For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

Last Revised: 2014-11-06 07:14:45.0

NI PXIe-4138, NI PXIe-4139

Broad-Range System SMU

- Up to 20W DC source with 6V at 3A, 20V at 1A, 60V at 0.3A
- Pulse up to 10A with 500W pulse power
- 100 fA or 100 nV resolution
- 1.8 MS/s sampling rate
- NI SourceAdaptTM Technology: customizable SMU response for fast and stable measurements even with capacitive loads
- Up to 17 SMU channels in a 4-U, 19-inch PXI chassis
- Direct DMA data streaming for large sequence sweeps or waveform generation
- Output disconnect relay for optimal isolation in production environment

Overview

The new NI PXIe-4138/4139 System SMUs deliver high power, precision, and speed in a single slot PXI-express module. The combination of power, precision and speed makes these SMUs suitable for a broad range of applications in manufacturing test or lab characterization with devices ranging from ICs (including PMICs, RFICs) and discretes (including LEDs, optical transceivers) to board level test.

Back to Top

Application and Technology

Both SMUs have 4-quadrant operation with the ability to source up to 20 W of DC power (or up to 500W pulse power with the PXIe-4139), with voltage and current boundaries at +/- 60 V and +/- 3 A. The unique ADC technology of the modules allows them to perform acquisitions at speeds up to 1.8 MS/s or with resolution of 100 fA. The PXIe-4139 also has Extended Range Pulsing and NI SourceAdapt Technology. These additional features allow the module to pulse up to 10 A of current and tune the control loop of the SMU for the optimal step response. For high channel count applications, you can combine up to 17 SMU channels into a single 4U PXI chassis.

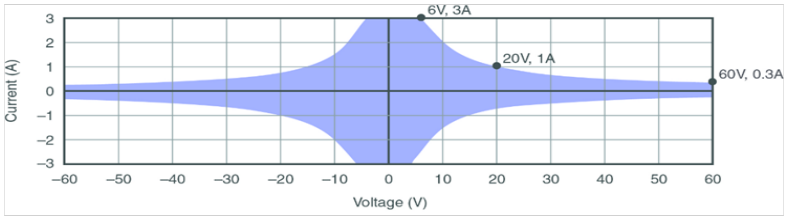

Figure 1. PXIe-4138 IV Boundary

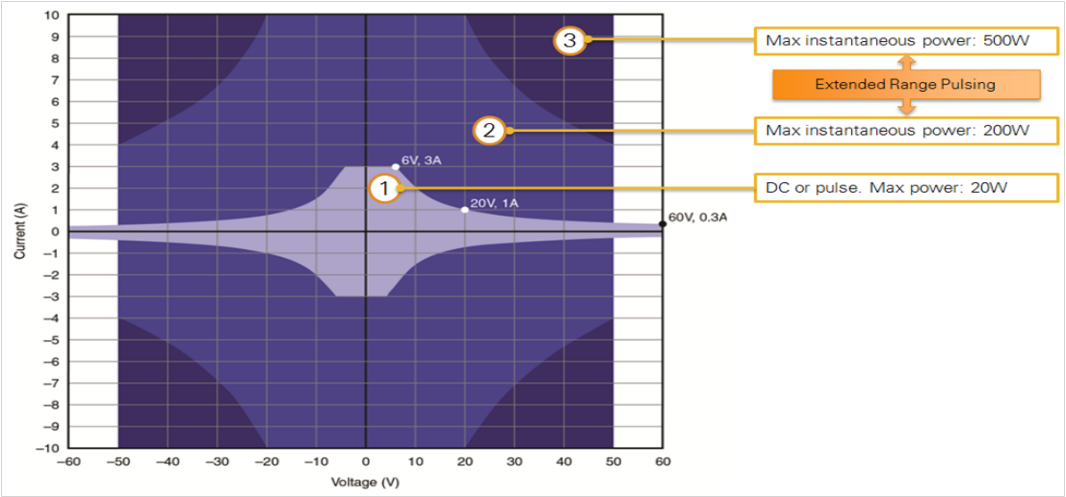

Figure 2. PXIe-4139 IV Boundary

PXIe-4138/4139 Functions:

- Precision current/voltage source and measure
- Isolated High voltage or current digitizer with up to 1.8 MS/s
- Pulse generation up to 10 A with built-in digitizer
- Resistance measurements with voltage or current source

Comparison Tables

	NI PXIe-4138	**NI PXIe-4139**
Maximum Voltage	60 V	60 V
Maximum Current	3 A	3 A DC, 10 A Pulsed
Maximum Power	20 W	20 W DC, 500 W Pulsed
Voltage Measure Range	60 V, 6 V, 600 mV	60 V, 6 V, 600 mV
Voltage Measure Sensitivity	1 uV	100 nV
Current Measure Range	3A, 1 A, 100 mA, 10 mA, 1 mA, 100 uA, 10 uA, 1 uA	10 A (pulse only), 3 A, 1 A, 100 mA, 10 mA, 1 mA, 100 uA, 10 uA, 1 uA
Current Measure Sensitivity	1 pA	100 fA
Maximum Sampling Rate	1.8 MS/s	1.8 MS/s
Maximum Source-Measure Rate	100 kS/s	100 kS/s
Compensation Modes	Slow, Normal, Fast	Slow, Normal, Fast, Custom
Timing	Hardware Timed	Hardware Timed
Additional Features		NI Source Adapt Technology, Custom Compensation Extended Range Pulsing Programmable Output Resistance

