PXI-4132 Features

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Contents

PXI-4132

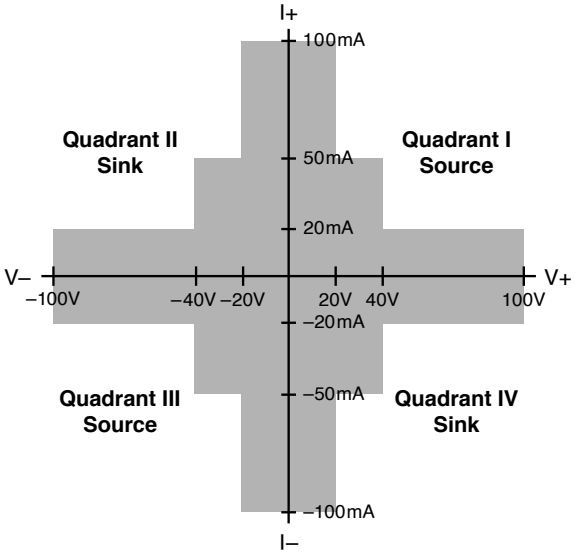
±100 V, 2 W Precision PXI Source Measure Unit

- 10 pA current sensitivity
- Current ranges: 10 µA, 100 µA, 1 mA, 10 mA, 100 mA
- 3.49 kS/s maximum sampling rate and 4.2 kS/s maximum update rate

Note The PXI-4132 is not recommended for new designs. NI recommends the PXIe-4137.

Quadrant Diagram

PXI-4132



PXI-4132 Pinout

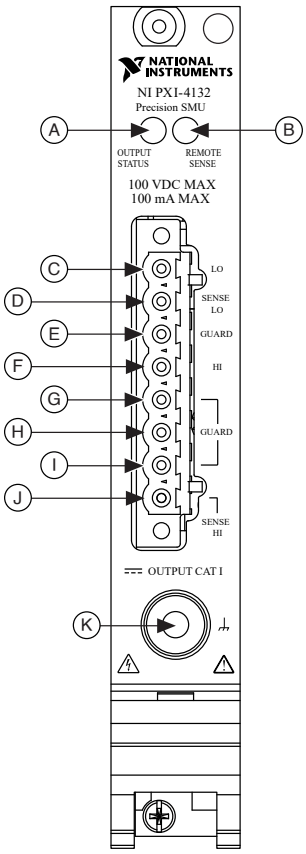


Table 1. Signal Descriptions

Item	Description
A	Output Status Indicator
B	Sense Status Indicator
C	Output LO Terminal
D	Sense LO Terminal
E	Guard Terminal
F	Output HI Terminal
G	Guard Terminal
H	Guard Terminal
I	Guard Terminal
J	Sense HI Terminal
K	Chassis Ground

Table 2. LED Channel Status Indicator

Status Indicator	Channel Output State
(Off)	Disabled
Green	Enabled (Constant voltage mode)
Amber	Enabled (Constant current mode)
Red	Disabled because of error, such as an overtemperature condition

Table 3. LED Sense Status Indicator

Status Indicator	Channel Sense State
(Off)	Local Sense enabled
Green	Remote Sense enabled

PXI-4132 Theory of Operation

The PXI-4132 precision source-measure unit (SMU) combines a high-precision, high-resolution DC amplifier that can be programmed as a voltage-controlled or current-controlled source with built-in measurement of voltage and current output.

In a dual control loop where voltage and current work together through the power amplifier stage, the PXI-4132 can operate in either constant voltage mode or constant current mode. In constant voltage mode, the PXI-4132 acts as a precision voltage source, and, regardless of the load, the voltage across the output terminals is held constant at the programmed value up to the programmed current limit. In constant current mode, the PXI-4132 acts as a precision current source, and, regardless of the output voltage, the current through the load is held constant at the programmed value up to the programmed voltage limit.

A measurement circuit on the PXI-4132 can simultaneously read the voltage and current values present at the output terminals. These measurements are performed by two delta-sigma analog-to-digital converters which are synchronized at all times. Additionally, the auto zero feature of the PXI-4132 can be used to improve the measurement quality.

