# 100 V Precision Source Measure Unit (SMU)

## NI PXI-4132 *NEW!*

**Analog Performance**
- Up to ±100 V and up to ±100 mA
- 4-quadrant operation
- 10 pA measurement sensitivity
- Typical sensitivity better than 100 pA at rates up to 1 kHz

**Additional Features**
- Remote sense connections for accurate voltage control
- Guard terminals for removing leakage currents from measurements
- High-speed hardware sequencing
- Triggering via the PXI backplane

**Operating Systems**
- Windows Vista/XP/2000

**Recommended Software**
- LabVIEW
- LabVIEW Real-Time
- LabWindows™/CVI
- Measurement Studio

**Other Compatible Software**
- Microsoft Visual Basic
- C/C++

**Driver Software (included)**
- NI-DCPower

## Overview

The NI PXI-4132 is a programmable, high-precision source measure unit (SMU) in a single-slot, 3U PXI module. It has a single, isolated SMU channel that offers a four-quadrant, ±100 V output incorporating remote (4-wire) sense as well as external guarding. This channel is capable of sourcing and sinking up to 2 W maximum – as shown in Figure 1, it can operate at up to 100 V at up to 20 mA, up to 40 V at up to 50 mA, and up to 20 V at up to 100 mA.

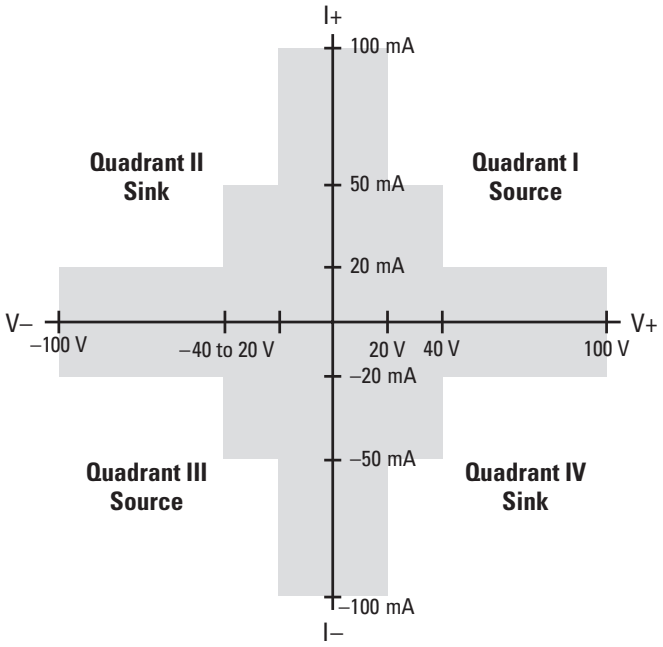
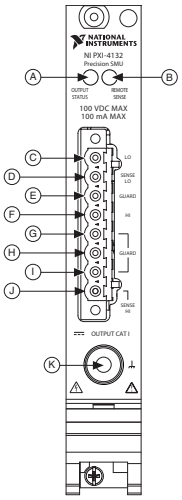



*Figure 1. PXI-4132 Quadrant Diagram*




| | Item | Description |
|---|---|---|
| A | Output Status Indicator | LED |
| B | Sense Status Indicator | LED |
| C | Output Connector, Terminal 0 | Output LO |
| D | Output Connector, Terminal 1 | Sense LO |
| E | Output Connector, Terminal 2 | Guard |
| F | Output Connector, Terminal 3 | Output HI |
| G | Output Connector, Terminal 4 | Guard |
| H | Output Connector, Terminal 5 | Guard |
| I | Output Connector, Terminal 6 | Guard |
| J | Output Connector, Terminal 7 | Sense HI |
| K | Binding Post | Chassis Ground |

*Figure 2. NI PXI-4132 Front Panel I/O Connector*

With measurement resolution down to 10 pA and integrated guarding, the PXI-4132 precision source is ideal for high-accuracy leakage measurements on integrated circuits, discrete components, PCBs, and cables. You can also perform high-speed I-V measurements on a variety of components including diodes and organic LEDs using the onboard hardware sequencing engine. In addition, you can synchronize multiple PXI-4132 SMUs via the PXI backplane to provide high-speed I-V measurements on transistors and more complex devices. For parallel test applications, you can use up to 17 PXI-4132 modules in a single PXI chassis for 17 high-precision SMU channels in a 19 in., 4U space.

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For power requirements higher than 2 W, consider the NI PXI-4130 power SMU, which offers up to 40 W (±20 V at up to ±2 A) and an additional power supply channel that can source up to 6 V at 1 A.

## Analog Performance

The PXI-4132 features five selectable current ranges, from 100 mA down to 10 µA, each of which offers superior measurement sensitivity to traditional SMUs, thereby allowing for more precise readings over a wider range. You can configure the programmable aperture time to optimize both measurement speed and quality for your application. Figure 3 shows a graph of typical measurement noise as a function of aperture time for any given range. For instance, at 1 PLC, current measurements have a sensitivity of roughly 1 ppm of the range – for the 10 µA range, this corresponds to 10 pA. The PXI-4132 was designed to optimize sensitivity at a variety of measurement rates (PLC settings). For instance, on the 10 µA current measurement range, you can typically achieve 100 pA sensitivity at up to 1000 readings per second.

