NI-9206

DATASHEET

NI 9206

16 AI Differential/32 AI Single-Ended, ±200 mV to ±10 V, 16 Bit, 250 kS/s Aggregate, Fuel-Cell Measurements

- Spring-terminal connectivity
- Protective backshell
- 600 VDC (US)/400 VDC (EU), CAT I, channel-to-earth isolation

The NI 9206 C Series module for use with any CompactDAQ or CompactRIO system features 16 differential analog inputs, 16-bit resolution, and a maximum sampling rate of 250 kS/s. Each channel has programmable input ranges of ±200 mV, ±1 V, ±5 V, and ±10 V.

To protect against signal transients, the NI 9206 includes ±30 V of overvoltage protection between input channels and common (COM). In addition, the NI 9206 also includes a channel-to-earth-ground double isolation barrier for safety, noise immunity, and high common-mode voltage range. The NI 9206 is rated for 1,000 Vrms transient overvoltage protection.

The NI 9206 provides up to 600 VDC (400 VDC in Europe) channel-to-earth ground isolation, making the module ideal for accurately monitoring large fuel cell and battery stacks. Though each bank of measured cells can be up to 600 V from earth ground, each channel of the NI 9206 must remain within 10 V of the module COM.

Kit Contents	• NI 9206 • NI 9206 Getting Started Guide
Accessories	• NI 9974 Spring-Terminal Block (196740-01) • NI 9941 Backshell Kit (779568-01)

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

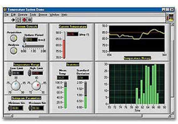
CompactRIO combines an open-embedded architecture with small size, extreme ruggedness, and C Series modules in a platform powered by the NI LabVIEW reconfigurable I/O (RIO) architecture. Each system contains an FPGA for custom timing, triggering, and processing with a wide array of available modular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

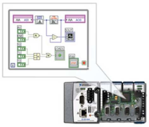
Software

LabVIEW Professional Development System for Windows



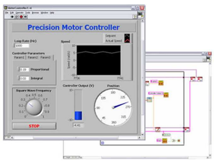
- Use advanced software tools for large project development
- Generate code automatically using DAQ Assistant and Instrument I/O Assistant
- Use advanced measurement analysis and digital signal processing
- Take advantage of open connectivity with DLLs, ActiveX, and .NET objects
- Build DLLs, executables,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

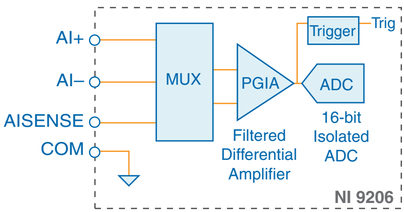


- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of 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

Input Circuitry

The NI 9206 channels share a common ground that is isolated from other modules in the system. All channels share a programmable gain instrumentation amplifier and are multiplexed to an ADC. Each channel also has ±30 V overvoltage protection.

Figure 1. Input Circuitry for One Analog Input Channel on the NI 9206



NI 9206 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 9206 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/Output Characteristics

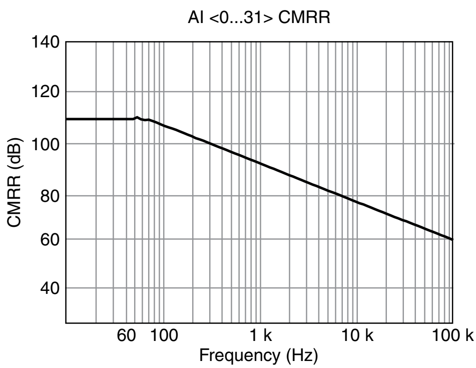
MTBF	765,695 hours at 25 °C; Bellcore Issue 6, Method 1, Case 3, Limited Part Stress Method

Analog Input Characteristics

Number of channels	16 differential/32 single-ended channels
ADC resolution	16 bits
DNL	No missing codes guaranteed
Conversion time (maximum sampling rate)	
CompactRIO & CompactDAQ chassis	4.00 µs (250 kS/s)
R Series Expansion chassis	4.50 µs (222 kS/s)
Input coupling	DC
Nominal input ranges	±10 V, ±5 V, ±1 V, ±0.2 V
Minimum overrange, ±10 V range	4%
Maximum working voltage for analog inputs (signal + common mode)	Each channel must remain within ±10.4 V of COM
Input impedance (AI-to-COM)	
Powered on	>10 GΩ in parallel with 100 pF
Powered off/overload	4.7 kΩ minimum
Input bias current	±100 pA
Crosstalk, at 100 kHz	
Adjacent channels	-65 dB
Non-adjacent channels	-70 dB
Analog bandwidth	370 kHz

Overvoltage protection	
AI channel, 0 to 31	±30 V, one channel only
AISENSE	±30 V
Settling time for multichannel measurements, accuracy, all ranges	
±120 ppm of full-scale step, ±8 LSB	4 µs convert interval
±30 ppm of full-scale step, ±2 LSB	8 µs convert interval
Analog triggers	
Number of triggers	1
Resolution	10 bits, 1 in 1,024
Bandwidth, -3 dB	370 kHz
Accuracy	±1% of full scale
Scaling coefficients	
±10 V range	328 µV/LSB
±5 V range	164.2 µV/LSB
±1 V range	32.8 µV/LSB
±0.2 V range	6.57 µV/LSB
CMRR, DC to 60 Hz	100 dB

Figure 2. CMRR, AI+ to AI-



Analog Input Absolute Accuracy

The following values are based on calibrated scaling coefficients, which are stored in the onboard EEPROM.

