2TEST

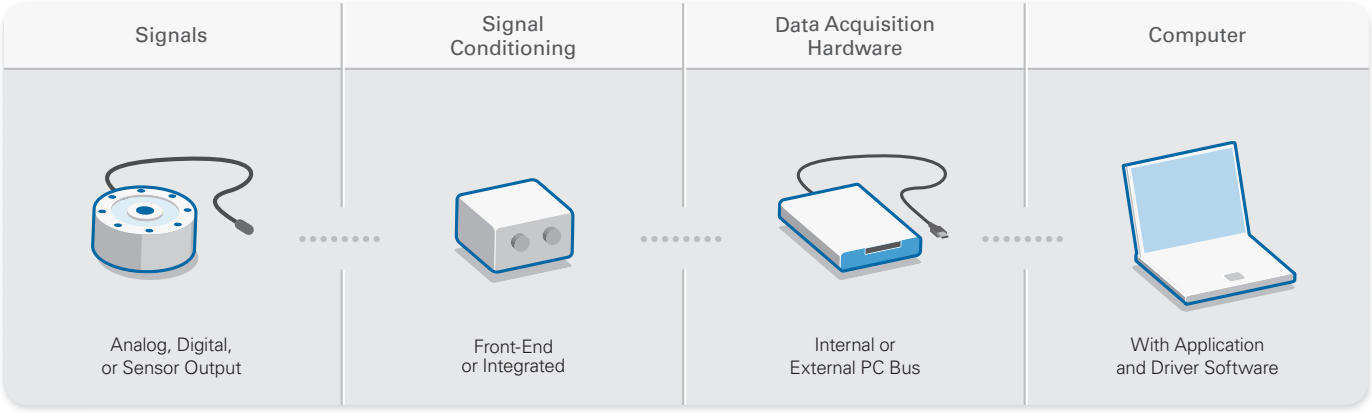
NI Data Acquisition

Benchtop | Industrial | Portable | Embedded

NATIONAL INSTRUMENTS

What is Data Acquisition?

Data acquisition is the process of measuring an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound. PC-based data acquisition uses a combination of modular hardware and flexible software to transform your standard laptop or desktop computer into a user-defined measurement or control system. While each data acquisition system has unique functionality to serve application-specific requirements, all systems share common components that include sensors, data acquisition hardware, and a computer.



You can use data acquisition tools for a variety of applications such as data logging, control, test automation, monitoring, and prototyping. Use NI data acquisition (DAQ) to meet application challenges for any signal on any bus with easy, powerful software.

Designed for Performance

NI data acquisition (DAQ) devices provide the I/O capabilities, measurement accuracy, and software flexibility your application requires. With patented hardware and software technologies, National Instruments offers PC-based measurement and control solutions that deliver increased productivity through user-defined logging, analysis, and visualization. NI-DAQmx multithreaded driver software provides ease of use, flexibility, and performance in multiple programming environments, including NI LabVIEW, NI LabWindows™/CVI, C/C++, Visual C#, and Visual Basic .NET.

High-Performance I/O

- Direct sensor connectivity
- Integrated signal conditioning
- High measurement accuracy
- High-channel-count synchronization

NI Technologies

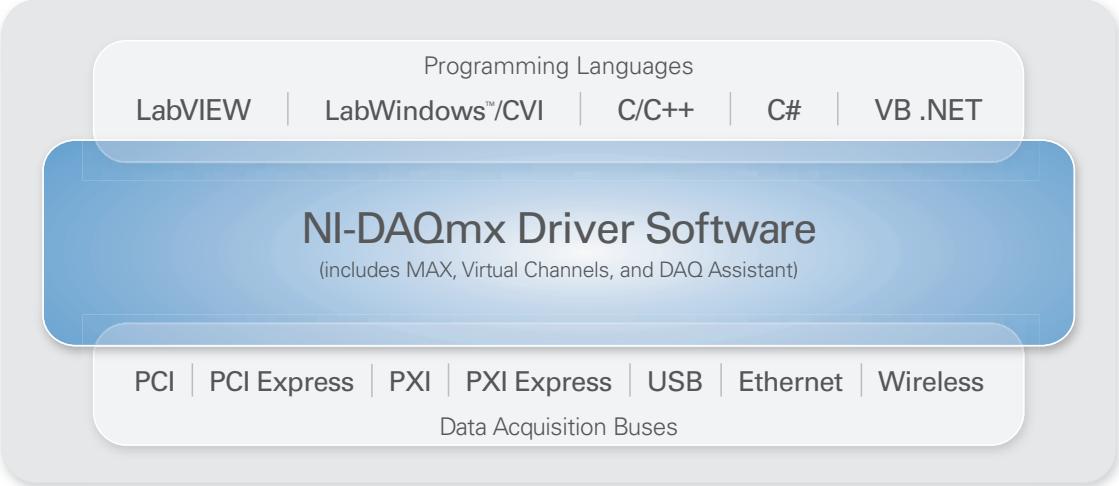
- NI-STC3: Timing and synchronization
- NI Signal Streaming: Efficient data streaming
- NI-MCal: Calibration methodology
- TDMS: Logging data to disk

Productivity through Software-Defined Instrumentation

- Inline data analysis
- Application-specific visualization
- Custom alarming and control
- Automated report generation

Easy, Powerful DAQ Software

When building a data acquisition system, selecting the right application and driver software is just as important as choosing the hardware. NI-DAQmx, a high-performance, multithreaded driver, provides a consistent set of functions across multiple programming languages and for all supported PC buses. So no matter which language you use, NI-DAQmx software can simplify any application.



Get More from Your System with NI-DAQmx Software

Every NI data acquisition device is supported by NI-DAQmx and is shipped with NI Measurement & Automation Explorer (MAX), NI-DAQmx virtual channels, and the DAQ Assistant.

Measurement & Automation Explorer (MAX)

- Configure and test hardware with interactive test panels
- Perform self-test sequences
- Create simulated devices
- Save, import, and export configuration files
- Reference wiring diagrams and documentation

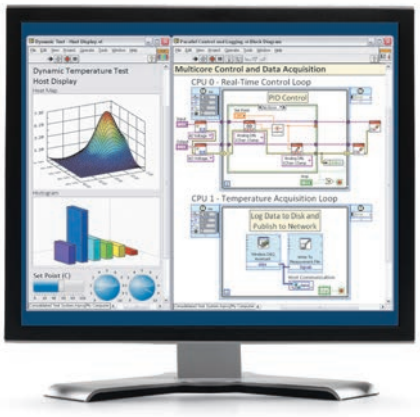
NI-DAQmx Virtual Channels

- Configure input ranges and signal conditioning parameters
- Convert sensor voltage measurements into real-world engineering units
- Apply user-defined scaling operations
- Create NI-DAQmx tasks by adding timing, triggering, and synchronization information

DAQ Assistant

- Create a measurement task interactively through a wizard-like configuration utility
- Configure sampling parameters, data scaling, and data-logging formats (including ASCII and TDMS)
- Automatically generate LabVIEW, C, C++, or Visual Basic .NET code[1]

[1]The DAQ Assistant generates C and .NET code when used with NI LabWindows/CVI or Measurement Studio.



LabVIEW System Design Software

LabVIEW is a highly productive development environment used by engineers and scientists who need to create custom measurement, control, and analysis applications without the hassle associated with traditional tools. Using graphical programming, you can quickly tie together acquisition, processing, analysis, and display functions to create your own virtual instruments. Learn more at **ni.com/labview/applications/daq**.

