

SPECIFICATIONS

PXIe-4147

PXIe, 4-channel  $\pm 8$  V, 3 A PXI Source Measure Unit

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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.

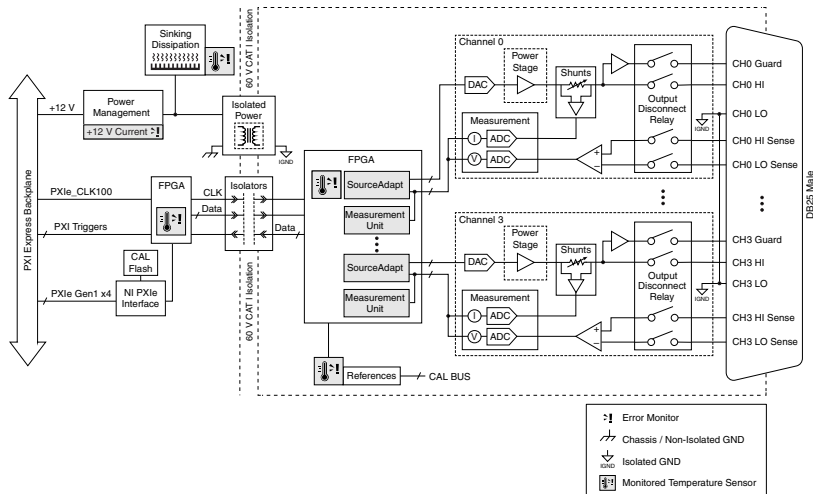
## Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature<sup>1</sup> of  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$
- 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  $\geq 38\text{ W}$ <sup>2</sup>
  - For chassis with slot cooling capacity = 38 W, fan speed set to HIGH
- Calibration interval of 1 year
- 30 minutes warm-up time
- Self-calibration performed within the last 24 hours
- **nIDC Power Aperture Time** property or `NIDCPOWER_ATTR_APERTURE_TIME` attribute set to 2 power-line cycles (PLC)

## Block Diagrams

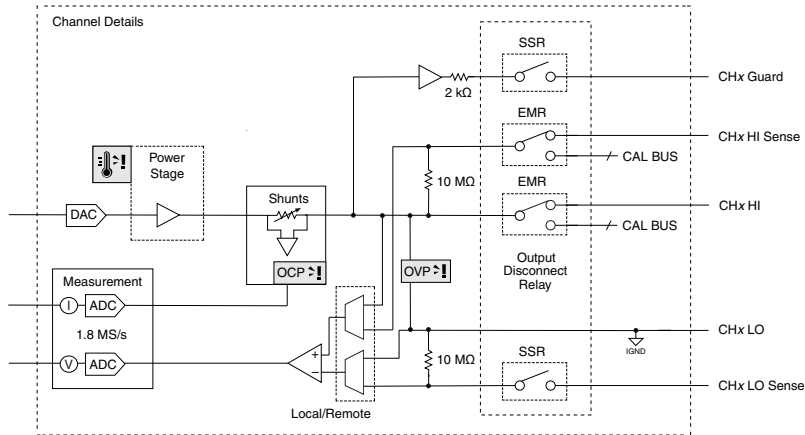
**Figure 1. PXIe-4147 Block Diagram**



<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  $\geq 58\text{ W}$ .

Figure 2. Channel-Level Block Diagram



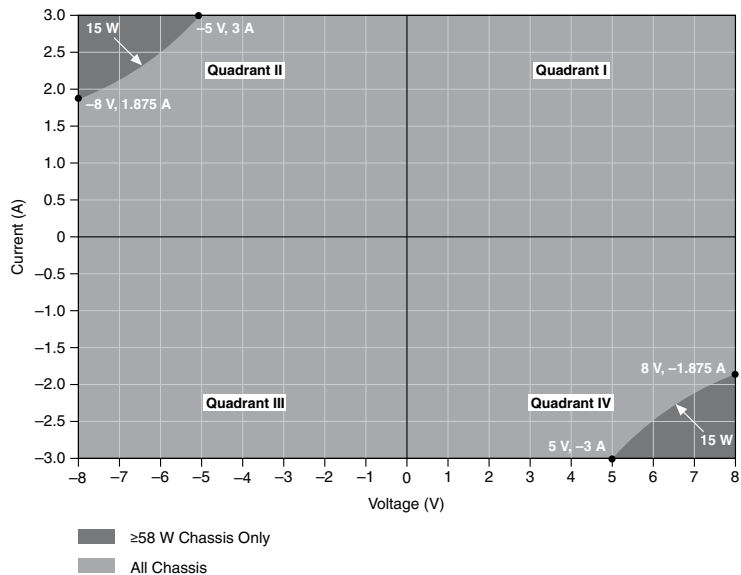
Instrument Capabilities

Channels	0 through 3 <sup>3</sup>
DC voltage ranges	1 V, 8 V
DC current ranges	1 μA, 10 μA, 100 μA, 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.

<sup>3</sup> Channels isolated from earth ground, but share a common LO for all channels (bank isolation).

