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**USB-9162**

# USER GUIDE AND SPECIFICATIONS

# NI 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/manuals](http://ni.com/manuals)を参照してください。(For a Japanese language version, go to [ni.com/manuals](http://ni.com/manuals).)

This user guide describes how to use the National Instruments NI USB-9201/9221 devices and lists the specifications. In this user guide, the NI USB-9201/9221 with screw terminal and NI USB-9201/9221 with D-SUB are referred to inclusively as the NI USB-9201/9221.

## Introduction

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

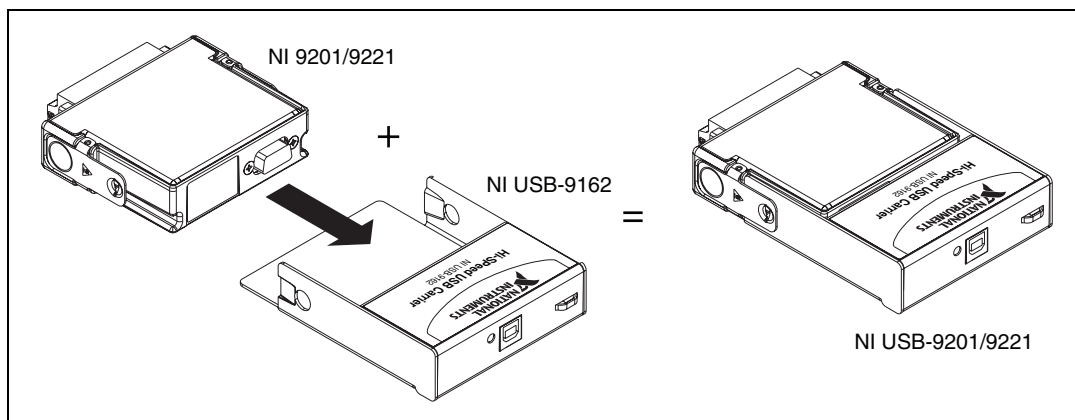
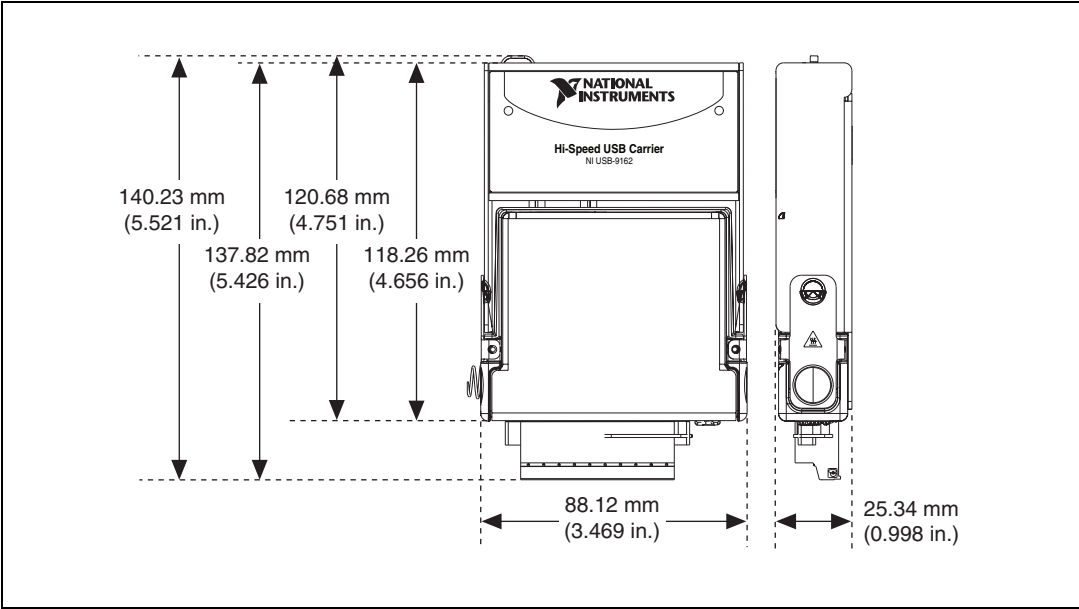


