

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 <i>AI Absolute Accuracy Table</i>
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 <i>AO Absolute Accuracy Table</i>
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

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 (μ Vrms)	Absolute Accuracy at Full Scale ¹ (μ V)	Sensitivity ² (μ V)
Positive Full Scale	Negative Full Scale									
5	-5	190	110	25	60	248	150	5,080	48.8	
1	-1	244	110	25	55	294	150	1,110	12.0	
0.2	-0.2	275	110	25	80	526	150	283	6.4	

$AbsoluteAccuracy = Reading \cdot (GainError) + Range \cdot (OffsetError) + NoiseUncertainty$
 $GainError = ResidualAIGainError + GainTempco \cdot (TempChangeFromLastInternalCal) + ReferenceTempco \cdot (TempChangeFromLastExternalCal)$
 $OffsetError = ResidualAIOffsetError + OffsetTempco \cdot (TempChangeFromLastInternalCal) + INL_Error$
 $NoiseUncertainty = \frac{RandomNoise \cdot 3}{\sqrt{100}}$ 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
 NoiseUncertainty = $\frac{122 \mu V \cdot 3}{\sqrt{100}}$ NoiseUncertainty = 37 μ V
 AbsoluteAccuracy = 5 V · (GainError) + 5 V · (OffsetError) + NoiseUncertainty AbsoluteAccuracy = 5,080 μ V

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.

$AbsoluteAccuracy = OutputValue \cdot (GainError) + Range \cdot (OffsetError)$
 $GainError = ResidualGainError + GainTempco \cdot (TempChangeFromLastInternalCal) + ReferenceTempco \cdot (TempChangeFromLastExternalCal)$
 $OffsetError = ResidualOffsetError + AOffsetTempco \cdot (TempChangeFromLastInternalCal) + INL_Error$

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> protection¹+10 V/-5 V

PFI/Port 1/Port 2 Functionality

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

Timing output sourcesMany AI, counter,
timing signals

Debounce filter settings.....125 ns, 6.425 μ s,
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 (V_{T+}).....2.1 V max

Negative-going threshold (V_{T-})0.7 V min

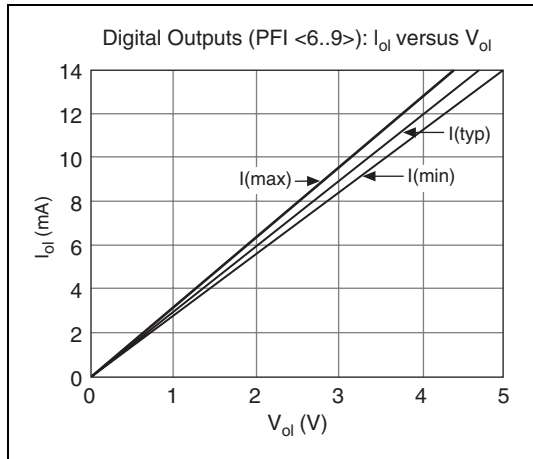
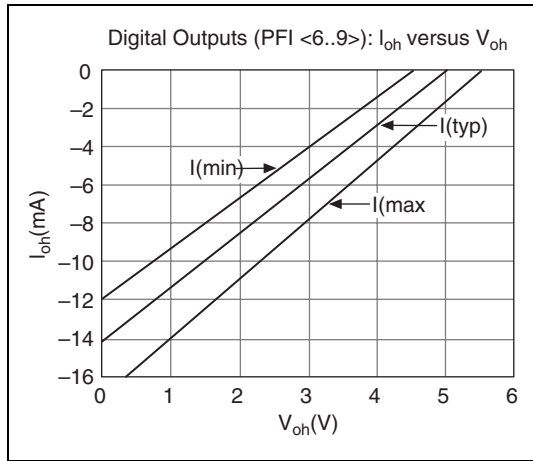
Hysteresis ($V_{T+} - V_{T-}$).....0.4 V min

Pull-up resistor50 k Ω to 75 k Ω

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 ($\pm 5\%$)	0.3 A
+12 V ($\pm 5\%$)	0.08 A
-12 V ($\pm 5\%$)	0.05 A
Current draw from bus during AI and AO overvoltage condition	
+5 V ($\pm 5\%$)	0.3 A
+12 V ($\pm 5\%$)	0.13 A
-12 V ($\pm 5\%$)	0.08 A

Physical Requirements

Printed circuit board dimensions	11.5 cm \times 8.4 cm (4.7 in. \times 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

ImmunityEN 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.

