PXIe-6349 Specifications

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Contents

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Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

Characteristics describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- ***Typical*** specifications describe the performance met by a majority of models.
- ***Nominal*** specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are ***Typical*** unless otherwise noted.

PXIe-6349 Pinout

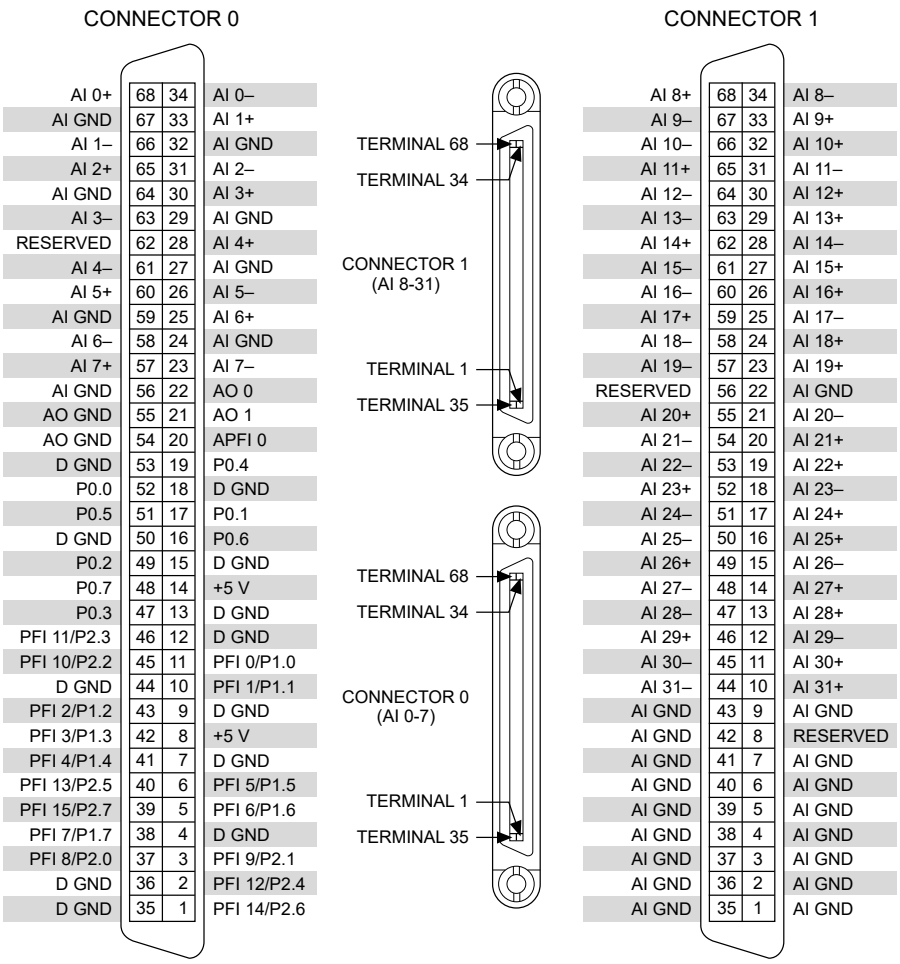


Table 1. Default Counter/Timer Terminals

Counter/Timer Signal	Default PFI Terminal
CTR 0 SRC	PFI 8
CTR 0 GATE	PFI 9
CTR 0 AUX	PFI 10
CTR 0 OUT	PFI 12
CTR 0 A	PFI 8
CTR 0 Z	PFI 9
CTR 0 B	PFI 10
CTR 1 SRC	PFI 3
CTR 1 GATE	PFI 4

Counter/Timer Signal	Default PFI Terminal
CTR 1 AUX	PFI 11
CTR 1 OUT	PFI 13
CTR 1 A	PFI 3
CTR 1 Z	PFI 4
CTR 1 B	PFI 11
CTR 2 SRC	PFI 0
CTR 2 GATE	PFI 1
CTR 2 AUX	PFI 2
CTR 2 OUT	PFI 14
CTR 2 A	PFI 0
CTR 2 Z	PFI 1
CTR 2 B	PFI 2
CTR 3 SRC	PFI 5
CTR 3 GATE	PFI 6
CTR 3 AUX	PFI 7
CTR 3 OUT	PFI 15
CTR 3 A	PFI 5
CTR 3 Z	PFI 6
CTR 3 B	PFI 7
FREQ OUT	PFI 14