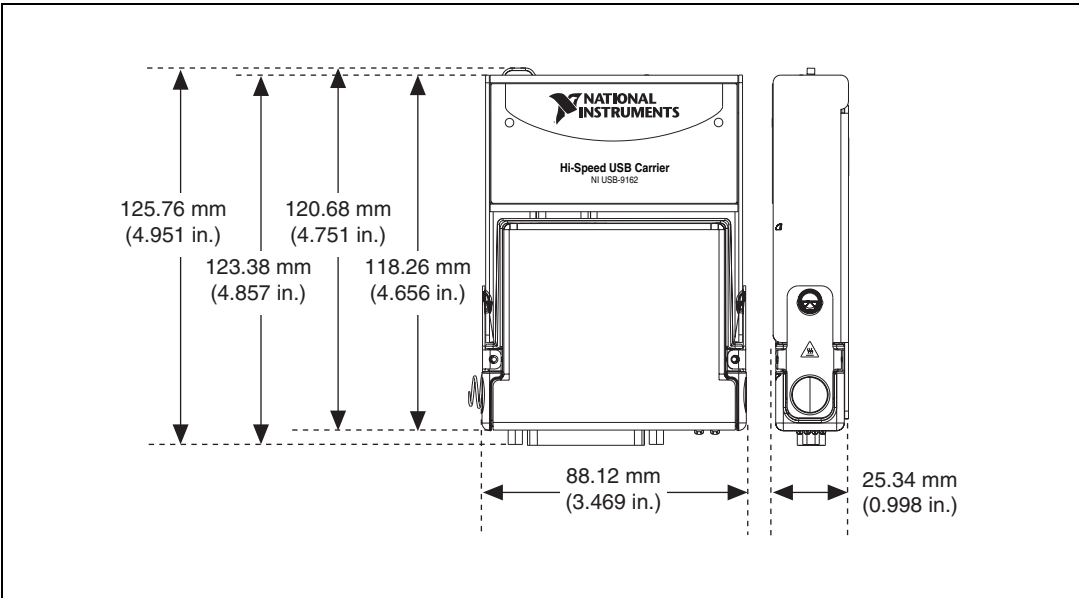
Figure 1. NI USB-9201/9221 Components

# Dimensions

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



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



**Figure 3.** NI USB-9201/9221 (D-SUB) Devices in Millimeters (Inches)

# Safety Guidelines

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



**Caution** Although the NI 9201/9221 might have more stringent certification standards than the NI USB-9201/9221, when used with the NI 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 NI USB-9201/9221 is *not* certified for use in hazardous locations.

## Safety Guidelines for Hazardous Voltages

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

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.

# Related Documentation

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Each application software package and driver includes information about writing applications for taking measurements and controlling measurement devices. The following references to documents assume you have NI-DAQmx 8.7 or later, and where applicable, version 7.1 or later of the NI application software.

## NI-DAQmx for Windows

The *DAQ Getting Started Guide* describes how to install your NI-DAQmx for Windows software, your NI-DAQmx-supported DAQ device, and how to confirm that your device is operating properly. Select **Start»All Programs»National Instruments»NI-DAQ»DAQ Getting Started Guide**.

The *NI-DAQ Readme* lists which devices are supported by this version of NI-DAQmx. Select **Start»All Programs»National Instruments»NI-DAQ»NI-DAQ Readme**.

The *NI-DAQmx Help* contains general information about measurement concepts, key NI-DAQmx concepts, and common applications that are applicable to all programming environments. Select **Start»All Programs»National Instruments»NI-DAQ»NI-DAQmx Help**.

## LabVIEW

If you are a new user, use the *Getting Started with LabVIEW* manual to familiarize yourself with the LabVIEW graphical programming environment and the basic LabVIEW features you use to build data acquisition and instrument control applications. Open the *Getting Started with LabVIEW* manual by selecting **Start»All Programs»National Instruments»LabVIEW»LabVIEW Manuals** or by navigating to the `labview\manuals` directory and opening `LV_Getting_Started.pdf`.