Advantages of LabVIEW for DAQ Applications

LabVIEW has many benefits for data acquisition applications:

- Add power and flexibility through software
- Accelerate your productivity
- Builld upon industry leading innovation
- Turn raw data into results
- Create a user interface by dragging and dropping controls
- Distribute stand-alone applications

C, C++, .NET, and Other Programming Options

The NI-DAQmx driver features native high-performance libraries for popular general-purpose programming languages such as ANSI C, C++, and C#/Visual Basic .NET. The consistent API ensures easy migration between languages, and advanced features such as virtual channels help you configure channels independently of your code. In addition, National Instruments offers LabWindows/CVI and Measurement Studio to make ANSI C and Microsoft Visual Studio users more productive when creating data acquisition applications.

NI LabWindows/CVI

LabWindows/CVI is a proven ANSI C integrated development environment that provides a comprehensive set of programming tools for creating high-performance test and control applications.

NI Measurement Studio

Measurement Studio is a suite of native user interface controls, tools, and class libraries to add engineering acquisition, analysis, and presentation to Microsoft Visual Studio to dramatically reduce development time.

DAQ Applications

Data acquisition tools are used in applications such as measurement, data logging, control, test automation, monitoring, and prototyping in a wide range of industries including medical, consumer electronics, and civil and chemical engineering.

Visualizing Measurements

You can take measurements with many traditional stand-alone instruments, but those are often vendor-defined and difficult to customize. With PC-based data acquisition, the software defines the instrument. Transform your standard computer into a user-defined measurement system and add the exact analysis and visualization capabilities your application requires. Learn more at **ni.com/daqmeasurement**.

Advantages of Using NI Data Acquisition for Visualizing Measurements

- Use your existing PC for taking measurements
- Create real-time graphs for viewing data
- Perform inline signal processing and analysis
- Design custom graphical user interfaces (GUIs)
- Tailor visualization components to specific applications
- Automatically generate reports for sharing results

Wyeth Neuroscience

Wyeth Neuroscience conducts pharmaceutical research targeting the therapeutic modulation of neuronal synapses. Unable to identify a commercial product with all the flexibility and power needed for its synaptic stimulus-response field potential experiments, the company developed an automated system to facilitate the design, execution, and analysis needs of its research.

> *"The NI PCI-6229 data acquisition board, in a Dell Precision 340 running Windows XP, provided a powerful yet remarkably cost-effective basis for our instrument."*
>
> – Robert Arias, Principal Research Scientist, Wyeth Neuroscience

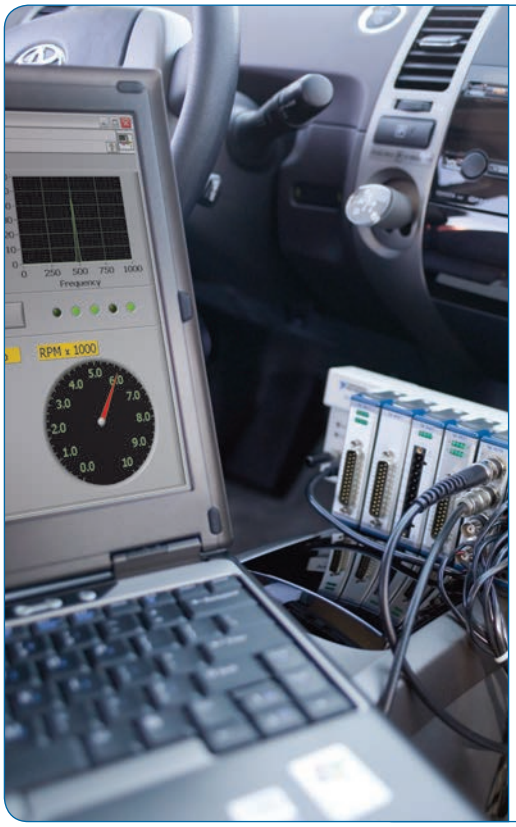
>> Learn about this case study at **ni.com/wyeth**

Data Logging

Data logging is used in a broad spectrum of applications. For example, chemists record data such as temperature, pH, and pressure when performing experiments in a lab. Civil engineers record strain and load on bridges over time to evaluate safety. With data acquisition hardware, a PC can be transformed into a user-defined, high-speed, streaming data logger. Learn more at **ni.com/daqlogdata**.

Advantages of Using NI Data Acquisition for Data Logging

- Log data to PC hard drives for terabytes of data storage
- Connect data to the Web with PC network connectivity
- Create a paperless chart recorder with custom functionality
- Perform inline analysis with PC processing power
- Visualize data in real time as it is being logged
- Get started quickly with free data-logging software



Faculty of Electrical Engineering and Computing

The Faculty of Electrical Engineering and Computing in Zagreb, Croatia, required a cost-effective measurement system to analyze automobile speed and acceleration. Using LabVIEW and NI data acquisition, faculty members quickly and easily built an integrated PC-based data-logging system.

"Using LabVIEW and NI DAQ hardware, we developed a cost-effective in-vehicle data-logging system in a short period of time that can acquire, analyze, and present measurement data from different types of sensors."

– Hrvoje Hegeduš, Engineer,
Faculty of Electrical Engineering and Computing

>> Learn about this case study at **ni.com/feec**

Control

Regardless of your application type, you can use data acquisition hardware to connect sensors and actuators to your computer and build the exact control system you require. In addition to taking advantage of software flexibility, you can choose from a variety of ways to integrate PC-based control systems with your existing instruments, programmable logic controllers (PLCs), and single-loop controllers. Learn more at **ni.com/daqcontrol**.

Advantages of Using NI Data Acquisition for Control Applications

- Integrate with existing systems over standard communication buses
- Scale from basic on/off control to PID and more advanced algorithms
- Incorporate the right combination of I/O
- Design custom user interfaces for supervisory control
- Increase system functionality with monitoring and reporting features
- Use multicore PC processing

Bloomy Controls

HydrogenSource develops fuel processors and hydrogen generation systems for the fuel cell and hydrogen fuel markets. Contracted by HydrogenSource, Bloomy Controls needed to automate its complex and lengthy experiments involving hundreds of controlled parameters for the evaluation of chemical catalysts used in the production of hydrogen for fuel cells.

"We estimate that these automation systems using National Instruments products have cumulatively saved in excess of 10,000 man-hours of manual control, monitoring, and data collection."

– Robert Hamburger, Business Development Manager, Bloomy Controls

>> Learn about this case study at **ni.com/bloomy**

Test Automation

From initial design validation to the final production line, testing electrical or mechanical designs is required to ensure proper performance and reliability. With PC-based data acquisition, you can select the right combination of I/O, configure special timing or triggering functionality, and automate test sequences with low-cost PC system components and commercial off-the-shelf (COTS) hardware. Learn more at **ni.com/daqtest**.

Advantages of Using NI Data Acquisition for Test Automation

- Increase test coverage with flexible I/O functionality
- Reduce your system costs with COTS hardware and PC components
- Interface with existing instruments and other test equipment
- Use software to generate test reports
- Implement custom signal processing and analysis routines
- Automatically stream data to disk over high-speed PC buses

Microsoft

Microsoft required a comprehensive, low-cost production test system for the Microsoft Xbox 360 wired and wireless controllers. Using NI data acquisition hardware and LabVIEW, the company was able to create a flexible, automated, and PC-based test system.

