APEX WAVES PXIe-4142 PXI Source Measure Unit User Manual

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PXIe-4142 Product Information

The PXIe-4142 is a device that provides voltage and current source and sink ranges. It is designed to operate under stated conditions and comes with a model warranty. The device has 32 channels that are isolated from earth ground but share a common LO. The voltage programming and measurement accuracy/resolution ranges from 24V to 200V with a resolution of 0.1% + 10mV to 0.0005% + 1V. The current programming and measurement accuracy/resolution ranges
from 10A to 150mA with a resolution of 0.1% + 5.0nA to 0.002% + 150nA.

PXIe-4142 Product Usage Instructions

To use the PXIe-4142, follow the steps below:

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

It is important to note that accuracy is specified for no load output configurations and additional accuracy derating and conditions may apply for load regulation and remote sense. The device also has additional specifications such as settling time, transient response, wideband source noise, cable guard output impedance, maximum lead drop, isolation voltage, channel-to-earth ground, and absolute maximum voltage between any terminal and LO, which can be found on page 6 of the user manual.

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 temperature1 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)
- Fans set to the highest setting if the PXI Express chassis has multiple fan speed settings

Device Capabilities

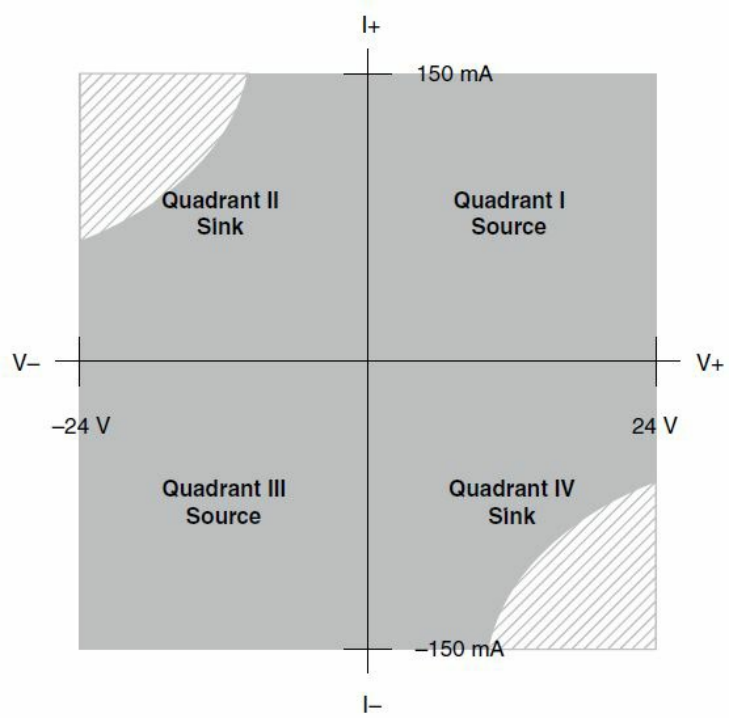
The following table and figure illustrate the voltage and the current source and sink ranges of the PXIe-4142.

Table 1. PXIe-4142 Current Source and Sink Ranges

Channels	DC Voltage Ranges	DC Current Source and Sink Ranges
0 through 3[2]	±24 V	10 µA 100 µA 1 mA 10 mA 150 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. PXIe-4142 Quadrant Diagram, All Channels



Limit power sinking to 6 W per module.

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] T_{cal} ±5 °C	Temperature Coefficient ± (% of V oltage + Offset) / °C[4], 0 °C to 55 °C
24 V	200 µV	0.1% + 10 mV	0.0005% + 1 µV

Related Information

- Additional Specifications on
- Calculating SMU Resolution on

Current

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), T_{cal} ±5 °C	Tempco ± (% of current + offset)/°C, 0 °C to 55 °C [5]
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% + 0.5 µA	0.002% + 1.0 nA
10 mA	100 nA	0.1% + 5.0 µA	0.002% + 10 nA
150 mA	1.5 µA	0.1% + 75 µA	0.002% + 150 nA