Table 2. Signal Descriptions

Signal	Reference	Description
AI GND	—	Analog Input Ground—These terminals are the bias current return point for DIFF measurements. All ground references—AI GND, AO GND,

Signal	Reference	Description
		and D GND—are connected on the device. Though AI GND, AO GND, and D GND are connected on the device, they are connected by small traces to reduce crosstalk between subsystems. Each ground has a slight difference in potential.
AI <0..31>	AI GND	Analog Input Channels—AI 0+ and AI 0- are the positive and negative inputs of differential analog input channel 0.
AO <0,1>	AO GND	Analog Output Channels—These terminals supply voltage output.
AO GND	—	Analog Output Ground—AO GND is the reference for AO. All ground references—AI GND, AO GND, and D GND—are connected on the device. Though AI GND, AO GND, and D GND are connected on the device, they are connected by small traces to reduce crosstalk between subsystems. Each ground has a slight difference in potential.
D GND	—	Digital Ground—D GND supplies the reference for port 0, port 1, port 2 digital channels, PFI, and

Signal	Reference	Description
		+5 V. All ground references—AI GND, AO GND, and D GND—are connected on the device. Though AI GND, AO GND, and D GND are connected on the device, they are connected by small traces to reduce crosstalk between subsystems. Each ground has a slight difference in potential.
P0.<0..7>	D GND	Port 0 Digital I/O Channels—You can configure each signal individually as an input or output.
APFI 0	AI GND	Analog Programmable Function Interface Channel—The APFI signal can be used as an analog trigger input. APFI 0 is referenced to AI GND when it is used as an analog trigger input.
+5 V	D GND	+5 V Power Source—These terminals provide a fused +5 V power source.
PFI <0..7>/P1.<0..7>, PFI <8..15>/P2.<0..7>	D GND	Programmable Function Interface or Digital I/O Channels—Each of these terminals can be individually configured as a PFI terminal or a digital I/O terminal. As an input, each PFI terminal

Signal	Reference	Description
		can be used to supply an external source for AI, AO, DI, and DO timing signals or counter/timer inputs. As a PFI output, you can route many different internal AI, AO, DI, or DO timing signals to each PFI terminal. You can also route the counter/timer outputs to each PFI terminal. As a port 1 or port 2 digital I/O signal, you can individually configure each signal as an input or output.
Reserved	—	Reserved Pin—May be connected internally to device. Should never be connected to any signal.

Analog Input

Note Floating inputs can cause unnecessary power consumption and higher operating temperatures. NI recommends connecting unused analog input channels to AIGND.

Number of channels	32 differential
ADC resolution	16 bits
DNL	No missing codes, warranted

INL	Refer to the ***AI Absolute Accuracy*** section.
Sample rate (simultaneous sampling on all channels sampled)	
Maximum	500 kS/s
Minimum	No minimum
Timing resolution	10 ns
Timing accuracy	50 ppm of sample rate
Input coupling	DC
Input range	±1 V, ±2 V, ±5 V, ±10 V
Maximum working voltage for all analog inputs (AI±)	
Ranges ±10 V, ±5 V	±11 V, Measurement Category I
Ranges ±2 V, ±1 V	±9 V, Measurement Category I

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

CMRR (at 60 Hz)	80 dB

Bandwidth (small signal)	2.0 MHz at ±1 V 2.9 MHz at other ranges
Input impedance	
Device on	
AI+ to AI GND	>1 GΩ in parallel with 18 pF
AI- to AI GND	>1 GΩ in parallel with 18 pF
Device off	
AI+ to AI GND	2.37 kΩ
AI- to AI GND	2.37 kΩ
Input bias current	±6 nA ±90 nA, maximum over full temperature range
Crosstalk (at 100 kHz)	-80 dB
Input FIFO size	4,095 samples shared among channels used
Data transfers	DMA (scatter-gather), programmed I/O
Overvoltage protection for AI<0..31>	
Device on	±30 V

Device off	±15 V
Input current during overvoltage conditions	±6.3 mA maximum/AI pin
Maximum AI channels in overvoltage	4 channels on AI<0..15> and 4 channels on AI<16..31>

Notice Exceeding overvoltage specifications may result in data corruption on non-overvoltaged channels.