> *"Using PXI instrumentation and LabVIEW, we built the test system in our Xbox 360 controller design validation lab and deployed it to our production line."*
>
> – D.J. Mathias, Development Test Engineer Lead, Microsoft

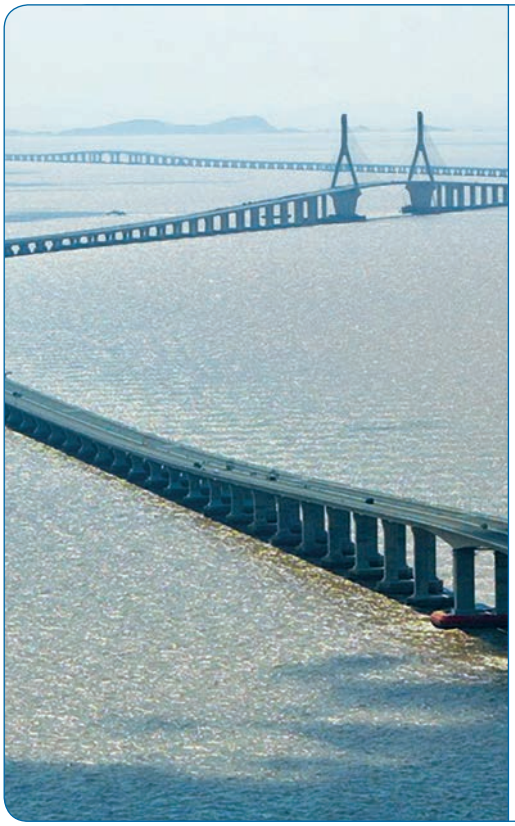
>> Learn about this case study at **ni.com/xbox**

Monitoring

Monitoring is everywhere, from weather stations and power meters to industrial machines and laboratories. It is used to help reduce cost, improve efficiency, and even save lives. Scalability and customization are essential to building monitoring systems because unique application requirements evolve over time. NI data acquisition hardware turns a PC into a software-defined, flexible, and high-performance monitoring system. Learn more at **ni.com/daqmonitoring**.

Advantages of Using NI Data Acquisition for Monitoring

- Connect data to the Web with PC network connectivity
- Perform inline analysis with PC processing power
- Develop custom functionality for alarms and notifications
- Turn displays into human machine interfaces (HMIs)
- Log data to PC hard drives for terabytes of data storage
- Identify data trends with user-defined algorithms



Donghai Bridge

Performing synchronized, real-time monitoring of the structural integrity and response of an expansive 32.5 km bridge requires a rugged, reliable, and flexible platform. In an environment prone to typhoons, earthquakes, and corrosive saltwater, reliable operation and minimal maintenance are very important.

"With accurate GPS synchronization and timestamping, NI PXI dynamic signal acquisition hardware, and LabVIEW, our team successfully created a rugged, modular, reliable, low-maintenance, and accurate monitoring system for the Donghai Bridge."

–Yonglin Zhan, Engineer,
JUST ONE Technology

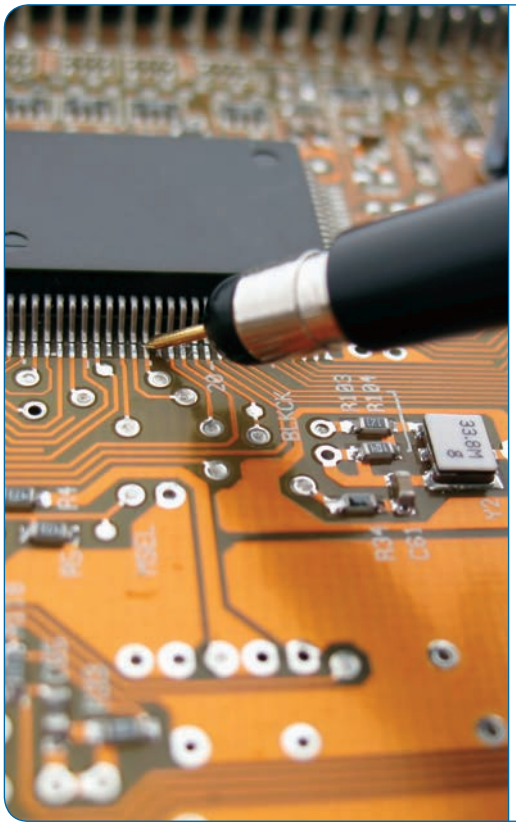
>> Learn about this case study at **ni.com/donghai**

Prototyping

Prototyping is crucial to the design process. The ability to demonstrate a functioning proof of concept to managers and customers is the first step in proving out an idea. The flexibility and productivity of NI PC-based data acquisition systems have proven useful in getting a prototype working quickly – from medical devices to industrial machinery and automated test systems. Learn more at **ni.com/daqprototyping**.

Advantages of Using NI Data Acquisition for Prototyping

- Save time by making design changes in software
- Create compelling demonstrations for customers
- Take proven ideas to market faster, with minimal rework
- Reduce the cost of experimentation with COTS hardware
- Simulate designs with virtual prototypes
- Quickly add I/O for real-world signals



San Francisco Industrial Software

San Francisco Industrial Software needed to quickly and cost-effectively prototype a digital flow cytometer to potentially replace a customer's current analog card-cage electronics. By using NI data acquisition hardware and LabVIEW, the company created the first prototype in approximately three months.

> *"Our development effort of six months had more accuracy and versatility than an analog system that had been evolving for 25 years."*
>
> – Eric Nehrlich, Engineer,
> San Francisco Industrial Software

>> Learn about this case study at **ni.com/sfis**

Multifunction Data Acquisition

National Instruments multifunction DAQ devices integrate analog input and output, digital input and output, and counter/timer circuitry. These devices offer up to 10 MS/s simultaneous analog input rates and up to 80 analog inputs, four analog outputs, 48 digital I/O lines, and four counters. They are available for USB, PCI, PCI Express, PXI, and PXI Express. From low-cost to high-performance, these devices provide exceptional value and flexibility.

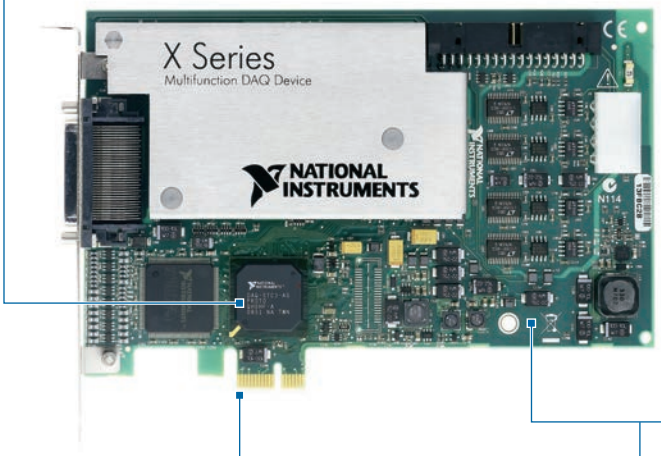
NI-STC3 Timing and Synchronization Technology

