

# NI 6154 Specifications

This document lists the specifications for the NI PCI-6154. For the most current edition of this document, refer to [ni.com/manuals](http://ni.com/manuals). Refer to the *DAQ Getting Started Guide* for more information about accessing documents on the NI-DAQ CD.

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

## Analog Input

Number of channels .....	4, isolated per channel
ADC characteristics	
Resolution .....	16 bits
Pipeline .....	0
Sampling rate	
Maximum .....	250 kS/s
Minimum .....	No minimum
DNL .....	No missing codes guaranteed
INL .....	±3 LSB max
Input coupling .....	DC
Input range .....	±10 V, ±5 V, ±2 V, ±1 V
Input impedance (device on)	
AI+ to AI- .....	>100 MΩ in parallel with 10 pF
Input bias current .....	±100 pA
Overvoltage protection (AI+, AI-) .....	±25 V powered, ±15 V unpowered
Input current during overvoltage conditions .....	±20 mA max
CMRR (at 60 Hz) .....	100 dB
Crosstalk (at 10 kHz) .....	-100 dB
Phase mismatch .....	±1.50° at 25 kHz
Input FIFO size .....	8,190 samples
Data transfers .....	DMA (scatter-gather), interrupts, programmed I/O

## Analog Output

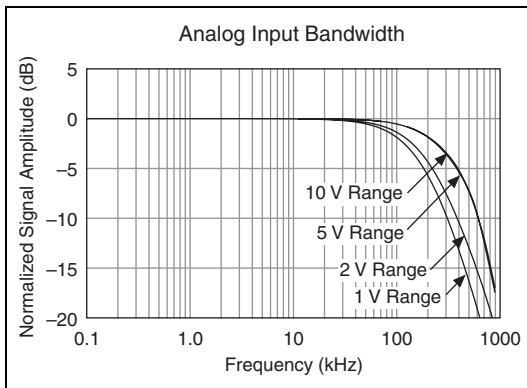
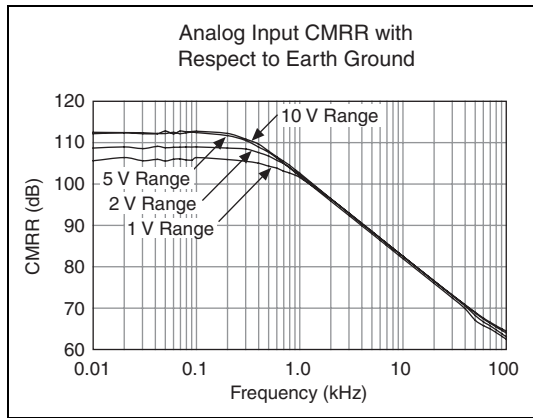
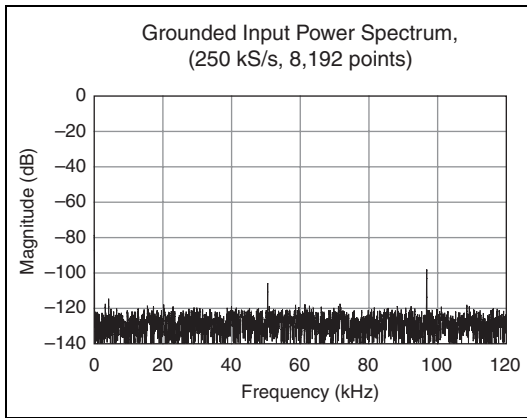
Number of channels .....	4, isolated per channel
DAC characteristics	
Resolution .....	16 bits
Pipeline .....	0
Sampling rate	
Maximum .....	250 kS/s
Minimum .....	No minimum
DNL .....	±1 LSB max
Monotonicity .....	16 bit guaranteed
Output coupling .....	DC
Output range .....	±10 V
Output impedance .....	0.2 Ω
Output current drive .....	±5 mA
Overdrive protection .....	±25 V
Overdrive current .....	10 mA
Power-on state .....	±20 mV
Power-on glitch .....	8.5 V peak for 14.5 ms
Settling time, full scale step	
15 ppm (1 LSB) .....	15.8 μs
Slew rate .....	4 V/μs
Glitch energy	
Magnitude .....	100 mV
Duration .....	2.6 μs
Output FIFO size .....	8,191 samples
Data transfers .....	DMA (scatter-gather), interrupts, programmed I/O

**Table 1.** NI 6154 Analog Input Range-Dependent Characteristics

Input Range	Bandwidth <sup>1</sup> (kHz)	THD (dB at 10 kHz)	System Noise (LSB <sub>rms</sub> )	SFDR Typ <sup>2</sup> (dB)
±10 V	275	-85	0.9	95
±5 V	270	-85	1.2	95
±2 V	158	-90	1.7	90
±1 V	132	-85	2.3	85

<sup>1</sup> -3 dB frequency  
<sup>2</sup> Measured at 100 kHz, not including harmonics.

