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PXI-6236

DEVICE SPECIFICATIONS

NI 6236

M Series Data Acquisition: 16-Bit, 250 kS/s, 4 AI, 4 AO, 6 DI, 4 DO, Current Input, Voltage Output, Bank Isolation

The following specifications are typical at 25 °C, unless otherwise noted. For more information about the NI 6236, refer to the *NI 6236 User Manual* available at ni.com/manuals.

Analog Input

| | |
|--|---|
| Number of channels | 4 differential current inputs |
| Channel type | Current input |
| ADC resolution | 16 bits |
| DNL | No missing codes guaranteed |
| INL | Refer to <i>AI Absolute Accuracy</i> section |
| Sample rate | |
| Maximum | 250 kS/s |
| Minimum | No minimum |
| Timing accuracy | 50 ppm of sample rate |
| Timing resolution | 50 ns |
| Input coupling | DC |
| Input range | ±20 mA |
| Maximum working voltage for analog inputs | Refer to <i>Maximum Working Voltage</i> section |
| Input impedance under normal operating conditions (AI+ to AI-) | |
| Typical (25 °C) | 92 Ω in parallel with 100 pF |
| Maximum (55 °C) | 110 Ω in parallel with 100 pF |
| Input bias current | ±100 pA |
| Crosstalk (at 100 kHz) | |
| Adjacent channels | -75 dB |
| Non-adjacent channels | -90 dB |

| | |
|--|--|
| Small signal bandwidth (-3 dB) | 700 kHz |
| Input FIFO size | 4,095 samples |
| Scan list memory | 4,095 entries |
| Data transfers | DMA (scatter-gather), interrupts, programmed I/O |
| Overvoltage protection (AI x+ or AI x- with respect to AI GND) | |
| Device on | ±25 V for up to two AI pins |
| Device off | ±15 V for up to two AI pins |
| Overvoltage protection (AI x+ to AI x-) | ±20 V maximum |
| Overcurrent protection | ±40 mA maximum ¹ |

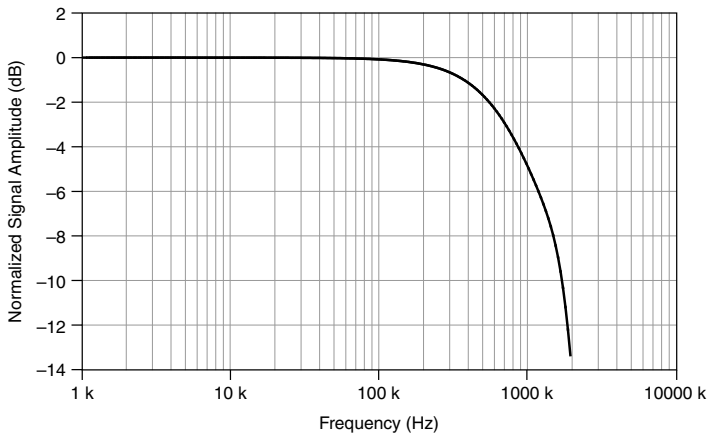
Settling Time for Multichannel Measurements

Accuracy, full-scale step, all ranges

| | |
|--------------------------|-----------------------|
| ±90 ppm of step (±6 LSB) | 4 μs convert interval |
| ±30 ppm of step (±2 LSB) | 5 μs convert interval |
| ±15 ppm of step (±1 LSB) | 7 μs convert interval |

