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PRODUCT FLYER

Multifunction I/O

CONTENTS

Multifunction I/O Device
PXI Multifunction I/O Module
Platform-Based Approach to Test and Measurement
Hardware Services

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Multifunction I/O Device

List of Multifunction I/O Devices



- **Software:** Includes DAQExpress™ interactive measurement software as well as API support for LabVIEW and text-based languages, shipping examples, and detailed help files
- Voltage measurements up to 10 MS/s per channel
- Multiplexed or simultaneous analog architectures
- Software-selectable input ranges and input channel isolation available
- Up to four analog output channels and four counters
- USB or PCI/PCIe bus connectivity

Built for Accuracy and Reliability

NI Multifunction I/O Devices provide a combination of analog I/O, digital I/O, and counter/timer functionality in a single device for computer-based systems.

Multifunction I/O devices offer a mix of I/O with varying channel counts, sample rates, output rates, and other features to meet many common measurement requirements. These devices are ideal for a wide variety of industry applications such as laboratory automation, research, and design verification. The included DAQExpress interactive measurement software enables quick hardware setup and data visualization, while the included NI-DAQmx driver enables complete customization of measurement and automation applications from a variety of supported programming languages.

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Table 1. NI USB multifunction I/O devices provide a simple plug-in interface with many specification options.

	Analog Input					Analog Output		DIO	Counters	Connectivity*
	Max Num Ch.	Simul-taneous	Sample Rate	Resolution	Absolute Accuracy	Num Ch.	Update Rate	No. Channels	No. Channels	
USB-6366	8	yes	2 MS/s	16 bits	2.69 mV	2	3.33 MS/s	24	4	ST,MT,BNC
USB-6363	16	no	2 MS/s	16 bits	1.66 mV	4	2.86 MS/s	48	4	ST,MT,BNC
USB-6361	16	no	2 MS/s	16 bits	1.66 mV	2	2.86 MS/s	24	4	ST,MT,BNC
USB-6356	8	yes	1.25 MS/s	16 bits	2.69 mV	2	3.33 MS/s	24	4	ST,BNC
USB-6353	32	no	1.25 MS/s	16 bits	1.52 mV	4	2.86 MS/s	48	4	ST
USB-6351	16	no	1.25 MS/s	16 bits	1.52 mV	2	2.86 MS/s	24	4	ST
USB-6343	32	no	500 kS/s	16 bits	2.19 mV	4	900 kS/s	48	4	ST,BNC
USB-6341	16	no	500 kS/s	16 bits	2.19 mV	2	900 kS/s	24	4	ST,BNC
USB-6289	32	no	625 kS/s	18 bits	0.98 mV	4	2.86 MS/s	48	2	ST,MT
USB-6281	16	no	625 kS/s	18 bits	0.98 mV	2	2.86 MS/s	24	2	ST,MT
USB-6255	80	no	1.25 MS/s	16 bits	1.92 mV	2	2.86 MS/s	24	2	ST,MT
USB-6225	80	no	250 kS/s	16 bits	3.1 mV	2	833 kS/s	24	2	ST,MT
USB-6218	32	no	250 kS/s	16 bits	2.69 mV	2	250 kS/s	8 in/8 out	2	ST,BNC
USB-6216	16	no	400 kS/s	16 bits	2.71 mV	2	250 kS/s	32	2	ST,MT,BNC
USB-6215	16	no	250 kS/s	16 bits	2.69 mV	2	250 kS/s	4 in/4 out	2	ST
USB-6212	16	no	400 kS/s	16 bits	2.71 mV	2	250 kS/s	24	2	ST,MT,BNC
USB-6211	16	no	250 kS/s	16 bits	2.69 mV	2	250 kS/s	4 in/4 out	2	ST
USB-6210	16	no	250 kS/s	16 bits	2.69 mV	0	-	4 in/4 out	2	ST
USB-6003	8	no	100 kS/s	16 bits	26 mV	2	5 kS/s	13	1	ST
USB-6002	8	no	50 kS/s	16 bits	26 mV	2	5 kS/s	13	1	ST
USB-6001	8	no	20 kS/s	14 bits	26 mV	2	5 kS/s	13	1	ST
USB-6000	8	no	10 kS/s	12 bits	26 mV	0	-	4	1	ST

**ST=Screw Terminals | MT=Mass Termination | BNC=BNC Terminals*

***Has only dedicated digital input and/or digital output lines*

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Table 2. NI PCI(e) multifunction I/O devices add high quality I/O to a desktop PC.