Analog Triggers

Number of triggers	1
Source	AI <0..31>, APFI 0
Functions	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Source level	
AI <0..31>	±Full scale
APFI 0	±10 V
Resolution	16 bits

Modes	Analog edge triggering, analog edge triggering with hysteresis, and analog window triggering
Bandwidth (large signal, to -3 dB)	
AI <0..31>	600 kHz
APFI 0	3.9 MHz
Accuracy	±1% of range
APFI 0 characteristics	
Input impedance	10 kΩ
Coupling	DC
Protection, power on	±30 V
Protection, power off	±15 V

AI Absolute Accuracy

Table 3. AI Absolute Accuracy

Nominal Range Positive Full Scale	Nominal Range Negative Full Scale	Residual Gain Error (ppm of Reading)	Offset Tempco (ppm of Range/°C)	Random Noise, σ (µVrms)	Absolute Accuracy at Full Scale (µV)
10	-10	115	2	265	3,225
5	-5	115	2	148	1,613

Nominal Range Positive Full Scale	Nominal Range Negative Full Scale	Residual Gain Error (ppm of Reading)	Offset Tempco (ppm of Range/°C)	Random Noise, σ (µVrms)	Absolute Accuracy at Full Scale (µV)
2	-2	117	2	74	650
1	-1	124	3	50	333

Note For more information about absolute accuracy at full scale, refer to the ***AI Absolute Accuracy Example*** section.

Gain tempco	16.7 ppm/°C
Reference tempco	5 ppm/°C
Residual offset error	12 ppm of range
INL error	126 ppm of range

Note Accuracies listed are warranted for up to one year from the device external calibration when the device is within 10 °C of the external calibration temperature and 1 °C of the last self calibration, when averaging 10,000 DC samples. Other accuracies may be calculated for different temperatures and sample sizes using the given equations.

Notice This product may become more sensitive to electromagnetic disturbances in the operational environment when test leads are attached or when connected to a test object.

AI Absolute Accuracy Equation

$$\textbf{\textit{AbsoluteAccuracy}} = \textbf{\textit{Reading}} \cdot \textbf{\textit{(GainError)}} + \textbf{\textit{Range}} \cdot \textbf{\textit{(OffsetError)}} + \textbf{\textit{NoiseUncertainty}}$$

- $\textbf{\textit{GainError}} = \textbf{\textit{ResidualGainError}} + \textbf{\textit{GainTempco}} \cdot \textbf{\textit{(TempChangeFromLastInternalCal)}} + \textbf{\textit{ReferenceTempco}} \cdot \textbf{\textit{(TempChangeFromLastExternalCal)}}$
- $\textbf{\textit{OffsetError}} = \textbf{\textit{ResidualOffsetError}} + \textbf{\textit{OffsetTempco}} \cdot \textbf{\textit{(TempChangeFromLastInternalCal)}} + \textbf{\textit{INLError}}$
- $\textbf{\textit{NoiseUncertainty}} = \frac{\text{Random Noise} \cdot 3}{\sqrt{10,\,000}}$
  for a coverage factor of 3 σ and averaging 10,000 points.

