Technical Sales
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Requirements and Compatibility | Ordering Information | Detailed Specifications | Pinouts/Front Panel Connections
For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

Last Revised: 2008-12-01 13:13:50.0

M Series Multifunction DAQ for USB - 16-Bit, 250 kS/s, up to 80 Analog Inputs

- Up to 80 analog inputs at 16 bits, 250 kS/s
- Up to 4 analog outputs at 16 bits, 833 kS/s
- Up to 48 TTL/CMOS digital I/O lines (up to 32 hardware-timed at up to 1 MHz)
- Two 32-bit, 80 MHz counter/timers
- Digital triggering supported; power supply included
- NI-PGIA 2 and NI-MCal calibration technology for improved measurement accuracy
- NI signal streaming for 4 high-speed data streams on USB
- NI-DAQmx driver software and LabVIEW SignalExpress LE included

Overview

With recent bandwidth improvements and new innovations from National Instruments, USB has evolved into a core bus of choice for measurement and automation applications. NI M Series devices for USB deliver high-performance data acquisition in an easy-to-use and portable form factor through USB ports on laptop computers and other portable computing platforms. NI created NI signal streaming, an innovative patent-pending technology that enables sustained bidirectional high-speed data streams on USB. The new technology, combined with advanced external synchronization, helps engineers and scientists achieve high-performance applications on USB.

M Series multifunction data acquisition (DAQ) modules for USB are optimized for superior accuracy at fast sampling rates. They provide an onboard NI-PGIA 2 amplifier designed for fast settling times at high scanning rates, ensuring 16-bit accuracy even when measuring all available channels at maximum speed. All externally powered M Series devices have a minimum of 16 analog inputs, 24 digital I/O lines, digital triggering, and two counter/timers. USB M Series devices are ideal for test, control, and design applications including portable data logging, field monitoring, embedded OEM, in-vehicle data acquisition, and academic. NI USB-622x M Series devices have a one-year calibration interval.

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Requirements and Compatibility

OS Information

- Windows 2000/XP
- Windows Vista x64/x86

Driver Information

- NI-DAQmx

Software Compatibility

- ANSI C/C++
- LabVIEW
- LabVIEW SignalExpress
- Visual Studio .NET
- Visual C#
- Measurement Studio

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Comparison Tables

Family	Connector	Analog Inputs	Resolution	Max Rate	Analog Outputs	Resolution	Max Rate	Digital I/O	Counter/ Timer
USB-6221	Screw	16 SE/8 DI	16 bits	250 kS/s	2	16 bits	833 kS/s	24 (8 clocked)	2
USB-6229	Screw	32 SE/16 DI	16 bits	250 kS/s	4	16 bits	833 kS/s	48 (32 clocked)	2
USB-6225	Screw/68-pin SCSI	80 SE/40 DI	16 bits	250 kS/s	2	16 bits	833 kS/s	24 (8 clocked)	2

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Application and Technology

NI Signal Streaming

Unlike typical multifunction USB data acquisition devices, NI M Series DAQ devices for USB incorporate NI signal streaming, a patent-pending technology that combines three innovative hardware- and software-level design elements to enable sustained high-speed and bidirectional data streams over USB. NI signal streaming, along with the error correction, noise rejection, power management, and power distribution inherent in the USB protocol, yields a robust, secure, and reliable bus. Without NI signal streaming, a multifunction data acquisition device could sustain only a single high-speed data stream, effectively making it a single-function device. For more information, visit **ni.com/usb**.

USB M Series for Test

For test, you can use the M Series high-speed analog inputs and 10 MHz digital lines with NI signal conditioning for applications including test, component characterization, and sensor measurement. The NI USB-6225 M Series mass terminal device is compatible with the NI SCC signal conditioning platform, providing amplification filtering and power for virtually every type of sensor. This platform is also compliant with IEEE 1451.4 smart transducer electronic data sheet (TEDS) sensors, which offer digital storage for sensor data sheet information.

USB M Series multifunction DAQ devices also complement existing test systems that need additional measurement channels. For higher-channel-count signal conditioning on USB, consider the NI CompactDAQ or NI SCXI platform.

USB M Series for Control

USB M Series digital lines can drive 24 mA for relay and actuator control. By clocking the digital lines as fast as 10 MHz (with onboard regeneration), you can use these lines for pulse-width modulation (PWM) to control valves, motors, fans, lamps, and pumps. With four waveform analog outputs, two 80 MHz counter/timers, and four high-speed data streams on USB, M Series devices can execute multiple control loops simultaneously. NI USB-622x M Series devices also offer direct support for encoder measurements, protected digital lines, and digital debounce filters. With up to 80 analog inputs, 32 clocked digital lines, and four analog outputs, you can execute multiple control loops with a single device.

You can also create a complete custom motion controller by combining USB M Series devices with the NI SoftMotion Development Module.

USB M Series for Design

For design applications, you can use a wide range of I/O – from 80 analog inputs to 48 digital lines – to measure and verify prototype designs. USB M Series devices and NI LabVIEW SignalExpress interactive measurement software deliver benchtop measurements to the PC. With LabVIEW SignalExpress, you can quickly create design verification tests. The fast acquisition and generation rates of USB M Series devices along with LabVIEW SignalExpress provide fast design analysis. You can convert your tested and verified LabVIEW SignalExpress projects to LabVIEW applications for immediate M Series DAQ use, and bridge the gap between test, control, and design applications.

USB M Series for OEMs

Shorten your time to market by integrating National Instruments OEM products in your design. Board-only versions of USB M Series DAQ devices are available for OEM applications, with competitive quantity pricing and software customization. The NI OEM Elite Program offers free 30-day trial kits for qualified customers. Visit **ni.com/oem** for more information.

Recommended Software

National Instruments measurement services software, built around NI-DAQmx driver software, includes intuitive application programming interfaces, configuration tools, I/O assistants, and other tools designed to reduce system setup, configuration, and development time. National Instruments recommends using the latest version of NI-DAQmx driver software for application development in NI LabVIEW, LabVIEW SignalExpress, LabWindows™/CVI, and Measurement Studio. To obtain the latest version of NI-DAQmx, visit **ni.com/support/daq/versions**. NI measurement services software speeds up your development with features including:

- A guide to create fast and accurate measurements with no programming using the DAQ Assistant
- Automatic code generation to create your application in LabVIEW; LabWindows/CVI; LabVIEW SignalExpress; and Visual Studio .NET, ANSI C/C++, C#, or Visual Basic using Measurement Studio
- Multithreaded streaming technology for 1,000 times performance improvements
- Automatic timing, triggering, and synchronization routing to make advanced applications easy
- More than 3,000 free software downloads to jump-start your project available at **ni.com/zone**
- Software configuration of all digital I/O features without hardware switches/jumpers
- Single programming interface for analog input, analog output, digital I/O, and counters on hundreds of multifunction data acquisition hardware devices

M Series devices are compatible with the following versions (or later) of NI application software – LabVIEW, LabWindows/CVI, or Measurement Studio versions 7.x or LabVIEW SignalExpress 2.x.