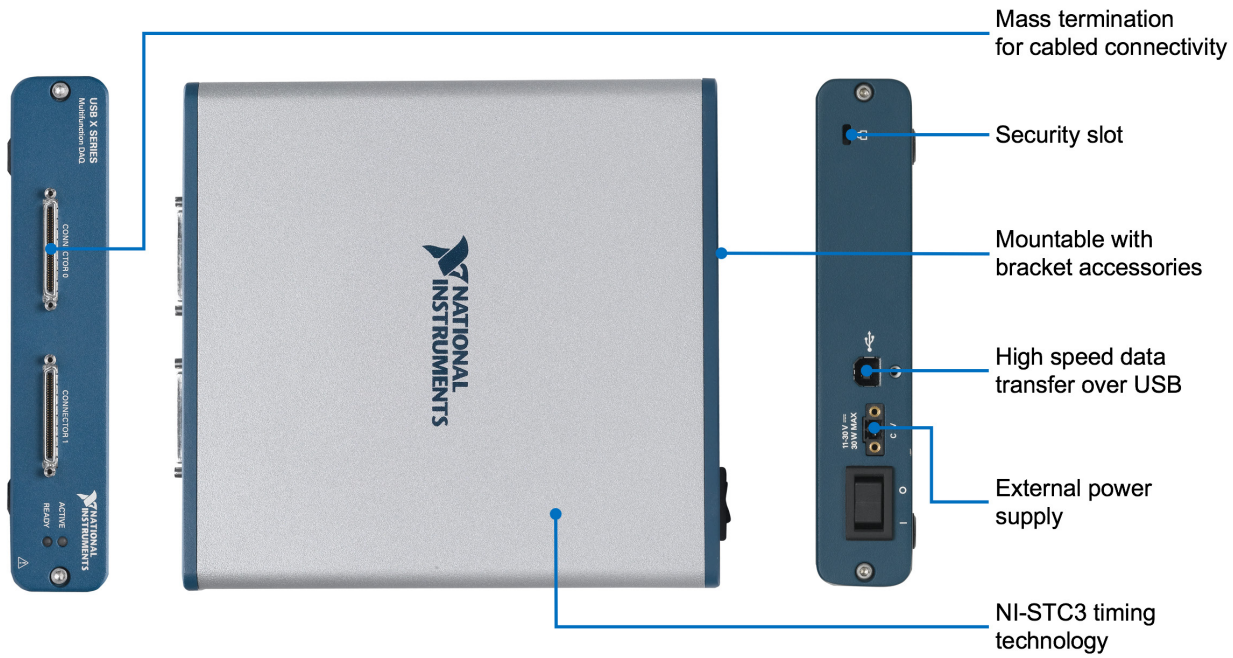
	Analog Input					Analog Output		DIO	Counters
	Max Num Ch.	Simul-taneous	Sample Rate	Resolution	Absolute Accuracy	Num Ch.	Update Rate	No. Channels	No. Channels
PCIe-6363	32	no	2 MS/s	16 bits	1.66 mV	4	2.86 MS/s	48	4
PCIe-6361	16	no	2 MS/s	16 bits	1.66 mV	2	2.86 MS/s	24	4
PCIe-6353	32	no	1.25 MS/s	16 bits	1.52 mV	4	2.86 MS/s	48	4
PCIe-6351	16	no	1.25 MS/s	16 bits	1.52 mV	2	2.86 MS/s	24	4
PCIe-6343	32	no	500 kS/s	16 bits	2.19 mV	4	900 kS/s	48	4
PCIe-6341	16	no	500 kS/s	16 bits	2.19 mV	2	900 kS/s	24	4
PCIe-6323	32	no	250 kS/s	16 bits	2.2 mV	4	900 kS/s	48	4
PCIe-6321	16	no	250 kS/s	16 bits	2.2 mV	2	900 kS/s	24	4
PCIe-6320	16	no	260 kS/s	16 bits	2.2 mV	0	-	24	4
PCI-6289	32	no	625 kS/s	16 bits	0.98 mV	4	2.86 MS/s	48	2
PCI-6284	32	no	625 kS/s	18 bits	0.98 mV	0	-	48	2
PCI-6281	16	no	625 kS/s	18 bits	0.98 mV	2	2.86 MS/s	24	2
PCI-6280	16	no	625 kS/s	18 bits	0.98 mV	0	-	24	2
PCI-6255	80	no	1.25 MS/s	16 bits	1.92 mV	2	2.86 MS/s	24	2
PCI-6229	32	no	250 kS/s	16 bits	3.1 mV	4	833 kS/s	48	2
PCI-6225	80	no	250 kS/s	16 bits	3.1 mV	2	833 kS/s	24	2
PCI-6221	16	no	250 kS/s	16 bits	3.1 mV	2	833 kS/s	24	2
PCI-6154	0	yes	250 kS/s	16 bits	5.28 mV	4	250 kS/s*	0	2
PCI-6143	0	yes	250 kS/s	16 bits	3.61 mV	0	-	8	2
PCI-6133	8	yes	2.5 MS/s	14 bits	4.66 mV	0	-	8	2
PCI-6132	4	yes	2.5 MS/s	14 bits	4.66 mV	0	-	8	2
PCI-6123	8	yes	500 kS/s	16 bits	4.96 mV	0	-	8	2
PCI-6122	4	yes	500 kS/s	16 bits	4.96 mV	0	-	8	2
PCI-6120	4	yes	1 MS/s	16 bits	76 mV	2	4 MS/s	8	2
PCI-6115	4	yes	10 MS/s	12 bits	184 mV	2	4 MS/s	8	2
PCI-6111	2	yes	5 MS/s	12 bits	252 mV	2	4 MS/s	8	2
PCI-6110	4	yes	5 MS/s	12 bits	252 mV	2	4 MS/s	8	2
PCI-6010	16	no	200 kS/s	16 bits	5.08 mV	2	-	0	2

**Simultaneous – sample rate is per output channel*

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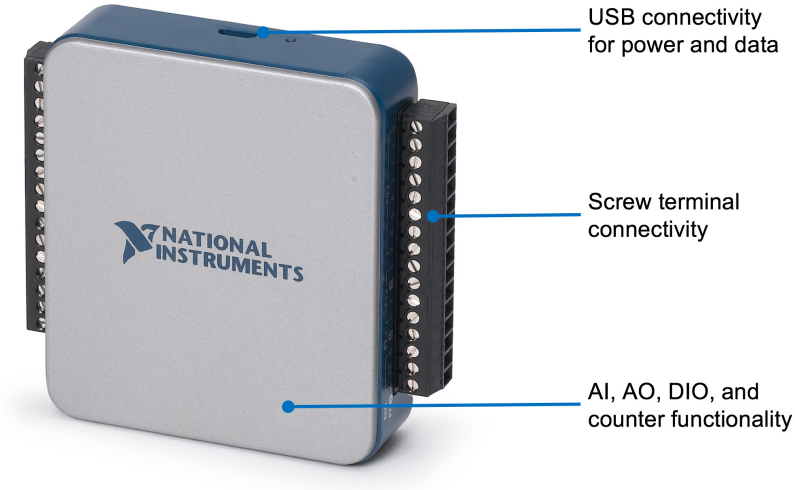
Detailed Views of Multifunction I/O Devices

