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Data Acquisition and Signal Conditioning

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Data Acquisition and Signal Conditioning Overview

What Is Data Acquisition and What Are Data Acquisition Systems?

The purpose of data acquisition (DAQ) is to measure a physical phenomenon such as voltage, current, light, temperature, pressure, or sound. PC-based data acquisition uses a combination of hardware, software, and a computer to form a data acquisition system for automating measurements and making data available for analysis. Data acquisition systems come in many different configurations and address a wide variety of applications. While each DAQ system is uniquely defined by its application requirements, every system shares a common goal of acquiring, analyzing, and presenting information from a signal or sensor. For sensor measurements, a DAQ system must in corporate the following four components:

- Sensor (transducer)
- Signal conditioning
- Data acquisition device
- Software

Selecting the Right Hardware

This section provides basic overviews and specifications for NI data acquisition and signal conditioning hardware and software. Although National Instruments provides a wide variety of measurement hardware, choosing the right hardware for your measurement application does not have to be difficult. Follow these simple steps to guide you through the selection process:

Step 1. Choose DAQ and Signal Conditioning Hardware

Use Tables 1 and 2 on page 184 to guide you to the proper measurement hardware for your data acquisition system.

Step 2. Choose Accessories (Cable and Terminal Block), If Necessary

Step 3. Choose Your Application Development Software

- LabVIEW graphical development environment
- Measurement Studio development tools for Visual Studio .NET
- LabWindows/CVI development tools for ANSI C
- SignalExpress interactive configuration-based measurements
- VI Logger ready-to-run data-logging software



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Data Acquisition and Signal Conditioning Overview

Common Sensors	1 to 32 channels	16 to 256 channels	257 to 3072 channels	Also see …
Thermocouples	High-precision DAQ – page 234 or NI CompactDAQ – page 240	NI CompactDAQ – page 240 or SCXI[1] – page 256	SCXI[1] – page 256	FieldPoint/Compact FieldPoint – page 448
RTDs, thermistors	SCC[1] – page 249 or high-precision DAQ – page 228	SCXI[1] – page 256	SCXI[1] – page 256	FieldPoint/Compact FieldPoint – page 448
Strain gages	NI CompactDAQ – page 210 or DAQ for high-speed strain – page 234	NI CompactDAQ – page 210 or SCXI[1] – page 256	SCXI[1] – page 256	SCC[1] – page 249
Dynamic sensors – sound and vibration	NI CompactDAQ – page 210 or DSA hardware	NI CompactDAQ – page 210 or SCXI[1] – page 256	SCXI[1] – page 256	–
DC LVDTs	Multifunction DAQ[2] – page 191	SCXI[1] – page 256	SCXI[1] – page 256	–
AC LVDTs		SCXI[1] – page 256		–

Sensor and Analog I/O	1 to 32 channels	16 to 256 channels	257 to 3072 channels	Also see …
±10 VDC to 5 MHz	Multifunction DAQ[2] – page 191	Multifunction DAQ[2] – page 191 or SCXI[1] – page 256	SCXI[1] – page 256	
0 to 20 mA input	SCC[1] – page 249 or M Series – page 195	SCC[1] – page 249 or SCXI[1] – page 256	SCXI[1] – page 256	
0 to 20 mA output	Signal sources – page 211 or M Series – page 195	Signal sources – page 211 or PXI signal sources – page 211	PXI signal sources – page 211	SCC[1] – page 249, SCXI[1] – page 256
Millivolts <10 kHz	Multifunction DAQ[2] – page 191 or NI CompactDAQ – page 240	NI CompactDAQ – page 240 or SCXI[1] – page 256	SCXI[1] – page 256	SCC[1] – page 249
Millivolts >10 kHz	Multifunction DAQ[2] – page 176 or NI CompactDAQ – page 240	Multifunction DAQ[2] – page 191 or NI CompactDAQ – page 240 or PXI multifunction DAQ[2] – page 134	PXI multifunction DAQ[2] – page 177	–
Voltage outputs, DC	NI CompactDAQ – page 240 or Signal sources – page 211	NI CompactDAQ – page 240 or Signal sources – page 211 or SCXI[1] – page 256	SCXI[1] – page 256	–
Voltage outputs, waveform		Signal sources – page 180, NI CompactDAQ – page 210, PXI signal sources – 135		
Frequency inputs	SCC[1] – page 249 or SCXI[1] – page 256	SCC[1] – page 249 or SCXI[1] – page 228	SCXI[1] – page 256	–
High bandwidth, 1 MHz to 2.7 GHz	M Series multifunction DAQ[2] – page 161, S Series multifunction DAQ[2] – page 168, high-speed digitizers – page 288, RF signal analyzer – page 328			
High-voltage inputs, 10 to 100 VDC	SCC[1] – page 249	SCC[1] – page 249 or SCXI[1] – page 256	SCXI[1] – page 256	–
High-voltage inputs, 10 to 300 VAC	DAQ for high voltage – page 204 or SCXI[1] – page 256	SCXI[1] – page 256	SCXI[1] – page 256	–
Isolated voltage inputs	Multifunction DAQ[2] – page 191 or DAQ for high voltages – page 204	SCXI[1] – page 256	SCXI[1] – page 256	–
Isolated current inputs	SCC[1] – page 256	SCXI[1] – page 256	SCXI[1] – page 256	
Real-time voltage I/O	PCI real-time – page 105	PCI real-time PXI real-time – page 89	PXI real-time – page 89	FieldPoint/ Compact FieldPoint – page 448, CompactRIO – page 465

