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Industrial M Series Multifunction DAQ – 16-Bit, ±10 V/±20 mA Analog I/O, 5 V/24 V Digital I/O





- Up to sixteen ±10 V or eight ±20 mA analog inputs at 16 bits, 250 kS/s
- Up to four ±10 V or two 0 to 20 mA analog outputs at 16 bits, 500 kS/s (6 µs full-scale settling time)
- 6 digital input and 4 digital output channels, 24 V (sourcing or sinking) or 5 V TTL/CMOS
- Two 32-bit, 80 MHz counter/timers
- Programmable input range (±10, ±5, ±1, ±0.2 V) per channel
- NI-MCal calibration technology for improved measurement accuracy
- 60 VDC continuous bank isolation, 1,400 Vrms/1,950 VDC channel-to-bus, isolation withstand for 5 s
- Per-channel selectable debounce filters for digital input lines and programmable power-up states for digital outputs

Overview

NI M Series industrial multifunction data acquisition (DAQ) devices combine the safety of isolation with the high-performance timing, amplification, and calibration methodologies unique to M Series devices to deliver accurate measurements and precise control. You can use industrial M Series devices for measurement, control, and design applications including measuring and controlling voltages and process currents from analog and digital sensors, transducers, relays, motors, valves, pumps, and other actuators.

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Requirements and Compatibility

OS Information

Real-Time OS
Windows 2000/XP
Windows 7
Windows Vista x64/x86

Driver Information

NI-DAQmx

Software Compatibility

ANSI C
LabVIEW
LabVIEW Real-Time Module
LabWindows/CVI
Measurement Studio
SignalExpress
Visual Basic
Visual Studio .NET

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Comparison Tables

Family	Bus	Analog Input Channels	Max AI Range	Analog Output Channels	Max AO Range	Digital Inputs	Digital Outputs	Digital Voltage	Max DO Current Drive
NI 6230	PCI/PXI	8	±10 V	4	±10 V	6	4	5 V TTL/CMOS	10 mA
NI 6232	PCI/PXI	16	±10 V	2	±10 V	6	4	24 V (sourcing DO)	350 mA
NI 6233	PCI/PXI	16	±10 V	2	±10 V	6	4	24 V (sinking DO)	350 mA
NI 6236	PCI/PXI	4	±20 mA	4	±10 V	6	4	5 V TTL/CMOS	10 mA
NI 6238	PCI/PXI	8	±20 mA	2	0 to 20 mA	6	4	24 V (sourcing DO)	350 mA

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Family	Bus	Analog Input Channels	Max AI Range	Analog Output Channels	Max AO Range	Digital Inputs	Digital Outputs	Digital Voltage	Max DO Current Drive
NI 6239	PCI/PXI	8	±20 mA	2	0 to 20 mA	6	4	24 V (sinking DO)	350 mA

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Application and Technology

Industrial Feature Set

Industrial M Series multifunction DAQ devices offer a set of high-reliability features designed to automate even the most demanding applications.

Isolation prevents ground loops, rejects high common-mode voltages, and protects users and equipment from high-voltage transients
±20 mA current inputs provide direct connectivity for 4 to 20 mA process current loops
Programmable digital debounce filters eliminate glitches/spikes and remove noise
Change detection triggers on a digital event with minimal processor usage
Sourcing or sinking digital I/O with 24 V logic levels interfaces directly with industry-standard sensors and actuators
Programmable power-up states provide safe startup operation when connected to pumps, valves, motors, and relays
X1, X2, and X4 encoder inputs perform angular and linear position measurements

Isolation

These devices use digital isolation technology based on chip-scale transformers for increased signal bandwidth over slower optical isolators. Groups of channels form three “banks” (analog I/O, digital input, and digital output) that have a separate ground plane from each other and earth ground. Industrial M Series devices feature 60 VDC continuous bank isolation and 1,400 V_{rms}/1,950 VDC of channel-to-earth isolation withstand for up to 5 s. Isolation provides three main benefits:

Safety from hazardous high voltages and transients
Rejection of common-mode voltages
Removal of ground loops

Safety from High-Voltage Transients

Isolation electrically separates the high-voltage front end and the low-voltage back end of industrial M Series devices. Signals are passed between the two sections of the devices using digital isolators. By separating the two sections, any voltages within the isolation specifications are prevented from entering the bus section (see Figure 1). Isolation provides protection for the user, data acquisition system, and measurement data.

