OPERATING INSTRUCTIONS

USB-9215

4-Channel, ±10 VDC, 16-Bit Simultaneous Sampling Analog Input Module

These operating instructions describe how to use the National Instruments USB-9215.

Contents

NATIONAL INSTRUMENTS™

Introduction

The NI USB-9215 data acquisition device provides a USB interface for four channels of 16-bit simultaneous sampling analog inputs with integrated signal conditioning. The USB-9215 consists of two components: a cRIO-9215 module and a USB-9161 USB carrier, as shown in Figure 1.
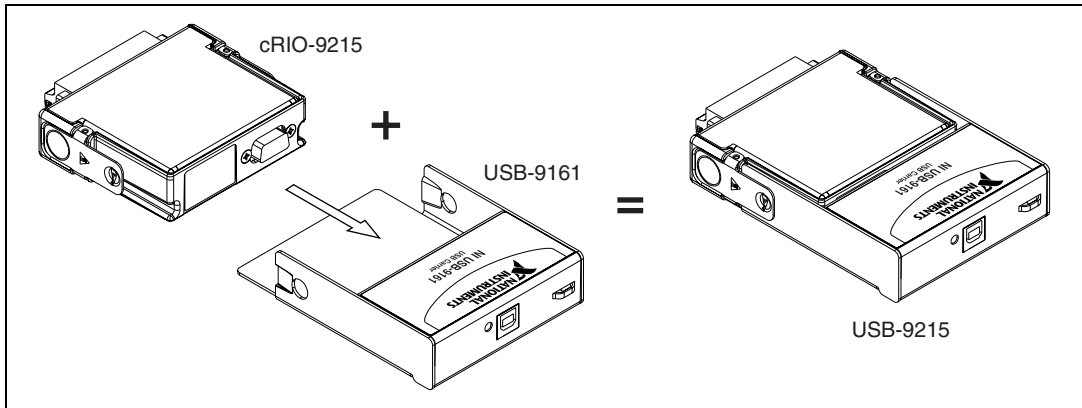
Figure 1. USB-9215 Components

Software support is provided by NI-DAQmx Base. For more information about NI-DAQmx Base, refer to the *NI-DAQmx Base Getting Started Guide*.

Safety Guidelines

Operate the USB-9215 only as described in these operating instructions.

Note Although the cRIO-9215 module may have more stringent certification standards than the USB-9215, when used with the USB-9161 carrier, the combined system may be limited. Refer to the *Specifications* section of this document for more details.

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 or the area is known to be nonhazardous.

Safety Guidelines for Hazardous Voltages

If *hazardous voltages* are connected to the module, take the following precautions. A hazardous voltage is a voltage greater than 42.4 V_{peak} 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.

Installing the cRIO-9215 in the USB-9161 Carrier

The cRIO-9215 module and USB-9161 carrier are packaged separately. Refer to Figures 2 and 3 while completing the following assembly steps:

1. Make sure that no signals are connected to the CompactRIO module.
2. Align the I/O module with the carrier, as shown in Figure 2.
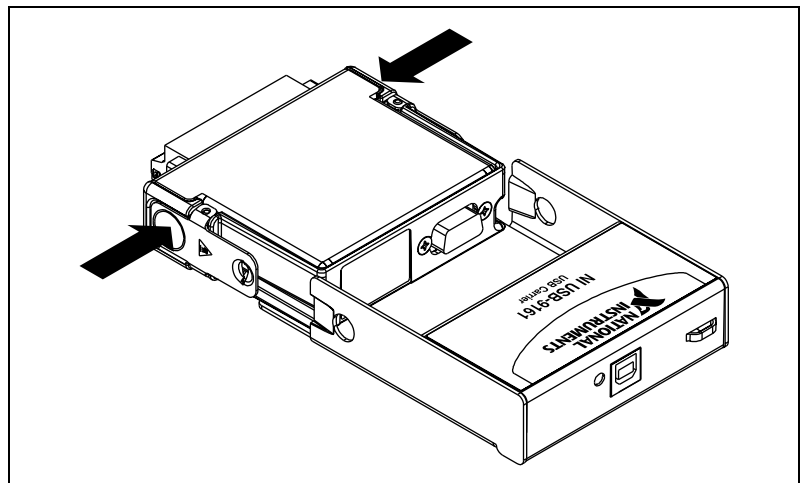
Figure 2. Module Installation