Digital and Timing Signals	1 to 96 channels	16 to 3072 channels	Also see …
Static signals – relays, switches, LEDs, etc.	Software-timed digital I/O – page 214	SCXI digital I/O[1] – page 256	
Isolated input/output	Industrial digital I/O – page 214	SCXI digital I/O[1] – page 256	SCC[1] – page 249
Pattern or handshaking I/O to 76 MB/s	R Series – page 170 or high-speed digital I/O – page 288		–
Timing I/O – pulse I/O, frequency I/O, etc.	Counter/timers – page 258 or R Series – page 170		–

[1]DAQ device is required –see page 191. [2]Accessories are required – see page 223.

Table 1. Select Hardware by Signal Type

	Bus					
	PCI/PCI Express	PXI/Compact PCI	USB	PCMCIA	CompactFlash	But I need …
Platform	Desktop	PXI	Desktop/Laptop/External	Portable	Handheld	Ethernet Industrial/ rugged platform - page 465 Distributed control - page 448
Number of Channels						
1 to 32	M Series[1] – page 195	M Series[1] – page 195	M Series[1] – page 195or	DAQCard-6036E – page 205	CF-6004 (4 SE, 4 DIO) – page 207	–
16 to 256	M Series – page 195 and SCC – page 249 or SCXI – page 256	M Series – page 195 and SCC – page 249 or SCXI – page 256	NI CompactDAQ – page 240	DAQCard-6036E – page 205 and SCC – page 249 or SCXI – page 256	–	–
16 to 3,072	M Series – page 195 and SCXI – page 256	M Series – page 195 and SCXI – page 256	NI CompactDAQ – page 240 or SCXI-1600 – page 260	DAQCard-6036E – page 205 and SCXI – page 256	–	–
Sampling Rate						
Up to 100 kS/s	M Series[1] – page 195	M Series[1] – page 195	M Series[1] – page 161or	DAQCard-6036E – page 205	CF-6004 – page 207	–
100 kS/s to 1 MS/s	M Series[1] – page 195	M Series[1] – page 195	NI CompactDAQ – page 240	DAQCard-6062E – page 205	CF-6004 (up to 200 kS/s) –page 207	–
1 to 10 MS/s	S Series[1] – page 200	S Series[1] – page 200	–	–	–	Faster sampling rates – page 319
Resolution						
Up to 14 bits	M Series[1] – page 195	M Series[1] – page 195	Portable DAQ – page 176	DAQCard-6036E – page 205	CF-6004 – page 207	–
16 bits	M Series[1] – page 195	M Series[1] – page 195	M Series – page 161	DAQCard-6036E – page 205	–	–
18 to 24 bits	M Series[1] – page 195 (up to 18 bits) or DSA	M Series[1] – page 195 (up to 18 bits) or DSA	NI CompactDAQ – page 240	–	–	More accuracy – page 234

[1] Signal conditioning is required for high-voltage or sensor measurements – see page 238.