Table 1. Absolute accuracy

Range	Accuracy at Full Scale[1]	Random Noise, σ	Sensitivity[2]
±10 V	6,230 µV	240 µVrms	96.0 µV
±5 V	3,230 µV	116 µVrms	46.4 µV
±1 V	690 µV	26 µVrms	10.4 µV
±0.2 V	174 µV	10 µVrms	4.0 µV

Residual gain error	
±10 V range	115 ppm of reading
±5 V range	135 ppm of reading
±1 V range	155 ppm of reading
±0.2 V range	215 ppm of reading
Gain tempco	11 ppm/°C
Reference tempco	5
Residual offset error	
±10 V range	20 ppm of range
±5 V range	20 ppm of range
±1 V range	25 ppm of range
±0.2 V range	40 ppm of range
Offset tempco	
±10 V range	44 ppm of range/°C
±5 V range	47 ppm of range/°C
±1 V range	66 ppm of range/°C
±0.2 V range	162 ppm of range/°C
INL error	76 ppm of range

Analog Input Accuracy Formulas

*Absolute Accuracy = Reading * Gain Error + Range * Offset Error + Noise Uncertainty*

where

*Gain Error = Residual Gain Error + Gain Tempco * Temp Change from Last Internal Cal + Reference Tempco * Temp Change from Last External Cal*

1 Absolute accuracy values at full scale on the analog input channels assume the device is operating within 70 °C of the last external calibration and are valid for averaging 100 samples immediately following self-calibration.

2 Sensitivity is a function of noise and indicates the smallest voltage change that can be detected.

Offset Error = *Residual Offset Error* + *Offset Tempco* * *Temp Change from Last Internal Cal* + *INL Error*

Noise Uncertainty = (*Random Noise* * 3) / √100 for a coverage factor of 3 σ and averaging 100 points

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

Temp Change from Last External Cal = 70 °C

Temp Change from Last Internal Cal = 1 °C

Number of Readings = 100

Coverage Factor = 3 σ

For example, on the ±10 V range, the absolute accuracy at full scale is as follows:

Gain Error = 115 ppm + 11 ppm * 1 + 5 ppm * 70

Gain Error = 476 ppm

Offset Error = 20 ppm + 44 ppm * 1 + 76 ppm

Offset Error = 140 ppm

Noise Uncertainty = (240 µV * 3) / √100

Noise Uncertainty = 72 µV

Absolute Accuracy = 10 V * 476 ppm + 10 V * 140 ppm + 72 µV

Absolute Accuracy = 6,232 µV, rounds to 6,230 µV

Digital Characteristics

Number of channels	1 digital input channel, 1 digital output channel
Overvoltage protection	±30 V
Digital logic levels	
Input high, V_{IH}	
Minimum	2.0 V
Maximum	3.3 V
Input low, V_{IL}	
Minimum	0 V
Maximum	0.34 V
Output high, V_{OH}, sourcing 75 µA	
Minimum	2.1 V
Maximum	3.3 V

[3] The digital output channel is supported only in CompactRIO Systems with the FPGA Interface.

Output low, V_{OH}, sinking 250 μA	
Minimum	0 V
Maximum	0.4 V
External digital triggers	
Source	PFI0
Delay	100 ns maximum

Power Requirements

Power consumption from chassis	
Active mode	625 mW maximum
Sleep mode	15 mW
Thermal dissipation (at 70 °C)	
Active mode	625 mW maximum
Sleep mode	15 mW

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.

Spring-terminal wiring	
Gauge	0.08 mm^2 to 1.0 mm^2 (28 AWG to 18 AWG) copper conductor wire
Wire strip length	7 mm (0.28 in.) of insulation stripped from the end
Temperature rating	90 °C minimum
Wires per spring terminal	One wire per spring terminal
Connector securement	
Securement type	Screw flanges provided
Torque for screw flanges	0.2 N · m (1.80 lb · in.)
Weight	158 g (5.8 oz)

Safety Voltages

Connect only voltages that are within the following limits:

Maximum voltage[4]	
AI, PFI0, and D0 to COM	±30 VDC

Isolation Voltages

Channel-to-channel	None
Channel-to-earth ground	
Continuous	
U.S. (UL 61010-1)	600 VDC, Measurement Category I
Europe (IEC 61010-1)	400 VDC, Measurement Category I
Withstand	2,500 Vpk, 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 9206 to signals or use for measurements within Measurement Categories II, 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; Class I, Zone 2, AEx nA IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA IIC T4
Europe (ATEX) and International (IECEx)	Ex nA IIC T4 Gc

4 The maximum voltage that can be applied or output between AI and COM without creating a safety hazard.

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 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; Industrial 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 shielded cabling.

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 9206 at *ni.com/calibration*.

Calibration interval	2 years

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