COMPREHENSIVE SERVICES

We offer competitive repair and calibration services, as well as easily accessible documentation and free downloadable resources.

SELL YOUR SURPLUS

We buy new, used, decommissioned, and surplus parts from every NI series. We work out the best solution to suit your individual needs.

Sell For Cash Get Credit Receive a Trade-In Deal

OBSOLETE NI HARDWARE IN STOCK & READY TO SHIP

We stock **New, New Surplus, Refurbished,** and **Reconditioned** NI Hardware.

APEX WAVES

Bridging the gap *between the manufacturer and your legacy test system.*

1-800-915-6216

www.apexwaves.com

sales@apexwaves.com

All trademarks, brands, and brand names are the property of their respective owners.

Request a Quote CLICK HERE *USB-4431*

NI USB-443*x* Specifications

Français	Deutsch	日本語	한국어	简体中文

ni.com/manuals

This document lists specifications for the NI USB-443*x* 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.

NATIONAL INSTRUMENTS

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 kΩ ‖ 130 pF	800 kΩ ‖ 120 pF
Between negative input and chassis ground	1 kΩ	1 kΩ

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	±0.15% typ
	±0.032 dB max	±0.3% max
–30 °C to 70 °C	±0.052 dB max	±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 Hz to 20 kHz .....±0.01°
f_{in} = 20 Hz to 46.4 kHz .....±0.05°

AI interchannel phase mismatch

(f_{in} ≥100 Hz).....0.02°/kHz · f_{in} typ, 0.04°/kHz · f_{in} max

–3 dB bandwidth.....0.49 · f_s

AC coupling

NI USB-4431

–3 dB cutoff frequency .....0.8 Hz
–0.1 dB cutoff frequency .....6 Hz

NI USB-4432

–3 dB cutoff frequency .....0.1 Hz

–0.1 dB cutoff frequency .....0.7 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-4431 .....100 dB typ, 98 dB min

NI USB-4432 .....101 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 Hz to 1 kHz)

NI USB-4431 .....55 dB

NI USB-4432 .....45 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 ≤50 Ω		

IEPE Excitation

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

Current .....0 or 2.1 mA, each channel independently software selectable

Compliance voltage .....20 V min

Output impedance .....200 kΩ at 1 kHz

Current noise density .....25 pA/$\sqrt{\text{Hz}}$ at 10 kHz

Fault detection

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

Indication .....Software, 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 range .....DC to 43.5 kHz

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

DAC resolution .....24 bits

DAC type .....Delta-sigma

Output signal range.....±3.5 V_{pk}

Output coupling .....DC

Short circuit protection .....Indefinite

Minimum working load .....1 kΩ

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 kS/s, 80 kS/s, 96 kS/s}, and

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

n	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 µV 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} = DC to 20 kHz .....±0.25°

f_{out} = DC to 43.5 kHz .....±2.5°

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 × the Update Rate.

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

† 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 × the Update Rate.

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

† 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 × 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 × 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 × the Update Rate.

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

† V_{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.)

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 generates 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:

- 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`.

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`.)

LabVIEW, National Instruments, NI, ni.com, the National Instruments corporate logo, and the Eagle logo are trademarks of National Instruments Corporation. Refer to the *Trademark Information* at `ni.com/trademarks` for other National Instruments trademarks. Other product and company names mentioned herein are trademarks or trade names of their respective companies. For patents covering National Instruments products/technology, refer to the appropriate location: **Help»Patents** in your software, the `patents.txt` file on your media, or the *National Instruments Patent Notice* at `ni.com/patents`. Refer to the *Export Compliance Information* at `ni.com/legal/export-compliance` for the National Instruments global trade compliance policy and how to obtain relevant HTS codes, ECCNs, and other import/export data.

© 2008–2011 National Instruments Corporation. All rights reserved.

372485E-01 Oct11