

Detailed Specifications

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

Last Revised: 2014-09-24 22:56:37.0

## NI PXIe-4331

### Data Acquisition with Integrated Signal Conditioning for High-Speed Bridge-Based Measurements



- 8 simultaneously sampled analog input channels
- 102.4 kS/s/ch sampling rate; 24-bit ADC per channel; antialias filtering
- 0.02 percent of reading typical accuracy
- Software-selectable excitation voltage per channel (0.625 to 10 V)
- Built-in programmable quarter-, half-, and full-bridge completion per channel
- Software-selectable shunt calibration options per channel
- Multidevice triggering and synchronization via PXI Express
- Supported by NI-DAQmx driver software

#### Overview

The NI PXIe-4331 dynamic bridge input module provides data acquisition with integrated signal conditioning for measuring bridge-based sensors, such as strain gages, load cells, and pressure transducers. It features eight channels with 24-bit analog-to-digital converters (ADCs) per channel and 102.4 kS/s sampling rate for simultaneous high-speed measurements. To remove noise, each module offers antialiasing and digital filters per channel. Each channel also features an independent programmable 0.625 to 10 V excitation voltage. Additionally, the NI PXIe-4331 provides remote sensing, internal bridge completion, and shunt calibration options per channel. The NI PXIe-4331 is intended to be used with the NI TB-4330 front-mounting terminal block for screw-terminal connectivity.

[Back to Top](#)

#### Comparison Tables

Module	Channels	Max Sample Rate (kS/s/ch)	Resolution (bits)	Bridge Type	Simultaneous
NI PXIe-4330	8	25	24	1/4, 1/2, Full	Yes
NI PXIe-4331	8	102.4	24	1/4, 1/2, Full	Yes

[Back to Top](#)

#### Application and Technology

##### Integrated Signal Conditioning

By combining signal conditioning and analog-to-digital converters (ADCs) on the same device, the NI PXIe-4331 bridge input module delivers a smaller footprint and higher measurement performance. Integrated signal conditioning also provides simplified cable management and calibration due to fewer components, which drastically reduces the installation and maintenance cost of a high-channel-count measurement system.

##### Ratiometric Bridge-Based Measurements

Many sensors including strain gages, load cells, pressure sensors, and torque sensors are based on the concept of a Wheatstone bridge. The output of a Wheatstone bridge is measured between the middle nodes of the two voltage dividers. The output voltage of the bridge scales with the excitation voltage. However, the ratio of the bridge output (VCH) and the excitation voltage (VEX) remains fixed over variations in excitation voltage, and it is this unitless ratio (VCH/VEX) that is of interest. To accurately measure the ratiometric output of a bridge-based sensor, both the bridge output voltage (VCH) and the excitation voltage must be known.

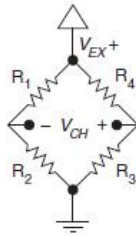


Figure 1. Wheatstone Bridge

The NI PXIe-4331 bridge input module uses circuitry that continuously measures the excitation voltage and applies it as a reference to its ADC. In this way, variations in the excitation voltage are compensated for, and the module returns data as a ratio of the bridge output voltage and the excitation voltage. This approach removes the measurement's dependence on the stability and accuracy of the excitation voltage. Due to the ratiometric design, measurements with the NI PXIe-4331 bridge input module are less susceptible to temperature drift and other variations in the excitation voltage.

### PXI Express Dedicated Data Throughput

SC Express modules are built on the x1 PXI Express bus with dedicated bandwidth per device up to 250 MB/s. Because of the added bandwidth provided by PXI Express, SC Express modules offer simultaneous sampling options using the same channel counts and connectivity as multiplexed devices. Unlike multiplexed devices that reduce sampling rates, you can use simultaneous sampling devices to maintain sampling rates as you expand the number of channels.

### PXI Platform Advanced Timing and Synchronization

PXI Express provides advanced timing and synchronization features, including a 100 MHz differential system clock, differential signaling, and differential star triggers. By using differential clocking and synchronization, PXI Express systems benefit from increased noise immunity for instrumentation clocks and the ability to transmit at higher-frequency rates. The SC Express family takes advantage of PXI Express to deliver tight synchronization between modules in one chassis or multiple chassis.

### Wide Variety of I/O on the PXI Platform

When combined with more than 1,500 I/O types in the PXI platform, this module offers the flexibility you require to develop a measurement system that meets your application needs. PXI modules are compatible with the CompactPCI and CompactPCI Express industrial computer standards and provide additional features such as environmental specifications, standardized software, and built-in timing and synchronization.