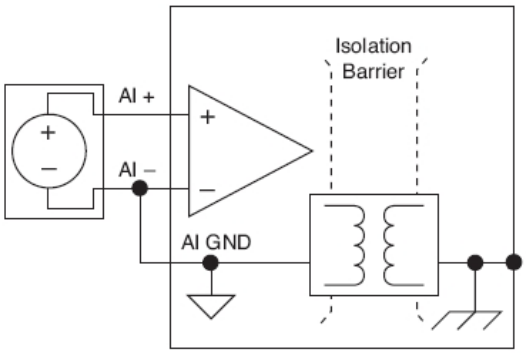


Figure 1. Isolation Barrier on Industrial M Series Devices

Common-Mode Voltage Rejection

A voltage common to both sides of a differential circuit pair is called common-mode voltage. The differential voltage across the circuit pair is the desired signal, whereas the common voltage signal is the unwanted signal that may have been integrated into the transmission line. Isolation allows M Series industrial multifunction DAQ devices to measure signals from lines with signal plus common-mode voltage of up to 60 VDC. (Note: The maximum analog input signal voltage between positive and negative terminals for the industrial M Series devices is ±10 V.) Isolation also provides greater overall common-mode rejection ratios (CMRRs), rejecting noise up to 10 times better than a low-cost M Series device (see Figure 2).

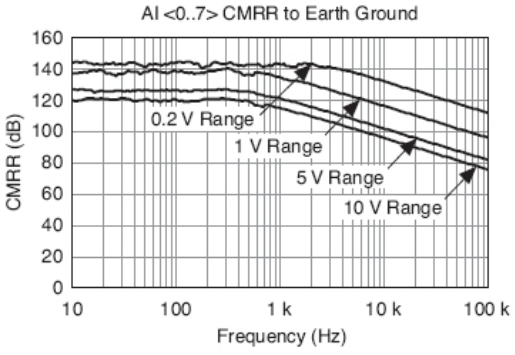


Figure 2. Common-Mode Rejection Ratios for NI 623x Devices Relative to Earth Ground

Ground Loop Removal

Ground loops are one of the most common sources of noise in data acquisition applications. They occur when two connected terminals in a circuit are at different ground potentials, causing current to flow between the two points. This additional voltage can cause significant error in the measurement. When a ground loop exists, the measured voltage is the sum of the signal voltage and the

potential difference between the signal source ground and the measurement system ground. This potential is generally not a DC level; therefore, the result is a noisy measurement system, often showing power-line frequency (60 Hz) components in the readings. By offering an isolated floating ground on the front end, the industrial M Series devices are able to prevent ground loops from forming.

4 to 20 mA Process Current Loops

Long cable lengths and the presence of electrical noise in industrial environments can make accurate voltage measurements difficult. As a result, industrial transducers that sense pressure, flow, proximity, and so on often emit current signals instead of voltage. Each of these current
loops contains a power source, a transducer, and one or more data acquisition devices. The current signal is typically between 4 and 20 mA, with 0 mA indicating an open circuit; power supplies are typically in the range of 24 to 30 VDC. Because all the current that flows from one lead
of the power supply must return to the other, current loops are immune to most sources of electrical noise and voltage (IR) drops along extensive cable lengths. The leads that provide power to the sensor also carry the measurement signal, greatly simplifying field wiring. NI 6236, NI 6238, and NI 6239 industrial M Series devices provide direct connectivity for current loops and loop-powered sensors with ±20 mA inputs. NI 6238 and NI 6239 devices also offer 0 to 20 mA static or waveform outputs.

Programmable Debounce Filters

Programmable debounce filters remove noise, glitches, and spikes from digital switches and relays connected to the digital input lines of the industrial M Series devices. This feature is important for applications in noisy industrial environments to prevent false readings. You can configure the programmable input filter for each digital line by setting the filter time in software. Any digital noise, glitch, or spike that is shorter than half of the specified filter time is blocked by the industrial
M Series device to prevent invalid readings.

Change-of-State Detection

With change detection, you can automatically trigger your software application to perform a digital read operation upon a digital change of state. A digital change of state is defined as the rising edge (0 to 1 transition) or falling edge (1 to 0 transition) on one or more digital lines. Using change detection, you can monitor for digital events with minimal processor usage. No polling is necessary because the industrial M Series device generates an interrupt to automatically wake up your application. To minimize the effects of noisy input lines, use programmable input filters in combination with change detection to eliminate spurious change-detection events caused by noise or glitches.

Programmable Power-Up States

Using programmable power-up states, you can configure the initial digital output states in software to ensure glitch-free operation when connected to industrial actuators such as pumps, valves, motors, and relays. An industrial M Series device holds these output states after receiving power, so your computer can boot and your software application can begin running. Programmable power-up states are glitch free, meaning the outputs never go through an incorrect state during
power up. You can configure each digital line as high-output or low-output. Each industrial M Series device stores the settings in onboard nonvolatile memory and implements the power-up states instantaneously after power is applied to the device.

