DEVICE SPECIFICATIONS

NI PXIe-4304/4305

32 Ch, 24-bit, ±42 V, 5 kS/s or 51.2 kS/s Simultaneous Filtered Data Acquisition Module

Français Deutsch 日本語 한국어 简体中文

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This document lists specifications for the NI PXIe-4304/4305 simultaneous filtered data acquisition module. All specifications are subject to change without notice. Visit ni.com/manuals for the most current specifications and product documentation.

Note To maintain forced air cooling in the PXI Express system, refer to the *Maintain Forced-Air Cooling Note to Users*.

Terminology

Maximum and *minimum* specifications characterize the warranted performance of the instrument within the recommended calibration interval and under the stated operating conditions. These specifications are subject to production verification or guaranteed by design.

Typical specifications are specifications met by the majority of the instruments within the recommended calibration interval and under the stated operating conditions, based on measurements taken during production verification and/or engineering development. The performance of the instrument is not warranted.

Supplemental specifications describe the basic function and attributes of the instrument established by design and are not subject to production verification. They provide information that is relevant for the adequate use of the instrument that is not included in the previous definitions.

All performance specifications are *typical* unless otherwise noted. These specifications are valid within the full operating temperature range. Accuracy specifications are valid within ±5 °C of the calibration or over the full operating range as specifically noted.

NATIONAL INSTRUMENTS

Input Characteristics

Number of channels ..... 32 differential analog input channels

ADC resolution ..... 24 bits

Type of ADC ..... Delta-Sigma

Sampling mode ..... Simultaneous

Sample rates (f_s)

- PXIe-4304
  - Range ..... 1 S/s to 5 kS/s
  - Resolution ..... ≤181.9 µS/s
- PXIe-4305
  - Range ..... 1 S/s to 51.2 kS/s
  - Resolution ..... ≤181.9 µS/s

Input coupling ..... DC

Input ranges (FS)

- Nominal ..... ±42 V
- Max ..... ±42 V

Maximum working voltage (signal + common mode) ..... ±42 V

Input impedance

- Device powered on
  - AI+ to AI GND ..... 575 KΩ
  - AI- to AI GND ..... 575 KΩ
  - AI+ to AI- ..... 1.15 MΩ

CMRR (DC to 60 Hz) ..... 80 dB

FIFO Buffer Size ..... 1,023 samples

Data transfers ..... Direct memory access (DMA), programmed I/O

Fault Protection (Power On or Off)

AI±<0..31>, AIGND ..... 42 V between any two pins

PFI0 ..... 30 V to DGND

Accuracy[1]

Measurement Conditions	Gain Error (% of Reading)	Offset Error (mV)
Typ (23 °C ±5 °C)	0.027	2.2
Max (23 °C ±5 °C)	0.037	4.5
Max (0 °C to 55 °C)	0.093	11.6

Temperature Stability

Gain stability..... 12 ppm/°C

Offset stability ..... 135 µV/°C

Input Noise

Total buffered mode noise

f_s = 5 kS/s..... 94 μV_{rms}

f_s = 51.2 kS/s..... 300 μV_{rms} (PXIe-4305 only)

Table 1. Optional Buffered Mode IIR Filtering Noise Scaling Coefficients

Filter Cut-Off Frequency	Noise Scaling Coefficient (K)
2 kHz	1.1
1 kHz	1.8
200 Hz	3
20 Hz	12
2 Hz	30

Buffered mode noise with IIR filters

$$Input\ Noise = \frac{Total\_Buffer\_Mode\_Noise}{\sqrt{Highest\_Rate \times \frac{Hz}{S/s} \times 0.45}} \times \sqrt{K \times Filter\_Cut\text{-}off\_Frequency}$$

[1] Accuracies listed are warranted for the conditions described in the tables and for up to one year from the module external calibration.

