PXIe-4145 Specifications

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Contents

PXIe-4145 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[1] of 23 °C ± 5 °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).

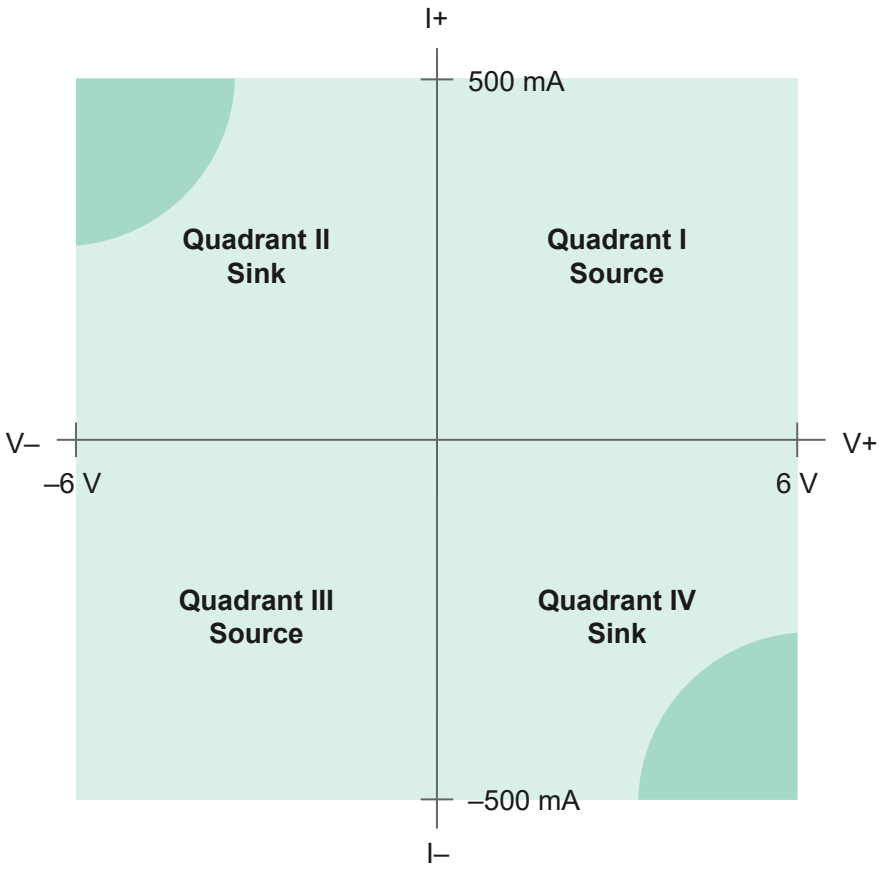
Device Capabilities

The following table and figure illustrate the voltage and the current source and sink ranges of the PXIe-4145.

Table 1. PXIe-4145 Current Source and Sink Ranges

Channels	DC Voltage Ranges	DC Current Source and Sink Ranges
0 through 3*	±6 V	• 10 µA • 100 µA • 1 mA • 10 mA • 100 mA • 500 mA
* Channels are isolated from earth ground but share a common LO.		

Figure 1. PXIe-4145 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)[2]		Tempco ± (% of voltage + offset)/°C, 0 °C to 55 °C
		T_{cal} ± 5 °C	T_{cal} ± 1 °C	
6 V	6 µV	0.015% + 600 µV	0.013% + 200 µV	0.0005% + 1 µV

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 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)		Tempco ± (% of current + offset)/°C, 0 °C to 55 °C
		T_{cal} ± 5 °C	T_{cal} ± 1 °C	
10 µA	15 pA	0.03% + 3 nA	0.03% + 1.2 nA	0.002% + 20 pA
100 µA	100 pA	0.03% + 25 nA	0.03% + 6.0 nA	0.002% + 200 pA
1 mA	1 nA	0.03% + 250 nA	0.03% + 60 nA	0.002% + 2.0 nA
10 mA	10 nA	0.03% + 2.5 µA	0.03% + 600 nA	0.002% + 20 nA
100 mA	100 nA	0.03% + 25 µA	0.03% + 6.0 µA	0.002% + 200 nA
500 mA	500 nA	0.1% + 125 µA	0.1% + 30 µA	0.008% + 1 µA

Related tasks:

- Calculating SMU Resolution

Related reference:

- Additional Specifications

Output Resistance Programming Accuracy/Resolution, Typical

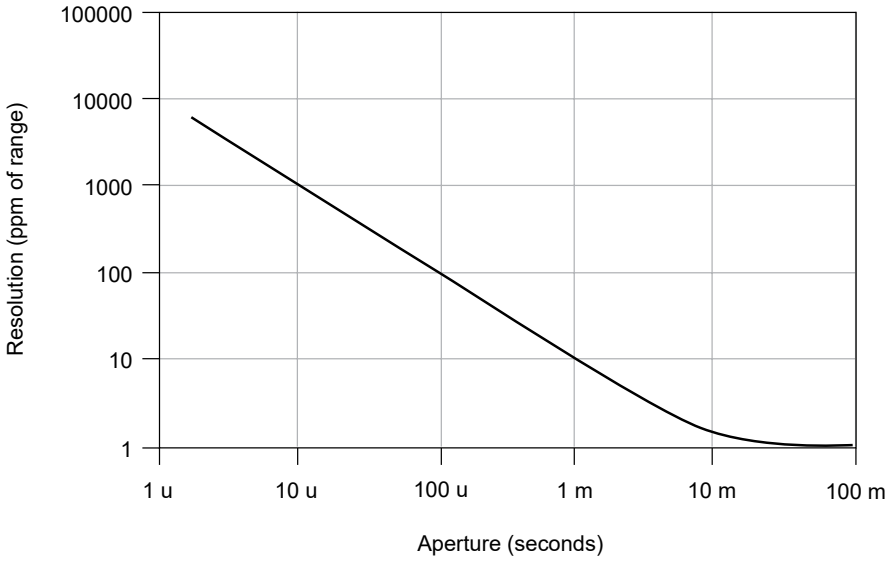
Table 4. Output Resistance Programming Accuracy/Resolution, Typical

Current limit range	Programmable resistance range	Resolution	Accuracy ± (% of resistance setting), T_{cal} ± 5 °C
10 µA	± 50 kΩ	1.0 Ω	0.04% + 260 mΩ
100 µA	± 5 kΩ	100 mΩ	0.04% + 35 mΩ
1 mA	± 500 Ω	10 mΩ	0.04% + 13 mΩ
10 mA	± 50 Ω	1.0 mΩ	0.04% + 10 mΩ
100 mA	± 5 Ω	100 µΩ	0.04% + 10 mΩ
500 mA	± 1 Ω	20 µΩ	0.12% + 10 mΩ

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 PXIe-4145 has a resolution of 100 ppm when set to a 100 µs aperture time. In the 6 V range, resolution can be calculated by multiplying 6 V by 100 ppm, as shown in the following equation:

$6\ V * 100\ ppm = 6\ V * 100 * 1\times10^{-6} = 600\ \mu V$

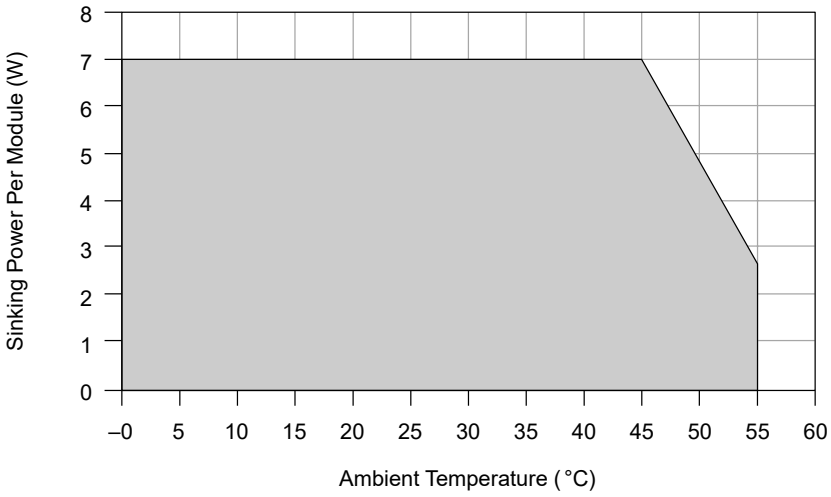
Likewise, in the 10 mA range, resolution can be calculated by multiplying 10 mA by 100 ppm, as shown in the following equation:

$10\ mA * 100\ ppm = 10\ mA * 100 * 1\times10^{-6} = 1\ \mu A$

Sinking Power vs. Ambient Temperature Derating

The following figure illustrates sinking power derating as a function of ambient temperature.

