

# USER GUIDE AND SPECIFICATIONS

# USB-9201/9221

## 8-Channel, 12-Bit Analog Input Devices

このドキュメントの日本語版については、[ni.com/jp/manuals](http://ni.com/jp/manuals)を参照してください。(For a Japanese language version, go to [ni.com/jp/manuals](http://ni.com/jp/manuals).)

This user guide describes how to use the National Instruments USB-9201/9221 devices and lists the specifications.

## Introduction

This user guide describes how to use the National Instruments USB-9201/9221. In this document, the USB-9201/9221 with screw terminal and USB-9201/9221 with DSUB are referred to inclusively as the USB-9201/9221. For information about installing, configuring, and programming your system, refer to your system documentation.

The USB-9210/9221 data acquisition device provides a USB interface for eight channels of 12-bit analog inputs with integrated signal conditioning. The USB-9201/9221 consists of two components: an NI 9201/9221 module and a USB-9162 carrier, as shown in Figure 1.

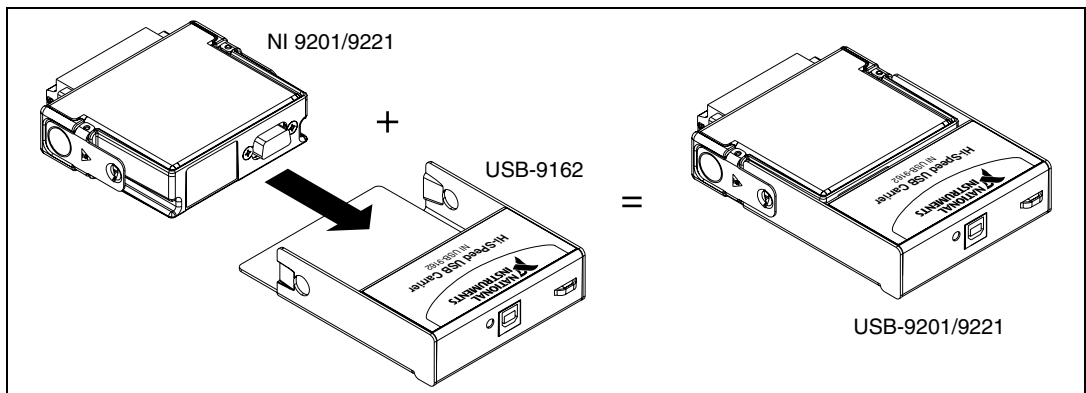
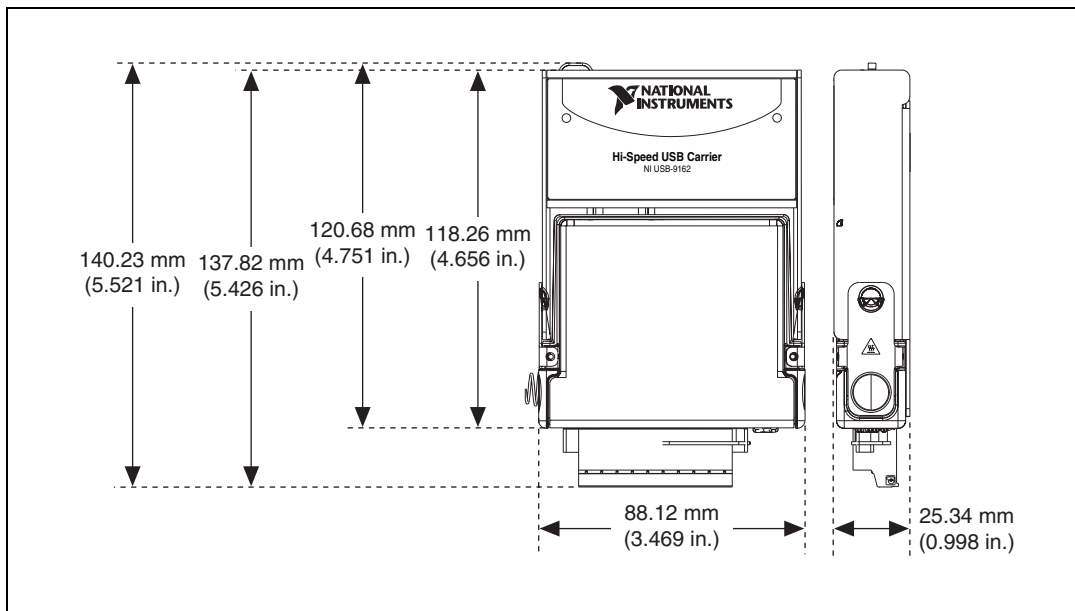


