SPECIFICATIONS

# PXIe-4147

PXIe, 4-channel ±8 V, 3 A PXI Source Measure Unit

## Contents



## 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.

NATIONAL INSTRUMENTS

# Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature[1] of 23 °C ± 5 ºC
- 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[2]
  - 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
- **niDCPower Aperture Time** property or `NIDCPOWER_ATTR_APERTURE_TIME` attribute set to 2 power-line cycles (PLC)

# Instrument Capabilities

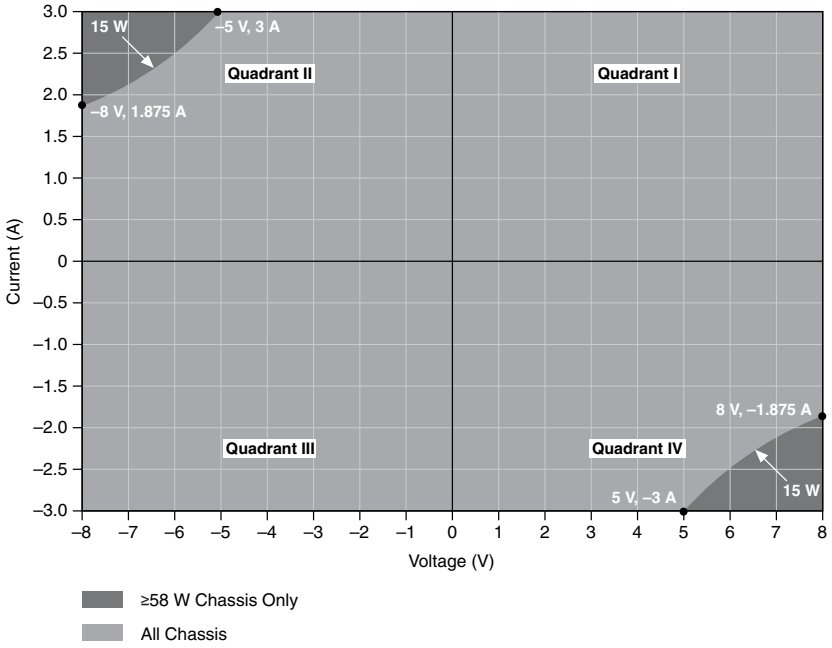
| | |
|---|---|
| Channels | 0 through 3 |
| DC voltage ranges | 1 V, 8 V |
| DC current ranges | 1 µA, 10 µA, 100 µA, 1 mA, 10 mA, 100 mA, 3 A |

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

[1] The ambient temperature of a PXI system is defined as the temperature at the chassis fan inlet (air intake).

[2] For increased capability, NI recommends installing the PXIe-4147 in a chassis with slot cooling capacity ≥58 W.

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




| | |
|---|---|
| Available DC output power[3] | |
| Sourcing[4] | |
| All chassis | 24 W per channel and 40 W total |
| Sinking | |
| ≥58 W Slot Cooling Capacity Chassis[5] | 24 W per channel and 40 W total |
| <58 W Slot Cooling Capacity Chassis | 15 W per channel and 15 W total |

[3] Power limit defined by voltage measured between HI and LO terminals.

[4] 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.

[5] When sinking more than 15 W into the PXIe-4147, transients may not exceed 200 mW/µs.

# Voltage Programming and Measurement Accuracy/Resolution

**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)[6] | | Tempco[7] ± (% of Voltage + Offset)/°C |
|---|---|---|---|---|---|
| | | | $T_{ambient}$ 23 °C ±5 °C, $T_{cal}$[8] ±5 °C | | |
| | | | Multiple Channels[9] | Single Channel[10] | $T_{ambient}$ 0 °C to 55 °C, $T_{cal}$ ±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 | |

6 Refer to the *Remote Sense* and *Load Regulation* sections for additional accuracy derating and conditions.

7 Temperature coefficient applies beyond 23 °C ±5 °C ambient within ±5 °C of $T_{cal}$.

8 $T_{cal}$ is the internal device temperature recorded by the PXIe-4147 at the completion of the last self-calibration.

9 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.

10 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.

