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 GΩ in parallel with 10 pF
- AI + to AI GND ..... >100 GΩ 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

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

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

NATIONAL INSTRUMENTS

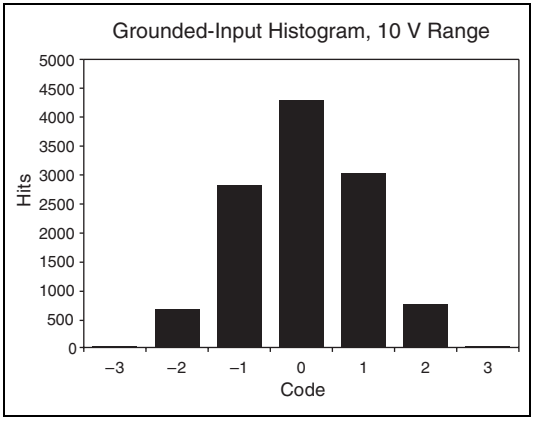
Table 1. NI 6124 Analog Input Range-Dependent Characteristics

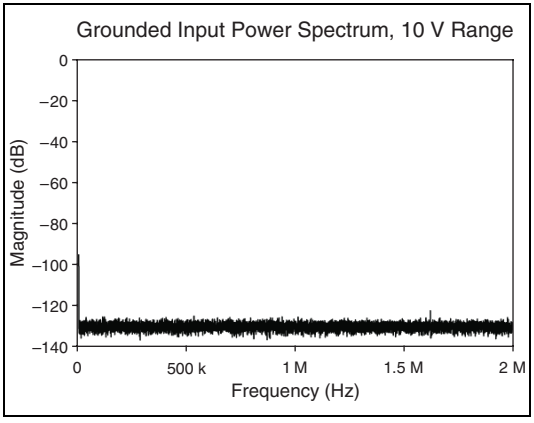
Input Range	Bandwidth* (MHz)	THD (dB at 100 kHz)	System Noise (LSB_{rms})	SFDR Typ† (dB)
±10 V	2	–100	0.95	100
±5 V	2	–97	1.0	100
±2 V	2	–95	1.3	100
±1 V	2	–93	1.9	100

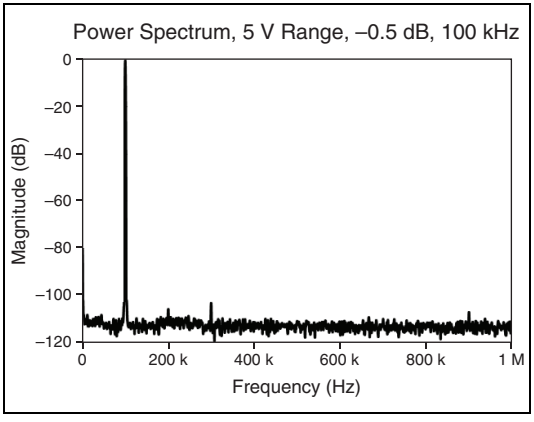
* –3 dB frequency

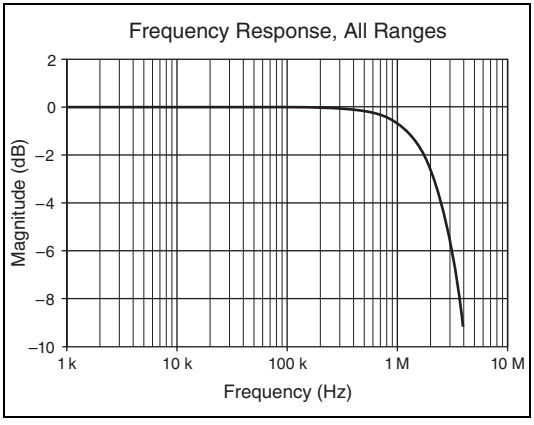
† Measured at 100 kHz, not including harmonics.

