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NI 6010 Specifications

Specifications listed below are typical at 25 °C unless otherwise noted.

Analog Input

Number of channels ..... 8 differential or 16 single ended

ADC resolution ..... 16 bits

DNL ..... No missing codes

INL ..... Refer to the *AI Absolute Accuracy Table*

Sampling rate

- Maximum ..... 200 kS/s (single channel) 33.3 kS/s (scanning)
- Timing accuracy ..... 50 ppm of sample rate
- Timing resolution ..... 50 ns

Input coupling ..... DC

Input range ..... ±5 V, ±1 V, ±0.2 V

Maximum working voltage for analog inputs (signal + common mode) ..... ±5.5 V of AI GND

CMRR (DC to 60 Hz) ..... 75 dB

Input impedance

- AI+ to AI GND ..... >10 GΩ in parallel with 100 pF
- AI– to AI GND ..... >10 GΩ in parallel with 100 pF

Input bias current ..... ±200 pA

Crosstalk (at 10 kHz) ..... –70 dB

Small signal bandwidth (–3 dB) ..... 50 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 <0..15>, AI SENSE)

- Device on/off ..... ±42 V

Overload/powered off input impedance ..... 22 kΩ

Settling time for multichannel measurements ..... 30 µs to 100 ppm, 50 µs to 40 ppm

Analog Output

Number of channels 2

Accuracy ..... Refer to the *AO Absolute Accuracy Table*

DAC resolution ..... 16 bits

DNL ..... ±1 LSB

Output range ..... ±5 V

Output coupling ..... DC

Output impedance ..... 0.2 Ω

Output current drive ..... ±5 mA

Protection ..... Short-circuit to ground

Power-on state ..... ±100 mV

Power-on glitch ..... 3.6 V peak for 25 ms

Data transfers ..... Programmed I/O

Settling time, full scale step to 100 ppm ..... 1.2 ms

Interchannel crosstalk ..... 0.5 mV

AO noise (50 kHz bandwidth) ..... 135 µV

Calibration (AI and AO)

Recommended warm-up time ..... 15 minutes

Calibration interval ..... 1 year

NATIONAL INSTRUMENTS

AI Absolute Accuracy Table

Nominal Range		Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	INL Error (ppm of Range)	Random Noise, σ (μVrms)	Absolute Accuracy at Full Scale[1] (μV)	Sensitivity[2] (μV)
Positive Full Scale	Negative Full Scale									
5	–5	190	110	25	60	248	150	122	5,080	48.8
1	–1	244	110	25	55	294	150	30	1,110	12.0
0.2	–0.2	275	110	25	80	526	150	16	283	6.4

AbsoluteAccuracy = Reading · (GainError) + Range · (OffsetError) + NoiseUncertainty

GainError = ResidualAIGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)

OffsetError = ResidualAIOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

$$\text{NoiseUncertainty} = \frac{\text{RandomNoise} \cdot 3}{\sqrt{100}}$$ For a coverage factor of 3 σ and averaging 100 points.

[1] 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 5 V range, the absolute accuracy at full scale is as follows:

GainError = 190 ppm + 110 ppm · 1 + 25 ppm · 10 GainError = 550 ppm

OffsetError = 60 ppm + 248 ppm · 1 + 150 ppm OffsetError = 458 ppm

$$\text{NoiseUncertainty} = \frac{122\ \mu\text{V} \cdot 3}{\sqrt{100}}$$ NoiseUncertainty = 37 μV

AbsoluteAccuracy = 5 V · (GainError) + 5 V · (OffsetError) + NoiseUncertainty AbsoluteAccuracy = 5,080 μV

[2] Sensitivity is the smallest voltage change that can be detected. It is a function of noise.

AO Absolute Accuracy Table

Nominal Range		Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	INL Error (ppm of Range)	Absolute Accuracy at Full Scale[1] (μV)
Positive Full Scale	Negative Full Scale							
5	–5	360	144	25	130	13	180	5,386

[1] 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.

AbsoluteAccuracy = OutputValue · (GainError) + Range · (OffsetError)

GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)

OffsetError = ResidualOffsetError + AOOffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

Digital I/O/PFI

Static Characteristics

Number of channels.....6 digital input
(PFI <0..5>)
4 digital output
(PFI <6..9>)

Ground reference.....D GND

PFI <0..9> protection[1].....+10 V/–5 V

PFI/Port 1/Port 2 Functionality

Functionality.....Static digital input,
static digital output,
timing input,
timing output

Timing output sources.....Many AI, counter,
timing signals

Debounce filter settings.....125 ns, 6.425 µs,
2.54 ms, disable;
high and low transitions;
selectable per input