Recommended Accessories (USB-6225 Mass Terminal Version Only)

Signal conditioning is required for sensor measurements or voltage inputs greater than 10 V. NI SCC products, which are designed to increase the performance and reliability of your data acquisition system, are up to 10 times more accurate than using terminal blocks alone. For more information, visit **ni.com/sigcon**.

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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
Board-Only Devices for Embedded Systems and OEM			
USB-6229 OEM (Quantity 1)	195959-01	No accessories required.	
USB-6221 OEM (Quantity 1)	195959-02	No accessories required.	
USB-6225 OEM (Quantity 1)	197294-01	No accessories required.	
M Series Multifunction DAQ for USB			
USB-6225 Mass Term Requires: 2 Cables, 2 Connector Blocks	779974-0P	**Connector 0:** **Cable:** Shielded - SH68-68-EPM Noise Rejecting, Shielded Cable, 1 m ***Also Available: Unshielded* **Connector Block:** Shielded - SCB-68 Shielded I/O Connector Block for DAQ Devices ***Also Available: BNC Termination, Unshielded* **Connector 1:** **Cable:** Shielded - SH68-68-S Noise Rejecting, Shielded Cable, 1 m ***Also Available: Unshielded* **Connector Block:** Shielded - SCB-68 Shielded I/O Connector Block for DAQ Devices ***Also Available: Unshielded, BNC Termination*	199006-01 776844-01 185262-01 776844-01
USB-6225 Screw Term	779973-0P	No accessories required.	
USB-6229 Screw Term	779810-0P	No accessories required.	
USB-6221 Screw Term	779808-0P	No accessories required.	

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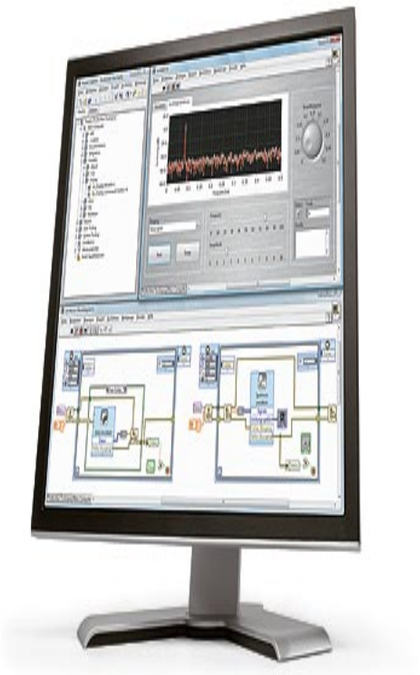
Software Recommendations

NI LabVIEW Professional Development System for Windows

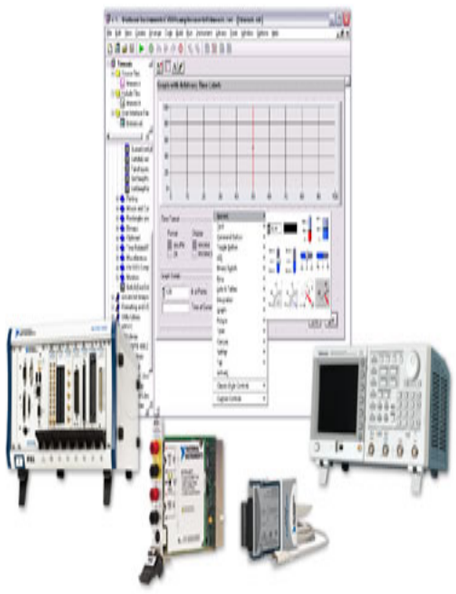
- Easy-to-use graphical development environment
- Tight integration with a wide range of measurement hardware
- Rapid user interface development for displaying live data
- Extensive signal processing, analysis, and math functionality
- Source code control integration and code complexity metrics
- Support for Windows Vista/XP/2000

NI Measurement Studio Professional Edition

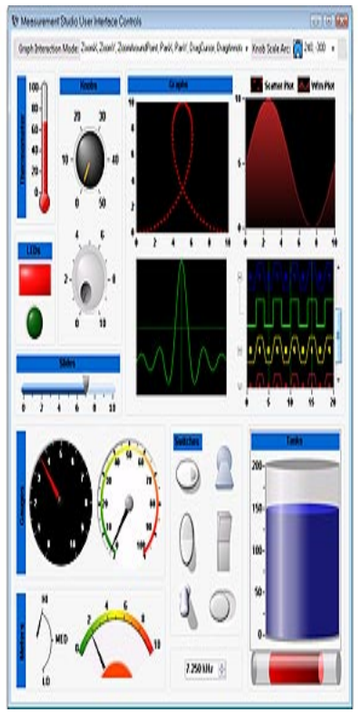
- Base analysis and instrumentation components for Microsoft Visual Basic, Visual C#, and Visual C++
- Cross-platform communication with network variables
- Scientific user interface controls
- Code-generating DAQ Assistant and Instrument I/O Assistant
- Acquire data from GPIB, serial, Ethernet, and plug-in data acquisition devices
- Requires Microsoft Visual Studio 2008/2005/.NET 2003 or Visual Studio 6.0



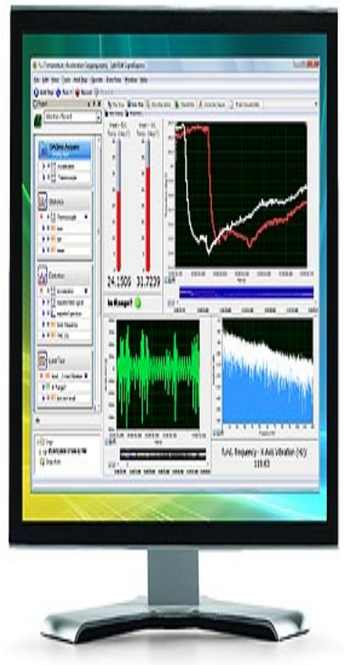
NI LabWindows™/CVI for Windows



- Real-time advanced 2D graphs and charts with support for Windows Vista/XP/2000
- 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 LabVIEW 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

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Support and Services

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 600 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. Refer to the *M Series User Manual* for more information about NI 622*x* devices.