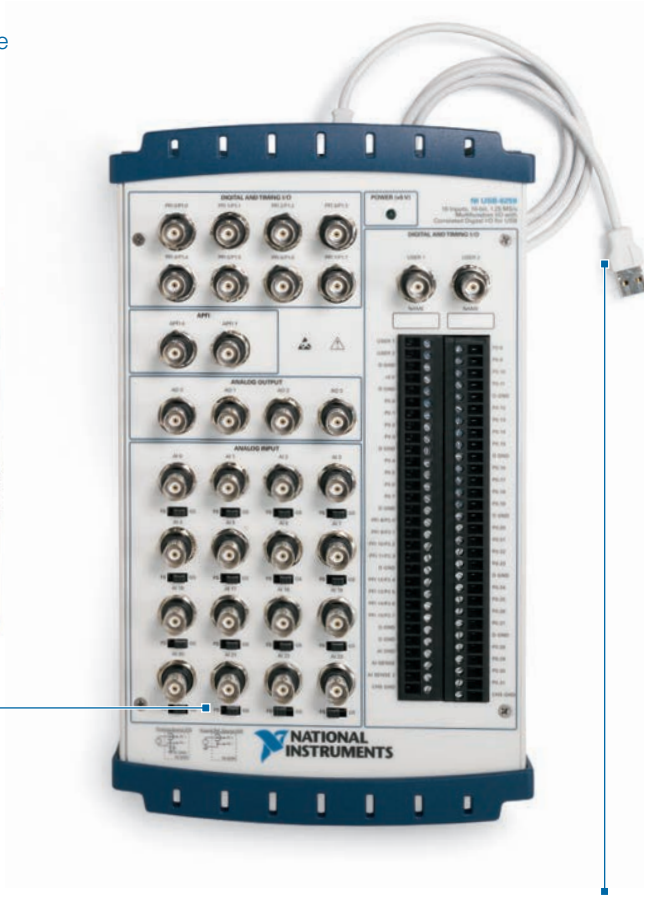
Four 32-bit counters for PWM, encoder, frequency, and more

100 MHz timebase for precise sample clock generation

Independent analog and digital timing engines

Retriggerable analog I/O, digital I/O, and counter I/O





Native x1 PCI Express Interface

Dedicated bandwidth of up to 250 MB/s in each direction

Eight DMA channels for analog I/O, digital I/O, and all four counters

NI-MCal Calibration Methodology

4X more accurate self-calibration

Third-order correction for nonlinearity, offset, and gain

Calibration for each input range in a scan list

Ultrastable, low-drift precision voltage reference

NI USB DAQ devices are an easy-to-use, portable option with integrated signal connectivity

X Series Multifunction DAQ

NI X Series devices for USB, PCI Express, and PXI Express are the most advanced DAQ devices ever designed by National Instruments. The X Series DAQ family features new NI-STC3 timing and synchronization technology that provides four advanced counters, a 100 MHz timebase, and additional I/O timing and triggering functionality.

Model	Bus	Analog Inputs	Input Resolution (bits)	Max Sampling Rate	Aggregate AI Throughput	Analog Triggering	Analog Outputs	Max Output Rate	DIO	Max DIO Rate (MHz)
Multiplexed										
NI 6320	PCIe[1]	16	16	250 kS/s	250 kS/s	–	0	–	24	1
NI 6321	PCIe[1]	16	16	250 kS/s	250 kS/s	–	2	900 kS/s	24	1
NI 6323	PCIe[1]	32	16	250 kS/s	250 kS/s	–	4	900 kS/s	48	1
NI 6341	USB, PCIe[1], PXIe[2]	16	16	500 kS/s	500 kS/s	–	2	900 kS/s	24	1
NI 6343	USB, PCIe[1]	32	16	500 kS/s	500 kS/s	–	4	900 kS/s	48	1
NI 6351	USB, PCIe[1]	16	16	1.25 MS/s	1 MS/s	✓	2	2.86 MS/s	24	10
NI 6353	USB, PCIe[1]	32	16	1.25 MS/s	1 MS/s	✓	4	2.86 MS/s	48	10
NI 6361	USB, PCIe[1], PXIe[2]	16	16	2 MS/s	1 MS/s	✓	2	2.86 MS/s	24	10
NI 6363	USB, PCIe[1], PXIe[2]	32	16	2 MS/s	1 MS/s	✓	4	2.86 MS/s	48	10
Simultaneous										
NI 6356	USB, PXIe[2]	8 simultaneous	16	1.25 MS/s/ch	10 MS/s	✓	2	3.33 MS/s	24	10
NI 6358	PXIe[2]	16 simultaneous	16	1.25 MS/s/ch	20 MS/s	✓	4	3.33 MS/s	48	10
NI 6366	USB, PXIe[2]	8 simultaneous	16	2 MS/s/ch	16 MS/s	✓	2	3.33 MS/s	24	10
NI 6368	PXIe[2]	16 simultaneous	16	2 MS/s/ch	32 MS/s	✓	4	3.33 MS/s	48	10

[1]PCI Express, [2]PXI Express

M Series Multifunction DAQ

NI M Series devices offer a broad set of I/O options and bus connectivity for data acquisition applications. M Series USB hardware includes up to 80 channels on a single device, and industrial M Series devices offer built-in isolation circuitry and analog current measurement options.

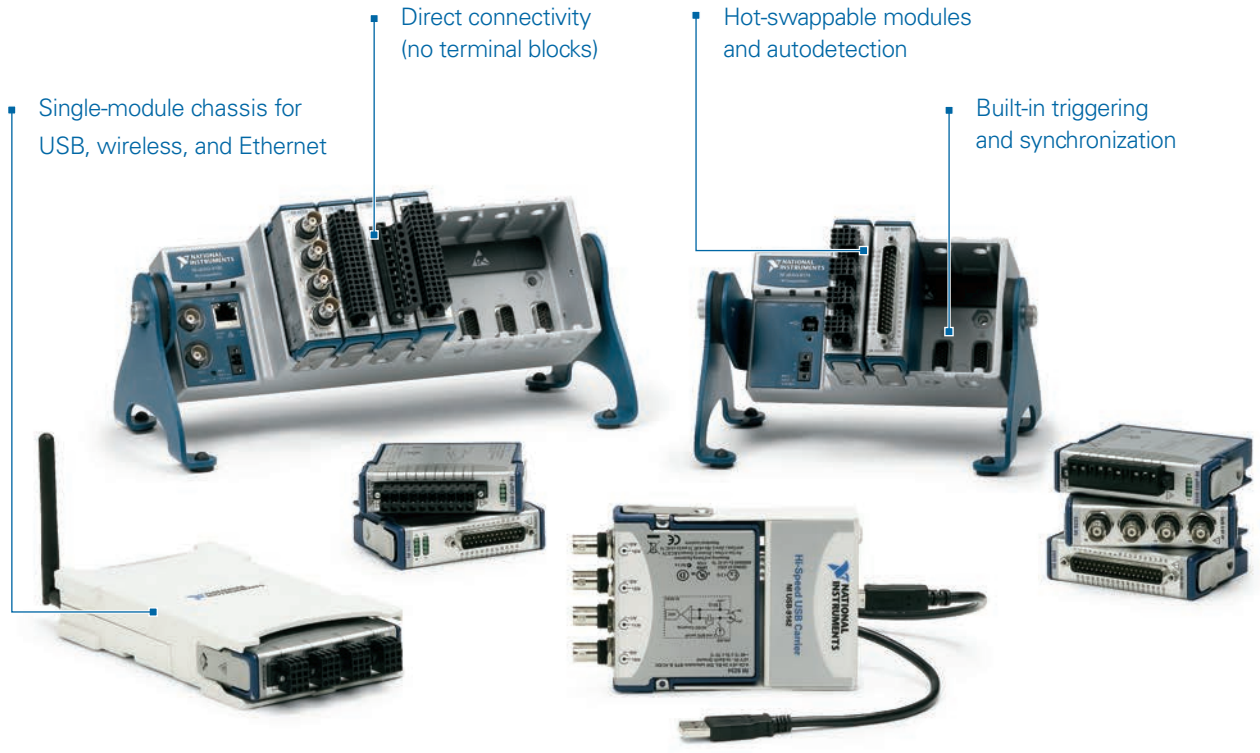
Model	Bus	Analog Inputs[1]	Input Resolution (bits)	Max Sampling Rate (S/s)[2]	Analog Triggering	Integrated Signal Conditioning	Analog Outputs[1]	Max Output Rate (S/s)	Output Range (V)	DIO	DIO Features[3]
High-Accuracy											
NI 6289	USB, PCI, PXI	32	18	625 k	✓	Lowpass filters	4	2.8 M	Programmable per channel	48	5 V TTL, 10 MHz
NI 6284	PCI, PXI	32	18	625 k	✓	Lowpass filters	0	–	–	48	5 V TTL, 10 MHz
NI 6281	USB, PCI, PXI	16	18	625 k	✓	Lowpass filters	2	2.8 M	Programmable per channel	24	5 V TTL, 10 MHz
NI 6280	PCI, PXI	16	18	625 k	✓	Lowpass filters	0	–	–	24	5 V TTL, 10 MHz
High-Speed											
NI 6259	PCI, PXI	32	16	1.25 M	✓	–	4	2.8 M	±10, ±5, ±ext ref	48	5 V TTL, 10 MHz
NI 6255	PCI, PXI, USB	80	16	1.25 M	✓	–	2	2.8 M	±10, ±5, ±ext ref	24	5 V TTL, 10 MHz
NI 6254	PCI, PXI	32	16	1.25 M	✓	–	0	–	–	48	5 V TTL, 10 MHz
NI 6251	PCI, PXI	16	16	1.25 M	✓	–	2	2.8 M	±10, ±5, ±ext ref	24	5 V TTL, 10 MHz
NI 6250	PCI, PXI	16	16	1.25 M	✓	–	0	–	–	24	5 V TTL, 10 MHz
Low-Cost											
NI 6229	PCI, PXI	32	16	250 k	–	–	4	833 k	±10	48	5 V TTL, 1 MHz
NI 6225	PCI, PXI, USB	80	16	250 k	–	–	2	833 k	±10	24	5 V TTL, 1 MHz
NI 6224	PCI, PXI	32	16	250 k	–	–	0	–	–	48	5 V TTL, 1 MHz
NI 6221	PCI, PXI	16	16	250 k	–	–	2	833 k	±10	24	5 V TTL, 1 MHz
NI 6221 (37-pin)	PCI	16	16	250 k	–	–	2	833 k	±10	10	5 V TTL, 1 MHz
NI 6220	PCI, PXI	16	16	250 k	–	–	0	–	–	24	5 V TTL, 1 MHz
Bus-Powered											
NI 6218	USB	32	16	250 k	–	Bank isolation	2	250 k	±10	16	5 V TTL, static
NI 6216	USB	16	16	400 k	–	Bank isolation	2	250 k	±10	32[4]	5 V TTL, static
NI 6215	USB	16	16	250 k	–	Bank isolation	2	250 k	±10	8	5 V TTL, static
NI 6212	USB	16	16	400 k	–	–	2	250 k	±10	32[4]	5 V TTL, static
NI 6211	USB	16	16	250 k	–	–	2	250 k	±10	8	5 V TTL, static
NI 6210	USB	16	16	250 k	–	–	0	–	–	8	5 V TTL, static