Figure 3. Sinking Power vs Ambient Temperature Derating



Additional Specifications

Settling time[3]	<100 µs to settle to 0.1% of voltage step, device configured for fast transient

	response, typical
Transient response	<100 µs to recover within ±20 mV after a load current change from 10% to 90% of range, device configured for fast transient response, typical
Wideband source noise[4]	1.5 mV RMS, typical <20 mV_{pk-pk}, typical
Cable guard output impedance	10 kΩ, typical

Remote sense	
Voltage	Add 0.1% of LO lead drop to voltage accuracy specification
Current	No additional error due to lead drop
Maximum lead drop	Up to 1 V drop per lead for $\|V_{out}\| \leq 5$ V. For $\|V_{out}\| > 5$ V, keep sum of $\|V_{out}\|$ and total lead drop below 7 V

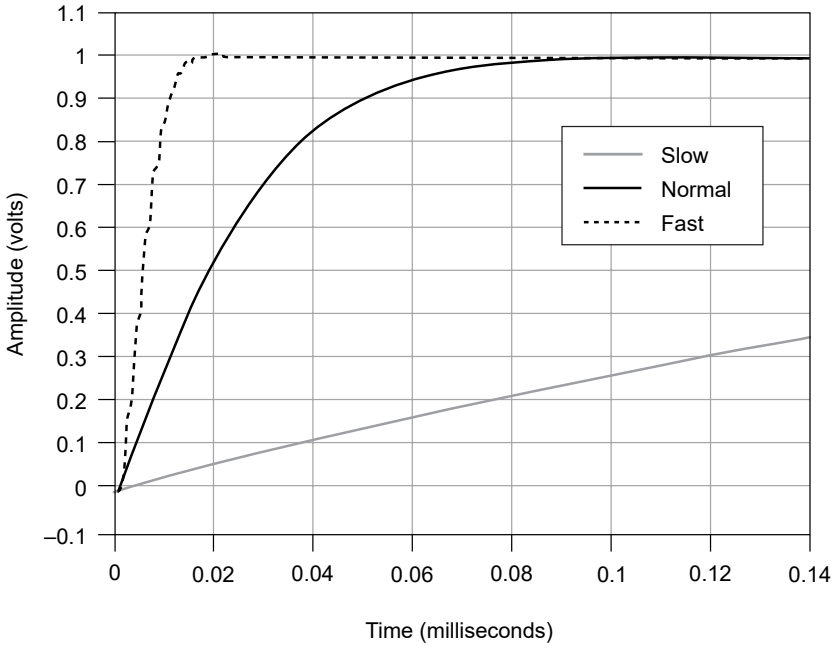
Load regulation	
Voltage	10 µV at connector pins per mA of output load when using local sense, typical
Current	20 pA + (1 ppm of range per volt of output change) when using local sense, typical

3. Current limit set to ≥1 mA and ≥10% of the selected current limit range.
4. 20 Hz to 20 MHz bandwidth. PXIe-4145 configured for normal transient response.

Isolation voltage, Channel-to-earth ground[5]	60 VDC, CAT I, verified by dielectric withstand test, 5 s, continuous, characteristic
Absolute maximum voltage between any terminal and LO	20 VDC, continuous

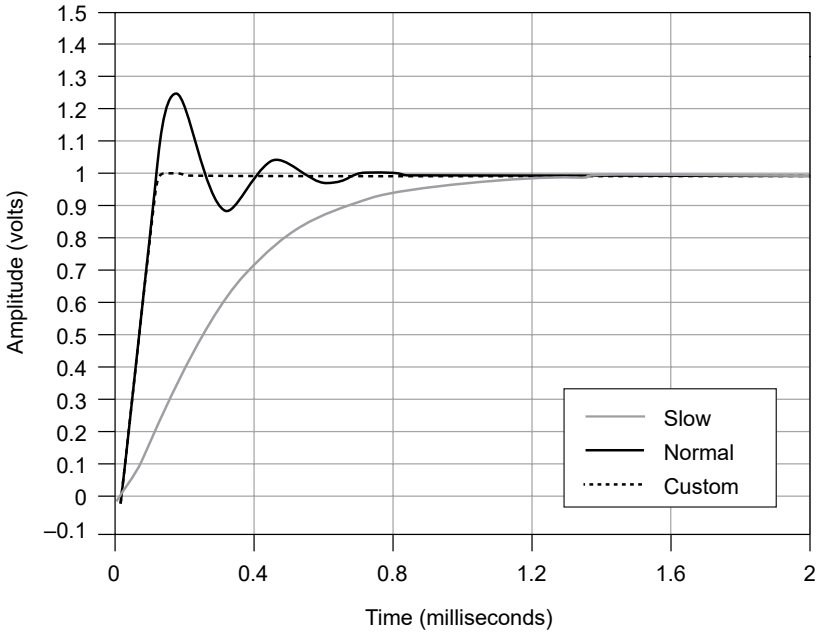
The following figures illustrate the effect of the transient response setting on the step response of the PXIe-4145 for different loads.