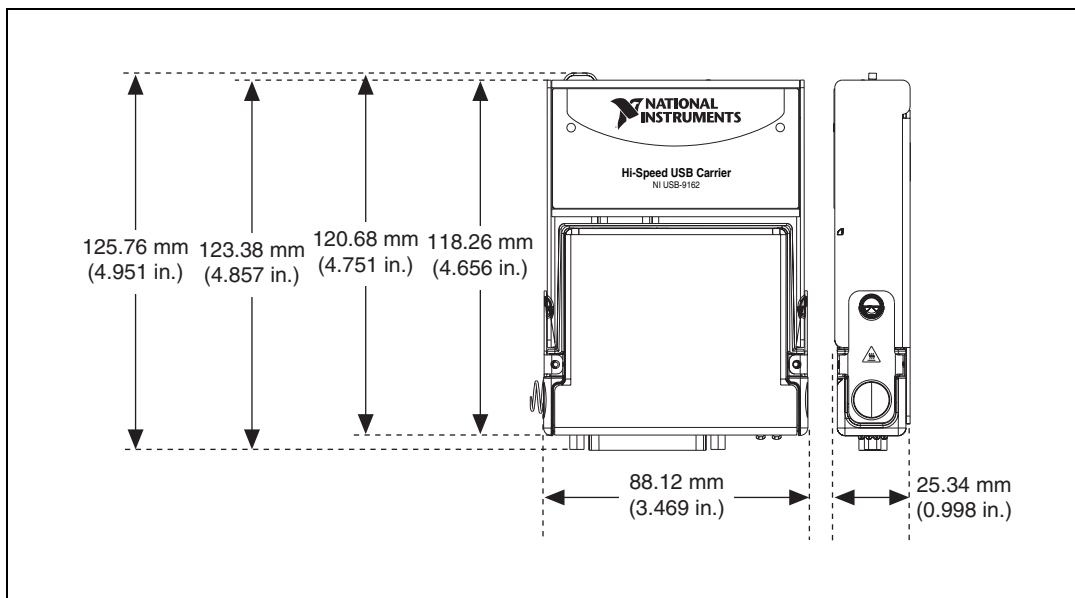
Figure 1. USB-9201/9221 Components

# Dimensions

Figures 2 and 3 show the USB-9201/9221 device dimensions.



**Figure 2.** USB-9201/9221 Devices in Inches (Millimeters)



**Figure 3.** USB-9201/9221 (DSUB) Devices in Inches (Millimeters)

# Safety Guidelines

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Operate the USB-9201/9221 only as described in these operating instructions.



**Caution** Although the NI 9201/9221 might have more stringent certification standards than the USB-9201/9221, when used with the USB-9162 carrier, the combined system might be limited. Refer to the *Specifications* section for more information.



**Hot Surface** This icon denotes that the component may be hot. Touching this component may result in bodily injury.



**Caution** Do *not* disconnect I/O-side wires or connectors unless power has been switched off or the area is known to be nonhazardous.



**Caution** Do *not* remove modules unless power has been switched off and the area is known to be nonhazardous.



**Caution** The USB-9201/9221 is *not* certified for use in hazardous locations.

## Safety Guidelines for Hazardous Voltages

You can connect hazardous voltages to the USB-9201/9221 with the screw terminal only. Do *not* connect hazardous voltages to the USB-9201/9221 with DSUB.

If *hazardous voltages* are connected to the module, take the following precautions. A hazardous voltage is a voltage  $>42.4 V_{pk}$  or 60 VDC to earth ground.



**Caution** Ensure that hazardous voltage wiring is performed only by qualified personnel adhering to local electrical standards.



**Caution** Do *not* mix hazardous voltage circuits and human-accessible circuits on the same module.



**Caution** Make sure that devices and circuits connected to the module are properly insulated from human contact



**Caution** When module terminals are live with hazardous voltages, make sure that the terminals are *not* accessible by using the high voltage screw terminal backshell. Refer to the *Assembling the High Voltage Screw Terminal Backshell* section for more information.

