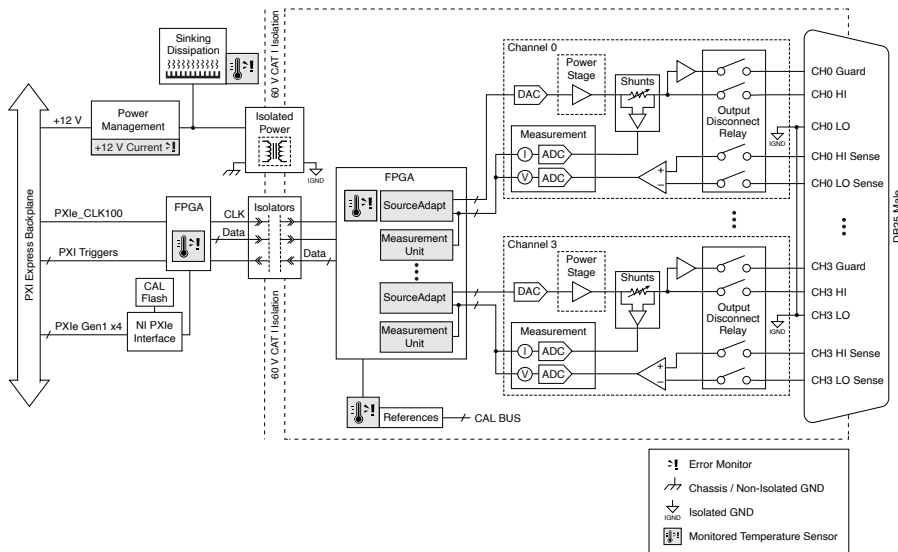
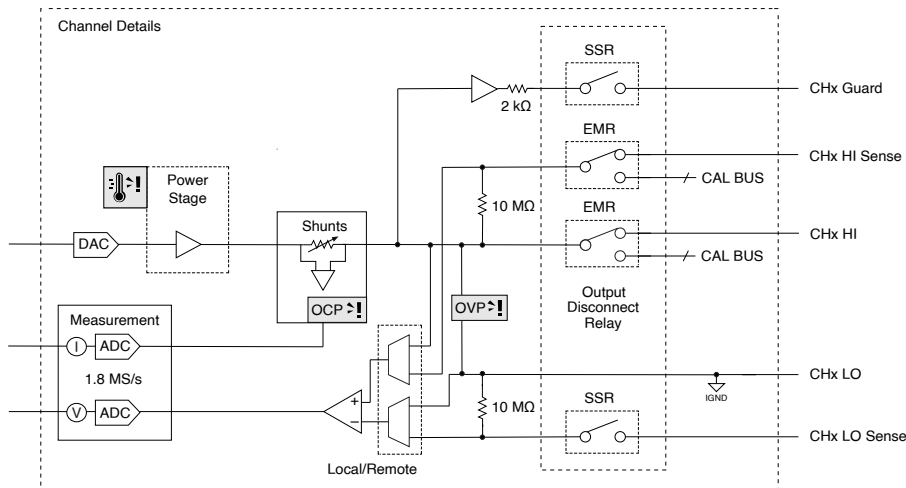