Use the *LabVIEW Help*, available by selecting **Help»Search the LabVIEW Help** in LabVIEW, to access information about LabVIEW programming concepts, step-by-step instructions for using LabVIEW, and reference information about LabVIEW VIs, functions, palettes, menus, and tools. Refer to the following locations on the Contents tab of the *LabVIEW Help* for information about NI-DAQmx:

- **Getting Started»Getting Started with DAQ**—Includes overview information and a tutorial to learn how to take an NI-DAQmx measurement in LabVIEW using the DAQ Assistant.
- **VI and Function Reference»Measurement I/O VIs and Functions**—Describes the LabVIEW NI-DAQmx VIs and properties.

- **Taking Measurements**—Contains the conceptual and how-to information you need to acquire and analyze measurement data in LabVIEW, including common measurements, measurement fundamentals, NI-DAQmx key concepts, and device considerations.

## LabWindows/CVI

The **Data Acquisition** book of the *LabWindows/CVI Help* contains measurement concepts for NI-DAQmx. This book also contains *Taking an NI-DAQmx Measurement in LabWindows/CVI*, which includes step-by-step instructions about creating a measurement task using the DAQ Assistant. In LabWindows™/CVI™, select **Help»Contents**, then select **Using LabWindows/CVI»Data Acquisition**.

The **NI-DAQmx Library** book of the *LabWindows/CVI Help* contains API overviews and function reference for NI-DAQmx. **Select Library Reference»NI-DAQmx Library** in the *LabWindows/CVI Help*.

## Measurement Studio

If you program your NI-DAQmx-supported device in Measurement Studio using Visual C++, Visual C#, or Visual Basic .NET, you can interactively create channels and tasks by launching the DAQ Assistant from MAX or from within Visual Studio .NET. You can generate the configuration code based on your task or channel in Measurement Studio. Refer to the *DAQ Assistant Help* for additional information about generating code. You also can create channels and tasks, and write your own applications in your ADE using the NI-DAQmx API.

For help with NI-DAQmx methods and properties, refer to the NI-DAQmx .NET Class Library or the NI-DAQmx Visual C++ Class Library included in the *NI Measurement Studio Help*. For general help with programming in Measurement Studio, refer to the *NI Measurement Studio Help*, which is fully integrated with the Microsoft Visual Studio .NET help. To view this help file in Visual Studio .NET, select **Measurement Studio»NI Measurement Studio Help**.

To create an application in Visual C++, Visual C#, or Visual Basic .NET, follow these general steps:

1. In Visual Studio .NET, select **File»New»Project** to launch the New Project dialog box.
2. Find the Measurement Studio folder for the language you want to create a program in.
3. Choose a project type. You add DAQ tasks as a part of this step.

## ANSI C without NI Application Software

The *NI-DAQmx Help* contains API overviews and general information about measurement concepts. Select **Start»All Programs»National Instruments»NI-DAQ»NI-DAQmx Help**.

The *NI-DAQmx C Reference Help* describes the NI-DAQmx Library functions, which you can use with National Instruments data acquisition devices to develop instrumentation, acquisition, and control applications. Select **Start»All Programs»National Instruments»NI-DAQ»NI-DAQmx C Reference Help**.

## .NET Languages without NI Application Software

With the Microsoft .NET Framework version 1.1 or later, you can use NI-DAQmx to create applications using Visual C# and Visual Basic .NET without Measurement Studio. You need Microsoft Visual Studio .NET 2003 or Microsoft Visual Studio 2005 for the API documentation to be installed.

The installed documentation contains the NI-DAQmx API overview, measurement tasks and concepts, and function reference. This help is fully integrated into the Visual Studio .NET documentation. To view the NI-DAQmx .NET documentation, go to **Start»Programs»National Instruments»NI-DAQ»NI-DAQmx .NET Reference Help**. Expand **NI Measurement Studio Help»NI Measurement Studio .NET Class Library»Reference** to view the function reference. Expand **NI Measurement Studio Help»NI Measurement Studio .NET Class Library»Using the Measurement Studio .NET Class Libraries** to view conceptual topics for using NI-DAQmx with Visual C# and Visual Basic .NET.

