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USB-4432

NI USB-443x Specifications

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This document lists specifications for the NI USB-443x devices. The specifications apply to both the NI USB-4431 and NI USB-4432 unless otherwise noted. These specifications are typical at 25 °C unless otherwise stated. All specifications are subject to change without notice. Visit ni.com/manuals for the most current specifications and product documentation.



Caution The inputs of this sensitive test and measurement product are not protected for electromagnetic interference for functional reasons. As a result, this product may experience reduced measurement accuracy or other temporary performance degradation when cables are attached in an environment with electromagnetic interference present. Refer to the Declaration of Conformity (DoC) of this product for details of the standards applied to assess electromagnetic compatibility performance. To obtain the DoC, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.



Caution To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

Analog Input

Input channels	
NI USB-4431	4
NI USB-4432	5
Input connector	1 BNC per channel
PC communication.....	USB 2.0
Power consumption.....	2.5 W max
ADC resolution	24 bits
ADC type	Delta-sigma
Sampling mode	Simultaneous
Sample rates (f_s)	
Range	1 kS/s to 102.4 kS/s
Resolution ¹	≤2.10 mS/s
Internal frequency timebase accuracy	±100 ppm max

¹ Depends on the sample rate. Refer to the *Sample Rate and Update Rate, Accuracy and Coercion* section of the *NI Dynamic Signal Acquisition User Manual* for more information.

Input range

NI USB-4431 ± 10 V_{pk}

NI USB-4432 ± 40 V_{pk}

FIFO buffer size 1,023 samples (shared between all channels)

Input coupling AC or DC, each channel independently software selectable

Input Impedance

Terminal	NI USB-4431 Input Impedance	NI USB-4432 Input Impedance
Between positive input and negative input	200 k Ω 130 pF	800 k Ω 120 pF
Between negative input and chassis ground	1 k Ω	1 k Ω

Absolute Maximum Input Voltage

Input	Voltage (V _{pk}) [*]
Positive terminal (+)	± 60
Negative terminal (-)	± 10

Notes: Voltages above those listed in this table may cause permanent damage to the device.

This is a stress rating only; specifications for the device are only valid when it is operated within its listed input range.

^{*} Voltages with respect to chassis ground.

AI Gain Accuracy (NI USB-4431)

Temperature Range	Amplitude Accuracy (AC at 1 kHz) ^{* †}	Amplitude Accuracy (DC) [*]
10 °C to 40 °C	± 0.025 dB typ	$\pm 0.15\%$ typ
	± 0.032 dB max	$\pm 0.3\%$ max
-30 °C to 70 °C	± 0.052 dB max	$\pm 0.5\%$ max

^{*} For sample rates lower than 40 kS/s, add 0.01 dB of AC error and 0.1% of DC error to both typical and maximum specifications.

[†] Applies to both AC and DC coupling.

AI Gain Accuracy (NI USB-4432)

Temperature Range	Amplitude Accuracy (AC at 1 kHz)*	Amplitude Accuracy (DC)*
10 °C to 40 °C	±0.025 dB typ	±0.25% typ
	±0.035 dB max	±0.35% max
-30 °C to 70 °C	±0.055 dB max	±0.65% max
* For sample rates lower than 40 kS/s, add 0.06 dB of AC error and 0.25% of DC error to both typical and maximum specifications.		

AI interchannel gain mismatch (-30 °C to 70 °C)

NI USB-4431	0.01 dB at 1 kHz
NI USB-4432	0.015 dB at 1 kHz

AI Offset

Temperature Range	NI USB-4431 Offset*	NI USB-4432 Offset*
10 °C to 40 °C	±750 µV typ	±2.6 mV typ
	±2.25 mV max	±7 mV max
-30 °C to 70 °C	±6.25 mV max	±17 mV max
* Source impedance ≤ 1 Ω. Offsets apply for both AC and DC coupling settings.		

AI Frequency Response

AI Amplitude Flatness

Input Signal Frequency (f_{in})	Flatness*
20 Hz to 20 kHz	±0.01 dB typ
	±0.02 dB max
20 Hz to 46.4 kHz	±0.02 dB typ
	±0.05 dB max
* Relative to 1 kHz	

AI phase linearity

$$f_{in} = 20 \text{ Hz to } 20 \text{ kHz} \dots\dots\dots \pm 0.01^\circ$$

$$f_{in} = 20 \text{ Hz to } 46.4 \text{ kHz} \dots\dots\dots \pm 0.05^\circ$$

AI interchannel phase mismatch

$$(f_{in} \geq 100 \text{ Hz}) \dots\dots\dots 0.02^\circ/\text{kHz} \cdot f_{in} \text{ typ, } 0.04^\circ/\text{kHz} \cdot f_{in} \text{ max}$$

$$-3 \text{ dB bandwidth} \dots\dots\dots 0.49 \cdot f_s$$

AC coupling

NI USB-4431

$$-3 \text{ dB cutoff frequency} \dots\dots\dots 0.8 \text{ Hz}$$

$$-0.1 \text{ dB cutoff frequency} \dots\dots\dots 6 \text{ Hz}$$

NI USB-4432

-3 dB cutoff frequency0.1 Hz

-0.1 dB cutoff frequency0.7 Hz

ADC filter delay (nominal).....39 samples

AI Distortion Plus Noise (NI USB-4431)