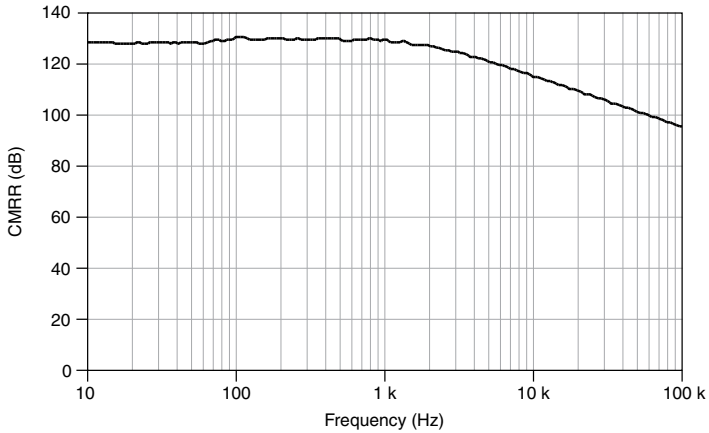
Typical Performance Graphs

Figure 1. AI Small Signal Bandwidth



¹ Any voltage applied resulting in current flowing above 40 mA can damage the device permanently.

Figure 2. AI CMRR to Earth Ground



AI Absolute Accuracy



Note Accuracies listed are valid for up to one year from the device external calibration.

Table 1. AI Absolute Accuracy

| Nominal Range Positive Full Scale | Nominal Range Negative Full Scale | Residual Gain Error (ppm of Reading) | Residual Offset Error (ppm of Range) | Offset Tempco (ppm of Range/°C) | Random Noise, σ (μ Arms) | Absolute Accuracy at Full Scale (μ A) | Sensitivity (μ A) |
|-----------------------------------|-----------------------------------|--------------------------------------|--------------------------------------|---------------------------------|--------------------------------------|--|------------------------|
| 0.02 | -0.02 | 595 | 100 | 79 | 0.6 | 18.9 | 0.24 |



Note Sensitivity is the smallest current change that can be detected. It is a function of noise.

Gain tempco 35 ppm/°C

Reference tempco 5 ppm/°C

INL error 76 ppm of range

AI Absolute Accuracy Equation

$$\text{AbsoluteAccuracy} = \text{Reading} \cdot (\text{GainError}) + \text{Range} \cdot (\text{OffsetError}) + \text{NoiseUncertainty}$$

$$\begin{aligned} \text{GainError} = & \text{ResidualAIGainError} + \text{GainTempco} \cdot (\text{TempChangeFromLastInternalCal}) \\ & + \text{ReferenceTempco} \cdot (\text{TempChangeFromLastExternalCal}) \end{aligned}$$

$$\text{OffsetError} = \text{ResidualAIOffsetError} + \text{OffsetTempco} \cdot (\text{TempChangeFromLastInternalCal}) + \text{INLError}$$

$$\text{NoiseUncertainty} = \frac{\text{Random Noise} \cdot 3}{\sqrt{100}} \text{ for a coverage factor of } 3 \sigma \text{ and averaging } 100 \text{ points.}$$

AI Absolute Accuracy Example

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

- TempChangeFromLastExternalCal = 10 °C
- TempChangeFromLastInternalCal = 1 °C
- number_of_readings = 100
- CoverageFactor = 3 σ

For example, on the 20 mA range, the absolute accuracy at full scale is as follows:

$$\text{GainError} = 595 \text{ ppm} + 35 \text{ ppm} \cdot 1 + 5 \text{ ppm} \cdot 10 = 680 \text{ ppm}$$

$$\text{OffsetError} = 100 \text{ ppm} + 79 \text{ ppm} \cdot 1 + 76 \text{ ppm} = 255 \text{ ppm}$$

$$\text{NoiseUncertainty} = \frac{.6 \mu\text{A} \cdot 3}{\sqrt{100}} = .18 \mu\text{A}$$

$$\text{AbsoluteAccuracy} = 20 \text{ mA} \cdot (\text{GainError}) + 20 \text{ mA} \cdot (\text{OffsetError}) + \text{NoiseUncertainty} = 18.9 \mu\text{A}$$

