DATASHEET

# NI 9201

## 8 AI, ±10 V, 12 Bit, 500 kS/s Aggregate

- DSUB, screw-terminal, or spring-terminal connectivity
- 250 Vrms, CAT II, channel-to-earth isolation (screw and spring terminal); 60 VDC, CAT I, channel-to-earth isolation (DSUB)
- -40 °C to 70 °C operating range, 5 g vibration, 50 g shock

The NI 9201 is an analog input module for CompactDAQ and CompactRIO systems. The NI 9201 provides eight channels of ±10 V input with 500 kS/s sample rate.

| | |
|---|---|
| Kit Contents | • NI 9201<br>• NI 9201 Getting Started Guide |
| Accessories | • NI 9927 Backshell Connector Kit (Screw Terminal)<br>• NI 9981 Backshell Connector Kit (Spring Terminal)<br>• NI 9924 Screw-Terminal Block (DSUB) |

NATIONAL INSTRUMENTS™

| C SERIES ANALOG INPUT MODULE COMPARISON | | | | | | |
|---|---|---|---|---|---|---|
| Product Name | Signal Levels | Channels | Sample Rate | Simultaneous | Resolution | Connectivity |
| NI 9201 | ±10 V | 8 Single-Ended | 500 kS/s | No | 12-Bit | Screw-Terminal, Spring-Terminal, DSUB |
| NI 9205 | ±200 mV, ±1 V, ±5 V, ±10 V | 32 Single-Ended, 16 differential | 250 kS/s | No | 16-Bit | Spring-Terminal, DSUB |
| NI 9206 | ±200 mV, ±1 V, ±5 V, ±10 V | 32 Single-Ended, 16 Differential | 250 kS/s | No | 16-Bit | Spring-Terminal |
| NI 9207 | ±10 V | 8 Differential | 500 S/s | No | 24-Bit | DSUB |
| NI 9209 | ±10 V | 32 Single-Ended, 16 Differential | 500 S/s | No | 24-Bit | DSUB |
| NI 9215 | ±10 V | 4 Differential | 100 kS/s/ch | Yes | 16-Bit | Screw-Terminal, Spring-Terminal, BNC |
| NI 9220 | ±10 V | 16 Differential | 100 kS/s/ch | Yes | 16-Bit | Spring-Terminal, DSUB |
| NI 9221 | ±60 V | 8 Single-Ended | 800 kS/s | No | 12-Bit | Screw-Terminal, Spring-Terminal, DSUB |
| NI 9222 | ±10 V | 4 Differential | 500 kS/s/ch | Yes | 16-Bit | Screw-Terminal, BNC |
| NI 9223 | ±10 V | 4 Differential | 1 MS/s/ch | Yes | 16-Bit | Screw-Terminal, BNC |

# NI C Series Overview

NI provides more than 100 C Series modules for measurement, control, and communication applications. C Series modules can connect to any sensor or bus and allow for high-accuracy measurements that meet the demands of advanced data acquisition and control applications.

- Measurement-specific signal conditioning that connects to an array of sensors and signals
- Isolation options such as bank-to-bank, channel-to-channel, and channel-to-earth ground
- -40 °C to 70 °C temperature range to meet a variety of application and environmental needs
- Hot-swappable

The majority of C Series modules are supported in both CompactRIO and CompactDAQ platforms and you can move modules from one platform to the other with no modification.

## CompactRIO

CompactRIO combines an open-embedded architecture with small size, extreme ruggedness, and C Series modules in a platform powered by the NI LabVIEW reconfigurable I/O (RIO) architecture. Each system contains an FPGA for custom timing, triggering, and processing with a wide array of available modular I/O to meet any embedded application requirement.

## CompactDAQ

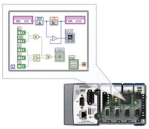
CompactDAQ is a portable, rugged data acquisition platform that integrates connectivity, data acquisition, and signal conditioning into modular I/O for directly interfacing to any sensor or signal. Using CompactDAQ with LabVIEW, you can easily customize how you acquire, analyze, visualize, and manage your measurement data.