To get to the same help topics from within Visual Studio, go to **Help»Contents**. Select **Measurement Studio** from the **Filtered By** drop-down list and follow the previous instructions.

## Device Documentation and Specifications

NI-DAQmx includes the Device Document Browser, which contains online documentation for supported DAQ, SCXI, and switch devices, such as help files describing device pinouts, features, and operation, and PDF files of the printed device documents. You can find, view, and/or print the documents for each device using the Device Document Browser at any time by inserting the CD. After installing the Device Document Browser, device documents are accessible from **Start»All Programs»National Instruments»NI-DAQ»Browse Device Documentation**.



**Note** You can also download these documents at [ni.com/manuals](http://ni.com/manuals).

## Training Courses

If you need more help getting started developing an application with NI products, NI offers training courses. To enroll in a course or obtain a detailed course outline, refer to [ni.com/training](http://ni.com/training).

## Technical Support on the Web

For additional support, refer to [ni.com/support](http://ni.com/support) or [zone.ni.com](http://zone.ni.com).

## Installing the Software

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Software support for the NI USB-9201/9221 for Windows Vista/XP/2000 is provided by NI-DAQmx. The *DAQ Getting Started Guide*, which you can download at [ni.com/manuals](http://ni.com/manuals), offers NI-DAQmx users step-by-step instructions for installing software and hardware, configuring channels and tasks, and getting started developing an application.

## Installing Other Software

If you are using other software, refer to the installation instructions that accompany your software.

## Example Programs

The NI-DAQmx CD contains example programs that you can use to get started programming with the NI 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 NI USB-9201/9221 Device

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Before installing the device, you must install the software you plan to use with the device. Refer to the *Installing the Software* section of this guide and the documentation included with the software for more information.

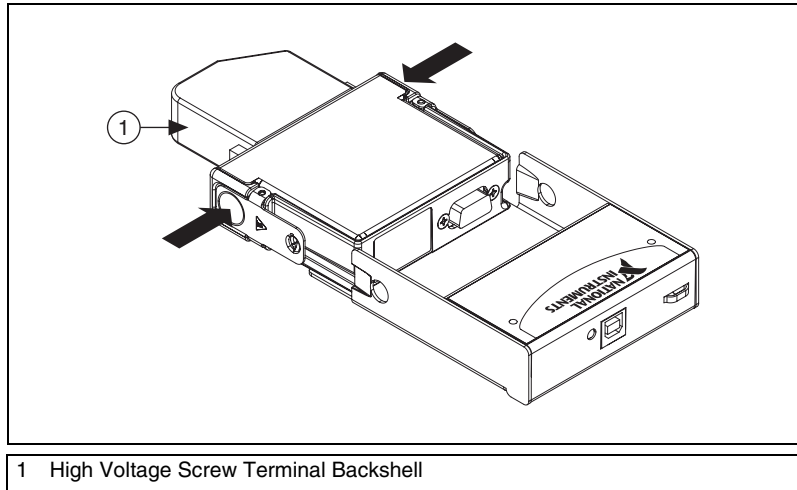
## Installing the NI 9201/9221 in the NI USB-9162 Carrier

The NI 9201/9221 module and the NI 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 D-SUB connector.

