NI 6052E Family Specifications

This document lists the I/O terminal summary and specifications for the devices that make up the NI 6052E family of devices. This family includes the following devices:

- NI DAQPad-6052E
- NI PCI-6052E
- NI PXI-6052E

I/O Terminal Summary

Note With NI-DAQmx, National Instruments revised its terminal names so they are easier to understand and more consistent among NI hardware and software products. The revised terminal names used in this document are usually similar to the names they replace. For a complete list of Traditional NI-DAQ (Legacy) terminal names and their NI-DAQmx equivalents, refer to *Terminal Name Equivalents* of the *E Series Help*.

Table 1. I/O Terminals

Terminal Name	Terminal Type and Direction	Impedance Input/ Output	Protection (V) On/Off	Source (mA at V)	Sink (mA at V)	Rise Time (ns)	Bias
AI <0..15>	AI	100 GΩ in parallel with 100 pF	±25/15	—	—	—	±200 pA
AI SENSE, AI SENSE 2	AI	100 GΩ in parallel with 100 pF	±25/15	—	—	—	±200 pA
AI GND	—	—	—	—	—	—	—
AO 0	AO	0.1 Ω	Short-circuit to ground	5 at 10	5 at –10	20 V/µs	—
AO 1	AO	0.1 Ω	Short-circuit to ground	5 at 10	5 at –10	20 V/µs	—
AO EXT REF	AI	10 kΩ	±25/15	—	—	—	—
AO GND	—	—	—	—	—	—	—
D GND	—	—	—	—	—	—	—
+5 V	—	0.1 Ω	Short-circuit to ground	1 A at 5	—	—	—

NATIONAL INSTRUMENTS

Table 1. I/O Terminals (Continued)

Terminal Name	Terminal Type and Direction	Impedance Input/ Output	Protection (V) On/Off	Source (mA at V)	Sink (mA at V)	Rise Time (ns)	Bias
P0.<0..7>	DIO	—	V_{CC} + 0.5	13 at (V_{CC} – 0.4)	24 at 0.4	1.1	50 kΩ pu
AI HOLD COMP	DO	—	—	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
EXT STROBE*	DO	—	—	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 0/ (AI START TRIG)	AI/DIO	10 kΩ	V_{CC} + 0.5/±35	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	9 kΩ pu, 10 kΩ pd
PFI 1/ (AI REF TRIG)	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 2/ (AI CONV CLK)*	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 3/ CTR 1 SOURCE	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 4/CTR 1 GATE	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
CTR 1 OUT	DO	—	—	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 5/ (AO SAMP CLK)*	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 6/ (AO START TRIG)	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 7/ (AI SAMP CLK)	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 8/ CTR 0 SOURCE	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
PFI 9/CTR 0 GATE	DIO	—	V_{CC} + 0.5	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
CTR 0 OUT	DO	—	—	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu
FREQ OUT	DO	—	—	3.5 at (V_{CC} – 0.4)	5 at 0.4	1.5	50 kΩ pu

* Indicates active low.

AI = Analog Input DIO = Digital Input/Output pd = pull-down
AO = Analog Output DO = Digital Output pu = pull-up
AI/DIO = Analog Input/Digital Input/Output

Note: The tolerance on the 50 kΩ pull-up and pull-down resistors is large. Actual value may range between 17 kΩ and 100 kΩ.

Specifications

The following specifications are typical at 25 °C unless otherwise noted.

Analog Input

Input Characteristics

Number of channels ..... 16 single-ended or
8 differential
(software-selectable
per channel)

Type of A/D converter (ADC)..... Successive
approximation

Resolution ..... 16 bits, 1 in 65,536

Max sampling rate ..... 333 kS/s guaranteed

Input signal ranges

Range (Software-Selectable)	Input Range	
	Bipolar	**Unipolar**
20 V	±10 V	—
10 V	±5 V	0 to 10 V
5 V	±2.5 V	0 to 5 V
2 V	±1 V	0 to 2 V
1 V	±500 mV	0 to 1 V
500 mV	±250 mV	0 to 500 mV
200 mV	±100 mV	0 to 200 mV
100 mV	±50 mV	0 to 100 mV