Example

The buffer mode noise of the PXIe-4305 with the 1 kHz optional IIR filter is:

Highest_Rate of the PXIe-4305 = 51.2 kS/s

Total_Buffer_Mode_Noise = 300 μV_{rms}

Noise Scaling Coefficient (K) of 1 kHz filter = 1.8

K × Filter_Cut-off_Frequency= 1.8 × 1 kHz = 1.8 kHz

$$Input\ Noise = \frac{Total\_Buffer\_Mode\_Noise}{\sqrt{Highest\_Rate \times \frac{Hz}{S/s} \times 0.45}} \times \sqrt{K \times Filter\_Cut\text{-}off\_Frequency}$$

$$= \frac{300\ \mu V_{rms}}{\sqrt{51.2\ kS/s \times \frac{Hz}{S/s} \times 0.45}} \times \sqrt{1.8\ kHz} = 83.9\ \mu V_{rms}$$

Absolute Accuracy

$$Absolute\ Accuracy = Reading \times Gain\ Error + Offset\ Error + Noise\ Uncertainty$$

$$Noise\ Uncertainty = 3 \times \frac{Random\ Noise}{\sqrt{\#\ Samples}}$$

Where

Random Noise is the input noise for the sample rate used.

3 converts the RMS value to peak value for a coverage of 3σ.

 # Samples is the number of samples averaged.

For example, when using an operating temperature of 23 °C ±5 °C, the absolute accuracy at full-scale input with 5000 samples acquired at 5 kS/s is:

$$Gain\ Error = 0.037\%\ of\ Reading$$

$$Offset\ Error = 4.5\ mV$$

$$Noise\ Uncertainty = \frac{94\ \mu V \times 3}{\sqrt{5000}} = 4\ \mu V$$

$$Absolute\ Accuracy = 42\ V \times Gain\ Error + Offset\ Error + Noise\ Uncertainty = 20\ mV$$

Phase linearity

PXIe-4304
(f_{in} = DC to 2.25 kHz)..... ±1°

PXIe-4305
(f_{in} = DC to 23.04 kHz)..... ±1°

Spurious free dynamic range (SFDR)

1 kHz, -60 dBFS ..... 120 dB

Total harmonic distortion (THD)

1 kHz, -1 dBFS ..... -98 dB

Crosstalk

1 kHz..... -95 dB

10 kHz..... -75 dB (PXIe-4305 only)

Bandwidth and Alias Rejection

Passband

Frequency (for 1 S/s ≤ f_s < 25 S/s)..... ≤ 0.1 × f_s

Frequency (for 25 S/s ≤ f_s ≤ 25.6 kS/s).... ≤ 0.45 × f_s

In band flatness

f_{in} = DC to 2.25 kHz ..... 10 mdB max

f_{in} = 2.25 kHz to 23.04 kHz ..... 100 mdB max (PXIe-4305 only)

Stopband

Frequency (for 1 S/s ≤ f_s < 25 S/s)..... ≥ 0.9 × f_s

Frequency (for 25 S/s ≤ f_s ≤ 25.6 kS/s).... ≥ 0.57 × f_s

Rejection..... 100 dB

Alias-free bandwidth
(for 1 S/s ≤ f_s < 25 S/s)..... 0.1 × f_s

Alias-free bandwidth
(for 25 S/s ≤ f_s ≤ 25.6 kS/s)..... 0.45 × f_s

Minimum frequency
for ADC alias hole..... 3.320313 MHz

Rejection at alias hole..... 100 dB

Uncompensated filter delay[1]

Group Delay = Analog Delay + Digital Filter Group Delay [2]

Analog delay ..... 6.77 µs

Compensated digital filter group delay..... 1.79742 ms + Variable Filter Delay

Sample Rate	Variable Filter Delay (Samples)
1 S/s ≤ f_s < 25 S/s	4.000
25.0 S/s ≤ f_s ≤ 25.3 S/s	57.995
25.3 S/s < f_s ≤ 50.7 S/s	57.991
50.7 S/s < f_s ≤ 101.3 S/s	57.981
101.3 S/s <f_s ≤ 202.7 S/s	57.963
202.7 S/s < f_s ≤ 405.3 S/s	57.926
405.3 S/s < f_s ≤ 810.6 S/s	57.852
810.6 S/s < f_s ≤ 1621.2 S/s	57.703
1621.2 S/s < f_s ≤ 3242.5 S/s	57.406
3242.5 S/s < f_s ≤ 6485.0 S/s	56.813
6485.0 S/s < f_s ≤ 12970.0 S/s	55.625
12970.0 S/s < f_s ≤ 25939.9 S/s	53.250
25939.9 S/s < f_s ≤ 51200 S/s	48.500