Figure 2. Channel-Level Block Diagram

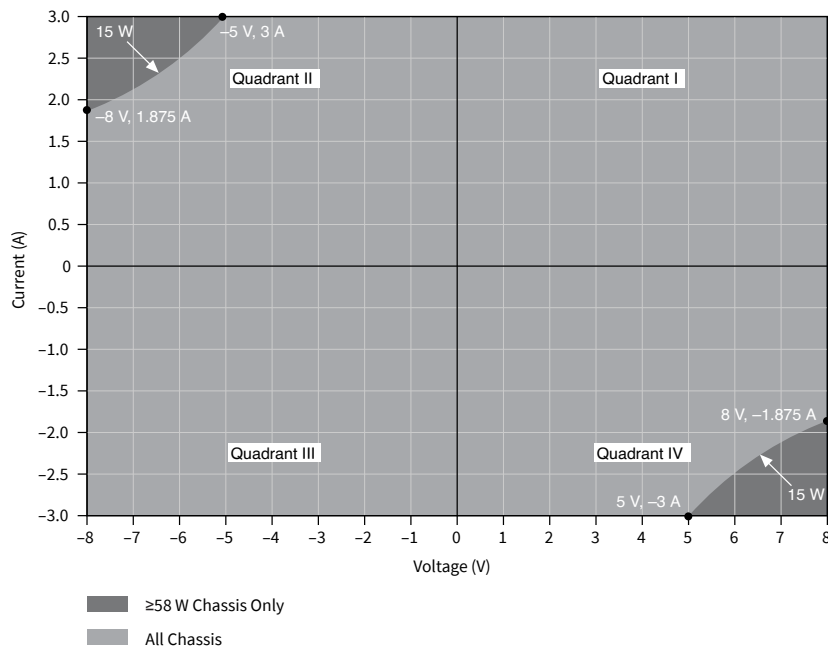


# Instrument Capabilities

Channels	0 through 3 <sup>3</sup>
DC voltage ranges	1 V, 8 V
DC current ranges	1 $\mu$ A, 10 $\mu$ A, 100 $\mu$ A, 1 mA, 10 mA, 100 mA, 3 A

The following figure illustrates the voltage and the current source and sink ranges of the PXIe-4147.

**Figure 1.** PXIe-4147 Quadrant Diagram, Any Channel



## Available DC output power<sup>4</sup>

### Sourcing<sup>5</sup>

All chassis	24 W per channel and 40 W total
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<sup>3</sup> Channels isolated from earth ground, but share a common LO for all channels (bank isolation).

<sup>4</sup> Power limit defined by voltage measured between HI and LO terminals.

<sup>5</sup> Sourcing power may be limited by total power available from the chassis power supply. Refer to the [Performing a Power Budget on a PXI/PXIe System](#) article for more information.

Sinking	
≥58 W Slot Cooling Capacity Chassis <sup>6</sup>	24 W per channel and 40 W total
<58 W Slot Cooling Capacity Chassis	15 W per channel and 15 W total

## Voltage

**Table 1.** Voltage Programming and Measurement Accuracy/Resolution

Range	Resolution (Noise Limited)	Noise (0.1 Hz to 10 Hz, peak- to-peak, typical)	Accuracy ± (% of Voltage + Offset) <sup>7</sup>		Tempco <sup>8</sup> ± (% of Voltage + Offset)/°C
			T <sub>ambient</sub> 23 °C ± 5 °C, T <sub>cal</sub> <sup>9</sup> ± 5 °C		
			Multiple Channels <sup>10</sup>	Single Channel <sup>11</sup>	T <sub>ambient</sub> 0 °C to 55 °C, T <sub>cal</sub> ± 5 °C
1 V	100 nV	2 μV	0.025% + 110 μV	0.02% + 70 μV	0.0002% + 1 μV
8 V	1 μV	12 μV	0.02% + 600 μV	0.015% + 400 μV	

<sup>6</sup> When sinking more than 15 W into the PXIe-4147, transients may not exceed 200 mW/μs.

<sup>7</sup> Refer to the [Remote Sense](#) and [Load Regulation](#) sections for additional accuracy derating and conditions.

<sup>8</sup> Temperature coefficient applies beyond 23 °C ± 5 °C ambient within ± 5 °C of T<sub>cal</sub>.

<sup>9</sup> T<sub>cal</sub> is the internal device temperature recorded by the PXIe-4147 at the completion of the last self-calibration.

<sup>10</sup> Multiple-channel specifications apply whenever two or more channels are connected and sourcing/sinking current. Multiple-channel specifications account for interactions between the channels when operated at high current, including board heating.

<sup>11</sup> Single-channel specifications assume only one channel is connected and sourcing/sinking current which results in improved accuracy due to the reduction of effects between the channels, including board heating. When transitioning from a multiple-channel configuration to a single-channel configuration, a ten-minute cool down period is required to meet Single Channel accuracy specifications.