Accuracy Information

Nominal Range (V)		Absolute Accuracy							Relative Accuracy Resolution (μV)	
		% of Reading			Noise + Quantization (μV)					
Positive Full Scale	Negative Full Scale	24 Hours	1 Year	Offset (μV)	Single Pt.	Averaged	Temp Drift (%/°C)	Absolute Accuracy at Full Scale (mV)	Single Pt.	Averaged
10	–10	0.0354	0.0371	947.0	981.0	87.0	0.0006	4.747	1,145.0	115.0
5	–5	0.0054	0.0071	476.0	491.0	43.5	0.0001	0.876	573.0	57.3
2.5	–2.5	0.0354	0.0371	241.0	245.0	21.7	0.0006	1.190	286.0	28.6
1	–1	0.0354	0.0371	99.2	98.1	8.7	0.0006	0.479	115.0	11.5
0.5	–0.5	0.0354	0.0371	52.1	56.2	5.0	0.0006	0.243	66.3	6.6
0.25	–0.25	0.0404	0.0421	28.6	32.8	3.0	0.0006	0.137	39.2	3.9
0.1	–0.1	0.0454	0.0471	14.4	22.4	2.1	0.0006	0.064	27.7	2.8
0.05	–0.05	0.0454	0.0471	9.7	19.9	1.9	0.0006	0.035	25.3	2.5
10	0	0.0054	0.0071	476.0	491.0	43.5	0.0001	1.232	573.0	57.3
5	0	0.0354	0.0371	241.0	245.0	21.7	0.0006	2.119	286.0	28.6
2	0	0.0354	0.0371	99.2	98.1	8.7	0.0006	0.850	115.0	11.5
1	0	0.0354	0.0371	52.1	56.2	5.0	0.0006	0.428	66.3	6.6
0.5	0	0.0404	0.0421	28.6	39.8	3.0	0.0006	0.242	48.2	3.9
0.2	0	0.0454	0.0471	14.4	22.4	2.1	0.0006	0.111	27.7	2.8
0.1	0	0.0454	0.0471	9.7	19.9	1.9	0.0006	0.059	25.3	2.5

Note: Accuracies are valid for measurements following an internal E Series calibration. Averaged numbers assume dithering and averaging of 100 single-channel readings. Measurement accuracies are listed for operational temperatures within ±1 °C of internal calibration temperature and ±10 °C of external or factory-calibration temperature. NI recommends a one-year calibration interval. The Absolute Accuracy at Full Scale calculations were performed for a maximum range input voltage (for example, 10 V for the ±10 V range) after one year, assuming 100 points of averaged data. Go to `ni.com/info` and enter info code `rdspec` for example calculations.

Input coupling ..... DC

Max working voltage
(signal + common-mode)..... Each input should remain within ±11 V of ground.

Overvoltage protection
- Powered on ..... ±25 V
- Powered off ..... ±15 V

Inputs protected..... AI <0..15>, AI SENSE

FIFO buffer size..... 512 samples (S)

DMA (PCI and PXI only)
- Channels 3
- Data sources/destinations ..... Analog input, analog output, counter/timer 0, or counter/timer 1

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

DMA modes..... Scatter-gather

Configuration memory size ..... 512 words

Transfer Characteristics

Relative accuracy..... ±1.5 LSB typ, ±3.0 LSB max

Differential nonlinearity (DNL)..... ±0.5 LSB typ, ±1.0 LSB max

No missing codes ..... 16 bits, guaranteed

Offset error
- Pregain error after calibration..... ±1.0 µV max
- Pregain error before calibration..... ±2.6 mV max
- Postgain error after calibration ... ±76 µV
- Postgain error before calibration..... ±82 mV

Gain error (relative to calibration reference)
- After calibration (gain = 1)..... ±30.5 ppm of reading max
- Before calibration..... ±22,000 ppm of reading max