3. Squeeze the latches and insert the CompactRIO module into the carrier.

4. Press firmly on the connector side of the CompactRIO module until the latches lock the module into place.
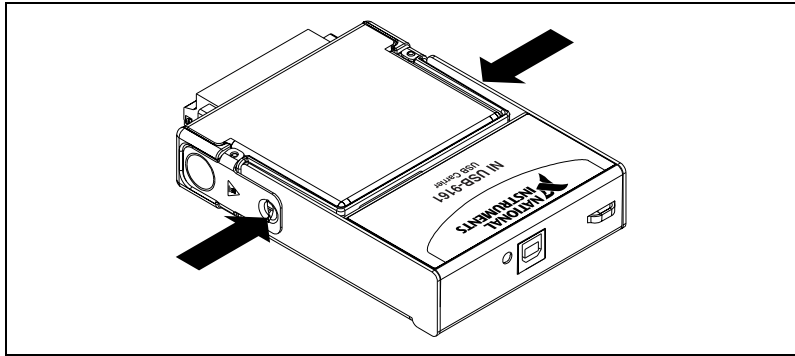
Figure 3. Locking Module into Place

5. Connect the USB cable to the assembled USB-9215.

Mounting the USB-9215 to a Panel

Thread inserts are located in the USB-9215 for mounting it to a panel. Refer to Figure 4 for dimensions.

Figure 4. USB-9215 Dimensions

Software
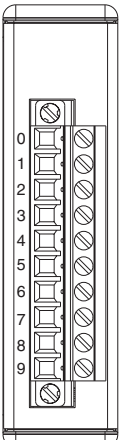
Software support for the USB-9215 is provided by NI-DAQmx Base. NI-DAQmx Base is a subset of the NI-DAQmx API.

The NI-DAQmx Base CD contains example programs that you can use to get started programming with the USB-9215. Refer to the *NI-DAQmx Base 1.x Getting Started Guide* for more details.
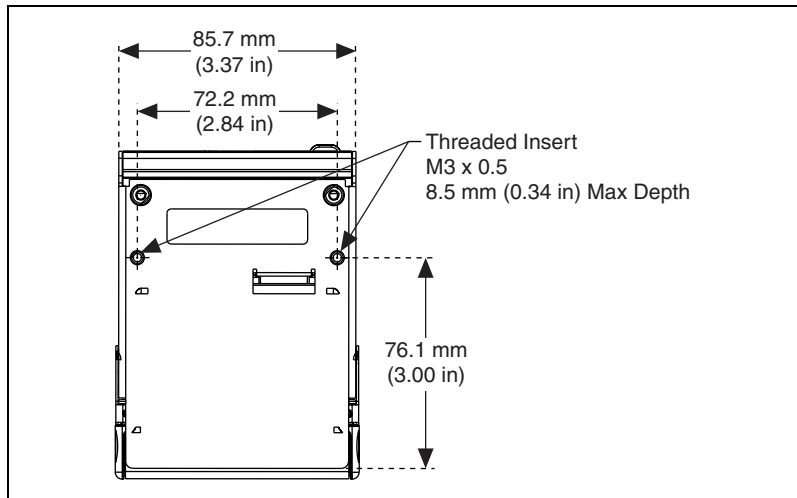
Wiring the USB-9215

The USB-9215 has a 10-terminal, detachable screw-terminal connector that provides connections for four analog input channels. Each channel has a terminal to which you can connect the positive lead of a voltage signal, AI+, and a terminal to which you can connect the negative lead of the voltage signal, AI−. The USB-9215 also has a common terminal, COM, that is internally connected to the isolated ground reference of the module. Refer to Table 1 for the terminal assignments for each channel.

Table 1. Terminal Assignments

Module	Terminal	Signal
	0	AI0+
	1	AI0−
	2	AI1+
	3	AI1−
	4	AI2+
	5	AI2−
	6	AI3+
	7	AI3−
	8	No Connection
	9	Common (COM)

