

NI 6124 Specifications

This document lists the specifications for the NI PXIe-6124. 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-DAQmx media.

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

Français	Deutsch	日本語	한국어	简体中文
ni.com/manuals				

Analog Input

Number of channels	4 differential
Type of ADC	
Resolution	16 bits, 1 in 65,536
Pipeline	0
Sampling rate	
Maximum	4 MS/s per channel
Minimum	No minimum
Input impedance	
AI – to AI GND	>100 G Ω in parallel with 10 pF
AI + to AI GND	>100 G Ω in parallel with 10 pF
Input bias current	± 10 pA
Input coupling	DC
Max working voltage for all analog input channels	
Positive input (AI +)	± 11 V for all ranges, Measurement Category I
Negative input (AI –)	± 11 V for all ranges, Measurement Category I

Overvoltage protection (AI +, AI –)	± 36 V
Input current during overvoltage conditions	± 20 mA max
Input FIFO size	16,382 samples shared among channels used
Data transfers	DMA (scatter-gather), interrupts, programmed I/O
Interchannel skew	5 nS
Crosstalk (at 100 kHz)	-100 dB
CMRR (at 60 Hz)	75 dB

DC Transfer Characteristics

INL	± 1 LSB typ, ± 2 LSB max
DNL	± 1 LSB max, no missing codes



Caution Do *not* use for measurements within Categories II, III, and IV.

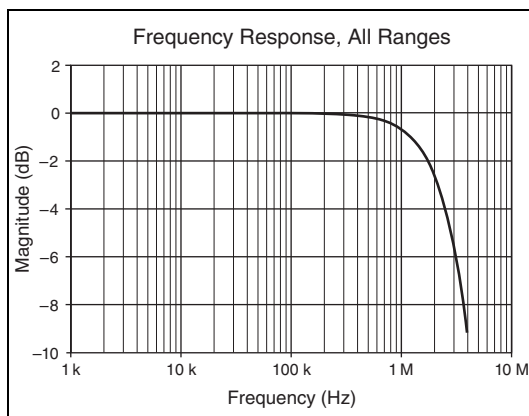
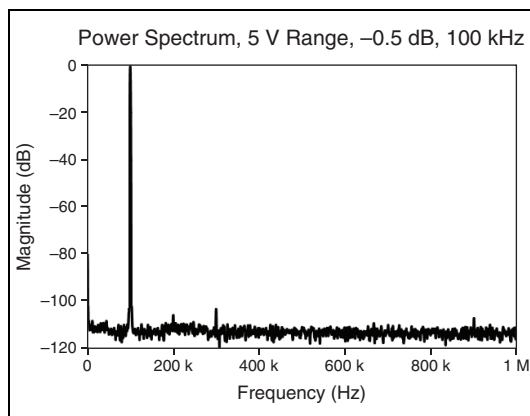
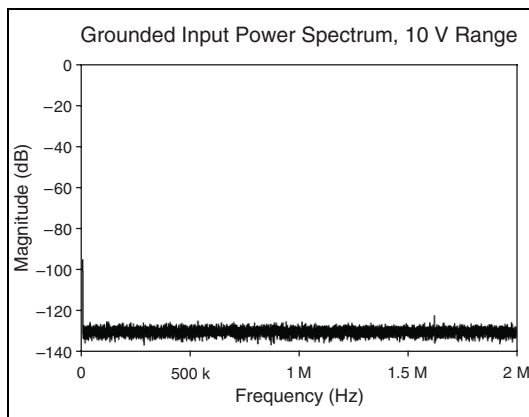
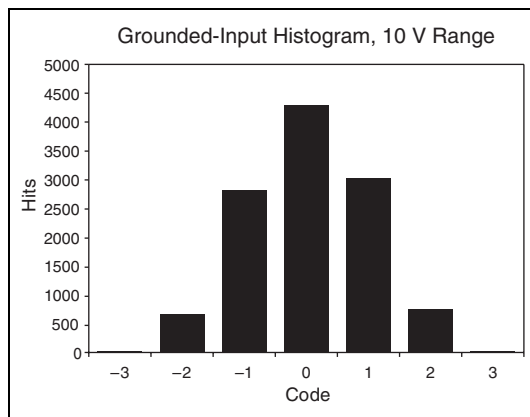
Table 1. NI 6124 Analog Input Range-Dependent Characteristics

Input Range	Bandwidth* (MHz)	THD (dB at 100 kHz)	System Noise (LSB _{rms})	SFDR Typ [†] (dB)
±10 V	2	−100	0.95	100
±5 V	2	−97	1.0	100
±2 V	2	−95	1.3	100
±1 V	2	−93	1.9	100

* −3 dB frequency

[†] 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, σ (μ V rms)	Absolute Accuracy at Full Scale* (μ V)	Sensitivity† (μ V)
Positive Full Scale	Negative Full Scale									
10	-10	165	18	1	40	9	64	290	3,147	116
5	-5	175	18	1	40	11	64	153	1,636	61
2	-2	195	18	1	40	18	64	79	714	32
1	-1	215	18	1	40	28	64	58	393	23

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 σ and averaging 100 points.

