cDAQ-SV1101
CompactDAQ Sound and Vibration Bundle
Datasheet and Specifications
cDAQ-9174 and NI-9234
CompactDAQ Sound and Vibration Bundle

In-Box Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI-9234</td>
<td>Sound and Vibration Module</td>
<td></td>
</tr>
<tr>
<td>cDAQ-9171</td>
<td>1-Slot CompactDAQ Chassis</td>
<td></td>
</tr>
<tr>
<td>USB Cable</td>
<td>(USB-A to USB-B)</td>
<td></td>
</tr>
</tbody>
</table>

Recommended Software

FlexLogger

No code software that accelerates measurement configuration and logging with NI DAQ Hardware.
- Acquire data and log test results to .tdms or .csv files
- Inline calculations for simple math, filtering, Boolean logic, and more
- Integrated TDMS Viewer for interactive data review

P/N: 785748-3501

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DEVICE SPECIFICATIONS

NI cDAQ™-9171
NI CompactDAQ One-Slot Bus-Powered USB Chassis

These specifications are for the NI cDAQ-9171 chassis only. These specifications are typical at 25 °C unless otherwise noted. For the C Series module specifications, refer to the documentation for the C Series module you are using.

### Analog Input

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input FIFO size</td>
<td>127 samples</td>
</tr>
<tr>
<td>Maximum sample rate</td>
<td>Determined by the C Series module</td>
</tr>
<tr>
<td>Timing accuracy</td>
<td>50 ppm of sample rate</td>
</tr>
<tr>
<td>Timing resolution</td>
<td>12.5 ns</td>
</tr>
<tr>
<td>Number of channels supported</td>
<td>Determined by the C Series module</td>
</tr>
</tbody>
</table>

### Analog Output

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels supported</td>
<td></td>
</tr>
<tr>
<td>Hardware-timed task</td>
<td></td>
</tr>
<tr>
<td>Onboard regeneration</td>
<td>16</td>
</tr>
<tr>
<td>Non-regeneration</td>
<td>Determined by the C Series module</td>
</tr>
<tr>
<td>Non-hardware-timed task</td>
<td>Determined by the C Series module</td>
</tr>
<tr>
<td>Maximum update rate</td>
<td></td>
</tr>
<tr>
<td>Onboard regeneration</td>
<td>1.6 MS/s (multi-channel, aggregate)</td>
</tr>
<tr>
<td>Non-regeneration</td>
<td>Determined by the C Series module</td>
</tr>
</tbody>
</table>

---

1. Performance dependent on type of installed C Series module and number of channels in the task.
2. Does not include group delay. For more information, refer to the documentation for each C Series module.
Timing accuracy

50 ppm of sample rate

Timing resolution

12.5 ns

Output FIFO size

<table>
<thead>
<tr>
<th>Onboard regeneration</th>
<th>8,191 samples shared among channels used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-regeneration</td>
<td>127 samples</td>
</tr>
</tbody>
</table>

AO waveform modes

Non-periodic waveform, periodic waveform regeneration mode from onboard memory, periodic waveform regeneration from host buffer including dynamic update

Digital Waveform Characteristics

Waveform acquisition (DI) FIFO

<table>
<thead>
<tr>
<th>Parallel modules</th>
<th>511 samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial modules</td>
<td>63 samples</td>
</tr>
</tbody>
</table>

Waveform generation (DO) FIFO

<table>
<thead>
<tr>
<th>Parallel modules</th>
<th>2,047 samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial modules</td>
<td>63 samples</td>
</tr>
</tbody>
</table>

Digital input sample clock frequency

<table>
<thead>
<tr>
<th>Streaming to application memory</th>
<th>System-dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finite</td>
<td>0 MHz to 10 MHz</td>
</tr>
</tbody>
</table>

Digital output sample clock frequency

<table>
<thead>
<tr>
<th>Streaming from application memory</th>
<th>System-dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regeneration from FIFO</td>
<td>0 MHz to 10 MHz</td>
</tr>
<tr>
<td>Finite</td>
<td>0 MHz to 10 MHz</td>
</tr>
</tbody>
</table>

