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**USB-6009**

## SPECIFICATIONS

# USB-6009

8 AI (14-Bit, 48 kS/s), 2 AO (150 Hz), 13 DIO USB Multifunction I/O Device

## Definitions

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

The following characteristic specifications 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.

## Conditions

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Specifications are valid at 25 °C unless otherwise noted.

## Analog Input

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Analog inputs

Differential	4
Single-ended	8, software-selectable
Input resolution	
Differential	14 bits
Single-ended	13 bits
Maximum sample rate (aggregate)	48 kS/s, system dependent
Converter type	Successive approximation
AI FIFO	512 bytes
Timing resolution	41.67 ns (24 MHz timebase)

Timing accuracy	100 ppm of actual sample rate
Input range	
Differential	$\pm 20\text{ V}^1$ , $\pm 10\text{ V}$ , $\pm 5\text{ V}$ , $\pm 4\text{ V}$ , $\pm 2.5\text{ V}$ , $\pm 2\text{ V}$ , $\pm 1.25\text{ V}$ , $\pm 1\text{ V}$
Single-ended	$\pm 10\text{ V}$
Working voltage	$\pm 10\text{ V}$
Input impedance	144 k $\Omega$
Overvoltage protection	$\pm 35\text{ V}$
Trigger source	Software or external digital trigger
System noise <sup>2</sup>	
Differential	
$\pm 20\text{ V}$ range	5 mV <sub>rms</sub>
$\pm 1\text{ V}$ range	0.5 mV <sub>rms</sub>
Single-ended, $\pm 10\text{ V}$ range	5 mV <sub>rms</sub>

**Table 1. Absolute Accuracy at Full Scale, Differential**

Range (V)	Typical at 25 °C (mV)	Maximum over Temperature (mV)
$\pm 20$	14.7	138
$\pm 10$	7.73	84.8
$\pm 5$	4.28	58.4
$\pm 4$	3.59	53.1
$\pm 2.5$	2.56	45.1
$\pm 2$	2.21	42.5
$\pm 1.25$	1.70	38.9
$\pm 1$	1.53	37.5



**Note** Input voltages may not exceed the working voltage range.

<sup>1</sup>  $\pm 20\text{ V}$  means that  $|AI^+ - (AI^-)| \leq 20\text{ V}$ . However,  $AI^+$  and  $AI^-$  must both be within  $\pm 10\text{ V}$  of GND. Refer to the *Taking Differential Measurements* section of the *NI USB-6008/6009 User Guide* for more information.

<sup>2</sup> System noise measured at maximum sample rate.

**Table 2. Absolute Accuracy at Full Scale, Single-Ended**

Range (V)	Typical at 25 °C (mV)	Maximum over Temperature (mV)
±10	14.7	138

## Analog Output

Analog outputs	2
Output resolution	12 bits
Maximum update rate	150 Hz, software-timed
Output range	0 V to +5 V
Output impedance	50 Ω
Output current drive	5 mA
Power-on state	0 V
Slew rate	1 V/μs
Short circuit current	50 mA
Absolute accuracy (no load)	
Typical	7 mV
Maximum at full scale	36.4 mV

## Digital I/O

Digital I/O lines	
P0.<0..7>	8 lines
P1.<0..3>	4 lines
Direction control	Each channel individually programmable as input or output
Output driver type <sup>3</sup>	Each channel individually programmable as open collector or active drive
Compatibility	TTL, LVTTTL, CMOS
Absolute maximum voltage range	-0.5 V to 5.8 V with respect to GND

<sup>3</sup> This document uses NI-DAQmx naming conventions. Open-drain is called open collector and push-pull is called active drive.

Pull-up resistor 4.7 kΩ to 5 V

Power-on state Input

**Table 3.** Digital Logic Levels

Level	Minimum	Maximum
Input low voltage	-0.3 V	0.8 V
Input high voltage	2.0 V	5.8 V
Input leakage current	—	50 μA
Output low voltage (I = 8.5 mA)	—	0.8 V
Output high voltage, active drive (I = -8.5 mA)	2.0 V	3.5 V
Output high voltage, open collector (I = -0.6 mA, nominal)	2.0 V	5.0 V
Output high voltage, open collector (I = -8.5 mA, with external pull-up resistor)	2.0 V	—

## External Voltage

+5 V output (200 mA maximum)

