NI 6351/6353 Specifications

Français Deutsch 日本語 한국어 简体中文

ni.com/manuals

Specifications listed below are typical at 25 °C unless otherwise noted. Refer to the *X Series User Manual* for more information about NI PCIe-6351/6353 and NI USB-6351/6353 devices.

Analog Input

Number of channels

- NI 6351 ..... 8 differential or 16 single ended
- NI 6353 ..... 16 differential or 32 single ended

ADC resolution ..... 16 bits

DNL ..... No missing codes guaranteed

INL ..... Refer to the *AI Absolute Accuracy Table*

Sampling rate

- Maximum ..... 1.25 MS/s single channel, 1.00 MS/s multi-channel (aggregate)
- Minimum ..... No minimum
- Timing accuracy ..... 50 ppm of sample rate
- Timing resolution ..... 10 ns

Input coupling ..... DC

Input range ..... ±10 V, ±5 V, ±2 V, ±1 V, ±0.5 V, ±0.2 V, ±0.1 V

Maximum working voltage for analog inputs (signal + common mode) ..... ±11 V of AI GND

CMRR (DC to 60 Hz) ..... 100 dB

Input impedance

- Device on
  - AI+ to AI GND ..... >10 GΩ in parallel with 100 pF
  - AI– to AI GND ..... >10 GΩ in parallel with 100 pF
- Device off
  - AI+ to AI GND ..... 820 Ω
  - AI– to AI GND ..... 820 Ω

Input bias current ..... ±100 pA

Crosstalk (at 100 kHz)

- Adjacent channels ..... –75 dB
- Non-adjacent channels ..... –95 dB

Small signal bandwidth (–3 dB) ..... 1.7 MHz

Input FIFO size ..... 4,095 samples

Scan list memory ..... 4,095 entries

Data transfers

- NI PCIe-6351/6353 ..... DMA (scatter-gather), programmed I/O
- NI USB-6351/6353 ..... USB Signal Stream, programmed I/O

Overvoltage protection (AI <0..31>, AI SENSE, AI SENSE 2)

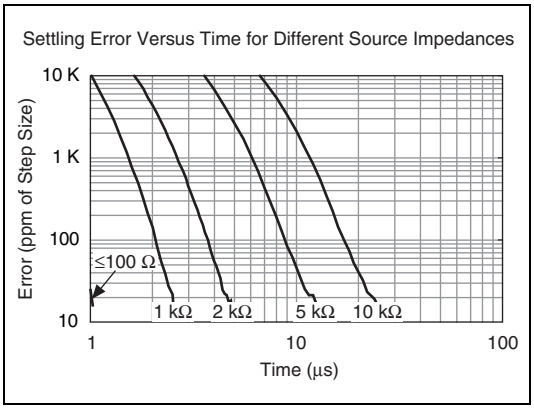
- Device on ..... ±25 V for up to two AI pins
- Device off ..... ±15 V for up to two AI pins

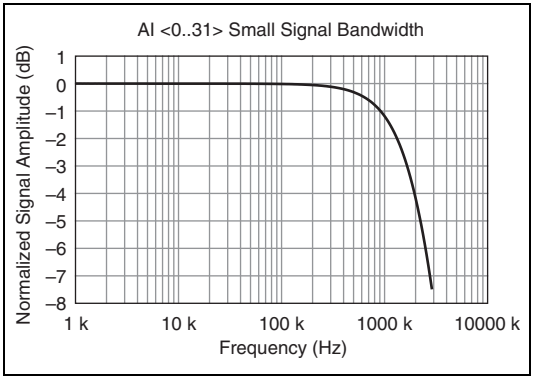
Input current during overvoltage condition ..... ±20 mA max/AI pin

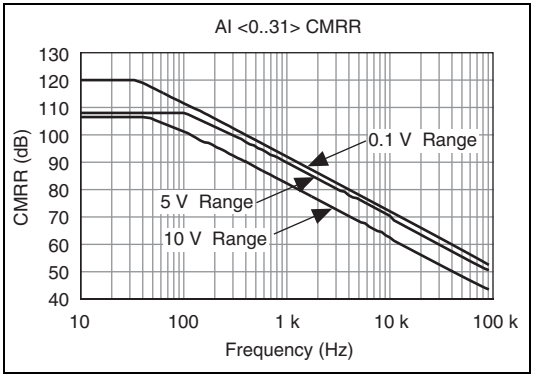
Settling Time for Multichannel Measurements

Range	±60 ppm of Step (±4 LSB for Full Scale Step)	±15 ppm of Step (±1 LSB for Full Scale Step)
±10 V, ±5 V, ±2 V, ±1 V	1 µs	1.5 µs
±0.5 V	1.5 µs	2 µs
±0.2 V, ±0.1 V	2 µs	8 µs