**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)[11] | | Tempco[7] ± (% of Current + Offset)/°C |
|---|---|---|---|---|---|
| | | | $T_{ambient}$ 23 °C ±5 °C, $T_{cal}$[8] ±5 °C | | $T_{ambient}$ 0 °C to 55 °C, $T_{cal}$ ±5 °C |
| | | | Multiple Channels[9] | Single Channel[10] | |
| 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 | |

# Transient Response and Settling Time

Settling time[12]

| | |
|---|---|
| Voltage mode, ≤4 V step, unloaded[13] | <50 µs, typical |
| Current mode, full-scale step, 3 A to 100 µA ranges[14] | <50 µs, typical |

[11] Relative humidity between 10% and 70%, noncondensing. When operating above 70% relative humidity, add 30 pA to current accuracy specifications.

[12] Measured as the time to settle to within 0.1% of step amplitude, PXIe-4147 configured for fast transient response.

[13] Current limit set to ≥30 µA and ≥20% of the selected current limit range.

[14] Voltage limit set to ≥2 V, resistive load set to 1 V/selected current range.

| | |
|---|---|
| Current mode, full-scale step, 10 µA range[14] | <100 µs, typical |
| Current mode, full-scale step, 1 µA range[14] | <200 µs, typical |
| Transient response[15] | |
| 3 A to 100 µA ranges | <40 µs, typical |
| 10 µA range | <100 µs, typical |
| 1 µA range | <200 µs, typical |

# Noise

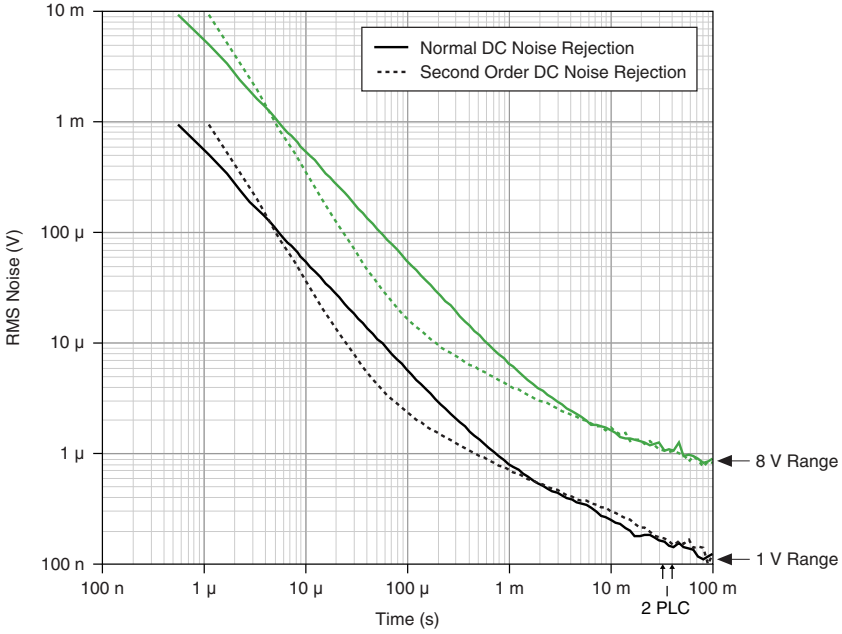
| | |
|---|---|
| Wideband source noise[16] | <10 $mV_{pk-pk}$, typical |

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

[15] Time to recover within 10 mV after a load current change from 10% to 90% of range, PXIe-4147 configured for fast transient response.

[16] 10 Hz to 20 MHz bandwidth. PXIe-4147 configured for normal transient response.

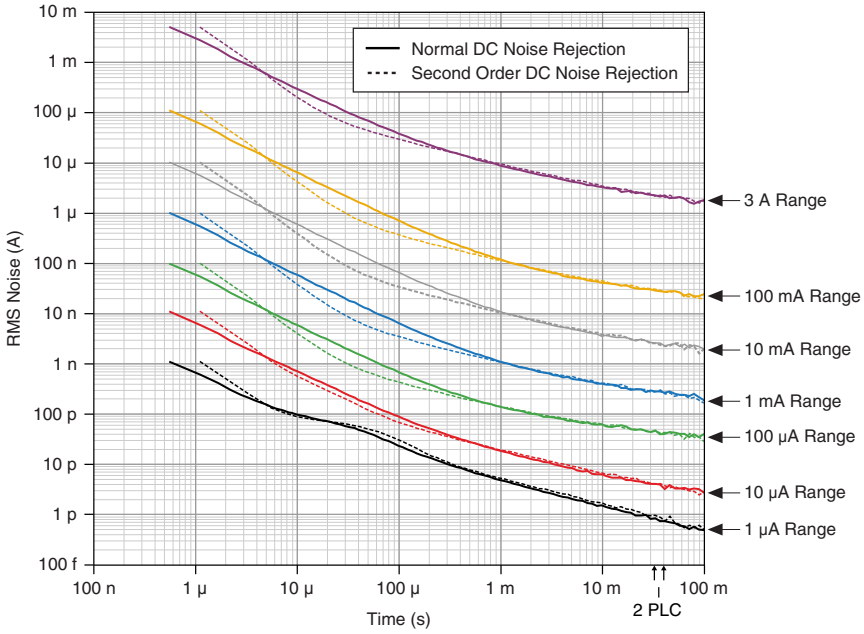
**Figure 2.** Voltage RMS Noise Versus Aperture Time, Nominal