Figure 4. 1 mA Range No Load Step Response, Typical



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

Figure 5. 1 mA Range, 100 nF Load Step Response, Typical



Supplemental Specifications

Measurement and Update Timing

Available sample rates[6]	(600 kS/s)/N

where

- N = 6, 7, 8, … 2^{20}
- S is samples

Sample rate accuracy	±50 ppm

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.

Maximum measure rate to host[7]	600,000 S/s per channel, continuous
Maximum source update rate[8]	
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

Input triggers	
Types	Start Source Sequence Advance Measure
Sources (PXI trigger lines 0 to 7)	

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.

Polarity	Configurable
Minimum pulse width	100 ns, nominal
Destinations[9] **(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 µs, 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

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	408 g (14.39 oz)
Front panel connectors	25-position D-SUB, male

Power Requirements

PXI Express power requirement	2.1 A from the 12 V rail and 2.9 A from the 3.3 V rail

Environmental Characteristics

Temperature	
Operating	0 °C to 55 °C
Storage	-40 °C to 70 °C
Humidity	

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

PXIe-4145 Pinout

The following figure shows the terminals on the PXIe-4145 connector.

Figure 6. PXIe-4145 Connector Pinout

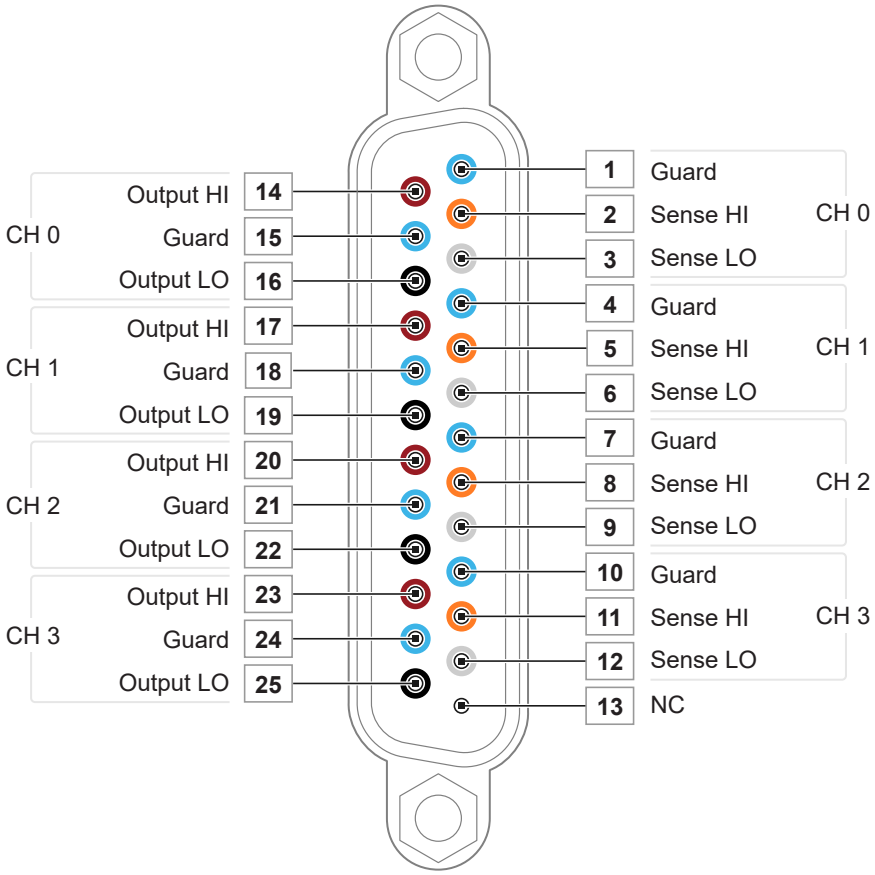


Table 5. Signal Descriptions

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*R*** voltage drops in cable leads, connectors, and switches.
CH <0..3> Sense LO	
NC	No Connect.

Note PXIe-4145 channels are bank-isolated from earth ground, but also share a common LO.