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**NI-9230**

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# NI-9230

# Specifications

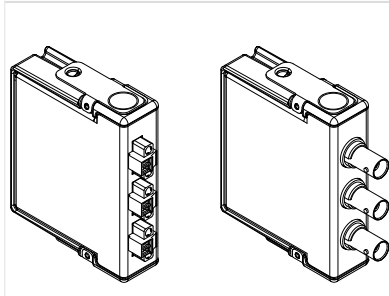
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2022-10-03

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# NI 9230 Datasheet



- Screw-terminal or BNC connectivity
- Software-selectable AC/DC coupling
- Software-selectable IEPE signal conditioning (0 mA or 4 mA)
- Smart TEDS sensor compatibility
- 60 V DC, CAT I, channel-to-earth isolation

The NI-9230 is a 3-channel C Series dynamic signal acquisition module for making industrial measurements from integrated electronic piezoelectric (IEPE) and non-IEPE sensors with NI CompactDAQ or NI CompactRIO systems.

 <p>Kit Contents</p>	<ul style="list-style-type: none"> <li>• NI 9230</li> <li>• NI 9230 Getting Started Guide</li> </ul>
 <p>Accessories</p>	<p><b>Required</b></p> <ul style="list-style-type: none"> <li>• EMI suppression ferrite (782802-01) (for screw terminal)</li> </ul> <p><b>Recommended</b></p> <ul style="list-style-type: none"> <li>• NI 9971 Backshell Kit (for screw terminal)</li> </ul>

C SERIES DYNAMIC SIGNAL ACQUISITION MODULE COMPARISON							
Product Name	Signal Ranges	Channels	Sample Rate	Input Configurations	Noise at Maximum Sample Rate	Connectivity	Isolation Continuous
NI 9218	±5 V	2	51.2 kS/s/ch	IEPE with AC Coupling	50 $\mu$ Vrms	9-Position DSUB, LEMO	60 VDC Ch-Ch
NI 9230	±30 V	3	12.8 kS/s/ch	IEPE with AC Coupling, AC Coupling, DC Coupling	106 $\mu$ Vrms	Screw Terminal, BNC	60 VDC Ch-Earth
NI 9232	±30 V	3	102.4 kS/s/ch	IEPE with AC Coupling, AC Coupling, DC Coupling	251 $\mu$ Vrms	Screw Terminal, BNC	60 VDC Ch-Earth
NI 9234	±5 V	4	51.2 kS/s/ch	IEPE with AC Coupling, AC Coupling, DC Coupling	50 $\mu$ Vrms	BNC	None
NI 9250	±5 V	2	102.4 kS/s/ch	IEPE with AC Coupling, AC Coupling, DC Coupling	9.7 $\mu$ Vrms	BNC	None
NI 9251	3 Vrms ( $\pm$ 4.243 V)	2	102.4 kS/s/ch	AC Coupling, DC Coupling	8.5 $\mu$ Vrms	mini XLR	None

## 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

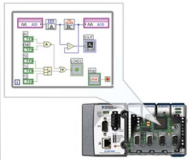


- Use advanced software tools for large project development
- Generate code automatically using DAQ Assistant and Instrument I/O Assistant

## LabVIEW Professional Development System for Windows

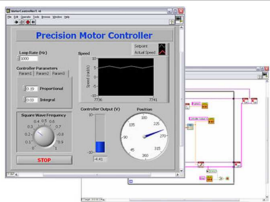
- Use advanced measurement analysis and digital signal processing
- Take advantage of open connectivity with DLLs, ActiveX, and .NET objects
- Build DLLs, executables, and MSI installers

## 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

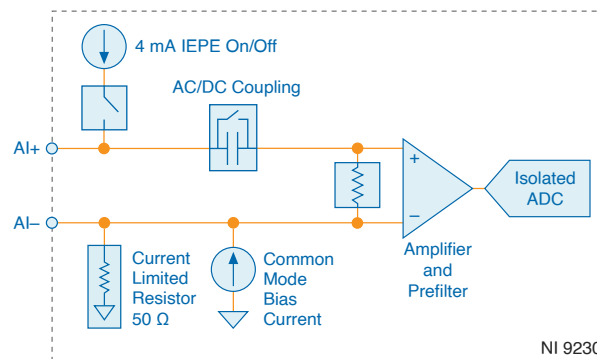


- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of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

## Circuitry

The NI-9230 analog input channels are referenced to an isolated ground through a 50  $\Omega$  resistor. Each channel is protected from overvoltages. The input signal on each channel is buffered, conditioned, and then sampled by an isolated 24-bit Delta-Sigma ADC. You can configure each channel in software for AC or DC coupling. For channels set to AC coupling, you can turn the IEPE excitation current on or off. Refer to the software help for information about configuring channels on the NI-9230.