Input Signal Frequency (f_{in})	THD*	THD+N*
20 Hz to 20 kHz	-99 dB typ	-90 dB typ
	-93 dB max	-84 dB max
20 Hz to 46.4 kHz	-93 dB typ	-86 dB typ
	-87 dB max	-80 dB max
* $V_{in} = 8.9 V_{pk}$		

AI Distortion Plus Noise (NI USB-4432)

Input Signal Frequency (f_{in})	THD*	THD+N*
20 Hz to 20 kHz	-97 dB typ	-92 dB typ
	-91 dB max	-86 dB max
20 Hz to 46.4 kHz	-95 dB typ	-91 dB typ
	-89 dB max	-85 dB max
* $V_{in} = 8.9 V_{pk}$		

AI dynamic range (-60 dBFS, 1 kHz tone; $f_s = 102.4$ kS/s)

NI USB-4431100 dB typ, 98 dB min

NI USB-4432101 dB typ, 99 dB min

AI spurious free dynamic range (SFDR)

(-1 dBFS, 1 kHz tone; $f_s = 102.4$ kS/s).....104 dB

AI non-harmonic SFDR

(-1 dBFS, 1 kHz tone; $f_s = 102.4$ kS/s).....110 dB

AI intermodulation distortion (IMD)

(CCIF 11 kHz + 12 kHz, 1:1, -6 dBFS)-100 dB

AI Noise

Measurement Bandwidth	NI USB-4431 Noise	NI USB-4432 Noise
20 kHz	55 μV_{rms} typ	200 μV_{rms} typ
	75 μV_{rms} max	240 μV_{rms} max
46.4 kHz	75 μV_{rms} typ	250 μV_{rms} typ
	100 μV_{rms} max	300 μV_{rms} max

AI Common-Mode Rejection Ratio (CMRR)

AI CMRR ($f_{in} = 20 \text{ Hz to } 1 \text{ kHz}$)

NI USB-443155 dB

NI USB-443245 dB

AI Crosstalk

f_{in}	NI USB-4431*	NI USB-4432*
1 kHz	-110 dB	-105 dB
46.4 kHz	-90 dB	-80 dB
* Source impedance $\leq 50 \Omega$		

IEPE Excitation

Channels.....AI0, AI1, AI2, AI3

Current0 or 2.1 mA, each channel independently software selectable

Compliance voltage20 V min

Output impedance200 k Ω at 1 kHz

Current noise density25 pA/ $\sqrt{\text{Hz}}$ at 10 kHz

Fault detection

Thresholds.....<1.5 V (short),
>19.5 V (open)

IndicationSoftware, per channel

Transducer Electronic Data Sheet (TEDS) Support

Analog inputs AI<0..3> support Transducer Electronic Data Sheet (TEDS) according to the IEEE 1451 Standard.

For more information about TEDS, go to ni.com/info and enter the Info Code `rdteds`.

Maximum cable length 100 ft

Tachometer Inputs

You can use any analog input channel as a tachometer input.

Analog Output (NI USB-4431)

Output channels 1

AO signal connection.....BNC

AO frequency rangeDC to 43.5 kHz

Internal frequency timebase accuracy..... ± 100 ppm max

DAC resolution 24 bits

DAC typeDelta-sigma

Output signal range..... $\pm 3.5 \text{ V}_{pk}$

Output coupling	DC
Short circuit protection	Indefinite
Minimum working load	1 k Ω
Output impedance	50 Ω
DAC filter delay ¹	63.3 samples max
FIFO buffer size	4,095 samples

AO Update Rates

Available rates are expressed by the following equation:

$$f_M/n$$

where

$$f_M = \{51.2 \text{ kS/s}, 80 \text{ kS/s}, 96 \text{ kS/s}\}, \text{ and}$$

$$n = \{1, 2, 4, 8, 16, 32, 64\}$$

<i>n</i>	51.2 kS/s	80 kS/s	96 kS/s
1	51.2 kS/s	80 kS/s	96 kS/s
2	25.6 kS/s	40 kS/s	48 kS/s
4	12.8 kS/s	20 kS/s	24 kS/s
8	6.4 kS/s	10 kS/s	12 kS/s
16	3.2 kS/s	5 kS/s	6 kS/s
32	1.6 kS/s	2.5 kS/s	3 kS/s
64	800 S/s	1.25 kS/s	1.5 kS/s

AO Gain Accuracy

Temperature Range	Amplitude Accuracy (AC at 1 kHz)	Amplitude Accuracy (DC)
10 °C to 40 °C	±0.025 dB typ	±0.2% typ
	±0.045 dB max	±0.4% max
-30 °C to 70 °C	±0.1 dB max	±1.1% max

AO Offset

Temperature Range	Offset (DC)
10 °C to 40 °C	±700 μ V typ
	±2 mV max
-30 °C to 70 °C	±6.5 mV max

¹ Refer to the *Filter Delay* section of the *NI Dynamic Signal Acquisition User Manual* for more information.

