NI-9230 Getting Started

ES France - Département NI
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 71
Fax. 01 47 01 16 22
e-mail : ni@es-france.com
Site Web : www.es-france.com

NI-9230 Getting Started 3-Channel, 12.8 kS/s/channel, ±30 V, C Series Sound and Vibration Input Module

Contents

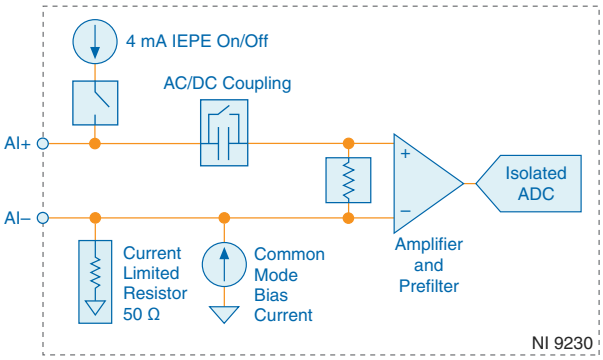
NI-9230 Overview

In this article, the NI-9230 with screw terminal, NI-9230 with snap in terminal, and NI-9230 with BNC are referred to inclusively as the NI-9230. The information in this document applies to all versions of the NI-9230 unless otherwise specified.

NI-9230 Block Diagram

The NI-9230 analog input channels are referenced to an isolated ground through a 50 Ω 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 : Block Diagram for One Channel



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

Filtering

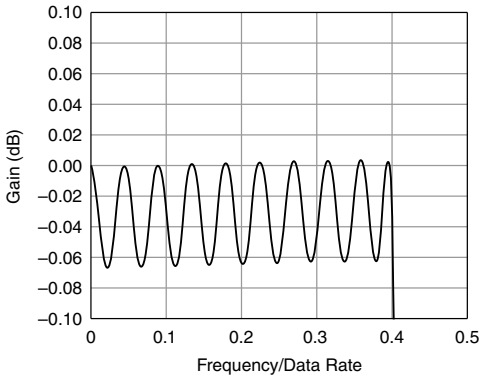
The NI-9230 uses a combination of analog and digital filtering to provide an accurate representation of in-band signals while rejecting out-of-band signals. The filters discriminate between signals based on the frequency range, or bandwidth, of the signal. The three important bandwidths to consider are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

Figure 2 : Typical Passband Flatness



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.

Table 1 : 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

Table 1 : Available Data Rates with the Internal Master Timebase (Continued)

f_s (kS/s)	Decimation Rate	Clock Divider
4.88	64	21
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

Table 1 : Available Data Rates with the Internal Master Timebase (Continued)

f_s (kS/s)	Decimation Rate	Clock Divider
1.16	256	22
1.11	256	23
1.07	256	24
1.02	256	25
0.98	256	26

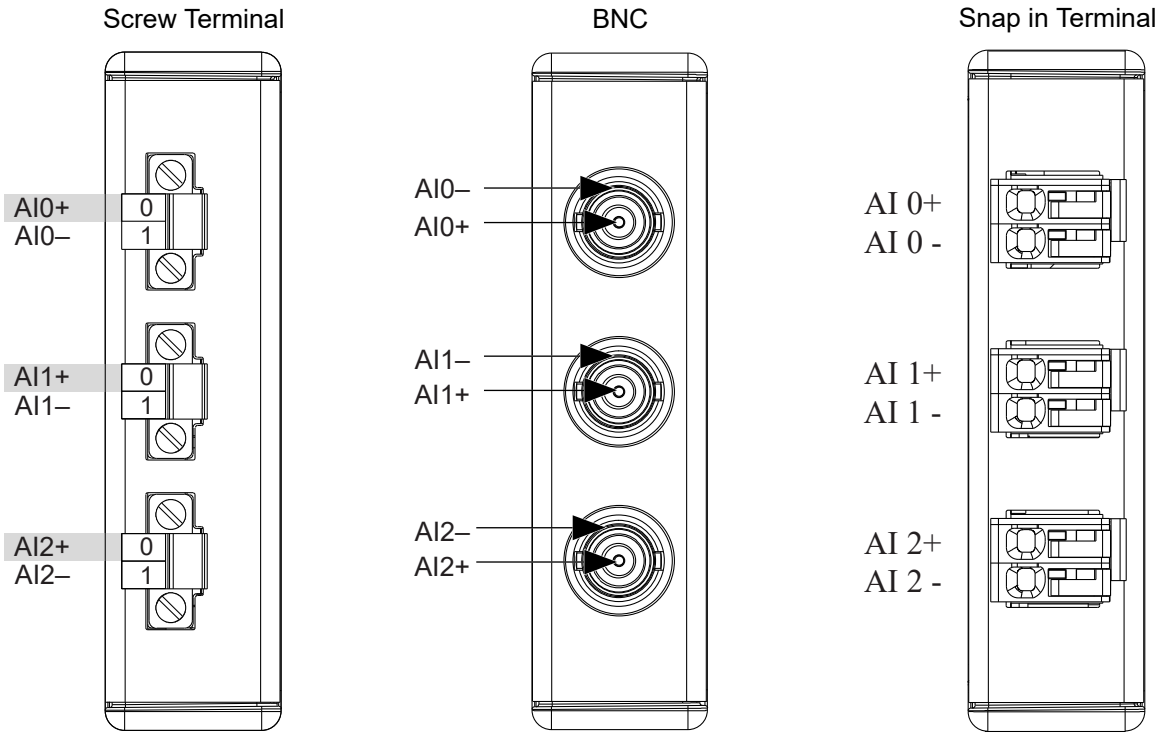
External Master Timebase

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.