# Software

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Software support for the USB-9201/9221 is provided by NI-DAQmx.

The NI-DAQmx CD contains example programs that you can use to get started programming with the USB-9201/9221. Refer to the *NI-DAQmx for USB Devices Getting Started Guide* that shipped with your device, and is also accessible from **Start»All Programs»National Instruments»NI-DAQ**, for more information.

## Installing the USB-9201/9221

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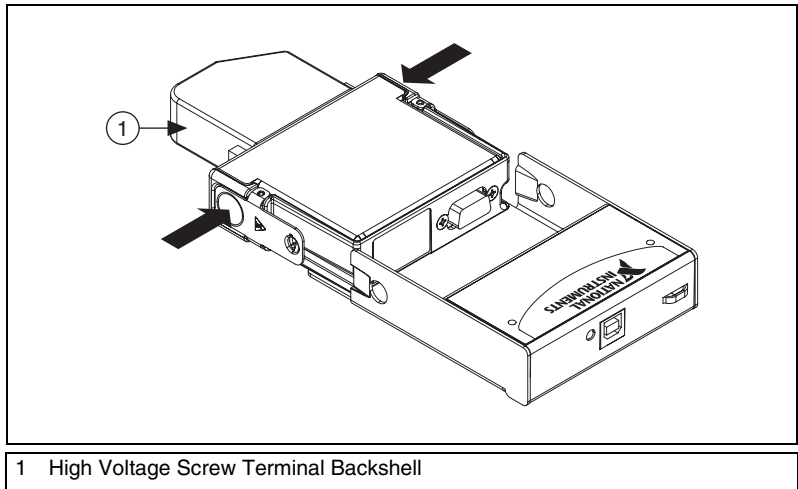
### Installing the Software

Before installing the device, you must install the software you plan to use with the device. Refer to the *Software* section of this guide and the *NI-DAQmx for USB Devices Getting Started Guide* that shipped with your device, and is also accessible from **Start»All Programs»National Instruments»NI-DAQ**, for more information.

### Installing the NI 9201/9221 in the USB-9162 Carrier

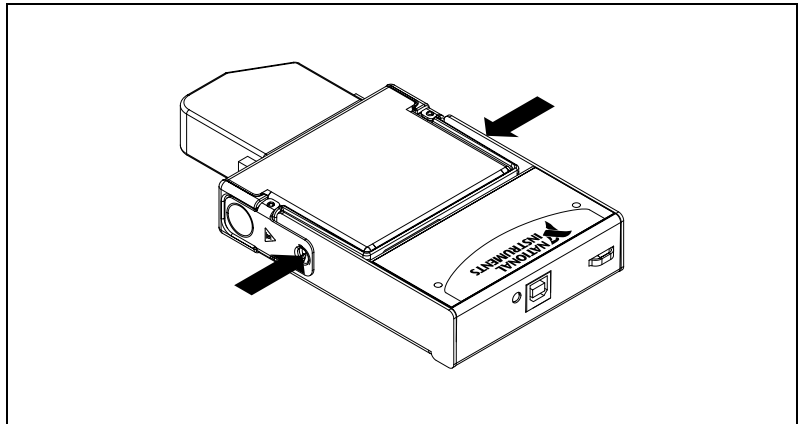
The NI 9201/9221 module and the USB-9162 carrier are packaged separately. Refer to Figure 2, while completing the following assembly steps:

1. Make sure that no signals are connected to the NI 9201/9221 module and that the USB cable is not connected to the device.
2. Remove the protective cover from the 15-pin DSUB connector.
3. Align the I/O module with the carrier, as shown in Figure 4.



**Figure 4.** Module Installation

4. Squeeze the latches and insert the NI 9201/9221 module into the USB-9162 carrier.
5. Press firmly on the connector side of the NI 9201/9221 module until the latches lock the module into place, as shown in Figure 5.



**Figure 5.** Locking Module into Place

6. Connect the USB cable to the assembled USB-9201/9221.

## Mounting the USB-9201/9221 to a Panel

Threaded inserts are located in the USB-9201/9221 for mounting it to a panel. Refer to Figure 6 for dimensions.