## Current

**Table 2.** Current Programming and Measurement Accuracy/Resolution

Range	Resolution (Noise Limited)	Noise (0.1 Hz to 10 Hz, peak- to-peak, typical)	Accuracy $\pm$ (% of Current + Offset) <sup>12</sup>		Tempco <sup>13</sup> $\pm$ (% of Current + Offset)/°C
			T <sub>ambient</sub> 23 °C $\pm$ 5 °C, T <sub>cal</sub> <sup>14</sup> $\pm$ 5 °C		
			Multiple Channels <sup>15</sup>	Single Channel <sup>16</sup>	T <sub>ambient</sub> 0 °C to 55 °C, T <sub>cal</sub> $\pm$ 5 °C
1 $\mu$ A	100 fA	8 pA	0.045% + 250 pA	0.035% + 150 pA	0.0003% + 2 pA
10 $\mu$ A	1 pA	60 pA	0.05% + 1.6 nA	0.035% + 1 nA	
100 $\mu$ A	10 pA	400 pA	0.045% + 14 nA	0.035% + 8 nA	
1 mA	100 pA	4 nA	0.04% + 120 nA	0.03% + 70 nA	
10 mA	1 nA	40 nA	0.04% + 1.2 $\mu$ A	0.03% + 700 nA	
100 mA	10 nA	400 nA	0.045% + 12 $\mu$ A	0.035% + 7 $\mu$ A	
3 A	1 $\mu$ A	40 $\mu$ A	0.07% + 800 $\mu$ A	0.07% + 400 $\mu$ A	

## Noise

Wideband source noise <sup>17</sup>	<10 mV <sub>pk-pk</sub> , typical
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<sup>12</sup> Relative humidity between 10% and 70%, noncondensing. When operating above 70% relative humidity, add 30 pA to current accuracy specifications.

<sup>13</sup> Temperature coefficient applies beyond 23 °C  $\pm$  5 °C ambient within  $\pm$  5 °C of T<sub>cal</sub>.

<sup>14</sup> T<sub>cal</sub> is the internal device temperature recorded by the PXIe-4147 at the completion of the last self-calibration.

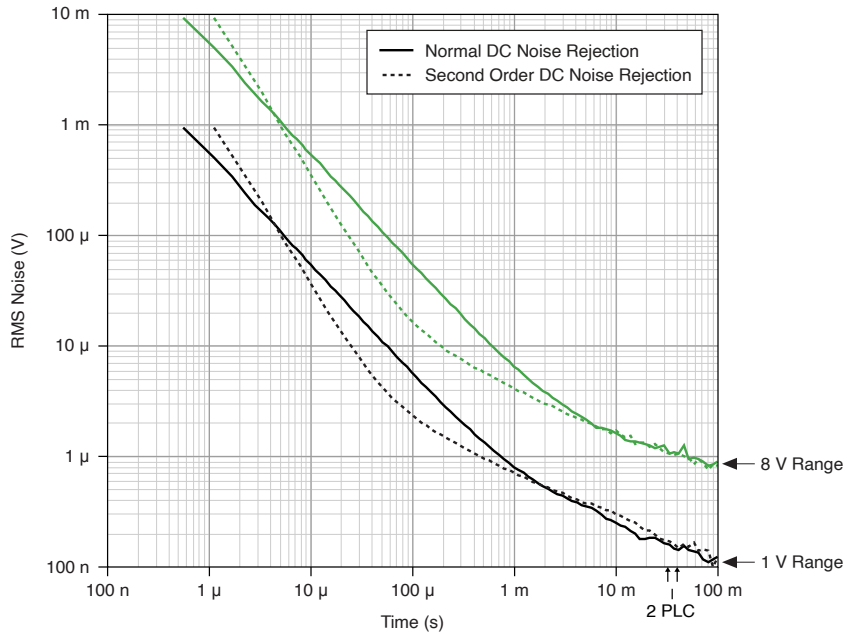
<sup>15</sup> Multiple-channel specifications apply whenever two or more channels are connected and sourcing/sinking current. Multiple-channel specifications account for interactions between the channels when operated at high current, including board heating.