* 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 = 165 ppm + 18 ppm · 1 + 1 ppm · 10

GainError = 193 ppm

OffsetError = 40 ppm + 9 ppm · 1 + 64 ppm

OffsetError = 113 ppm

NoiseUncertainty = $\frac{290 \mu\text{V} \cdot 3}{\sqrt{100}}$

NoiseUncertainty = 87 μ V

AbsoluteAccuracy = 10 V · (GainError) + 10 V · (OffsetError) + NoiseUncertainty AbsoluteAccuracy = 3,147 μ V

† 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.

Analog Output

Number of channels.....	2 voltage
DAC characteristics	
Resolution	16 bits
Pipeline	0
Sampling rate	
Maximum	
One channel	4 MS/s
Two channels.....	2.5 MS/s
Minimum	No minimum
DNL.....	±1 LSB max
Monotonicity	16 bit guaranteed
Output coupling.....	DC
Output range	±10 V
Output impedance.....	0.4 Ω
Output current drive	±5 mA
Overdrive protection.....	±25 V
Overdrive current	10 mA
Power-on glitch	1.5 V for 10 μ s
Settling time, full scale step	
15 ppm (1 LSB).....	2 μ s
Slew rate.....	20 V/ μ s
AO waveform modes:	
• Non-periodic waveform	
• Periodic waveform regeneration mode from onboard FIFO	
• Periodic waveform regeneration from host buffer including dynamic update	
Glitch energy at midscale transition	
Magnitude	30 mV
Duration	200 ns
Output FIFO size	8,191 samples shared among channels used
Data transfers.....	DMA (scatter-gather), interrupts, programmed I/O

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* (µV)
Positive Full Scale	Negative Full Scale							
10	-10	180	20	1	80	2	64	3,560

$\text{Absolute Accuracy} = \text{Output Value} \cdot (\text{Gain Error}) + \text{Range} \cdot (\text{Offset Error})$
 $\text{Gain Error} = \text{Residual Gain Error} + \text{Gain Tempco} \cdot (\text{TempChangeFromLastInternalCal}) + \text{Reference Tempco} \cdot (\text{TempChangeFromLastExternalCal})$
 $\text{Offset Error} = \text{Residual Offset Error} + \text{AO Offset Tempco} \cdot (\text{TempChangeFromLastInternalCal}) + \text{INL_Error}$

* Absolute accuracy at full scale on the analog output channels is determined using the following assumptions:

$\text{TempChangeFromLastExternalCal} = 10\text{ }^{\circ}\text{C}$
 $\text{TempChangeFromLastInternalCal} = 1\text{ }^{\circ}\text{C}$

The absolute accuracy at full scale is as follows:

$\text{Gain Error} = 180\text{ ppm} + 20\text{ ppm} \cdot 1 + 1\text{ ppm} \cdot 10$ $\text{Gain Error} = 210\text{ ppm}$
 $\text{Offset Error} = 80\text{ ppm} + 2\text{ ppm} \cdot 1 + 64\text{ ppm}$ $\text{Offset Error} = 146\text{ ppm}$
 $\text{Absolute Accuracy} = 10\text{ V} \cdot (\text{Gain Error}) + 10\text{ V} \cdot (\text{Offset Error})$ $\text{Absolute Accuracy} = 3,560\text{ }\mu\text{V}$

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

Digital I/O/PFI

Static Characteristics

Number of channels.....	24 total, 8 (P0.<0..7>), 16 (PFI <0..7>/P1, PFI <8..15>/P2)
Ground reference.....	D GND
Direction control.....	Each terminal individually programmable as input or output
Pull-down resistor.....	50 k Ω typ, 20 k Ω min
Input voltage protection ¹	± 20 V on up to two pins

Waveform Characteristics (Port 0 Only)

Terminals used	Port 0 (P0.<0..7>)
Port/sample size.....	Up to 8 bits
Waveform generation (DO) FIFO.....	2,047 samples
Waveform acquisition (DI) FIFO.....	2,047 samples
DI Sample Clock frequency	0 to 10 MHz ²
DO Sample Clock frequency	
Regenerate from FIFO	0 to 10 MHz
Streaming from memory	0 to 10 MHz system dependent ²
Data transfers.....	DMA (scatter-gather), interrupts, programmed I/O
DO or DI Sample Clock source ³	Any PFI, RTSI, AI Sample or Convert Clock, AO Sample Clock, Ctr n Internal Output, and many other signals