Quadrature Encoder Measurements

Industrial M Series devices feature two 32-bit, 80 MHz counter/timers capable of measuring angular position with X1, X2, and X4 angular encoders or linear position with two-pulse encoders. Each encoder can have up to three channels: an A phase, a B phase, and a Z index. When channel A leads channel B in a quadrature cycle, the counter increments, and when channel B leads channel A in a cycle, the counter decrements. A high level on channel Z causes the counter to be reloaded with a specified value. Encoder channels use digital inputs on the industrial M Series devices, which may be 5 V TTL or 24 VDC.

Simultaneous and Intelligent Data Acquisition

When you need to obtain performance beyond the capabilities of a multifunction DAQ device, National Instruments provides simultaneous sampling with the S Series and intelligent DAQ with the R Series. The S Series architecture dedicates an analog-to-digital converter (ADC) per channel to provide higher aggregate sampling rates compared to multiplexed devices. S Series devices are ideal for applications including IF digitization, transient recording, ultrasound and sonar testing, and high-energy physics.

R Series multifunction DAQ devices contain a 1/3M gate FPGA that is reconfigurable using the NI LabVIEW FPGA Module. These devices have up to eight independent 16-bit analog inputs with up to 200 kHz simultaneous sampling, up to eight independent 16-bit analog outputs with up to 1 MHz simultaneous update rates, and up to 96 digital I/O lines configurable at rates up to 40 MHz. You can customize these devices to develop capabilities such as complete control over the synchronization and timing of all signals and operations.

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Ordering Information

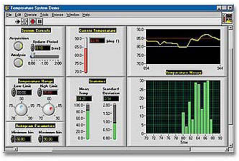
For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI PCI-6232			
NI PCI-6232 Each NI PCI-6232 requires: 1 Cable, 1 Connector Block	779617-01	**Cable:** Shielded - SH37F-37M Cable (1m)	778621-01
		Connector Block: Screw Terminals - CB-37F-HVD	779491-01
NI PXI-6232			
NI PXI-6232 Each NI PXI-6232 requires: 1 Cable, 1 Connector Block	779618-01	**Cable:** Shielded - SH37F-37M Cable (1m)	778621-01
		Connector Block: Screw Terminals - CB-37F-HVD	779491-01
NI PCI-6233			
NI PCI-6233 Each NI PCI-6233 requires: 1 Cable, 1 Connector Block	779619-01	**Cable:** Shielded - SH37F-37M Cable (1m)	778621-01
		Connector Block: Screw Terminals - CB-37F-HVD	779491-01
NI PXI-6233			
NI PXI-6233 Each NI PXI-6233 requires: 1 Cable, 1 Connector Block	779620-01	**Cable:** Shielded - SH37F-37M Cable (1m)	778621-01

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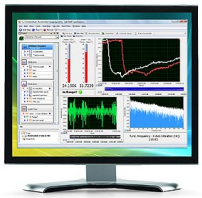
Software Recommendations

LabVIEW Professional Development System for Windows



Advanced software tools for large project development
Automatic code generation using DAQ Assistant and Instrument I/O Assistant
Tight integration with a wide range of hardware
Advanced measurement analysis and digital signal processing
Open connectivity with DLLs, ActiveX, and .NET objects
Capability to build DLLs, executables, and MSI installers

SignalExpress for Windows



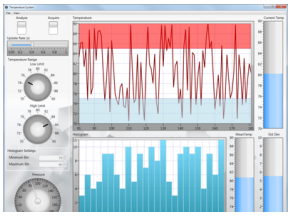
Quickly configure projects without programming
Control over 400 PC-based and stand-alone instruments
Log data from more than 250 data acquisition devices
Perform basic signal processing, analysis, and file I/O
Scale your application with automatic LabVIEW code generation
Create custom reports or easily export data to LabVIEW, DIAdem or Microsoft Excel

NI LabWindows™/CVI for Windows



Real-time advanced 2D graphs and charts
Complete hardware compatibility with IVI, VISA, DAQ, GPIB, and serial
Analysis tools for array manipulation, signal processing statistics, and curve fitting
Simplified cross-platform communication with network variables
Measurement Studio .NET tools (included in LabWindows/CVI Full only)
The mark LabWindows is used under a license from Microsoft Corporation.