USB Multifunction I/O Device, Mass Termination Variant*



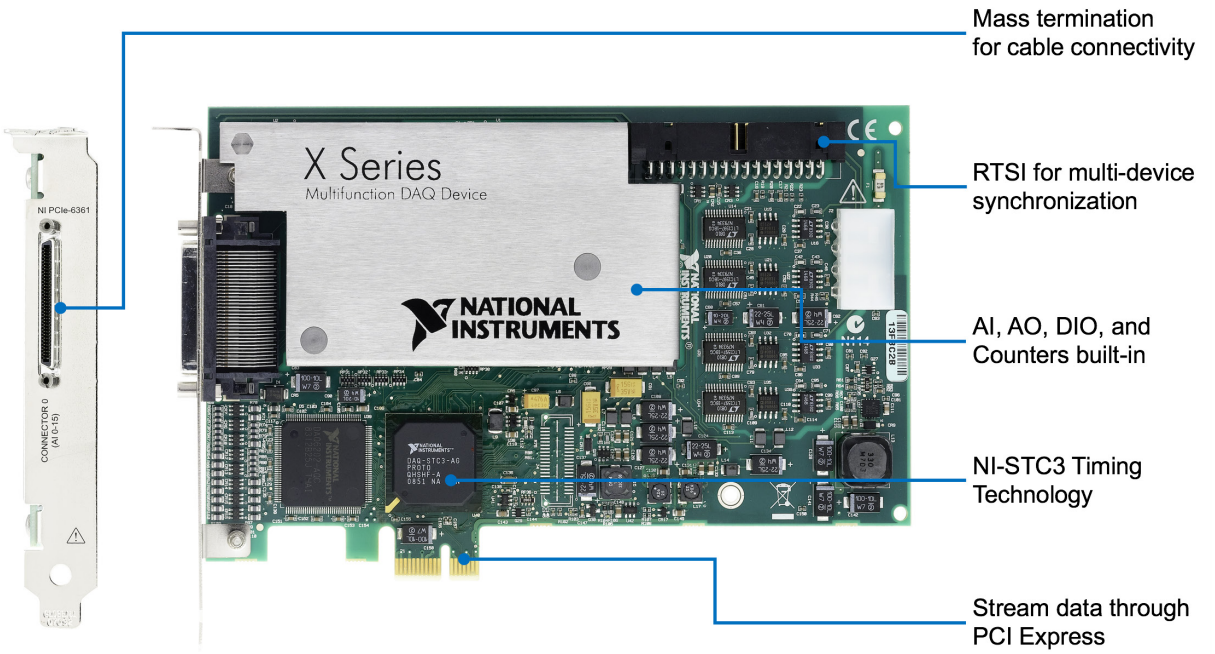
*Screw terminal and BNC terminal variants also available

Bus-Powered USB Multifunction I/O Device



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PCI Express Multifunction I/O Device



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Key Features

High Resolution, High Accuracy Analog Measurements

NI Multifunction I/O Devices have analog signal paths that have been meticulously designed, tested, and calibrated to ensure the highest possible accuracy is achieved across all input channels. Because of this thorough design-and-test philosophy, NI is able to provide thoroughly documented accuracy specifications to allow a complete understanding of device performance under a range of possible operating conditions. The specifications documentation for each device provides a section dedicated to understanding the calculation of AI absolute accuracy, alongside a wealth of other performance details.

Advanced Timing Technology

All multifunction data acquisition hardware requires onboard timing circuitry to control analog, digital, and counter I/O lines. Much of the Multifunction I/O Device family features the NI-STC3 chipset to provide up to four enhanced counters, a 100 MHz timebase, and additional options for I/O timing and triggering.

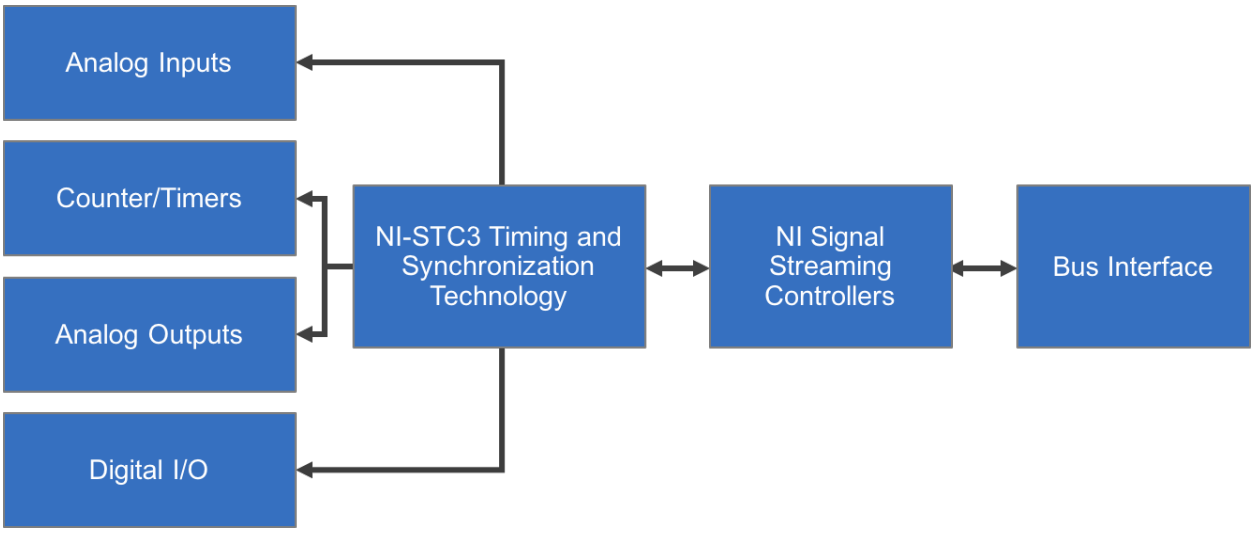


Figure 1. Modern NI DAQ devices feature NI-STC3 timing and synchronization technology – a USB Multifunction I/O Device is shown here as an example.