PFI/Port 1/Port 2 Functionality

Functionality	Static digital input, static digital output, timing input, timing output
Timing output sources	Many AI, AO, counter, DI, DO timing signals
Debounce filter settings	125 ns, 6.425 μ s, 2.56 ms, disable; high and low transitions; selectable per input

Recommended Operation Conditions

Level	Min	Max
Input high voltage (V_{IH})	2.2 V	5.25 V
Input low voltage (V_{IL})	0 V	0.8 V
Output high current (I_{OH}) P0.<0..7> PFI <0..15>/P1/P2	— —	–24 mA –16 mA
Output low current (I_{OL}) P0.<0..7> PFI <0..15>/P1/P2	— —	24 mA 16 mA

Electrical Characteristics

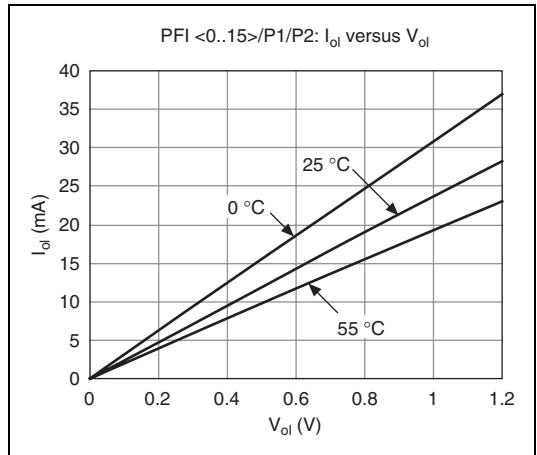
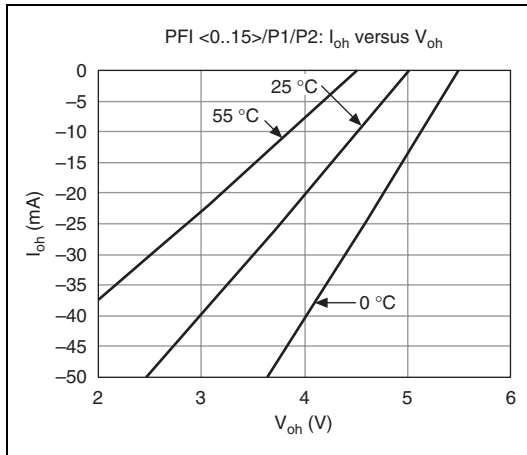
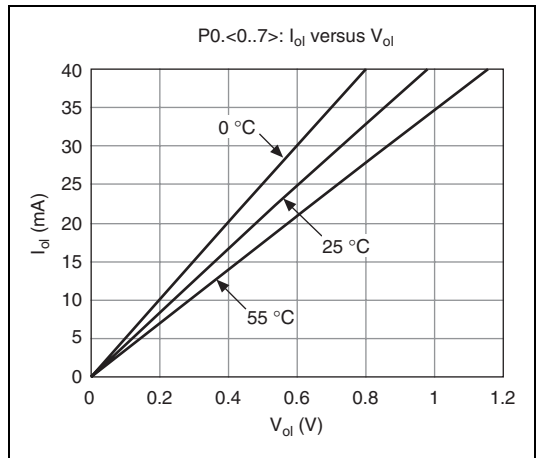
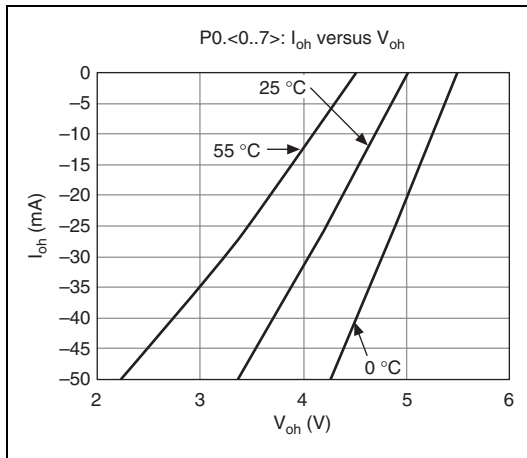
Level	Min	Max
Positive-going threshold (V_{T+})	—	2.2 V
Negative-going threshold (V_{T-})	0.8 V	—
Delta VT hysteresis ($V_{T+} - V_{T-}$)	0.2 V	—
I_{IL} input low current ($V_{in} = 0$ V)	—	–10 μ A
I_{IH} input high current ($V_{in} = 5$ V)	—	250 μ A

¹ Stresses beyond those listed under *Input voltage protection* may cause permanent damage to the device.