Digital Inputs PFI <0..5>

Input high voltage (V_{IH}).....2.0 V min, 5.25 V max

Input low voltage (V_{IL}).....0.8 V max, –0.3 V min

Positive-going threshold (VT+).....2.1 V max

Negative-going threshold (VT–).....0.7 V min

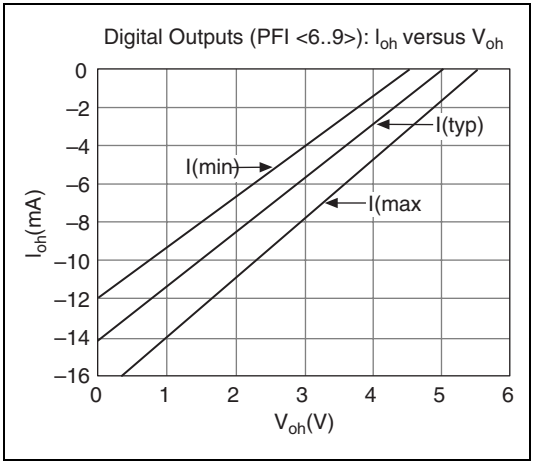
Hysteresis (VT+ – VT–).....0.4 V min

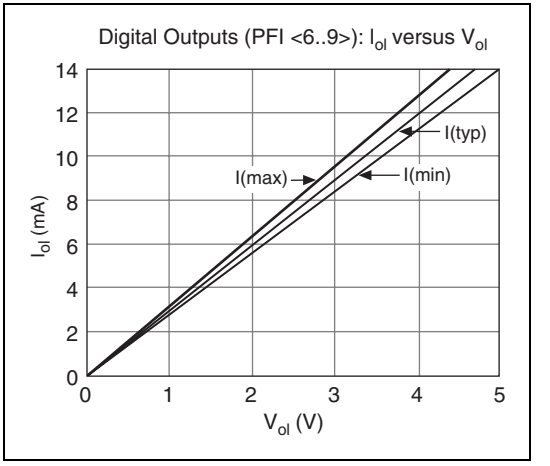
Pull-up resistor.....50 kΩ to 75 kΩ

Digital Outputs PFI <6..9>

Output high current (I_{OH}).....–6 mA max

Output low current (I_{OL}).....2 mA max





[1] Stresses beyond those listed under *PFI <0..9> protection* may cause permanent damage to the device.

General-Purpose Counter/Timers

Number of counter/timers 2

Resolution ..... 32 bits

Counter measurements ..... Edge counting, pulse, semi-period, period, two-edge separation

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, Up_Down

Routing options for inputs ..... Input PFI lines, analog trigger, many internal signals

FIFO ..... 2 samples

Data transfers ..... Dedicated scatter-gather DMA controller for each counter/timer; interrupts; programmed I/O

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 line.

External Digital Triggers

Source ..... Any input PFI line

Polarity ..... Software-selectable for most signals

Analog input function ..... Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Convert Clock, Sample Clock Timebase

Counter/timer functions ..... Gate, Source, HW_Arm, Aux, Up_Down,

Bus Interface

PCI ..... 3.3 V or 5 V signal environment

DMA channels ..... 3, analog input, counter/timer 0, counter/timer 1

Power Requirements

Current draw from bus during no-load condition

+5 V (±5%) ..... 0.3 A

+12 V (±5%) ..... 0.08 A

–12 V (±5%) ..... 0.05 A

Current draw from bus during AI and AO overvoltage condition

+5 V (±5%) ..... 0.3 A

+12 V (±5%) ..... 0.13 A

–12 V (±5%) ..... 0.08 A

Physical Requirements

Printed circuit board dimensions ..... 11.5 cm × 8.4 cm (4.7 in. × 3.4 in.)

I/O connector ..... 1 37-pin D-Sub

Environmental

Operating temperature ..... 0 to 55 °C

Storage temperature ..... –20 to 70 °C

Humidity ..... 10 to 90% RH, noncondensing

Maximum altitude ..... 2,000 m

Pollution Degree (indoor use only) 2

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
- CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label, or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

Emissions.....EN 55011 Class A at 10 m; FCC Part 15A above 1 GHz

Immunity .....EN 61326:1997 + A2:2001, Table 1

CE, C-Tick, and FCC Part 15 (Class A) Compliant

Note For EMC compliance, operate this device with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety).....73/23/EEC

Electromagnetic Compatibility Directive (EMC).....89/336/EEC

Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain 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.

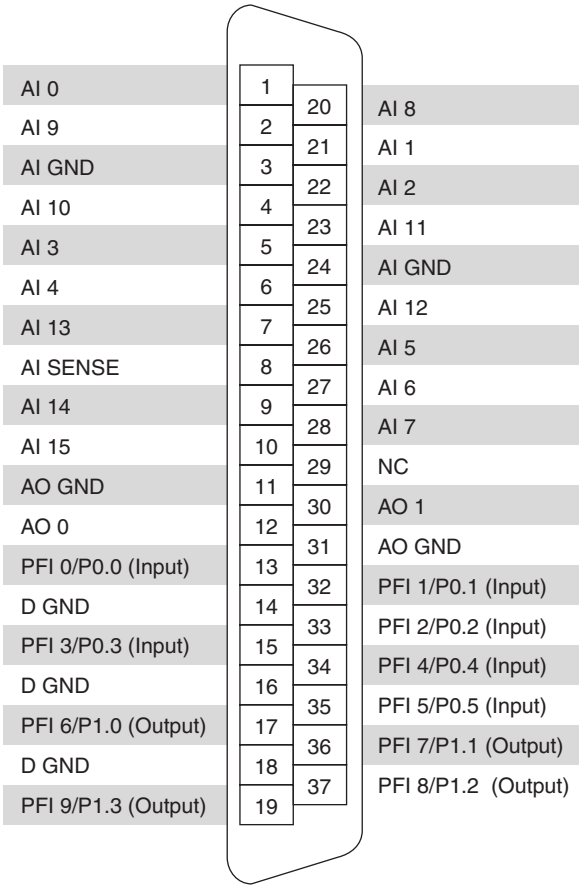


Figure 1. NI 6010 Pin Assignments

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