NI Measurement Studio Professional Edition



Customizable graphs and charts for WPF, Windows Forms, and ASP.NET Web Forms UI design
Analysis libraries for array operations, signal generation, windowing, filters, signal processing
Hardware integration support with native .NET data acquisition and instrument control libraries
Automatic code generation for all NI-DAQmx data acquisition hardware
Intelligent and efficient data-logging libraries for streaming measurement data to disk
Support for Microsoft Visual Studio .NET 2012/2010/2008

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Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **Course kits** - lowest-cost, self-paced training that you can use as reference guides.
- **Training memberships** and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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Detailed Specifications

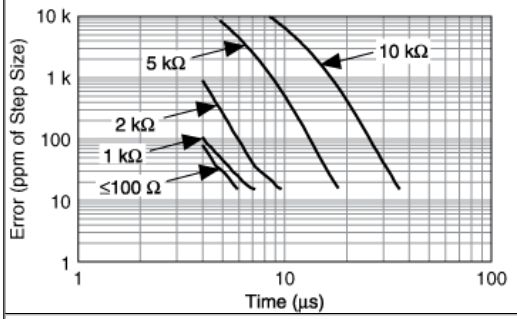
Specifications listed below are typical at 25 °C unless otherwise noted.

Analog Input	
Number of channels	8 differential or 16 single ended
Channel type	Voltage input
Ground reference	AI GND
ADC resolution	16 bits
DNL	No missing codes guaranteed
INL	Refer to the *AI Absolute Accuracy Table*
Sampling rate	
Maximum	250 kS/s
Minimum	0 S/s
Timing accuracy	50 ppm of sample rate
Timing resolution	50 ns
Input coupling	DC
Input range	±10 V, ±5 V, ±1 V, ±0.2 V
Maximum working voltage for analog inputs	Refer to the *Maximum Working Voltage* section
CMRR (DC to 60 Hz)	95 dB (with respect to AI GND)
Input impedance	
Device on	
AI+ to AI GND	>10 GΩ in parallel with 100 pF
AI- to AI GND	>10 GΩ in parallel with 100 pF
Device off	
AI+ to AI GND	820 Ω
AI- to AI GND	820 Ω
Input bias current	±100 pA
Crosstalk (at 100 kHz)	
Adjacent channels	-75 dB
Non-adjacent channels	-90 dB
Small signal bandwidth (-3 dB)	700 kHz
Input FIFO size	4,095 samples
Scan list memory	4,095 entries
Data transfers	DMA (scatter-gather), interrupts, programmed I/O
Overvoltage protection (AI <0..7> with respect to AI GND)	
Device on	±25 V for up to two AI pins

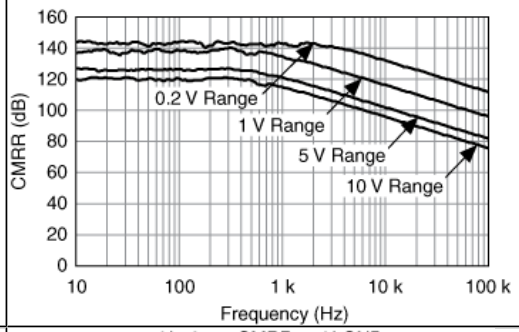
Device off	±15 V for up to two AI pins
Input current during overvoltage condition	±20 mA max/AI pin
Settling Time for Multichannel Measurements	
Accuracy, full scale step, all ranges	
±90 ppm of step (±6 LSB)	4 µs convert interval
±30 ppm of step (±2 LSB)	5 µs convert interval
±15 ppm of step (±1 LSB)	7 µs convert interval

Typical Performance Graphs

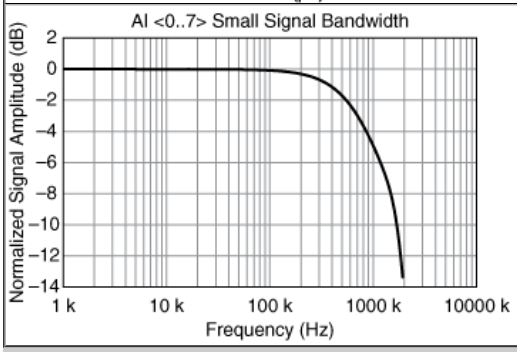
Settling Error Versus Time for Different Source Impedances