Channel to Channel Matching[3]

Gain matching

Input frequency (f_{in})

DC to 2.25 kHz ..... 17 mdB

2.25 kHz to 23.04 kHz ..... 170 mdB (PXIe-4305 only)

Phase matching ..... 0.035°/kHz × f_{in}

[1] The compensated digital filter group delay is a result of using the anti-alias filtering in buffered mode. Hardware automatically compensates for this group delay when synchronizing.
Hardware does not compensate for filter delay from either the analog filter or the optional buffered mode digital filter or the filter used for hardware-timed single point mode.

[2] Digital filter group delay results from using the optional IIR filter in buffered mode or the IIR filter selected in hardware-timed single point mode.

[3] Identical channel configurations.

Optional Buffered Mode IIR Filtering

Filter Cut-Off Frequency	Filter Type	Stopband Attenuation	Passband Ripple
2 kHz Filter	Fourth order, Elliptic Filter	-120 dB	0.2 dB
1 kHz Filter	Fourth order, Elliptic Filter	-120 dB	0.2 dB
200 Hz Filter	Fourth order, Elliptic Filter	-120 dB	0.2 dB
20 Hz Filter	Fourth order, Elliptic Filter	-120 dB	0.2 dB
2 Hz Filter	Fourth order, Elliptic Filter	-120 dB	0.2 dB