**Typical Performance Graphs**



## 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, $\sigma$ ( $\mu$ Vrms)	Absolute Accuracy at Full Scale <sup>1</sup> ( $\mu$ V)	Sensitivity <sup>2</sup> ( $\mu$ V)
Positive Full Scale	Negative Full Scale									
10	-10	194	112	5	60	12	92	262	5,279	105
5	-5	194	162	5	90	13	92	188	3,061	75
2	-2	194	156	5	120	17	92	103	1,289	41
1	-1	194	156	5	150	23	92	71	686	28

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

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

OffsetError = ResidualAIOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL\_Error

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

<sup>1</sup> 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  $\sigma$

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

GainError = 194 ppm + 112 ppm · 1 + 5 ppm · 10      GainError = 356 ppm

OffsetError = 60 ppm + 12 ppm · 1 + 92 ppm      OffsetError = 164 ppm

NoiseUncertainty =  $\frac{262 \mu\text{V} \cdot 3}{\sqrt{100}}$       NoiseUncertainty = 79  $\mu$ V

AbsoluteAccuracy = 10 V · (GainError) + 10 V · (OffsetError) + NoiseUncertainty      AbsoluteAccuracy = 5,279  $\mu$ V

<sup>2</sup> Sensitivity is the smallest voltage change that can be detected. It is a function of noise.

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

## A0 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 <sup>1</sup> (µV)
Positive Full Scale	Negative Full Scale							
10	-10	209	105	5	80	111	244	7,991

<sup>1</sup> 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. Accuracies listed are valid for up to one year from the device external calibration.

Absolute Accuracy = OutputValue · (GainError) + Range · (OffsetError)  
GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)  
OffsetError = ResidualOffsetError + AOffsetTempco · (TempChangeFromLastInternalCal) + INL\_Error

## Digital I/O

Number of channels .....	6 DI PFI <0..5>, 4 DO PFI <6..9>
Direction control .....	None, each terminal has a fixed direction
Compatibility .....	5 V TTL
Functionality .....	Static digital input, static digital output, timing input, timing output
Input voltage protection .....	±20 V on up to two pins

## Recommended Operating Conditions

Level	Min	Max
V <sub>IH</sub> input high voltage	2.0 V	5.25 V
V <sub>IL</sub> input low voltage	0 V	0.8 V
I <sub>OH</sub> output high current (V <sub>OH</sub> = 4.0 V)	—	–6 mA
I <sub>OH</sub> output high current (V <sub>OH</sub> = 2.8 V)	—	–24 mA
I <sub>OL</sub> output low current (V <sub>OL</sub> = 0.4 V)	—	7 mA
I <sub>OL</sub> output low current (V <sub>OL</sub> = 1.4 V)	—	24 mA

## General Purpose Counter/Timers

Number of counter/timers .....	2
Resolution .....	32 bits
Internal base clocks .....	80 MHz, 20 MHz, 100 kHz
External base clock frequency .....	0 Hz to 20 MHz
Base clock accuracy .....	50 ppm
FIFO .....	2 samples
Data transfers .....	DMA, 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

## Phase-Locked Loop (PLL)

Number of PLLs .....	1
Reference signal .....	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 Trigger

Source .....	PFI <0..5> or RTSI
Polarity .....	Software-selectable

## RTSI Trigger Lines

Trigger lines <0..6> .....	7
RTSI clock .....	1

## Bus Interface

PCI .....	3.3 V or 5 V signaling
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## Power Requirements

+5 V .....	1.3 A
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## Physical

Dimensions .....	15.6 cm × 9.8 cm (6.2 in. × 3.9 in.)
Weight .....	198 g (7.0 oz)
I/O connector .....	1 37-pin D-SUB

## Environmental

Operating temperature .....	0 to 50 °C
Storage temperature .....	–20 to 70 °C
Humidity .....	5 to 95% RH, noncondensing
Maximum altitude .....	2,000 m

Pollution Degree (indoor use only) .....	2
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## Calibration (AI and AO)

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

# Maximum Working Voltage<sup>1</sup>

## Channel-to-channel<sup>2</sup>

Continuous .....	≤30 Vrms/60 VDC, Measurement Category I <sup>3</sup>
Withstand .....	≤840 Vrms/1,200 VDC, verified by a 5 s dielectric withstand test

## Channel-to-earth ground<sup>4</sup>

Continuous .....	≤30 Vrms/60 VDC, Measurement Category I <sup>3</sup>
Withstand .....	≤840 Vrms/1,200 VDC, verified by a 5 s dielectric withstand test

## Channel-to-bus<sup>5</sup>

Continuous .....	≤30 Vrms/60 VDC, Measurement Category I <sup>3</sup>
Withstand .....	≤1,400 Vrms/ 1,950 VDC, verified by a 5 s dielectric withstand test

## AI+ to AI-

(in Figure 1,  $|V_a - V_b|$ ) ..... ≤11 V, Measurement  
Category I<sup>3</sup>

## PFI x to D GND

(in Figure 1,  $|V_e - V_f|$ ) ..... ≤5.25 V, Measurement  
Category I<sup>3</sup>



**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<sub>pk</sub>. Do not use for measurements within Categories II, III, or IV.

