NI-9251 Specifications

Contents

NI 9251 with mini XLR Datasheet

- Mini-XLR connectivity
- -106 dBc THD+N
- <10 µVrms noise

The NI 9251 with mini XLR is a 2-channel analog input module for CompactDAQ and CompactRIO with a 102.4 kS/s update rate, 24-bit resolution, and 3 Vrms input range. Channels on the NI 9251 with mini XLR allow for high dynamic range measurements necessary to fully test and evaluate modern audio outputs used in most consumer electronic devices. Unlike sound-card-based solutions, the NI 9251 with mini XLR can be deployed quickly and re-calibrated to guarantee long-term measurement repeatability and increased test system up-time. The NI 9251 with mini XLR also features ±30 V overvoltage protection and short circuit protection for safe deployment.

Pairing the NI 9251 with mini XLR with an NI 9260 will enable users to perform the full suite of measurements typically performed with high-end audio analyzers in a CompactDAQ or CompactRIO chassis, greatly improving the footprint and portability of those measurements.

	Kit Contents	• NI 9251 with mini XLR • NI 9251 with mini XLR Getting Started Guide
	Target Applications	• Audio Testing • Noise, Vibrations, and Harshness (NVH)

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
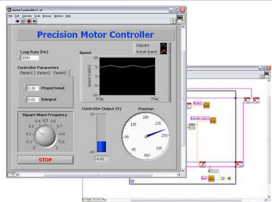
NI LabVIEW FPGA Module
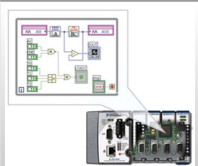
- Design FPGA applications for NI RIO hardware
- Program with the same graphical environment used for desktop and real-time applications
- Execute control algorithms with loop rates up to 300 MHz
- Implement custom timing and triggering logic, digital protocols, and DSP algorithms

| NI LabVIEW FPGA Module	
	■ 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-9251 with mini XLR can measure a maximum signal of 3 Vrms on AI+ with respect to AI-. The ground pin is connected to chassis ground internally, while the AI+ and AI- have a 2 MΩ resistor that is also connected to chassis ground. You can connect a floating differential signal or grounded differential signal to the input. Each channel also has ±30 V overvoltage protection.

Figure 1. NI-9251 with mini XLR Circuitry
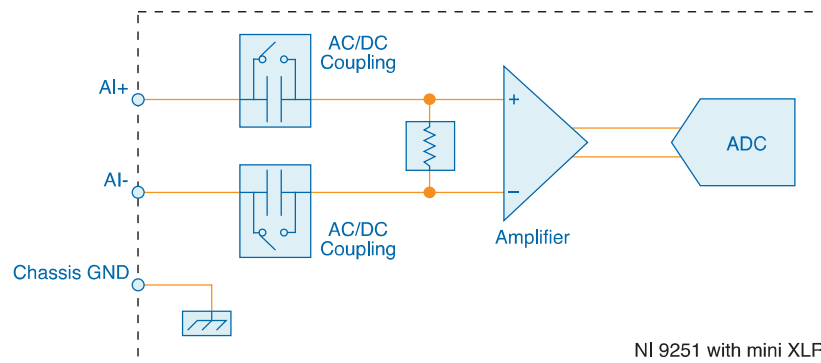
Filtering

The NI-9251 with mini XLR uses a combination of analog and digital filtering to provide an accurate representation of in-band signals and reject 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 anti-imaging bandwidth.

The NI-9251 with mini XLR 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-9251 with mini XLR 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 signals that appear in the alias-free bandwidth are not aliased artifacts 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. The alias-free bandwidth 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-9251 with mini XLR. The NI-9251 with mini XLR includes an internal master timebase with a frequency of 13.1072 MHz. Using the internal master timebase of 13.1072 MHz results in data rates of 102.4 kS/s, 51.2 kS/s, 25.6 kS/s, 17.067 kS/s, and so on down to 267 S/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-9251 with mini XLR:

$$f_s = \frac{f_M}{4 \times a \times b}$$

where **a** is the decimation rate (32, 64, 128, 256, 512, 1024), and **b** is the clock divider (integer between 1 and 12).

> ## Note
> $$\frac{f_M}{b}$$
> must be greater than or equal to 1 MHz.

There are multiple combinations of clock dividers and decimation rates that yield the same data rate. The software always picks the highest decimation rate for the selected data rate. The following table lists available data rates with the internal master timebase.

f $_s$ (kS/s)	Decimation Rate	Clock Divider
102.400	32	1
51.200	64	1
34.133	32	3
25.600	128	1
20.480	32	5
17.067	64	3
14.629	32	7
12.800	256	1
11.378	32	9
10.240	64	5
9.309	32	11
8.533	128	3
7.314	64	7
6.400	512	1
5.689	64	9
5.120	128	5
4.655	64	11
4.267	256	3
3.657	128	7
3.200	1024	1
2.844	128	9
2.560	256	5
2.327	128	11
2.133	512	3
1.829	256	7
1.600	1024	2
1.422	256	9
1.280	512	5
1.164	256	11
1.067	1024	3
0.914	512	7

f$_s$ (kS/s)	Decimation Rate	Clock Divider
0.800	1024	4
0.711	512	9
0.640	1024	5
0.582	512	11
0.533	1024	6
0.457	1024	7
0.400	1024	8
0.356	1024	9
0.320	1024	10
0.291	1024	11
0.267	1024	12

Table 2. Available Data Rates with the Internal Master Timebase

The NI-9251 with mini XLR also can accept an external master timebase or export its own master timebase. To synchronize the data rate of an NI-9251 with mini XLR 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-9251 with mini XLR has a different set of data rates. Refer to the software help for information about configuring the master timebase source for the NI-9251 with mini XLR.

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