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# PXle-4140

# Specifications

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# PXIe-4140 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.

Specifications are **Warranted** unless otherwise noted.

## Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature<sup>1</sup> of  $23\text{ °C} \pm 5\text{ °C}$
- 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)
- Fans set to the highest setting if the PXI Express chassis has multiple fan speed settings

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

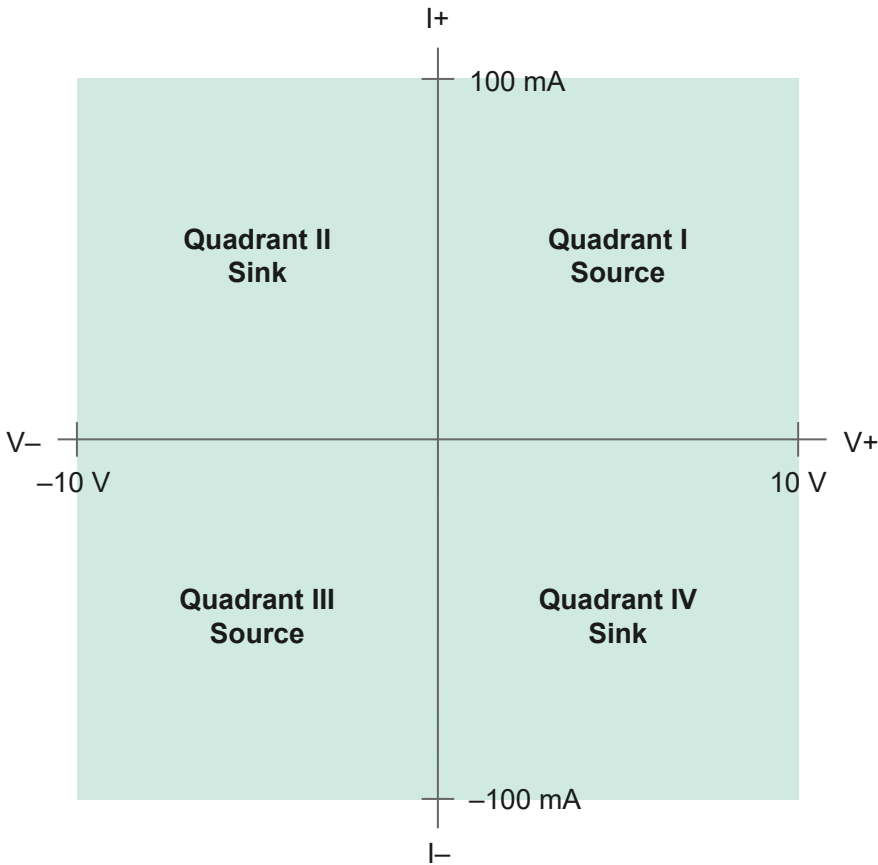
# Device Capabilities

The following table and figure illustrate the voltage and the current source and sink ranges of the PXIe-4140.

**Table 1.** Current Source and Sink Ranges

Channels	DC Voltage Ranges	DC Current Source and Sink Ranges
0 through 3 <sup>*</sup>	±10 V	<ul style="list-style-type: none"><li>• 10 µA</li><li>• 100 µA</li><li>• 1 mA</li><li>• 10 mA</li><li>• 100 mA</li></ul>
<sup>*</sup> Channels are isolated from earth ground but share a common LO.		

**Figure 1.** Quadrant Diagram, All Channels



# SMU Specifications

## Voltage Programming and Measurement Accuracy/Resolution

Table 2. Voltage Programming and Measurement Accuracy/Resolution

Range	Resolution and noise (0.1 Hz to 10 Hz)	1 Year Accuracy (23 °C ± 5 °C) ± (% of voltage + offset), <sup>2</sup> T <sub>cal</sub> ± 5 °C	Tempco ± (% of voltage + offset)/°C, 0 °C to 55 °C
10 V	100 µV	0.1% + 5.0 mV	0.0005% + 1 µV

### Related tasks:

- [Calculating SMU Resolution](#)

### Related reference:

- [Additional Specifications](#)

## Current

Table 3. Current Programming and Measurement Accuracy/Resolution

Range	Resolution and noise (0.1 Hz to 10 Hz)	1 Year Accuracy (23 °C ± 5 °C) ± (% of current + offset), T <sub>cal</sub> ± 5 °C	Tempco ± (% of current + offset)/°C, 0 °C to 55 °C
10 µA	100 pA	0.1% + 5.0 nA	0.002% + 10 pA
100 µA	1 nA	0.1% + 50 nA	0.002% + 100 pA
1 mA	10 nA	0.1% + 500 nA	0.002% + 1.0 nA
10 mA	100 nA	0.1% + 5.0 µA	0.002% + 10 nA
100 mA	1 µA	0.1% + 50 µA	0.002% + 100 nA

### Related tasks:

- [Calculating SMU Resolution](#)

2. Accuracy is specified for no load output configurations. Refer to Load Regulation and Remote Sense in the **Additional Specifications** section for additional accuracy derating and conditions.