Feature	**Benefit**
17 Channels in 4 U Chassis	Build high channel count systems in a consolidated space
20 W Power Boundary	Perform high power IV sweeps
100 fA Current Sensitivity	Accurately acquire low current measurements
1.8 MS/s Sampling Rate	Digitize voltage or current with the SMU
50 us Pulse Width	Quickly characterize components with minimal self-heating effects
Extended Range Pulsing	Extend the power boundary of the instrument by pulsing up to 500 W
NI SourceAdapt	Create the ideal step response with no overshoots or oscillations
DMA Streaming	Transparently stream large waveforms to the SMU

NI SourceAdaptTM Technology: The Next Generation SMU Technology

The NI PXIe-4139 features NI SourceAdaptTM technology. With this next-generation SMU technology, you can custom-tune the SMU response to any given load for optimum response with maximum stability and minimum transients. Removing overshoots helps protect the device under test, while eliminating oscillations are critical for system stability. Additionally, minimum rise and fall times help achieve the fastest possible test times. This feature is particularly useful for dealing with reactive loads, especially capacitance loads that are commonly encountered across various test applications.

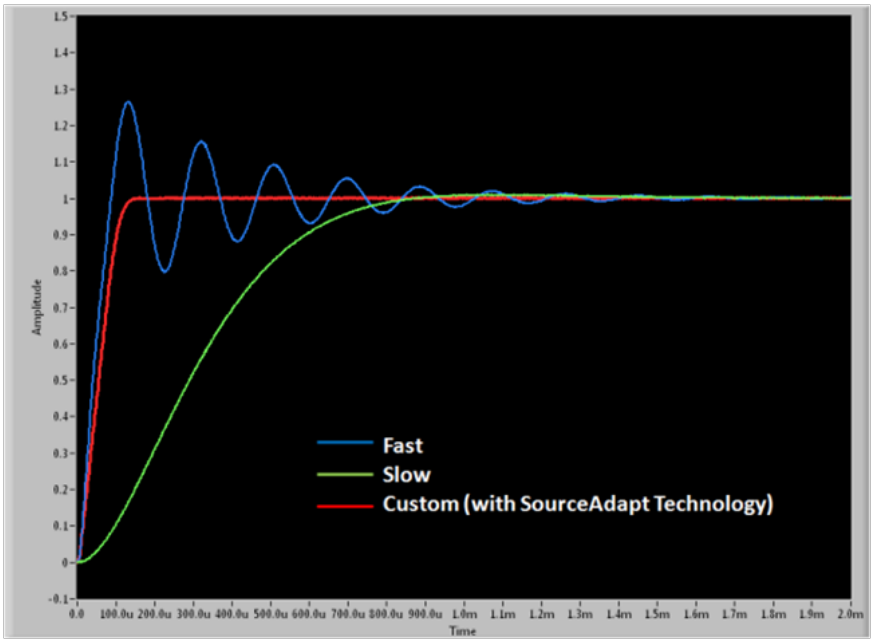

Figure 3. SMU Response to a Capacitive Load

NI SourceAdapt technology enables customized response (red) for maximum stability and minimum transient response times.

Extended Range Pulsing

For applications requiring higher current, the PXIe-4139 can pulse up to 10 A for instantaneous power up to 500W. Depending on the load and SourceAdapt control settings, pulse widths can be as short as 50us. These short pulse widths not only allow the test to complete faster, but also keep the local heating of the DUT to minimal levels – allowing test engineers to perform tests, that otherwise, might require heat sinks or other thermal control mechanisms.

Speed and Precision

The PXIe-4138/4139 has a unique ADC architecture that allows the module to perform high speed measurements as well as high resolution measurements. Users can reduce the aperture time of the module and sample up to 1.8 MS/s or extend the aperture time to perform precision current measurements with 100 fA sensitivity.

Data Streaming and Triggering

The PXI platform is optimized for triggering and data streaming on the PXIe-4138/39 modules. The modules use the PXI chassis backplane to send and receive triggers and events, which simplifies programming and system wiring. The modules are also hardware-timed and have a high-speed sequencing engine to synchronize hand-shaking between multiple SMUs.

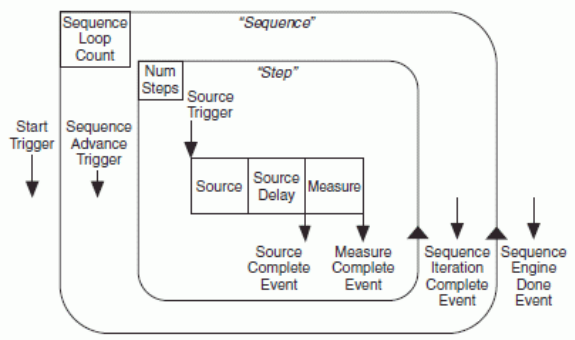

Figure 4. Sequence Engine Diagram for Triggering and Syncronization

The PXIe-4138 and 4139 modules support direct DMA streaming between the host PC and SMU, allowing users to transparently stream waveforms with millions of set-points to the instrument. Users can stream large waveforms and measurement data at the full update rate (100 kS/s) and sampling rate (1.8 MS/s) of the instrument;removing the bandwidth and latency bottlenecks associated with traditional instrument buses.