## Software

**LabVIEW Professional Development System for Windows**

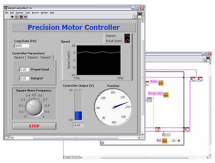
- Use advanced software tools for large project development
- Generate code automatically using DAQ Assistant and Instrument I/O Assistant
- Use advanced measurement analysis and digital signal processing
- Take advantage of open connectivity with DLLs, ActiveX, and .NET objects
- Build DLLs, executables, and MSI installers

### NI LabVIEW FPGA Module



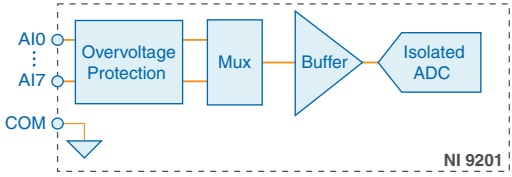
- Design FPGA applications for NI RIO hardware
- Program with the same graphical environment used for desktop and real-time applications
- Execute control algorithms with loop rates up to 300 MHz
- Implement custom timing and triggering logic, digital protocols, and DSP algorithms
- Incorporate existing HDL code and third-party IP including Xilinx IP generator functions
- Purchase as part of the LabVIEW Embedded Control and Monitoring Suite

### NI LabVIEW Real-Time Module




- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of multicore CPUs or set processor affinity manually
- Take advantage of real-time OS, development and debugging support, and board support
- Purchase individually or as part of a LabVIEW suite

# NI 9201 Input Circuitry




- Input signals are scanned, buffered, conditioned, and then sampled by a single ADC.
- Each AI channel provides an independent signal path and ADC, enabling you to sample all channels simultaneously.

# NI 9201 Specifications

The following specifications are typical for the range -40 °C to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.

**Caution** Do not operate the NI 9201 in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.

## Input Characteristics

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

**Table 1.** Sample Rate (Aggregate)

| Mode | Maximum Sample Rate (R Series Expansion Chassis) | Maximum Sample Rate (All Other Chassis) |
|---|---|---|
| Single Channel | 475 kS/s | 800 kS/s |
| Scanning | 475 kS/s | 500 kS/s |

| | |
|---|---|
| Input range | ±10 V |
| Measurement voltage, channel-to-COM (V) | |
| Minimum | ±10.3 |
| Typical | ±10.53 |
| Maximum | ±10.8 |
| Overvoltage protection, channel-to-COM | ±100 V |

**Table 2.** NI 9201 Accuracy (Excludes Noise)

| Measurement Conditions | | Percent of Reading (Gain Error) | Percent of Range[1] (Offset Error) |
|---|---|---|---|
| Calibrated | Typical (25 °C, ±5 °C) | ±0.04% | ±0.07% |
| | Maximum (-40 °C to 70 °C) | ±0.25% | ±0.25% |

[1] Range equals 10.53 V

**Table 2.** NI 9201 Accuracy (Excludes Noise) (Continued)

| Measurement Conditions | | Percent of Reading (Gain Error) | Percent of Range[1] (Offset Error) |
|---|---|---|---|
| Uncalibrated[2] | Typical (25 °C, ±5 °C) | ±0.26% | ±0.46% |
| | Maximum (-40 °C to 70 °C) | ±0.67% | ±1.25% |

| | |
|---|---|
| Stability | |
| Gain drift | ±34 ppm/°C |
| Offset drift | ±100 µV/°C |
| Input bandwidth (-3 dB) | 690 kHz min |
| Input impedance | |
| Resistance | 1 MΩ |
| Capacitance | 5 pF |
| Input noise, code-centered | |
| RMS | 0.7 LSBrms |
| Peak-to-peak | 5 LSB |
| No missing codes | 12 bits |
| DNL | -0.9 to 1.5 LSB |
| INL | ±1.5 LSB |
| Crosstalk, at 10 kHz | -75 dB |
| Settling time, to 1 LSB | 2 µs |
| MTBF | 1,092,512 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method |

# Power Requirements

| | |
|---|---|
| Power consumption from chassis | |
| Active mode | 1 W maximum |
| Sleep mode | 1 mW maximum |
| Thermal dissipation (at 70 °C) | |
| Active mode | 1 W maximum |
| Sleep mode | 32 mW maximum |

[1] Range equals 10.53 V

[2] Uncalibrated accuracy refers to the accuracy achieved when acquiring in raw or unscaled modes where the calibration constants stored in the module are not applied to the data.