[1]Indicates ±20 mA inputs or 0 to 20 mA outputs; all other devices have voltage I/O; [2]All channels share one A/D converter; [3]USB-625x modules can clock DIO up to 1 MHz across the bus and up to 10 MHz using onboard regeneration; [4]24 DIO for mass termination

The NI CompactDAQ Platform

NI CompactDAQ modular data acquisition systems for USB, wireless, and Ethernet provide sensor and electrical measurements on the benchtop, in the field, and on the production line. By combining more than 50 sensor-specific I/O modules with NI Signal Streaming technology, the NI CompactDAQ platform delivers performance and ease of use in a flexible, mixed-measurement system.

- Measure up to 256 channels of electrical, physical, mechanical, or acoustic signals in a single chassis
- Stream continuous analog measurements up to 1 MS/s per channel with patented NI Signal Streaming technology
- Run up to seven I/O tasks simultaneously at different sampling rates in the same chassis
- Measure in minutes with the easy-to-use DAQ Assistant and stream-to-disk Technical Data Management Streaming (TDMS) data-logging technology



C Series Modules

NI C Series modules combine A/D converters, signal conditioning, and signal connectivity in one package. Find out more information and view chassis compatibility at **ni.com/cseries**.

Signal	Module	Channels	Special Features	Connectivity
Analog Input				
Voltage, ±200 mV to ±10 V	NI 9205	32	16-bit; ±200 mV, ±1 V, ±5 V, and ±10 V programmable ranges; 250 kS/s; 32 single-ended or 16 differential; isolation	Spring-terminal, 37-pin D-Sub
Voltage, ±10 V; current, ±21.5 mA	NI 9207	16	24-bit, 500 S/s, 50/60 Hz rejection, combination 8 channels voltage and 8 channels current	37-pin D-Sub
Current, ±21.5 mA	NI 9208	16	24-bit, 500 S/s, 50/60 Hz rejection	37-pin D-Sub
Medium-voltage, ±10 V	NI 9201	8	12-bit, 500 kS/s, single-ended, isolation	Spring-terminal, 25-pin D-Sub
Simultaneous-voltage, ±10 V	NI 9215	4	16-bit, 100 kS/s/ch, simultaneous, differential	Screw-terminal, BNC
Simultaneous-voltage, ±10 V	NI 9222	4	16-bit, 500 kS/s/ch, simultaneous, differential	Screw-terminal
Simultaneous-voltage, ±10 V	NI 9223	4	16-bit, 1 MS/s/ch, simultaneous, differential	Screw-terminal
Voltage, 300 V_{rms}	NI 9225	3	24-bit, 50 kS/s/ch, 600 V ch-ch ISO antialias filter	Screw-terminal
Current, 5 A	NI 9227	4	24-bit, 50 kS/s/ch, 250 V ch-ch ISO, antialias filter	Screw-terminal
Simultaneous-voltage, ±60 V	NI 9229	4	24-bit, 50 kS/s/ch, 250 V ch-ch ISO, antialias filter	Screw-terminal
Simultaneous-voltage, ±10 V	NI 9239	4	24-bit, 50 kS/s/ch, 250 V ch-ch ISO, antialias filter	Screw-terminal
High-voltage, ±60 V	NI 9221	8	12-bit, 800 kS/s, single-ended, isolation	Spring-terminal, 25-pin D-Sub
Universal (TC, V, I, Ω, bridge, RTD)	NI 9219	4	24-bit, 100 S/s/ch universal, 250 V ch-ch ISO	Spring-terminal
Current, ±20 mA	NI 9203	8	16-bit, 200 kS/s, single-ended, isolation	Screw-terminal
Thermocouple	NI 9211	4	24-bit delta-sigma, 15 S/s, differential	Screw-terminal
Thermocouple	NI 9213	16	24-bit delta-sigma, 75 S/s, differential	Spring-terminal
Thermocouple	NI 9214	16	24-bit delta-sigma, 68 S/s, differential, isothermal	Screw-terminal
RTD	NI 9217	4	24-bit, 100 S/s, 100 Ω RTDs, 3- and 4-wire measurements	Screw-terminal
IEPE sensors AC (accel/microphones)	NI 9233	4	24-bit, 50 kS/s, IEPE excitation	BNC
IEPE sensors AC/DC (accel/microphones)	NI 9234	4	24-bit, 51.2 kS/s/ch, IEPE excitation, AC/DC software	BNC
120 Ω quarter-bridge	NI 9235	8	24-bit, 10 kS/s/ch, voltage excitation, 120 Ω	Screw-terminal
350 Ω quarter-bridge	NI 9236	8	24-bit, 10 kS/s/ch, voltage excitation, 350 Ω	Screw-terminal
Bridge-based sensors (strain gages/load cells)	NI 9237	4	24-bit, 50 kS/s, simultaneous, full-/half-bridge (quarter-bridge with accessory), antialiasing	10P10C (RJ50)
Fuel cell	NI 9206	16	16-bit; ±200 mV, ±1 V, ±5 V, and ±10 V programmable ranges; 250 kS/s, 16 differential channels; 600 VDC (U.S.)/400 VDC (EU) CAT I bank isolation connectivity	Spring-terminal