Connecting the NI-9230

The NI-9230 provides connections to three simultaneously sampled analog input channels.

NI-9230 Pinout



NOTE
You must use 2-wire ferrules to create a secure connection when connecting more than one wire to a single terminal on the NI-9230 with screw terminal and NI-9230 with snap in terminal.

Each channel has a terminal to which you can connect a signal source. The AI+ terminal of the connector provides the DC excitation, when enabled, and the positive input signal connection. The AI- terminal provides the excitation return path and the signal ground reference.

Table 2 : Signal Descriptions

Signal	Description
AI+	Positive analog input signal connection
AI-	Negative analog input signal connection

Connecting Signal Sources

You can connect ground-referenced or floating signal sources to the NI-9230.

If you make a ground-referenced connection between the signal source and the NI-9230, make sure the voltage on the AI+ and the AI- connections are in the channel-to-earth safety

voltage range to ensure proper operation of the NI-9230. Refer to the module specifications on *ni.com/docs* for more information about operating voltages and overvoltage protection.

Figure 3 : Connecting a Grounded Signal Source

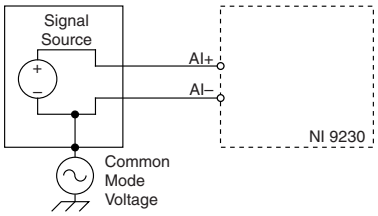
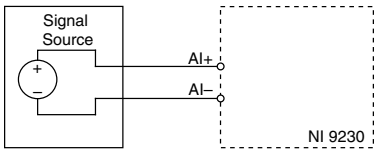


Figure 4 : Connecting a Floating Signal Source



Integrated Electronic Piezoelectric (IEPE) Sensors

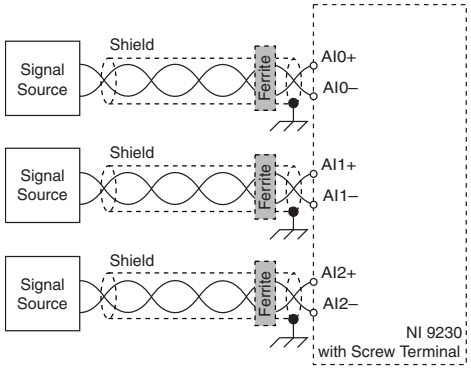
The NI-9230 provides an IEPE excitation current for each channel to measure the IEPE sensors. Typical IEPE sensors have a case that is electrically isolated from the IEPE electronics. As a result, connecting the sensor to the NI-9230 results in a floating connection even though the case of the sensor is grounded.

Cable Requirements for EMC Compliance

Select and install cables for the NI-9230 in accordance with the following requirements:

- Connect the cable shield to the chassis ground (grounding screw of the chassis).
- For the NI-9230 with screw terminal and NI-9230 with snap in terminal, install a clamp-on ferrite bead (part number 782802-01) on the input cable for each channel that you are connecting to on the NI-9230.
- For the NI-9230 with screw terminal and NI-9230 with snap in terminal, clamp-on ferrite beads must be installed on the cable as close to the module as possible. Placing the ferrite elsewhere on the cable noticeably impairs its effectiveness.

Figure 5 : Cable Connections for EMC Compliance



Wiring for High-Vibration Applications

If your application is subject to high vibration, NI recommends that you use the NI 9971 backshell kit to protect connections to the NI-9230 with screw terminals or NI 9990 backshell kit to protect connections to the NI-9230 with snap in terminals.

You must follow these guidelines to meet the shock and vibration performance specifications stated in the device datasheet on `ni.com/manuals`.

- Panel mount the system.
- Provide strain relief for the module by securing the cabling to a supporting fixture no more than 8 cm (3 in.) away from the opening of the connector backshell.
- Ensure that the supporting fixture for strain relief is stiff and rigidly coupled to the chassis mounting surface.
- Use ferrules to terminate wires to the detachable connector.

Conformal Coating

The NI-9230 with screw terminals is available with conformal coating for additional protection in corrosive and condensing environments, including environments with molds and dust.

In addition to the environmental specifications listed in the *NI-9230 Safety, Environmental, and Regulatory Information*, the NI-9230 with conformal coating meets the following specification for the device temperature range. To meet this specification, you must follow the appropriate setup requirements for condensing environments. Refer to *Conformal Coating and NI RIO Products* for more information about conformal coating and the setup requirements for condensing environments.

Operating humidity (IEC 60068-2-30 Test Db)	80 to 100% RH, condensing

ES France - Département NI
127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 71
Fax. 01 47 01 16 22
e-mail : ni@es-france.com
Site Web : www.es-france.com