

# 8-Channel Strain Gage Modules

## NI 9235, NI 9236

- 8 channels, simultaneous quarter-bridge inputs
- 10 kS/s/ch sample rate
- 1000 V<sub>rms</sub> transient isolation
- 24-bit resolution
- Multiple module synchronization within the same chassis
- Ability to program for USB with the easy-to-use NI-DAQmx driver
- Built-in excitation
- Built-in shunt calibration

### C Series Compatibility

- NI CompactDAQ (NI-DAQmx)
- CompactRIO (NI-RIO)
- R Series expansion chassis (NI-RIO)

### Recommended Software

- LabVIEW
- LabWindows™/CVI
- Measurement Studio

### NI-DAQmx Compatible Software

- LabVIEW SignalExpress
- Visual Studio .NET
- ANSI C/C++/C#

### Connectivity

- NI 9235/9236 modules are shipped with everything needed to connect signals out of the box
- Backshell is available for added strain relief and cable protection



Module	C Series Compatibility	Channels	Resolution	Excitation	Bridge Completion	Sample Rate (kS/s/ch)	Simultaneous
NI 9237	CompactRIO, NI CompactDAQ, USB, Wi-Fi	4	24 bits	Up to 10 V or external	Full, half, quarter (120, 350 Ω)	50	✓
NI 9235	CompactRIO, NI CompactDAQ, USB Carrier	8	24 bits	2.0 V	Quarter (120 Ω)	10	✓
NI 9236	CompactRIO, NI CompactDAQ, USB Carrier	8	24 bits	3.3 V	Quarter (350 Ω)	10	✓

Table 1. NI C Series Strain Gage Module Selection Guide

## Overview and Applications

NI 9235 and 9236 C Series analog input modules are ideal for medium- to high-channel-count strain measurement applications such as structural or impact test. You can use these modules in the 8-slot NI CompactDAQ USB chassis for a plug-and-play, portable setup that can measure up to 64 channels in a single chassis. All channels of all C Series modules synchronize in the backplane.

For structural health monitoring or other applications that require embedded logging or processing, you can use NI 9235/9236 modules in 4- and 8-slot NI CompactRIO chassis, which include an onboard processor and storage media. CompactRIO has an extended operational temperature range as well as rugged shock and vibration specifications and a Class 1, Division 2 hazardous location rating.

The small size and high performance of C Series hardware make it a good choice for compact test systems with multiple measurement types. You can add and synchronize new measurements by installing additional modules in the chassis. Common systems that use strain gages range from small engine test cells to mountain bike frame tests to in-vehicle chassis and suspension tests. The high bandwidth available in C Series hardware like NI CompactDAQ and CompactRIO delivers high-speed measurements such as dynamic strain, acceleration, and sound. You can mix these measurements with lower-speed measurements such as temperature in the same system with the same program.

## High Throughput with Multiple ADCs

The use of multiple analog-to-digital converters (ADCs) in a single module has two main benefits. First, the overall sample rate available to each channel is dramatically increased. This is important when conducting high-speed tests, such as impact or fracture tests, over multiple channels. The other main advantage is the elimination of phase offset between channels when sampling at higher speeds.

## Elimination of Unwanted Signals with Built-In Antialias Filters

For dynamic measurements, it is important to filter out unwanted signals. Without some form of filtering, unwanted high-frequency signals can alias the signal you are measuring, causing incorrect readings. To prevent these phenomena, NI 9235/9236 modules have built-in antialiasing filters that adjust to your selected sample rate and ensure that the signal you are measuring has no interference from signals beyond the Nyquist frequency.

## Mixed-Measurement Test System

NI 9235/9236 modules are just two in a collection of more than 50 C Series modules for measurements such as temperature, acceleration, voltage, current, sound, pressure, load, force, torque, and digital I/O. You can easily synchronize every C Series module you use in a chassis to acquire data from all channels at the same rate and at the same time.

## 8-Channel Strain Gage Modules

### Accessories

NI 9235/9236 modules are shipped with everything you need to take them out of the box and begin connecting signal wires. For added strain relief, you can purchase connector backshells as an accessory kit. Accessory kits are also available for spares or replacements of spring terminal connectors for the modules.