Analog Output				
Medium-voltage, ±10 V	NI 9263	4	16-bit, 100 kS/s/ch, simultaneous	Screw-terminal
Isolated output, ±10 V	NI 9269	4	16-bit, 100 kS/s/ch, simultaneous, 250 V ch-ch ISO	Screw-terminal
Voltage	NI 9264	16	±10 V, 16-bit, 25 kS/s/ch	Spring-terminal
Current output (0 to 20 mA)	NI 9265	4	16-bit, 100 kS/s/ch, simultaneous, ±36 V protection	Screw-terminal
Digital Input				
Bidirectional 5 V TTL	NI 9401	8	100 ns, 5 V TTL, bidirectional, 30 V protection	25-pin D-Sub connectivity
5 V TTL	NI 9403	32	DIO, 140 kHz	37-pin D-Sub
Differential or 5 V TTL	NI 9411	6	500 ns, ±5 to 24 V, single-ended TTL or differential, regulated 5 V supply output	15-pin D-Sub connectivity
24 V logic	NI 9421	8	100 µs, 24 V logic, 40 V protection	Screw-terminal, 25-pin D-Sub
24 V logic	NI 9422	8	100 µs, 24 V logic, 250 V ch-ch isolation	Screw-terminal
24 V logic	NI 9423	8	1 µs, high-speed, 24 V logic, 35 V protection	Screw-terminal
24 V logic	NI 9425	32	Sinking digital input, 140 kHz, 12 to 24 V logic	37-pin D-Sub connectivity
24 V logic	NI 9426	32	Sourcing digital input, 140 kHz, 12 to 24 V logic	37-pin D-Sub
250 AC/DC universal	NI 9435	4	3 ms, ±5 to 250 VDC, 10 to 250 VAC, universal, sink/source	Screw-terminal
High-voltage	NI 9475	8	Sourcing digital input, 1 MHz, 5 to 60 V	25-pin D-Sub
Digital Output				
Bidirectional 5 V TTL	NI 9401	8	100 ns, 5 V TTL, bidirectional, isolation	25-pin D-Sub
High-voltage	NI 9472	8	100 µs, 6 to 30 V, sourcing, isolation	Screw-terminal, 25-pin D-Sub
High-voltage	NI 9474	8	1 µs, 5 to 30 V, 8 A max per module, isolation	Screw-terminal
High-voltage	NI 9477	32	8 µs, 5 to 60 V, sinking, isolation, up to 20 A per module	37-pin D-Sub
High-voltage	NI 9478	16	50 µs, 0 to 60 V, sinking, isolation	37-pin D-Sub
Relay Output				
Electromechanical and solid-state relays	NI 9481	4	30 VDC (2 A), 60 VDC (1 A), 250 VAC (2 A) electromechanical Form A (SPST)	Screw-terminal
Electromechanical and solid-state relays	NI 9485	8	60 VDC, SSR Form A, up to 750 mA per ch, 5 ms set and reset time, ch-ch isolation	Screw-terminal
Specialty				
CAN Communication	NI 9862	–	1-port, high-speed CAN, 1 Mbits/S Max Baud	9-pin D-Sub
Counter (24 V)	NI 9423	8	1 µs, high-speed, 24 V logic, 35 V protection	Screw-terminal
Counter (24 V)	NI 9425	32	7 µs, 24 V logic, 40 V protection	37-pin D-Sub
Counter (TTL)	NI 9401	8	100 ns, 5 V TTL, bidirectional, 30 V protection	25-pin D-Sub
Counter (TTL)	NI 9411	6	500 ns, ±5 to 24 V, differential, six digital inputs for two encoders (phase A, phase B, and index inputs)	15-pin D-Sub
Quadrature encoder	NI 9411	2	500 ns, ±5 to 24 V, differential, six digital inputs for two encoders (phase A, phase B, and index inputs)	15-pin D-Sub
Quadrature encoder	NI 9401	2	100 ns, single-ended, 5 V TTL, eight digital inputs for two encoders (phase A, phase B, and index inputs)	Screw-terminal
Quadrature encoder	NI 9423	2	1 µs, single-ended, 24 V logic, eight digital inputs for two encoders (phase A, phase B, and index inputs)	Screw-terminal
PWM/pulse generation (high-voltage)	NI 9472	8	100 µs, 6 to 30 V, sourcing, isolation	Screw-terminal, 25-pin D-Sub
PWM/pulse generation (high-voltage)	NI 9474	8	1 µs, 5 to 30 V, 8 A max per module, isolation	Screw-terminal
PWM/pulse generation (high-voltage)	NI 9476	32	500 µs, 6 to 36 V, sourcing, isolation	37-pin D-Sub
PWM/pulse generation (high-voltage)	NI 9477	32	8 µs, 5 to 60 V, sinking, isolation, up to 20 A per module	37-pin D-Sub
PWM/pulse generation (TTL)	NI 9401	8	100 ns, 5 V TTL, bidirectional, 30 V protection	25-pin D-Sub

High-Channel-Count Sensor Measurements

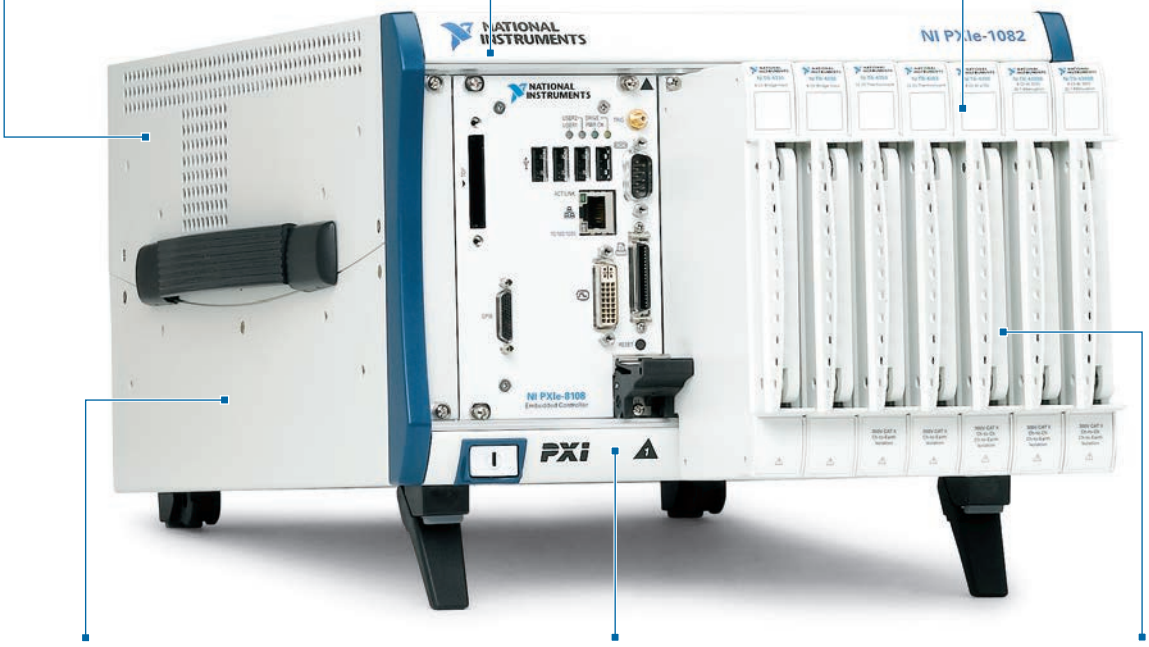
The NI SC Express family features PXI Express data acquisition modules with integrated signal conditioning for measuring electrical and optical strain gages, pressure transducers, load cells, thermocouples, high voltages, and more. These modules have been designed for maximum accuracy, high throughput, and tight synchronization for advanced measurement systems that can scale to thousands of channels.