Typical Performance Graphs







Analog Triggers

Number of triggers 1

Source
- NI 6351 ..... AI <0..15>, APFI 0
- NI 6353 ..... AI <0..31>, APFI <0..1>

Functions ..... Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Convert Clock, Sample Clock Timebase

Source level
- AI <0..31> ..... ±full scale
- APFI <0..1> ..... ±10 V

Resolution ..... 16 bits

Modes ..... Analog edge triggering, analog edge triggering with hysteresis, and analog window triggering

Bandwidth (–3 dB)
- AI <0..31> ..... 3.4 MHz
- APFI <0..1> ..... 3.9 MHz

Accuracy ..... ±1% of range

APFI <0..1> characteristics
- Input impedance ..... 10 kΩ
- Coupling ..... DC
- Protection
  - Power on ..... ±30 V
  - Power off ..... ±15 V

Analog Output

Number of channels
- NI 6351 2
- NI 6353 4

DAC resolution ..... 16 bits

DNL ..... ±1 LSB

Monotonicity ..... 16 bit guaranteed

Accuracy ..... Refer to the *AO Absolute Accuracy Table*

Maximum update rate
- 1 channel ..... 2.86 MS/s
- 2 channels ..... 2.00 MS/s
- 3 channels ..... 1.54 MS/s
- 4 channels ..... 1.25 MS/s

Timing accuracy ..... 50 ppm of sample rate

Timing resolution ..... 10 ns

Output range ..... ±10 V, ±5 V, ±external reference on APFI <0..1>

Output coupling ..... DC

Output impedance ..... 0.2 Ω

Output current drive ..... ±5 mA

Overdrive protection ..... ±25 V

Overdrive current ..... 26 mA

Power-on state ..... ±5 mV

Power-on/off glitch
- NI PCIe-6351/6353 ..... 1.5 V peak for 200 ms
- NI USB-6351/6353 ..... 1.5 V for 1.2 s[1]

Output FIFO size ..... 8,191 samples shared among channels used

Data transfers
- NI PCIe-6351/6353 ..... DMA (scatter-gather), programmed I/O
- NI USB-6351/6353 ..... USB Signal Stream, programmed I/O

AO waveform modes:
- Non-periodic waveform
- Periodic waveform regeneration mode from onboard FIFO
- Periodic waveform regeneration from host buffer including dynamic update

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

Slew rate ..... 20 V/µs

Glitch energy at midscale transition, ±10 V range ..... 10 nV · s

[1] Typical behavior. Time period may be longer due to host system USB performance. Time period will be longer during firmware updates.

External Reference

APFI <0..1> characteristics

Input impedance.....10 kΩ

Coupling.....DC

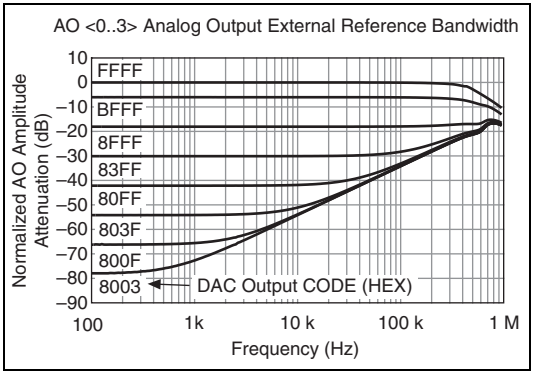
Protection

Power on.....±30 V

Power off.....±15 V

Range.....±11 V

Slew rate.....20 V/µs



Calibration (AI and AO)

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

Calibration interval.....2 years

AI Absolute Accuracy Table

Nominal Range		Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco (ppm/°C)	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)
Positive Full Scale	Negative Full Scale								
10	–10	48	13	1	13	21	46	281	1520
5	–5	55	13	1	13	21	46	137	800
2	–2	55	13	1	13	24	46	56	320
1	–1	65	13	1	17	27	46	35	180
0.5	–0.5	68	13	1	17	34	46	26	95
0.2	–0.2	95	13	1	27	55	46	21	50
0.1	–0.1	108	13	1	45	90	46	16	32

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

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

OffsetError = ResidualOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

$$\text{NoiseUncertainty} = \frac{\text{RandomNoise} \cdot 3}{\sqrt{10{,}000}}$$ For a coverage factor of 3 σ and averaging 10,000 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 = 10,000

CoverageFactor = 3 σ

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

GainError = 48 ppm + 13 ppm · 1 + 1 ppm · 10 GainError = 71 ppm

OffsetError = 13 ppm + 21 ppm · 1 + 46 ppm OffsetError = 80 ppm

$$\text{NoiseUncertainty} = \frac{281\ \mu\text{V} \cdot 3}{\sqrt{10{,}000}}$$ NoiseUncertainty = 8.4 μV

AbsoluteAccuracy = 10 V · (GainError) + 10 V · (OffsetError) + NoiseUncertainty AbsoluteAccuracy = 1,520 μV

Accuracies listed are valid for up to two years from the device external calibration.