Additionally, the PXI-4132 features Guard and Sense terminals on the output connector. You can use Guard terminals to implement guarding techniques in cabling and test fixtures. You can use Sense terminals when remote sense is enabled (constant voltage mode only) to compensate for current-resistance loss drops due to cables and switches.

Triggers and Events

The timing and triggering circuitry of the PXI-4132 enables precise control of the sourcing and measuring operations and synchronization with other instruments.

Sequence Engine

The sequence engine of the PXI-4132 enables precise control over the sourcing functionality of the instrument and enables fast, deterministic timing. Additionally, you can utilize sequencing with the measurement functionality of an instrument to achieve specific measurement timing.

A ***sequence*** is a collection of setpoints that is executed one after another. A ***setpoint*** is a single output setting for a channel. When running a sequence, you can apply output values in succession (one setpoint followed by its corresponding source delay, immediately proceeded by the next setpoint) or you can use a trigger to configure the output at a precise time.

Additional options allow for multiple executions of the sequence, synchronizing the engine at various points within its execution, and so on.

PXI-4132 Ranges

Note If a range other than what is listed in the following tables is selected, the range is coerced to the next-highest range. For example, requesting the 20 V voltage limit range on channel 0 of the PXI-4132 coerces the voltage limit range to 100 V.

PXI-4132 Voltage Ranges

For voltage output, the PXI-4132 uses the following ranges.

Table 4. PXI-4132 Voltage Levels

Channel	Voltage Level Range	Voltage Level
0	10 V	-10 V to +10 V
	100 V	-100 V to +100 V

Table 5. PXI-4132 Current Limits

Channel	Current Limit Range	Current Limit
0	10 µA	+0.2 µA to +10 µA
	100 µA	+2 µA to +100 µA
	1 mA	+0.02 mA to +1 mA
	10 mA	+0.2 mA to +10 mA
	100 mA	+2 mA to +100 mA

PXI-4132 Current Ranges

For current output, the PXI-4132 uses the following ranges.

Table 6. PXI-4132 Current Levels

Channel	Current Level Range	Current Level
0	10 µA	+0.2 µA to +10 µA and -0.2 µA to -10 µA
	100 µA	+2 µA to +100 µA and -2 µA to -100 µA
	1 mA	+0.02 mA to +1 mA and -0.02 mA to -1 mA
	10 mA	+0.2 mA to +10 mA and -0.2 mA to -10 mA
	100 mA	+2 mA to +100 mA and -2 mA to -100 mA

Table 7. PXI-4132 Voltage Limits

Channel	Voltage Limit Range	Voltage Limit
0	10 V	0 V to +10 V
	100 V	0 V to +100 V

PXI-4132 Overranging Capability

Enabling overranging for a particular channel of this instrument extends current and voltage output capabilities from 100% to 105% and current capabilities down from 2% to 1% for the output range.

Overranging is applicable to output ranges only and does not apply to measurement ranges. Measurements in any given range may be made up to 105% of the range by default without enabling overranging.

PXI-4132 Measurement Timing

The PXI-4132 has unique measurement timing behavior because it is the only NI-DCPower instrument that supports auto zero functionality.

The PXI-4132 measurement circuitry operates in one of the three active states:

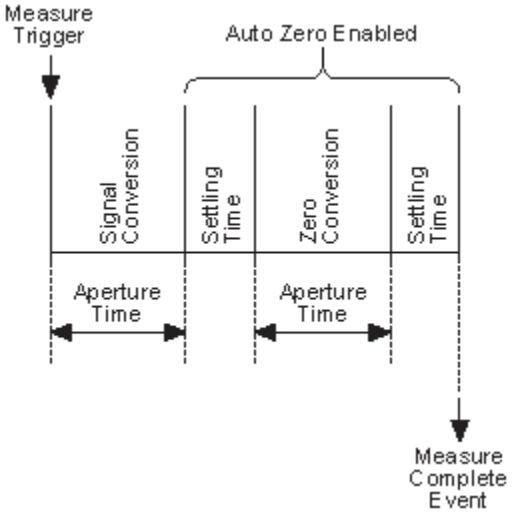
- **Signal conversion**—The PXI-4132 samples the input signal for the programmed aperture time of the device.
- **Zero conversion**—The PXI-4132 samples a zero and uses it to compensate for internal offsets. Zero conversion usually occurs after, and has the same aperture as, the signal conversion.
- **Settling time**—The analog circuitry of the PXI-4132 settles before the next measurement state occurs.