### Connectivity

The NI PXIe-4331 is designed to be used with the NI TB-4330 front-mounting terminal block. The SC Express terminal blocks are hot-swappable and automatically recognized in software. This makes troubleshooting easier because you can connect and remove terminal blocks without powering down the PXI measurement system. Each terminal block also includes alignment fins that guide the connector onto the PXI Express module without bent pins.

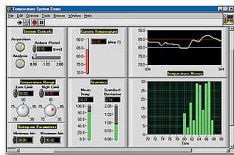


Figure 2. NI TB-4330 Front-Mounting Terminal Block

[Back to Top](#)

## Software Recommendations

### LabVIEW Professional Development System for Windows



- Advanced software tools for large project development
- Automatic code generation using DAQ Assistant and Instrument I/O Assistant
- Tight integration with a wide range of hardware
- Advanced measurement analysis and digital signal processing
- Open connectivity with DLLs, ActiveX, and .NET objects
- Capability to build DLLs, executables, and MSI installers

[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](http://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](http://ni.com/calibration).

## Technical Support

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

- **Support** - Visit [ni.com/support](http://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](http://forums.ni.com) for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit [community.ni.com](http://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](http://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](http://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](http://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](http://ni.com/oem).

## Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit [ni.com/alliance](http://ni.com/alliance).

[Back to Top](#)

## Detailed Specifications

This document lists specifications for the NI PXIe-4331 module. These specifications are typical for the range of 0 °C to 55 °C unless otherwise stated. The system must be allowed to warm up for 15 minutes to achieve the rated accuracy. All specifications are subject to change without notice. Visit [ni.com/manuals](http://ni.com/manuals) for the most current specifications and product documentation.



**Caution** The inputs of this sensitive test and measurement product are not protected from electromagnetic interference for functional reasons. As a result, this product may experience reduced measurement accuracy or other temporary performance degradation when cables are attached in an environment with electromagnetic interference present. Refer to the Declaration of Conformity (DoC) for this product for details of the standards applied to assess electromagnetic compatibility performance. To obtain the DoC, visit [ni.com/certification](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.



**Note** Keep the filler panels on all unused slots in your chassis to maintain forced air cooling.

### Input Characteristics

Number of channels	8 analog input channels
ADC resolution	24 bits
Type of ADC	Delta-Sigma (with analog prefiltering)

Sampling mode	Simultaneous
Input Ranges	
$V_{ex} \leq 2.5 \text{ V}$	$\pm 100 \text{ mV/V}$
$V_{ex} \geq 2.75 \text{ V}$	$\pm 25 \text{ mV/V}$
Common-mode voltage input range ( $V_{cm}$ )	$\pm 2\text{V}$
FIFO buffer size	1,022 samples
Data transfers	Direct memory access (DMA), Programmed I/O
Sample rates ( $f_s$ )	1 to 100 S/s in 1 S/s increments, 100 to 25.6 kS/s in 100 S/s increments

Fault protection (powered On or Off)	
Signal	Level
AI $\pm <0..7>$ , RS $\pm <0..7>$ , T $\pm <0..7>$	$\pm 30 \text{ V to GND}$
EX $\pm <0..7>$	Short-circuit protected
QTR/SC $<0..7>$	None
RSVD	$\pm 24 \text{ V to GND}$

### Bridge Completion

Modes	Full, half, and quarter
Selection	Software selectable, per channel
Half-bridge completion	
Tolerance	$\pm 500 \text{ } \mu\text{V/V max}$
Stability	$2.5 \text{ } \mu\text{V/V per } ^\circ\text{C max}$
Quarter-bridge completion	
Values	120 $\Omega$ , 350 $\Omega$ , 1 k $\Omega$
Tolerance	0.1% max
Stability	10 ppm/ $^\circ\text{C max}$

### Excitation Characteristics

Selection	Software selectable, per channel
Excitation type	Constant differential voltage (balanced)
Values ( $V_{ex}$ )	0.625 V, 1 V, 1.5 V, 2 V, 2.5 V, 2.75 V, 3.3 V, 5 V, 7.5 V, 10 V
Tolerance	$\pm 0.5\% \pm 83 \text{ mV max}$
Minimum current	29 mA

Maximum voltage excitation settings versus bridge configurations		
Bridge Resistance (individual element)	Bridge Configuration	$V_{ex}$ (max)
120 $\Omega$	Full	3.3 V
	Half and Quarter	5 V
350 $\Omega$	Full	10 V
	Half and Quarter	10 V
1 k $\Omega$	Full	10 V
	Half and Quarter	10 V