AO Absolute Accuracy Table

Nominal Range		Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco (ppm/°C)	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	63	17	1	33	2	64	1890
5	–5	70	8	1	33	2	64	935

[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 two years from the device external calibration.

AbsoluteAccuracy = OutputValue · (GainError) + Range · (OffsetError)
GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)
OffsetError = ResidualOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

Digital I/O/PFI

Static Characteristics

Number of channels
- NI 6351 ..... 24 total, 8 (P0.<0..7>), 16 (PFI <0..7>/P1, PFI <8..15>/P2)
- NI 6353 ..... 48 total, 32 (P0.<0..31>), 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
- NI 6351 ..... Port 0 (P0.<0..7>)
- NI 6353 ..... Port 0 (P0.<0..31>)

Port/sample size
- NI 6351 ..... Up to 8 bits
- NI 6353 ..... Up to 32 bits

Waveform generation (DO) FIFO ... 2,047 samples

Waveform acquisition (DI) FIFO ... 255 samples

DI Sample Clock frequency
- NI PCIe-6351/6353 ..... 0 to 10 MHz, system and bus activity dependent
- NI USB-6351/6353..... 0 to 1 MHz system and bus activity dependent

DO Sample Clock frequency
- NI PCIe-6351/6353
  - Regenerate from FIFO ..... 0 to 10 MHz
  - Streaming from memory ..... 0 to 10 MHz, system and bus activity dependent
- NI USB-6351/6353
  - Regenerate from FIFO ..... 0 to 10 MHz
  - Streaming from memory ..... 0 to 1 MHz system and bus activity dependent

Data transfers
- NI PCIe-6351/6353 ..... DMA (scatter-gather), programmed I/O
- NI USB-6351/6353 ..... USB Signal Stream, programmed I/O

Digital line filter settings ..... 160 ns, 10.24 µs, 5.12 ms, disable

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 ..... 90 ns, 5.12 µs, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input

Recommended Operation Conditions

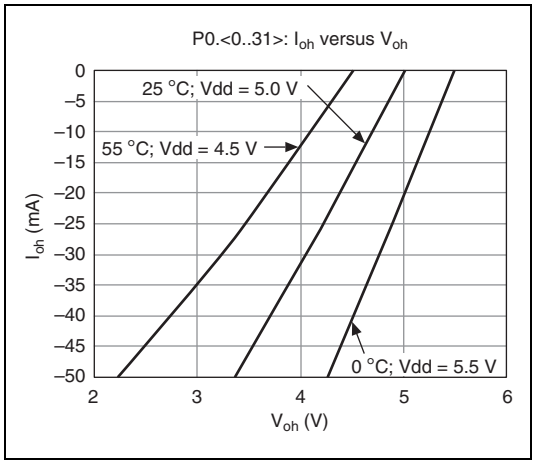
Level	Min	Max
Input high voltage (V_{IH})	2.2 V	5.25 V
Input low voltage (V_{IL})	0 V	0.8 V
Output high current (I_{OH})		
P0.<0..31>	—	–24 mA
PFI <0..15>/P1/P2	—	–16 mA
Output low current (I_{OL})		
P0.<0..31>	—	24 mA
PFI <0..15>/P1/P2	—	16 mA