> **Note** Settling time on the PXI-4132 is a fixed period of ≈300 µs. If auto zero is enabled, there will be settling time for the zero measurement as well as the output measurement, resulting in ≈600 µs total settling time.

Figure 1 illustrates the sequence of these states for a one sample measurement for

which auto zero is on.

Figure 1. PXI-4132 Measurement Timing



PXI-4132 Auto Zero Effects and Timing

Enabling auto zero on the PXI-4132 corrects for offsets in the measurement path. Auto zero increases measurement accuracy but increases the time necessary to make measurements.

Only the PXI-4132 supports auto zero.

When auto zero is enabled on the PXI-4132, the instrument switches the measurement path from sampling between the HI and LO terminals (signal conversion) and samples an internal short (zero conversion). The PXI-4132 then subtracts the value of the zero conversion from the signal conversion sample to correct for offset in the measurement path.

Note While in the zero conversion state, the output of the PXI-4132 continues to operate with normal functionality.

Use the Configure Auto Zero function to set the auto zero mode for the PXI-4132. You can choose among the following settings to suit your application.

- Auto Zero Off

- Auto Zero On
- Auto Zero Once

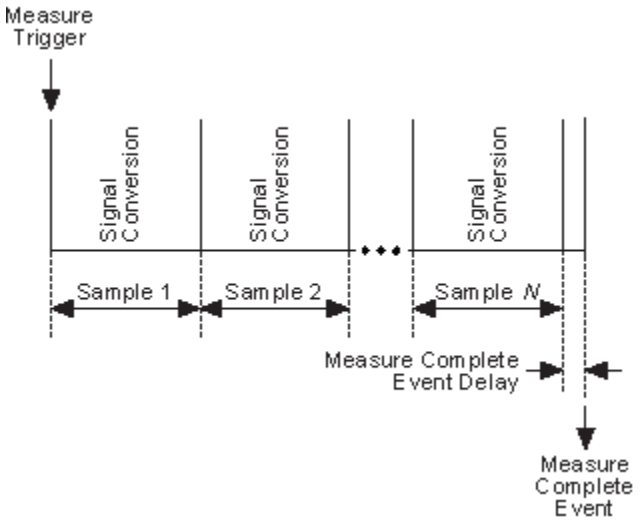
Auto Zero Off

Turning auto zero off allows for faster acquisition rates but does not correct for any drift in zero measurement over time.

When auto zero is off, a zero conversion is not performed; instead, the measurement subtracts the last zero that was acquired (or the zero that is automatically retrieved upon entering the Committed state for the first time in the session) to correct for offsets in the measurement path.

Figure 1 illustrates a measurement in which N samples are averaged and where auto zero is off.

Figure 2.



Auto Zero On

Using auto zero produces measurements with the best accuracy for the PXI-4132, but adds settling time to the measurement of each sample.

When auto zero is on, a zero conversion is performed after every sample conversion and subtracted to correct for measurement path offsets and drift.

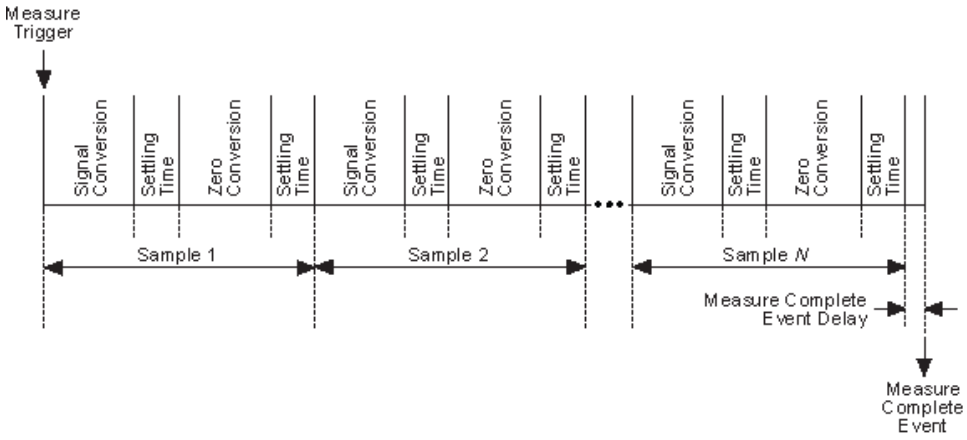
With auto zero is on, the PXI-4132 operates as follows for each sample of a

measurement:

1. The PXI-4132 digitizes and measures the signal
2. The measurement path is switched to an internal short
3. Settling time of ≈300 µs elapses, which allows the analog circuitry to settle
4. The zero conversion is taken using the same aperture time as the signal measurement
5. The switch is changed back to sample the signal and the ≈300 µs settling time elapses again

Figure 1 illustrates a measurement in which N samples are averaged and where auto zero is on.

Figure 3.



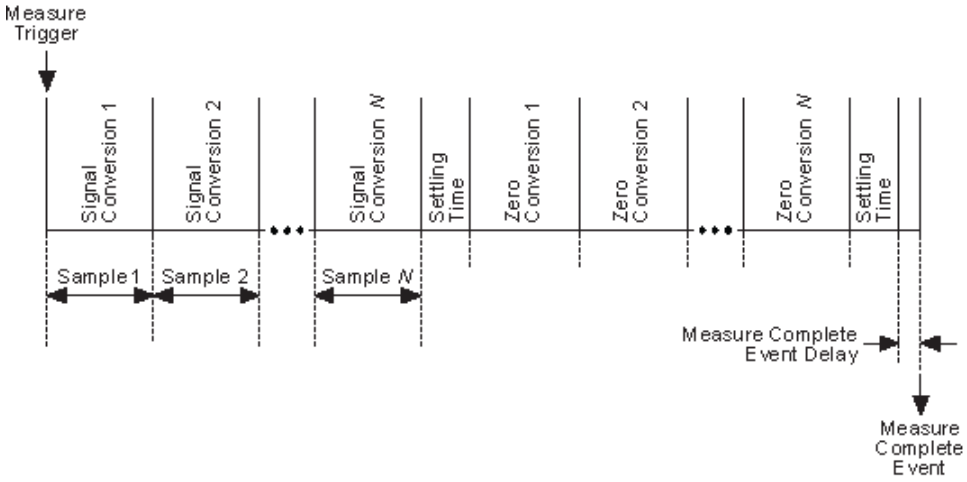
Auto Zero Once

Setting auto zero to Once allows the PXI-4132 to acquire measurements faster than when auto zero is on but does not correct for any drift during the measurements.

When auto zero is set to Once, zero conversions are performed for the first measurement after a channel enters the Running state. Measurements of subsequent samples then use the zero conversions from the first sample for their offset correction. Settling time occurs after all measurements are performed and then again after all zero conversions are applied, for a total of ≈600 µs settling time for the entire measurement.

Figure 1 illustrates a measurement in which N samples are averaged and where auto zero is set to Once.

Figure 4.



Timing for subsequent measurements is identical to having auto zero off.

Source Instability: Reactive Loads in Constant Current Mode

This instrument may experience instability with inductive loads in certain circumstances in constant current mode.

When operating in constant current mode, especially in higher current ranges, some inductive loads may cause instability.

Instability manifests as oscillating or unregulated behavior across the output terminals, which can result in excessive measurement noise, erratic behavior, or thermal shutdown.

If you notice abnormalities, you can attempt the following to troubleshoot:

- Verify the behavior of the channel by inspecting the voltage across the output terminals with an oscilloscope
- Use the Output Capacitance property to toggle the output capacitor

PXI-4132 Combining Multiple Outputs

The single channel of the PXI-4132 is an isolated output and can be cascaded in series with other output channels to generate larger output voltages.

Any terminal on an isolated channel can be connected to ground.

Caution Do not exceed 150 V DC, CAT I from any terminal to ground when cascading with multiple channels with a PXI-4132.

The PXI-4132 output cannot be combined in parallel with other channels to create larger output currents because the channel is a four-quadrant supply; the output may begin to sink current when connected in parallel to another channel with a higher voltage.