Gain ≠ 1 with gain error adjusted to 0 at gain = 1 ..... ±200 ppm of reading max

Amplifier Characteristics

Input impedance
- Normal powered on ..... 100 GΩ in parallel with 100 pF
- Powered off..... 820 Ω min

Overload ..... 820 Ω min

Input bias current..... ±200 pA

Input offset current ..... ±100 pA

Common-mode rejection ratio (CMRR), DC to 60 Hz

Range	Bipolar	Unipolar
20 V	92 dB	—
10 V	97 dB	97 dB
5 V	101 dB	101 dB
2 V	104 dB	104 dB
100 mV to 1 V	105 dB	105 dB

Dynamic Characteristics

Bandwidth
- Small signal (–3 dB) ..... 480 kHz
- Large signal (1% THD) ..... 500 kHz

Dynamic range
- Gain 0.5 to 5..... 87 dB, ±10 V input
- Gain 10..... 83 dB

Settling time for full-scale step

Full-Scale Step Accuracy*	Settling Time
±6 LSB	3 µs max
±4 LSB	4 µs max
±2 LSB	5 µs max, gain 0.5 to 10 10 µs max, gain 20 to 50 10 µs typ, gain 100
±1 LSB	10 µs max, gain 0.5 to 2 15 µs max, gain 5 to 10 15 µs typ, gain 20 to 100

* Settling times are valid for source impedances <1 kΩ. Refer to *Multichannel Scanning Considerations* of the *E Series Help* for more information.

System noise (LSB_{rms}, including quantization)

Range	Bipolar	Unipolar
2 to 20 V	0.95	0.95
1 V	1.1	1.1
500 mV	1.3	1.3
200 mV	2.7	2.7
100 mV	5.0	5.0

Crosstalk (DC to 100 kHz)

Adjacent channels .....–75 dB

All other channels .....–90 dB

Stability

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

Offset temperature coefficient

Pregain .....±4 µV/°C

Bipolar postgain.....±120 µV/°C

Unipolar postgain.....±30 µV/°C

Gain temperature coefficient.....±17 ppm/°C

Onboard calibration reference

Level .....5.000 V (±1.0 mV), (over full operating temperature, actual value stored in EEPROM)

Temperature coefficient.....±0.6 ppm/°C max

Long-term stability .....±6 ppm/ $\sqrt{1{,}000\ \text{h}}$

Analog Output

Output Characteristics

Number of channels.....2 voltage

Resolution.....16 bits, 1 in 65,536

Max update rate.....333 kS/s

Type of D/A converter (DAC) .....Double-buffered, multiplying

FIFO buffer size .....2,048 Samples (S)

Data transfers.....DMA, interrupts, programmed I/O

DMA modes .....Scatter-gather

Accuracy Information

Nominal Range (V)		Absolute Accuracy					Absolute Accuracy at Full Scale (mV)
		% of Reading					
Positive Full Scale	Negative Full Scale	24 Hours	90 Days	1 Year	Offset (µV)	Temp Drift (%/°C)	
10	–10	0.0044	0.0052	0.0061	798	0.0001	1.405
10	0	0.0044	0.0052	0.0061	569	0.0001	1.176

Note: Accuracies are valid for measurements following an internal E Series calibration. Averaged numbers assume dithering and averaging of 100 single-channel readings. Measurement accuracies are listed for operational temperatures within ±1 °C of internal calibration temperature and ±10 °C of external or factory-calibration temperature. NI recommends a one-year calibration interval. The Absolute Accuracy at Full Scale calculations were performed for a maximum range input voltage (for example, 10 V for the ±10 V range) after one year, assuming 100 points of averaged data. Go to `ni.com/info` and enter info code `rdspec` for example calculations.