AI Absolute Accuracy Example

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

- $\textbf{\textit{TempChangeFromLastExternalCal}} = 10\ °C$
- $\textbf{\textit{TempChangeFromLastInternalCal}} = 1\ °C$
- $\textbf{\textit{number\_of\_readings}} = 10{,}000$
- $\textbf{\textit{CoverageFactor}} = 3\ \sigma$

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

- $\textbf{\textit{GainError}} = 115\ ppm + 16.7\ ppm \cdot 1 + 5\ ppm \cdot 10 = 181.7\ ppm$
- $\textbf{\textit{OffsetError}} = 12\ ppm + 2\ ppm \cdot 1 + 126\ ppm = 140\ ppm$
- $\textbf{\textit{Noise Uncertainty}} = \frac{265\ \mu V \cdot 3}{\sqrt{10,\,000}} = 8\ \mu V$
- $\textbf{\textit{AbsoluteAccuracy}} = 10\ V \cdot (\textbf{\textit{GainError}}) + 10\ V \cdot (\textbf{\textit{OffsetError}}) + \textbf{\textit{NoiseUncertainty}} = 3225\ \mu V$

Analog Output

Number of channels	2
DAC resolution	16 bits
DNL	±1 LSB, maximum
Monotonicity	16 bit guaranteed
Accuracy	Refer to the ***AO Absolute Accuracy*** section.

Maximum update rate (simultaneous)	
1 channel	900 kS/s
2 channels	840 kS/s

Minimum update rate	No minimum
Timing accuracy	50 ppm of sample rate
Timing resolution	10 ns
Output range	±10 V

Output coupling	DC
Output impedance	0.2 Ω
Output current drive	±5 mA
Overdrive protection	±15 V
Overdrive current	15 mA
Power-on state	±20 mV
Power-on/off glitch	2 V peak for 150 ms
Output FIFO size	8,191 samples shared among channels used
Data transfers	DMA (scatter-gather), 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)	6 µs

Slew rate	15 V/µs
Glitch energy at midscale transition	100 mV · 2.6 µs

AO Absolute Accuracy

Accuracies listed are warranted for up to one year from the device external calibration when the device is within 10 °C of the external calibration temperature and 1 °C of the last self calibration.

Table 4. AO Absolute Accuracy

Nominal Range Positive Full Scale	Nominal Range Negative Full Scale	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 (µV)
10	-10	130	11.3	5	52	4.8	128	3,761

AO Absolute Accuracy Equation

$$AbsoluteAccuracy = OutputValue \cdot (GainError) + Range \cdot (OffsetError)$$

- $GainError = ResidualGainError + GainTempco \cdot (TempChangeFromLastInternalCal) + ReferenceTempco \cdot (TempChangeFromLastExternalCal)$
- $OffsetError = ResidualOffsetError + OffsetTempco \cdot (TempChangeFromLastInternalCal) + INLError$

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, typical 20 kΩ, minimum
Input voltage protection	±20 V on up to two pins

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

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	255 samples
DI Sample Clock frequency	0 to 1 MHz, system and bus activity dependent
DO Sample Clock frequency	
Regenerate from FIFO	0 to 1 MHz
Streaming from memory	0 to 1 MHz, system and bus activity dependent
Data transfers	DMA (scatter-gather), 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 Operating Conditions

Input high voltage (V_{IH})	
Minimum	2.2 V
Maximum	5.25 V
Input low voltage (V_{IL})	
Minimum	0 V
Maximum	0.8 V
Output high current (I_{OH})	
P0.<0..7>	-24 mA, maximum
PFI <0..15>/P1/P2	-16 mA, maximum
Output low current (I_{OL})	
P0.<0..7>	24 mA, maximum
PFI <0..15>/P1/P2	16 mA, maximum

Digital I/O Characteristics

Positive-going threshold (VT+)	2.2 V, maximum

Negative-going threshold (VT-)	0.8 V, minimum
Delta VT hysteresis (VT+ - VT-)	0.2 V , minimum
I_{IL} input low current (V_{IN} = 0 V)	-10 µA, maximum
I_{IH} input high current (V_{IN} = 5 V)	250 µA, maximum