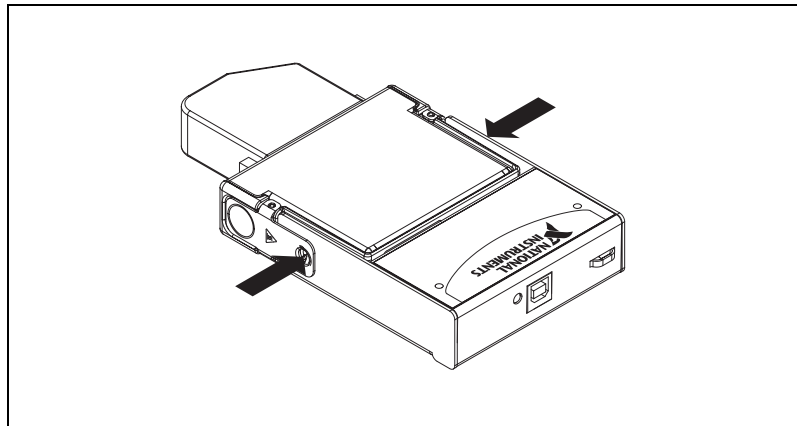


3. Align the I/O module with the carrier, as shown in Figure 4.



**Figure 4.** Module Installation

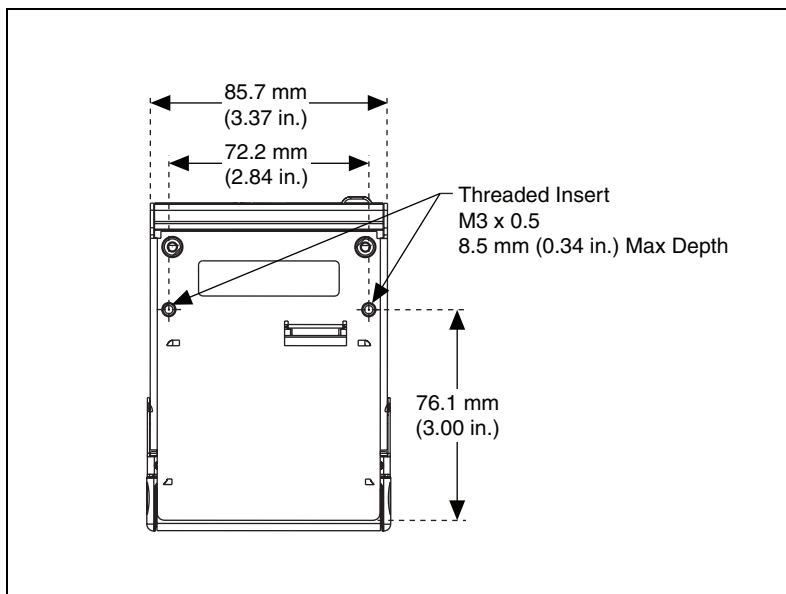
4. Squeeze the latches and insert the NI 9201/9221 module into the NI USB-9162 carrier.
5. Press firmly on the connector side of the NI 9201/9221 module until the latches lock the module into place, as shown in Figure 5.



**Figure 5.** Locking Module into Place

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

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



**Figure 6.** Module Dimensions in Millimeters (Inches)

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

Plug one end of the USB cable into the NI 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 NI USB-9201/9221 device has a green LED next to the USB connector. The LED indicator indicates device status, as listed in Table 1. When the device is connected to a USB port, the LED blinks steadily to indicate that the device is initialized and is receiving power from the connection.

If the LED is not blinking, it may mean that the device is not initialized or the computer is in standby mode. In order for the device to be recognized, the device must be connected to a computer that has NI-DAQmx installed on it. If your device is not blinking, make sure your computer has the latest version of NI-DAQmx installed on it, and the computer is not in standby mode.

**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.
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 NI USB-9201/9221 Device

The NI USB-9201/9221 provides connections for eight analog input channels.