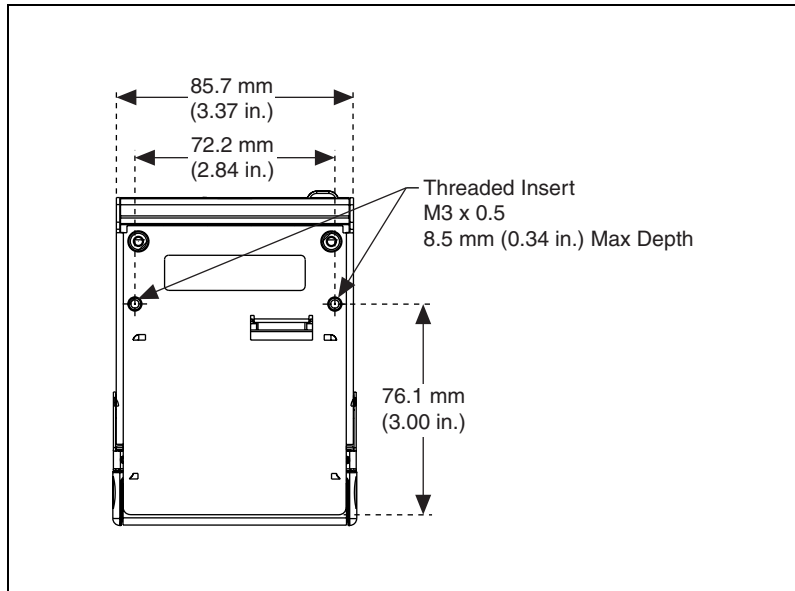


Figure 6. Module Dimensions

## Connecting the USB-9201/9221 to a Computer

Plug one end of the USB cable into the USB-9201/9221 and the other end into an available USB port on the computer. Refer to the *NI-DAQmx for USB Devices Getting Started Guide* that shipped with your device, and is also accessible from **Start»All Programs»National Instruments»NI-DAQ**, for more information.

## LED Indicator

The LED indicator indicates device status.

Table 1. LED State/Device Status

LED State	Device Status
Not lit	Device not connected or in suspend.
On, not blinking	Device connected, but no module installed.
Single-blink	Operating normally.

**Table 1.** LED State/Device Status (Continued)

LED State	Device Status
Double-blink	Connected to USB full speed port. Device performance might be affected. Refer to the <a href="#">Specifications</a> section for more information.
Quadruple-blink	Device error. Refer to <a href="http://ni.com/support">ni.com/support</a> .

## Wiring the USB-9201/9221

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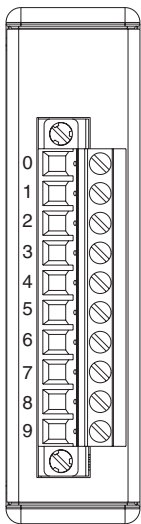
The USB-9201/9221 provides connections for eight analog input channels. The USB-9201/9221 with screw terminal has a 10-terminal, detachable high voltage screw-terminal backshell. The USB-9201/9221 with DSUB has a 25-pin DSUB connector.

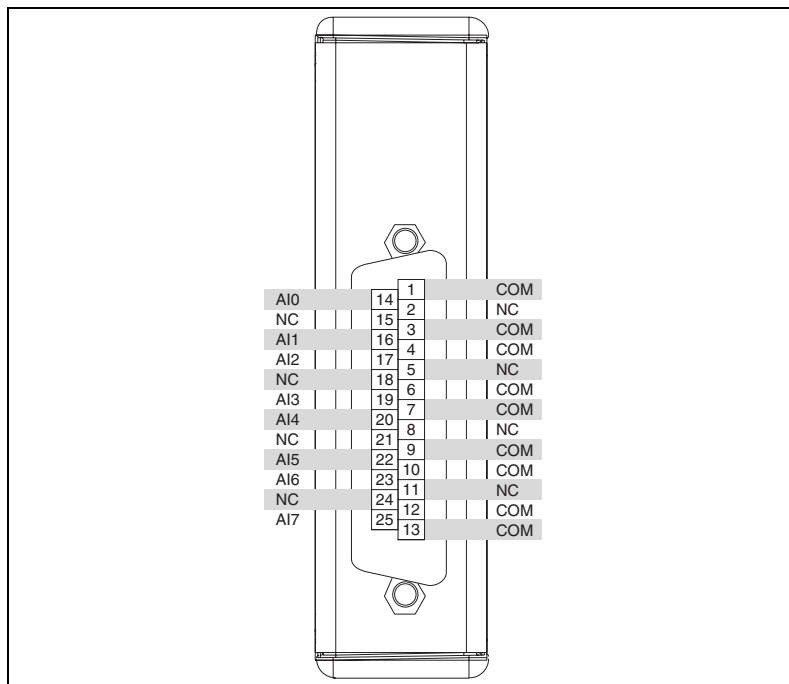
Each channel has a terminal or pin, AI, to which you can connect a voltage signal. The USB-9201/9221 also has a common terminal or pin, COM, that is internally connected to the isolated ground reference of the module. Refer to Table 2 for the terminal assignments of the USB-9201/9221 with screw terminal. Refer to Figure 7 for the pin assignments of the USB-9201/9221 with DSUB.