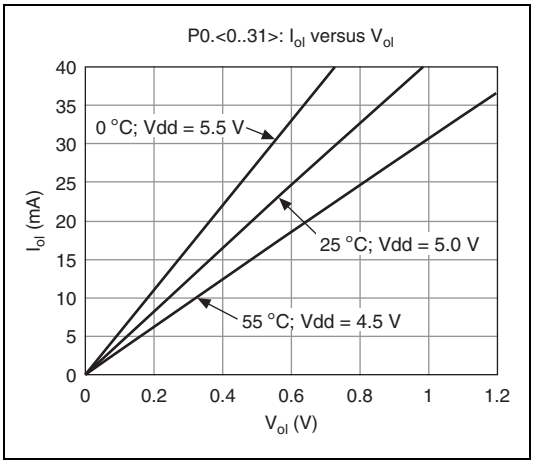
Electrical Characteristics

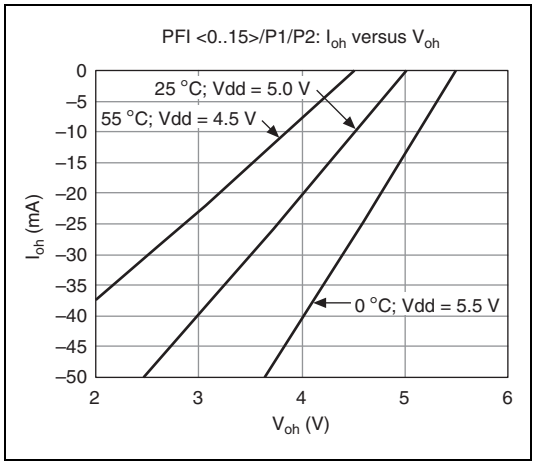
Level	Min	Max
Positive-going threshold (VT+)	—	2.2 V
Negative-going threshold (VT–)	0.8 V	—
Delta VT hysteresis (VT+ – VT–)	0.2 V	—
I_{IL} input low current (V_{in} = 0 V)	—	–10 µA
I_{IH} input high current (V_{in} = 5 V)	—	250 µA

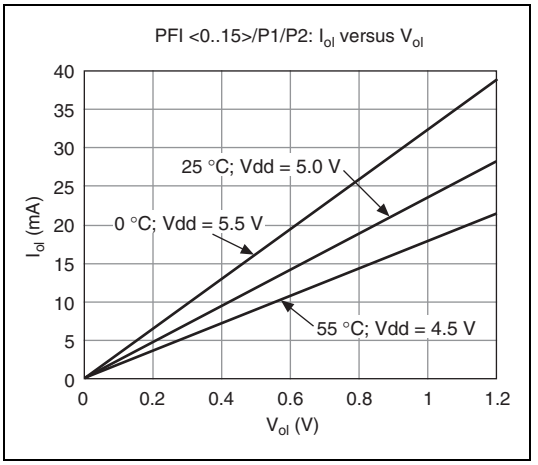
[1] Stresses beyond those listed under *Input voltage protection* may cause permanent damage to the device.

Digital I/O Characteristics









General-Purpose Counter/Timers

Number of counter/timers 4

Resolution ..... 32 bits

Counter measurements ..... Edge counting, pulse, pulse width, 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 ..... 100 MHz, 20 MHz, 100 kHz

External base clock frequency ..... 0 MHz to 25 MHz

Base clock accuracy ..... 50 ppm

Inputs ..... Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock

Routing options for inputs

- NI PCIe-6351/6353 ..... Any PFI, RTSI, analog trigger, many internal signals
- NI USB-6351/6353 ..... Any PFI, analog trigger, many internal signals

FIFO ..... 127 samples per counter

Data transfers

- NI PCIe-6351/6353 ..... Dedicated scatter-gather DMA controller for each counter/timer, programmed I/O
- NI USB-6351/6353 ..... USB Signal Stream, programmed I/O

Frequency Generator

Number of channels 1

Base clocks ..... 20 MHz, 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 clock locking frequencies

Reference Signal	Locking Input Frequency (MHz)	
	PCIe	USB
RTSI <0..7>	10, 20	—
PFI <0..15>	10, 20	10

Output of PLL ..... 100 MHz Timebase; other signals derived from 100 MHz Timebase including 20 MHz and 100 kHz Timebases

External Digital Triggers

Source

- NI PCIe-6351/6353 ..... Any PFI, RTSI
- NI USB-6351/6353 ..... Any PFI

Polarity ..... Software-selectable for most signals

Analog input function ..... Start Trigger, Reference Trigger, Pause 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, Sample Clock

Digital waveform generation (DO) function ..... Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase

Digital waveform acquisition (DI) function ..... Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase

Device-To-Device Trigger Bus

Input source

NI PCIe-6351/6353 ..... RTSI <0..7>

NI USB-6351/6353 ..... None

Output destination

NI PCIe-6351/6353 ..... RTSI <0..7>

NI USB-6351/6353 ..... None

Output selections ..... 10 MHz Clock; frequency generator output; many internal signals

Debounce filter settings ..... 90 ns, 5.12 µs, 2.56 ms, custom interval, disable; programmable high and low transitions; selectable per input

Bus Interface

NI PCIe-6351/6353

Form factor ..... x1 PCI Express, specification v1.1 compliant

Slot compatibility ..... x1, x4, x8, and x16 PCI Express slots[1]

DMA channels ..... 8, analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1, counter/timer 2, counter/timer 3

NI USB-6351/6353

USB compatibility ..... USB 2.0 Hi-Speed or full-speed[2]

USB Signal Stream ..... 8, can be used for analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1, counter/timer 2, counter/timer 3

Power Requirements

NI PCIe-6351/6353

Without disk drive power connector installed

+3.3 V ..... 4.6 W

+12 V ..... 5.4 W

With disk drive power connector installed

+3.3 V ..... 1.6 W

+12 V ..... 5.4 W

+5.0 V ..... 15 W

Caution NI USB-6351/6353 devices *must* be powered with NI offered AC adapter or a National Electric Code (NEC) Class 2 DC source that meets the power requirements for the device and has appropriate safety certification marks for country of use.