DEVICE SPECIFICATIONS

NI PXIe-4139

Single-Channel Precision System SMU

This document lists specifications for the NI PXIe-4139 (NI 4139) precision system source-measure unit (SMU).

Specifications are subject to change without notice. For the most recent NI 4139 specifications, visit *ni.com/manuals*.

Caution Using the NI 4139 in a manner not described in this document might impair the protection the NI 4139 provides.

Caution Refer to the *Read Me First: Safety and Electromagnetic Compatibility* document for important safety and electromagnetic compatibility information. To obtain a copy of this document online, visit *ni.com/manuals* and search for the document title.

Caution To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

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Typical Specifications are specifications met by the majority of the instruments within the recommended calibration interval and under the stated operating conditions. The performance of the instrument is not warranted.

Characteristic or *Supplemental Specifications* describe basic functions and attributes of the instrument established by design or during development and not evaluated during Verification or Adjustment. They provide information that is relevant for the adequate use of the instrument that is not included in the previous definitions.

Unless otherwise noted, specifications are valid under the following conditions:

- Ensure an ambient temperature of 23 °C ± 5 °C.
- Ensure a calibration interval of 1 year.
- Allow 30 minutes warm-up time.
- Perform self-calibration within the last 24 hours.
- Set the niDCPower Aperture Time property or NIDCPOWER_ATTR_APERTURE_TIME attribute to 2 power-line cycles (PLCs).
- If the PXI Express chassis has multiple fan speed settings, ensure the fans are set to the highest setting.

To access NI 4139 documentation, navigate to **Start»All Programs»National Instruments» NI-DCPower»Documentation**.

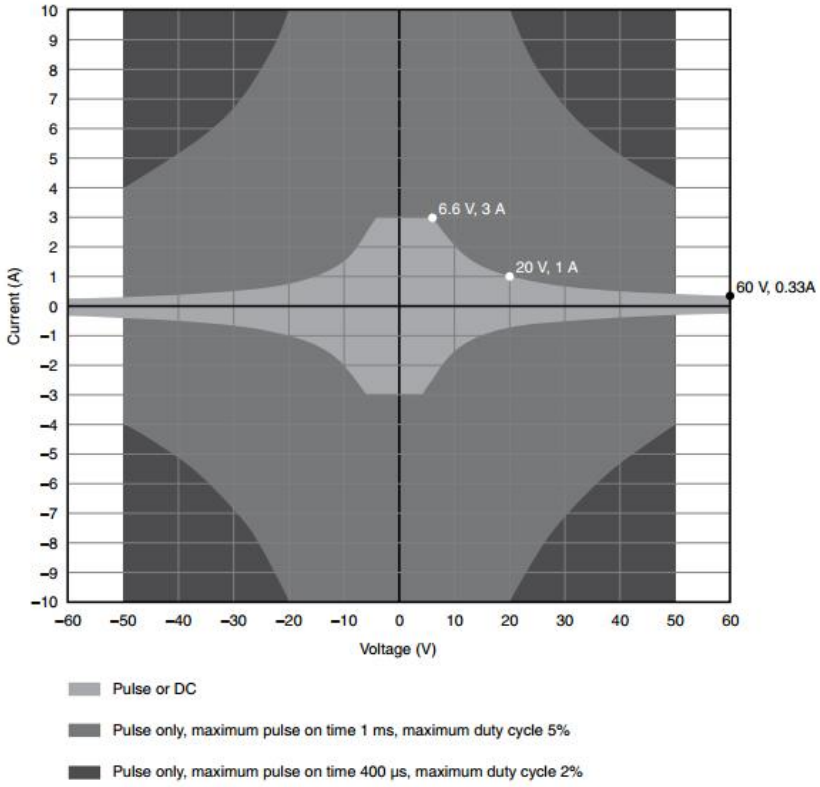
Device Capabilities

The following table and figure illustrate the voltage and the current source and sink ranges of the NI 4139.

Table 1. Current Source and Sink Ranges

DC Voltage Ranges	DC Current Source and Sink Ranges
600 mV	1 µA
6 V	10 µA
60 V	100 µA
	1 mA
	10 mA
	100 mA
	1 A
	3 A
	10 A, pulse only

Figure 1. Quadrant Diagram[1]



DC sourcing power is limited to 20 W, regardless of output voltage.[2]

Caution Limit DC power sinking to 12 W. Additional derating applies to sinking power when operating at an ambient temperature of >45 °C. If the PXI Express chassis has multiple fan speed settings, ensure the fans are set to the highest setting.