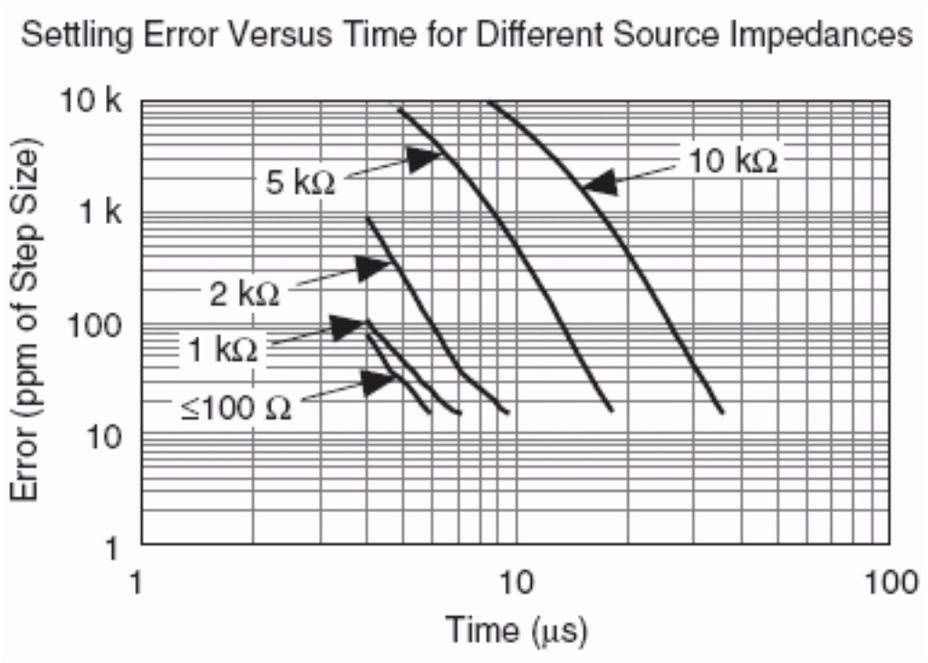
Analog Input	
Number of channels	
NI 6220/6221	8 differential or 16 single ended
NI 6224/6229	16 differential or 32 single ended
NI 6225	40 differential or 80 single ended
ADC resolution	16 bits
DNL	No missing codes guaranteed
INL	Refer to the *AI Absolute Accuracy Table*
Sampling rate	
Maximum	250 kS/s single channel, 250 kS/s multi-channel (aggregate)
Minimum	No minimum
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 (signal + common mode)	±11 V of AI GND
CMRR (DC to 60 Hz)	92 dB
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[1]

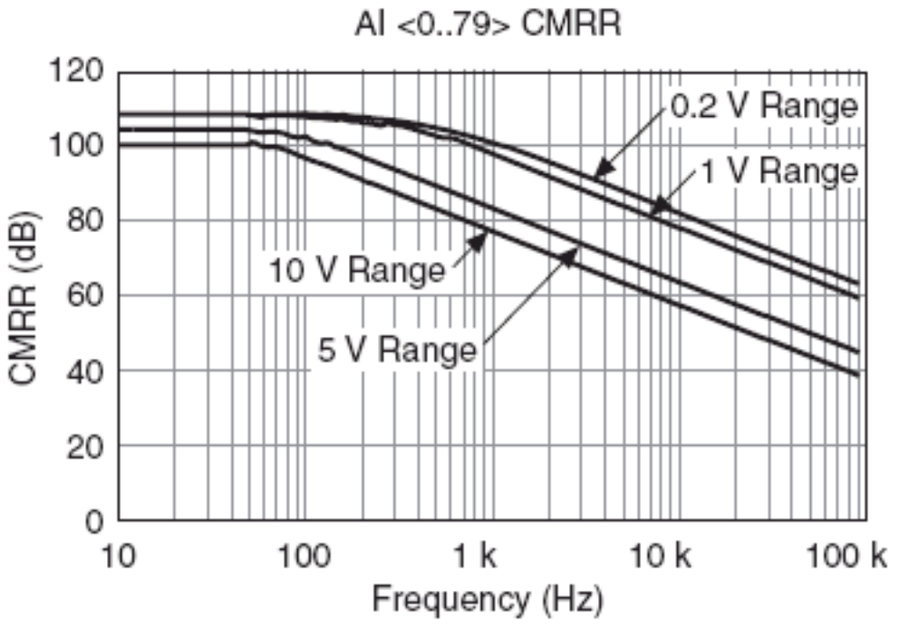
Small signal bandwidth (-3 dB)	700 kHz
Input FIFO size	4,095 samples
Scan list memory	4,095 entries
Data transfers	
PCI/PXI devices	DMA (scatter-gather), interrupts, programmed I/O
USB devices	USB Signal Stream, programmed I/O
Overvoltage protection (AI <0..79>, AI SENSE, AI SENSE 2)	
Device on	±25 V 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

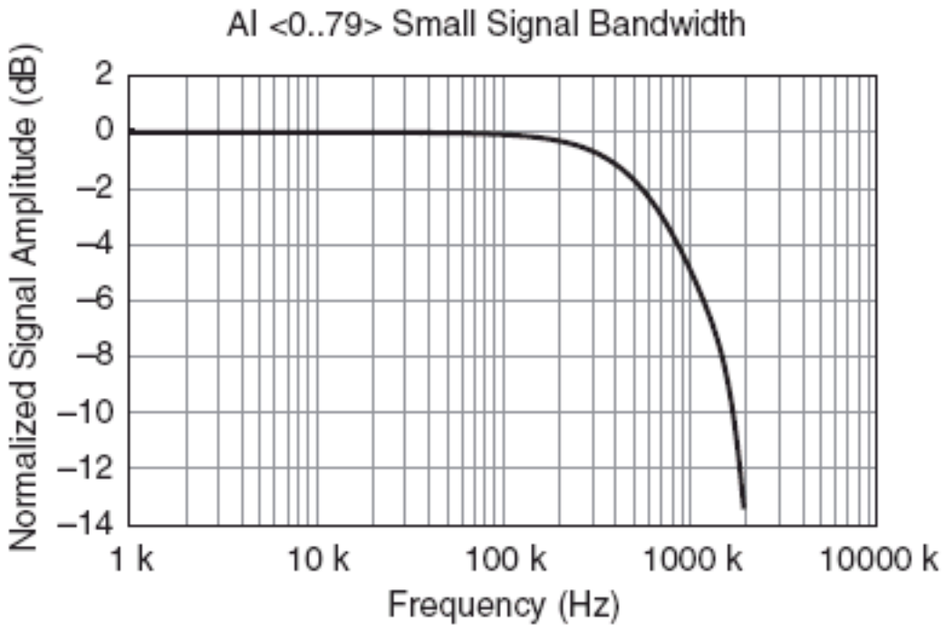
1 For USB-6225 devices, channel AI <0..15> crosstalk to channel AI <64..79> is -71 dB; applies to channels with 64-channel separation, for example, AI (*x*) and AI (*x* + 64).

