NI PXIe-4330/4331 Specifications

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This document lists specifications for the NI PXIe-4330/4331 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` 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`, 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

- $V_{ex} \leq 2.5$ V .... ±100 mV/V
- $V_{ex} \geq 2.75$ V .... ±25 mV/V

Common-mode voltage input range (V_{cm}) .... ±2 V

CMRR (DC to 1 kHz)..................... 85 dB

FIFO buffer size.............................. 1,023 samples

Data transfers .... Direct memory access (DMA), Programmed I/O

Sample rates (f_s)

- NI PXIe-4330............................. 1 S/s to 100 S/s in 1 S/s increments, 100 S/s to 25.6 kS/s in 100 S/s increments
- NI PXIe-4331............................. 1 S/s to 100 S/s in 1 S/s increments, 100 S/s to 102.4 kS/s in 100 S/s increments

Fault protection (powered On or Off)

Signal	Level
AI ±<0..7>, RS ±<0..7>, T ±<0..7>	±30 V to GND
EX ±<0..7>	Short-circuit protected
QTR/SC <0..7>	None
RSVD	±24 V to GND

Bridge Completion

Modes .... Full, half, quarter

Selection .... Software selectable, per channel

Half-bridge completion

- Tolerance .... ±500 µV/V max
- Stability .... 2.5 µV/V per °C max

Quarter-bridge completion

- Values .... 120 Ω, 350 Ω, 1 kΩ
- Tolerance .... 0.1% max
- Stability .... 10 ppm/°C max

Shunt Calibration

Selection .... Software selectable, per channel

Location .... Internal across quarter-bridge completion, External referenced to negative excitation

Values .... 33.333 kΩ, 50 kΩ, 100 kΩ

Tolerance .... 0.1% max

Stability .... 10 ppm/°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 .... ±0.5% ±83 mV max

Minimum current .... 29 mA

Maximum voltage excitation settings versus bridge configurations

Bridge Resistance (individual element)	Bridge Configuration	V_{ex} (max)
120 Ω	Full	3.3 V
	Half and Quarter	5 V
350 Ω	Full	10 V
	Half and Quarter	10 V
1 kΩ	Full	10 V
	Half and Quarter	10 V

Excitation noise .... 250 μV_{rms} (bandwidth = 50 kHz)

Short-circuit protection .... EX to GND and between terminals

Accuracy[1]

For Sample Rates ≤ 51.2 kS/s

Measurement Conditions*	Range: ±25 mV/V		Range: ±100 mV/V	
	Gain Error (% of Reading)	**Offset Error (μV/V)†**	**Gain Error (% of Reading)**	**Offset Error (μV/V)†**
typ (23 °C ±5 °C)	0.02%	$\frac{19\ \mu V}{V_{ex}}$	0.02%	$\frac{30\ \mu V}{V_{ex}}$
max (23 °C ±5 °C)	0.05%	$\frac{108\ \mu V}{V_{ex}}$	0.05%	$\frac{168\ \mu V}{V_{ex}}$
max (0 °C to 55 °C)	0.1%	$\frac{198\ \mu V}{V_{ex}}$	0.1%	$\frac{258\ \mu V}{V_{ex}}$

* Before offset null or shunt calibration, –0.1 V ≤ V_{cm} ≤ 0.1 V.
† Offset error excludes noise. Refer to the *Input noise* specifications.

Note: V_{ex} is the excitation voltage setting.