Excitation noise	$250 \text{ } \mu\text{V}_{\text{rms}}$ (bandwidth = 50 kHz)
Short-circuit protection	EX to GND and between terminals

## Shunt Calibration

Selection	Software selectable, per channel
Location	Internal across quarter-bridge completion, External referenced to negative excitation
Values	33.333 k $\Omega$ , 50 k $\Omega$ , 100 k $\Omega$
Tolerance	0.1% max
Stability	10 ppm/ $^{\circ}$ C max

## Accuracy <sup>1</sup>

Accuracy table				
Measurement Conditions*	Range: $\pm 25$ mV/V		Range: $\pm 100$ mV/V	
	Gain Error (% of Reading)	Offset Error ( $\mu$ V/V)	Gain Error (% of Reading)	Offset Error ( $\mu$ V/V)
typ (23 $^{\circ}$ C $\pm 5$ $^{\circ}$ C)	0.02%	19 $\mu$ V/V <sub>ex</sub>	0.02%	30 $\mu$ V/V <sub>ex</sub>
max (23 $^{\circ}$ C $\pm 5$ $^{\circ}$ C)	0.05%	108 $\mu$ V/V <sub>ex</sub>	0.05%	168 $\mu$ V/V <sub>ex</sub>
max (0 $^{\circ}$ C to 55 $^{\circ}$ C)	0.1%	198 $\mu$ V/V <sub>ex</sub>	0.1%	258 $\mu$ V/V <sub>ex</sub>

\* Before offset null or shunt calibration,  $-0.1$  V  $\leq V_{cm} \leq 0.1$  V

Gain stability	12 ppm/ $^{\circ}$ C max
Offset stability	4.5 $\mu$ V/V <sub>ex</sub> per $^{\circ}$ C max
CMRR (DC to 1 kHz)	85 dB
Spurious free dynamic range (SFDR)	
1 kHz, -60 dB FS	100 dB
Total harmonic distortion (THD)	
1 kHz, -1 dB FS	-88 dB
Crosstalk ( $f_{in} = 10$ kHz, not including cable effects)	-100 dB

Input noise	
Excitation Voltage	Total ( $\mu$ V/V <sub>rms</sub> ), $f_s = 25.6$ kS/s, 350 $\Omega$ Full Bridge
0.625 V	2.97
1 V	1.84
1.5 V	1.23
2 V	0.92
2.5 V	0.74
2.75 V	0.67
3.3 V	0.56
5 V	0.37
7.5 V	0.25
10 V	0.18

Channel-to-channel matching		
Input Signal Frequency ( $f_{in}$ )	Gain (max)	Phase (max)
0 to 10 kHz	0.12%	(0.032 $^{\circ}$ /kHz) $\cdot f_{in}$

Phase linearity ( $f_{in} = 0$ to 10 kHz)	$\pm 0.05^{\circ}$ max
---	------------------------

Digital filter group delay <sup>2</sup>	
Sample Rate ( $f_s$ )	Filter Delay (Samples)
$12.9 \text{ kS/s} \leq f_s \leq 25.6 \text{ kS/s}$	36
$6.5 \text{ kS/s} \leq f_s \leq 12.8 \text{ kS/s}$	34
$3.3 \text{ kS/s} \leq f_s \leq 6.4 \text{ kS/s}$	33
$26 \text{ S/s} \leq f_s \leq 3.2 \text{ kS/s}$	32
$13 \text{ S/s} \leq f_s \leq 25 \text{ S/s}$	17
$9 \text{ S/s} \leq f_s \leq 12 \text{ S/s}$	11
7 S/s, 8 S/s	9
6 S/s	7
4 S/s, 5 S/s	6
3 S/s	5
2 S/s	3
1 S/s	2

Analog input delay 1.1  $\mu\text{s}$

### Bandwidth and Alias Rejection

Passband

Frequency (for  $26 \text{ S/s} \leq f_s \leq 25.6 \text{ kS/s}$ )  $0.40 \cdot f_s$