Timing accuracy

50 ppm

General-Purpose Counters/Timers

Number of counters/timers

4

Resolution

32 bits

Counter measurements

Edge counting, pulse, semi-period, period, two-edge separation, pulse width

Position measurements

X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding
<table>
<thead>
<tr>
<th>Output applications</th>
<th>Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal base clocks</td>
<td>80 MHz, 20 MHz, 100 kHz</td>
</tr>
<tr>
<td>External base clock frequency</td>
<td>0 MHz to 20 MHz</td>
</tr>
<tr>
<td>Base clock accuracy</td>
<td>50 ppm</td>
</tr>
<tr>
<td>Output frequency</td>
<td>0 MHz to 20 MHz</td>
</tr>
<tr>
<td>Inputs</td>
<td>Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down</td>
</tr>
<tr>
<td>Routing options for inputs</td>
<td>Any module PFI, analog trigger, many internal signals</td>
</tr>
<tr>
<td>FIFO</td>
<td>Dedicated 127-sample FIFO</td>
</tr>
</tbody>
</table>

## Frequency Generator

<table>
<thead>
<tr>
<th>Number of channels</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base clocks</td>
<td>20 MHz, 10 MHz, 100 kHz</td>
</tr>
<tr>
<td>Divisors</td>
<td>1 to 16 (integers)</td>
</tr>
<tr>
<td>Base clock accuracy</td>
<td>50 ppm</td>
</tr>
<tr>
<td>Output</td>
<td>Any module PFI terminal</td>
</tr>
</tbody>
</table>

## Module PFI Characteristics

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Static digital input, static digital output, timing input, and timing output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing output sources&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Many analog input, analog output, counter, digital input, and digital output timing signals</td>
</tr>
<tr>
<td>Timing input frequency</td>
<td>0 MHz to 20 MHz</td>
</tr>
<tr>
<td>Timing output frequency</td>
<td>0 MHz to 20 MHz</td>
</tr>
</tbody>
</table>

## Digital Triggers

<table>
<thead>
<tr>
<th>Source</th>
<th>Any module PFI terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polarity</td>
<td>Software-selectable for most signals</td>
</tr>
</tbody>
</table>

<sup>3</sup> Actual available signals are dependent on type of installed C Series module.
Analog input function
Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase

Analog output function
Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase

Counter/timer function
Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down

Module I/O States

At power-on Module-dependent. Refer to the documentation for each C Series module.

Note The NI cDAQ-9171 may revert the input/output of the modules to their power-on state when the USB cable is removed.

Bus Interface

USB specification USB 2.0 Hi-Speed

High-performance data streams 6

Data stream types available Analog input, analog output, digital input, digital output, counter/timer input, counter/timer output, NI-XNET

Note If you are connecting the NI cDAQ-9171 to a USB hub, the hub must be externally powered.

Power Requirements

Caution The protection provided by the NI cDAQ-9171 chassis can be impaired if it is used in a manner not described in this document.

Note Some C Series modules have additional power requirements. For more information about C Series module power requirements, refer to the documentation for each C Series module.

Footnote

4 When a session is active, CAN or LIN (NI-XNET) C Series modules use a total of two data streams regardless of the number of NI-XNET modules in the chassis.
Note  Sleep mode for C Series modules is not supported in the NI cDAQ-9171.

Power consumption from USB  5 V, 500 mA maximum
Suspense mode  2.5 mA maximum

Physical Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (unloaded)</td>
<td>353 g (12.5 oz)</td>
</tr>
<tr>
<td>Dimensions (unloaded)</td>
<td>131.4 mm × 88.6 mm × 33.3 mm</td>
</tr>
<tr>
<td></td>
<td>(5.17 in. × 3.49 in. × 1.31 in.)</td>
</tr>
<tr>
<td></td>
<td>Refer to the following figure.</td>
</tr>
<tr>
<td>USB connector securement</td>
<td></td>
</tr>
<tr>
<td>USB securement type</td>
<td>Jackscrew provided on locking USB</td>
</tr>
<tr>
<td></td>
<td>cable (part number 198506-01 or 780534-01)</td>
</tr>
<tr>
<td>Torque for jackscrew</td>
<td>0.41 N · m (3.6 lb · in.)</td>
</tr>
<tr>
<td>Chassis ground</td>
<td></td>
</tr>
<tr>
<td>Gauge</td>
<td>1.31 mm² (16 AWG) or larger wire</td>
</tr>
<tr>
<td>Torque for ground screw</td>
<td>0.76 N · m (6.7 lb · in.)</td>
</tr>
</tbody>
</table>

If you need to clean the chassis, wipe it with a dry towel.