Figure 3. 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
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

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

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>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 ± (% of Current + Offset) <sup>12</sup>		Tempco <sup>8</sup> ± (% of Current + Offset)/°C
			T <sub>ambient</sub> 23 °C ±5 °C, T <sub>cal</sub> <sup>9</sup> ±5 °C		T <sub>ambient</sub> 0 °C to 55 °C, T <sub>cal</sub> ±5 °C
			Multiple Channels <sup>10</sup>	Single Channel <sup>11</sup>	
1 µA	100 fA	8 pA	0.045% + 250 pA	0.035% + 150 pA	0.0003% + 2 pA
10 µA	1 pA	60 pA	0.05% + 1.6 nA	0.035% + 1 nA	
100 µA	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 µA	0.03% + 700 nA	
100 mA	10 nA	400 nA	0.045% + 12 µA	0.035% + 7 µA	
3 A	1 µA	40 µA	0.07% + 800 µA	0.07% + 400 µA	

Noise

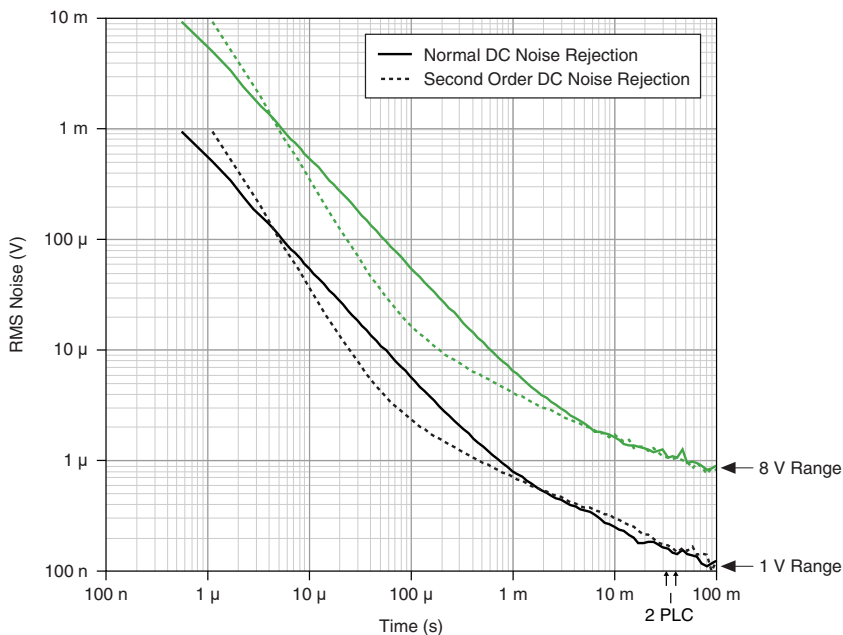
Wideband source noise<sup>13</sup> <10 mV<sub>pk-pk</sub>, typical

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

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

**Figure 4. Voltage RMS Noise Versus Aperture Time, Nominal**

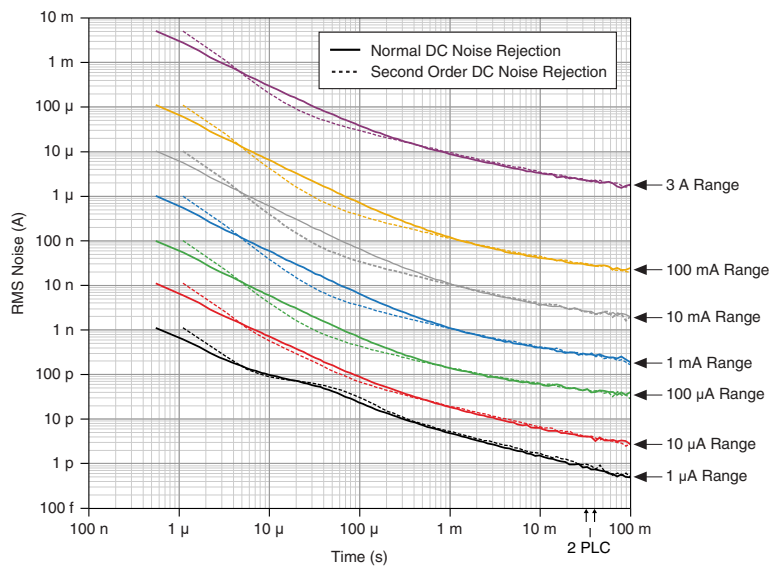


**Note** When the aperture time is set to two power-line cycles (PLCs), measurement noise differs slightly depending on whether the **niDCPower Power Line Frequency** property or **NIDCPOWER\_ATTR\_POWER\_LINE\_FREQUENCY** attribute is set to 50 Hz or 60 Hz.



**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 5. 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>14</sup>

Voltage mode, ≤4 V step, unloaded <sup>15</sup>	<50 μs, typical
Current mode, full-scale step, 3 A to 100 μA ranges <sup>16</sup>	<50 μs, typical

<sup>14</sup> Measured as the time to settle to within 0.1% of step amplitude, PXIe-4147 configured for fast transient response.