AO Frequency Response

AO phase linearity

$$f_{out} = \text{DC to 20 kHz} \dots\dots\dots \pm 0.25^\circ$$

$$f_{out} = \text{DC to 43.5 kHz} \dots\dots\dots \pm 2.5^\circ$$

AO Amplitude Flatness

Output Signal Frequency (f_{out})	Flatness*
DC to 20 kHz	±0.05 dB typ
	±0.09 dB max
DC to 43.5 kHz	±0.3 dB typ
	±0.4 dB max
* Relative to 1 kHz	

AO Distortion and Noise



Note Specifications for the listed update rates also apply to their respective derivative rates as listed in the [AO Update Rates](#) section.

AO Distortion

Update Rate*	THD [†] (1 kHz)	THD [†] (20 Hz to 20 kHz)
51.2 kS/s	-100 dB typ	-89 dB max
80 kS/s	-97 dB typ	-86 dB max
96 kS/s	-95 dB typ	-85 dB max

Note: The measurement bandwidth is 0 Hz to $0.453 \times$ the Update Rate.

* Refer to the note under the *AO Distortion and Noise* section for applicability to other update rates.

$$^\dagger V_{out} = 3.1 V_{pk}$$

AO Distortion Plus Noise

Update Rate*	THD+N [†] (1 kHz)	THD+N [†] (20 Hz to 20 kHz)
51.2 kS/s	-92 dB typ	-86 dB max
80 kS/s	-91 dB typ	-84 dB max
96 kS/s	-90 dB typ	-82 dB max

Note: The measurement bandwidth is 0 Hz to $0.453 \times$ the Update Rate.

* Refer to the note under the *AO Distortion and Noise* section for applicability to other update rates.

$$^\dagger V_{out} = 3.1 V_{pk}$$

AO Noise

Update Rate*	Noise
51.2 kS/s	90 μV_{rms} typ
	120 μV_{rms} max
80 kS/s	100 μV_{rms} typ
	150 μV_{rms} max
96 kS/s	120 μV_{rms} typ
	200 μV_{rms} max

Note: The measurement bandwidth is 0 Hz to $0.453 \times$ the Update Rate.

* Refer to the note under the *AO Distortion and Noise* section for applicability to other update rates.

AO Spurious Free Dynamic Range (Includes Harmonics)

Update Rate*	SFDR (-1 dBFS, 1 kHz)
51.2 kS/s	102 dB
80 kS/s	98 dB
96 kS/s	96 dB

Note: The measurement bandwidth is 0 Hz to $0.453 \times$ the Update Rate.

* Refer to the note under the *AO Distortion and Noise* section for applicability to other update rates.

AO Dynamic Range

Update Rate*	Dynamic Range [†]
51.2 kS/s	89 dB typ
	86 dB min
80 kS/s	88 dB typ
	84 dB min
96 kS/s	86 dB typ
	82 dB min

Note: The measurement bandwidth is 0 Hz to $0.453 \times$ the Update Rate.

* Refer to the note under the *AO Distortion and Noise* section for applicability to other update rates.

[†] $V_{\text{out}} = -60$ dBFS, 1 kHz

AO intermodulation distortion
(CCIF 11 kHz + 12 kHz, 1:1, -6 dBFS)-96 dB

AO Transients

The following actions will result in a transient on the analog output:

- Powering up the NI USB-4431
- Changing between AO rates in different columns of the table in the *AO Update Rates* section
- Changing the AI sample rate

Digital I/O Lines

Power-up mode	Inputs pulled low
Input protection.....	+5.6 V/-0.5 V
Purpose.....	Start or reference trigger (importing only)
Source	PFI<0..7>
Compatibility	Transistor-transistor logic (5V TTL)
Polarity.....	Rising or falling edge

Environment Specifications

Pollution degree	2
Maximum altitude.....	2,000 m
Indoor use only.	

Operating Environment

Operating temperature	-30 °C to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
Relative humidity range	0% to 95% RH, non-condensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range	-30 °C to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
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Calibration

External calibration interval.....	1 year
Warm-up time	15 minutes to rated specifications

General Specifications

Physical

Dimensions	142 mm × 180 mm × 38 mm (5.6 in. × 7.1 in. × 1.5 in.)
Weight	675 g (1.5 lbs)

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 61326-2-1 (IEC 61326-2-1): 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



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

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 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.

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