Figure 1. NI cDAQ-9171 Dimensions

Mounting Keyholes Use
M3.5 or #6 Panhead Screws with
7.37 mm (0.29 in.) Head Height
Environmental

Operating temperature (IEC-60068-2-1 and IEC-60068-2-2)  -20 °C to 55 °C
Storage temperature (IEC-600068-2-1 and IEC-60068-2-2)  -40 °C to 85 °C
Operating humidity (IEC-60068-2-56)  10% to 90% RH, noncondensing
Storage humidity (IEC-60068-2-56)  5% to 95% RH, noncondensing
Pollution Degree (IEC 60664)  2
Maximum altitude  5,000 m

Indoor use only.

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

Shock and Vibration

To meet these specifications, you must panel mount the NI cDAQ-9171 system, use an NI locking USB cable, and affix ferrules to the ends of the terminal lines.

Operational shock  30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC 60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)

Random vibration

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency Range</th>
<th>g\text{rms}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>5 Hz to 500 Hz</td>
<td>0.3</td>
</tr>
<tr>
<td>Non-operating</td>
<td>5 Hz to 500 Hz</td>
<td>2.4</td>
</tr>
</tbody>
</table>
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 6, UL 60079-15; Ed 4

Note For UL and other safety certifications, refer to the product label or the Online Product Certification section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.

Note For EMC declarations and certifications, and additional information, refer to the Online Product Certification section.
CE Compliance

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)
- 2014/34/EU; 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.

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.）
The NI 9234 is a four-channel dynamic signal acquisition module for making high-accuracy measurements from IEPE sensors. The NI 9234 delivers 102 dB of dynamic range and incorporates Integrated Electronics Piezoelectric (IEPE) signal conditioning at 2 mA constant current for accelerometers and microphones. The four input channels simultaneously acquire at rates up to 51.2 kS/s. In addition, the module includes built-in anti-aliasing filters that automatically adjust to your sampling rate. Compatible with a single-module USB carrier and NI CompactDAQ and CompactRIO hardware, the NI 9234 is ideal for a wide variety of mobile or portable applications such as industrial machine condition monitoring and in-vehicle noise, vibration, and harshness testing.
## 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.

### C SERIES ANALOG MODULE COMPARISON

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Signal Ranges</th>
<th>Channels</th>
<th>Sample Rate</th>
<th>Input Configurations</th>
<th>Noise at Maximum Sample Rate</th>
<th>Connectivity</th>
<th>Isolation Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 9218</td>
<td>±5 V</td>
<td>2</td>
<td>51.2 kS/s/ch</td>
<td>IEPE with AC Coupling</td>
<td>50 μVrms</td>
<td>9-Position DSUB, LEMO</td>
<td>60 VDC Ch-Ch</td>
</tr>
<tr>
<td>NI 9230</td>
<td>±30 V</td>
<td>3</td>
<td>12.8 kS/s/ch</td>
<td>IEPE with AC Coupling, AC Coupling</td>
<td>106 μVrms</td>
<td>Screw Terminal</td>
<td>60 VDC Ch-Earth</td>
</tr>
<tr>
<td>NI 9232</td>
<td>±30 V</td>
<td>3</td>
<td>102.4 kS/s/ch</td>
<td>IEPE with AC Coupling, AC Coupling, DC Coupling</td>
<td>251 μVrms</td>
<td>Screw Terminal</td>
<td>60 VDC Ch-Earth</td>
</tr>
<tr>
<td>NI 9234</td>
<td>±5 V</td>
<td>4</td>
<td>51.2 kS/s/ch</td>
<td>IEPE with AC Coupling, AC Coupling, DC Coupling</td>
<td>50 μVrms</td>
<td>BNC</td>
<td>None</td>
</tr>
<tr>
<td>NI 9251</td>
<td>±4.24 Vpk</td>
<td>2</td>
<td>102.4 kS/s/ch</td>
<td>AC Coupling, DC Coupling</td>
<td>8.8 μVrms</td>
<td>mini XLR</td>
<td>None</td>
</tr>
</tbody>
</table>
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

**Circuitry**

The input signal on each channel is buffered, conditioned, and then sampled by a 24-bit Delta-Sigma ADC.