100 MHz Timebase

The onboard timebase of any data acquisition device acts as the internal heartbeat that drives all digital circuitry. Everything from sample clocks to trigger lines uses the timebase as an onboard reference to generate clock frequencies and latch digital edges. Modern devices use a 100 MHz timebase for all analog and digital timing, which is up to five times faster than their predecessors. This means that sampling frequencies are up to five times more accurate, and analog triggers can respond within 10 ns of a trigger condition being met.

Independent Timing Engines for Analog and Digital I/O

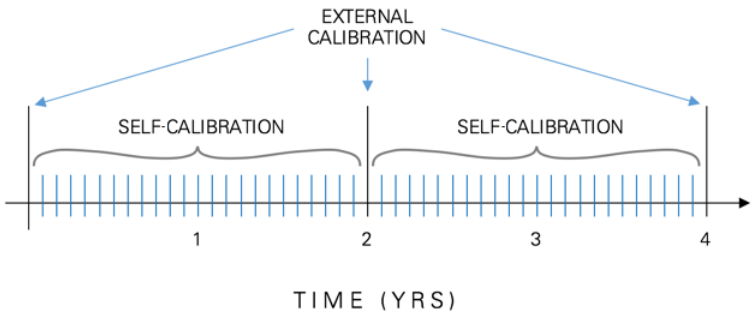
Advanced timing and triggering functionality on data acquisition devices has often relied on onboard counters and complex signal routing to achieve specialized hardware-timed performance. NI's multifunction I/O technology offers completely independent sample clocks and triggers for each different group of I/O on a multifunction device. Retriggerable acquisitions, for example, involve waiting for a trigger condition to be met, taking a finite number of samples, and then immediately rearming the trigger for the next acquisition. Using driver software function calls to rearm the trigger risks missing the next trigger due to software latency; therefore, the best possible performance requires a hardware-timed approach. In the past, counters were the only way to implement hardware-timed retriggering, and so counters would be used to generate a retriggerable pulse train, which was then internally routed to act as

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the analog input sample clock. Devices with advanced timing capabilities can perform this type of action natively, which greatly simplifies the hardware programming and measurement configuration process.

Self-Calibration and Two-Year Guaranteed Specifications

Self-calibration provides the ability to characterize nonlinearity, gain, and offset errors in Multifunction I/O Devices. These changes are caused by deviations in the operating environment as well as manufacturing variations in the integrated circuitry that may have shifted since the last external calibration. Supported devices use an integrated self-calibration algorithm called NI-MCal to characterize and save the correction polynomials to an onboard EEPROM, and does so in a matter of seconds. This allows subsequent measurements to be scaled automatically by the device driver software before being returned to the user through application software. NI-MCal has the unique ability to return calibrated data from every channel in a scan, even if they are at different input ranges. This means a device can easily load and apply channel-specific correction functions even while scanning at maximum device rates without impacting performance.

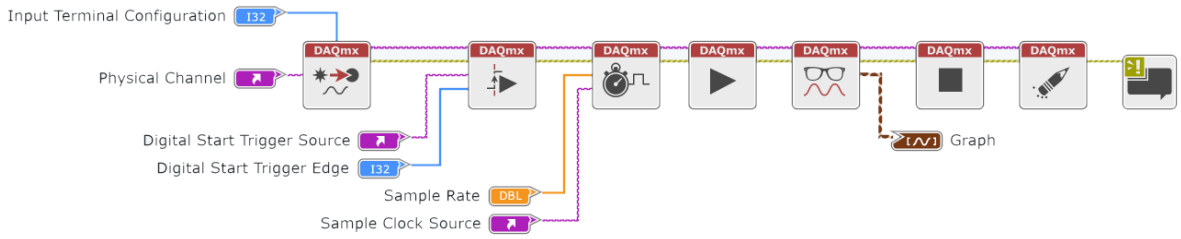


By eliminating the limitations of hardware components traditionally used for device error correction and using the power and speed of software and PC processing, NI-MCal raises the bar for measurement accuracy by redefining device self-calibration. Most Multifunction I/O Device models have a two-year external calibration cycle thanks to the self-calibration precision circuitry that minimizes the maintenance burden of deployed systems, while also maintaining tight measurement tolerances. Visit ni.com to learn more about NI's calibration services.

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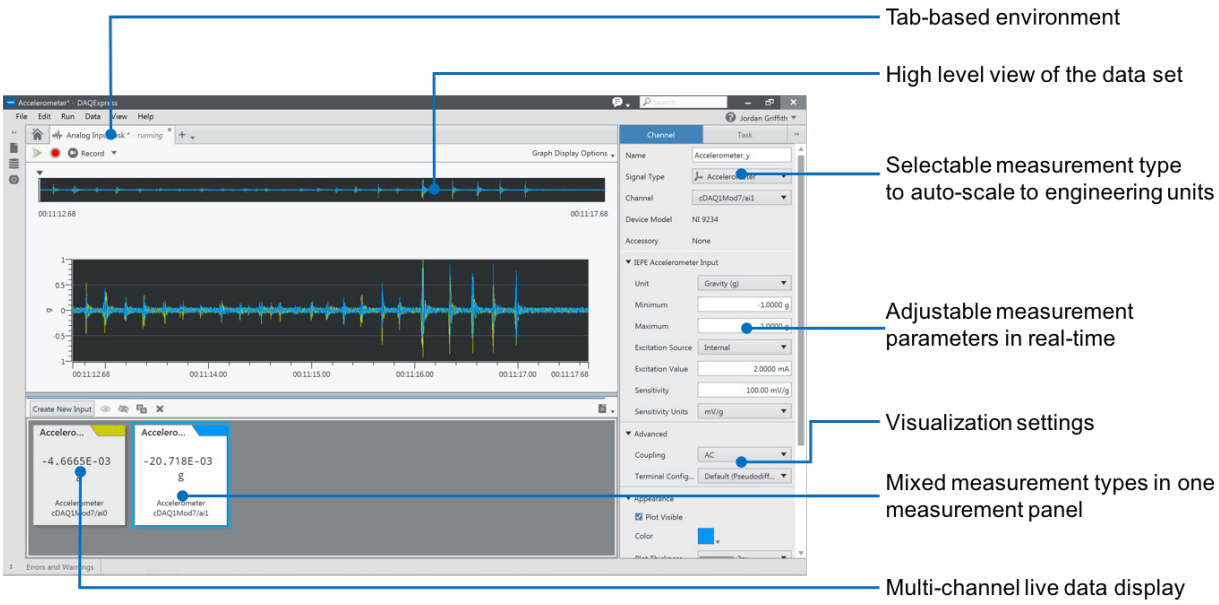
NI-DAQmx Application Programming Interface (API)