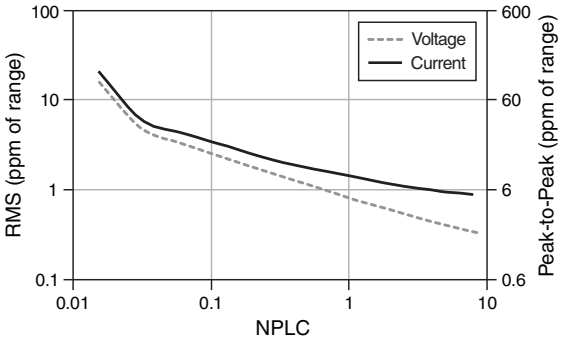


*Figure 3. Noise versus Aperture Time (typical)*

## Hardware Control

You can use the NI-DCPower software test panel to quickly troubleshoot or debug SMU operation interactively. For fast programming, you can take advantage of the DCPower Express VI for an intuitive, configuration-based method of controlling NI SMUs in the NI LabVIEW graphical development environment. For low-level control of the SMU hardware, the IVI-compliant NI-DCPower instrument driver provides a complete API that exposes the full functionality of the hardware in an intuitive hierarchy. NI-DCPower also includes prewritten example programs that demonstrate concepts ranging from simple configuration to advanced sweeping and monitoring.

The new PXI-4132 features a high-speed sequencing engine that you can use to synchronize multiple PXI-4132 SMUs or to synchronize to a single PXI-4132 with other instruments such as switches and high-speed digital devices. As shown in Figure 4, you can send and receive events and triggers across the PXI backplane, simplifying both programming and system wiring. Using this capability, you can easily perform accurate current and voltage sweeps for high-speed I-V characterization.

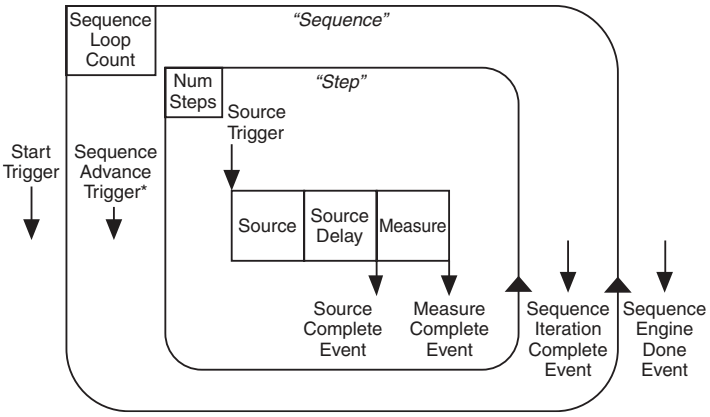


*Figure 4. Sequence Engine Diagram*

## Ordering Information

NI PXI-4132 ..... 780558-01

Includes NI-DCPower and the DCPower TestPanel.

**Accessories**

Additional Connector and Backshell Kit for the NI PXI-4132 ..... 781175-01

## BUY NOW

For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to **ni.com/modularinstruments**.

# SMU Specifications[1]

Specifications subject to change without notice. For complete specifications, see the *NI PXI-4132 Specifications* at **ni.com/manuals**.

### Voltage Programming Accuracy/Resolution

| Range | Resolution | Accuracy ± (% of output + offset) 1-Year, 23 °C ± 5 °C | Peak-to-Peak Noise, typical (0.1 to 10 Hz) |
|---|---|---|---|
| ±10 V | 50 µV | 0.025% + 3.0 mV | 70 µV |
| ±100 V | 500 µV | 0.025% + 10 mV | 300 µV |

### Current Programming Accuracy/Resolution[2]

| Range | Resolution | Accuracy ± (% of output + offset) 1-Year, 23 °C ± 5 °C | Peak-to-Peak Noise, typical (0.1 to 10 Hz) |
|---|---|---|---|
| 10 µA | 500 pA | 0.034% + 2.0 nA | 90 pA |
| 100 µA | 5 nA | 0.034% + 20 nA | 900 pA |
| 1 mA | 50 nA | 0.034% + 0.2 µA | 9 nA |
| 10 mA | 500 nA | 0.034% + 2.0 µA | 90 nA |
| 100 mA | 5 µA | 0.034% + 20 µA | 900 nA |

### Voltage Measurement Accuracy/Resolution

| Range | Resolution | Accuracy ± (% of output + offset) 1-Year, 23 °C ± 5 °C |
|---|---|---|
| ±10 V | 10 µV | 0.02% + 2.0 mV |
| ±100 V | 100 µV | 0.02% + 5.0 mV |

[1]Temperature coefficient (Tempco) is 15% of accuracy specification per °C.
[2]Minimum programmable current limit/level is 2% of range.