*Figure 1. NI 9234 Input Circuitry for One Channel*

The NI 9234 analog input channels are referenced to chassis ground through a 50 Ω resistor. To minimize ground noise, make sure the chassis ground is connected to earth ground. Each channel is protected from overvoltages.

**AC/DC Coupling**

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 your software help for more information about configuring AC/DC coupling and enabling excitation current.

**NI 9234 TEDS**

The NI 9234 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 9234 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 9234 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 9234 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 9234. The NI 9234 includes an internal master timebase with a frequency of 13.1072 MHz, but the module also can accept an external master timebase or export its own master timebase. To synchronize the data rate of an NI 9234 with other modules that use master timebases to control sampling, all of the modules must share a single master timebase source.

The following equation provides the available data rates of the NI 9234:

\[
 f_s = \frac{f_M}{256 n}
\]

where \( n \) is any integer from 1 to 31.

However, the data rate must remain within the appropriate data rate range. When using the internal master timebase of 13.1072 MHz, the result is data rates of 51.2 kS/s, 25.6 kS/s, 17.067 kS/s, and so on down to 1.652 kS/s, depending on the value of \( n \). When using an external timebase with a frequency other than 13.1072 MHz, the NI 9234 has a different set of data rates.

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

NI 9234 Specifications

The following specifications are typical for the range -40 °C to 70 °C unless otherwise noted.

**Caution** To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

**Caution** Do not operate the NI 9234 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 Characteristics

<table>
<thead>
<tr>
<th>Number of channels</th>
<th>4 analog input channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADC resolution</td>
<td>24 bits</td>
</tr>
<tr>
<td>Type of ADC</td>
<td>Delta-Sigma (with analog prefiltering)</td>
</tr>
<tr>
<td>Sampling mode</td>
<td>Simultaneous</td>
</tr>
<tr>
<td>Type of TEDS supported</td>
<td>IEEE 1451.4 TEDS Class I</td>
</tr>
</tbody>
</table>
Internal master timebase ($f_M$)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>13.1072 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>±50 ppm maximum</td>
</tr>
</tbody>
</table>

Data rate range ($f_s$)

<table>
<thead>
<tr>
<th>Using internal master timebase</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>1.652 kS/s</td>
</tr>
<tr>
<td>Maximum</td>
<td>51.2 kS/s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Using external master timebase</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0.391 kS/s</td>
</tr>
<tr>
<td>Maximum</td>
<td>52.734 kS/s</td>
</tr>
</tbody>
</table>

Data rates $^1$ ($f_s$)

$$\frac{f_M + 256}{n}, \quad n = 1, 2, ..., 31$$

Input coupling

- AC/DC (software-selectable)

AC cutoff frequency

<table>
<thead>
<tr>
<th>-3 dB</th>
<th>0.5 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.1 dB</td>
<td>4.6 Hz maximum</td>
</tr>
</tbody>
</table>

---

$^1$ The data rate must remain within the appropriate data range. Refer to the Data Rates for more information.
### Figure 3. AC Cutoff Frequency Response

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Gain (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1.0</td>
</tr>
<tr>
<td>1</td>
<td>-0.5</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>0.5</td>
</tr>
<tr>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td>6</td>
<td>2.0</td>
</tr>
<tr>
<td>7</td>
<td>2.5</td>
</tr>
<tr>
<td>8</td>
<td>3.0</td>
</tr>
<tr>
<td>9</td>
<td>3.5</td>
</tr>
<tr>
<td>10</td>
<td>4.0</td>
</tr>
</tbody>
</table>