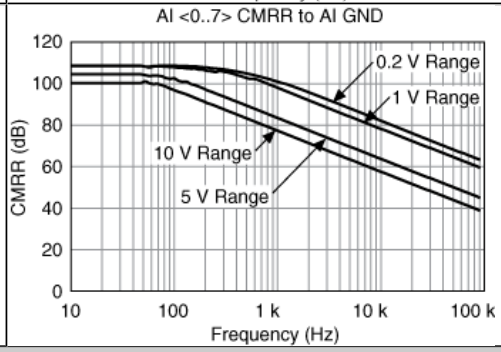
AI <0..7> CMRR to Earth Ground



AI <0..7> Small Signal Bandwidth



AI <0..7> CMRR to AI GND



Analog Output

Number of channels	2
Channel type	Voltage output
Ground reference	AO GND
DAC resolution	16 bits
DNL	±1 LSB
Monotonicity	16 bit guaranteed
Maximum update rate	
1 channel	500 kS/s
2 channels	450 kS/s per channel
Timing accuracy	50 ppm of sample rate
Timing resolution	50 ns
Output range	±10 V
Output coupling	DC
Output impedance	0.4 Ω
Output current drive	±5 mA
Overdrive protection	±25 V
Overdrive current	10 mA
Power-on state	±20 mV
Power-on glitch	0.25 V for 1 ms
Power-off glitch	±100 mV for 350 ms
Output FIFO size	8,191 samples shared among channels used

Data transfers	DMA (scatter-gather), interrupts, programmed I/O
AO waveform modes:	
Non-periodic waveform Periodic waveform regeneration mode from onboard FIFO Periodic waveform regeneration from host buffer including dynamic update	
Settling time, full scale step, 15 ppm (1 LSB)	6 µs
Slew rate	15 V/µs
Glitch energy	
Magnitude	100 mV
Duration	3 µs

Calibration (AI and AO)

Recommended warm-up time	15 minutes
Calibration interval	1 year

AI Absolute Accuracy Table

Nominal Range		Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	INL Error (ppm of Range)	Random Noise, σ (µVrms)	Absolute Accuracy at Full Scale[1] (µV)	Sensitivity[2] (µV)
Positive Full Scale	Negative Full Scale									
10	-10	75	25	5	20	57	76	244	3,100	97.6
5	-5	85	25	5	20	60	76	122	1,620	48.8
1	-1	95	25	5	25	79	76	30	360	12.0
0.2	- 0.2	135	25	5	80	175	76	13	112	5.2

AbsoluteAccuracy = Reading · (GainError) + Range · (OffsetError) + NoiseUncertainty

GainError = ResidualAIGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal)

OffsetError = ResidualAIOffsetError + OffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

$$\text{NoiseUncertainty} = \frac{\text{RandomNoise} \cdot 3}{\sqrt{100}}$$ For a coverage factor of 3 σ and averaging 100 points.

[1] Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

TempChangeFromLastExternalCal = 10 °C

TempChangeFromLastInternalCal = 1 °C

number_of_readings = 100

CoverageFactor = 3 σ

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

GainError = 75 ppm + 25 ppm · 1 + 5 ppm · 10 GainError = 150 ppm

OffsetError = 20 ppm + 57 ppm · 1 + 76 ppm OffsetError = 153 ppm

$$NoiseUncertainty = \frac{244\,\mu V \cdot 3}{\sqrt{100}} \qquad NoiseUncertainty = 73\,\mu V$$

AbsoluteAccuracy = 10 V · (GainError) + 10 V · (OffsetError) + NoiseUncertainty AbsoluteAccuracy = 3,100 µV

[2] Sensitivity is the smallest voltage change that can be detected. It is a function of noise.

Accuracies listed are valid for up to one year from the device external calibration.

AO Absolute Accuracy Table

Nominal Range		Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Reference Tempco	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	INL Error (ppm of Range)	Absolute Accuracy at Full Scale[1] (µV)
Positive Full Scale	Negative Full Scale							
10	-10	90	10	5	40	5	128	3,230

[1] Absolute Accuracy at full scale numbers is valid immediately following internal calibration and assumes the device is operating within 10 °C of the last external calibration.
Accuracies listed are valid for up to one year from the device external calibration.

AbsoluteAccuracy = OutputValue · (GainError) + Range · (OffsetError)