<sup>16</sup> Single-channel specifications assume only one channel is connected and sourcing/sinking current which results in improved accuracy due to the reduction of effects between the channels, including board heating. When transitioning from a multiple-channel configuration to a single-channel configuration, a ten-minute cool down period is required to meet Single Channel accuracy specifications.

<sup>17</sup> 10 Hz to 20 MHz bandwidth. PXIe-4147 configured for normal transient response.

The following figures illustrate measurement noise as a function of measurement aperture for the PXIe-4147.

**Figure 1.** Voltage RMS Noise Versus Aperture Time, Nominal

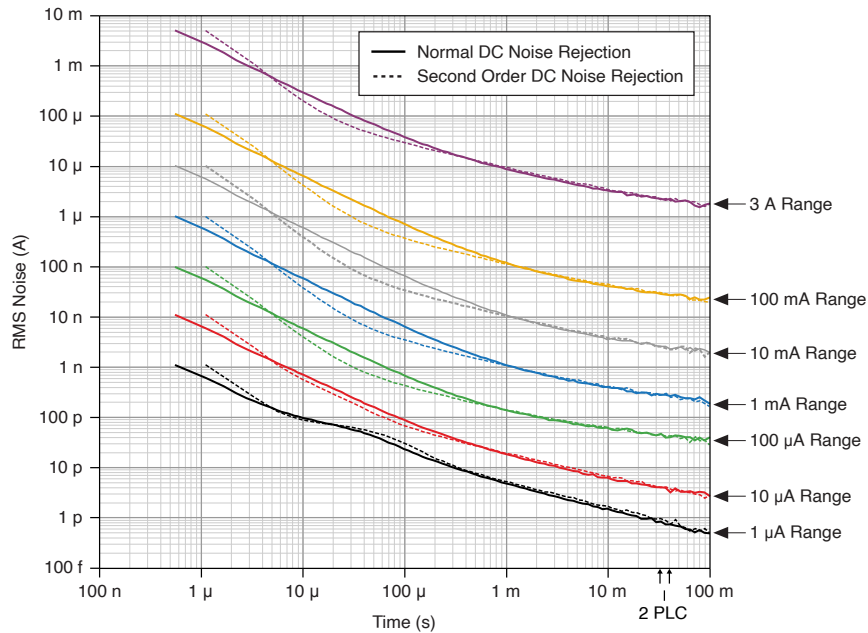


**Note** When the aperture time is set to two power-line cycles (PLCs), measurement noise differs slightly depending on whether the niDCPower Power Line Frequency property or NIDCPOWER\_ATTR\_POWER\_LINE\_FREQUENCY attribute is set to 50 Hz or 60 Hz.



**Note** To configure normal or second-order DC noise rejection, set the niDCPower DC Noise Rejection property or NIDCPOWER\_ATTR\_DC\_NOISE\_REJECTION attribute.



**Figure 1. Current RMS Noise Versus Aperture Time, Nominal**

**Note** When the aperture time is set to two power-line cycles (PLCs), measurement noise differs slightly depending on whether the niDCPower Power Line Frequency property or NIDCPOWER\_ATTR\_POWER\_LINE\_FREQUENCY attribute is set to 50 Hz or 60 Hz.



**Note** To configure normal or second-order DC noise rejection, set the niDCPower DC Noise Rejection property or NIDCPOWER\_ATTR\_DC\_NOISE\_REJECTION attribute.

## Transient Response and Settling Time

### Settling time<sup>18</sup>

Voltage mode,  $\leq 4$  V step, unloaded<sup>19</sup>

$< 50$   $\mu$ s, typical

<sup>18</sup> Measured as the time to settle to within 0.1% of step amplitude, PXIe-4147 configured for fast transient response.