Transfer Characteristics

Relative accuracy, or integral nonlinearity (INL)
- After calibration ..... ±0.35 LSB typ, ±1.0 LSB max
- Before calibration ..... ±4 LSB max

DNL
- After calibration ..... ±0.5 LSB typ, ±1.0 LSB max
- Before calibration ..... ±3 LSB max

Monotonicity ..... 16 bits, guaranteed after calibration

Offset error
- After calibration ..... ±305 µV max
- Before calibration ..... ±17 mV max

Gain error (relative to internal reference)
- After calibration ..... ±30.5 ppm of output max
- Before calibration ..... ±9,000 ppm of output max

Gain error (relative to external reference) ..... +0% to +0.5% of output max, not adjustable

Voltage Output

Ranges ..... ±10 V, 0 to 10 V, ± AO EXT REF, 0 V to AO EXT REF (software-selectable)

Output coupling ..... DC

Output impedance ..... 0.1 Ω max

Current drive ..... ±5 mA max

Protection ..... Short-circuit to ground

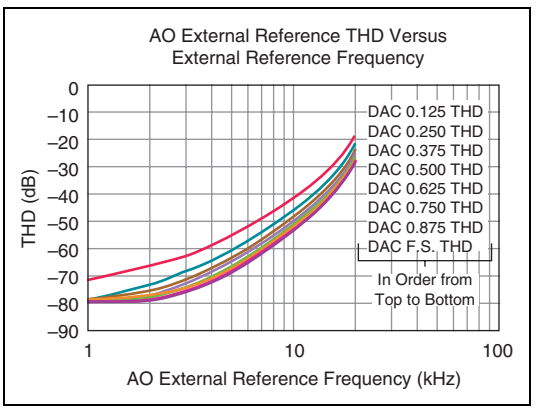
Power-on state ..... 0 V (±20 mV)

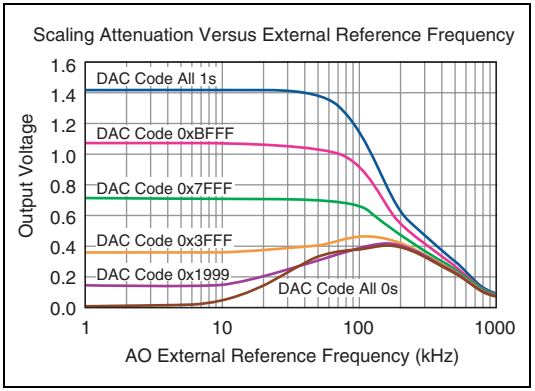
External reference input
- Range ..... ±11 V
- Overvoltage protection
  - Powered on ..... ±25 V
  - Powered off ..... ±15 V

Input impedance ..... 10 kΩ

Bandwidth (–3 dB) ..... 3 kHz

Slew rate ..... 0.3 V/µs





Dynamic Characteristics

Settling time for full-scale step .....3.5 µs to ±1.0 LSB accuracy

Settling time for half-scale step.....3.0 µs to ±1.0 LSB accuracy

Slew rate .....15 V/µs

Noise.....60 μV_{rms}, DC to 1 MHz

Glitch energy (at mid-scale transition)

- Magnitude .....10 mV
- Duration .....1 µs

Stability

Offset temperature coefficient.....±35 µV/°C

Gain temperature coefficient

- Internal reference .....±6.5 ppm/°C
- External reference .....±5 ppm/°C

Onboard calibration reference

- Level .....5.000 V (±1.0 mV), (over full operating temperature, actual value stored in EEPROM)
- Temperature coefficient.....±0.6 ppm/°C max
- Long-term stability .....±6 ppm/ $\sqrt{1{,}000\ h}$

Digital I/O

Number of channels ..... 8 input/output

Compatibility ..... 5 V TTL/CMOS

Digital logic levels on P0.<0..7>

Level	Min	Max
Input low voltage	0 V	0.8 V
Input high voltage	2.0 V	5.0 V
Input low current (V_{in} = 0 V)	—	–320 µA
Input high current (V_{in} = 5 V)	—	10 µA
Output low voltage (I_{OL} = 24 mA)	—	0.4 V
Output high voltage (I_{OH} = –13 mA)	4.35 V	—

Power-on state..... Input (high-impedance)