For Sample Rates > 51.2 kS/s (NI PXIe-4331 only)

Measurement Conditions*	Range: ±25 mV/V		Range: ±100 mV/V	
	Gain Error (% of Reading)	**Offset Error (μV/V)†**	**Gain Error (% of Reading)**	**Offset Error (μV/V)†**
typ (23 °C ±5 °C)	$0.02\% + 0.01\% \cdot \frac{10\ V}{V_{ex}}$	$\frac{39\ \mu V}{V_{ex}}$	$0.02\% + 0.01\% \cdot \frac{2.5\ V}{V_{ex}}$	$\frac{50\ \mu V}{V_{ex}}$
max (23 °C ±5 °C)	$0.05\% + 0.015\% \cdot \frac{10\ V}{V_{ex}}$	$\frac{138\ \mu V}{V_{ex}}$	$0.05\% + 0.015\% \cdot \frac{2.5\ V}{V_{ex}}$	$\frac{198\ \mu V}{V_{ex}}$
max (0 °C to 55 °C)	$0.1\% + 0.015\% \cdot \frac{10\ V}{V_{ex}}$	$\frac{228\ \mu V}{V_{ex}}$	$0.1\% + 0.015\% \cdot \frac{2.5\ V}{V_{ex}}$	$\frac{288\ \mu V}{V_{ex}}$

* Before offset null or shunt calibration, –0.1 V ≤ V_{cm} ≤ 0.1 V.
† Offset error excludes noise. Refer to the *Input noise* specifications.

Note: V_{ex} is the excitation voltage setting.

Absolute Accuracy

Absolute Accuracy = Reading · Gain Error + Offset Error + Noise Uncertainty,
Noise Uncertainty = 3 · Random Noise / $\sqrt{(\#\ samples)}$

where Random Noise is the Input noise for the Sample Rate used,
3 converts the RMS value to peak value,
\# samples is the number of samples averaged

If the operating ambient temperature is outside the range of 23 °C ±5 °C,
include additional gain error of deltaT · Gain Stability and additional offset error of deltaT· Offset Stability
where deltaT is the temperature difference between the ambient temperature and 18 °C or 28 °C, whichever is smaller.

[1] Accuracies listed are warranted for the conditions described in the tables and for up to one year from the module external calibration.

Temperature Stability

Gain stability .... 12 ppm/°C max

Offset stability .... 4.5 $\mu V/V_{ex}$ per °C max

Relative Gain and Offset Stability for Sample Rates >51.2 kS/s (PXIe-4331 only)

The following table represents relative gain and offset errors corresponding to the indicated temperature changes. These errors are already included in the accuracy specifications. *Absolute Accuracy*, *Example 4* shows an example of inclusion of the relative offset stability following a bridge-offset null operation.

Temperature Change	Range: ±25 mV/V		Range: ±100 mV/V	
	Gain Stability (ppm of Reading) max	**Offset Stability (µV/V) max**	**Gain Stability (ppm of Reading) max**	**Offset Stability (µV/V) max**
±1 °C	$12\text{ ppm} + 47\text{ ppm} \cdot \frac{10\text{ V}}{V_{ex}}$	$\frac{20\ \mu\text{V}}{V_{ex}}$	$12\text{ ppm} + 47\text{ ppm} \cdot \frac{2.5\text{ V}}{V_{ex}}$	$\frac{20\ \mu\text{V}}{V_{ex}}$
±2 °C	$24\text{ ppm} + 70\text{ ppm} \cdot \frac{10\text{ V}}{V_{ex}}$	$\frac{26\ \mu\text{V}}{V_{ex}}$	$24\text{ ppm} + 70\text{ ppm} \cdot \frac{2.5\text{ V}}{V_{ex}}$	$\frac{26\ \mu\text{V}}{V_{ex}}$
±3 °C	$36\text{ ppm} + 95\text{ ppm} \cdot \frac{10\text{ V}}{V_{ex}}$	$\frac{33\ \mu\text{V}}{V_{ex}}$	$36\text{ ppm} + 95\text{ ppm} \cdot \frac{2.5\text{ V}}{V_{ex}}$	$\frac{33\ \mu\text{V}}{V_{ex}}$
±5 °C	$60\text{ ppm} + 120\text{ ppm} \cdot \frac{10\text{ V}}{V_{ex}}$	$\frac{52.5\ \mu\text{V}}{V_{ex}}$	$60\text{ ppm} + 120\text{ ppm} \cdot \frac{2.5\text{ V}}{V_{ex}}$	$\frac{52.5\ \mu\text{V}}{V_{ex}}$
More than ±5 °C	$\frac{12\text{ ppm}}{°\text{C}} + 120\text{ ppm} \cdot \frac{10\text{ V}}{V_{ex}}$	$\frac{4.5\ \mu V}{V_{ex}}\text{ per °C} + \frac{30\ \mu\text{V}}{V_{ex}}$	$\frac{12\text{ ppm}}{°\text{C}} + 120\text{ ppm} \cdot \frac{2.5\text{ V}}{V_{ex}}$	$\frac{4.5\ \mu\text{V}}{V_{ex}}\text{ per °C} + \frac{30\ \mu\text{V}}{V_{ex}}$
Note: 1 ppm = 0.0001%				