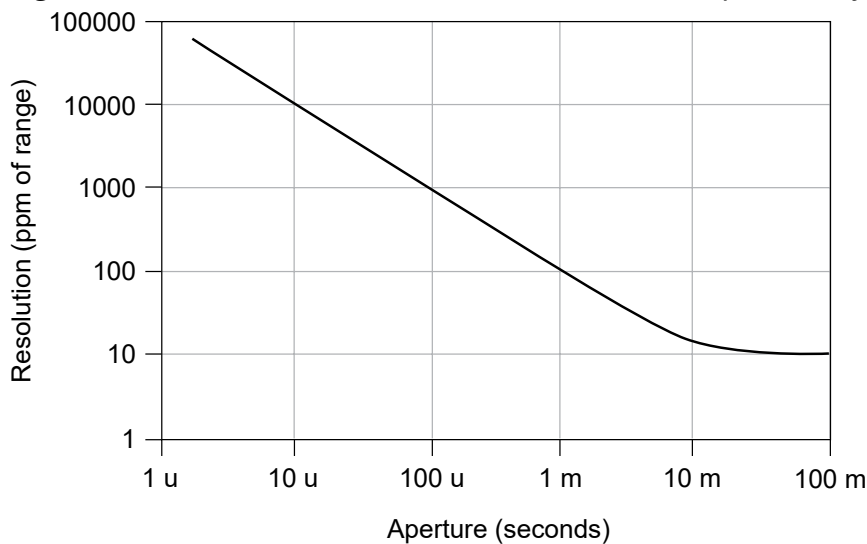
## Related reference:

- [Additional Specifications](#)

## Calculating SMU Resolution

Refer to the following figure as you complete the following steps to derive a resolution in absolute units:

**Figure 2.** Noise and Resolution versus Measurement Aperture, Typical



1. Select a voltage or current range.
2. For a given aperture time, find the corresponding resolution.
3. To convert resolution from ppm of range to absolute units, multiply resolution in ppm of range by the selected range.

## Example of Calculating SMU Resolution

The PXle-4140 has a resolution of 1,000 ppm when set to a 100  $\mu$ s aperture time. In the 10 V range, resolution can be calculated by multiplying 10 V by 1,000 ppm, as shown in the following equation:

$$10 \text{ V} * 1,000 \text{ ppm} = 10 \text{ V} * 1,000 * 1 \times 10^{-6} = 10 \text{ mV}$$

Likewise, in the 100 mA range, resolution can be calculated by multiplying 100 mA by 1,000 ppm, as shown in the following equation:

$$100 \text{ mA} * 1,000 \text{ ppm} = 100 \text{ mA} * 1,000 * 1 \times 10^{-6} = 100 \text{ } \mu\text{A}$$

## Additional Specifications

Settling time <sup>3</sup>	<100 $\mu\text{s}$ to settle to 0.1% of voltage step, device configured for fast transient response, typical
Transient response	<100 $\mu\text{s}$ to recover within $\pm 20 \text{ mV}$ after a load current change from 10% to 90% of range, device configured for fast transient response, typical
Wideband source noise <sup>4</sup>	1.5 mV RMS, typical <20 mV <sub>pk-pk</sub> , typical
Cable guard output impedance	10 k $\Omega$ , typical

Remote sense	
Voltage	Add 0.1% of LO lead drop to voltage accuracy specification
Current	Add 0.02% of range per volt of total HI and LO lead drop to current accuracy specification
Maximum lead drop	Up to 1 V drop per lead