Voltage Programming and Measurement Accuracy/Resolution

Table 2. Voltage Programming and Measurement Accuracy/Resolution[3]

Range	Resolution (Noise Limited)	Noise (0.1 Hz to 10 Hz, Peak to Peak), Typical	Accuracy (23 °C ± 5 °C) ± (% of Voltage + Offset)		Temperature Coefficient ± (% of Voltage + Offset)/°C, 0 °C to 55 °C
			T_{cal} ± 5 °C[4]	T_{cal} ± 1 °C	
600 mV	100 nV	2 µV	0.02% + 50 µV	0.016% + 30 µV	0.0005% + 1 µV
6 V	1 µV	6 µV	0.02% + 300 µV	0.016% + 90 µV	
60 V	10 µV	60 µV	0.02% + 3 mV	0.016% + 900 µV	

Current Programming and Measurement Accuracy/Resolution

Table 3. Current Programming and Measurement Accuracy/Resolution

Range	Resolution (Noise Limited)	Noise (0.1 Hz to 10 Hz, Peak to Peak), Typical	Accuracy (23 °C ± 5 °C) ± (% of Current + Offset)		Temperature Coefficient ± (% of Current + Offset)/ °C, 0 °C to 55 °C
			T_{cal} ± 5 °C[5]	T_{cal} ± 1 °C	
1 µA	100 fA	4 pA	0.03% + 100 pA	0.022% + 40 pA	0.0005% + 2 pA
10 µA	1 pA	30 pA	0.03% + 700 pA	0.022% + 300 pA	0.0005% + 20 pA
100 µA	10 pA	200 pA	0.03% + 6 nA	0.022% + 2 nA	0.0005% + 200 pA
1 mA	100 pA	2 nA	0.03% + 60 nA	0.022% + 20 nA	0.0005% + 2 nA
10 mA	1 nA	20 nA	0.03% + 600 nA	0.022% + 200 nA	0.0005% + 20 nA
100 mA	10 nA	200 nA	0.03% + 6 µA	0.022% + 2 µA	0.0005% + 200 nA
1 A	100 nA	2 µA	0.03% + 60 µA	0.027% + 20 µA	0.0005% + 2 µA
3 A	1 µA	20 µA	0.06% + 900 µA	0.056% + 600 µA	0.0005% + 20 µA
10 A, pulsing only, typical					

Noise, Typical

Wideband source noise.....<20 mV peak-to-peak in 60 V range, normal compensation, 10 Hz to 20 MHz

The following figures illustrate noise as a function of measurement aperture for the NI 4139.

Figure 2. Voltage Measurement Noise vs. Measurement Aperture

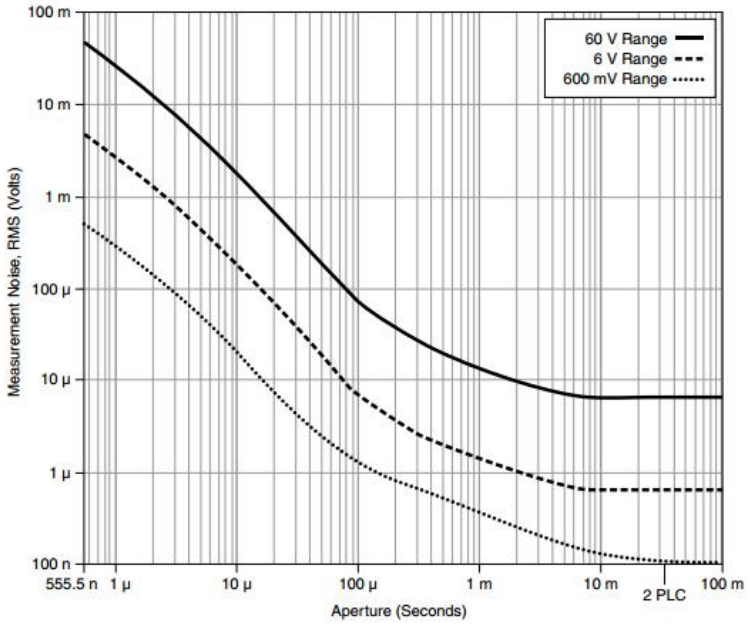
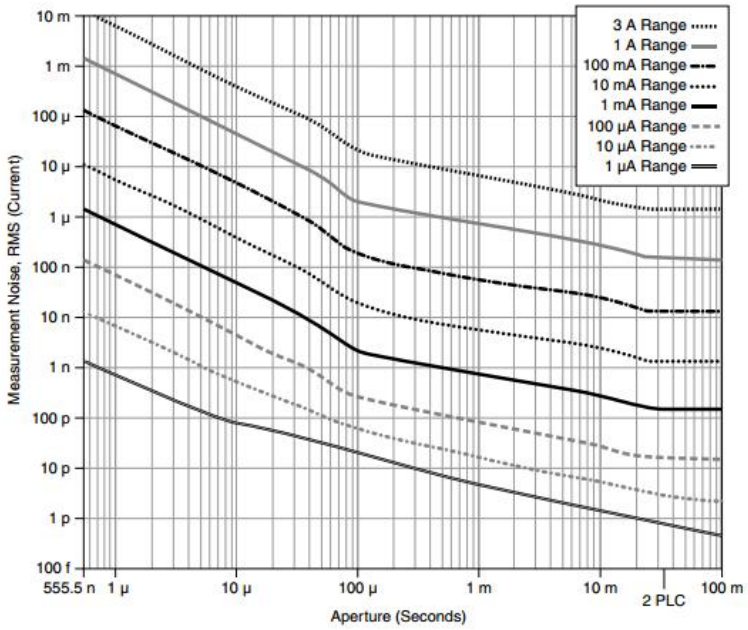