NI USB-6351/6353

Power supply requirements ..... 11 to 30 VDC, 30 W, 2 positions 3.5mm pitch pluggable screw terminal with screw locks similar to Phoenix Contact MC 1,5/2-STF-3,5 BK

Power input mating connector .... Phoenix Contact MC 1,5/2-GF-3,5 BK or equivalent

[1] Some motherboards reserve the x16 slot for graphics use. For PCI Express guidelines, refer to `ni.com/pciexpress`.

[2] Operating on a full-speed bus will result in lower performance and you might not be able to achieve maximum sampling/update rates.

Current Limits

Caution Exceeding the current limits may cause unpredictable behavior by the device and/or PC.

NI PCIe-6351/6353

Without disk drive power connector installed

P0/PFI/P1/P2 and +5 V terminals combined ..... 0.59 A max

With disk drive power connector installed

+5 V terminal (connector 0)... 1 A max[1]

+5 V terminal (connector 1)... 1 A max[1]

P0/PFI/P1/P2 combined ..... 1 A max

NI USB-6351/6353

+5 V terminal..... 1 A max[1]

P0/PFI/P1/P2 and +5 V terminals combined ..... 2 A max

Physical Requirements

Printed circuit board dimensions

NI PCIe-6351/6353 ..... 9.9 × 16.8 cm (3.9 × 6.6 in.) (half-length)

Enclosure dimensions (includes connectors)

NI USB-6351/6353 ..... 26.4 × 17.3 × 3.6 cm (10.4 × 6.8 × 1.4 in.)

Weight

NI PCIe-6351 ..... 161 g (5.6 oz)

NI PCIe-6353 ..... 169 g (5.9 oz)

NI USB-6351/6353..... 1.42 kg (3 lb 2 oz)

I/O connector

NI PCIe-6351 ..... 1 68-pin VHDCI

NI PCIe-6353 ..... 2 68-pin VHDCI

NI USB-6351..... 64 screw terminals

NI USB-6353..... 128 screw terminals

NI PCIe-6351/6353 mating connectors:

- 68-Pos Right Angle Single Stack PCB-Mount VHDCI (Receptacle), MOLEX 71430-0011
- 68-Pos Right Angle Dual Stack PCB-Mount VHDCI (Receptacle), MOLEX 74337-0016
- 68-Pos Offset IDC Cable Connector (Plug) (SHC68-*), MOLEX 71425-3001

NI PCIe-6351/6353

disk drive power connector ..... Standard ATX peripheral connector (not serial ATA)

NI USB-6351/6353

screw terminal wiring..... 16–24 AWG

Maximum Working Voltage[2]

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

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

Environmental

Operating temperature

NI PCIe-6351/6353..... 0 to 50 °C

NI USB-6351/6353 ..... 0 to 45 °C

Storage temperature..... –40 to 70 °C

Humidity..... 10 to 90% RH, noncondensing

Maximum altitude ..... 2,000 m

Pollution Degree (indoor use only) 2

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.

[1] Has a self-resetting fuse that opens when current exceeds this specification.

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

Electromagnetic Compatibility

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

- EN 61326-1 (IEC 61326-1): 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

Caution When operating this product, use shielded cables and accessories

Note For EMC declarations and certifications, refer to the *Online Product Certification* section.

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

To obtain product certifications and the Declaration of Conformity (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 the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, 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`.)