Load regulation
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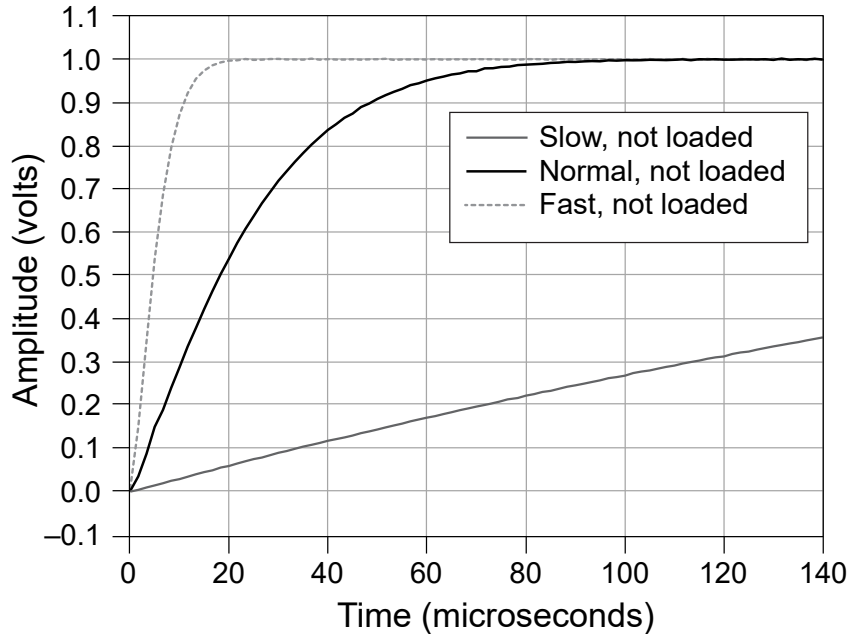
3. Current limit set to  $\geq 1 \text{ mA}$  and  $\geq 10\%$  of the selected current limit range.
4. 20 Hz to 20 MHz bandwidth. PXle-4140 configured for normal transient response.

Voltage	10 $\mu$ V at connector pins per mA of output load when using local sense, typical
Current	20 pA + (10 ppm of range per volt of output change) when using local sense, typical

Isolation voltage, channel-to-earth ground <sup>5</sup>	60 VDC, CAT I, verified by dielectric withstand test, 5 s, continuous
Absolute maximum voltage between any terminal and LO	20 V DC, continuous

The following figures illustrate the effect of the transient response setting on the step response of the PXle-4140 for different loads.

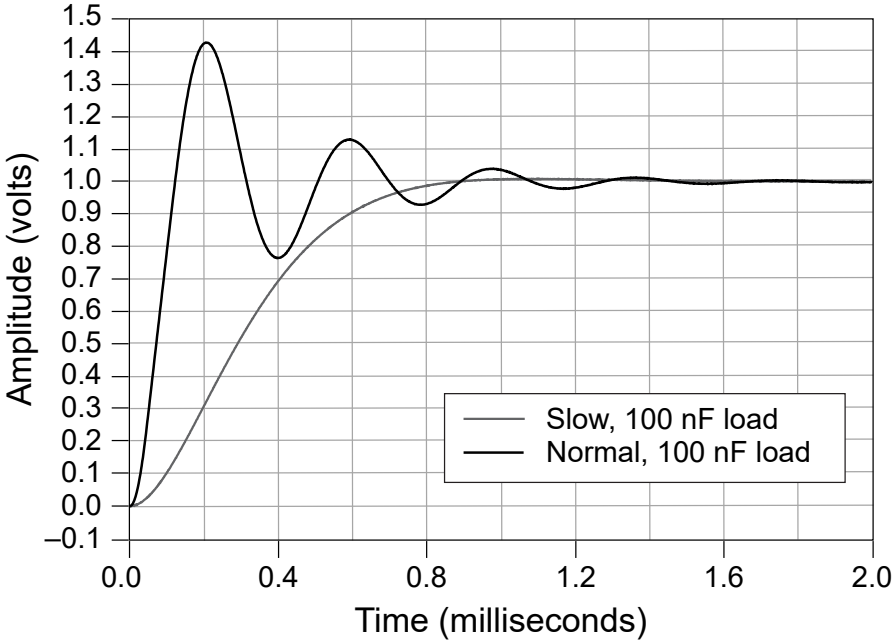
**Figure 3. 1 mA Range No Load Step Response, Typical**



5. Channels are isolated from earth ground but share a common LO.



Figure 4. 1 mA Range, 100 nF Load Step Response, Typical



Related reference:

- [Voltage Programming and Measurement Accuracy/Resolution](#)
- [Current](#)

## Supplemental Specifications

### Measurement and Update Timing

Available sample rates <sup>6</sup>	(600 kS/s)/N
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where

- $N = 6, 7, 8, \dots 2^{20}$
- S is samples

6. 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.