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







Analog Output	
Number of channels	
NI 6220/6224	0
NI 6221/6225	2
NI 6229	4
DAC resolution	16 bits
DNL	±1 LSB
Monotonicity	16 bit guaranteed
Maximum update rate	
1 channel	833 kS/s
2 channels	740 kS/s per channel
3 channels	666 kS/s per channel
4 channels	625 kS/s per channel
Timing accuracy	50 ppm of sample rate
Timing resolution	50 ns
Output range	±10 V
Output coupling	DC
Output impedance	0.2 Ω
Output current drive	±5 mA
Overdrive protection	±25 V
Overdrive current	10 mA
Power-on state	±20 mV^2
Power-on glitch	400 mV for 200 ms

Output FIFO size	8,191 samples shared among channels used
Data transfers	
PCI/PXI devices	DMA (scatter-gather), interrupts, programmed I/O
USB devices	USB Signal Stream, 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	2.6 µs

2 For all USB-6221/6229 Screw Terminal devices, when powered on, the analog output signal is not defined until after USB configuration is complete.

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

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

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	
NI 6220/6221 (68-pin)/6225	24 total 8 (P0.<0..7>) 16 (PFI <0..7>/P1, PFI <8..15>/P2)
PCI-6221 (37-pin)	10 total 2 (P0.<0, 1>) 8 (PFI <0..7>/P1)
NI 6224/6229	48 total 32 (P0.<0..31>) 16 (PFI <0..7>/P1, PFI <8..15>/P2)
Ground reference	D GND
Direction control	Each terminal individually programmable as input or output
Pull-down resistor	50 kΩ typical, 20 kΩ minimum
Input voltage protection[3]	±20 V on up to two pins

3 Stresses beyond those listed under *Input voltage protection* may cause permanent damage to the device.

Waveform Characteristics (Port 0 Only)	
Terminals used	
NI 6220/6221 (68-pin)/6225	Port 0 (P0.<0..7>)
PCI-6221 (37-pin)	Port 0 (P0.<0, 1>)
NI 6224/6229	Port 0 (P0.<0..31>)
Port/sample size	

NI 6220/6221 (68-pin)/6225	Up to 8 bits
PCI-6221 (37-pin)	Up to 2 bits
NI 6224/6229	Up to 32 bits
Waveform generation (DO) FIFO	2,047 samples
Waveform acquisition (DI) FIFO	2,047 samples
DI or DO Sample Clock frequency[4]	0 to 1 MHz
Data transfers	
PCI/PXI devices	DMA (scatter-gather), interrupts, programmed I/O
USB devices	USB Signal Stream, programmed I/O
DO or DI Sample Clock source[5]	Any PFI, RTSI, AI Sample or Convert Clock, AO Sample Clock, Ctr *n* Internal Output, and many other signals

4 Performance can be dependent on bus latency and volume of bus activity.
5 The digital subsystem does not have its own dedicated internal timing engine. Therefore, a sample clock must be provided from another subsystem on the device or an external source.

PFI/Port 1/Port 2 Functionality[6]	
Functionality	Static digital input, static digital output, timing input, timing output
Timing output sources	Many AI, AO, counter, DI, DO timing signals
Debounce filter settings	125 ns, 6.425 µs, 2.56 ms, disable; high and low transitions; selectable per input

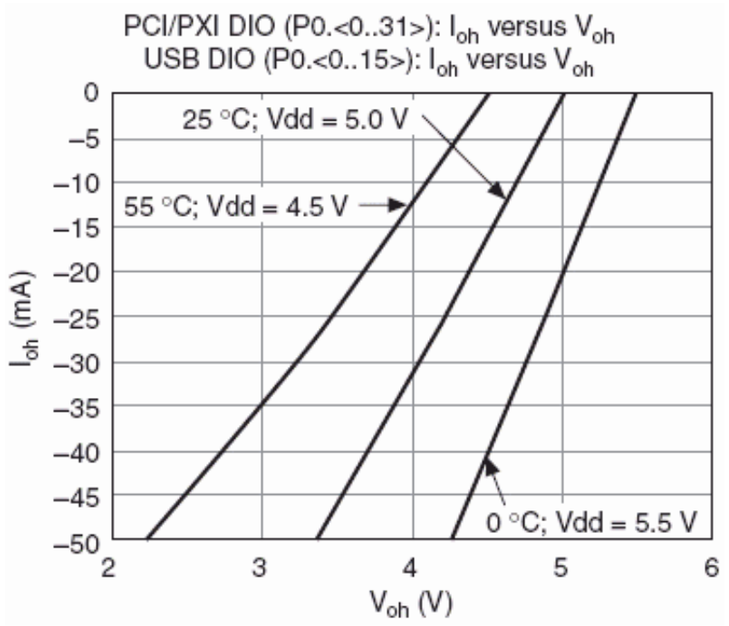
6 Port 2 is not available on PCI-6221 (37-pin) devices.

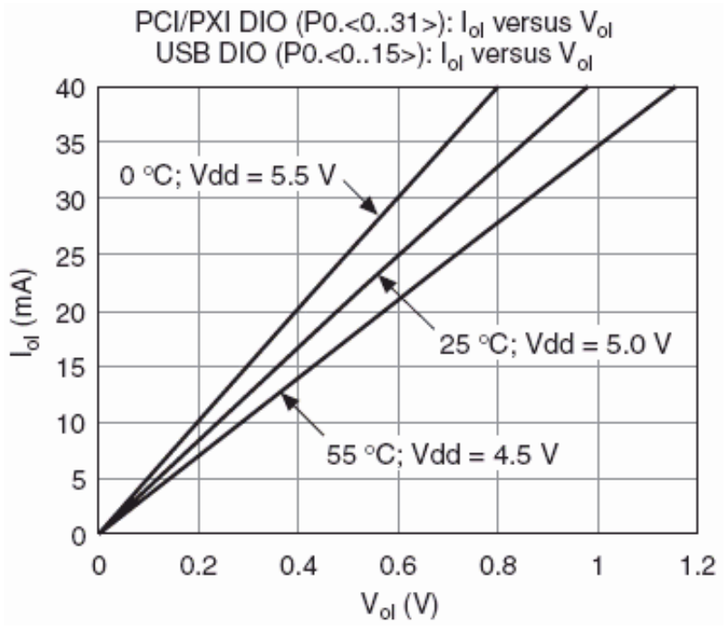
Recommended Operation Conditions, PCI/PXI Devices		
Level	Min	Max
Input high voltage (V_{IH})	2.2 V	5.25 V
Input low voltage (V_{IL})	0 V	0.8 V
Output high current (I_{OH}) P0.<0..31> PFI <0..15>/P1/P2	— —	-24 mA -16 mA
Output low current (I_{OL}) P0.<0..31> PFI <0..15>/P1/P2	— —	24 mA 16 mA