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 (μVrms)	Absolute Accuracy at Full Scale* (μV)	Sensitivity† (μV)
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

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

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

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

NoiseUncertainty = 87μV

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

† 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 µs

Settling time, full scale step
15 ppm (1 LSB).....2 µs

Slew rate.....20 V/µs

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

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

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

OffsetError = ResidualOffsetError + AOOffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

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

TempChangeFromLastExternalCal = 10 °C

TempChangeFromLastInternalCal = 1 °C

The absolute accuracy at full scale is as follows:

GainError = 180 ppm + 20 ppm · 1 + 1 ppm · 10 GainError = 210 ppm

OffsetError = 80 ppm + 2 ppm · 1 + 64 ppm OffsetError = 146 ppm

AbsoluteAccuracy = 10 V · (GainError) + 10 V · (OffsetError) AbsoluteAccuracy = 3,560 µV

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 kΩ typ,
20 kΩ 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 µs,
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>	—	–24 mA
PFI <0..15>/P1/P2	—	–16 mA
Output low current (I_{OL})		
P0.<0..7>	—	24 mA
PFI <0..15>/P1/P2	—	16 mA

Electrical Characteristics

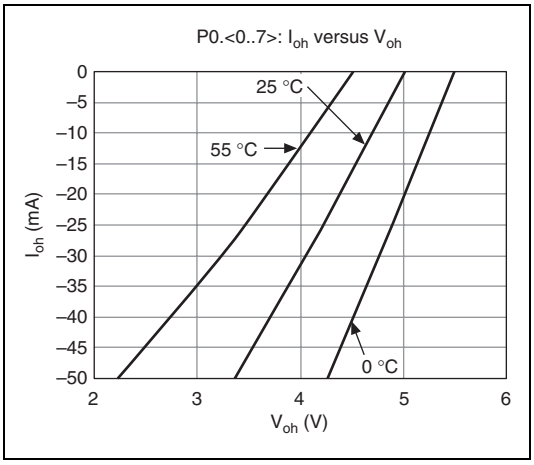
Level	Min	Max
Positive-going threshold (VT+)	—	2.2 V
Negative-going threshold (VT–)	0.8 V	—
Delta VT hysteresis (VT+ – VT–)	0.2 V	—
I_{IL} input low current (V_{in} = 0 V)	—	–10 µA
I_{IH} input high current (V_{in} = 5 V)	—	250 µA

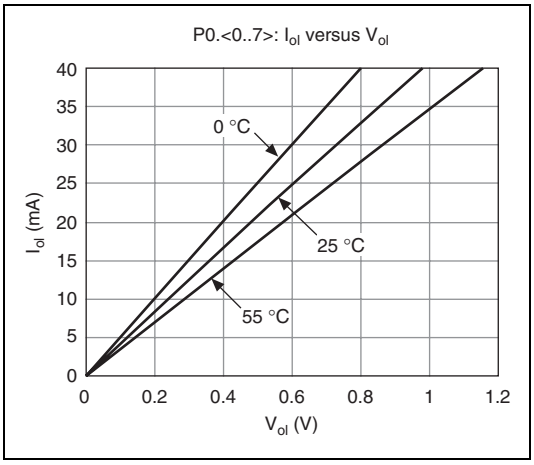
[1] Stresses beyond those listed under *Input voltage protection* may cause permanent damage to the device.

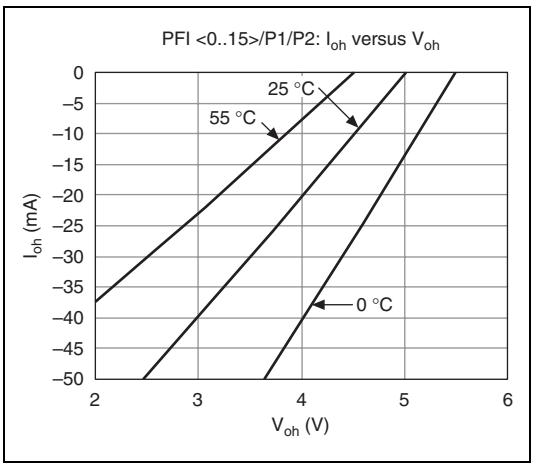
[2] Performance can be dependent on bus latency and volume of bus activity.

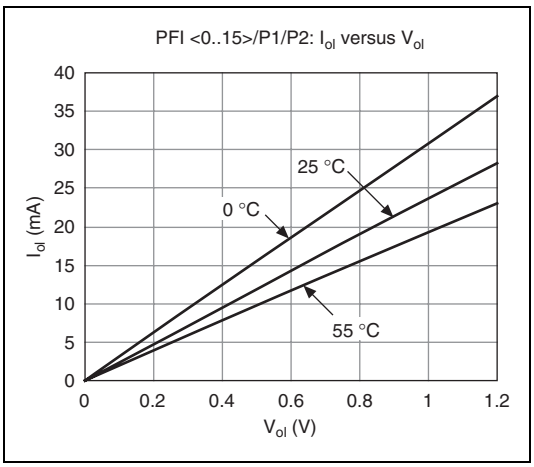
[3] The digital subsystem does not have its own dedicated internal timing engine. Therefore, a sample clock must be provided from another subsystem on the device or an external source.