Figure 1. Input Circuitry for One Channel



The NI-9230 also has TEDS circuitry. For more information about TEDS, visit [ni.com/info](http://ni.com/info) and enter the Info Code `rdteds`.

## Filtering

The NI-9230 uses a combination of analog and digital filtering to provide an accurate representation of in-band signals while rejecting out-of-band signals. The filters discriminate between signals based on the frequency range, or bandwidth, of the signal. The three important bandwidths to consider are the passband, the stopband, and the alias-free bandwidth.

The NI-9230 represents signals within the passband, as quantified primarily by passband ripple and phase nonlinearity. All signals that appear in the alias-free bandwidth are either unaliased signals or signals that have been filtered by at least the amount of the stopband rejection.



## Passband

The signals within the passband have frequency-dependent gain or attenuation. The small amount of variation in gain with respect to frequency is called the passband flatness. The digital filters of the NI-9230 adjust the frequency range of the passband to match the data rate. Therefore, the amount of gain or attenuation at a given frequency depends on the data rate.

## Stopband

The filter significantly attenuates all signals above the stopband frequency. The primary goal of the filter is to prevent aliasing. Therefore, the stopband frequency scales precisely with the data rate. The stopband rejection is the minimum amount of attenuation applied by the filter to all signals with frequencies within the stopband.

## Alias-Free Bandwidth

Any signal that appears in the alias-free bandwidth of the NI-9230 is not an aliased artifact of signals at a higher frequency. The alias-free bandwidth is defined by the ability of the filter to reject frequencies above the stopband frequency, and it is equal to the data rate minus the stopband frequency.

## Data Rates

The frequency of a master timebase ( $f_M$ ) controls the data rate ( $f_s$ ) of the NI-9230.

## Internal Master Timebase

The NI-9230 includes an internal master timebase with a frequency of 13.1072 MHz. When using the internal master timebase, the result is data rates of 12.8 kS/s, 11.38 kS/s, 10.24 kS/s, 9.31 kS/s, and so on down to 0.98 kS/s, depending on the decimation rate and the value of the clock divider. However, the data rate must remain within the appropriate data rate range.

The following equation provides the available data rates of the NI-9230:

$$f_s = \frac{f_M}{2 \times m \times n}$$

where

- $f_s$  is the data rate
- $f_M$  is the master timebase
- $m$  is the decimation rate
- $n$  is the clock divider from 2 to 26

For  $m = 64$ ,  $n = 9$  to 25. For  $m = 128$ ,  $n = 5$  to 25. For  $m = 256$ ,  $n = 2$  to 26.

There are multiple combinations of clock divider and decimation rate that yield the same data rate. The software always picks the highest decimation rate for the selected data rate.

## Data Rates with the Internal Master Timebase

The following table lists the available data rates with the internal master timebase.

$f_s$ (kS/s)	Decimation Rate	Clock Divider
12.80	256	2
11.38	64	9
10.24	128	5
9.31	64	11
8.53	256	3
7.88	64	13
7.31	128	7
6.83	64	15
6.40	256	4
6.02	64	17
5.69	128	9
5.39	64	19
5.12	256	5
4.88	64	21

$f_s$ (kS/s)	Decimation Rate	Clock Divider
4.65	128	11
4.45	64	23
4.27	256	6
4.10	64	25
3.94	128	13
3.66	256	7
3.41	128	15
3.20	256	8
3.01	128	17
2.84	256	9
2.69	128	19
2.56	256	10
2.44	128	21
2.33	256	11
2.23	128	23
2.13	256	12
2.05	128	25
1.97	256	13
1.83	256	14
1.71	256	15
1.60	256	16
1.51	256	17
1.42	256	18
1.35	256	19
1.28	256	20
1.22	256	21
1.16	256	22
1.11	256	23
1.07	256	24
1.02	256	25

$f_s$ (kS/s)	Decimation Rate	Clock Divider
0.98	256	26

Table 1. Available Data Rates with the Internal Master Timebase

## External Master Timebase

The NI-9230 also can accept an external master timebase or export its own master timebase. To synchronize the data rate of an NI-9230 with other modules that use master timebases to control sampling, all of the modules must share a single master timebase source. When using an external timebase with a frequency other than 13.1072 MHz, the NI-9230 has a different set of data rates. Refer to the software help for information about configuring the master timebase source for the NI-9230.

**Note** The NI 9151 R Series Expansion chassis does not support sharing timebases between modules.