Related Information

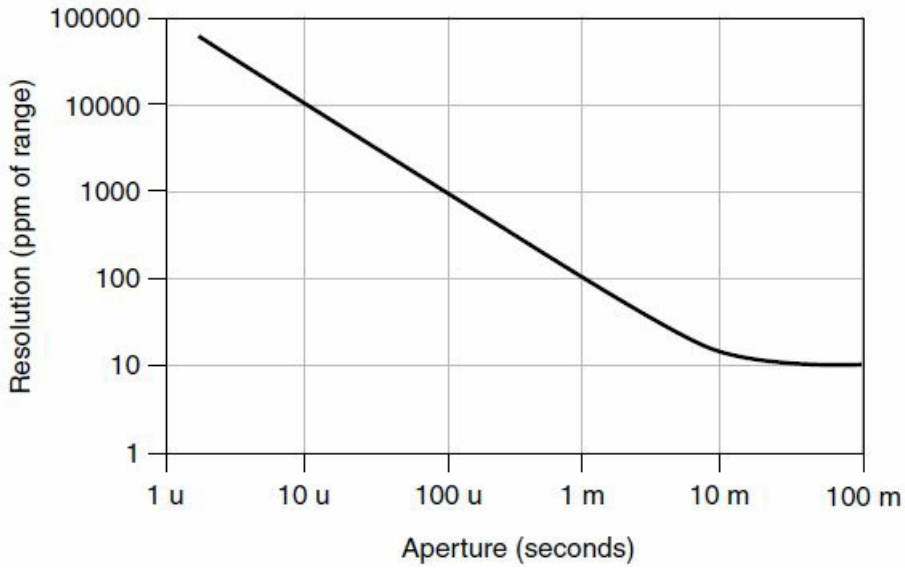
- Additional Specifications on
- Calculating SMU Resolution on

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.
Temperature Coefficient applies beyond 23 °C ± 5 °C within a given tolerance of Tcal.
Temperature Coefficient applies beyond 23 °C ± 5 °C within a given tolerance of Tcal.

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-4142 has a resolution of 1,000 ppm when set to a 100 µs aperture time. In the 24 V range, resolution can be calculated by multiplying 24V by 1,000 ppm, as shown in the following equation:
24 V * 1,000 ppm = 24 V * 1,000 * 1 × 10-6 = 24 mV
Likewise, in the 150 mA range, resolution can be calculated by multiplying 150 mA by 1,000 ppm, as shown in the following equation:
150 mA * 1,000 ppm = 150 mA * 1,000 * 1 × 10-6 = 150 µA

Additional Specifications

- Settling time6 <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 noise7 2 mV RMS, typical <20 mVpk-pk, typical
- Cable guard output impedance 10 kΩ, typical

Remote sense

- Voltage Add 0.1% of LO lead drop to voltage accuracy specification
- Current Add 0.03% 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 ground8 60 VDC, CAT I, verified by dielectric withstand test, 5 s, continuous, characteristic
- Absolute maximum voltage between any terminal and LO 30 VDC, continuous

The following figures illustrate the effect of the transient response setting on the step response of the PXIe-4142 for different loads.

- 6 Current limit set to ≥1 mA and ≥10% of the selected current limit range.
- 7 20 Hz to 20 MHz bandwidth. PXIe-4142 configured for normal transient response.
- 8 Channels are isolated from earth ground but share a common LO.

