SPECIFICATIONS

PXIe-4141

4-Channel ±10 V, 100 mA, Precision PXI Source Measure Unit

These specifications apply to the PXIe-4141.

Contents

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

NATIONAL INSTRUMENTS

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 expected performance met by a majority of the models.
- *Nominal* specifications describe parameters and attributes that may be useful in operation.

Specifications are *Warranted* unless otherwise noted.

Conditions

Specifications are valid under the following conditions unless otherwise noted.

- Ambient temperature[1] of 23 °C ± 5 ºC
- 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)

Device Capabilities

The following table and figure illustrate the voltage and the current source and sink ranges of the PXIe-4141.

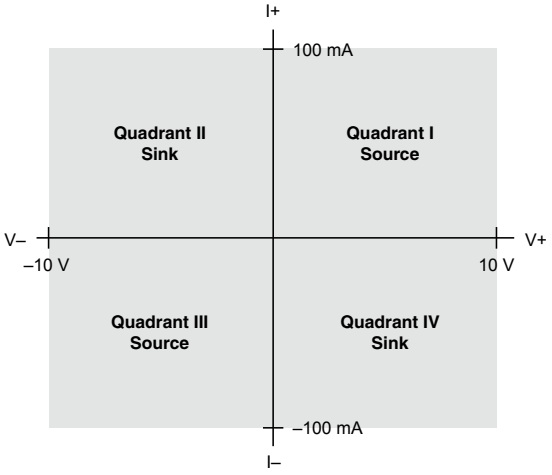
Table 1. Current Source and Sink Ranges

Channels	DC Voltage Ranges	DC Current Source and Sink Ranges
0 through 3[2]	±10 V	10 µA 100 µA 1 mA 10 mA 100 mA

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

[2] 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)	Accuracy (23 °C ± 5 °C) ± (% of voltage + offset)[3]		Tempco ± (% of voltage + offset)/°C, 0 °C to 55 °C
		T_{cal} ± 5 °C	T_{cal} ± 1 °C	
10 V	10 µV	0.015% + 600 µV	0.013% + 150 µV	0.0005% + 1 µV

Related Information

Additional Specifications on page 5
Calculating SMU Resolution on page 4

[3] 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.

Current Programming and Measurement Accuracy/ Resolution

Table 3. Current Programming and Measurement Accuracy/Resolution

Range	Resolution and noise (0.1 Hz to 10 Hz)	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	10 pA	0.03% + 1.5 nA	0.03% + 300 pA	0.002% + 10 pA
100 µA	100 pA	0.03% + 15 nA	0.03% + 3.0 nA	0.002% + 100 pA
1 mA	1 nA	0.03% + 150 nA	0.03% + 30 nA	0.002% + 1.0 nA
10 mA	10 nA	0.03% + 1.5 µA	0.03% + 300 nA	0.002% + 10 nA
100 mA	100 nA	0.03% + 15 µA	0.03% + 3.0 µA	0.002% + 100 nA

Related Information

Additional Specifications on page 5
Calculating SMU Resolution on page 4

Output Resistance Programming Accuracy/Resolution, Typical

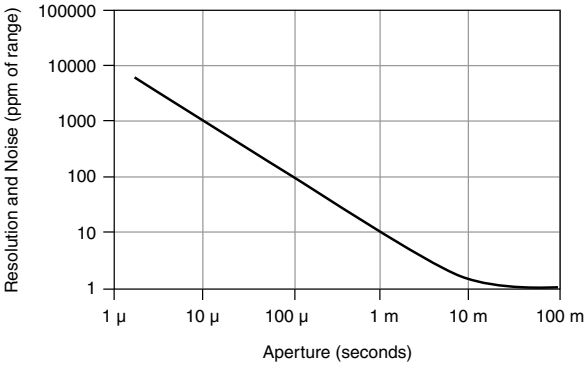
Table 4. Output Resistance Programming Accuracy/Resolution, Typical

Current limit range	Programmable resistance range	Resolution	Accuracy ± (% of resistance setting), T_{cal} ± 5 °C
10 µA	± 100 kΩ	1 Ω	0.04% + 510 mΩ
100 µA	± 10 kΩ	100 mΩ	0.04% + 60 mΩ
1 mA	± 1 kΩ	10 mΩ	0.04% + 15 mΩ
10 mA	± 100 Ω	1 mΩ	0.04% + 10 mΩ
100 mA	± 10 Ω	100 µΩ	0.04% + 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-4141 has a resolution of 100 ppm when set to a 100 µs aperture time. In the 10 V range, resolution can be calculated by multiplying 10 V by 100 ppm, as shown in the following equation:

$10\ V * 100\ ppm = 10\ V * 100 * 1 \times 10^{-6} = 1\ mV$

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

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

Additional Specifications

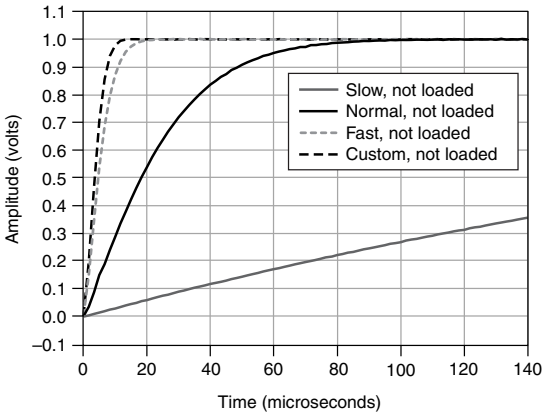
Settling time[4]	<100 µs to settle to 0.1% of voltage step, device configured for fast transient response, typical
Transient response	<100 µs to recover within ±20 mV after a load current change from 10% to 90% of range, device configured for fast transient response, typical

[4] Current limit set to ≥1 mA and ≥10% of the selected current limit range.

Wideband source noise	1.5 mV RMS (20 Hz to 20 MHz bandwidth), normal transient response, typical
Cable guard output impedance	10 kΩ, 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	
Voltage	10 µV 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[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

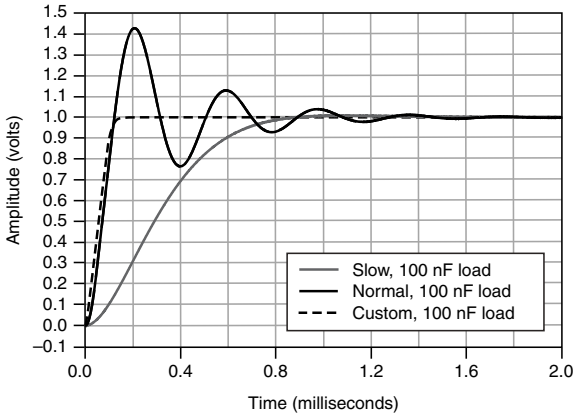
The following figures illustrate the effect of the transient response setting on the step response of the PXIe-4141 for different loads.

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 Information

Voltage Programming and Measurement Accuracy/Resolution on page 3
Current Programming and Measurement Accuracy/Resolution on page 4

Supplemental Specifications

Measurement and Update Timing

Available sample rates[6]	(600 kS/s)/*N* where *N*= 1, 2, 3, … 2^{20} and S is samples, nominal
Sample rate accuracy	±50 ppm
Maximum measure rate to host[7]	600,000 S/s per channel, continuous
Maximum source update rate[8]	100,000 updates/s
Input trigger to	
Source event delay	5 µs
Source event jitter	1.7 µs
Measure event jitter	1.7 µs

[6] When source-measuring, both the **niDCPower Source Delay** and **niDCPower Aperture Time** properties affect the sampling rate. When taking a measure record, only the **niDCPower Aperture Time** property affects the sampling rate.
[7] Load dependent settling time is not included. Normal DC noise rejection is used.
[8] As the source delay is adjusted, maximum source rates vary.

Triggers

Input triggers	
Types	Start, Source, Sequence Advance, Measure
Sources (PXI trigger lines 0 to 7)[9]	
Polarity	Configurable
Minimum pulse width	100 ns, nominal
Destinations[10] (PXI trigger lines 0 to 7)[9]	
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)[9]	
Polarity	Configurable
Pulse width	Configurable between 250 ns and 1.6 µs, nominal

Calibration Interval

Recommended calibration interval	1 year

Physical Characteristics

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

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

[10] 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.

Power Requirement

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

Environment

Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range	10% to 70%, noncondensing; derate 1.3% per °C above 40 °C (Tested in accordance with IEC 60068-2-56.) (Tested in accordance with IEC 60068-2-56.)

Storage Environment

Ambient temperature range	-40 °C to 70 ºC (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC 60068-2-56.)

Shock and Vibration

Operating shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)

Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g_{rms} (Tested in accordance with IEC 60068-2-64.)
Nonoperating	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC 60068-2-64. Test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Compliance and Certifications

Safety

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia, and New Zealand (per CISPR 11), Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations, certifications, and additional information, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at *ni.com/environment*. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit *ni.com/environment/weee*.

电子信息产品污染控制管理办法（中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令(RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

376075B-01 Jan17