Figure 1. P0.<0..7>: I_{OH} versus V_{OH}

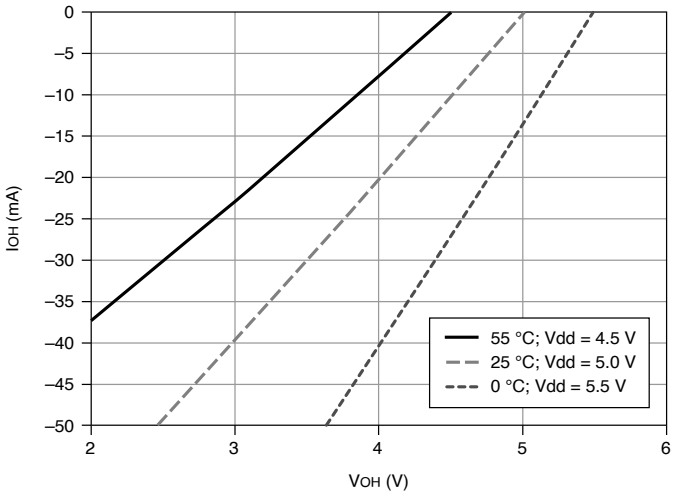


Figure 2. P0.<0..7>: I_{OL} versus V_{OL}

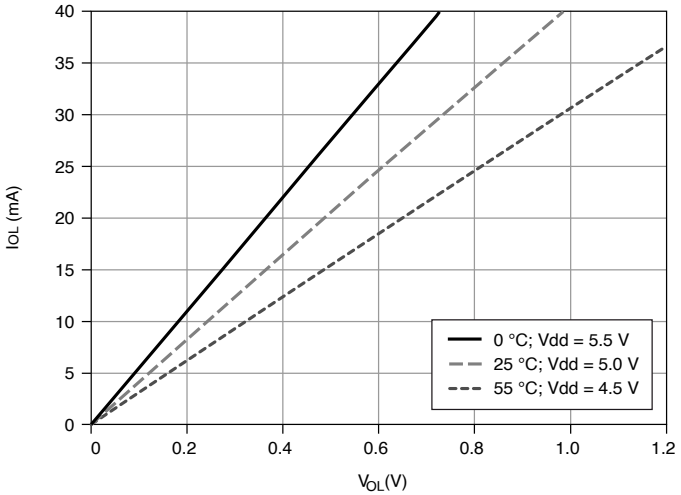


Figure 3. PFI <0..15>/P1/P2: I_{OH} versus V_{OH}

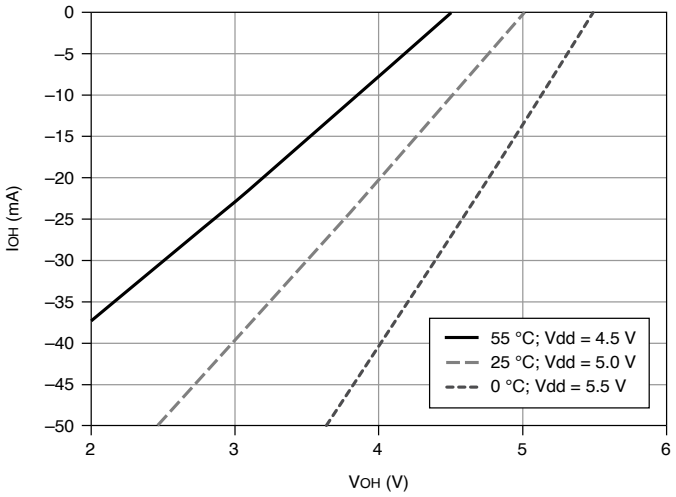
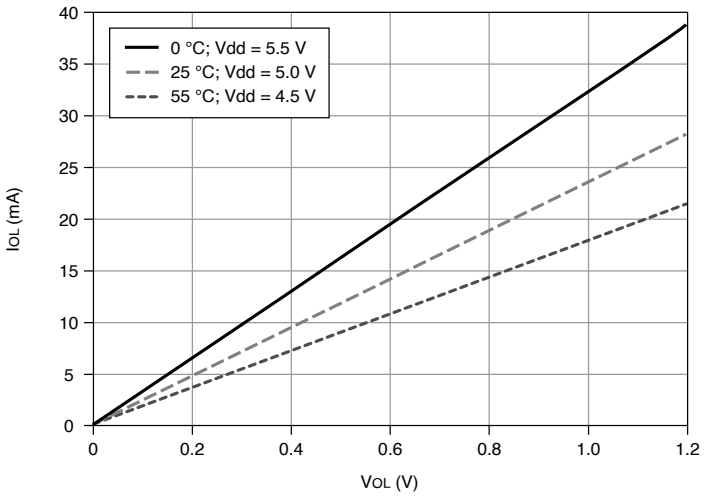