PXI-4132 Safety

This product is intended to be used by qualified personnel who are familiar with shock hazards and the safety precautions required to avoid possible injury. Read and follow all installation and operation information carefully before using the product. The protection provided by this equipment might be impaired if it is used in a manner not described in the documentation.

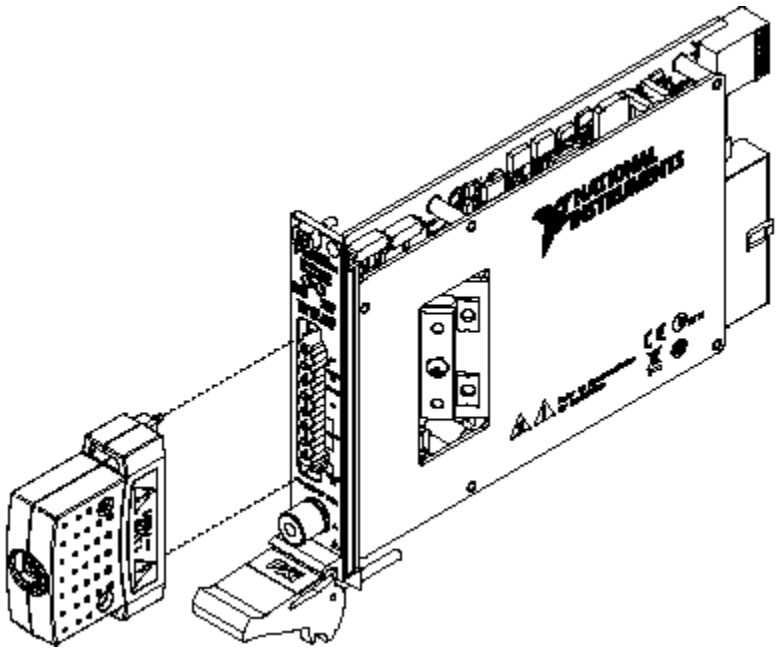
For safety, always operate the PXI-4132 with suitably rated cables and the backshell provided in the shipping kit. Additional backshell kits can be purchased from NI (part number 781175-01). Operating the instrument without the provided backshell can expose users to high voltage.

Caution Shock hazards exist when voltage levels are greater than 30 V RMS, 42.4 V peak, or 60 V DC. Extreme caution should be used when a shock hazard is present. Always ensure the test system is deenergized before connecting or disconnecting the backshell or cables from the PXI-4132.

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

Figure 1 illustrates the PXI-4132 and backshell connector.

Figure 5.



PXI-4132 Protection

The SMU channel (CH 0) of the PXI-4132 is protected against overcurrent, overvoltage, and overtemperature conditions.

Output Channel Protection

> **Notice** Do not apply voltages at the output that might exceed the ratings for the SMU channel (CH 0).

There are no user-replaceable fuses on the PXI-4132. In the event of an overtemperature condition (that is, the enclosure or component temperatures exceed safe operating limits), the thermal shutdown circuits on the PXI-4132 disable the output channel. You can reset the output channel after the failure condition is cleared.

PXI-4132 Thermal Protections and Precautions

The PXI-4132 is protected against excessive temperatures and will shut down in the

presence of excessive heat.

In the event of an overtemperature condition, NI-DCPower reports an error and disables the output of the instrument. The output relays also disconnect HI and LO from the output connector to prevent the PXI-4132 from sinking power. Once the PXI-4132 is disabled, the error condition must be cleared by resetting the instrument in order to resume normal operation.

During normal sourcing operation (up to 2 W output), the thermal protection should not engage over the rated ambient temperature range of the instrument. Also, sinking power levels within the rated specifications of the instrument should not trigger the thermal protection when the instrument is within the ambient temperature range.

Hot Surface Do not touch the outer shield of the PXI-4132 as it may become very hot during an overtemperature condition.

Thermal protection may also become engaged if the output becomes unstable because of inductive loads in the highest current range. If you are operating the PXI-4132 within the rated specifications and the thermal protection is engaging, consider whether instability may be a factor in overtemperature operation of your instrument.