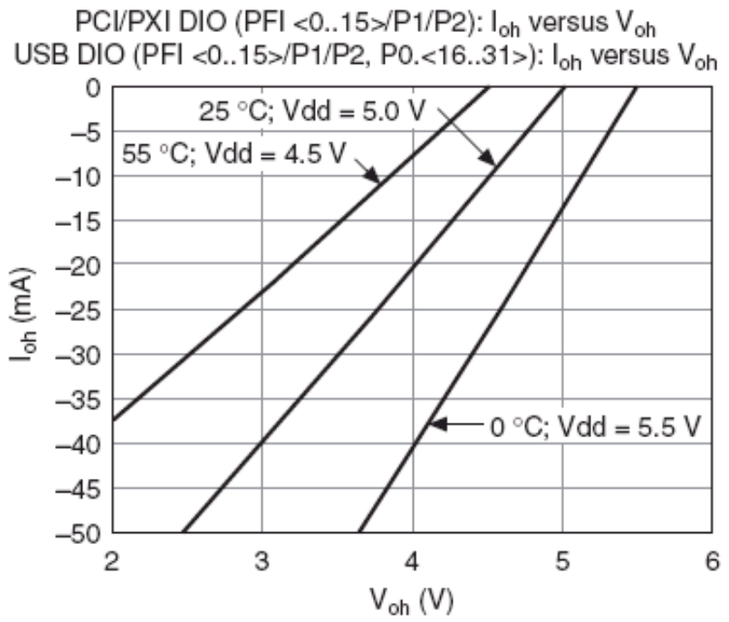
Recommended Operation Conditions, USB Devices		
Level	Min	Max
Input high voltage (V_{IH})	2.2 V	5.25 V
Input low voltage (V_{IL})	0 V	0.8 V
Output high current (I_{OH}) P0.<0..15> P0.<16..31> PFI <0..15>/P1/P2	— — —	-24 mA -16 mA -16 mA
Output low current (I_{OL}) P0.<0..15> P0.<16..31> PFI <0..15>/P1/P2	— — —	24 mA 16 mA 16 mA

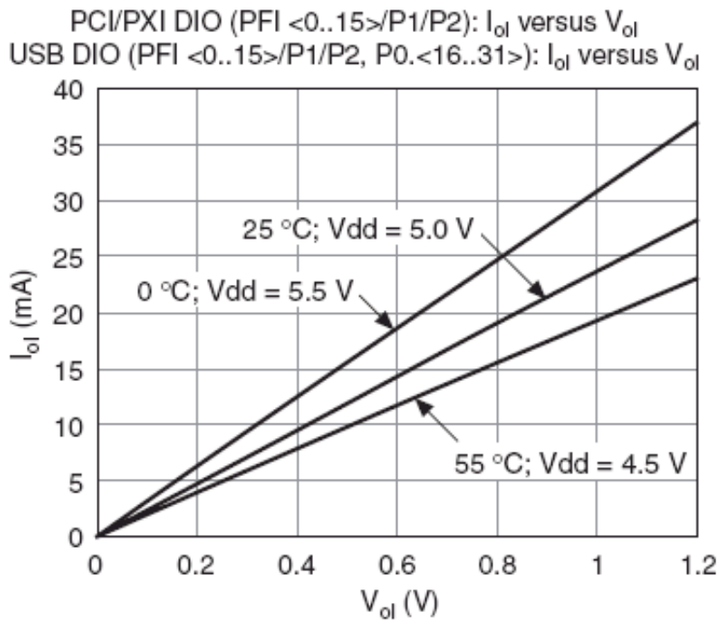
Electrical Characteristics		
Level	Min	Max
Positive-going threshold (VT+) Negative-going threshold (VT-)	— 0.8 V	2.2 V —
Delta VT hysteresis (VT+ - VT-)	0.2 V	—
I_{IL} input low current (V_{in} = 0 V) I_{IH} input high current (V_{in} = 5 V)	— —	-10 µA 250 µA

Digital I/O Characteristics[6]









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 PFI, RTSI, PXI_TRIG, PXI_STAR, analog trigger, many internal signals
FIFO	2 samples
Data transfers	
PCI/PCIe/PXI/PXIe devices	Dedicated scatter-gather DMA controller for each counter/timer; interrupts, programmed I/O
USB devices	USB Signal Stream, 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 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 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
Digital waveform generation (DO) function	Sample Clock
Digital waveform acquisition (DI) function	Sample Clock
Device-To-Device Trigger Bus	
PCI/PCIe devices	RTSI <0..7>[7]
PXI/PXIe devices	PXI_TRIG <0..7>, PXI_STAR
USB devices	None
Output selections	10 MHz Clock; frequency generator output; many internal signals
Debounce filter settings	125 ns, 6.425 µs, 2.56 ms, disable; high and low transitions; selectable per input

7 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/PXI devices	3.3 V or 5 V signal environment
USB devices	USB 2.0 Hi-Speed or full-speed[8]
DMA channels (PCI/PXI devices)	6, analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1
USB Signal Stream (USB devices)	4, can be used for analog input, analog output, digital input, digital output, counter/timer 0, counter/timer 1
All PXI-625x devices support one of the following features: • May be installed in PXI Express hybrid slots • Or, may be used to control SCXI in	

PXI/SCXI combo chassis	

8 If you are using a USB M Series device in full-speed mode, device performance will be lower and you will not be able to achieve maximum sampling/update rates.

Table 1. PXI/SCXI Combo and PXI Express Chassis Compatibility

M Series Device	M Series Part Number	SCXI Control in PXI/SCXI Combo Chassis	PXI Express Hybrid Slot Compatible
PXI-6220	191332B-04	No	Yes
PXI-6221	191332B-03	No	Yes
	191332B-13	Yes	No
PXI-6224	191332B-02	No	Yes
PXI-6225	192227A-01	No	Yes
PXI-6229	191332B-01	No	Yes
	191332B-11	Yes	No
Earlier versions of PXI-6220/6221/6224/6229	191332A-0*x*	Yes	No

Power Requirements

Current draw from bus during no-load condition[9]	
PCI/PXI devices	
+5 V	0.02 A[10]
+3.3 V	0.25 A[10]
+12 V	0.15 A
Current draw from bus during AI and AO overvoltage condition[9]	
PCI/PXI devices	
+5 V	0.02 A[10]
+3.3 V	0.25 A[10]
+12 V	0.25 A

Caution USB-622*x* devices must be powered with NI offered AC adapter or a National Electric Code (NEC) Class 2 DC source that meets the power requirements for the device and has appropriate safety certification marks for country of use.