Figure 1. Magnitude Response

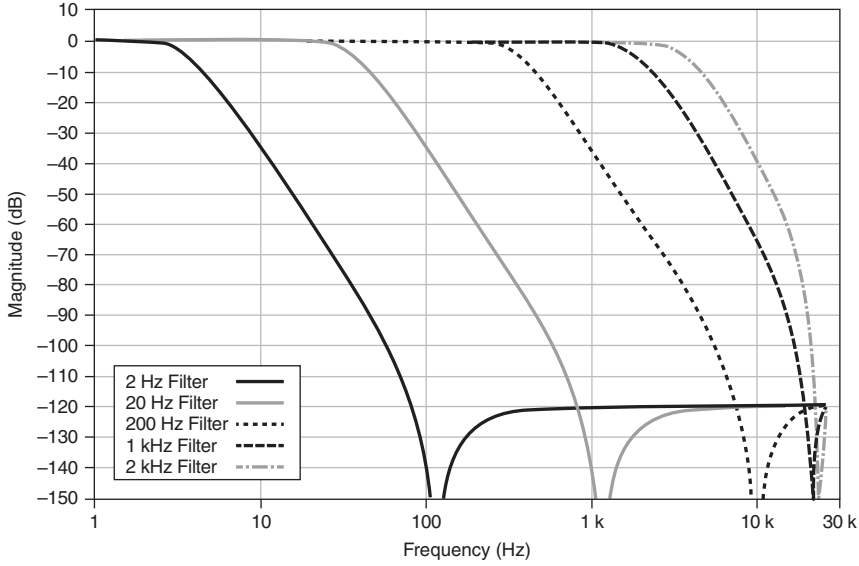

Figure 2. Passband

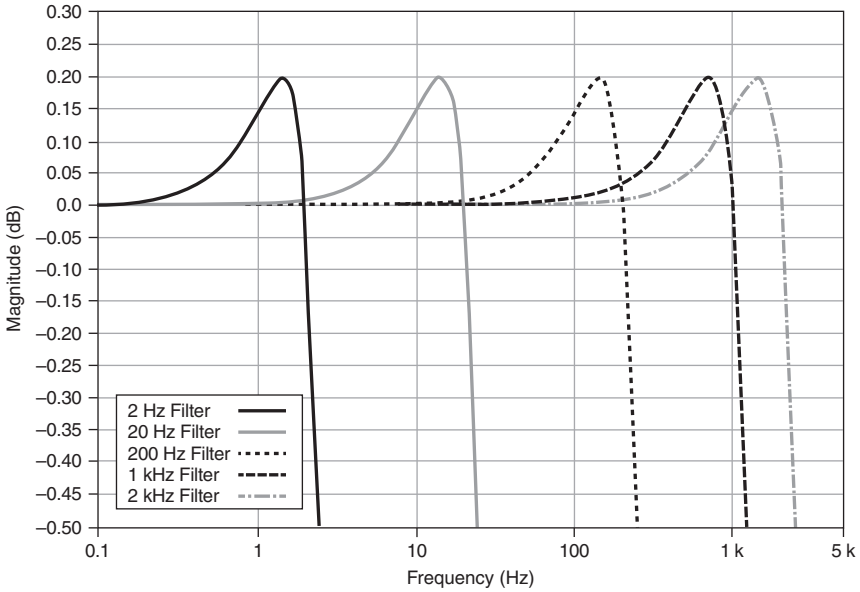

Figure 3. Phase Response

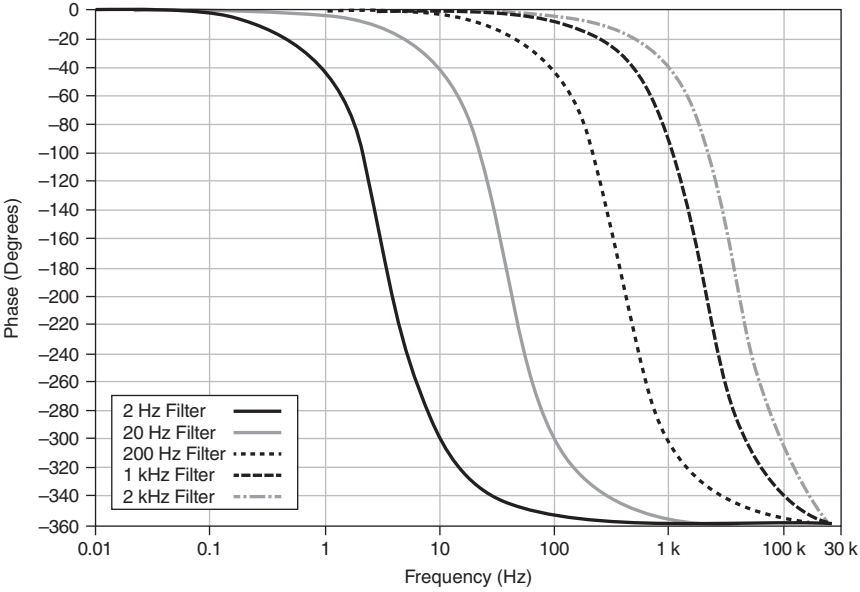

Figure 4. Group Delay

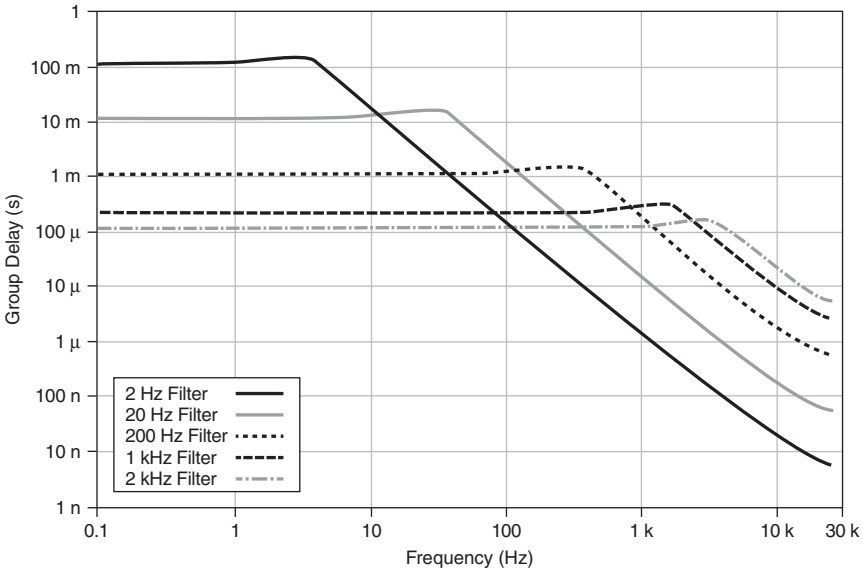

Table 2. Digital Filter Group Delay

Filter Cut-Off Frequency	Group Delay at 0.1 Hz
2 kHz Filter	113.4 µs
1 kHz Filter	227.4 µs
200 Hz Filter	1.1385 ms
20 Hz Filter	11.3856 ms
2 Hz Filter	113.856 ms