<sup>19</sup> Current limit set to  $\geq 30$   $\mu$ A and  $\geq 20\%$  of the selected current limit range.

Current mode, full-scale step, 3 A to 100 $\mu$ A ranges <sup>20</sup> <a href="#">[20]</a>	<50 $\mu$ s, typical
Current mode, full-scale step, 10 $\mu$ A range <sup>20</sup> <a href="#">[20]</a>	<100 $\mu$ s, typical
Current mode, full-scale step, 1 $\mu$ A range <sup>20</sup> <a href="#">[20]</a>	<200 $\mu$ s, typical
<b>Transient response<sup>21</sup></b>	
3 A to 100 $\mu$ A ranges	<40 $\mu$ s, typical
10 $\mu$ A range	<100 $\mu$ s, typical
1 $\mu$ A range	<200 $\mu$ s, typical

## Remote Sense

Voltage accuracy	Add (10 ppm of voltage range + 25 $\mu$ V) per volt of LO lead drop, plus 10 $\mu$ V per volt of HI lead drop to voltage accuracy specification
Maximum sense lead resistance	100 $\Omega$
Maximum lead drop per lead	1 V, maximum 8 V between HI and LO terminals

## Load Regulation

Voltage, local sense <sup>22</sup>	100 $\mu$ V/mA, nominal; 200 $\mu$ V/mA, maximum
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<sup>20</sup> Voltage limit set to  $\geq 2$  V, resistive load set to 1 V/selected current range.

<sup>21</sup> Time to recover within 10 mV after a load current change from 10% to 90% of range, PXIe-4147 configured for fast transient response.

<sup>22</sup> At the output terminals of attached TB-414X Screw Terminal Connector Kit.

Voltage, remote sense	Error included in accuracy specifications.
Current	Error included in accuracy specifications.

## Isolation

Isolation voltage, any pin to earth ground <sup>23</sup>	60 V DC, CAT I
Withstand voltage	800 V <sub>pk</sub>

## Protection

<b>Absolute maximum voltage to Output LO, all pins</b>	
Output HI	±10 V
All other pins	±60 V
<b>Output channel protection</b>	
Overcurrent or overvoltage	Automatic shutdown, output disconnect relay opens
Overtemperature	Automatic shutdown, output disconnect relay opens

## Guard Output Characteristics

<b>Cable guard</b>	
Output impedance	2 kΩ, nominal

<sup>23</sup> Channels isolated from earth ground, but share a common LO for all channels (bank isolation).

Offset voltage	1 mV, typical
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## Output Resistance Programming Accuracy

**Table 3.** Output Resistance Programming Accuracy

Current Level/ Limit Range	Voltage Mode		Current Mode	
	Programmable Resistance Range	Accuracy, $\pm$ (% of Resistance Setting + Offset) <sup>24</sup> [24]	Programmable Resistance Range	Accuracy, $\pm$ (% of resistance setting    Offset) <sup>24</sup> [24]
1 $\mu$ A	0 to $\pm$ 4 M $\Omega$	0.05% + 100 $\Omega$	$\pm$ 2.5 M $\Omega$ to $\pm$ infinity	0.05%    100 G $\Omega$
10 $\mu$ A	0 to $\pm$ 400 k $\Omega$	0.05% + 10 $\Omega$	$\pm$ 250 k $\Omega$ to $\pm$ infinity	0.05%    10 G $\Omega$
100 $\mu$ A	0 to $\pm$ 40 k $\Omega$	0.05% + 1 $\Omega$	$\pm$ 25 k $\Omega$ to $\pm$ infinity	0.05%    1 G $\Omega$
1 mA	0 to $\pm$ 4 k $\Omega$	0.05% + 100 m $\Omega$	$\pm$ 2.5 k $\Omega$ to $\pm$ infinity	0.05%    100 M $\Omega$
10 mA	0 to $\pm$ 400 $\Omega$	0.05% + 10 m $\Omega$	$\pm$ 250 $\Omega$ to $\pm$ infinity	0.05%    10 M $\Omega$
100 mA	0 to $\pm$ 40 $\Omega$	0.05% + 1 m $\Omega$	$\pm$ 25 $\Omega$ to $\pm$ infinity	0.05%    1 M $\Omega$
3 A	0 to $\pm$ 1.25 $\Omega$	0.08% + 100 $\mu\Omega$	$\pm$ 750 m $\Omega$ to $\pm$ infinity	0.08%    10 k $\Omega$

