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`. 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

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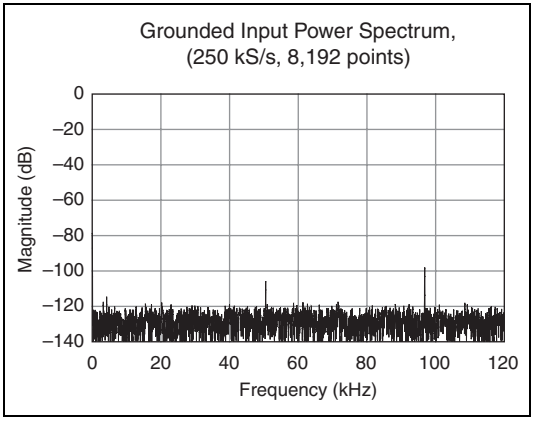
Table 1. NI 6154 Analog Input Range-Dependent Characteristics

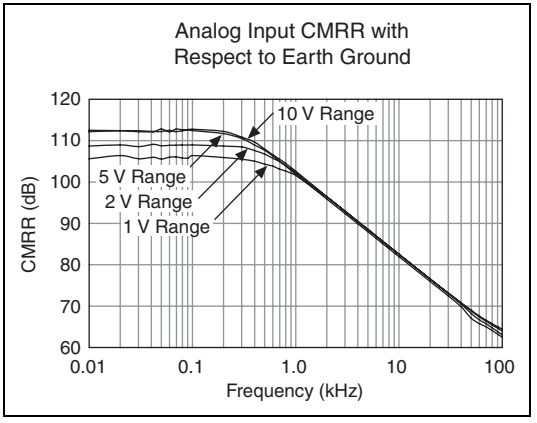
Input Range	Bandwidth[1] (kHz)	THD (dB at 10 kHz)	System Noise (LSB_{rms})	SFDR Typ[2] (dB)
±10 V	275	–85	0.9	95
±5 V	270	–85	1.2	95
±2 V	158	–90	1.7	90
±1 V	132	–85	2.3	85

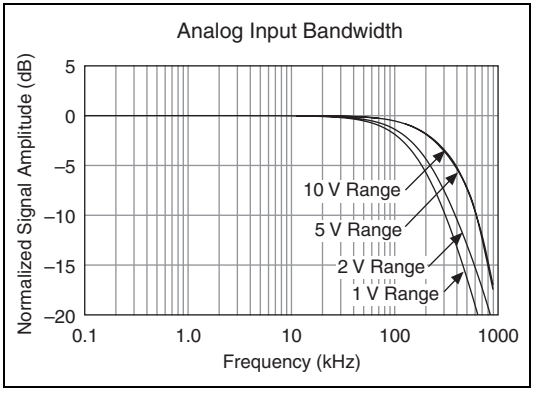
[1] –3 dB frequency

[2] Measured at 100 kHz, not including harmonics.

Typical Performance Graphs







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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									
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

$$\text{NoiseUncertainty} = \frac{\text{RandomNoise} \cdot 3}{\sqrt{100}}$$ 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 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

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

AbsoluteAccuracy = 10 V · (GainError) + 10 V · (OffsetError) + NoiseUncertainty AbsoluteAccuracy = 5,279 μV

[2] 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.

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							
10	–10	209	105	5	80	111	244	7,991

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

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

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

OffsetError = ResidualOffsetError + AOOffsetTempco · (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_{IH} input high voltage	2.0 V	5.25 V
V_{IL} input low voltage	0 V	0.8 V
I_{OH} output high current (V_{OH} = 4.0 V)	—	–6 mA
I_{OH} output high current (V_{OH} = 2.8 V)	—	–24 mA
I_{OL} output low current (V_{OL} = 0.4 V)	—	7 mA
I_{OL} output low current (V_{OL} = 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

Power Requirements

+5 V ..... 1.3 A

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

Calibration (AI and AO)

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

Calibration interval ..... 1 year

Maximum Working Voltage[1]