Connecting Floating Differential Voltage Signals to the USB-9215

You can connect floating differential signals to the USB-9215. However, doing so may cause the voltage to go outside of the common-mode signal range of the USB-9215. If the voltage source is outside of the common-mode range, data read by the USB-9215 is not accurate. To keep the voltage source within the common-mode range of the module, connect the negative lead of the signal to COM through a 1 MΩ resistor.
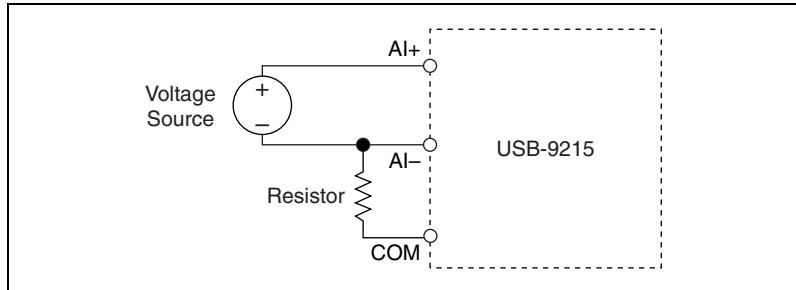
Figure 5. Connecting a Floating Differential Voltage Signal to the USB-9215

Connecting Single-Ended Voltage Signals to the USB-9215

You can connect single-ended voltage signals to the USB-9215. Connect the positive voltage signal to the AI+ terminal, and connect the ground signal to the AI– terminal. You also must connect the ground signal to the COM terminal to keep the common-mode voltage in the specified range. For more information about the common-mode voltage range, refer to the *Specifications* section.
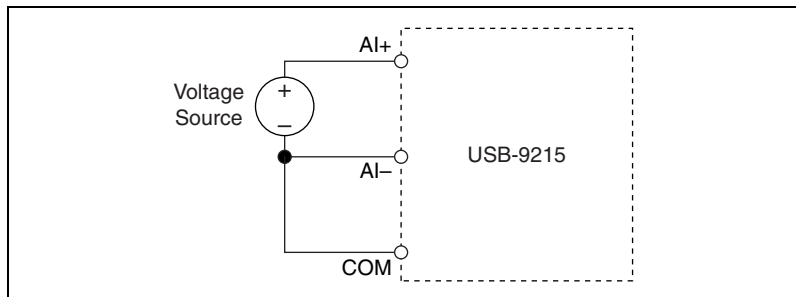
Figure 6. Connecting a Single-Ended Voltage Signal to the USB-9215

USB-9215 Circuitry

The USB-9215 channels share a common ground that is isolated from the chassis and the host computer. The module protects each channel from overvoltages. For more information about overvoltage protection, refer to the *Specifications* section. The signal is buffered and conditioned by the instrumentation amplifier. Then the signal is sampled by a 16-bit ADC. The channels have independent track and hold amplifiers that allow you to sample all four channels simultaneously.
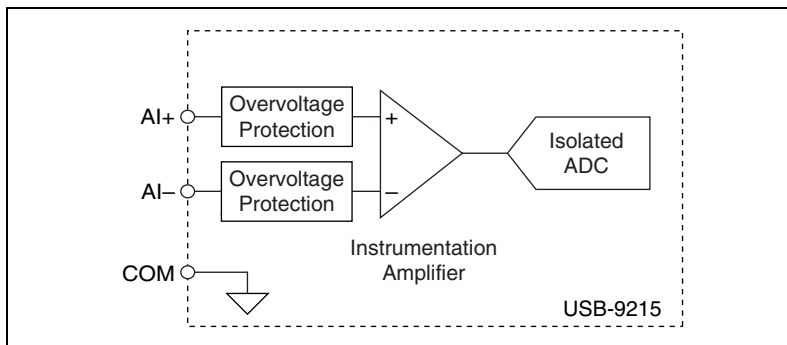
Figure 7. Input Circuitry for One Channel

Specifications

The following specifications are typical at 25 °C, unless otherwise noted.

Input Characteristics

Number of channels .... 4 analog input channels

ADC resolution .... 16 bits

Type of ADC... Successive approximation register (SAR)

Operating voltage range (AI+-to-AI–)

    Typical .... ±10.4 V

    Minimum .... ±10.2 V

    Maximum....................................... ±10.6 V

Maximum working voltage
(signal + common mode) .... Each channel must remain within ±10.2 V of common

Overvoltage protection ....±30 V

Conversion time

    One channel ....4.34 µs

    Two channel ....6 µs

    Three channel ....8 µs

    Four channel ....10 µs

Max sampling rate ....20 kS/s guaranteed

Accuracy

Error	Percent of Reading	Percent of Range*
Calibrated, max (0 to 60 °C)	0.2%	0.067%
Calibrated, typ (25 °C, ±5 °C)	0.02%	0.0067%
Uncalibrated, max (0 to 60 °C)	1.05%	0.82%
Uncalibrated, typ (25 °C, ±5 °C)	0.6%	0.38%
* Range equals 10.4 V		