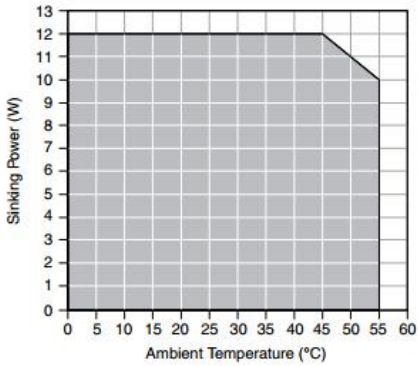
Figure 3. Current Measurement Noise vs. Measurement Aperture



Sinking Power vs. Ambient Temperature Derating

The following figure illustrates sinking power derating as a function of ambient temperature for the NI 4139.

Figure 4. Sinking Power vs. Ambient Temperature Derating



Output Resistance Programming Accuracy Characteristics

Table 4. Output Resistance Programming Accuracy Characteristics

Current Level/Limit Range	Programmable Resistance Range, Voltage Mode	Programmable Resistance Range, Current Mode	Accuracy ± (% of Resistance Setting), T_{cal} ± 5 °C [6]
1 µA	0 to ±5 MΩ	±5 MΩ to ±infinity	0.03%
10 µA	0 to ±500 kΩ	±500 kΩ to ±infinity	
100 µA	0 to ±50 kΩ	±50 kΩ to ±infinity	
1 mA	0 to ±5 kΩ	±5 kΩ to ±infinity	
10 mA	0 to ±500 Ω	±500 Ω to ±infinity	
100 mA	0 to ±50 Ω	±50 Ω to ±infinity	
1 A	0 to ±5 Ω	±5 Ω to ±infinity	
3 A	0 to ±500 mΩ	±500 mΩ to ±infinity	
10 A , pulsing only			

Extended Range Pulsing, Typical[7]

Maximum pulse

- Voltage.....50 V
- Current.....10 A
- On time[8].....1 ms
- Minimum pulse cycle time.....5 ms
- Energy.....200 mJ
- Cycle average power.....10 W
- Duty cycle.....5%

Transient Response and Settling Time, Typical

Transient response[9].....<70 µs to recover within 0.1% of voltage range after a load current change from 10% to 90% of range, device configured for fast transient response

Settling time[10]

- Voltage mode, 50 V step, unloaded[11].....<200 µs
- Voltage mode, 5 V step or smaller, unloaded[12].....<70 µs
- Current mode, full-scale step, 10 A to 100 µA ranges[13].....<50 µs
- Current mode, full-scale step, 10 µA range[13].....<150 µs
- Current mode, full-scale step, 1 µA range[13].....<300 µs

The following figures illustrate the effect of the transient response setting on the step response of the NI 4139 for different loads.

Figure 5. 1 mA Range No Load Step Response, Typical

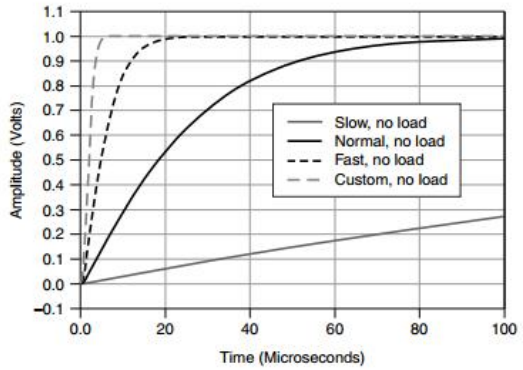
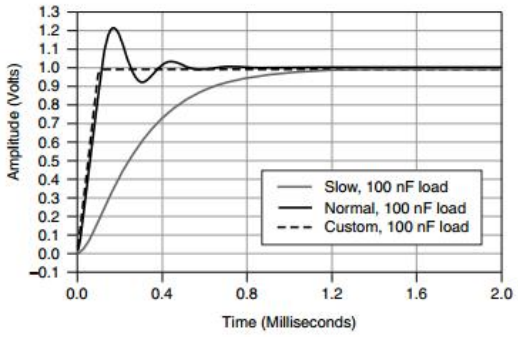


Figure 6. 1 mA Range, 100 nF Load Step Response, Typical



Load Regulation, Typical

Voltage

- Device configured for local sense.....100 µV per mA of output load change (measured between output channel terminals)
- Device configured for remote sense.....Load regulation effect included in voltage accuracy specifications

Current, device configured for local or remote sense.....Load regulation effect included in current accuracy specifications

Measurement and Update Timing Characteristics

Available sample rates.....(1.8 MS/s)/*N* where *N* = 1, 2, 3, … 2^{20}

Sample rate accuracy.....Equal to PXIe_CLK100 accuracy

Maximum measure rate to host.....1.8 MS/s per channel, continuous

Maximum source update rate[14].....100,000 updates/s

Input trigger to

- Source event delay.....10 µs
- Source event jitter.....1 µs
- Measure event jitter.....1 µs