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

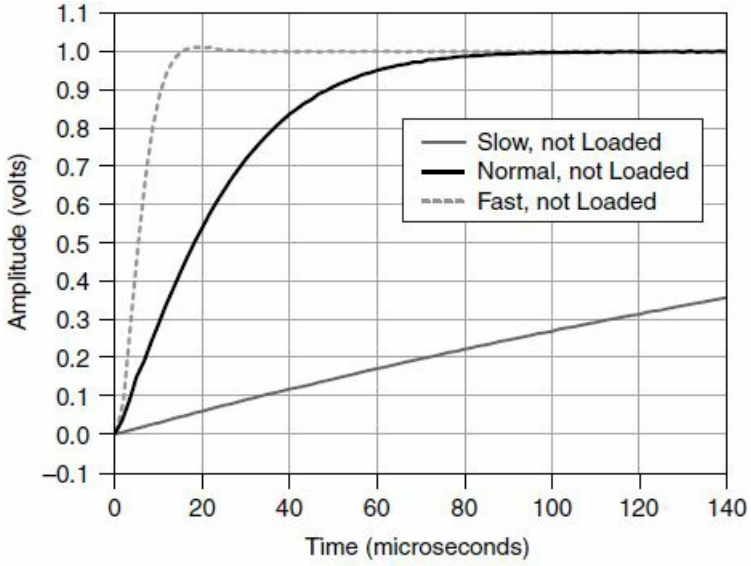
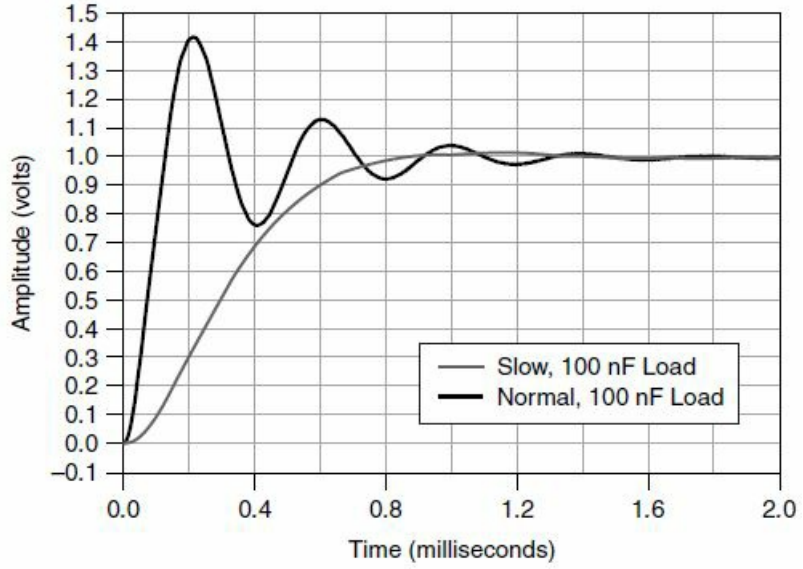


Figure 4. 1 mA Range, 100 nF Load Step Response, Typical



Related Information
Voltage Programming and Measurement Accuracy/Resolution on page 4 Current on page 4

Supplemental Specifications

Measurement and Update Timing

- Available sample rates9 (600 kS/s)/N
  - where
  - N = 6, 7, 8, … 220
  - S is samples
- Sample rate accuracy ±50 ppm
- Maximum measure rate to host10 600,000 S/s per channel, continuous
- Maximum source update rate11
- 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)12
- Polarity Configurable
- Minimum pulse width 100 ns, nominal

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 affectsthe sampling rate.

10 Load dependent settling time is not included. Normal DC noise rejection is used.
11 As the source delay is adjusted or if advanced sequencing is used, maximum source update rates may vary.
12 Pulse widths and logic levels are compliant with PXI Express Hardware Specification Revision 1.0 ECN 1.

- Destinations13 (PXI trigger lines 0 to 7)12
- 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)12
- Polarity Configurable
- Pulse width Configurable between 250 ns and 1.6 µs, nominal

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 412 g (14.53 oz)
- Front panel connectors 25-position D-SUB, male

Power Requirement

- PXI Express power requirement 2 A from the 12 V rail and 1.9 A from the 3.3 V rail

Environment

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

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.

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 grms (Tested in accordance with IEC 60068-2-64.)
- Nonoperating 5 Hz to 500 Hz, 2.4 grms (Tested in accordance with IEC 60068-2-64. Test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Compliance and Certifications

Safety Compliance Standards
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 Product Certifications and Declarations 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
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: 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

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)

Product Certifications and Declarations
Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, 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**.

National Instruments complies with China's restrictions on the use of certain hazardous substances in electronic information products Quality Directive (RoHS). For National Instruments China RoHS compliance information, please log in
ni.com/environment/rohs_china. (For information about China RoHS compliance, go to **ni.com/environment/rohs_china**.)

- 1-800-915-6216
- **www.apexwaves.com**
- **sales@apexwaves.com**

Documents / Resources

	**APEX WAVES PXIe-4142 PXI Source Measure Unit** [pdf] User Manual PXIe-4142 PXI Source Measure Unit, PXIe-4142, PXI Source Measure Unit, Source Measure Unit, Measure Unit

References

- Engineer Ambitiously - NI
- Engineer Ambitiously - NI
- Engineering a Healthy Planet - NI
- Managing Critical Substances - NI
- Product Take-Back Program and Recycling - NI
- Trade Compliance - NI
- National Instruments Patents - NI
- NI Trademarks and Logo Guidelines - NI
- Product Certifications - NI
- Product Take-Back Program and Recycling - NI
- Engineering a Healthy Planet - NI
- PXIe-4142 National Instruments PXI Source Measure Unit | Apex Waves