Stability

    Offset drift ....60 µV/°C

    Gain drift ....10 ppm/°C

CMRR (at 60 Hz) ....–73 dB min

Input bandwidth (–3 dB).........................420 kHz min

Input impedance

    Resistance.......................................1 GΩ

    Capacitance.....................................25 pF

Input bias current ....10 nA

Input noise

    RMS..1.2 LSB_{rms}

    Peak-to-peak ....7 LSB

Crosstalk ....–80 dB

Settling time (to 2 LSBs)

    10 V step...10 µs

    20 V step...15 µs

No missing codes .... 15 bits guaranteed

DNL .... −1.9 to 2 LSB max

INL .... ±6 LSB max

Power Requirements

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

    Suspend mode .... 500 μA, max

Bus Interface

USB .... USB 2.0 Full Speed

Physical Characteristics

Dimensions .... 12.1 cm × 8.6 cm × 2.5 cm
(4.75 in. × 3.37 in. × 0.99 in.)

Weight.. Approx. 249 g (8.8 oz)

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 to 0.6 N · m
(4.4 to 5.3 lb · in.)

Safety

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

Standards

The USB-9215 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 610610-1

*   CAN/CSA C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label, or visit
`ni.com/certification`, search by model number or product line, and click the
appropriate link in the Certification column.

Voltages

Connect only voltages that are within these limits.

Channel-to-COM ....±30 V max,
                                        Installation Category I

Installation 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.

Isolation
    Channel-to-channel..........................No isolation between channels
    Channel-to-earth ground
        Withstand ....$2,300\ V_{rms}$, 1 minute max
        Continuous ....$250\ V_{rms}$,
                                        Installation Category II

Installation 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).

Hazardous Locations

The USB-9215 is not certified for use in hazardous locations.

Environmental

The USB-9215 device is intended for indoor use only.

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

Storage temperature
(IEC 60068-2-1 and 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 (at 25 °C ambient
                                                                              temperature)

Pollution Degree (IEC 60664) 2

Electromagnetic Compatibility

Emissions .... EN 55011 Class A at 10 m
                                                                             FCC Part 15A above 1 GHz

Immunity .... EN 61326-1:1997 + A2:2001,
                                                                             Table 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`, 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-9215 at
`ni.com/calibration`.

Calibration interval .... 1 year

Technical Support Resources

Web Support

National Instruments Web support is your first stop for help in solving
installation, configuration, and application problems and questions. Online
problem-solving and diagnostic resources include frequently asked

questions, knowledge bases, product-specific troubleshooting wizards, manuals, drivers, software updates, and more. Web support is available through the Technical Support section of ni.com.

Worldwide Support

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. You can access our branch office Web sites from the Worldwide Offices section of ni.com. Branch office Web sites provide up-to-date contact information, support phone numbers, email addresses, and current events.

If you have searched the technical support resources on our Web site and still cannot find the answers you need, contact your local office or National Instruments corporate. For telephone support in the United States, dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 1800 300 800, Austria 43 0 662 45 79 90 0,
Belgium 32 0 2 757 00 20, Brazil 55 11 3262 3599,
Canada (Calgary) 403 274 9391, Canada (Ottawa) 613 233 5949,
Canada (Québec) 450 510 3055, Canada (Toronto) 905 785 0085,
Canada (Vancouver) 604 685 7530, China 86 21 6555 7838,
Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,
Finland 385 0 9 725 725 11, France 33 0 1 48 14 24 24,
Germany 49 0 89 741 31 30, India 91 80 51190000,
Israel 972 0 3 6393737, Italy 39 02 413091, Japan 81 3 5472 2970,
Korea 82 02 3451 3400, Malaysia 603 9131 0918,
Mexico 01 800 010 0793, 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 7 095 783 68 51, Singapore 65 6226 5886,
Slovenia 386 3 425 4200, South Africa 27 0 11 805 8197,
Spain 34 91 640 0085, Sweden 46 0 8 587 895 00,
Switzerland 41 56 200 51 51, Taiwan 886 2 2528 7227,
Thailand 662 992 7519, United Kingdom 44 0 1635 523545

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