Figure 1 illustrates the maximum working voltage specifications.

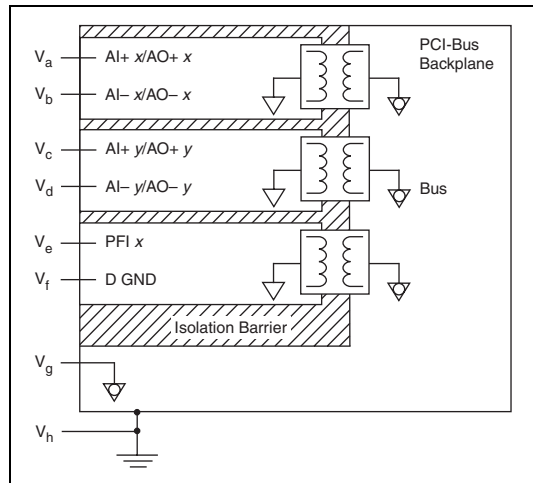


Figure 1. NI 6154 Maximum Working Voltage

## 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](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

<sup>1</sup> Maximum working voltage refers to the signal voltage plus the common-mode voltage.

<sup>2</sup> In Figure 1,  $|V_a, V_b - V_c, V_d|$ ,  $|V_a, V_b - V_e, V_f|$ , and  $|V_c, V_d - V_e, V_f|$ .

<sup>3</sup> 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.

<sup>4</sup> In Figure 1,  $|V_a - V_h|$ ,  $|V_b - V_h|$ ,  $|V_c - V_h|$ ,  $|V_d - V_h|$ ,  $|V_e - V_h|$ , and  $|V_f - V_h|$ .

<sup>5</sup> In Figure 1,  $|V_a - V_g|$ ,  $|V_b - V_g|$ ,  $|V_c - V_g|$ ,  $|V_d - V_g|$ ,  $|V_e - V_g|$ , and  $|V_f - V_g|$ .

## Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A



**Notes** For EMC compliance, operate this device with shielded cabling.

Please refer to the *S Series Help* for EMC cabling issues.

## CE Compliance

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

- 73/23/EEC; Low-Voltage Directive (safety)
- 89/336/EEC; Electromagnetic Compatibility Directive (EMC)



**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](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## Waste Electrical and Electronic Equipment (WEEE)



**EU Customers** At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit [ni.com/environment/weee.htm](http://ni.com/environment/weee.htm).

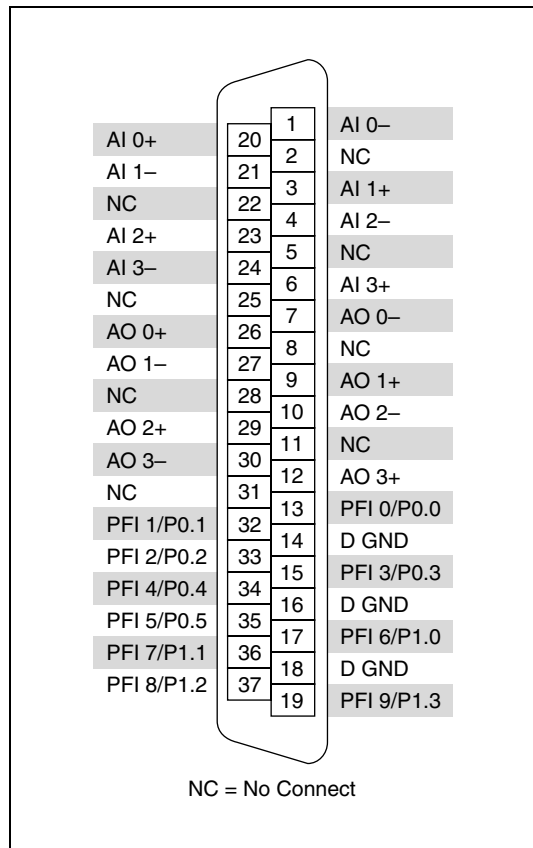


Figure 2. NI 6154 Pinout

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