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



**Note** Table 2 illustrates the accessories available from [ni.com](http://ni.com) for use with the NI USB-9201/9221.

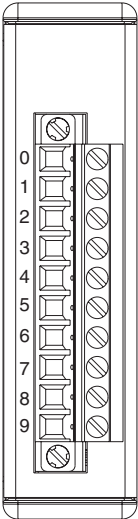
**Table 2.** Accessories

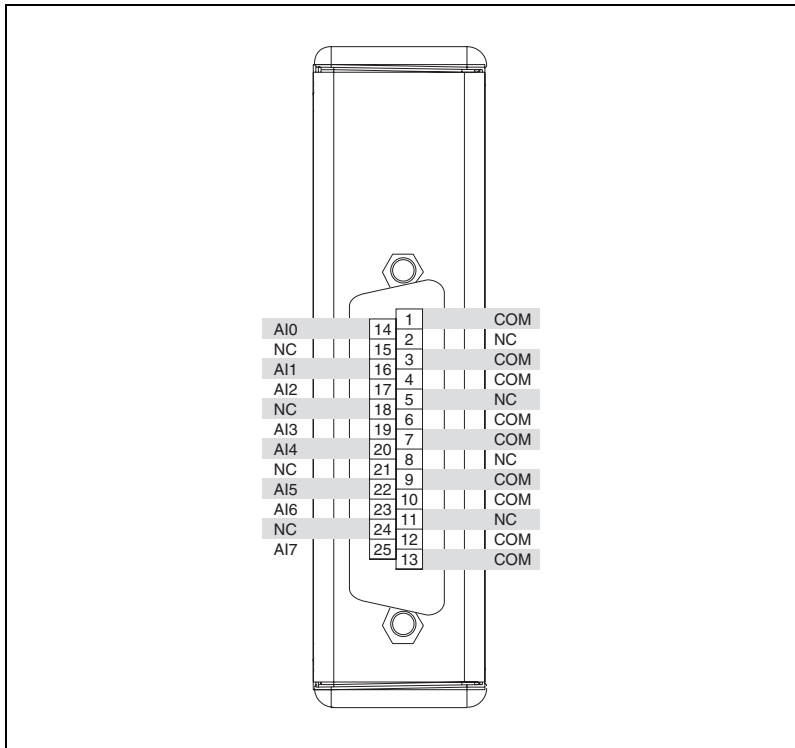
Device	Accessory	Accessory Description
USB-9201/9221 with Screw Terminal	NI 9932	10-terminal, detachable, high voltage, screw terminal backshell <sup>1</sup>
USB-9201/9221 with 25-pin D-SUB	NI 9934	25-pin D-SUB connector

<sup>1</sup> For more information about installing the backshell, refer to the [Assembling the High Voltage Screw Terminal Backshell](#) section.

Each channel has a terminal or pin, AI, to which you can connect a voltage signal. The NI 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 3 for the terminal assignments of the NI USB-9201/9221 with screw terminal. Refer to Figure 7 for the pin assignments of the NI USB-9201/9221 with D-SUB.

**Table 3.** Terminal Assignments

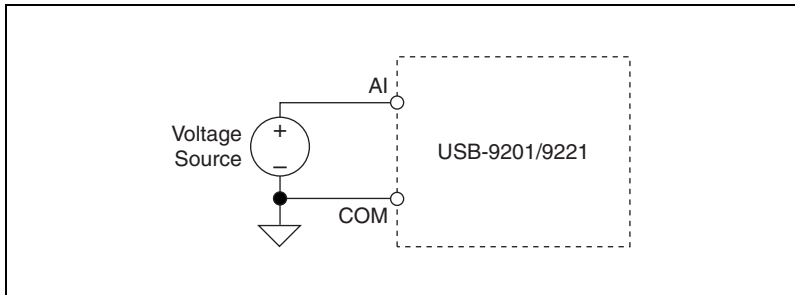
Module	Terminal	Signal
	0	AI 0
	1	AI 1
	2	AI 2
	3	AI 3
	4	AI 4
	5	AI 5
	6	AI 6
	7	AI 7
	8	No connection
	9	Common (COM)