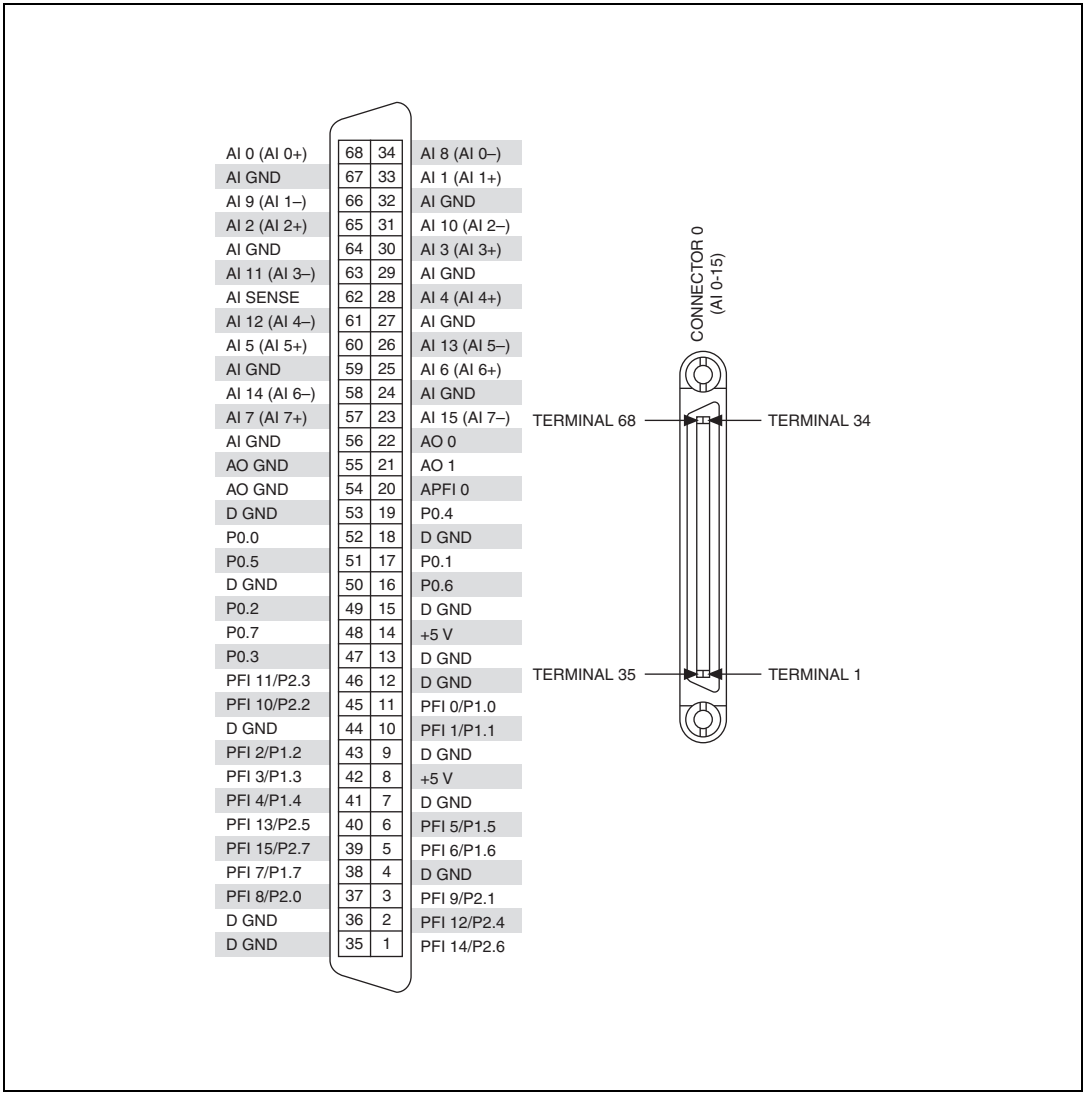


Figure 1. NI PCIe-6351 Pinout

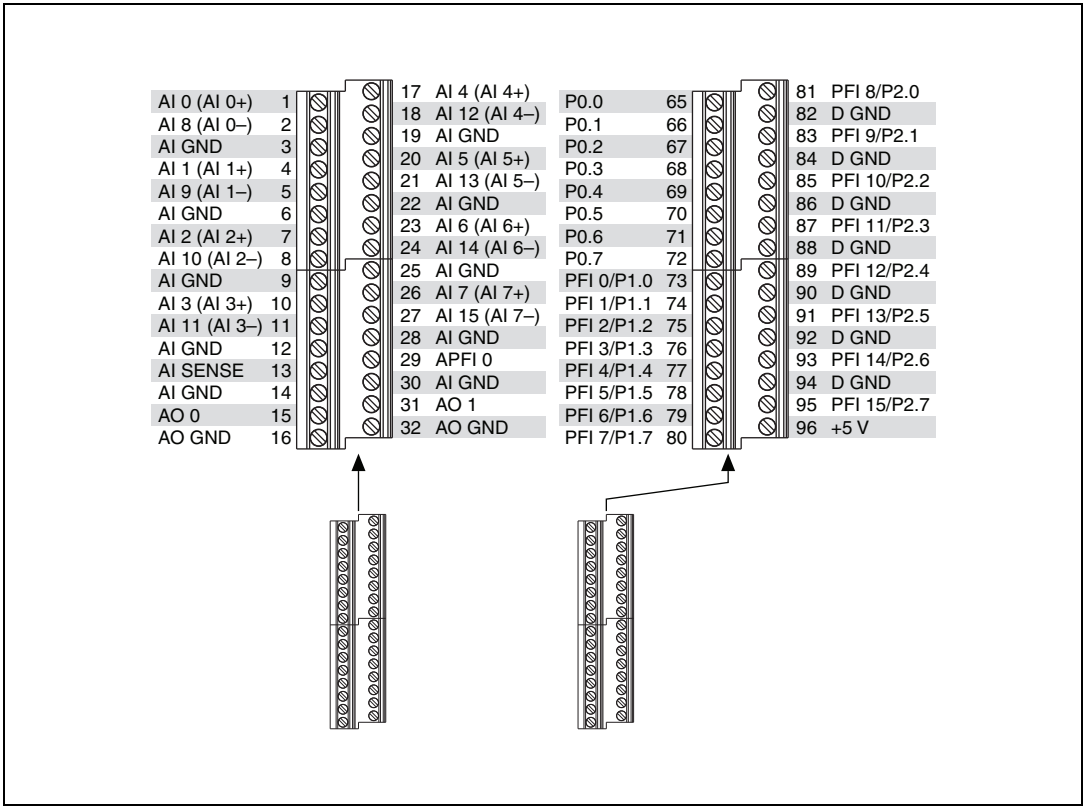