<sup>15</sup> Current limit set to ≥30 μA and ≥20% of the selected current limit range.

<sup>16</sup> Voltage limit set to ≥2 V, resistive load set to 1 V/selected current range.



Current mode, full-scale step, 10 $\mu$ A range <sup>16</sup>	<100 $\mu$ s, typical
Current mode, full-scale step, 1 $\mu$ A range <sup>16</sup>	<200 $\mu$ s, typical
Transient response <sup>17</sup>	
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>18</sup>	100 $\mu$ V/mA, nominal; 200 $\mu$ V/mA, maximum
Voltage, remote sense	Error included in accuracy specifications.
Current	Error included in accuracy specifications.

## Isolation

Isolation voltage, any pin to earth ground <sup>19</sup>	60 V DC, CAT I
Withstand voltage	800 V <sub>pk</sub>

<sup>17</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>18</sup> At the output terminals of attached TB-414X Screw Terminal Connector Kit.

<sup>19</sup> Channels isolated from earth ground, but share a common LO for all channels (bank isolation).

Protection

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

Guard Output Characteristics

Cable guard	
Output impedance	2 kΩ, nominal
Offset voltage	1 mV, typical

Output Resistance Programming Accuracy

Table 3. Output Resistance Programming Accuracy

Current Level/ Limit Range	Voltage Mode		Current Mode	
	Programmable Resistance Range	Accuracy, ±(% of Resistance Setting + Offset) <sup>20</sup>	Programmable Resistance Range	Accuracy, ±(% of resistance setting    Offset) <sup>20</sup>
1 μA	0 to ±4 MΩ	0.05% + 100 Ω	±2.5 MΩ to ±infinity	0.05%    100 GΩ
10 μA	0 to ±400 kΩ	0.05% + 10 Ω	±250 kΩ to ±infinity	0.05%    10 GΩ
100 μA	0 to ±40 kΩ	0.05% + 1 Ω	±25 kΩ to ±infinity	0.05%    1 GΩ
1 mA	0 to ±4 kΩ	0.05% + 100 mΩ	±2.5 kΩ to ±infinity	0.05%    100 MΩ

<sup>20</sup> Accuracy is typical and applies within ±5 °C of last self calibration.

Table 3. Output Resistance Programming Accuracy (Continued)

Current Level/ Limit Range	Voltage Mode		Current Mode	
	Programmable Resistance Range	Accuracy, ±(% of Resistance Setting + Offset) <sup>20</sup>	Programmable Resistance Range	Accuracy, ±(% of resistance setting    Offset) <sup>20</sup>
10 mA	0 to ±400 Ω	0.05% + 10 mΩ	±250 Ω to ±infinity	0.05%    10 MΩ
100 mA	0 to ±40 Ω	0.05% + 1 mΩ	±25 Ω to ±infinity	0.05%    1 MΩ
3 A	0 to ±1.25 Ω	0.08% + 100 μΩ	±750 mΩ to ±infinity	0.08%    10 kΩ

Measurement and Update Timing

Available sample rates <sup>21</sup>	(1.8 MS/s)/N, nominal
where	
$N = 1, 2, 3, \dots 2^{24}$	
S is samples	
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>22</sup>	100,000 updates/s, nominal
Input trigger to	
Source event delay	10 μs, nominal
Source event jitter	2 μs <sub>pk-pk</sub> , nominal
Measure event jitter	2 μs <sub>pk-pk</sub> , nominal

<sup>20</sup> Accuracy is typical and applies within ±5 °C of last self calibration.

<sup>21</sup> When source-measuring, both the NI-DCPower **Source Delay** and **Aperture Time** properties affect the sampling rate. When taking a measure record, only the **Aperture Time** property affects the sampling rate.

<sup>22</sup> As the source delay is adjusted or if advanced sequencing is used, maximum source update rates may vary.

## Triggers

Input triggers	
Types	Start Source Sequence Advance Measure
Sources (PXI trigger lines 0 to 7) <sup>23</sup>	
Polarity	Active high (not configurable)
Minimum pulse width	100 ns
Destinations <sup>24</sup> (PXI trigger lines 0 to 7) <sup>23</sup>	
Polarity	Active high (not configurable)
Minimum pulse width	>200 ns
Output triggers (events)	
Types	Source Complete Sequence Iteration Complete Sequence Engine Done Measure Complete
Destinations (PXI trigger lines 0 to 7) <sup>23</sup>	
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.)
Weight	448 g (15.8 oz)
Front panel connectors	25-position D-SUB, male

<sup>23</sup> Pulse widths and logic levels are compliant with *PXI Express Hardware Specification Revision 1.0 ECN 1*.

<sup>24</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.

## 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	
Temperature	
Operating	0 °C to 55 °C <sup>25</sup>
Storage	-40 °C to 71 °C
Humidity	
Operating	10% to 90%, noncondensing <sup>26</sup>
Storage	5% to 95%, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)

<sup>25</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>26</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.

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