The PXI platform offers an adaptable and simplified architecture for developing highly scalable measurement systems. Measurement modules integrate with a wide variety of PXI chassis, controllers, and I/O options.

PXI Express interface for dedicated data bandwidth per device up to 250 MB/s throughput

Automatic synchronization of one to 544 channels in a single chassis with the same NI-DAQmx code

High-accuracy strain, pressure, temperature, and isolated analog input measurements



Scalability to 10,000 channels with multichassis timing and triggering buses; options for time-referenced synchronization (GPS, IRIG-B, 1588)

Front-end signal conditioning available for lowpass filters, isolation, and other sensor types

Integration with more than 1,500 modules on PXI platform, including dynamic signal acquisition (DSA) and X Series multifunction DAQ modules

Module	Channels[2]	Signal Types: Millivolts/Volts	Medium Voltage (60 V)	High Voltage (300 V/1,000 V[1])	Current (4 to 20 mA)	Frequency-to-Voltage	Thermocouples	RTDs/Thermistors	Strain Gages	Force, Load, Torque, Pressure	LVDTs, RVDTs, Resolvers	IEPE (Accelerometers, Microphones)	TTL/CMOS	Optical Sensors	Description	Ranges/Signal Types	Filtering	Isolation	Excitation Values
PXI Express Analog Input																			
NI PXIe-4300	8 ISO	●	●	●	–	–	–	–	–	–	–	–	–	–	Simultaneous isolated analog input	±1 V to ±300 V[3]	10 kHz, 100 kHz, bypass	300 V_{rms} (CAT II)	–
NI PXIe-4330	8 DI	–	–	–	–	–	–	–	●	●	–	–	–	–	Simultaneous bridge input (25 kS/s/ch)	±25 mV/V or ±100 mV/V	Antialias	–	0.625 to 10 V (program per channel)
NI PXIe-4331	8 DI	–	–	–	–	–	–	–	●	●	–	–	–	–	Simultaneous bridge input (102.4 kS/s/ch)	±25 mV/V or ±100 mV/V	Antialias	–	0.625 to 10 V (program per channel)
NI PXIe-4353	32 DI	○	–	–	–	–	●	–	–	–	–	–	–	–	Thermocouple input	±80 mV	50/60 Hz	–	–
NI PXIe-4492	8 DI	–	–	–	–	–	–	–	–	–	–	●	–	–	Simultaneous IEPE sensor input	±1, ±10	Antialias, AC/DC coupled	–	4 mA (program per channel)
NI PXIe-4497	16 DI[4]	–	–	–	–	–	–	–	–	–	–	●	–	–	Simultaneous IEPE sensor input	±1, ±10	Antialias, AC/DC coupled	–	4 mA (program per channel)
NI PXIe-4499	16 DI[4]	–	–	–	–	–	–	–	–	–	–	●	–	–	Simultaneous IEPE sensor input	±0.316, ±1, ±3.16, ±10	Antialias, AC/DC coupled	–	4 mA (program per channel)
NI PXIe-4844	4 optical	–	–	–	–	–	–	–	–	–	–	–	–	●	Optical sensor interrogator	1510 to 1590 nm	–	Non-conductive	0.06 to 0.25 mW laser
SCXI Analog Input																			
NI SCXI-1100	32 DI	○	–	–	○	–	○	–	–	–	–	–	–	–	Multiplexer amplifier	±2.5 mV to ±10 V; 4 to 20 mA	4 Hz, 10 kHz, bypass[5]	–	–
NI SCXI-1102	32 DI	●	–	–	●	–	●	–	–	–	–	–	–	–	Thermocouple amplifier	±100 mV to ±10 V; 4 to 20 mA; TC[6]	2 Hz	–	–
NI SCXI-1102B, NI SCXI-1102C	32 DI	●	–	–	○	–	–	–	–	–	–	–	–	–	Multiplexer amplifier	±100 mV to ±10 V; 4 to 20 mA	1102B – 200 Hz, 1102C – 10 kHz	–	–
NI SCXI-1104, NI SCXI-1104C	32 DI	○	●	–	–	–	–	–	–	–	–	–	–	–	Multiplexer	±60 VDC, ±42 VAC	1104 – 2 Hz, 1104C – 10 kHz	–	–
NI SCXI-1112[7]	8 DI	–	–	–	–	–	●	–	–	–	–	–	–	–	Thermocouple input	TC[6]	2 Hz	–	–
NI SCXI-1120	8 ISO	○	○	○	○	–	○	–	–	–	–	–	–	–	Isolation amplifier	±2.5 mV to ±1000 V[8,1]; 4 to 20 mA	4 Hz, 10 kHz (per channel)	250 V_{rms} (CAT II)	–
NI SCXI-1120D	8 ISO	○	○	○	○	–	–	–	–	–	–	–	–	–	Wideband isolation amplifier	±5 mV to ±1000 V[8,1] (per channel)	4.5 kHz, 22.5 kHz (per channel)	250 V_{rms} (CAT II)	–
NI SCXI-1121	4 ISO	○	○	○	○	–	○	○	○	○	–	–	–	–	Isolation amplifier with excitation and filter	±2.5 mV to ±250 V[8]; 4 to 20 mA; TC[5]	4 Hz, 10 kHz (per channel)	250 V_{rms} (CAT II)	3.33 V, 10 V, 0.15 mA, 0.45 mA
NI SCXI-1122	16 ISO	○	○	○	○	–	○	○	○	○	–	–	–	–	Isolated multiplexer amplifier	±5 mV to ±250 V[8]; 4 to 20 mA	4 Hz, 4 kHz[5]	480 V_{rms} (CAT II)	3.33 V, 1 mA
NI SCXI-1125	8 ISO	●	●	●	●	–	●	–	–	–	–	–	–	–	Isolation amplifier	±2.5 mV to ±1000 V[8,1]; 4 to 20 mA; TC[6]	4 Hz, 10 kHz (per channel)	300 V_{rms} (CAT II)	–
NI SCXI-1126	8 ISO	○	○	○	○	●	–	–	–	–	–	–	–	–	Programmable isolated F-to-V	±50 mV to ±1000 V[8,1]; 15 Hz to 128 kHz	1, 40, 320, 1000 Hz	250 V_{rms} (CAT II)	–
NI SCXI-1140	8 DI	○	–	–	–	–	–	–	–	–	–	–	–	–	SSH8 amplifier	±10 mV to ±10 V	–	–	–
NI SCXI-1141, NI SCXI-1142, NI SCXI-1143	8 DI	○	–	–	–	–	–	–	–	–	–	–	–	–	Programmable lowpass filter	±50 mV to ±5 V	10 Hz to 25 kHz	–	–
NI SCXI-1503	16 DI	–	–	–	–	–	–	●	–	–	–	–	–	–	Programmable RTD/thermistor input	±100 mV, ±10 V	5 kHz	–	Current excitation 100 µA
NI SCXI-1520	8 DI	○	–	–	–	–	–	–	●	●	–	–	–	–	Programmable bridge input module w/SSH8	±10 mV to ±10 V strain gage	10 Hz to 10 kHz (program per channel)	–	0 to 10 V (17 settings)
NI SCXI-1521, NI SCXI-1521B	24 DI	–	–	–	–	–	–	–	○	–	–	–	–	–	Programmable quarter-bridge strain input	0 to 250 mV strain gage	10 Hz	–	00.0 to 5.0 V in 1,023 steps
NI SCXI-1530[7], NI SCXI-1531[7]	4/8 SE or DI	○	–	–	–	–	–	–	–	–	–	●	–	–	Programmable accelerometer input w/SSH8	±50 mV to ±5 V; AC-coupled accelerometer	2.5 to 20 kHz (program per channel)	–	4 mA (program per channel)
NI SCXI-1540	8 DI	–	–	–	–	–	–	–	–	–	●	–	–	–	Programmable LVDT input	±0.05 to ±6 V_{rms} (per channel)	250 Hz (per channel)	–	1 to 3 V_{rms}, 2.5 to 10 kHz
NI SCXI-1503	16 SE or DI	–	–	–	–	–	–	●	–	–	–	–	–	–	RTD/thermistor input and excitation	±100 mV to ±10 V; 2- ,3- ,4-RTD and thermistor	5 Hz (per channel)	–	100 µA
SCXI Analog Output																			
NI SCXI-1124	6 ISO output	●	–	–	●	–	–	–	–	–	–	–	–	–	Isolated output	±1 to ±10 V, 1 to 10 V, 0 to 20 mA	–	250 V (CAT II)	–
NI SCXI-1581	32	–	–	–	–	–	–	–	–	–	–	–	–	–	Current excitation	–	–	–	100 µA
SCXI DIO																			
NI SCXI-1162, NI SCXI-1162HV	32	–	–	○[9]	–	–	–	–	–	–	–	–	●[10]	–	Isolated digital input	TTL/CMOS, ±240 VAC/VDC	–	300 V_{rms}	–
NI SCXI-1163	32	–	–	–	–	–	–	–	–	–	–	–	●	–	Isolated digital output	TTL/CMOS	–	300 V_{rms}	–