Absolute Accuracy Example Calculations

Refer to the *Absolute Accuracy* section for the definition of absolute accuracy.

Example 1

For the 25 mV/V range with an excitation voltage of 10 V, an external temperature of 33 °C, a sample rate of 25.6 kS/s, with a sample of 100 readings, the absolute accuracy at full scale is as follows:

deltaT = 33 °C – 28 °C = 5 °C

Gain Error = 0.05% + (0.0012%/°C) · 5 °C = 0.056%

Offset Error = 108 µV/10 V + (4.5 µV/10 V/°C) · 5 °C = 13.05 µV/V

Noise Uncertainty = $3 \cdot 0.18\ \mu V/V / \sqrt{100} = 0.054\ \mu V/V$

Absolute Accuracy = 25 mV/V · 0.056% + 13.05 µV/V + 0.054 µV/V = 27.1 µV/V

Example 2

For the 25 mV/V range with an excitation voltage of 7.5 V, an external temperature of 33 °C, a sample rate of 60 kS/s, with a sample of 100 readings, the absolute accuracy at full scale is as follows:

deltaT = 33 °C – 28 °C = 5 °C

Gain Error = (0.05% + 0.015% · 10 V/7.5 V) + (0.0012%/°C) · 5 °C = 0.076%

Offset Error = 138 µV/7.5 V + (4.5 µV/7.5 V/°C) · 5 °C = 21.4 µV/V

Noise Uncertainty = $3 \cdot 0.5\ \mu V/V \cdot \sqrt{60\ kS/s / 102.4\ kS/s} / \sqrt{100} = 0.115\ \mu V/V$

Absolute Accuracy = 25 mV/V · 0.076% + 21.4 µV/V + 0.115 µV/V = 40.5 µV/V

Example 3

This example includes the accuracy calculation within ±5 °C of a bridge-null operation.

For the 25 mV/V range with an excitation voltage of 10 V, an external temperature of 32 °C, a sample rate of 25.6 kS/s, with a sample of 100 readings, and measurements within ±5 °C of a bridge-null operation, the absolute accuracy at 2 mV/V is as follows:

deltaT = 32 °C – 28 °C = 4 °C

deltaT_from_bridge_null = 5 °C

Gain Error = 0.05% + (0.0012%/°C) · 4 °C = 0.055%

Offset Error = (4.5 µV/10 V/°C) · 5 °C = 2.25 µV/V

Noise Uncertainty = $3 \cdot 0.18\ \mu V/V / \sqrt{100} = 0.054\ \mu V/V$

Absolute Accuracy = 2 mV/V · 0.055% + 2.25 µV/V + 0.054 µV/V = 3.4 µV/V

Example 4

This example includes the accuracy calculation within ±6 °C of a bridge-null operation for sample rates above 51.2 kS/S.