Data transfers ..... Programmed I/O

Max transfer rate ..... 50 kwords/s, system-dependent

Constant sustainable rate ..... 1 to 10 kwords/s, typ

Timing I/O

Number of channels

- Up/down counter/timers 2
- Frequency scaler..... 1

Resolution

- Up/down counter/timers ..... 24 bits
- Frequency scaler..... 4 bits

Compatibility ..... 5 V TTL/CMOS

Digital logic levels

Level	Min	Max
Input low voltage	0.0 V	0.8 V
Input high voltage	2.0 V	5.0 V
Output low voltage (I_{out} = 5 mA)	—	0.4 V
Output high voltage (I_{out} = –3.5 mA)	4.35 V	—

Base clocks available

- Up/down counter/timers ..... 20 MHz, 100 kHz
- Frequency scaler..... 10 MHz, 100 kHz

Base clock accuracy..... ±0.01%

Max external source frequency
Up/down counter/timers ..... 20 MHz

External source selections..... PFI <0..9>, RTSI <0..6>, analog trigger, software-selectable

External gate selections ..... PFI <0..9>, RTSI <0..6>, analog trigger, software-selectable

Min source pulse duration..... 10 ns in edge-detect mode

Min gate pulse duration ..... 10 ns in edge-detect mode

Data transfers
- PCI/PXI up/down counter/timer ..... DMA (scatter-gather), interrupts, programmed I/O
- DAQPad up/down counter/timer ..... Interrupts, programmed I/O

Frequency scaler ..... Programmed I/O

Triggers

Analog Trigger

Purpose
- Analog input ..... Start, reference, and pause trigger, sample clock
- Analog output ..... Start and pause trigger, sample clock
- Counter/timers ..... Source, gate

Source ..... AI <0..15>, PFI 0/AI START TRIG

Level
- Internal..... ±Full-scale
- External ..... ±10 V

Slope ..... Positive or negative (software-selectable)

Resolution ..... 12 bits, 1 in 4,096

Hysteresis..... Programmable

Bandwidth (–3 dB)
- Internal..... 700 kHz
- External ..... 700 kHz

External input (PFI 0/AI START TRIG)
- Impedance ..... 10 kΩ
- Coupling ..... DC

Protection
- When configured as a digital signal .....–0.5 to VCC + 0.5 V
- When configured as an analog trigger signal or disabled.....±35 V
- Powered off .....±35 V

Accuracy .....±1.0% of full-scale range max

Digital Trigger

Purpose
- Analog input .....Start, reference, and pause trigger, sample clock
- Analog output .....Start and pause trigger, sample clock
- Counter/timers .....Source, gate

Source.....PFI <0..9>, RTSI <0..6>

Compatibility.....5 V TTL

Response.....Rising or falling edge

Pulse width .....10 ns min

RTSI

Trigger lines
- NI PCI-6052E 7
- NI DAQPad-6052E.....4

Clock line 1

PXI Trigger Bus (PXI Only)

Trigger lines 6

Star trigger.....1

Calibration

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

Calibration interval.....1 year

Onboard calibration reference level .....5.000 V (±3.5 mV), (over full operating temperature, actual value stored in EEPROM)

Temperature coefficient .....±0.6 ppm/°C max

Long-term stability .....±6.0 ppm/ $\sqrt{1{,}000\ \text{h}}$

Bus Interface

NI PCI/PXI-6052E ..... Master, slave

NI DAQPad-6052E ..... Master, slave, asynchronous, 400 Mb/s

Power Requirement

Power available at I/O connector .... +4.65 VDC to +5.25 VDC at 1 A

NI PCI/PXI-6052E
+5 VDC (±5%) ..... 1.3 A (does not include current drawn from 5 V fuse on I/O connector)

NI DAQPad-6052E
9–24 VDC ..... 20 W

Physical

Dimensions (not including connectors)

- NI PCI-6052E ..... 17.5 cm × 10.6 cm (6.9 in. × 4.2 in.)
- NI PXI-6052E ..... 16 cm × 10 cm (6.3 in. × 3.9 in.)
- NI DAQPad-6052E ..... 30.7 cm × 25.4 cm × 4.3 cm (12.1 in. × 10 in. × 1.7 in.)