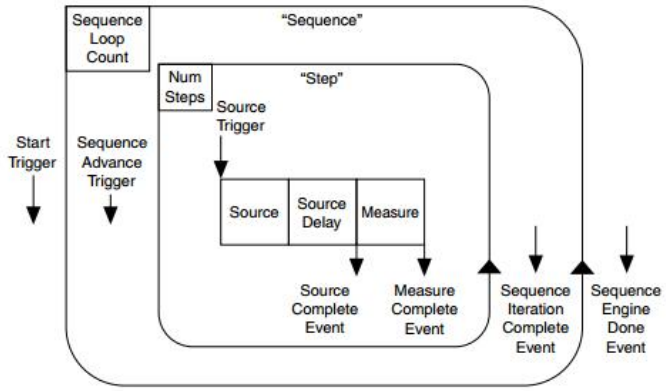
Pulse timing and accuracy

- Minimum pulse on time[15].....50 µs
- Minimum pulse off time[1617].....50 µs
- Pulse on time or off time programming resolution.....100 ns
- Pulse on time or off time programming accuracy.....±5 µs
- Pulse on time or off time jitter.....1 µs

NI-DCPower Sequence Source Model

The following figure illustrates the programming flow in NI-DCPower using Sequence source mode with automatic measurements.

Figure 7. NI-DCPower Programming Flow



Absolute Maximum Limit Characteristics

Voltage between any two terminals.....70 V

HI/LO current.....3.5 A, DC only

Caution Applying levels beyond the ratings specified in this section can result in permanent damage to the device.

Caution Connect only voltages that are within these limits.

Protection Characteristics

Output channel protection

Overcurrent or overvoltage.....Automatic shutdown, output disconnect relay opens

Overtemperature.....Automatic shutdown, output disconnect relay opens

Isolation Characteristics

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

Isolation voltage, Channel-to-earth ground.....150 VDC, CAT I, verified by dielectric withstand test, 5 s, continuous

Note Measurement Categories CAT I and CAT O (Other) are equivalent. These test and measurement circuits are not intended for direct connection to the MAINs building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Caution Take precautions to avoid electrical shock when operating this product at hazardous voltages.

Note Isolation voltage ratings apply to the voltage measured between any channel pin and the chassis ground connector of the front panel. When operating channels in series or floating on top of external voltage references, ensure that no terminal exceeds this rating.

Guard Output Characteristics

Cable guard

Output impedance.....2 kΩ

Offset voltage.....1 mV

Accessories

Table 5. NI 4139 Accessories

Accessory	Manufacturer	Part Number
Connector and Backshell Kit	National Instruments	156119A-01

Calibration Interval

Recommended calibration interval.....1 year

Power Requirement Characteristics

PXI Express power requirement.....2.5 A from the 3.3 V rail and 2.2 A from the 12 V rail

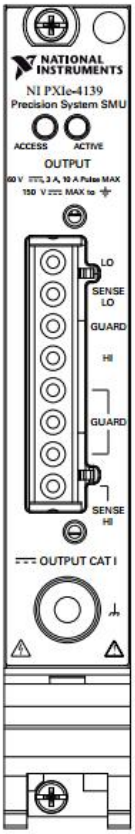
Physical Characteristics

Dimensions.....3U, one-slot, PXI Express/cPCI Express module; 2.0 cm × 13.0 cm × 21.6 cm (0.8 in. × 5.1 in. × 8.5 in.)

Weight.....419 g (14.8 oz)

Front panel connectors.....5.08 mm (8 position)

Figure 8. Front Panel



Environment

Maximum altitude.....2,000 m (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.)

Relative humidity range.....10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range.....-40 °C 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.)

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 Hz to 500 Hz, 0.3 g_{rms}
- Nonoperating.....5 Hz 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.)

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 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

- 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 CE

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

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

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 not only to the environment but also 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 products must be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, 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`.)

DEVICE SPECIFICATIONS

NI PXIe-4138

Single-Channel System SMU

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To access NI 4138 documentation, navigate to **Start»All Programs»National Instruments» NI-DCPower»Documentation**.

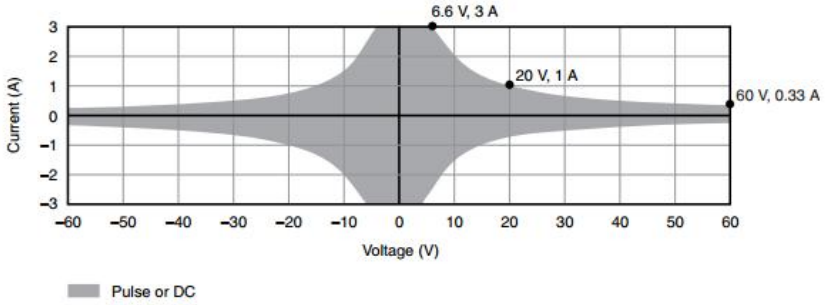
Device Capabilities

The following table and figure illustrate the voltage and the current source and sink ranges of the NI 4138.