USB power supply requirements	11 to 30 VDC, 20 W, locking or non-locking power jack with 0.080" diameter center pin, 5/16-32 thread for locking collars

9 Does not include P0/PFI/P1/P2 and +5 V terminals.
10 PCI-6221 (37-pin) devices do not use +3.3 V from the bus. The 3.3 V current draw, shown in the *Power Requirements* section, comes from the +5 V instead.

Power Limits

Caution Exceeding the power limits may cause unpredictable behavior by the device and/or PC/chassis.

PCI devices	
+5 V terminal (connector 0)	1 A max[11]
+5 V terminal (connector 1)	1 A max[11]
PXI devices	
+5 V terminal (connector 0)	1 A max[11]
+5 V terminal (connector 1)	1 A max[11]
P0/PFI/P1/P2 and +5 V terminals combined	2 A max
USB devices	
+5 V terminal	1 A max[11]
P0/PFI/P1/P2 and +5 V terminals combined	2 A max
Power supply fuse	2 A, 250 V

11 Has a self-resetting fuse that opens when current exceeds this specification.

Physical Requirements

Printed circuit board dimensions	
PCI-6220/6221/6224/6225/6229	9.7 x 15.5 cm (3.8 x 6.1 in.)
PXI-6220/6221/6224/6225/6229	Standard 3U PXI
Enclosure dimensions (includes connectors)	
USB-6221/6225/6229 Screw Terminal	26.67 x 17.09 x 4.45 cm (10.5 x 6.73 x 1.75 in.)
USB-6221/6229 BNC	28.6 x 17 x 6.9 cm (11.25 x 6.7 x 2.7 in.)
USB-6225 Mass Termination	18.8 x 17.09 x 4.45 cm (7.4 x 6.73 x 1.75 in.)
USB-6221/6225/6229 OEM	Refer to the *NI USB-622x/625x OEM User Guide*
Weight	
PCI-6220	91 g (3.2 oz)
PCI-6221 (68-pin)	92 g (3.2 oz)

PCI-6221 (37-pin)	95 g (3.3 oz)
PCI-6224	99 g (3.5 oz)
PCI-6225	103 g (3.6 oz)
PCI-6229	101 g (3.5 oz)
PXI-6220	158 g (5.5 oz)
PXI-6221	162 g (5.7 oz)
PXI-6224	170 g (5.9 oz)
PXI-6225	174 g (6.1 oz)
PXI-6229	171 g (6.0 oz)
USB-6221 Screw Terminal	1.2 kg (2 lb 10 oz)
USB-6225/6229 Screw Terminal	1.24 kg (2 lb 11 oz)
USB-6225 Mass Termination	907 g (2 lb)
USB-6221 OEM	131 g (4.6 oz)
USB-6225/6229 OEM	162 g (5.7 oz)
I/O connector	
PCI/PXI-6220/6221 (68-pin)	1 68-pin VHDCI
PCI/PXI-6224/6225/6229	2 68-pin VHDCI
PCI-6221 (37-pin)	1 37-pin D-SUB
USB-6221 Screw Terminal	64 screw terminals
USB-6225/6229 Screw Terminal	128 screw terminals
USB-6221 BNC	21 BNCs and 30 screw terminals
USB-6229 BNC	32 BNCs and 60 screw terminals
USB-6225 Mass Termination	2 68-pin SCSI
USB-6221/6225/6229 Screw Terminal/ USB-6221/6229 BNC screw terminal wiring	16-28 AWG
Maximum Working Voltage[12]	
NI 6220/6221/6224/6225/6229 channel-to-earth	11 V, Measurement Category I

Caution Do *not* use for measurements within Categories II, III, or IV.

12 *Maximum working voltage* refers to the signal voltage plus the common-mode voltage.

Environmental	
Operating temperature	
PCI/PXI devices	0 to 55 °C
USB devices	0 to 45 °C
Storage temperature	-20 to 70 °C
Humidity	10 to 90% RH, noncondensing
Maximum altitude	2,000 m
Pollution Degree (indoor use only)	2
Shock and Vibration (PXI Devices 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, CSA 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 with shielded cables.

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.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the NI and the Environment 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)

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.

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.)