Weight

- NI PCI-6052E ..... 160 g (5.6 oz)
- NI PXI-6052E ..... 206 g (7.2 oz)
- NI DAQPad-6052E ..... 1951 g (4 lb 4.8 oz)

I/O connector

- NI PCI/PXI-6052E ..... 68-pin male SCSI-II type
- NI DAQPad-6052E ..... 68-pin male SCSI-II type, or 15 BNCs and 30 removable screw terminals

Maximum Working Voltage

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

Channel-to-earth ..... 11 V, Installation Category I

Channel-to-channel ..... 11 V, Installation Category I

Environmental

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

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

Relative humidity ..... 10 to 90%, noncondensing

Maximum altitude ..... 2,000 m

Pollution Degree (indoor use only) 2

Safety

NI PCI/PXI-6052E

The NI PCI/PXI-6052E devices meet the requirements of the following standards for safety and 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.

NI DAQPad-6052E

The NI DAQPad-6052E devices meet the requirements of the following standards for safety and electrical equipment for measurement, control, and laboratory use:

- IEC 60950-1, EN 60950-1
- UL 60950-1
- CAN/CSA-C22.2 No. 60950-1

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 PCI/PXI-6052E Pinout

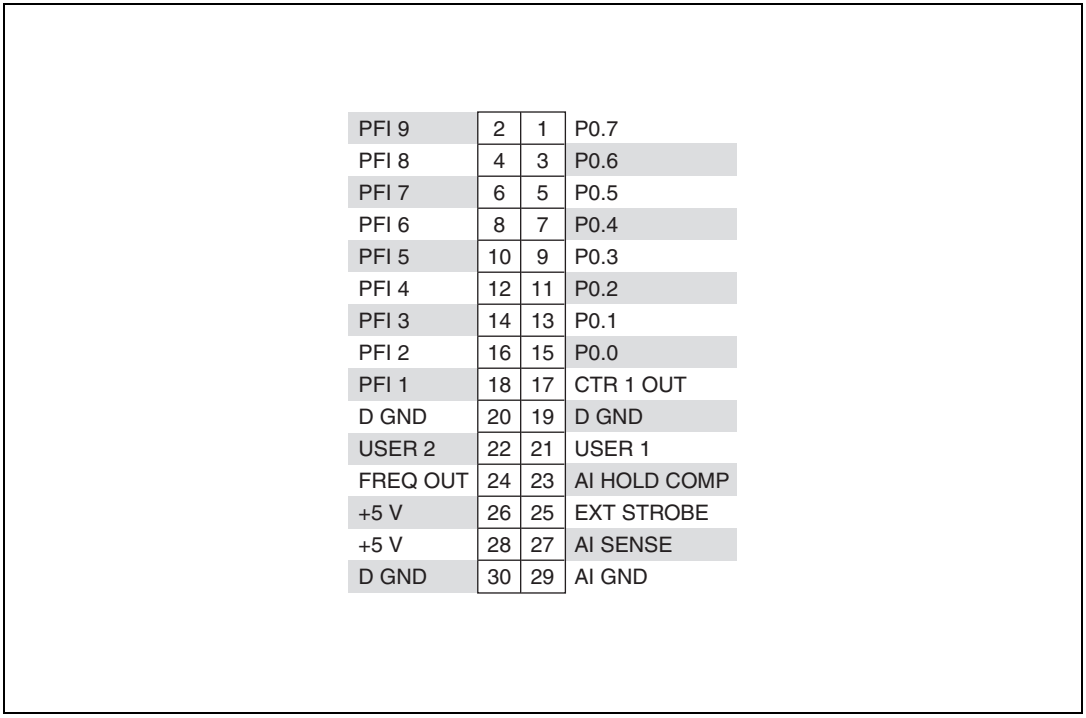


Figure 2. NI DAQPad-6052E BNC Pinout