**Figure 7.** Pin Assignments

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

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



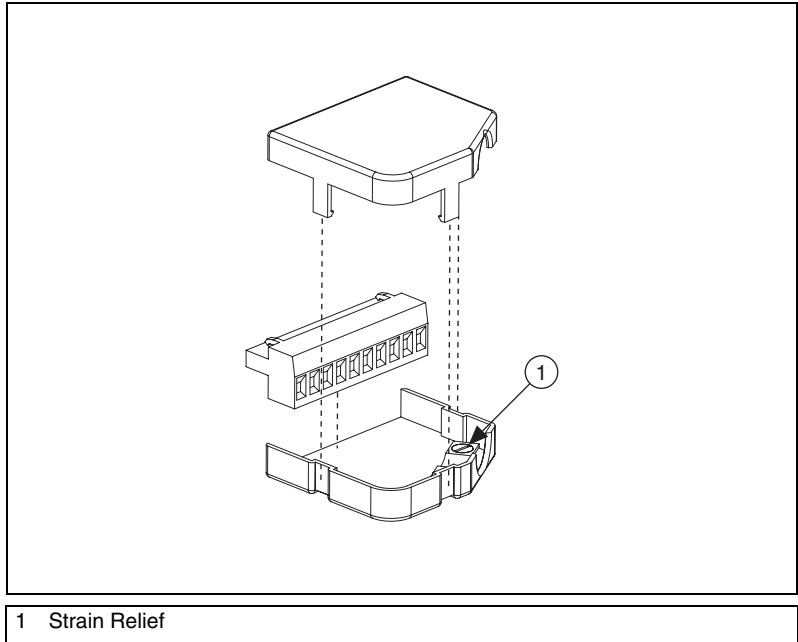
**Figure 8.** Connecting a Single-Ended Voltage Signal to the NI USB-9201/9221

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

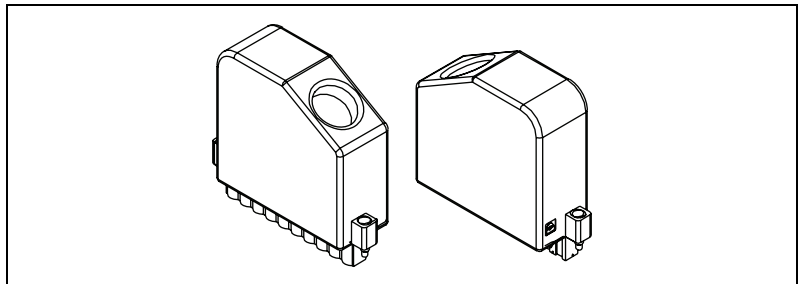
## Assembling the High Voltage Screw Terminal Backshell

The NI 9932 high voltage screw terminal backshell must be installed when using hazardous voltages ( $>42.4 \text{ V}_{pk}$ , 60 VDC). Refer to Figure 9 while completing the following steps to assemble the backshell:

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



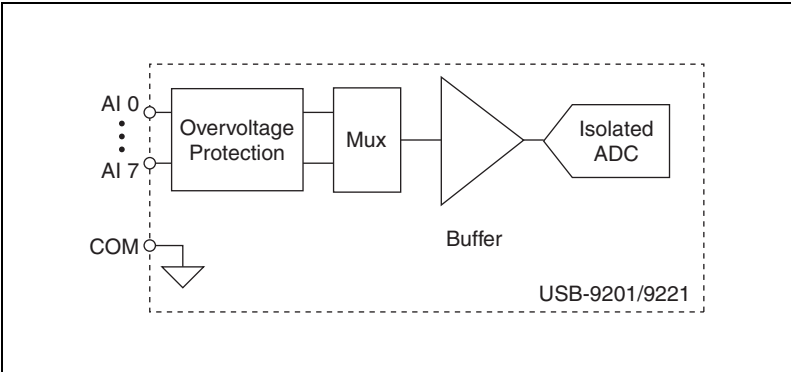
**Figure 9.** High Voltage Screw Terminal Backshell



**Figure 10.** Assembled High Voltage Screw Terminal Backshell

# NI USB-9201/9221 Circuitry

The NI 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 11.** 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>	
NI USB-9201	
Single channel .....	800 kS/s max
Scanning .....	500 kS/s
NI USB-9221 .....	800 kS/s max

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

### Operating voltage ranges<sup>1</sup>

NI USB-9201 .....  $\pm 10$  V (not software selectable)  
 NI USB-9221 .....  $\pm 60$  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>, 5 seconds max  
 D-SUB .....  $\pm 60$  VDC