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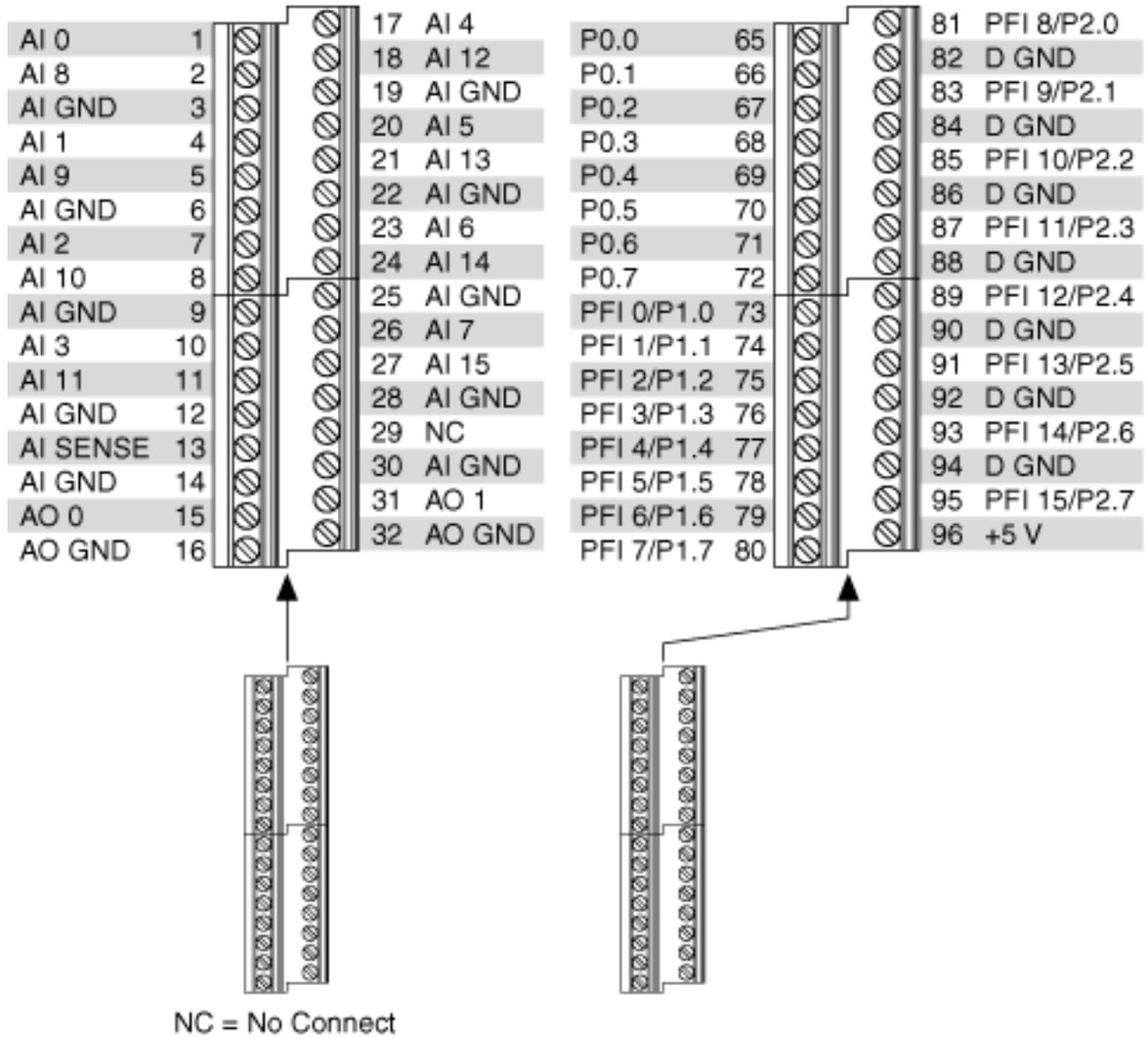
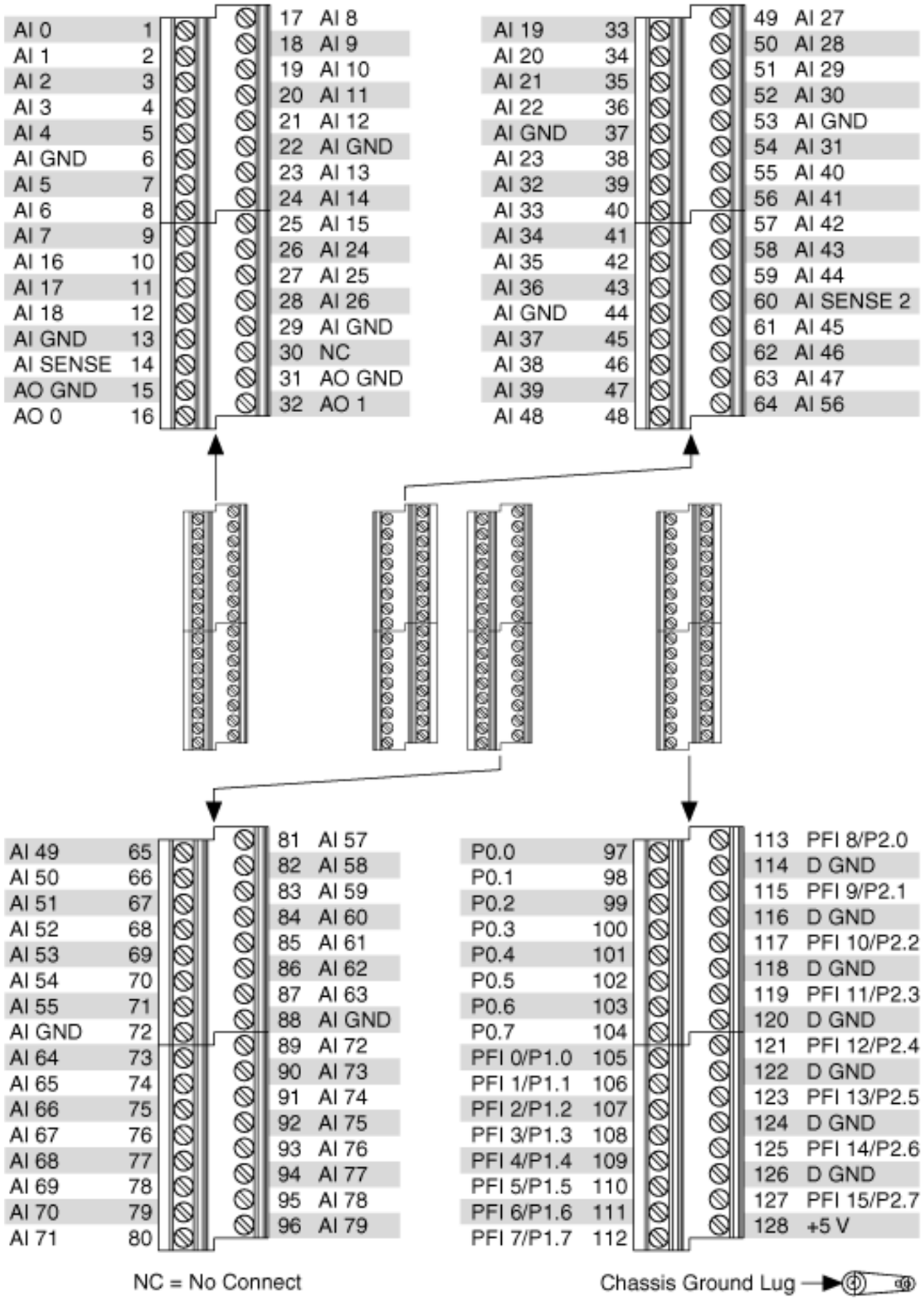
Pinouts/Front Panel Connections



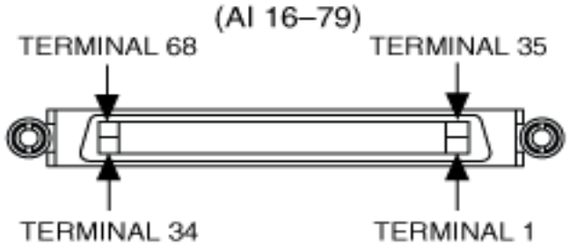
USB-6221 Screw Terminal Pinout



USB-6225 Screw Terminal Pinout

AI 24	34	68	AI 16
AI 17	33	67	AI 25
AI 18	32	66	AI 26
AI 27	31	65	AI 19
AI 20	30	64	AI 28
AI 21	29	63	AI 29
AI 30	28	62	AI 22
AI 23	27	61	AI 31
AI 32	26	60	AI 40
AI 41	25	59	AI 33
AI 34	24	58	AI 42
AI 35	23	57	AI 43
AI GND	22	56	AI SENSE 2
AI 44	21	55	AI 36
AI 37	20	54	AI 45
AI 38	19	53	AI 46
AI 47	18	52	AI 39
AI 48	17	51	AI 56
AI 49	16	50	AI 57
AI 58	15	49	AI 50
AI 51	14	48	AI 59
AI 52	13	47	AI 60
AI 61	12	46	AI 53
AI 54	11	45	AI 62
AI 55	10	44	AI 63
AI GND	9	43	AI GND
AI 72	8	42	AI 64
AI 65	7	41	AI 73
AI 66	6	40	AI 74
AI 75	5	39	AI 67
AI 68	4	38	AI 76
AI 69	3	37	AI 77
AI 78	2	36	AI 70
AI 71	1	35	AI 79