The NI-DAQmx driver includes a best-in-class API that works directly with a variety of development options including LabVIEW, DAQExpress, C, C#, Python, and others. The native integration provides exceptional performance and a seamless experience without the need for manual wrapping of functions. To ensure long-term interoperability of DAQ devices, the NI-DAQmx driver API is the same API used for all NI DAQ products – meaning re-development efforts can be minimized regardless of hardware changes or upgrades. Additionally, the driver provides access to help files, documentation, and dozens of ready-to-run shipping examples you can use as a starting point for your application.



DAQExpress Companion Software

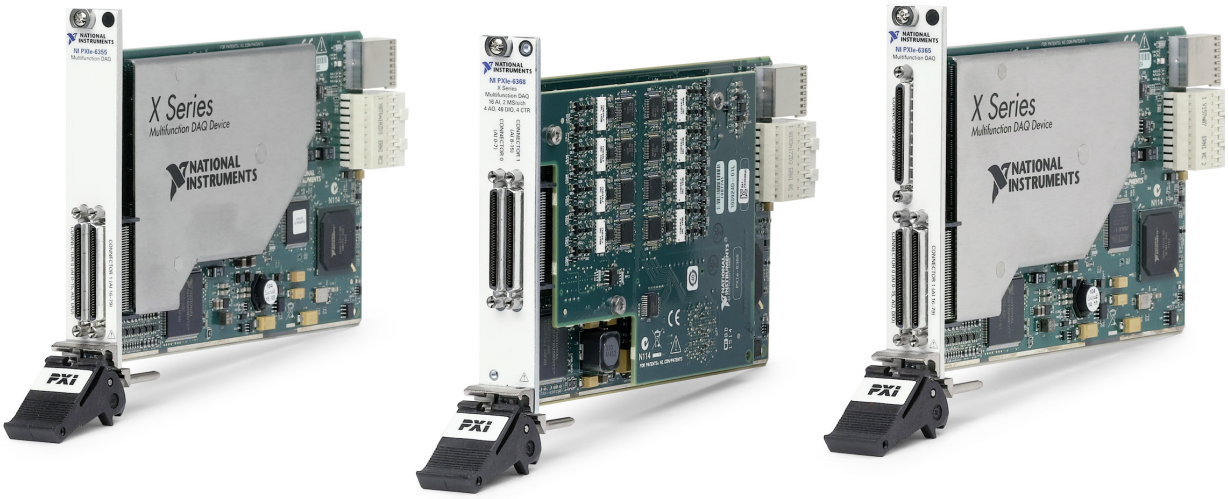
DAQExpress is interactive companion software included with the purchase of a supported hardware product. It provides quick, clear access to all the measurements supported by a DAQ device as soon as it is plugged it, and allows you to get instant access to the measurement data and apply analysis functions without writing any code. All USB and PCI(e) multifunction I/O devices are supported by, and ship with, DAQExpress and the NI-DAQmx driver.



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PXI Multifunction I/O Module

List of PXI Multifunction I/O Modules



- **Software:** Includes API support for LabVIEW and text-based languages, complete with shipping examples and detailed help files.
- Voltage measurements up to 10 MS/s per channel
- Multiplexed or simultaneous analog architectures
- Software-selectable input ranges and input channel isolation available
- Up to four analog output channels and four counters/timers
- PXI and PXI Express platform compatibility

Built for Accuracy and Reliability

NI PXI Multifunction I/O Modules provide a combination of analog I/O, digital I/O, and counter/timer functionality in a single device for PXI-based systems.

PXI Multifunction I/O Modules offer a mix of I/O with varying channel counts, sample rates, output rates, and other features to meet many common measurement requirements. These devices are ideal for a wide variety of industry applications such as laboratory automation, research, and design verification. The included NI-DAQmx driver enables complete customization of measurement and automation applications from a variety of supported programming languages.

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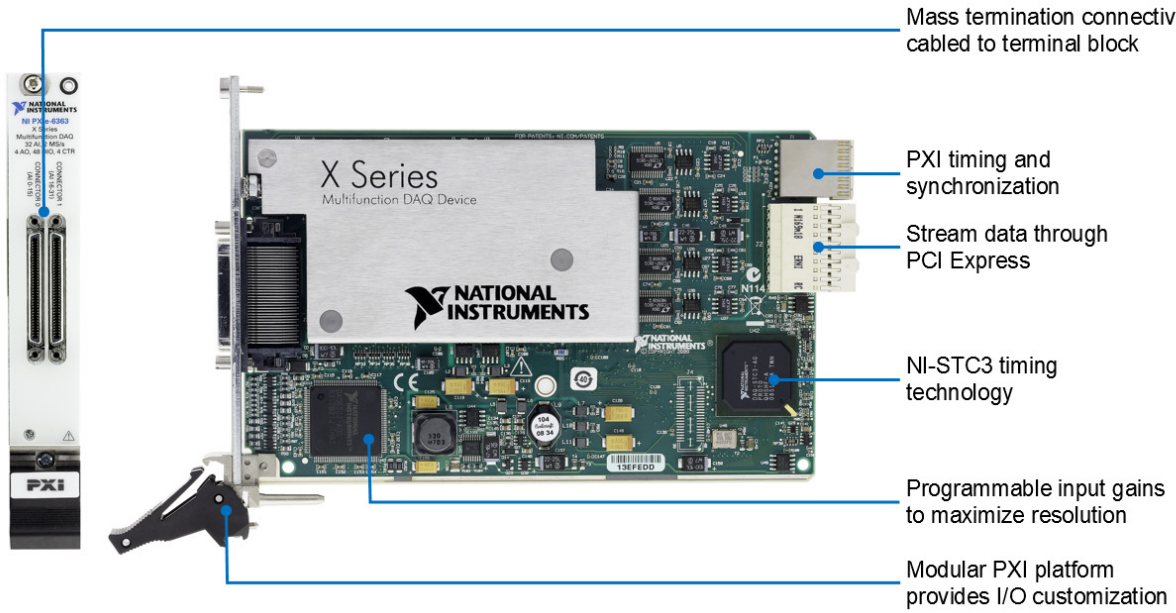
Table 2. NI PCI(e) multifunction I/O devices add high quality I/O to a desktop PC.