**Caution** The high voltage screw terminal backshell must be installed when using hazardous voltages ( $>42.4 V_{pk}$ , 60 VDC).

**Table 2.** Terminal Assignments

Module	Terminal	Signal
	0	AI 0
	1	AI 1
	2	AI 2
	3	AI 3
	4	AI 4
	5	AI 5
	6	AI 6
	7	AI 7
	8	No connection
	9	Common (COM)



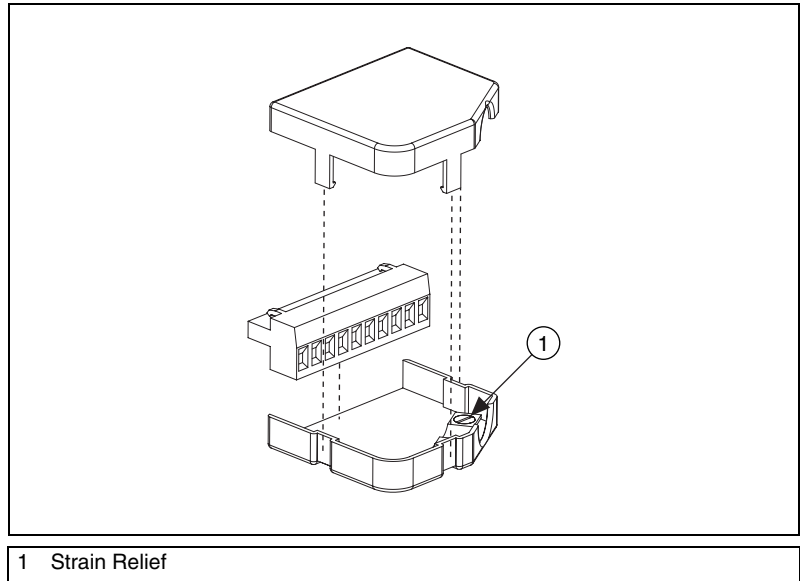
**Figure 7.** Pin Assignments



## Assembling the High Voltage Screw Terminal Backshell

The high voltage screw terminal backshell must be installed when using hazardous voltages ( $>42.4 V_{pk}$ , 60 VDC). Refer to Figure 8 while completing the following steps:

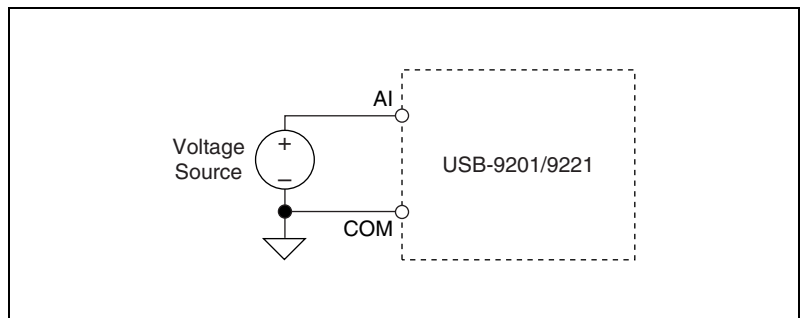
1. Connect the leads to the screw terminal and secure with the strain relief.
2. Finish by snapping the backshell around the connector.



**Figure 8.** High Voltage Screw Terminal Backshell

## Connecting Single-Ended Voltage Signals to the USB-9201/9221

You can connect single-ended voltage signals to the USB-9201/9221. Connect the positive lead of the voltage signal to AI. Connect the ground signal to COM.