Table 1. Current Source and Sink Ranges

DC Voltage Ranges	DC Current Source and Sink Ranges
600 mV 6 V 60 V	1 µA 10 µA 100 µA 1 mA 10 mA 100 mA 1 A 3 A

Figure 1. Quadrant Diagram[1]



DC sourcing power is limited to 20 W, regardless of output voltage.[2]

Caution Limit DC power sinking to 12 W. Additional derating applies to sinking power when operating at an ambient temperature of >45 °C. If the PXI Express chassis has multiple fan speed settings, ensure the fans are set to the highest setting.

Voltage Programming and Measurement Accuracy/Resolution

Table 2. Voltage Programming and Measurement Accuracy/Resolution[3]

Range	Resolution (Noise Limited)	Noise (0.1 Hz to 10 Hz, Peak to Peak), Typical	Accuracy (23 °C ± 5 °C) ± (% of Voltage + Offset), T_{cal} ±5 °C [4]	Temperature Coefficient ± (% of Voltage + Offset)/°C, 0 °C to 55 °C
600 mV	1 µV	4 µV	0.02% + 100 µV	0.0005% + 1 µV
6 V	10 µV	12 µV	0.02% + 600 µV	
60 V	100 µV	120 µV	0.02% + 6 mV	

Current Programming and Measurement Accuracy/Resolution

Table 3. Current Programming and Measurement Accuracy/Resolution

Range	Resolution (Noise Limited)	Noise (0.1 Hz to 10 Hz, Peak to Peak), Typical	Accuracy (23 °C ± 5 °C) ± (% of Current + Offset), T_{cal} ±5 °C [5]	Temperature Coefficient ± (% of Current + Offset)/°C, 0 °C to 55 °C
1 µA	1 pA	8 pA	0.03% + 200 pA	0.0005% + 2 pA
10 µA	10 pA	60 pA	0.03% + 1.4 nA	0.0005% + 20 pA
100 µA	100 pA	400 pA	0.03% + 12 nA	0.0005% + 200 pA
1 mA	1 nA	4 nA	0.03% + 120 nA	0.0005% + 2 nA
10 mA	10 nA	40 nA	0.03% + 1.2 µA	0.0005% + 20 nA
100 mA	100 nA	400 nA	0.03% + 12 µA	0.0005% + 200 nA
1 A	1 µA	4 µA	0.03% + 120 µA	0.0005% + 2 µA
3 A	10 µA	40 µA	0.06% + 1.8 mA	0.0005% + 20 µA

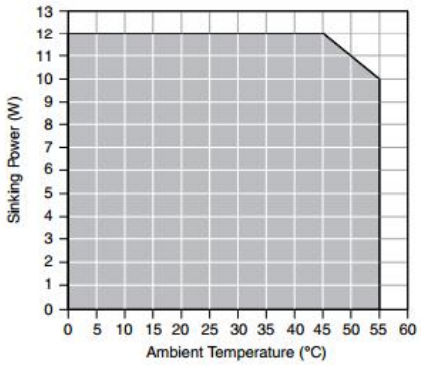
Noise, Typical

Wideband source noise.....<20 mV peak-to-peak in 60 V range, normal compensation, 10 Hz to 20 MHz

Sinking Power vs. Ambient Temperature Derating

The following figure illustrates sinking power derating as a function of ambient temperature for the NI 4138.

Figure 2. Sinking Power vs. Ambient Temperature Derating



Transient Response and Settling Time, Typical

Transient response[6] ..... <70 µs to recover within 0.1% of voltage range after a load current change from 10% to 90% of range, device configured for fast transient response

Settling time[7]

- Voltage mode, 50 V step, unloaded[8] ..... <200 µs
- Voltage mode, 5 V step or smaller, unloaded[9] ..... <70 µs
- Current mode, full-scale step, 3 A to 100 µA ranges[10] ..... <50 µs
- Current mode, full-scale step, 10 µA range[10] ..... <150 µs
- Current mode, full-scale step, 1 µA range[10] ..... <300 µs

The following figures illustrate the effect of the transient response setting on the step response of the NI 4138 for different loads.

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

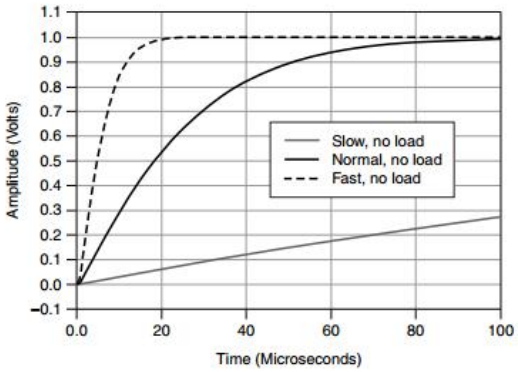
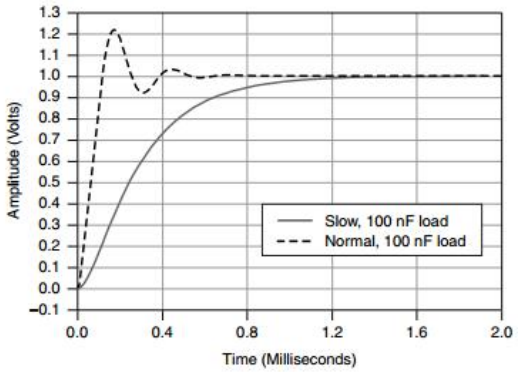