	Analog Input					Analog Output		DIO	Counters
	Max Num Ch.	Simul-taneous	Sample Rate	Resolution	Absolute Accuracy	Num Ch.	Update Rate	No. Channels	No. Channels
PXIe-6378	16	Yes	3.57 MS/s	16 bits	2.69 mV	4	3.3 MS/s*	48	4
PXIe-6376	8	Yes	3.57 MS/s	16 bits	2.69 mV	2	3.3 MS/s*	24	4
PXIe-6375	208	No	3.86 MS/s	16 bits	1.66 mV	2	2.86 MS/s	24	4
PXIe-6368	16	Yes	2 MS/s	16 bits	2.69 mV	4	3.3 MS/s*	48	4
PXIe-6366	8	Yes	2 MS/s	16 bits	2.69 mV	2	3.3 MS/s*	24	4
PXIe-6365	144	No	2 MS/s	16 bits	1.52 mV	2	2.86 MS/s	24	4
PXIe-6363	32	No	2 MS/s	16 bits	1.66 mV	4	2.86 MS/s	48	4
PXIe-6361	16	No	2 MS/s	16 bits	1.66 mV	2	2.86 MS/s	24	4
PXIe-6358	16	Yes	1.25 MS/s	16 bits	2.69 mV	4	3.3 MS/s*	48	4
PXIe-6356	8	Yes	1.25 MS/s	16 bits	2.69 mV	2	3.3 MS/s*	24	4
PXIe-6355	80	no	1.25 MS/s	16 bits	1.52 mV	2	2.86 MS/s	24	4
PXIe-6345	80	no	500 kS/s	16 bits	1.52 mV	2	2.86 MS/s	24	4
PXIe-6341	16	no	500 kS/s	16 bits	2.19 mV	2	900 kS/s	24	4
PXIe-6124	4	yes	4 MS/s	16 bits	3.15 mV	2	4 MS/s*	24	2
PXI-6289	32	no	625 kS/s	18 bits	0.98 mV	4	2.86 MS/s	48	2
PXI-6284	32	no	625 kS/s	18 bits	0.98 mV	0	2.86 MS/s	48	2
PXI-6281	16	no	625 kS/s	18 bits	0.98 mV	2	2.86 MS/s	24	2
PXI-6280	16	no	625 kS/s	18 bits	0.98 mV	0	2.86 MS/s	24	2
PXI-6239	8	no	250 kS/s	16 bits	-	2	500 kS/s	0	2
PXI-6238	8	no	250 kS/s	16 bits	-	2	500 kS/s	0	2
PXI-6236	4	no	250 kS/s	16 bits	-	4	500 kS/s	0	2
PXI-6233	16	no	250 kS/s	16 bits	3.1 mV	2	500 kS/s	0	2
PXI-6232	16	no	250 kS/s	16 bits	3.1 mV	2	500 kS/s	0	2
PXI-6230	8	no	250 kS/s	16 bits	3.1 mV	4	500 kS/s	0	2
PXI-6229	32	no	250 kS/s	16 bits	3.1 mV	4	833 kS/s	48	2
PXI-6225	80	no	250 kS/s	16 bits	3.1 mV	4	833 kS/s	48	2
PXI-6224	32	no	250 kS/s	16 bits	3.1 mV	0	-	48	2
PXI-6143	8	yes	250 kS/s	16 bits	3.61 mV	0	-	8	2
PXI-6133	8	yes	2.5 MS/s	14 bits	4.66 mV	0	-	8	2
PXI-6132	4	yes	2.5 MS/s	14 bits	4.66 mV	0	-	8	2
PXI-6123	8	yes	500 kS/s	16 bits	4.96 mV	0	-	8	2
PXI-6122	4	yes	500 kS/s	16 bits	4.96 mV	0	-	8	2
PXI-6120	4	yes	1 MS/s	16 bits	76 mV	2	4 MS/s	8	2
PXI-6115	4	yes	10 MS/s	12 bits	185 mV	2	4 MS/s	8	2

**Simultaneous – sample rate is per output channel*

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Detailed View of PXI Express Multifunction I/O Module