Flatness 0.05 dB max

Stopband

Frequency  $0.55 \cdot f_s$

Rejection 100 dB

Alias-free bandwidth

$0.45 \cdot f_s$

Minimum frequency for ADC alias hole

1.6384 MHz

Rejection at alias hole

53 dB

### Transducer Electronic Data Sheet (TEDS) Support

Number of channels

8

### Internal Frequency Timebase Characteristics

Frequency

100 MHz

Accuracy

$\pm 50$  ppm

### Synchronization

Reference clock source

Onboard 100 MHz clock, Backplane PXIe\_CLK100

### Triggers

Analog trigger

Source

AI <0..7>

Purpose

Reference trigger only

Level

Full scale (depending on input range), programmable

Mode

Rising-edge, Rising-edge with hysteresis, Falling-edge, Falling-edge with hysteresis, Entering Window, Leaving Window

Resolution

24-bits

Digital trigger	
Source	PXI_TRIG<0..7>, PXI_STAR, PXIe_DSTAR<A..B>
Purpose	Start or reference trigger
Polarity	Software-selectable
Debounce filter settings	Disable, 90 ns, 5.12 $\mu$ s, 2.56 ms, custom interval
Output timing signals	
Sources	Sample Clock, Start Trigger Out, Reference Trigger Out
Destinations	PXI_TRIG<0..7>, PXIe_DSTAR C
Polarity	Software-selectable
<b>Output Timing Signals</b>	
Sources	Sample Clock, Start Trigger Out, Reference Trigger Out
Destinations	PXI_TRIG<0..7>, PXIe_DSTAR C
Polarity	Software-selectable
<b>Bus Interface</b>	
Form factor	x1 PXI Express peripheral module, Specification rev 1.0 compliant
Slot compatibility	x1 and x4 PXI Express or PXI Express hybrid slots
DMA channels	1, analog input
<b>Calibration</b>	
You can obtain the calibration certificate and information about calibration services for the NI PXIe-4331 at <a href="http://ni.com/calibration">ni.com/calibration</a> .	
Recommended warm-up time	15 minutes
Calibration interval	1 year
<b>Power Requirements</b>	
+12 V	1.3 A
+3.3 V	1.1 A
<b>Physical Requirements</b>	
Dimensions	Standard 3U PXIe, 16 × 10 cm (6.3 × 3.9 in.)
Weight	152 g (5.3 oz)
I/O connector	96-pin male DIN 41612/IEC 60603-2 connector.
<b>Environmental Specifications</b>	
Maximum altitude	2,000 m (800 mbar), (at 25 °C ambient temperature)
Pollution Degree	2
Indoor use only	
<b>Operating Environment</b>	
Ambient temperature range	0 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 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)
<b>Storage Environment</b>	
Ambient temperature range	−40 to 71°C (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 to 500 Hz, 0.3 g <sub>rms</sub>
Non-operating	5 to 500 Hz, 2.4 g <sub>rms</sub> (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

## Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment 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.

Measurement Category I



**Caution** Do *not* use for measurements within Measurement Categories II, III, or IV.

## Electromagnetic Compatibility

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

- EN 61326-2-1 (IEC 61326-2-1): 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** For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.



**Note** For EMC compliance, operate this device with shielded cables and accessories.

## CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, 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](https://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 *NI and the Environment* Web page at [ni.com/environment](https://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.htm](https://ni.com/environment/weee.htm).

## 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](https://ni.com/environment/rohs_china)。(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](https://ni.com/environment/rohs_china).)

<sup>1</sup> Accuracies listed are warranted for the conditions described in the table above and for up to one year from the module external calibration.

<sup>2</sup> Digital Filter Group Delay defines the maximum amount of time required after the digitization of a sample begins until the sample is available to be read. The Sample Clock generated by this device for exporting across the NI PXIe backplane is not affected by the Digital Filter Group Delay.

©2010 National Instruments. All rights reserved. CompactRIO, FieldPoint, LabVIEW, National Instruments, National Instruments Alliance Partner, NI, ni.com, and NI-DAQ are trademarks of National Instruments. Other product and company names listed are trademarks or trade names of their respective companies. A National Instruments Alliance Partner is a business entity independent from National Instruments and has no agency, partnership, or joint-venture relationship with National Instruments.

[My Profile](#) | [RSS](#) | [Privacy](#) | [Legal](#) | [Contact NI](#) © 2014 National Instruments Corporation. All rights reserved.



Irrtum und Änderungen vorbehalten - auch ohne vorherige Ankündigung. Verwendete Hardware- und Softwarebezeichnungen, Marken sowie Firmennamen können eingetragene Warenzeichen sein und unterliegen somit den gesetzlichen Bestimmungen. / Information in this document is subject to change without prior practice. The software and hardware designations or brand names used in this text are in most cases trademarks of their respective companies and are thus subject to law.