Figure 4. PFI <0..15>/P1/P2: I_{OL} versus V_{OL}



General-Purpose Counters

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; 0 MHz to 100 MHz on PXIe_DSTAR<A,B>
Base clock accuracy	50 ppm
Inputs	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down, Sample Clock
Routing options for inputs	Any PFI, PXIe_DSTAR<A,B>, PXI_TRIG, PXI_STAR, analog trigger, many internal triggers
FIFO	127 samples per counter
Data transfers	Dedicated scatter-gather DMA controller for each counter/timer, 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 PXI TRIG<0..7> terminal.

Phase-Locked Loop (PLL)

Number of PLLs	1

Table 5. Reference Clock Locking Frequencies

Reference Signal	PXI Express Locking Input Frequency (MHz)
PXIe_DSTAR<A,B>	10, 20, 100
PXI_STAR	10, 20
PXIe_CLK100	100
PXI_TRIG <0..7>	10, 20
PFI <0..15>	10, 20

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

External Digital Triggers

Source	Any PFI, PXIe_DSTAR<A,B>, PXI_TRIG, PXI_STAR

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	PXI_TRIG <0..7>, PXI_STAR, PXIe_DSTAR<A,B>
Output destination	PXI_TRIG <0..7>, PXIe_DSTARC
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

Form factor	x1 PXI Express, specification v1.0 compliant
Slot compatibility	x1 and x4 PXI Express or PXI Express hybrid slots
DMA channels	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)

All PXIe devices may be installed in PXI Express slots or PXI Express hybrid slots.

Power Requirements

Caution The protection provided by the PXIe-6349 can be impaired if it is used in a manner not described in the user documentation.

Attention La protection apportée par le PXIe-6349 risque d'être endommagée s'il est utilisé d'une autre façon que celle décrite dans la documentation utilisateur.

+3.3 V	2.1 W
+12 V	22.5 W

Current Limits

Notice Exceeding the current limits may cause unpredictable device behavior.

+5 V terminal (connector 0)	1 A, maximum

Note Connector 0 has a self-resetting fuse that opens when current exceeds this specification.

P0/PFI/P1/P2 and +5 V terminals combined	1.2 A, maximum

Physical Characteristics

PXIe printed circuit board dimensions	Standard 3U PXI
Weight	140 g (4.8 oz)
I/O connectors	
PXIe module connector	68-Pos Right Angle Single Stack PCB-Mount VHDCI (Receptacle)
Cable connector	68-Pos Offset IDC Cable Connector (Plug) (SHC68-*)

Note For more information about the connectors used for DAQ devices, refer to the document, ***NI DAQ Device Custom Cables, Replacement Connectors, and Screws***, by going to ni.com/info and entering the Info Code `rdspmb`.

Calibration

Recommended warm-up time	15 minutes
Calibration interval	1 year

Maximum Working Voltage

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

Channel to earth	11 V, Measurement Category I

Caution Do not connect the PXIe-6349 to signals or use for measurements within Measurement Categories II, III, or IV.

Attention Ne connectez pas le PXIe-6349 à des signaux et ne l'utilisez pas pour effectuer des mesures dans les catégories de mesure II, III ou IV.

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.

Note Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are for other circuits not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

Environmental Characteristics

Temperature and Humidity

Temperature	
Operating	0 °C to 55 °C
Storage	-40 °C to 71 °C
Humidity	
Operating	10% to 90% RH, noncondensing
Storage	5% to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)

Shock and Vibration

Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g RMS
Non-operating	5 Hz to 500 Hz, 2.4 g RMS
Operating shock	30 g, half-sine, 11 ms pulse