**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 3.** 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.

# Remote Sense

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

# Load Regulation

| | |
|---|---|
| Voltage, local sense[17] | 100 µV/mA, typical |
| Voltage, remote sense | Error included in accuracy specifications. |
| Current | Error included in accuracy specifications. |

# Isolation

| | |
|---|---|
| Isolation voltage, any pin to earth ground | 60 V DC, CAT I |
| Withstand voltage | 800 $V_{pk}$ |

# 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 |

[17] At front panel connector pins.

# 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)[18] | Programmable Resistance Range | Accuracy, ±(% of resistance setting \|\| Offset)[18] |
| 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 |
| 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 |

[18] Accuracy is typical and applies within ±5 °C of last self calibration.

# Measurement and Update Timing

| | |
|---|---|
| Available sample rates[19] | (1.8 MS/s)/*N*, nominal |

where

*N* = 1, 2, 3, … $2^{24}$

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[20] | 100,000 updates/s, nominal |
| Input trigger to | |
| Source event delay | 10 µs, nominal |
| Source event jitter | 2 $\mu s_{pk\text{-}pk}$, nominal |
| Measure event jitter | 2 $\mu s_{pk\text{-}pk}$, nominal |

# Triggers

| | |
|---|---|
| Input triggers | |
| Types | Start<br>Source<br>Sequence Advance<br>Measure |
| Sources (PXI trigger lines 0 to 7)[21] | |
| Polarity | Active high (not configurable) |
| Minimum pulse width | 100 ns |
| Destinations[22] (PXI trigger lines 0 to 7)[21] | |
| Polarity | Active high (not configurable) |
| Minimum pulse width | >200 ns |

[19] 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.

[20] As the source delay is adjusted or if advanced sequencing is used, maximum source update rates may vary.

[21] Pulse widths and logic levels are compliant with *PXI Express Hardware Specification Revision 1.0 ECN 1*.

[22] 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.

| | |
|---|---|
| Output triggers (events) | |
| Types | Source Complete<br>Sequence Iteration Complete<br>Sequence Engine Done<br>Measure Complete |
| Destinations (PXI trigger lines 0 to 7)[21] | |
| Polarity | Active high (not configurable) |
| Pulse width | 230 ns |

# Physical

| | |
|---|---|
| Dimensions | 3U, one-slot, PXI Express/CompactPCI Express module<br>2.0 cm × 13.0 cm × 21.6 cm<br>(0.8 in. × 5.1 in. × 8.5 in.) |
| Weight | 448 g (15.8 oz) |
| Front panel connectors | 25-position D-SUB, male |

# Calibration Interval

| | |
|---|---|
| Recommended calibration interval | 1 year |

# 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[23] |
| Storage | -40 °C to 71 °C |

[23] Not all chassis can achieve this ambient temperature range. Refer to PXI chassis specifications to determine the ambient temperature ranges your chassis can achieve.

| | |
|---|---|
| Humidity | |
| Operating | 10% to 90%, noncondensing[24] |
| Storage | 5% to 95%, noncondensing |
| Pollution Degree | 2 |
| Maximum altitude | 2,000 m (800 mbar) (at 25 °C ambient temperature) |

## Shock and Vibration

| | |
|---|---|
| Random vibration | |
| Operating | 5 Hz to 500 Hz, 0.3 g RMS |
| Non-operating | 5 Hz to 500 Hz, 2.4 g RMS |
| Operating shock | 30 g, half-sine, 11 ms pulse |

[24] 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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