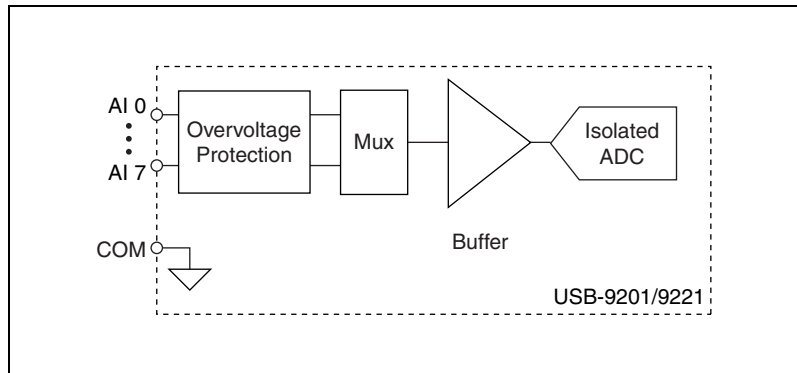


**Figure 9.** Connecting a Single-Ended Voltage Signal to the USB-9201/9221

Refer to your software documentation, accessible from **Start» All Programs»National Instruments»NI-DAQ**, for information about different methods of reading USB-9201/9221 data.

## USB-9201/9221 Circuitry

The USB-9201/9221 channels are isolated, and the device protects each channel from overvoltages. The input signals are scanned, buffered, conditioned, and then sampled by a single 12-bit ADC. For more information about overvoltage protection, refer to the *Specifications* section.



**Figure 10.** Input Circuitry for One Channel

## Specifications

The following specifications are typical for the range 0 to 60 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

### Input Characteristics

Number of channels.....	8
ADC resolution.....	12 bits
Type of ADC .....	Successive approximation register (SAR)

Sample rate (aggregate)<sup>1</sup>

USB-9201

Single channel..... 800 kS/s max

Scanning ..... 500 kS/s

USB-9221 ..... 800 kS/s max

Operating voltage ranges<sup>2</sup>

USB-9201 ..... ±10 V (not software selectable)

USB-9221 ..... ±60 V (not software selectable)

Maximum voltage, (AI or COM to earth ground, verified by a dielectric withstand test)

Screw terminal ..... 250 V<sub>rms</sub>

DSUB ..... ±60 VDC

Isolation voltage (AI or COM to earth ground, verified by a dielectric withstand test)

Screw terminal ..... 2,300 V<sub>rms</sub>

DSUB ..... 1,000 V<sub>rms</sub>

Overvoltage protection

(AI to COM)..... ±100 V

Accuracy<sup>3</sup>

<b>Error</b>	<b>Percent of Reading</b>	<b>Percent of Range*</b>
USB-9201		
Calibrated typ (25 °C, ±5 °C)	±0.04%	±0.07%
Calibrated max (0 to 60 °C)	±0.25%	±0.25%
Uncalibrated typ (25 °C, ±5 °C)	±0.26%	±0.46%
Uncalibrated max (0 to 60 °C)	±0.67%	±1.25%
USB-9221		
Calibrated typ (25 °C, ±5 °C)	±0.04%	±0.07%
Calibrated max (0 to 60 °C)	±0.25%	±0.25%

<sup>1</sup> Full performance requires the use of a USB 2.0 high-speed host controller and USB 2.0 hubs.

<sup>2</sup> Refer to the [Safety](#) section for details about safe operating voltages.

<sup>3</sup> Excludes noise.

<b>Error</b>	<b>Percent of Reading</b>	<b>Percent of Range*</b>
Uncalibrated typ (25 °C, ±5 °C)	±0.26%	±0.43%
Uncalibrated max (0 to 60 °C)	±0.67%	±1.06%
* Range equals 10.53 V for the USB-9201, 62.50 V for the USB-9221.		