Figure 2. NI USB-6351 Pinout

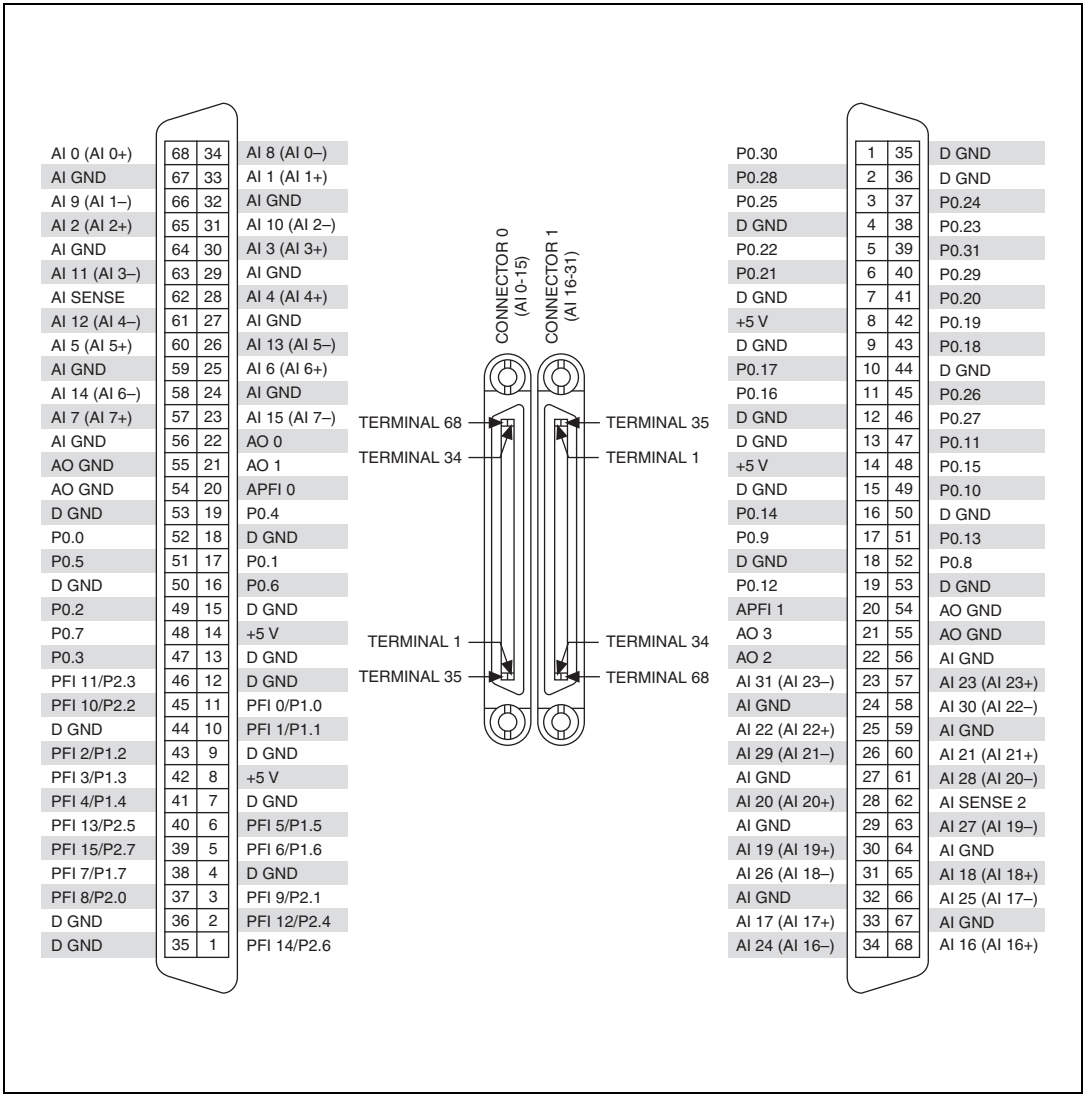