#### Input range

±5 V

#### AC voltage full-scale range

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>±5 Vpk</td>
</tr>
<tr>
<td>Typical</td>
<td>±5.1 Vpk</td>
</tr>
<tr>
<td>Maximum</td>
<td>±5.2 Vpk</td>
</tr>
</tbody>
</table>

#### Common-mode voltage range

(Al- to earth ground)

±2 V maximum

#### IEPE excitation current (software-selectable on/off)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>2.0 mA</td>
</tr>
<tr>
<td>Typical</td>
<td>2.1 mA</td>
</tr>
</tbody>
</table>

#### Power-on glitch

90 μA for 10 μs

#### IEPE compliance voltage

19 V maximum

If you are using an IEPE sensor, use the following equation to make sure your configuration meets the IEPE compliance voltage range.

\[(V_{\text{common-mode}} + V_{\text{bias}} \pm V_{\text{full-scale}})\] must be 0 to 19

Where

- \(V_{\text{common-mode}}\) is the common-mode voltage applied to the NI 9234
- \(V_{\text{bias}}\) is the bias voltage of the IEPE sensor
$V_{\text{full-scale}}$ is the full-scale voltage of the IEPE sensor

**Overvoltage protection (with respect to chassis ground)**

- For a signal source connected to AI+ and AI-: ±30 V
- For a low-impedance source connected to AI+ and AI-: -6 V to 30 V

**Input delay**

$(40 + 5/512)/f_s + 2.6 \mu s$

**Table 1. Accuracy**

<table>
<thead>
<tr>
<th>Measurement Conditions</th>
<th>Percent of Reading (Gain Error)</th>
<th>Percent of Range$^2$ (Offset Error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrated Max. (-40 °C to 70 °C)</td>
<td>0.34%, ±0.03 dB</td>
<td>±0.14%, 7.1 mV</td>
</tr>
<tr>
<td>Typical (25 °C ±5 °C)</td>
<td>0.05%, ±0.005 dB</td>
<td>±0.006%, 0.3 mV</td>
</tr>
<tr>
<td>Uncalibrated Max. (-40 °C to 70 °C)</td>
<td>1.9%, ±0.16 dB</td>
<td>±0.27%, 13.9 mV</td>
</tr>
<tr>
<td>Typical (25 °C ±5 °C)</td>
<td>0.48%, ±0.04 dB</td>
<td>±0.04%, 2.3 mV</td>
</tr>
</tbody>
</table>

**Gain drift**

- Typical: 0.14 mDB/°C (16 ppm/°C)
- Maximum: 0.45 mDB/°C (52 ppm/°C)

**Offset drift**

- Typical: 19.2 μV/°C
- Maximum: 118 μV/°C

**Channel-to-channel matching**

- Phase ($f_{in}$ in kHz)
  
  $(f_{in} * 0.045^\circ + 0.04 \text{ maximum})$

**Gain**

- Typical: 0.01 dB
- Maximum: 0.04 dB

**Passband**

- Frequency
  
  $0.45 * f_s$
- Flatness ($f_s = 51.2$ kS/s)
  
  40 mDB (pk-to-pk maximum)

---

$^2$ Range = 5.1 Vpk

$^3$ Uncalibrated accuracy refers to the accuracy achieved when acquiring in raw or unscaled modes where the calibration constants stored in the module are not applied to the data.
Phase nonlinearity \((f_s = 51.2 \text{ kS/s})\) ±0.45° maximum

Stopband

- Frequency \(0.55 * f_s\)
- Rejection 100 dB
-Alias-free bandwidth \(0.45 * f_s\)
-Oversample rate \(64 * f_s\)
-Crosstalk (1 kHz) -110 dB

CMRR \((f_{in} \leq 1 \text{ kHz})\)