² Performance can be dependent on bus latency and volume of bus activity.

³ The digital subsystem does not have its own dedicated internal timing engine. Therefore, a sample clock must be provided from another subsystem on the device or an external source.

Digital I/O Characteristics



General-Purpose Counter/Timers

Number of counter/timers	2
Resolution.....	32 bits
Counter measurements	Edge counting, pulse, semi-period, period, two-edge separation
Position measurements	X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding
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, A, B, Z, Up_Down
Routing options for inputs.....	Any PFI, RTSI, PXI_TRIG, PXI_STAR, 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 PFI or RTSI terminal.	

Phase-Locked Loop (PLL)

Number of PLLs	1
Reference signal.....	PXI_STAR, PXI_CLK10, 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 Triggers

Source	Any PFI, RTSI, PXI_TRIG, PXI_STAR
Polarity	Software-selectable for most signals
Analog input function	Start Trigger, Reference Trigger, Sample Clock, Convert Clock, Sample Clock Timebase
Analog output function	Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Counter/timer functions	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down
Digital waveform generation (DO) function.....	Sample Clock
Digital waveform acquisition (DI) function	Sample Clock

Device-To-Device Trigger Bus

Triggers	PXI_TRIG <0..7>, PXI_STAR
Output selections.....	10 MHz Clock, frequency generator output, many internal signals
Debounce filter settings	125 ns, 6.425 μ s, 2.56 ms, disable; high and low transitions; selectable per input

Bus Interface

Form factor	x1 PXI Express peripheral module, specification rev 1.0 compliant
Slot compatibility.....	x1 and x4 PXI Express or PXI Express hybrid slots
DMA channels	6, analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1

Power Requirement

+12 V	1.5 A
+3.3 V	1.2 A
Power available at I/O connector....	+4.65 to +5.25 VDC at 1 A

Physical

Dimensions (not including connectors)	Standard 3U PXI, 16 cm $\times$ 10 cm (6.3 in. $\times$ 3.9 in.)
I/O connector	68-pin VHDCI

Maximum Working Voltage

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

Channel-to-earth	42 V, Measurement Category I
Channel-to-channel.....	42 V, Measurement Category I

Environmental

The NI 6124 is intended for indoor use only.

Maximum altitude	2,000 m (at 25 $^{\circ}$ C ambient temperature)
Pollution Degree.....	2

Operating Environment

Ambient temperature range	0 to 55 $^{\circ}$ C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range	-40 to 71 $^{\circ}$ C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2. Meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range.....	5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Shock and Vibration

Operating shock.....	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Meets MIL-PRF-28800F Class 2 limits.)
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Random vibration

Operating	5 to 500 Hz, 0.3 g_{rms}
Nonoperating	5 to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

This product meets 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, CSA 61010-1



Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.



Note For EMC compliance, operate this product according to the documentation.

CE Compliance

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and 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.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

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.

电子信息产品污染控制管理办法（中国 RoHS）



中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息, 请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

AI 0 +	68	34	AI 0 –
AI 0 GND	67	33	AI 1 +
AI 1 –	66	32	AI 1 GND
AI 2 +	65	31	AI 2 –
AI 2 GND	64	30	AI 3 +
AI 3 –	63	29	AI 3 GND
NC	62	28	NC
NC	61	27	NC
NC	60	26	NC
NC	59	25	NC
NC	58	24	NC
NC	57	23	NC
NC	56	22	AO 0
AO GND	55	21	AO 1
AO GND	54	20	NC
D GND	53	19	P0.4
P0.0	52	18	D GND
P0.5	51	17	P0.1
D GND	50	16	P0.6
P0.2	49	15	D GND
P0.7	48	14	+5 V
P0.3	47	13	D GND
PFI 11/P2.3	46	12	D GND
PFI 10/P2.2	45	11	PFI 0/P1.0
D GND	44	10	PFI 1/P1.1
PFI 2/P1.2	43	9	D GND
PFI 3/P1.3	42	8	+5 V
PFI 4/P1.4	41	7	D GND
PFI 13/P2.5	40	6	PFI 5/P1.5
PFI 15/P2.7	39	5	PFI 6/P1.6
PFI 7/P1.7	38	4	D GND
PFI 8/P2.0	37	3	PFI 9/P2.1
D GND	36	2	PFI 12/P2.4
D GND	35	1	PFI 14/P2.6

NC = No Connect

Figure 1. NI 6124 Pinout

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