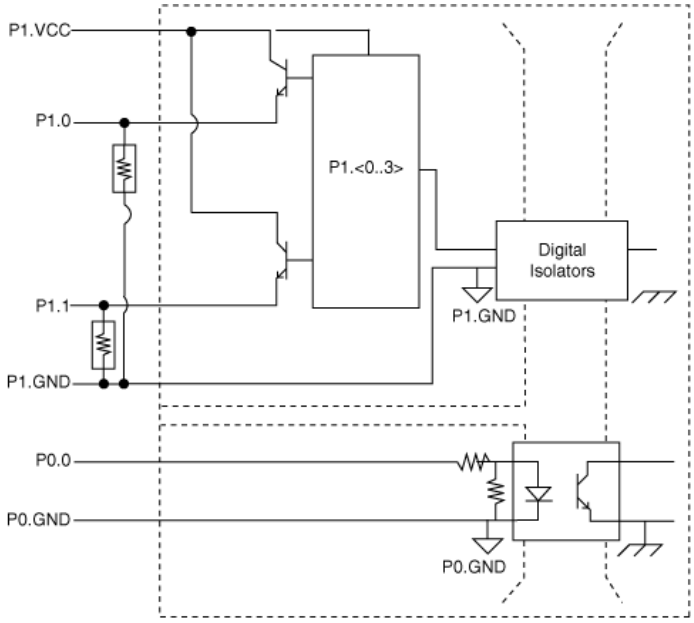
GainError = ResidualGainError + GainTempco · (TempChangeFromLastInternalCal) + ReferenceTempco · (TempChangeFromLastExternalCal) OffsetError = ResidualOffsetError + AOOffsetTempco · (TempChangeFromLastInternalCal) + INL_Error

Digital I/O/PFI

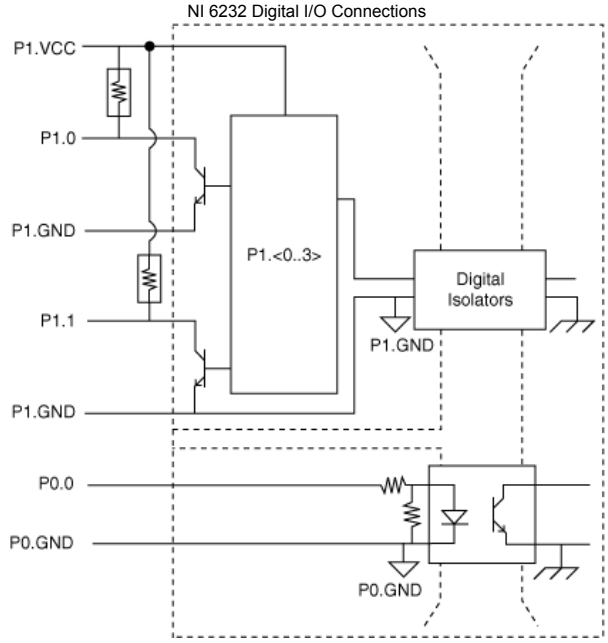
Static Characteristics	
Number of channels	10 total
Input	6 (PFI <0..5>/P0.<0..5>)
Output	4 (PFI <6..9>/P1.<0..3>)
Direction control	Fixed, lines are unidirectional
PFI/Port 0/Port 1 Functionality	
PFI <0..5>/P0.<0..5>	Static digital input, timing input
PFI <6..9>/P1.<0..3>	Static digital output, timing output
Timing output sources	Many AI, AO, counter, timing signals
Debounce filter settings	125 ns, 6.425 µs, 2.54 ms, disable; high and low transitions; selectable per input
Digital Input (Port 0)	
Number of channels	6
Ground reference	P0.GND
Input voltage range	0 to 30 V
Minimum pulse width for timing signal	0.5 µs
Logic "0" level	0 V to 4 V
Logic "1" level	10 V to 30 V
Minimum input impedance	3.3 kΩ
Typical input current	7 mA at 24 V input 2.5 mA at 8 V input
Maximum input current	9 mA
Propagation delay	
Low to high	150 ns, typical
High to low	100 ns, typical
Digital Output (Port 1)	
Number of channels	4
Ground reference	P1.GND
Digital output type[1]	
NI 6232	DO source
NI 6233	DO sink

[1] Refer to the *NI 6232 Digital I/O Connections* and *NI 6233 Digital I/O Connections* figures.

The *NI 6232 Digital I/O Connections* and *NI 6233 Digital I/O Connections* figures show P0.<0..5> and P1.<0..3> on the NI 6232 and NI 6233 devices, respectively



NI 6232 Digital I/O Connections



NI 6233 Digital I/O Connections

Maximum external supply voltage (P1.VCC)	30 V
On state saturation voltage	1.6 V maximum at 350 mA
Off state leakage	50 µA
Maximum current	100 mA for each line for simultaneous usage, 350 mA for single line usage
Minimum pulse width for timing signal	
NI 6232 (source output)	5 µs
NI 6233 (sink output)	1.25 µs
Propagation delay	
NI 6232 (source output)	
Open to close	0.45 µs
Close to open	2.15 µs
NI 6233 (sink output)	
Open to close	0.4 µs
Close to open	0.4 µs