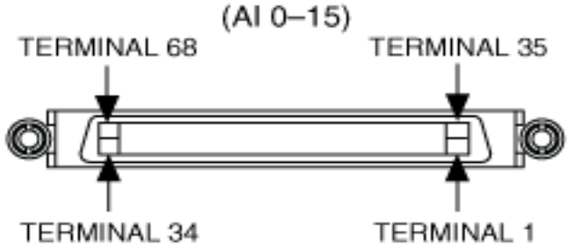
CONNECTOR 1
(AI 16–79)



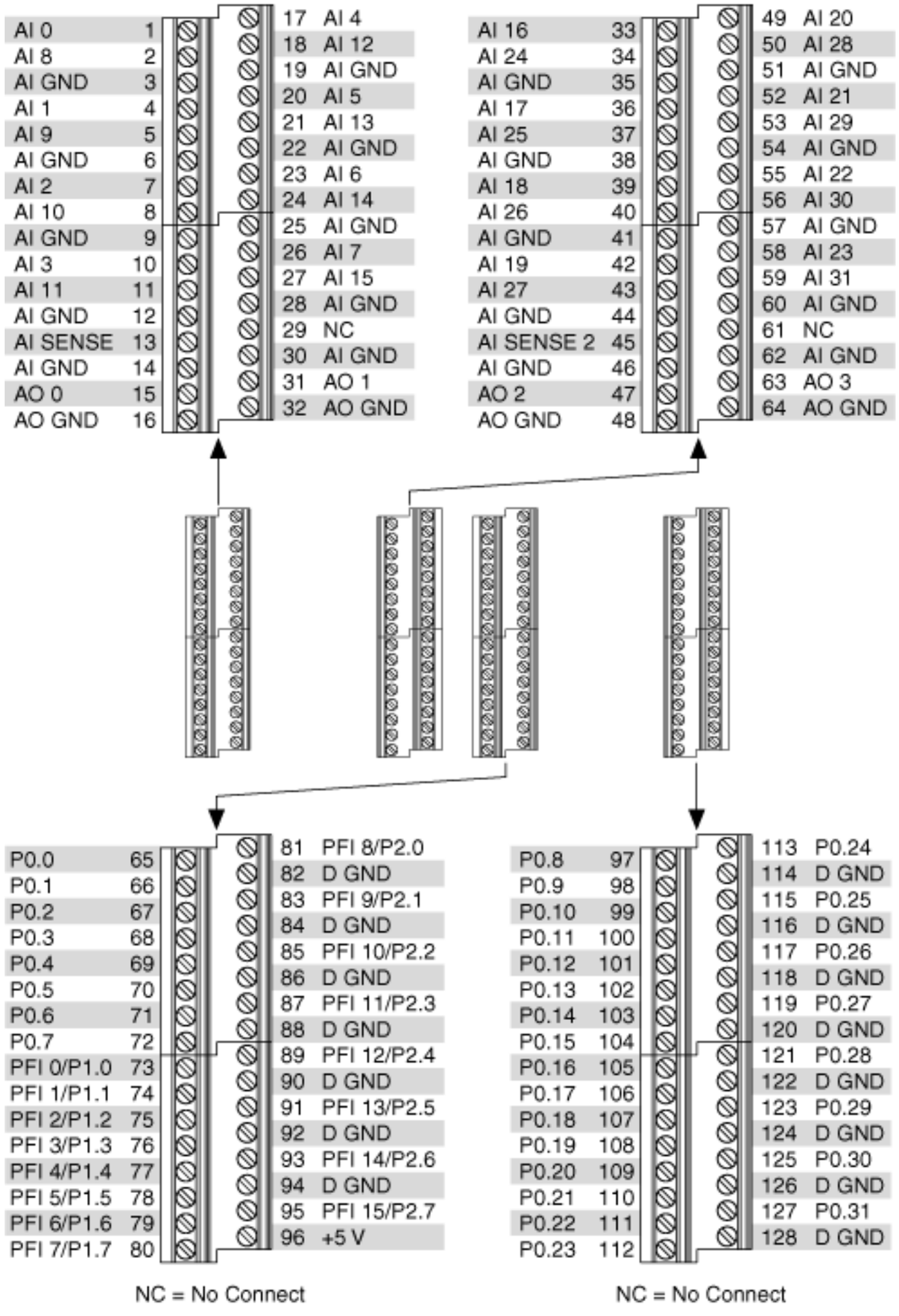
AI 8	34	68	AI 0
AI 1	33	67	AI GND
AI GND	32	66	AI 9
AI 10	31	65	AI 2
AI 3	30	64	AI GND
AI GND	29	63	AI 11
AI 4	28	62	AI SENSE
AI GND	27	61	AI 12
AI 13	26	60	AI 5
AI 6	25	59	AI GND
AI GND	24	58	AI 14
AI 15	23	57	AI 7
AO 0	22	56	AI GND
AO 1	21	55	AO GND
NC	20	54	AO GND
P0.4	19	53	D GND
D GND	18	52	P0.0
P0.1	17	51	P0.5
P0.6	16	50	D GND
D GND	15	49	P0.2
+5 V	14	48	P0.7
D GND	13	47	P0.3
D GND	12	46	PFI 11/P2.3
PFI 0/P1.0	11	45	PFI 10/P2.2
PFI 1/P1.1	10	44	D GND
D GND	9	43	PFI 2/P1.2
+5 V	8	42	PFI 3/P1.3
D GND	7	41	PFI 4/P1.4
PFI 5/P1.5	6	40	PFI 13/P2.5
PFI 6/P1.6	5	39	PFI 15/P2.7
D GND	4	38	PFI 7/P1.7
PFI 9/P2.1	3	37	PFI 8/P2.0
PFI 12/P2.4	2	36	D GND
PFI 14/P2.6	1	35	D GND

NC = No Connect

CONNECTOR 0
(AI 0–15)



USB-6225 Mass Termination Pinout



USB-6229 Screw Terminal Pinout

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