Analog Output

| | |
|---------------------|-----------------------|
| Number of channels | 4 |
| Channel type | Voltage output |
| DAC resolution | 16 bits |
| DNL | ± 1 LSB |
| Monotonicity | 16 bit guaranteed |
| Maximum update rate | |
| 1 channel | 500 kS/s |
| 2 channels | 450 kS/s per channel |
| 3 channels | 425 kS/s per channel |
| 4 channels | 400 kS/s per channel |
| Timing accuracy | 50 ppm of sample rate |
| Timing resolution | 50 ns |
| Output range | ± 10 V |
| Output coupling | DC |

| | |
|--|--|
| Output impedance | 0.4 Ω |
| Output current drive | ± 5 mA |
| Overdrive protection | ± 25 V |
| Overdrive current | 10 mA |
| Power-on state | ± 20 mV |
| Power-on glitch | ± 2 V for 2 ms |
| Power-off glitch ² | ± 100 mV for 350 ms |
| Output FIFO size | 8,191 samples shared among channels used |
| Data transfers | DMA (scatter-gather), interrupts, programmed I/O |
| AO waveform modes | Non-periodic waveform, periodic waveform regeneration mode from onboard FIFO, periodic waveform regeneration from host buffer including dynamic update |
| Settling time, full-scale step, 15 ppm (1 LSB) | 6 μ s |
| Slew rate | 15 V/ μ s |
| Glitch energy | |
| Magnitude | 100 mV |
| Duration | 3 μ s |

AO Absolute Accuracy

Absolute accuracy at full-scale numbers is valid immediately following internal calibration and assumes the device is operating within 10 °C of the last external calibration.



Note Accuracies listed are valid for up to one year from the device external calibration.

² When outputting 0 V on power down from the analog output channel.

Table 2. AO Absolute Accuracy

| Nominal Range Positive Full Scale (A) | Nominal Range Negative Full Scale (A) | Residual Gain Error (ppm of Reading) | Gain Tempco (ppm/°C) | Residual Offset Error (ppm of Range) | Offset Tempco (ppm of Range/°C) | Absolute Accuracy at Full Scale (µA) |
|---------------------------------------|---------------------------------------|--------------------------------------|----------------------|--------------------------------------|---------------------------------|--------------------------------------|
| 10 | -10 | 90 | 10 | 40 | 5 | 3,230 |

Reference tempco 5 ppm/°C

INL error 128 ppm of range

AO Absolute Accuracy Equation

$$AbsoluteAccuracy = OutputValue \cdot (GainError) + Range \cdot (OffsetError)$$

$$GainError = ResidualGainError + GainTempco \cdot (TempChangeFromLastInternalCal) + ReferenceTempco \cdot (TempChangeFromLastExternalCal)$$

$$OffsetError = ResidualOffsetError + AOffsetTempco \cdot (TempChangeFromLastInternalCal) + INLError$$

Digital I/O/PFI

Static Characteristics

Number of channels (10 total)

Number of input channels 6 (PFI <0..5>/P0.<0..5>)

Number of output channels 4 (PFI <6..9>/P1.<0..3>)

Ground reference D GND

Direction control Fixed, lines are unidirectional

Input voltage protection ±20 V on up to two pins³

PFI/Port 0/Port 1 Functionality

PFI <0..5>/P0.<0..5> Static digital input, timing input

PFI <6..9>/P1.<0..3> Static digital output, timing output

³ Stresses beyond those listed under *Input voltage protection* may cause permanent damage to the device.

| | |
|--------------------------|---|
| Timing output sources | Many AI, AO, counter timing signals |
| Debounce filter settings | 125 ns, 6.425 μ s, 2.56 ms, disable; high and low transitions; selectable per input |

Digital Input Characteristics

| Level | Minimum | Maximum |
|---|---------|-------------|
| V_{IL} input low voltage | 0 V | 0.8 V |
| V_{IH} input high voltage | 2 V | 5.25 V |
| I_{IL} input low current ($V_{in} = 0$ V) | - | -10 μ A |
| I_{IH} input high current ($V_{in} = 5$ V) | - | 10 μ A |