General-Purpose Counter/Timers

Number of counter/timers	2
Resolution	32 bits
Counter measurements	Edge counting, pulse, semi-period, period, two-edge separation
Position measurements	X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding
Output applications	Pulse, pulse train with dynamic updates, frequency division,equivalent time sampling
Internal base clocks	80 MHz, 20 MHz, 0.1 MHz
External base clock frequency	0 MHz to 20 MHz
Base clock accuracy	50 ppm
Inputs	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down
Routing options for inputs	Any input PFI, RTSI, PXI_TRIG, PXI_STAR, many internal signals
FIFO	2 samples
Data transfers	Dedicated scatter-gather DMA controller for each counter/timer; interrupts; programmed I/O

Frequency Generator

Number of channels	1
Base clocks	10 MHz, 100 kHz
Divisors	1 to 16
Base clock accuracy	50 ppm

Output can be available on any output PFI or RTSI terminal.

Phase-Locked Loop (PLL)

Number of PLLs	1
Reference signal	PXI_STAR, PXI_CLK10, RTSI <0..7>
Output of PLL	80 MHz Timebase; other signals derived from 80 MHz Timebase including 20 MHz and 100 kHz Timebases

External Digital Triggers

Source	Any input PFI, RTSI, PXI_TRIG, PXI_STAR
Polarity	Software-selectable for most signals
Analog input function	Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Convert Clock, Sample Clock Timebase
Analog output function	Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase
Counter/timer functions	Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down
Device-to-Device Trigger Bus	
PCI devices	RTSI <0..7>[1]
PXI devices	PXI_TRIG <0..7>, PXI_STAR
Output selections	10 MHz Reference Clock; frequency generator output; many internal signals
Debounce filter settings	125 ns, 6.425 µs, 2.54 ms, disabled; high and low transitions selectable per input

[1] In other sections of this document, *RTSI* refers to RTSI <0..7> for PCI devices or PXI_TRIG <0..7> for PXI devices.

Bus Interface

PCI or PXI	3.3 V or 5 V signal environment

PXI-6232/6233 devices can be installed in PXI slots or PXI Express hybrid slots.

DMA channels	4, analog input, analog output, counter/timer 0, counter/timer 1

Power Requirements

Current draw from bus during no-load condition

+5 V	0.7 A
+12 V	20 mA

Current draw from bus during AI and AO overvoltage condition

+5 V	0.95 A
+12 V	20 mA

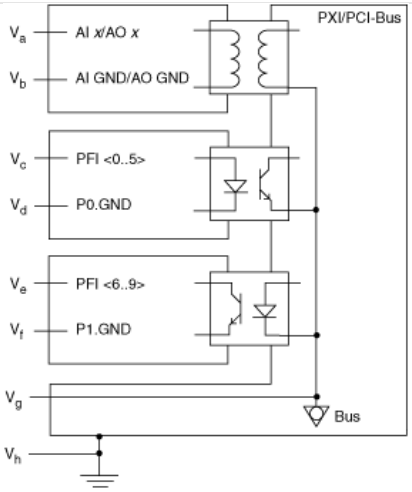
Physical Requirements

Printed circuit board dimensions	
NI PCI-6232/6233	9.7 cm × 15.5 cm (3.8 in. × 6.1 in.)
NI PXI-6232/6233	Standard 3U PXI
Weight	
NI PCI-6232/6233	103 g (3.6 oz)
NI PXI-6232/6233	142 g (5.0 oz)
I/O connector	37-pin D-SUB

Maximum Working Voltage[1]

Channel-to-earth ground[2]	
Continuous	≤30 Vrms/60 VDC Measurement Category[3]
Withstand	≤840 Vrms/1200 VDC, verified by a 5 s dielectric withstand test
Channel-to-bus [4]	
Continuous	≤30 Vrms/60 VDC Measurement Category I[4]
Withstand	≤1,400 Vrms/1,950 VDC, verified by a 5 s dielectric withstand test
Analog channel to AI GND/AO GND (in the *NI 6232/6233 Maximum Working Voltage* figure, $\|V_a - V_b\|$)	≤11 V, Measurement Category I[3]
Digital channel to P1.GND/P0.GND (in the *NI 6232/6233 Maximum Working Voltage* figure, $\|V_c - V\|_d$ or $\|V_e - V_f\|$)	≤30 V, Measurement Category I[3]

Caution This device is rated for Measurement Category I and the voltage across the isolation barrier is limited to no greater than 30 Vrms/60 VDC/42.4 V_{pk} continuous. Do *not* use for measurements within Categories II, III, or IV.



NI 6232/6233 Maximum Working Voltage

[1] Maximum working voltage refers to the signal voltage plus the common-mode voltage.