Sample rate accuracy	±50 ppm	
Maximum measure rate to host <sup>7</sup>	600,000 S/s per channel, continuous	
Maximum source update rate <sup>8</sup>		
Sequence length <300 steps per iteration	100,000 updates/s per channel	
Sequence length ≥300 steps per iteration	100,000 updates/s per board	
Input trigger to		
Source event delay	5 μs	
Source event jitter	1.7 μs	
Measure event jitter	1.7 μs	

## Triggers

<b>Input triggers</b>	
Types	Start Source Sequence Advance Measure

7. Load dependent settling time is not included. Normal DC noise rejection is used.

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

Sources (PXI trigger lines 0 to 7)	
Polarity	Configurable
Minimum pulse width	100 ns, nominal
Destinations <sup>9</sup> (PXI trigger lines 0 to 7)	
Polarity	Active high (not configurable)
Minimum pulse width	>200 ns, nominal

Output triggers (events)	
Types	Source Complete Sequence Iteration Complete Sequence Engine Done Measure Complete
Destinations (PXI trigger lines 0 to 7)	
Polarity	Configurable
Pulse width	Configurable between 250 ns and 1.6 $\mu$ s, nominal



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

9. 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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## 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	425 g (14.99 oz)
Front panel connectors	25-position D-SUB, male

## Power Requirements

PXI Express power requirement	600 mA from the 12 V rail and 350 mA from the 3.3 V rail
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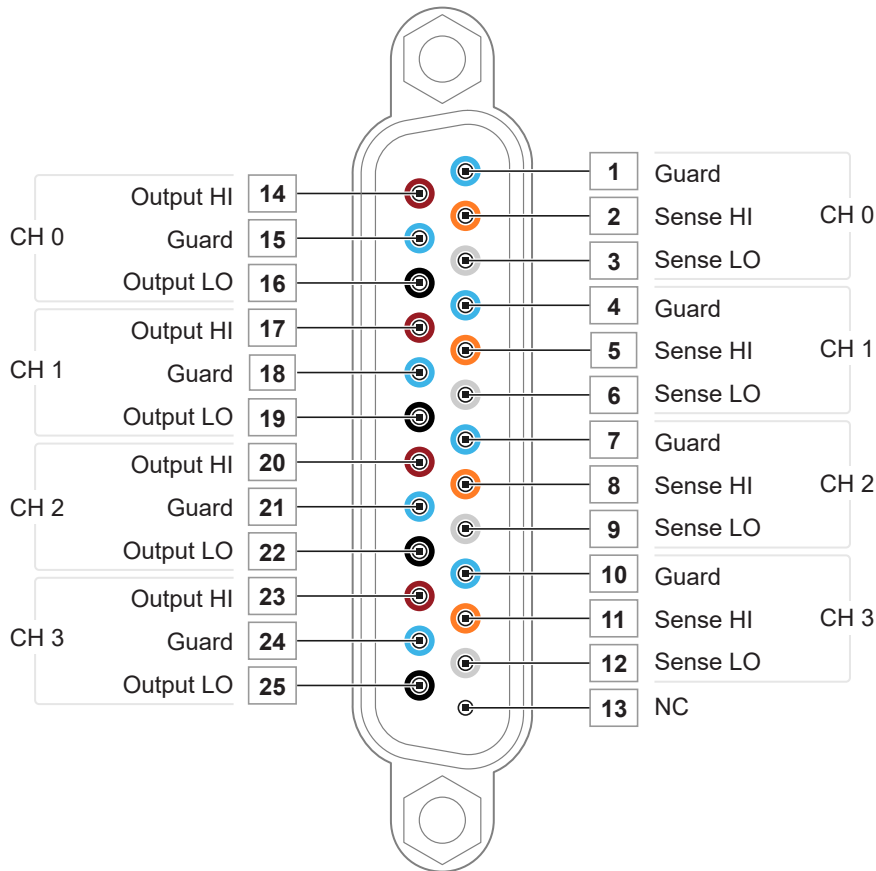
## Environmental Characteristics

<b>Temperature</b>	
Operating	0 °C to 55 °C
Storage	-40 °C to 70 °C
<b>Humidity</b>	

Operating	10% to 70%, noncondensing. Derate 1.3% per °C above 40 °C	
Storage	5% to 95%, noncondensing	
Pollution Degree	2	
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)	
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	

## PXle-4140 Pinout

The following figure shows the terminals on the PXle-4140 connector.

**Figure 5.** PXle-4140 Connector Pinout**Table 4.** Signal Descriptions

Signal Name	Description
CH <0..3> Output HI	HI force terminal connected to channel power stage (generates and/or dissipates power). Positive polarity is defined as voltage measured on HI > LO.
CH <0..3> Guard	Buffered output that follows the voltage of the HI force terminal. Used to drive shield conductors surrounding HI force and Sense HI conductors to minimize effects of leakage and capacitance on low level currents.
CH <0..3> Output LO	LO force terminal connected to channel power stage (generates and/or dissipates power). Positive polarity is defined as voltage measured on HI > LO.
CH <0..3> Sense HI	Voltage remote sense input terminals. Used to compensate for $I \cdot R$ voltage drops in cable leads, connectors, and switches.
CH <0..3> Sense LO	
NC	No Connect.



**Note** PXle-4140 channels are bank-isolated from earth ground, but also share a common LO.