Figure 4. 1 mA Range, 100 nF Load Step Response, Typical



Load Regulation, Typical

Voltage

Device configured for local sense	100 µV per mA of output load change (measured between output channel terminals)
Device configured for remote sense	Load regulation effect included in voltage accuracy specifications

Current, device configured for local or remote sense	Load regulation effect included in current accuracy specifications

Measurement and Update Timing Characteristics

Available sample rates.....(1.8 MS/s)/*N* where *N* = 1, 2, 3, … 2^{20}

Sample rate accuracy.....Equal to PXIe_CLK100 accuracy

Maximum measure rate to host.....1.8 MS/s per channel, continuous

Maximum source update rate[11].....100,000 updates/s

Input trigger to

- Source event delay.....10 µs
- Source event jitter.....1 µs
- Measure event jitter.....1 µs

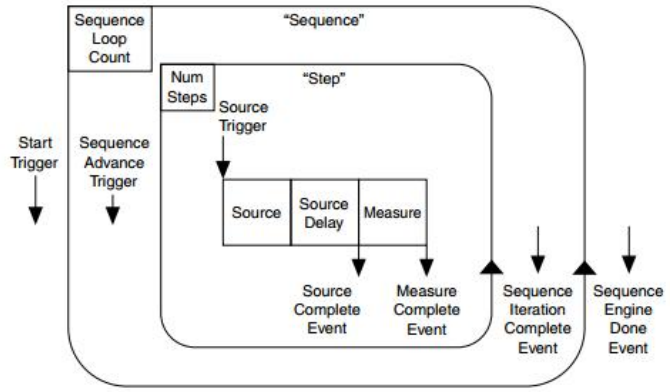
Pulse timing and accuracy

- Minimum pulse on time[12].....50 µs
- Minimum pulse off time[13].....50 µs
- Pulse on time or off time programming resolution.....100 ns
- Pulse on time or off time programming accuracy.....±5 µs
- Pulse on time or off time jitter.....1 µs

NI-DCPower Sequence Source Model

The following figure illustrates the programming flow in NI-DCPower using Sequence source mode with automatic measurements.

Figure 5. NI-DCPower Programming Flow



Absolute Maximum Limit Characteristics

Voltage between any two terminals.....70 V

HI/LO current.....3.5 A, DC only

Caution Applying levels beyond the ratings specified in this section can result in permanent damage to the device.

Caution Connect only voltages that are within these limits.

Protection Characteristics

Output channel protection

Overcurrent or overvoltage.....Automatic shutdown, output disconnect relay opens

Overtemperature.....Automatic shutdown, output disconnect relay opens

Isolation Characteristics

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

Isolation voltage, Channel-to-earth ground.....150 VDC, CAT I, verified by dielectric withstand test, 5 s, continuous

Note Measurement Categories CAT I and CAT O (Other) are equivalent. These test and measurement circuits are not intended for direct connection to the MAINs building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Caution Take precautions to avoid electrical shock when operating this product at hazardous voltages.

Note Isolation voltage ratings apply to the voltage measured between any channel pin and the chassis ground connector of the front panel. When operating channels in series or floating on top of external voltage references, ensure that no terminal exceeds this rating.

Guard Output Characteristics

Cable guard

Output impedance.....2 kΩ

Offset voltage.....1 mV

Accessories

Table 4. NI 4138 Accessories

Accessory	Manufacturer	Part Number
Connector and Backshell Kit	National Instruments	156119A-01

Calibration Interval

Recommended calibration interval.....1 year

Power Requirement Characteristics

PXI Express power requirement.....2.5 A from the 3.3 V rail and 2.2 A from the 12 V rail

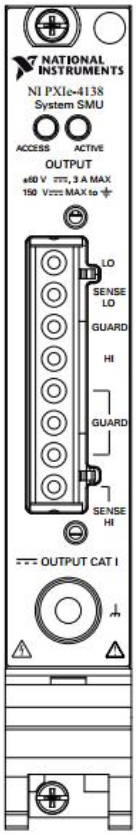
Physical Characteristics

Dimensions.....3U, one-slot, PXI Express/cPCI Express module; 2.0 cm × 13.0 cm × 21.6 cm (0.8 in. × 5.1 in. × 8.5 in.)

Weight.....419 g (14.8 oz)

Front panel connectors.....5.08 mm (8 position)

Figure 6. Front Panel



Environment

Maximum altitude.....2,000 m (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.)

Relative humidity range.....10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range.....-40 °C 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.)

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 Hz to 500 Hz, 0.3 g_{rms}

Nonoperating.....5 Hz 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.)

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 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

- 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 CE

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

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

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 not only to the environment but also 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 products must be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, 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`.)

Back to Top

Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **Course kits** - lowest-cost, self-paced training that you can use as reference guides.
- **Training memberships** and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

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Back to Top

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