Backshell for NI 9235/9236 Strain Gage Modules

### C Series Chassis

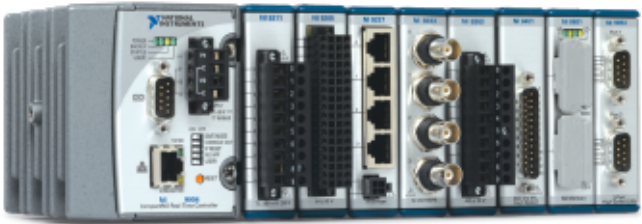
#### NI CompactDAQ Platform

NI CompactDAQ delivers the simplicity of USB to sensor and electrical measurements on the benchtop, in the field, and on the production line. By combining the ease of use and low cost of a data logger with the performance and flexibility of modular instrumentation, NI CompactDAQ offers fast, accurate measurements in a small, simple, and affordable system. Flexible software options make it easy to use NI CompactDAQ to log data for simple experiments or to develop a fully automated test or control system. The modular design can measure up to 256 channels of electrical, physical, mechanical, or acoustical signals in a single system. In addition, per-channel ADCs and individually isolated modules ensure fast, accurate, and safe measurements.



#### NI CompactRIO Platform

When used with the small, rugged CompactRIO embedded control and data acquisition system, C Series analog input modules connect directly to reconfigurable I/O (RIO) field-programmable gate array (FPGA) hardware to create high-performance embedded systems. The reconfigurable FPGA hardware within CompactRIO provides a variety of options for custom timing, triggering, synchronization, filtering, signal processing, and high-speed decision making for all C Series analog input modules. For instance, with CompactRIO, you can implement custom triggering for any analog sensor type on a per-channel basis using the flexibility and performance of the FPGA and the numerous arithmetic and comparison function blocks built into the NI LabVIEW FPGA Module.



#### Ordering Information

NI 9235 (120 $\Omega$ ) .....	779993-01
NI 9236 (350 $\Omega$ ) .....	779994-01
NI 9965 strain relief backshell .....	780216-01
NI 9966 replacement connector .....	780542-01

#### BUY NOW!

For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to [ni.com/compactrio](http://ni.com/compactrio).

## 8-Channel Strain Gage Modules

### Specifications

The following specifications are typical for the range -40 to 70 °C unless otherwise noted. The specifications are the same for the NI 9235 and the NI 9236 unless otherwise noted.

#### Input Characteristics

Number of channels.....	8 analog input channels
Quarter-bridge completion	
NI 9235 .....	120 $\Omega$ , 10 ppm/°C max
NI 9236 .....	350 $\Omega$ , 10 ppm/°C max
ADC resolution.....	24 bits
Type of ADC .....	Delta-sigma (with analog prefiltering)
Sampling mode .....	Simultaneous
Internal master timebase ( $f_M$ )	
Frequency.....	12.8 MHz
Accuracy .....	$\pm 100$ ppm max
Data rate range ( $f_s$ ) using internal master timebase	
Minimum.....	794 S/s
Maximum.....	10 kS/s
Data rate range ( $f_s$ ) using external master timebase	
Minimum.....	195.3125 S/s
Maximum.....	10.547 kS/s
Data rates ( $f_s$ ) .....	$\frac{f_M \div 256}{n}$ , $n = \{2, 4, 5, \dots, 63\}$
Full-scale range.....	$\pm 29.4$ mV/V (+62,500 $\mu\text{E}$ /-55,500 $\mu\text{E}$ )
Scaling coefficient.....	3.5062 nV/V per LSB
Overvoltage protection	
between any two terminals .....	$\pm 30$ V

#### Accuracy, NI 9235

Measurement Conditions	Percent of Reading <sup>1</sup> (Gain Error)	Percent of Range <sup>2</sup> , <sup>3</sup> (Offset Error)	
		30 Days after Cal. ( $\pm 5$ °C)	1 Year after Cal. ( $\pm 5$ °C)
Calibrated typ (25 °C, $\pm 5$ °C)	0.02%	0.1%	0.15%
Calibrated max (-40 to 70 °C)	0.07%	0.17%	0.4%
Uncalibrated typ (25 °C, $\pm 5$ °C)	0.15%	1.25%	
Uncalibrated max (-40 to 70 °C)	0.53%	2.14%	

<sup>1</sup>Exclusive of lead wire desensitization error.

<sup>2</sup>Range equals 29.4 mV/V.

<sup>3</sup>Calibrated errors represent offset stability following unstrained measurement.

Errors include the effect of completion resistor tolerance and drift.

#### Stability, NI 9235

Gain drift .....	6 ppm/°C
Offset drift.....	2.2 $\mu\text{V/V}/^\circ\text{C}$

#### Accuracy, NI 9236

Measurement Conditions	Percent of Reading <sup>1</sup> (Gain Error)	Percent of Range <sup>2</sup> , <sup>3</sup> (Offset Error)	
		30 Days after Cal. ( $\pm 5$ °C)	1 Year after Cal. ( $\pm 5$ °C)
Calibrated typ (25 °C, $\pm 5$ °C)	0.02%	0.08%	0.14%
Calibrated max (-40 to 70 °C)	0.07%	0.16%	0.39%
Uncalibrated typ (25 °C, $\pm 5$ °C)	0.15%	0.79%	
Uncalibrated max (-40 to 70 °C)	0.53%	1.67%	

<sup>1</sup>Exclusive of lead wire desensitization error.