[2] In the *NI 6232/6233 Maximum Working Voltage* figure, $|V_a - V_h|$, $|V_c - V_h|$, and $|V_e - V_h|$.

[3] 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.

[4] In the *NI 6232/6233 Maximum Working Voltage* figure, $|V_a - V_g|$, $|V_c - V_g|$, and $|V_e - V_g|$.

Environmental

Maximum altitude	2,000 m (at 25 °C ambient temperature)
Pollution Degree	2
Indoor use only.	

Operating Environment

Ambient temperature range	0 to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)
Storage Environment	
Ambient temperature range	-40 to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
Relative humidity range	5% to 95% noncondensing (Tested in accordance with IEC-60068-2-56.)
Shock and Vibration (PXI Only)	
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	
Operating	5 to 500 Hz, 0.3 g_{rms}
Nonoperating	5 to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Safety

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

IEC 61010-1, EN-61010-1
UL 61010-1, CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label or visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:
EN 61326 EMC requirements; Minimum Immunity
EN 55011 Emissions; Group 1, Class A
CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note For EMC compliance, operate this device according to product documentation.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

73/23/EEC; Low-Voltage Directive (safety)

89/336/EEC; Electromagnetic Compatibility Directive (EMC)

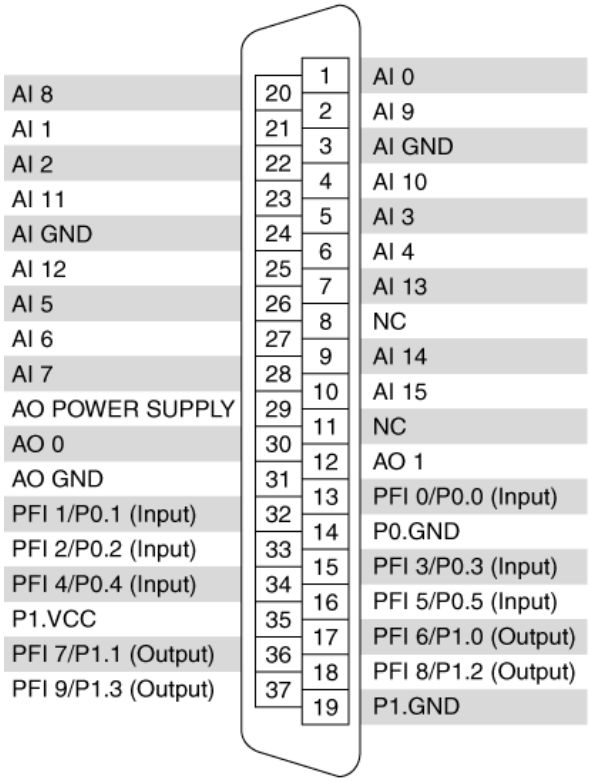
Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of their life cycle, all products must be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit ni.com/environment/weee.htm.

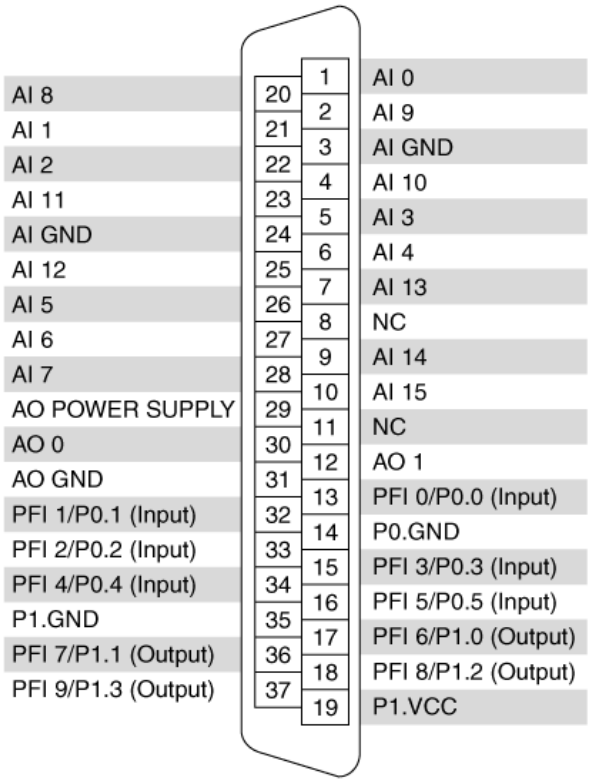
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Pinouts/Front Panel Connections



NC = No Connect

NI PCI/PXI-6232 Pinout



NC = No Connect

NI PCI/PXI-6233 Pinout

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