Hardware-Timed Single Point Sample Mode

Acquisition rate[1]

Minimum ..... 1 S/s

Maximum

PXIe-4304 ..... 5 kS/s

PXIe-4305 ..... 51.2 kS/s

Table 3. Measured Hardware-Timed Single Point Sample Mode Noise at 23 °C

Filter Cut-Off Frequency	Noise
3 kHz Filter	144.3 μV_{rms}
2 kHz Filter	131.2 μV_{rms}
1 kHz Filter	117.9 μV_{rms}
500 Hz Filter	110.2 μV_{rms}
200 Hz Filter	101.9 μV_{rms}
100 Hz Filter	100.9 μV_{rms}

Hardware-Timed Single Point Filtering

Filter type ..... Fourth order, elliptic filter

Stopband attenuation ..... -120 dB

Passband ripple ..... 0.2 dB

[1] Depends on the system setup and application time. Refer to the *NI PXIe-4304/4305 User Manual* for more information.

Figure 5. Filter Magnitude Response

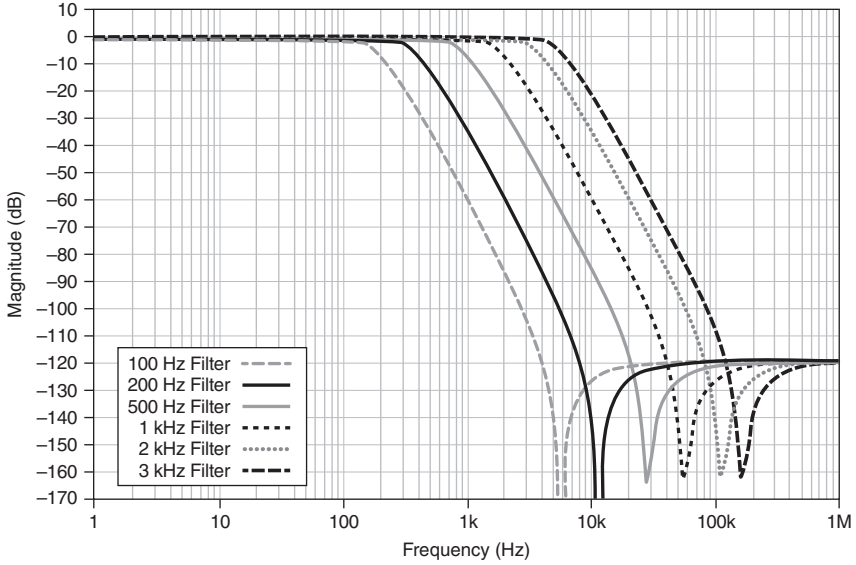

Figure 6. Passband Ripple

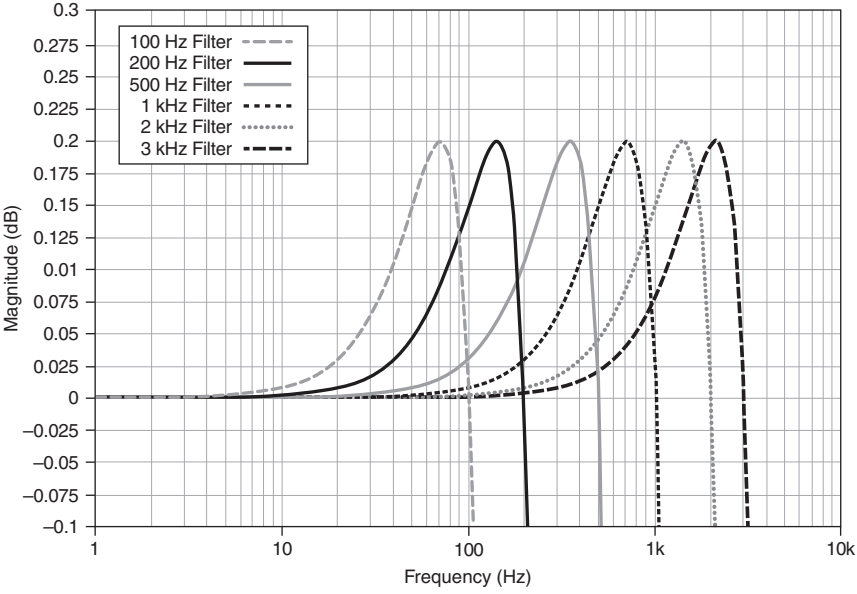

Figure 7. Filter Phase Response

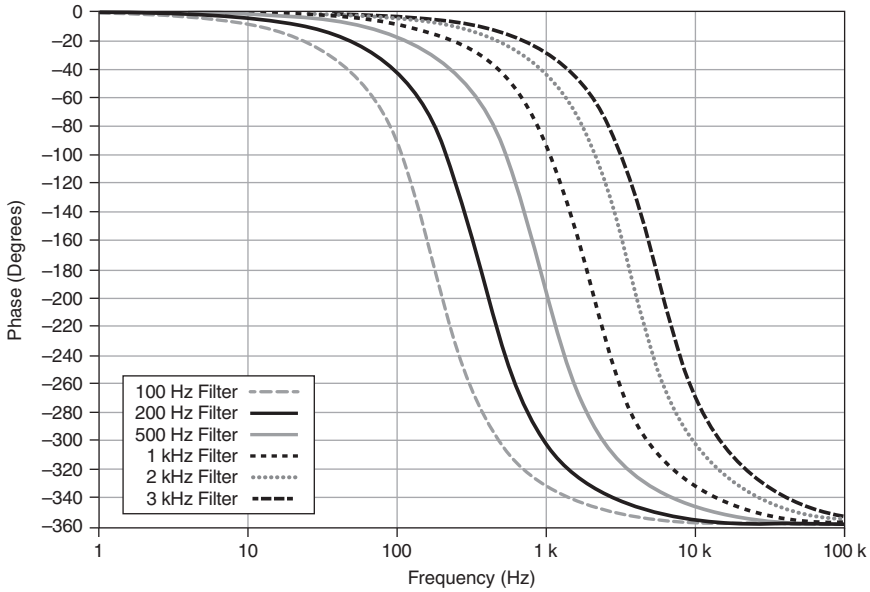

Figure 8. Filter Group Delay

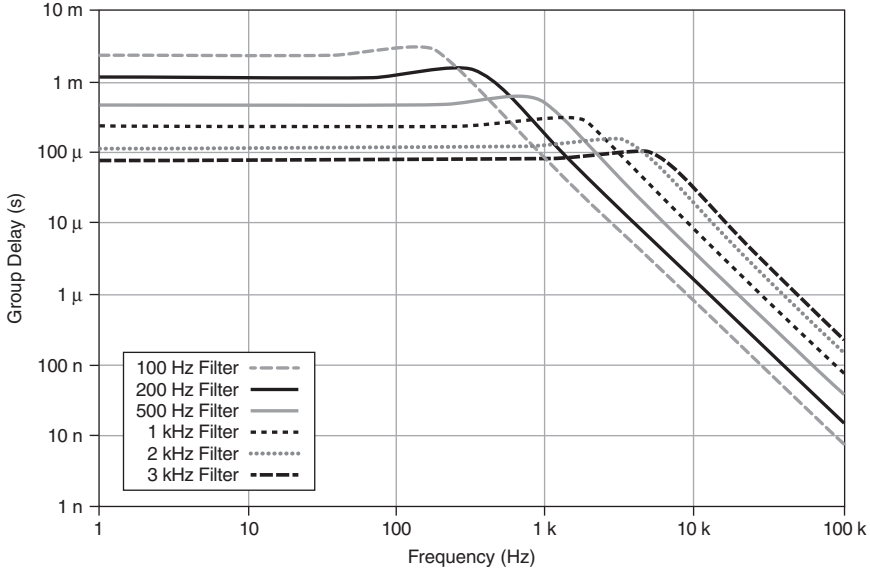

Table 4. Digital Filter Group Delay

Filter Cut-Off Frequency	Group Delay at 1 Hz
3 kHz Filter	75.9 µs
2 kHz Filter	113.9 µs
1 kHz Filter	227.7 µs
500 Hz Filter	455.4 µs
200 Hz Filter	1.1386 ms
100 Hz Filter	2.28 ms

Hardware-timed single point ADC group delay[1] ..... 1.6 µs

Internal Frequency Timebase Characteristics

Frequency ..... 106.25 MHz

Accuracy ..... ±50 ppm

Synchronization

Reference clock source ..... Onboard 106.25 MHz clock, Backplane PXIe_CLK100

Task Resources[2]

Timing engines 4

Buffered mode streams 4

Hardware-timed single point streams 4

Maximum channels per stream 8