Channel-to-channel[2]

Continuous .....≤30 Vrms/60 VDC, Measurement Category I[3]

Withstand .....≤840 Vrms/1,200 VDC, verified by a 5 s dielectric withstand test

Channel-to-earth ground[4]

Continuous .....≤30 Vrms/60 VDC, Measurement Category I[3]

Withstand .....≤840 Vrms/1,200 VDC, verified by a 5 s dielectric withstand test

Channel-to-bus[5]

Continuous .....≤30 Vrms/60 VDC, Measurement Category I[3]

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[3]

PFI *x* to D GND
(in Figure 1, $|V_e - V_f|$).....≤5.25 V, Measurement Category I[3]

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}. Do *not* use for measurements within Categories II, III, or IV.

Figure 1 illustrates the maximum working voltage specifications.

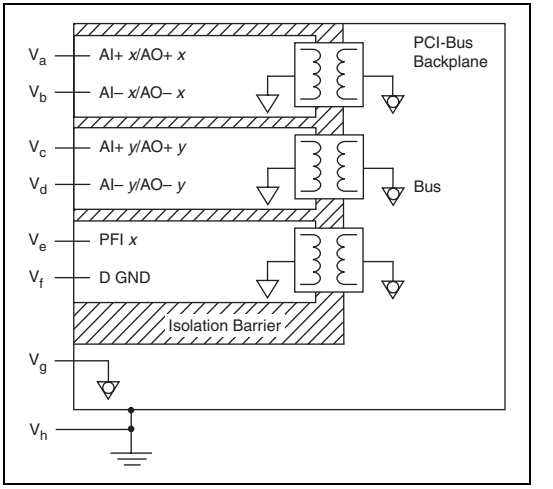

Figure 1. NI 6154 Maximum Working Voltage

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`, search by model number or product line, and click the appropriate link in the Certification column.

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

[2] In Figure 1, $|V_a,V_b - V_c,V_d|$, $|V_a,V_b - V_e,V_f|$, and $|V_c,V_d - V_e,V_f|$.

[3] 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.

[4] In Figure 1, $|V_a - V_h|$, $|V_b - V_h|$, $|V_c - V_h|$, $|V_d - V_h|$, $|V_e - V_h|$, and $|V_f - V_h|$.

[5] 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`, 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`.

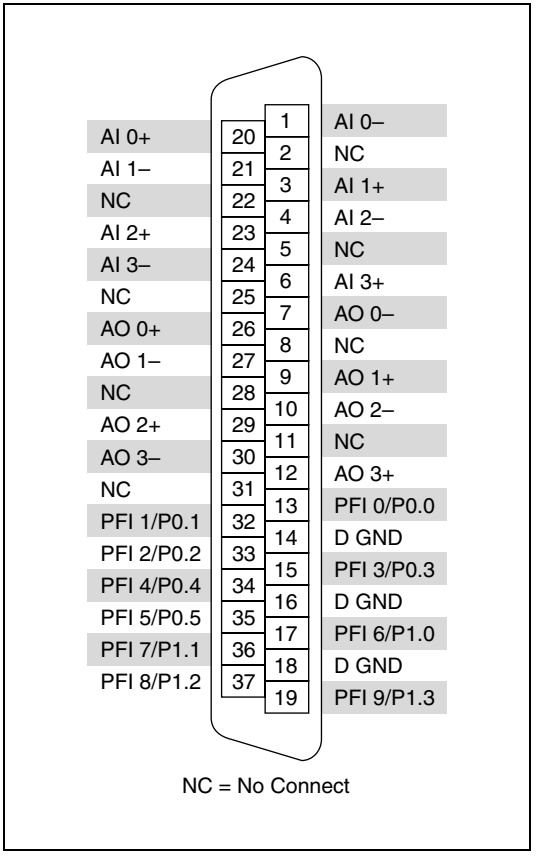

Figure 2. NI 6154 Pinout

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