Digital Output Characteristics

Table 3. Guaranteed Output Levels

| Level | Voltage Level | Current Level |
|----------|---------------|---------------|
| V_{OL} | 0.4 V | 7 mA |
| V_{OL} | 0.6 V | 10 mA |
| V_{OH} | 2.8 V | -24 mA |
| V_{OH} | 4.0 V | -6 mA |

Maximum Operating Conditions

| Level | Minimum | Maximum |
|--|---------|---------|
| I_{OL} output low current P1.<0..3> | — | 10 mA |
| I_{OH} output high current P1.<0..3> | — | -24 mA |

General-Purpose Counters/Timers

| | |
|--------------------------|--|
| Number of counter/timers | 2 |
| Resolution | 32 bits |
| Counter measurements | Edge counting, pulse, semi-period, period, two-edge separation |

| | |
|-------------------------------|--|
| Position measurements | X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding |
| Output applications | Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling |
| Internal base clocks | 80 MHz, 20 MHz, 0.1 MHz |
| External base clock frequency | 0 MHz to 20 MHz |
| Base clock accuracy | 50 ppm |
| Inputs | Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down |
| Routing options for inputs | Any input PFI, RTSI, PXI_TRIG, PXI_STAR, many internal signals |
| FIFO | 2 samples |
| Data transfers | Dedicated scatter-gather DMA controller for each counter/timer; interrupts; programmed I/O |

Isolation Effects

| | |
|--|-------|
| Maximum propagation delay through isolator | |
| Digital inputs | 35 ns |
| Digital outputs | 45 ns |
| Propagation delay skew between channels (inputs and outputs) | 15 ns |

Frequency Generator

| | |
|---------------------|-----------------|
| Number of channels | 1 |
| Base clocks | 10 MHz, 100 kHz |
| Divisors | 1 to 16 |
| Base clock accuracy | 50 ppm |

Output can be available on any output PFI or RTSI terminal.

Phase-Locked Loop (PLL)

| | |
|------------------|--|
| Number of PLLs | 1 |
| Reference signal | PXI_STAR, PXI_CLK10, RTSI <0..7> |
| Output of PLL | 80 MHz Timebase; other signals derived from 80 MHz Timebase including 20 MHz and 100 kHz Timebases |

External Digital Triggers

| | |
|------------------------|---|
| Source | Any PFI, RTSI, PXI_TRIG, PXI_STAR |
| Polarity | Software-selectable for most signals |
| Analog input function | Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Convert Clock, Sample Clock Timebase |
| Analog output function | Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |
| Counter/timer function | Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down |

Device-to-Device Trigger Bus

| | |
|--------------------------|---|
| PCI | RTSI <0..7> ⁴ |
| PXI | PXI_TRIG <0..7>, PXI_STAR |
| Output selections | 10 MHz Reference Clock, frequency generator output, many internal signals |
| Debounce filter settings | 125 ns, 6.425 μ s, 2.56 ms, disable; high and low transitions; selectable per input |

Bus Interface

| | |
|---------|---------------------------------|
| PCI/PXI | 3.3 V or 5 V signal environment |
|---------|---------------------------------|

The PXI device can be installed in PXI slots or PXI Express hybrid slots.

| | |
|--------------|--|
| DMA channels | 4, analog input, analog output, counter/timer 0, counter/timer 1 |
|--------------|--|

⁴ In other sections of this document, RTSI refers to RTSI <0..7> for the PCI devices or PXI_TRIG <0..7> for PXI devices.