# Physical Characteristics

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

**Tip** For two-dimensional drawings and three-dimensional models of the C Series module and connectors, visit *ni.com/dimensions* and search by module number.

| | |
|---|---|
| Screw-terminal wiring | |
| Gauge | 0.2 $mm^2$ to 2.5 $mm^2$ (26 AWG to 14 AWG) copper conductor wire |
| Wire strip length | 13 mm (0.51 in.) of insulation stripped from the end |
| Temperature rating | 90 °C minimum |
| Torque for screw terminals | 0.5 N · m to 0.6 N · m (4.4 lb · in. to 5.3 lb · in.) |
| Wires per screw terminal | One wire per screw terminal; two wires per screw terminal using a 2-wire ferrule |
| Ferrules | 0.25 $mm^2$ to 2.5 $mm^2$ |
| Spring-terminal wiring | |
| Gauge | 0.2 $mm^2$ to 2.5 $mm^2$ (30 AWG to 12 AWG) copper conductor wire |
| Wire strip length | 10 mm (0.39 in.) of insulation stripped from the end |
| Temperature rating | 90 °C minimum |
| Wires per spring terminal | One wire per spring terminal; two wires per spring terminal using a 2-wire ferrule |
| Ferrules | 0.25 $mm^2$ to 2.5 $mm^2$ |
| Connector securement | |
| Securement type | Screw flanges provided |
| Torque for screw flanges | 0.2 N · m (1.80 lb · in.) |
| Weight | |
| NI 9201 with screw terminal | 165 g (5.8 oz) |
| NI 9201 with spring terminal | 152 g (5.4 oz) |
| NI 9201 with DSUB | 142 g (5.0 oz) |

## NI 9201 with Screw Terminal and NI 9201 with Spring Terminal Safety Voltages

Connect only voltages that are within the following limits.

| | |
|---|---|
| Channel-to-COM | ±60 VDC maximum |
| Channel-to-channel | None |
| Channel-to-earth ground | |
| Continuous | 250 Vrms, Measurement Category II |
| Withstand | 2,300 Vrms, verified by a 5 s 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.

**Caution** Do not connect the NI 9201 with screw terminal or NI 9201 with spring terminal to signals or use for measurements within Measurement Categories III or IV.

## NI 9201 with DSUB Safety Voltages

Connect only voltages that are within the following limits.

| | |
|---|---|
| Channel-to-COM | ±60 VDC maximum |
| Channel-to-channel | None |
| Channel-to-earth | |
| Continuous | 60 VDC, Measurement Category I |
| Withstand | 1,000 Vrms, verified by a 5 s 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.

**Caution** Do not connect the NI 9201 with DSUB to signals or use for measurements within Measurement Categories III or IV.

**Note** Measurement Categories CAT I and CAT O 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.

## Hazardous Locations

| | |
|---|---|
| U.S. (UL) | Class I, Division 2, Groups A, B, C, D, T4;<br>Class I, Zone 2, AEx nA IIC T4 |
| Canada (C-UL) | Class I, Division 2, Groups A, B, C, D, T4;<br>Class I, Zone 2, Ex nA IIC T4 |
| Europe (ATEX) and International (IECEx) | Ex nA IIC T4 Gc |

## Safety and Hazardous Locations Standards

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 61010-1
- EN 60079-0:2012, EN 60079-15:2010
- IEC 60079-0: Ed 6, IEC 60079-15; Ed 4
- UL 60079-0; Ed 5, UL 60079-15; Ed 3
- CSA 60079-0:2011, CSA 60079-15:2012

**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 sensitive electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Industrial 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** For EMC declarations and certifications, and additional information, refer to the *Online Product Certification* section.

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

# CE Compliance CE

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)
- 94/9/EC; Potentially Explosive Atmospheres (ATEX)

# 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.

# Shock and Vibration

To meet these specifications, you must panel mount the system.

| | |
|---|---|
| Operating vibration | |
| Random (IEC 60068-2-64) | 5 $g_{rms}$, 10 Hz to 500 Hz |
| Sinusoidal (IEC 60068-2-6) | 5 g, 10 Hz to 500 Hz |
| Operating shock (IEC 60068-2-27) | 30 g, 11 ms half sine; 50 g, 3 ms half sine; 18 shocks at 6 orientations |

# Environmental

Refer to the manual for the chassis you are using for more information about meeting these specifications.

| | |
|---|---|
| Operating temperature (IEC 60068-2-1, IEC 60068-2-2) | -40 °C to 70 °C |
| Storage temperature (IEC 60068-2-1, IEC 60068-2-2) | -40 °C to 85 °C |
| Ingress protection | IP40 |
| Operating humidity (IEC 60068-2-78) | 10% RH to 90% RH, noncondensing |
| Storage humidity (IEC 60068-2-78) | 5% RH to 95% RH, noncondensing |
| Pollution Degree | 2 |
| Maximum altitude | 2,000 m |

Indoor use only.

# 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 *Minimize Our Environmental Impact* 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 NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, 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`.)

# Calibration

You can obtain the calibration certificate and information about calibration services for the NI 9201 at *ni.com/calibration*.

| | |
|---|---|
| Calibration interval | 1 year |

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