<sup>2</sup>Range equals 29.4 mV/V.

<sup>3</sup>Calibrated errors represent offset stability following unstrained measurement.

Errors include the effect of completion resistor tolerance and drift.

#### Stability, NI 9236

Gain drift .....	6 ppm/°C
Offset drift.....	1.7 $\mu\text{V/V}/^\circ\text{C}$

#### Dynamic Characteristics

Channel-to-Channel Matching (Calibrated)

Input Signal Frequency ( $f_{in}$ )	Gain		Phase
	Typical	Maximum	Maximum
0 to 1 kHz	0.08%	0.11%	$0.34^\circ/\text{kHz} \cdot f_{in}$
0 to 4 kHz	0.17%	0.32%	

Phase nonlinearity

$f_{in} = 0$  to 1 kHz .....  $\pm 0.002^\circ$

$f_{in} = 0$  to 4 kHz .....  $\pm 0.1^\circ$

Input delay .....  $38.2/f_s + 11$   $\mu\text{s}$

Passband

Frequency.....  $0.45 \cdot f_s$

Flatness ( $f_s = 10$  kS/s)..... 33 mdB max

Stopband

Frequency.....  $0.55 \cdot f_s$

Rejection..... 100 dB

Alias-free bandwidth .....  $0.45 \cdot f_s$

Oversample rate.....  $64 \cdot f_s$

Rejection at oversample rate

( $f_s = 10$  kS/s) ..... 80 dB at 640 kHz

Input noise

$f_s = 1$  kS/s

NI 9235..... 0.38  $\mu\text{V}/V_{\text{rms}}$

NI 9236..... 0.25  $\mu\text{V}/V_{\text{rms}}$

$f_s = 10$  kS/s

NI 9235..... 0.85  $\mu\text{V}/V_{\text{rms}}$

NI 9236..... 0.5  $\mu\text{V}/V_{\text{rms}}$

SFDR (1 kHz, -60 dBFS)

NI 9235 ..... 110 dB

NI 9236 ..... 115 dB

THD (1 kHz, -20 dBFS)

NI 9235 ..... -90 dB

NI 9236 ..... -95 dB

Crosstalk ( $f_{in} = 1$  kHz)..... -100 dB

Common-mode voltage,

all signals to earth ground.....  $\pm 60$  VDC

CMRR ( $f_{in} = 0$  to 60 Hz)

NI 9235 ..... 120 dB

NI 9236 ..... 110 dB

MTBF ..... 566,796 hours at 25 °C; Bellcore  
Issue 2, Method 1, Case 3,  
Limited Part Stress Method

**Note:** Contact NI for Bellcore MTBF specifications at other temperatures  
or for MIL-HDBK-217F specifications.

#### Shunt Calibration Characteristics

Shunt calibration accuracy

Measurement Conditions	NI 9235 Percent of Reading (Gain Error)	NI 9236 Percent of Reading (Gain Error)
Typical (25 °C, $\pm 5$ °C)	0.09%	0.07%
Maximum (-40 to 70 °C)	0.22%	0.2%

## 8-Channel Strain Gage Modules

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Resistance	
NI 9235 .....	50 k $\Omega$
NI 9236 .....	100 k $\Omega$
Output value	
NI 9235 .....	-599.28 $\mu$ V/V
NI 9236 .....	-873.47 $\mu$ V/V
Temperature drift .....	15 ppm/ $^{\circ}$ C
Method.....	Shunt across completion resistor

### Excitation Characteristics

Excitation type .....	Constant voltage
Excitation value	
NI 9235 .....	2.0 V $\pm$ 1%
NI 9236 .....	3.3 V $\pm$ 1%
Maximum output current	
NI 9235 .....	80 mA
NI 9236 .....	46 mA

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## Hardware Services

### NI Factory Installation Services

NI Factory Installation Services (FIS) is the fastest and easiest way to use your PXI or PXI/SCXI combination systems right out of the box. Trained NI technicians install the software and hardware and configure the system to your specifications. NI extends the standard warranty by one year on hardware components (controllers, chassis, modules) purchased with FIS. To use FIS, simply configure your system online with [ni.com/pxiadvisor](http://ni.com/pxiadvisor).

### Calibration Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit [ni.com/calibration](http://ni.com/calibration).

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