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 µs, 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 × 10 cm (6.3 in. × 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 °C ambient temperature)

Pollution Degree..... 2

Operating Environment

Ambient temperature range ..... 0 to 55 °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 °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.)

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 CE

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`.)

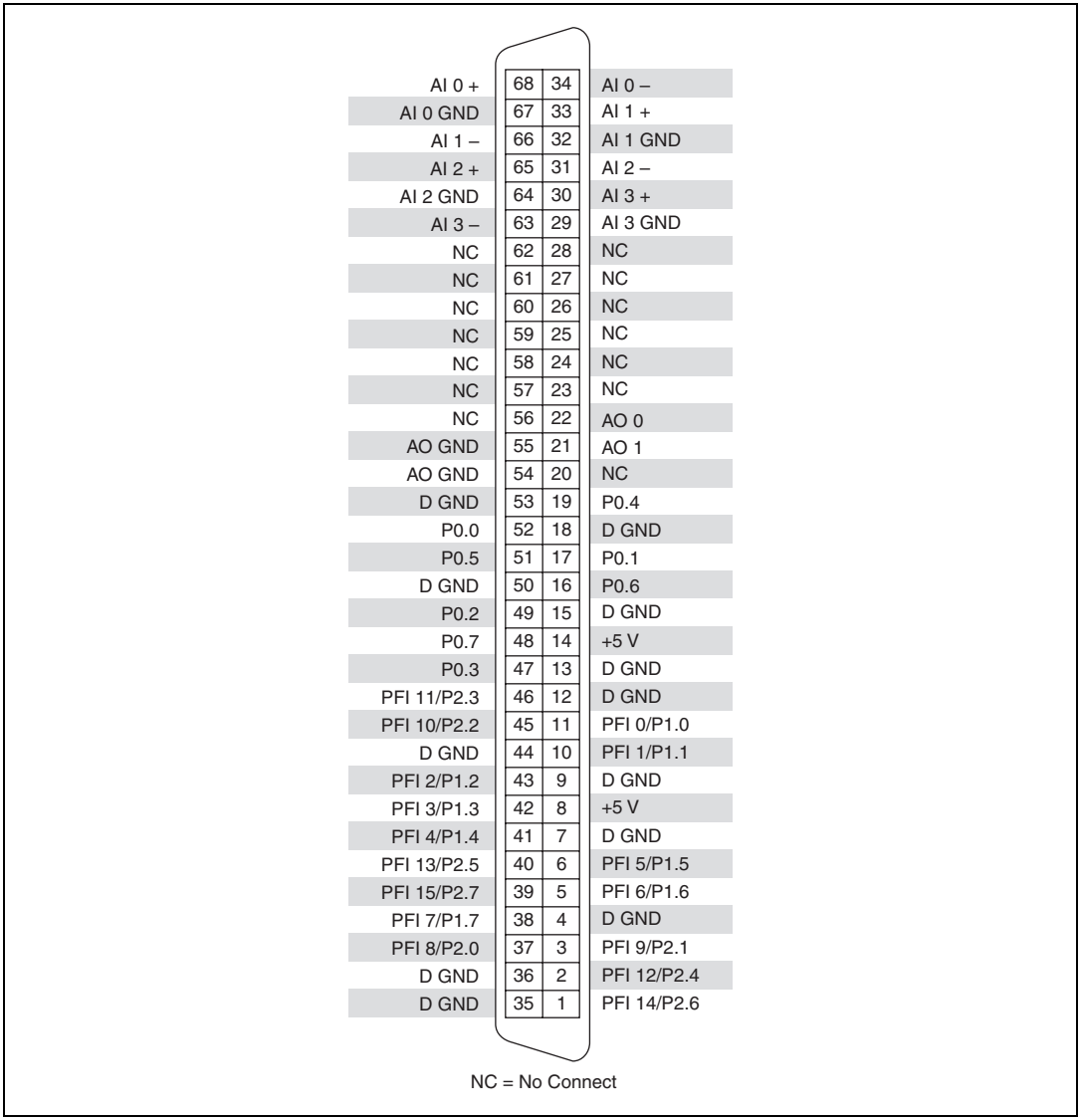


Figure 1. NI 6124 Pinout