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

Screw terminal ..... 2,300 V<sub>rms</sub>, 5 seconds max  
 D-SUB ..... 1,000 V<sub>rms</sub>, 5 seconds max

### Overvoltage protection

(AI to COM).....  $\pm 100$  V

### Accuracy<sup>2</sup>

Error	Percent of Reading (Gain Error)	Percent of Range (Offset Error)*
NI USB-9201		
Calibrated typ (25 °C, $\pm 5$ °C)	$\pm 0.04\%$	$\pm 0.07\%$
Calibrated max (0 to 60 °C)	$\pm 0.25\%$	$\pm 0.25\%$
Uncalibrated typ (25 °C, $\pm 5$ °C)	$\pm 0.26\%$	$\pm 0.46\%$
Uncalibrated max (0 to 60 °C)	$\pm 0.67\%$	$\pm 1.25\%$
NI USB-9221		
Calibrated typ (25 °C, $\pm 5$ °C)	$\pm 0.04\%$	$\pm 0.07\%$
Calibrated max (0 to 60 °C)	$\pm 0.25\%$	$\pm 0.25\%$
Uncalibrated typ (25 °C, $\pm 5$ °C)	$\pm 0.26\%$	$\pm 0.43\%$
Uncalibrated max (0 to 60 °C)	$\pm 0.67\%$	$\pm 1.06\%$
* Range equals 10.53 V for the NI USB-9201, 62.50 V for the NI USB-9221.		

<sup>1</sup> Refer to the [Safety](#) section for details about safe operating voltages.

<sup>2</sup> Excludes noise.



## Stability

### Offset drift

NI USB-9201..... $\pm 100 \mu\text{V}/^\circ\text{C}$

NI USB-9221..... $\pm 580 \mu\text{V}/^\circ\text{C}$

Gain drift ..... $\pm 34 \text{ ppm}/^\circ\text{C}$

### Input bandwidth (–3 dB)

NI USB-9201 .....690 kHz min

NI USB-9221 .....950 kHz min

### Input impedance

Resistance .....1 M $\Omega$

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..... $\pm 1.5 \text{ LSB}$

Crosstalk .....–75 dB, 10 kHz

### Settling time (to 1 LSB)

NI USB-9201 .....2  $\mu\text{s}$

NI USB-9221 .....1.25  $\mu\text{s}$

## Power Requirements

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

Suspend mode.....2.5 mA, max

## Bus Interface

USB specification .....USB 2.0 Hi-Speed

## Physical Characteristics

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

### Dimensions

With screw terminal.....	14.0 cm × 8.8 cm × 2.5 cm (5.52 in. × 3.47 in. × 1.00 in.)
With 25-pin D-SUB.....	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

With screw terminal.....	Approx. 250 g (8.8 oz)
With D-SUB .....	Approx. 245 g (8.6 oz)

## Safety

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

## Safety Voltages

### Maximum Voltage

Connect only voltages that are within these limits.

AI to COM .....	±60 VDC
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### Isolation Voltages for NI USB-9201/9221 with Screw Terminal

Channel-to-channel isolation .....	None
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#### Channel-to-earth ground isolation

Continuous .....	250 V <sub>rms</sub> , Measurement Category II
Withstand .....	2,300 V <sub>rms</sub> , verified by a 5 second 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 NI USB-9201/9221 with D-SUB

Channel-to-channel.....	None
Channel-to-earth ground	
Continuous.....	60 VDC, Measurement Category I
Withstand.....	1,000 V <sub>rms</sub> , verified by a 5 second 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

This product is designed to meet 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 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 NI USB-9201/9221 is *not* certified for use in hazardous locations.

## Environmental

The NI 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

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

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A



**Note** For EMC compliance, operate this device with double-shielded cables.

## CE Compliance

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

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)



**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 module number or product line, and click the appropriate link in the Certification column.

## Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* 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** At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit [ni.com/environment/weee.htm](http://ni.com/environment/weee.htm).

## 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](http://ni.com/environment/rohs_china)。(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](http://ni.com/environment/rohs_china).)

## Calibration

You can obtain the calibration certificate for the NI 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.

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