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Key Features

High Resolution, High Accuracy Analog Measurements

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Advanced Timing Technology

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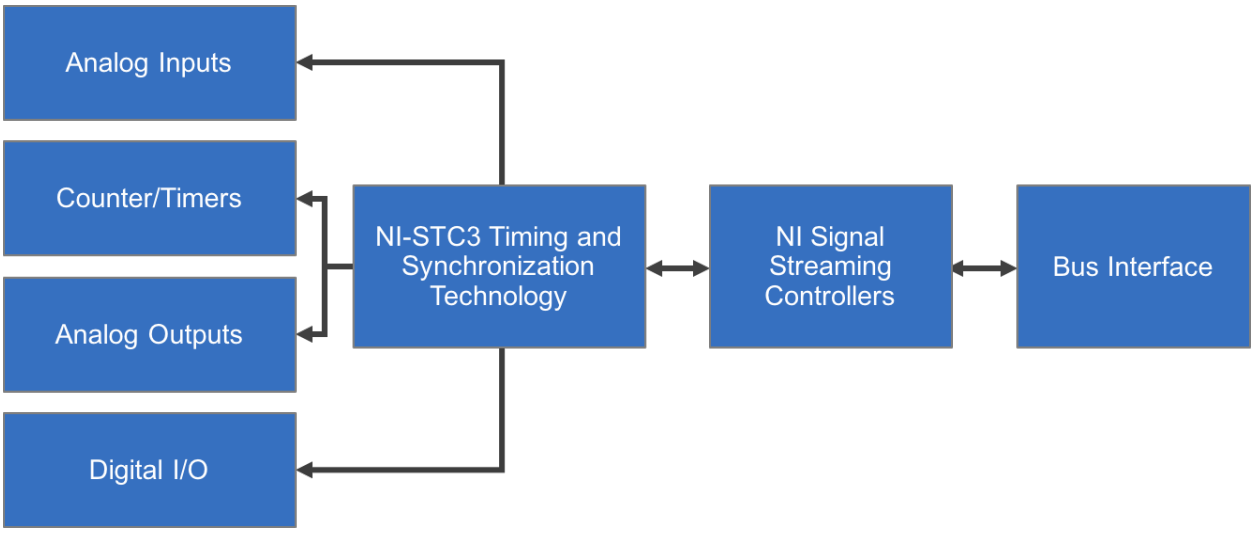


Figure 1. Modern NI DAQ modules feature NI-STC3 timing and synchronization technology.

100 MHz Timebase

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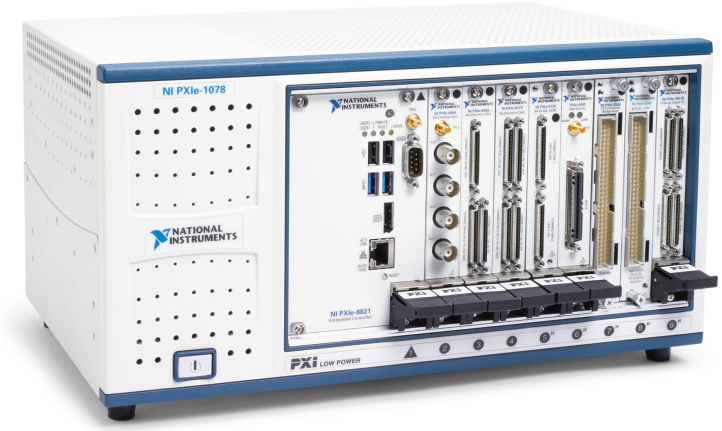
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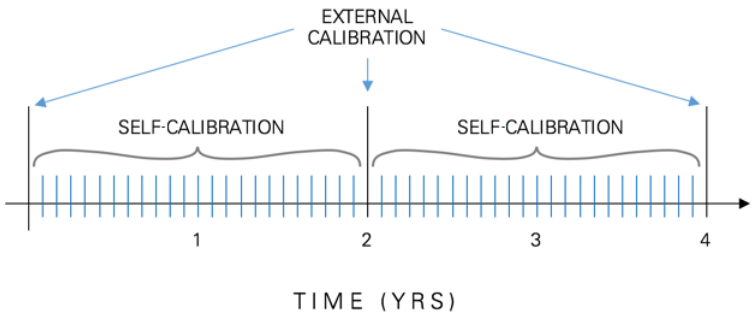
Synchronization and Integration

PXI Multifunction I/O Modules use the inherent timing and synchronization capabilities of the PXI platform to synchronize measurements between multiple modules, which is ideal for high-channel-count applications. PXI builds on its CompactPCI architecture base by adding integrated timing and synchronization that is used to route synchronization clocks and triggers internally. A PXI chassis incorporates a dedicated 10 MHz system reference clock, PXI trigger bus, star trigger bus, and slot-to-slot local bus, while a PXI Express chassis adds a 100 MHz differential system clock, differential signaling, and differential star triggers to address the need for advanced timing and synchronization.



Self-Calibration and Two-Year Guaranteed Specifications

Self-calibration provides the ability to characterize nonlinearity, gain, and offset errors in PXI Multifunction I/O Modules. These changes are caused by deviations in the operating environment as well as manufacturing variations in the integrated circuitry that may have shifted since the last external calibration. Supported modules use an integrated self-calibration algorithm called NI-MCal to characterize and save the correction polynomials to an onboard EEPROM, and does so in a matter of seconds. This allows subsequent measurements to be scaled automatically by the device driver software before being returned to the user through application software. NI-MCal has the unique ability to return calibrated data from every channel in a scan, even if they are at different input ranges. This means a device can easily load and apply channel-specific correction functions even while scanning at maximum device rates without impacting performance.

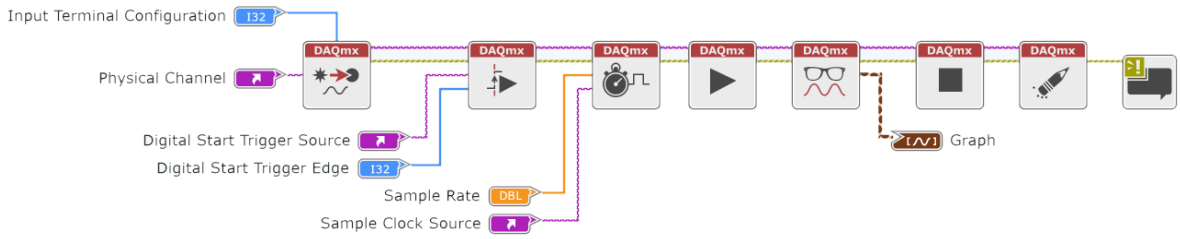


By eliminating the limitations of hardware components traditionally used for device error correction and using the power and speed of software and PC processing, NI-MCal raises the bar for measurement accuracy by redefining device self-calibration. Most PXI Multifunction I/O Module models have a two-year external calibration cycle thanks to the self-calibration precision circuitry that minimizes the maintenance burden of deployed systems, while also maintaining tight measurement tolerances. Visit ni.com to learn more about NI's calibration services.