For the 25 mV/V range with an excitation voltage of 7.5 V, an external temperature of 32 °C, a sample rate of 60 kS/s, with a sample of 100 readings, and measurements within ±6 °C of a bridge-null operation, the absolute accuracy at 2 mV/V is as follows:

deltaT = 32 °C – 28 °C = 4 °C

deltaT_from_bridge_null = 6 °C

Gain Error = (0.05% + 0.015% · 10 V/7.5 V) + (0.0012%/°C) · 4 °C = 0.0748%

Offset Error = (4.5 µV/7.5 V/°C) · 6 °C + 30 µV/7.5 V = 7.6 µV/V

Noise Uncertainty = $3 \cdot 0.5\ \mu V/V \cdot \sqrt{60\ kS/s / 102.4\ kS/s} / \sqrt{100} = 0.115\ \mu V/V$

Absolute Accuracy = 2 mV/V · 0.0748% + 7.6 µV/V + 0.115 µV/V = 9.2 µV/V

Input noise

Excitation Voltage	**Total (µV/V_{rms})*, f_s = 25.6 kS/s, 350 Ω Full Bridge**	**Total (µV/V_{rms})†, f_s = 102.4 kS/s, 350 Ω Full Bridge**
0.625 V	2.97	5.94
1 V	1.84	3.69
1.5 V	1.23	2.45
2 V	0.92	1.84
2.5 V	0.74	1.47
2.75 V	0.67	1.34
3.3 V	0.56	1.12
5 V	0.37	0.74
7.5 V	0.25	0.50
10 V	0.18	0.36

* For lower sample rates multiply by $\sqrt{\frac{f_s}{25.6\ \text{kS/s}}}$

† For lower sample rates multiply by $\sqrt{\frac{f_s}{102.4\ \text{kS/s}}}$

Channel-to-channel matching

Module	**Input Signal Frequency (f_{in})**	**Gain (max)**	**Phase (max)**
NI PXIe-4330/ NI PXIe-4331	DC to 10 kHz	0.12%	$\frac{0.032°}{\text{kHz}} \cdot f_{in}$
NI PXIe-4331	DC to 20 kHz	0.3%	

Phase linearity
(f_{in} = DC to 20 kHz) ....±0.05°

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

Digital filter group delay[1]

Sample Rate (f_s)	**Filter Delay (Samples)**
25.7 kS/s ≤ f_s ≤ 102.4 kS/s	41
12.9 kS/s ≤ f_s ≤ 25.6 kS/s	36
6.5 kS/s ≤ f_s ≤ 12.8 kS/s	34
3.3 kS/s ≤ f_s ≤ 6.4 kS/s	33
26 S/s ≤ f_s ≤ 3.2 kS/s	32
13 S/s ≤ f_s ≤ 25 S/s	17
9 S/s ≤ f_s ≤ 12 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 µs

Bandwidth and Alias Rejection

Passband

Frequency
(for 26 S/s ≤ f_s ≤ 25.6 kS/s) .... 0.40·f_s

Frequency (for f_s > 25.6 kS/s) ... 0.45·f_s

Flatness...................................... 0.05 dB max

Stopband

Frequency .... 0.55·f_s

Rejection.................................... 100 dB

Alias-free bandwidth....................... 0.45·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

[1] 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.

Internal Frequency Timebase Characteristics

Frequency.. 100 MHz

Accuracy .... ±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 µs, 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

Bus Interface

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

Calibration

You can obtain the calibration certificate and information about calibration services for the NI PXIe-4330/4331 at `ni.com/calibration`.

Recommended warm-up time .... 15 minutes

Calibration interval.......................... 1 year

Power Requirements

+12 V... 1.3 A

+3.3 V... 1.1 A

Physical Requirements

Dimensions..................................... Standard 3U PXIe, 16 cm × 10 cm (6.3 in. × 3.9 in.)

Weight .... 152 g (5.3 oz)

I/O connector.................................. 96-pin male DIN 41612/ IEC 60603-2 connector.

Environmental Specifications

Maximum altitude .... 2,000 m (800 mbar)

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. 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.)

Storage Environment

Ambient temperature range ....–40 °C 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 Hz to 500 Hz, 0.3 g_{rms}
- Non-operating ....5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Non-operating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

This product meets 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 follows:

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

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. 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 to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* 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 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`.)

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