[1] When in hardware-timed single point mode, *Total group delay = ADC group delay + Filter group delay*.

[2] The PXIe-4304/4305 can operate four independent timing engines simultaneously. Each timing engine can utilize one or more buffered mode or hardware-timed single point streams, but not both types simultaneously. Refer to the *PXIe-4304/4305 User Manual* for more details about timing engines and DSP streams.

Triggers

Analog trigger

Purpose	Reference trigger only
Source	AI<0..31>
Level	Full scale (depending on input range), programmable
Mode	Rising-edge, Rising-edge with hysteresis, Falling-edge, Falling-edge with hysteresis, Entering Window, Leaving Window
Resolution	24 bits

Digital trigger

Purpose	Start or reference trigger
Source	PFI0, PXI_TRIG <0..7>, PXI_STAR, PXIe_DSTAR <A..B>
Polarity	Software-selectable
Minimum pulse width	100 ns for PXI_TRIG <0..7>, 20 ns for others

Output Timing Signals

Sources	Sample Clock, Start Trigger Out, Reference Trigger Out
Destinations	PFI0, PXI_TRIG <0..7>, PXIe_DSTARC
Polarity	Software-selectable

PFI Characteristics

Input

Logic compatibility	3.3 V to 5 V
High, VIH	2.40 V
Low, VIL	0.95 V
Input impedance	10 KΩ

Output

High, VOH	3.43 V max
Sourcing 5 mA	2.88 V min
Low, VOL sinking 5 mA	0.33 V max
Output impedance	50 Ω
Output current	±5 mA min

Bus Interface

Form factor ..... x1 PXI Express peripheral module, Specification rev 1.0 compliant

Slot compatibility ..... PXI Express or PXI Express hybrid slots

DMA channels ..... 4, analog input

Calibration

You can obtain the calibration certificate and information about calibration services for the PXIe-4304/4305 at ni.com/calibration.

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

Calibration interval ..... 1 year

Power Requirement

+12 V ..... 1.3 A

+3.3 V ..... 1.1 A

Physical Requirements

Dimensions ..... Standard 3U PXIe, 16 cm × 10 cm (6.3 in. × 3.9 in.)

Weight ..... 156 g (5.5 oz)

I/O connector ..... 96-pin male DIN 41612/IEC 60603-2 connector

Caution Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

Environmental Specifications

Maximum altitude ..... 2,000 m (800 mbar)

Pollution Degree 2

Indoor use only.

Operating Environment

Ambient temperature range ..... 0 °C 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 °C 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 Hz to 500 Hz, 0.3 g_{rms}
- Non-operating ..... 5 Hz to 500 Hz, 2.4 g_{rms}

(Tested in accordance with IEC 60068-2-64. Non-operating 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.

Caution The protection provided by the PXIe-4304/4305 can be impaired if it is used in a manner not described in this documents.

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
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

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

CE Compliance CE

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

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; 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 *Minimize Our Environmental Impact* 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 and Electronic Equipment, visit ni.com/environment/weee.

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.)

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377009B-01 May16