Power Requirements

Current draw from bus during no-load condition

| | |
|-------|-------|
| +5 V | 0.5 A |
| +12 V | 20 mA |

Current draw from bus during AI and AO overvoltage condition

| | |
|-------|--------|
| +5 V | 0.75 A |
| +12 V | 20 mA |

Physical Characteristics

Dimensions

| | |
|---------------------------|--------------------------------------|
| PCI printed circuit board | 9.7 cm × 15.5 cm (3.8 in. × 6.1 in.) |
| PXI printed circuit board | Standard 3U PXI |

Weight

| | |
|---------------|----------------|
| PCI | 110 g (3.8 oz) |
| PXI | 150 g (5.2 oz) |
| I/O connector | 37-pin D-SUB |

Calibration

| | |
|--------------------------|------------|
| Recommended warm-up time | 15 minutes |
| Calibration interval | 1 year |

Maximum Working Voltage

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Channel-to-earth ground⁵

| | |
|------------|--|
| Continuous | ≤30 Vrms/60 VDC Measurement Category I |
| Withstand | ≤840 Vrms/1,200 VDC, verified by a 5 s dielectric withstand test |

⁵ In the figure, $|V_a - V_e|$, $|V_b - V_e|$, $|V_c - V_e|$, and $|V_d - V_e|$.

Channel-to-bus⁶

| | |
|---|--|
| Continuous | ≤ 30 Vrms/60 VDC Measurement Category I |
| Withstand | $\leq 1,400$ Vrms/1,950 VDC, verified by a 5 s dielectric withstand test |
| AI channel-to-AI GND (in the following figure, $ V_a - V_d $) | ≤ 11 V, Measurement Category I |
| AO channel-to-AO GND (in the following figure, $ V_b - V_d $) | ≤ 11 V, Measurement Category I |
| Digital channel-to -D GND (in the following figure, $ V_c - V_d $) | ≤ 5.25 V, Measurement Category I |

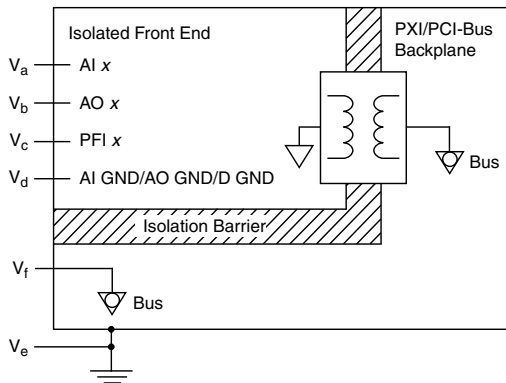
Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.



Caution This device is rated for Measurement Category I and the voltage across the isolation barrier is limited to no greater than 30 Vrms/60 VDC/42.4 V_{pk} continuous. 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.

The following figure illustrates the maximum working voltage specifications.

Figure 3. NI 6236 Maximum Working Voltage



⁶ In the figure, $|V_a - V_f|$, $|V_b - V_f|$, $|V_c - V_f|$, and $|V_d - V_f|$.

Environmental

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.) |
| Maximum altitude | 2,000 m |
| Pollution Degree | 2 |

Indoor use only.

Shock and Vibration (PXI Only)

| | |
|-------------------|---|
| 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.) |

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 and certifications, and additional information, refer to the [Online Product Certification](#) section.

CE Compliance

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

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

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 *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.

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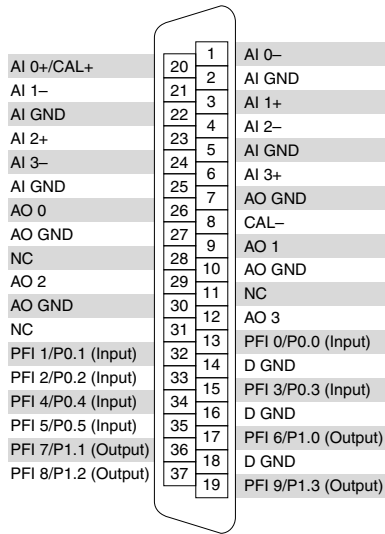
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Device Pinout

Figure 4. NI PCI/PXI-6236 Pinout



NC = No Connect

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