Minimum +4.85 V

Typical +5 V

+2.5 V output (1 mA maximum) +2.5 V

+2.5 V accuracy 0.25% maximum

Reference temperature drift 50 ppm/°C maximum

## Event Counter

Number of counters 1

Resolution 32 bits

Counter measurements Edge counting (falling-edge)

Counter direction Count up

Pull-up resistor 4.7 kΩ to 5 V

Maximum input frequency 5 MHz

Minimum high pulse width 100 ns

Minimum low pulse width 100 ns

Input high voltage	2.0 V
Input low voltage	0.8 V

## Bus Interface

USB specification	USB 2.0 full-speed (12 Mb/s)
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## Power Requirements

USB, 4.10 VDC to 5.25 VDC

Typical	80 mA
Maximum	500 mA
USB suspend	
Typical	300 $\mu$ A
Maximum	500 $\mu$ A

## Physical Characteristics

Dimensions

Without connectors	63.5 mm $\times$ 85.1 mm $\times$ 23.2 mm (2.50 in. $\times$ 3.35 in. $\times$ 0.91 in.)
With connectors	81.8 mm $\times$ 85.1 mm $\times$ 23.2 mm (3.22 in. $\times$ 3.35 in. $\times$ 0.91 in.)

Weight

Without connectors	54 g (1.9 oz)
With connectors	84 g (3 oz)

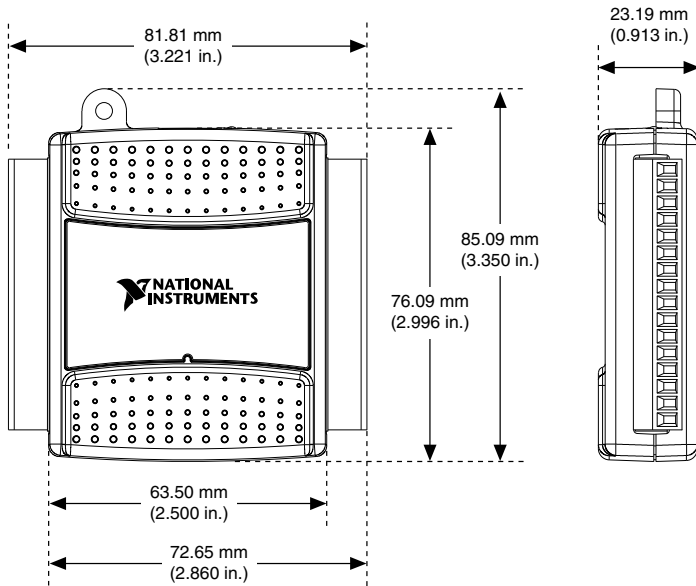
USB connector	USB series B receptacle (1)
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I/O connectors

Type	16-position screw terminal plugs (2)
Screw-terminal wiring	16 AWG to 28 AWG
Torque for screw terminals	0.22 N $\cdot$ m to 0.25 N $\cdot$ m (2.0 lb $\cdot$ in. to 2.2 lb $\cdot$ in.)

If you need to clean the module, wipe it with a dry towel.

**Figure 1. USB-6009 Dimensions**



## Safety Voltages

Connect only voltages that are within these limits.

Channel-to-GND  $\pm 30$  V max, Measurement Category I

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



**Caution** Do not use this module for connection to signals or for measurements within Measurement Categories II, III, or IV



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

# Environmental

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## Temperature (IEC 60068-2-1 and IEC 60068-2-2)

Operating	0 °C to 55 °C
Storage	-40 °C to 85 °C

## Humidity (IEC 60068-2-56)

Operating	5% RH to 95% RH, noncondensing
Storage	5% RH to 90% RH, noncondensing

## Pollution Degree (IEC 60664)

2

## Maximum altitude

2,000 m

Indoor use only.

# Safety

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This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1



**Note** For UL and other safety certifications, refer to the product label or the [Online Product Certification](#) section.

# Electromagnetic Compatibility

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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

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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

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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](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## Environmental Management

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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](http://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** This symbol indicates that waste products should be disposed of separately from municipal household waste according to WEEE Directive 2002/96/EC of the European Parliament and the Council on waste electrical and electronic equipment (WEEE). All products at the end of their life cycle must be sent to a WEEE collection and recycling center. Proper WEEE disposal reduces environmental impact and the risk to human health due to potentially hazardous substances used in such equipment. Your cooperation in proper WEEE disposal will contribute to the effective usage of natural resources. For information about the available collection and recycling scheme in a particular country, go to [ni.com/environment/weee](http://ni.com/environment/weee).

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