• Recommended module for that type of measurement, [1]Input signals greater than ±300 V require the TBX-1316 terminal block, [2]DI – differential, SE – single-ended, ISO – isolated input, [3]Input signals greater than ±10 V require the TB-4300B terminal block, [4]Pseudodifferential analog input signals, [5]One filter for entire module, low-bandwidth settings reduce usable scanning rate, [6]TC – works with these thermocouple types: K, T, E, R, S, N, B, or custom, [7]Module does not require a terminal block, [8]Input signals greater than ±5 V require SCXI-1313 or SCXI-1327, TBX-1316 terminal blocks, [9]SCXI-1162HV only, [10]SCXI-1162 only.

Analog Output

NI offers analog output devices that include 16-bit DC voltage and current sources and hardware-timed buffered waveform generators. These software-timed and high-speed waveform generation devices include up to 32 outputs, digital I/O, and counters.

Model[1]	Bus	Analog Outputs	Resolution (bits)	Update Rate[2]	Output Range	Digital I/O	Counter/Timers	Triggers
NI 6703	PCI	16	16	Static	±10 V	8	–	–
NI 6704	PCI, PXI	32	16	Static	±10 V, 0 to 20 mA	8	–	–
NI 6711 (3)	PCI, PXI	4 (8)	12	1 MS/s	±10 V	8	2, 24-bit	✓
NI 6715	PCMCIA	8	12	1 MS/s	±10 V	8	2, 24-bit	✓
NI 6722 (3)	PCI, PXI	8 (32)	13	800 kS/s	±10 V	8	2, 24-bit	✓
NI 6731 (3)	PCI	4 (8)	16	1 MS/s	±10 V	8	2, 24-bit	✓

[1]Number in parentheses refers to NI 67x3 model, [2]Single-channel rate.

Digital Input/Output

NI digital I/O (DIO) devices are suitable for a wide range of industrial automation applications including controlling switches, relays, actuators, fans, lights, and motors. Most NI DIO devices provide industrial features including programmable power-up states, watchdog timers, change detection, isolation, and programmable input filters.

Model	Bus	Digital I/O Lines	Voltage Range	Max Output Current	Isolation	Industrial Feature Set
NI 6501	USB	24 DIO, 32-bit counter	5 V/TTL/CMOS	8.5 mA	–	–
NI 6503	PCI, PCMCIA	24 DIO	5 V/TTL/CMOS	4 mA	–	–
NI 6509	USB, PCI, PXI	96 DIO	5 V/TTL/CMOS	24 mA	–	✓
NI 6509	USB	96 DIO	±5	±24 mA	–	✓
NI 6510	PCI	32 DI	±30 V	–	Bank	✓
NI 6511	PCI, PXI	64 DI	±30 V	–	Bank	✓
NI 6512	PCI, PXI	64 DO (source)	±30 V	350 mA	Bank	✓
NI 6513	PCI, PXI	64 DO (sink)	±30 V	500 mA	Bank	✓
NI 6514	PCI, PXI	32 DI and 32 DO (source)	±30 V	350 mA	Bank	✓
NI 6515	PCI, PXI	32 DI and 32 DO (sink)	±30 V	500 mA	Bank	✓
NI 6516	PCI	32 DO (source)	±30 V	350 mA	Bank	✓
NI 6517	PCI	32 DO (sink)	±30 V	500 mA	Bank	✓
NI 6518	PCI	16 DI and 16 DO (source)	±30 V	350 mA	Bank	✓
NI 6519	PCI	16 DI and 16 DO (sink)	±30 V	500 mA	Bank	✓
NI 6520	PCI	8 DI, 8 mechanical relay DO	±60 V	2 A[1]	Ch-ch	✓
NI 6521	PCI, PXI	8 DI, 8 mechanical relay DO	±30 V DI, 150 V DO	2 A[1]	Ch-ch	✓
NI 6525	USB	8 DI, 8 SSR[2] DO	±60 V	500 mA	Ch-ch	✓
NI 6528	PCI, PXI	24 DI, 24 SSR[2] DO	±60 V	150 mA	Ch-ch	✓

[1]NI 6520 and NI 6521 devices have a maximum switching power of 60 W/ch, [2]Solid-state relay.

Counter/Timers

You can use versatile National Instruments counter/timer devices to create a wide range of measurement solutions, including measuring several time-related quantities, counting events or totalizing, and monitoring quadrature encoders. Counter/timers can generate pulses and pulse trains. These devices often fulfill critical timing functions as components of complex measurement systems.

Model	Bus	Counter/ Timers	Resolution (bits)	Max Source Frequency	Compatibility	Voltage Range (V)	Isolation	Digital I/O	Pulse Generation	Buffered Operations	Digital Filtering	Quadrature Encoder
NI 6601	PCI	4	32	20 MHz[1]	5 V/TTL	5	–	Up to 32	✓	✓	✓	✓
NI 6602	PCI, PXI	8	32	80 MHz[1]	5 V/TTL	5	–	Up to 32	✓	✓	✓	✓
NI 6608	PXI	8	32	80 MHz[1]	5 V/TTL	5	–	Up to 32	✓	✓	✓	✓
NI 6624	PCI, PXI	8	32	20 MHz	5 V	48	Ch-ch	–	✓	✓	✓	✓

[1]Max source frequency with prescalers is 80 MHz for an NI 6601 and 125 MHz for an NI 6602 and NI 6608.

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