Figure 3. NI PCIe-6353 Pinout

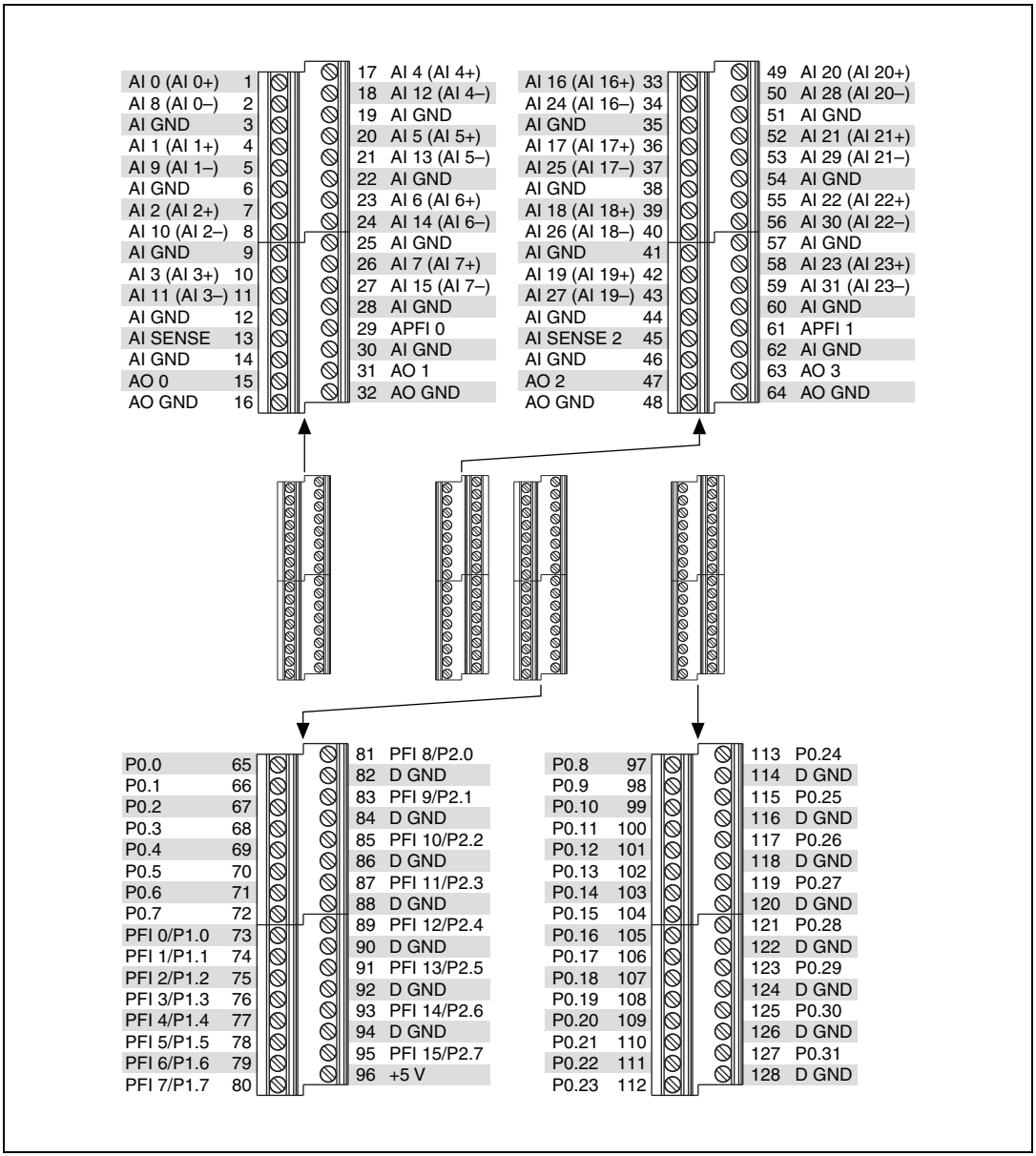


Figure 4. NI USB-6353 Pinout