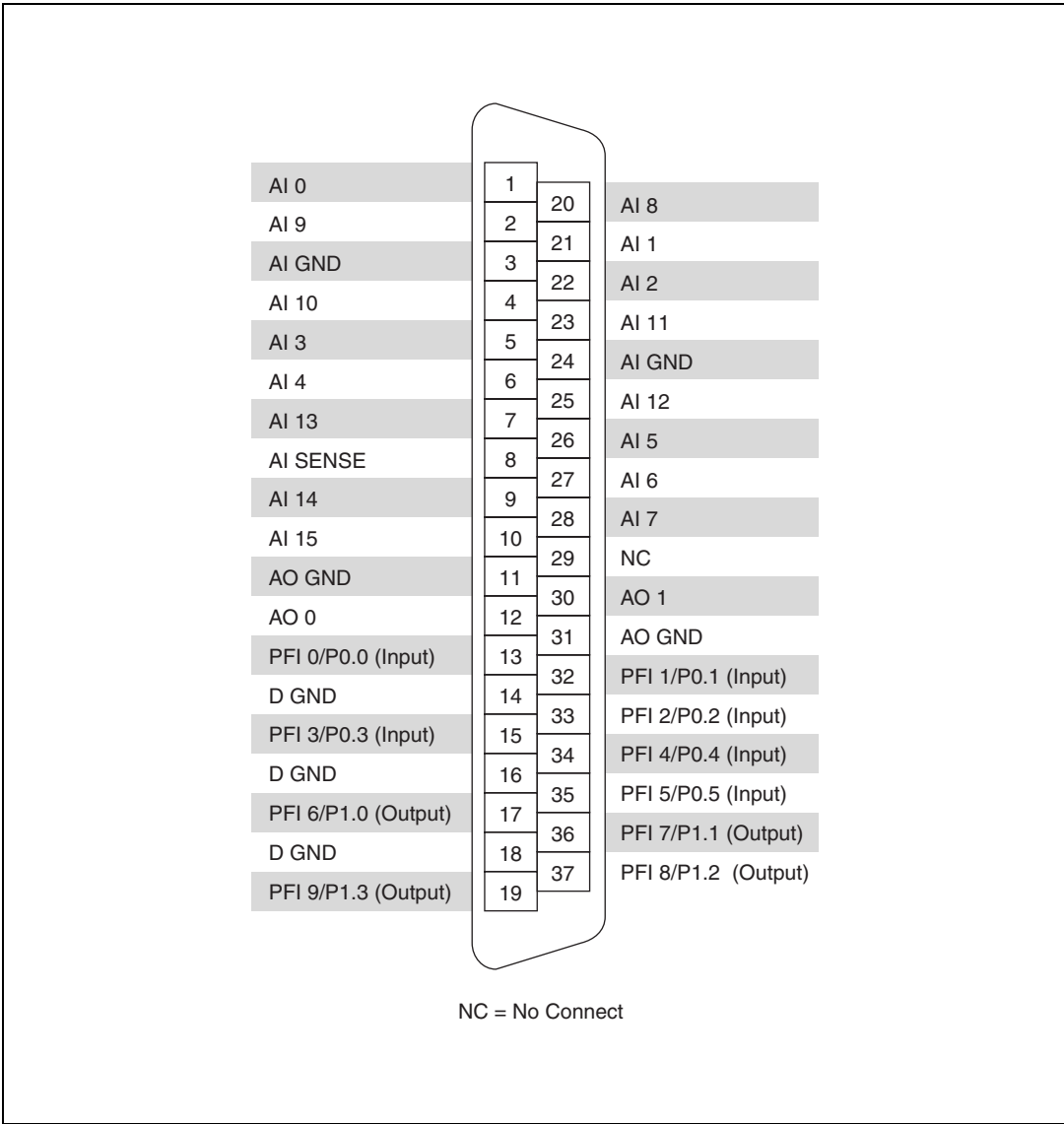


Figure 1. NI 6010 Pin Assignments

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