### Stability

#### Offset drift

USB-9201 .....±100 µV/°C

USB-9221 .....±580 µV/°C

Gain drift .....±34 ppm/°C

### Input bandwidth (–3 dB)

USB-9201 .....690 kHz min

USB-9221 .....950 kHz min

### Input impedance

Resistance .....1 MΩ

Capacitance.....5 pF

### Input noise (code-centered)

RMS.....0.7 LSB<sub>rms</sub>

Peak-to-peak .....5 LSB

No missing codes .....12 bits

DNL .....–0.9 to 1.5 LSB

INL.....±1.5 LSB

Crosstalk .....–75 dB, 10 kHz

### Settling time (to 1 LSB)

USB-9201 .....2 µs

USB-9221 .....1.25 µs

## Power Requirements

Power consumption from USB .....500 mA, max

Suspend mode.....2.5 mA, max

## Bus Interface

USB specification .....USB 2.0 high speed

## Physical Characteristics

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

### Dimensions

With combicon..... 14.0 cm × 8.8 cm × 2.5 cm  
..... (5.52 in. × 3.47 in. × 1.00 in.)

25-pin DSUB ..... 12.6 cm × 8.8 cm × 2.5 cm  
..... (4.95 in. × 3.47 in. × 1.00 in.)

Screw-terminal wiring..... 12 to 24 AWG copper conductor  
wire with 10 mm (0.39 in.) of  
insulation stripped from the end

Torque for screw terminals ..... 0.5 – 0.6 N · m (4.4 – 5.3 lb · in.)

### Weight

USB-9201/9221 with combicon ..... Approx. 250 g (8.8 oz)

USB-9201/9221 with DSUB ..... Approx. 245 g (8.6 oz)

## Safety

### Maximum Voltage

Connect only voltages that are within these limits.

AI to COM ..... ±60 VDC

### Isolation Voltages for USB-9201/9221 with Screw Terminals

Channel-to-channel isolation ..... None

Channel-to-earth ground isolation

Continuous ..... 250 V<sub>rms</sub>, Measurement  
Category II

Withstand ..... 2,300 V<sub>rms</sub>, verified by a  
dielectric withstand test

Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (for example, 115 V for U.S. or 230 V for Europe). Do *not* use this module with Measurement Category III or IV voltages.

# Isolation Voltages for USB-9201/9221 with DSUB

Channel-to-channel.....None

Channel-to-earth ground

Continuous.....60 VDC, Measurement  
Category I

Withstand.....1,000 V<sub>rms</sub>, verified by a  
dielectric withstand test

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. *Do not* use this module with Measurement Category II, III, or IV voltages.

## Safety Standards

The USB-9201/9221 is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

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



**Note** For UL and other safety certifications, refer to the product label, or visit [ni.com/certification](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## Hazardous Locations

The USB-9201/9221 is *not* certified for use in hazardous locations.

## Environmental

The USB-9201/9221 is intended for indoor use only.

Operating temperature  
(IEC 60068-2-1, IEC 60068-2-2) .....0 to 60 °C

Storage temperature  
(IEC 60068-2-1, IEC 60068-2-2) .....-40 to 85 °C

Operating humidity (IEC 60068-2-56).....	10 to 90% RH, noncondensing
Storage humidity (IEC 60068-2-56).....	5 to 95% RH, noncondensing
Maximum altitude .....	2,000 m
Pollution Degree (IEC 60664) .....	2

## Electromagnetic Compatibility

Emissions .....	EN 55011 Class A at 10 m FCC Part 15A above 1 GHz
Immunity .....	Industrial levels per EN 61326-1:1997 + A2:2001, Table A.1
EMC/EMI.....	CE, C-Tick, and FCC Part 15 (Class A) Compliant



**Note** For EMC compliance, operate this device with shielded cabling.

## CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety) ..... 73/23/EEC

Electromagnetic Compatibility  
Directive (EMC) ..... 89/336/EEC



**Note** Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain 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.

## Calibration

You can obtain the calibration certificate for the USB-9201/9221 at [ni.com/calibration](http://ni.com/calibration).

Calibration interval ..... 1 year

# Where to Go for Support

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The National Instruments Web site is your complete resource for technical support. At [ni.com/support](http://ni.com/support) you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504. National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at [ni.com/support](http://ni.com/support) and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

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Netherlands 31 0 348 433 466, New Zealand 0800 553 322,  
Norway 47 0 66 90 76 60, Poland 48 22 3390150,  
Portugal 351 210 311 210, Russia 7 495 783 68 51,  
Singapore 1800 226 5886, Slovenia 386 3 425 42 00,  
South Africa 27 0 11 805 8197, Spain 34 91 640 0085,  
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