## Measurement and Update Timing

Available sample rates <sup>25</sup>	(1.8 MS/s)/N, nominal
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where

- $N = 1, 2, 3, \dots 2^{24}$

<sup>24</sup> Accuracy is typical and applies within  $\pm 5$  °C of last self calibration.

<sup>25</sup> When source-measuring, both the NI-DCPowerSource Delay and Aperture Time properties affect the sampling rate. When taking a measure record, only the Aperture Time property affects the sampling rate.

<ul style="list-style-type: none"> <li>▪ S is samples</li> </ul>	
Sample rate accuracy	Equal to PXIe_CLK100 accuracy, nominal
Maximum measure rate to host	1.8 MS/s per channel, continuous, nominal
Maximum source update rate <sup>26</sup>	100,000 updates/s, nominal
<b>Input trigger to</b>	
Source event delay	10 $\mu$ s, nominal
Source event jitter	2 $\mu$ s <sub>pk-pk</sub> , nominal
Measure event jitter	2 $\mu$ s <sub>pk-pk</sub> , nominal

## Triggers

<b>Input triggers</b>	
Types	Start Source Sequence Advance Measure
<b>Sources (PXI trigger lines 0 to 7)<sup>[27]</sup><sup>27</sup></b>	
Polarity	Active high (not configurable)

<sup>26</sup> As the source delay is adjusted or if advanced sequencing is used, maximum source update rates may vary.

<sup>27</sup> Pulse widths and logic levels are compliant with **PXI Express Hardware Specification Revision 1.0 ECN 1**.

Minimum pulse width	100 ns
<b>Destinations<sup>28</sup> (PXI trigger lines 0 to 7)<sup>[27]</sup></b>	
Polarity	Active high (not configurable)
Minimum pulse width	>200 ns
<b>Output triggers (events)</b>	
Types	Source Complete Sequence Iteration Complete Sequence Engine Done Measure Complete
<b>Destinations (PXI trigger lines 0 to 7)<sup>[27]</sup></b>	
Polarity	Active high (not configurable)
Pulse width	230 ns

## Physical

Dimensions	3U, one-slot, PXI Express/CompactPCI Express module  2.0 cm × 13.0 cm × 21.6 cm (0.8 in. × 5.1 in. × 8.5 in.)
<b>Weight</b>	
20 W	448 g (15.8 oz)

<sup>28</sup> Input triggers can come from any source (PXI trigger or software trigger) and be exported to any PXI trigger line. This allows for easier multi-board synchronization regardless of the trigger source.

40 W	428 g (15.1 oz)
Front panel connectors	25-position D-SUB, male

## Calibration Interval

Recommended calibration interval	1 year
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## Power Requirements

+3.3 V	1 A, typical
+12 V	1.3 A, typical at idle; 6 A, maximum at full load

## Environmental Characteristics

### Temperature and Humidity

<b>Temperature</b>	
Operating	0 °C to 55 °C <sup>29</sup>
Storage	-40 °C to 71 °C
<b>Humidity</b>	
Operating	10% to 90%, noncondensing <sup>30</sup>

<sup>29</sup> Not all chassis can achieve this ambient temperature range. Refer to PXI chassis specifications to determine the ambient temperature ranges your chassis can achieve.

<sup>30</sup> When transitioning a device from a storage or operation environment with relative humidity above 70%, device should be allowed to stabilize in the lower humidity environment for several hours before use. Refer to the PXIe-4147 **Programming and Measurement Accuracy/Resolution** specifications for additional performance derating when operating above 70% relative humidity.

Storage	5% to 95%, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)