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NI-DAQmx Application Programming Interface (API)

The NI-DAQmx driver includes a best-in-class API that works directly with a variety of development options including LabVIEW, DAQExpress, C, C#, Python, and others. The native integration provides exceptional performance and a seamless experience without the need for manual wrapping of functions. To ensure long-term interoperability of DAQ devices, the NI-DAQmx driver API is the same API used for all NI DAQ products – meaning re-development efforts can be minimized regardless of hardware changes or upgrades. Additionally, the driver provides access to help files, documentation, and dozens of ready-to-run shipping examples you can use as a starting point for your application.

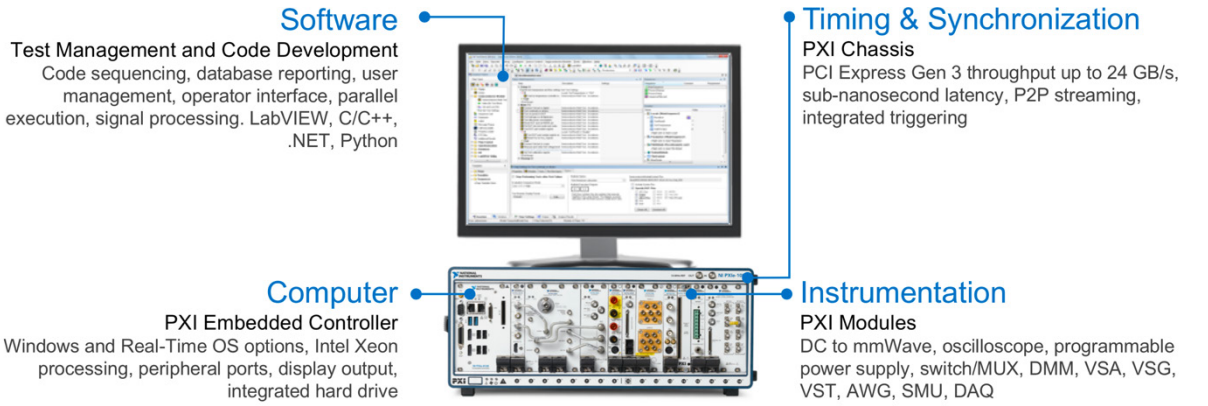


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Platform-Based Approach to Test and Measurement

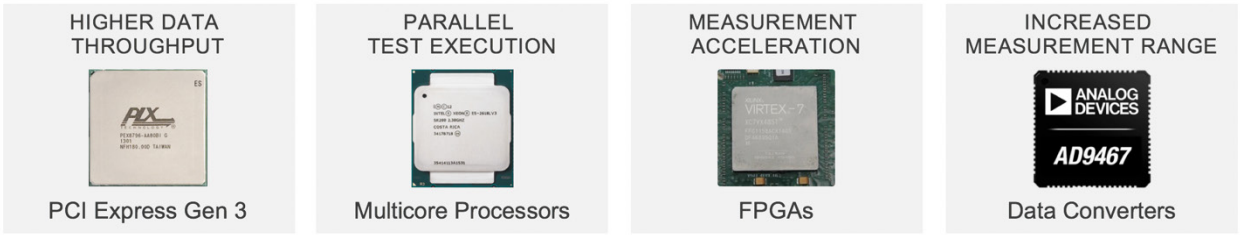
What Is PXI?

Powered by software, PXI is a rugged PC-based platform for measurement and automation systems. PXI combines PCI electrical-bus features with the modular, Eurocard packaging of CompactPCI and then adds specialized synchronization buses and key software features. PXI is both a high-performance and low-cost deployment platform for applications such as manufacturing test, military and aerospace, machine monitoring, automotive, and industrial test. Developed in 1997 and launched in 1998, PXI is an open industry standard governed by the PXI Systems Alliance (PXISA), a group of more than 70 companies chartered to promote the PXI standard, ensure interoperability, and maintain the PXI specification.



Integrating the Latest Commercial Technology

By leveraging the latest commercial technology for our products, we can continually deliver high-performance and high-quality products to our users at a competitive price. The latest PCI Express Gen 3 switches deliver higher data throughput, the latest Intel multicore processors facilitate faster and more efficient parallel (multisite) testing, the latest FPGAs from Xilinx help to push signal processing algorithms to the edge to accelerate measurements, and the latest data converters from TI and ADI continually increase the measurement range and performance of our instrumentation.



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Hardware Services

All NI hardware includes a one-year warranty for basic repair coverage, and calibration in adherence to NI specifications prior to shipment. PXI systems also include basic assembly and a functional test. NI offers additional entitlements to improve uptime and lower maintenance costs with service programs for hardware. Learn more at ni.com/services/hardware.

	Standard	Premium	Description
Program Duration	3 or 5 years	3 or 5 years	Length of service program
Extended Repair Coverage	•	•	NI restores your device's functionality and includes firmware updates and factory calibration.
System Configuration, Assembly, and Test[1]	•	•	NI technicians assemble, install software in, and test your system per your custom configuration prior to shipment.
Advanced Replacement[2]		•	NI stocks replacement hardware that can be shipped immediately if a repair is needed.
System Return Material Authorization (RMA)[1]		•	NI accepts the delivery of fully assembled systems when performing repair services.
Calibration Plan (Optional)	Standard	Expedited[3]	NI performs the requested level of calibration at the specified calibration interval for the duration of the service program.

[1]This option is only available for PXI, CompactRIO, and CompactDAQ systems.
[2]This option is not available for all products in all countries. Contact your local NI sales engineer to confirm availability.
[3]Expedited calibration only includes traceable levels.

PremiumPlus Service Program

NI can customize the offerings listed above, or offer additional entitlements such as on-site calibration, custom sparing, and life-cycle services through a PremiumPlus Service Program. Contact your NI sales representative to learn more.

Technical Support

Every NI system includes a 30-day trial for phone and e-mail support from NI engineers, which can be extended through a Software Service Program (SSP) membership. NI has more than 400 support engineers available around the globe to provide local support in more than 30 languages. Additionally, take advantage of NI's award winning online resources and communities.

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