### Current Measurement Accuracy/Resolution

| Range | Resolution | Accuracy ± (% of output + offset) 1-Year, 23 °C ± 5 °C |
|---|---|---|
| 10 µA | 10 pA | 0.028% + 1.0 nA |
| 100 µA | 100 pA | 0.028% + 10 nA |
| 1 mA | 1 nA | 0.028% + 0.1 µA |
| 10 mA | 10 nA | 0.028% + 1.0 µA |
| 100 mA | 100 nA | 0.020% + 10 µA |

## Measurement Speed[1]

Maximum Operation Rates Per Second for 60 Hz (50 Hz)

| ADC Aperture Time | Measure to Host | Source-Measure to Host[2] |
|---|---|---|
| 1/64 PLC | 3490 (2900) | 1900 (1700) |
| 1/8 PLC | 470 (390) | 425 (360) |
| 1 PLC | 59.9 (49.9) | 59.0 (49.3) |

Maximum source update rate ..... 4,200 updates/s
Trigger in to source delay ..... 500 ns

## Triggers

Input Triggers

Types ..... Start, Source, Sequence Advance, Measure
Sources ..... PXI Trigger lines 0–7[3]
Polarity ..... Configurable
Minimum pulse width ..... 100 ns
Destinations[4] ..... PXI Trigger lines 0–7[3]
Polarity ..... Active high (unconfigurable)
Pulse width ..... 150 ns

## Power Requirements

PXI power requirement ..... 10 W at 5 V, 1 W at 3.3 V, 2 W at 12 V

## Environment

Maximum altitude ..... 2,000 m (at 25 °C ambient temperature)
Pollution degree ..... 2
Indoor use only.

[1]Does not include load-dependent settling time; niDCPower Auto Zero property/attribute set to Off.
[2]Source-measure to host and maximum source update rate are performed with the source delay set to 200 µs. This is sufficient for the output to settle within 1 percent of the requested level with a simple resistive load. As you adjust the source delay for your application's requirements, maximum rates vary.
[3]Pulse widths and logic levels compliant with PXI specifications.
[4]Input triggers can be reexported.

# 100 V Precision Source Measure Unit (SMU)

## Operating Environment

| | |
|---|---|
| Ambient temperature range | 0 to 55 °C (tested in accordance with IEC-60068-2-1 and IEC-60068-2-2) |
| Relative humidity range | 10 to 70%, noncondensing; derate 1.3% per °C above 40 °C (tested in accordance with IEC-60068-2-56) |

## Storage Environment

| | |
|---|---|
| Ambient temperature range | -40 to 70 °C (tested in accordance with IEC-60068-2-1 and IEC-60068-2-2) |
| Relative humidity range | 5 to 95%, noncondensing (tested in accordance with IEC-60068-2-56) |

## Shock and Vibration

| | |
|---|---|
| Operational shock | 30 g peak, half-sine, 11 ms pulse (tested in accordance with IEC-60068-2-27; test profile developed in accordance with MIL-PRF-28800F) |
| Random vibration | |
| Operating | 5 to 500 Hz, 0.3 $g_{rms}$ |
| Nonoperating | 5 to 500 Hz, 2.4 $g_{rms}$ (tested in accordance with IEC-60068-2-64; nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3) |

## Physical Characteristics

| | |
|---|---|
| Dimensions | 3U, one-slot, PXI/cPCI module; 2.0 cm by 13.0 cm by 21.6 cm (0.8 in. by 5.1 in. by 8.5 in.) |
| Weight | 295 g (10.4 oz) |
| Front panel connectors | COMBICON, 5.08 mm (8 position) |

**Note:** Front panel connectors can accept wire gauges from 12 to 28 AWG.

## Additional Specifications

| | |
|---|---|
| Settling time, typical | <300 µs Settled to 0.1% of final value (1 V step at 50% load of current range) |
| Transient response, typical | Recovers to <0.1% of voltage range within 100 µs after a change in load current from 10 to 90% of current range |
| Wideband source noise, typical | 8 $mV_{p-p}$ into resistive load <1 mV RMS (20 Hz to 20 MHz bandwidth) |
| Remote sense | Add 0.5% of HI lead drop to voltage accuracy specification |
| Maximum lead drop | Up to 1 V drop per lead |
| Load regulation | |
| Voltage | 0.5 mV per mA of output load using Local Sense |
| Current | 0.01% of range per volt of output change |
| Guard offset voltage, typical | <10 mV (Current <100 µA) |
| Isolation voltage (continuous), characteristic | |
| Channel-to-earth ground | 150 VDC, CAT I, verified by dielectric withstand test, 5 s |

**Caution:** Do not connect to MAINs. Do not connect to signals or use for measurements within CAT II, III, or IV.

## Additional Information

| | |
|---|---|
| Recommended Calibration Interval | One year |

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