- Minimum 40 dB
- Typical 47 dB

SFDR \((f_{in} = 1 \text{ kHz}, -60 \text{ dBFS})\) 120 dB

**Table 2. Idle Channel Noise and Noise Density**

<table>
<thead>
<tr>
<th>Idle Channel</th>
<th>51.2 kS/s</th>
<th>25.6 kS/s</th>
<th>2.048 kS/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>97 dBFS</td>
<td>99 dBFS</td>
<td>103 dBFS</td>
</tr>
<tr>
<td></td>
<td>50 μVrms</td>
<td>40 μVrms</td>
<td>25 μVrms</td>
</tr>
<tr>
<td>Noise density</td>
<td>310 nV/√Hz</td>
<td>350 nV/√Hz</td>
<td>780 nV/√Hz</td>
</tr>
</tbody>
</table>

Input impedance

- Differential 305 kΩ
- AI- (shield) to chassis ground 50 Ω

**Table 3. Total Harmonic Distortion (THD)**

<table>
<thead>
<tr>
<th>Input Amplitude</th>
<th>1 kHz</th>
<th>8 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1 dBFS</td>
<td>-95 dB</td>
<td>-87 dB</td>
</tr>
<tr>
<td>-20 dBFS</td>
<td>-95 dB</td>
<td>-80 dB</td>
</tr>
</tbody>
</table>

Intermodulation distortion (-1 dBFS)

- DIN 250 Hz/8 kHz 4:1 amplitude ratio -80 dB
- CCIF 11 kHz/12 kHz 1:1 amplitude ratio -93 dB

MTBF 390,362 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method
Power Requirements

<table>
<thead>
<tr>
<th>Power consumption from chassis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Active mode</td>
<td>900 mW maximum</td>
</tr>
<tr>
<td>Sleep mode</td>
<td>25 μW maximum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal dissipation (at 70 °C)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Active mode</td>
<td>930 mW maximum</td>
</tr>
<tr>
<td>Sleep mode</td>
<td>25 μW maximum</td>
</tr>
</tbody>
</table>

Physical Characteristics

If you need to clean the module, wipe it with a dry towel.

| Weight | 173 g (6.1 oz) |

Safety Voltages

Connect only voltages that are within the following limits:

| Channel-to-earth ground | ±30 V maximum, Measurement Category I |
| Isolation               | |
| Channel-to-channel      | None |
| Channel-to-earth ground | None |

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 9234 to signals or use for measurements within Measurement Categories II, III, or IV.

Hazardous Locations

<table>
<thead>
<tr>
<th>U.S. (UL)</th>
<th>Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nA IIC T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada (C-UL)</td>
<td>Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA IIC T4</td>
</tr>
<tr>
<td>Europe (ATEX) and International (IECEx)</td>
<td>Ex nA IIC T4 Gc</td>
</tr>
</tbody>
</table>
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

Note For UL and other safety certifications, refer to the product label or the Online Product Certification section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for sensitive electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note For the standards applied to assess the EMC of this product, refer to the Online Product Certification section.

Note For EMC compliance, operate this device with shielded cabling.

CE Compliance

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random (IEC 60068-2-64)</td>
<td>5 g(_{\text{rms}}), 10 Hz to 500 Hz</td>
</tr>
<tr>
<td>Sinusoidal (IEC 60068-2-6)</td>
<td>5 g, 10 Hz to 500 Hz</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature (IEC 60068-2-1, IEC 60068-2-2)</td>
<td>-40 °C to 70 °C</td>
</tr>
<tr>
<td>Storage temperature (IEC 60068-2-1, IEC 60068-2-2)</td>
<td>-40 °C to 85 °C</td>
</tr>
<tr>
<td>Ingress protection</td>
<td>IP40</td>
</tr>
<tr>
<td>Operating humidity (IEC 60068-2-78)</td>
<td>10% RH to 90% RH, noncondensing</td>
</tr>
<tr>
<td>Storage humidity (IEC 60068-2-78)</td>
<td>5% RH to 95% RH, noncondensing</td>
</tr>
<tr>
<td>Pollution Degree</td>
<td>2</td>
</tr>
<tr>
<td>Maximum altitude</td>
<td>5,000 m</td>
</tr>
</tbody>
</table>

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.
China Customer National Instruments complies with the Restriction of Hazardous Substances (RoHS) directive in 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 9234 at ni.com/calibration.

<table>
<thead>
<tr>
<th>Calibration interval</th>
<th>1 year</th>
</tr>
</thead>
</table>

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