Table 2. Select Hardware by Platform or Bus

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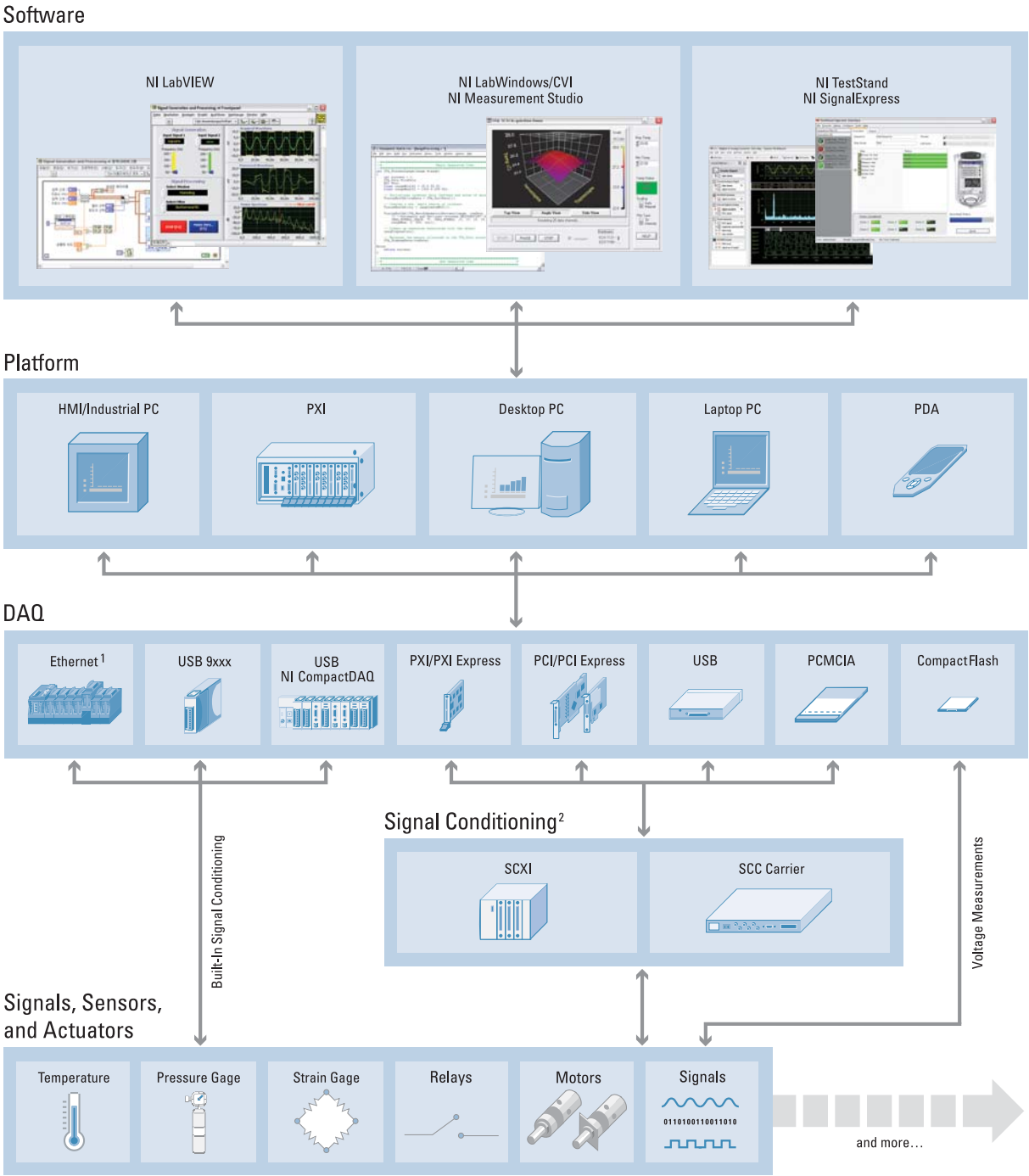


Figure 1. Data Acquisition System Architecture.

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Data Acquisition and Signal Conditioning Driver Software Options

NI-DAQmx

- Compatible with more than 300 data acquisition devices
- Full-featured driver software for Windows and Linux®
- High-performance driver engine
- Fast single-point and multithreaded I/O
- Automatic code generation with the DAQ Assistant
- Virtual channels for simple measurement configuration
- Multiple-device synchronization
- Optimized integration with LabVIEW VIs and analysis
- API for LabVIEW, ANSI C/C++, C#, Visual Basic .NET, and Visual Basic
- Free data-logging software included

NI-DAQmx Base

- Compatible with more than 80 data acquisition devices
- Multiplatform driver for Linux, Mac OS X, Windows Mobile, Windows CE, and Windows Vista/XP
- Subset of NI-DAQmx functionality
- Similar programming interface to NI-DAQmx
- Basic DAQ driver for LabVIEW and ANSI C

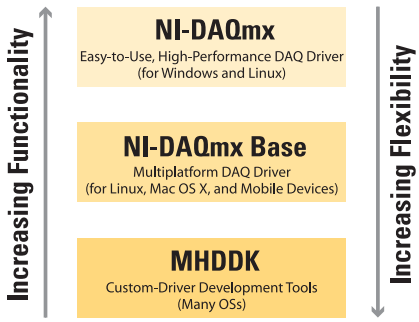
Measurement Hardware DDK

- Custom-driver development tools
- Register-level programming interface
- Designed for OEM customers
- Data acquisition for virtually any OS



Overview

The quality of the driver software is just as important as the quality of the measurement hardware. National Instruments provides three levels of data acquisition (DAQ) software, each with its own unique features. The result is a complete offering of data acquisition software to simplify use of National Instruments DAQ hardware in any application.



Three Levels of DAQ Driver Software

1. NI-DAQmx is full-featured, high-performance driver software that maximizes productivity and performance through an intuitive programming interface and added software.
2. NI-DAQmx Base is a basic multiplatform DAQ driver with a subset of NI-DAQmx functionality.
3. NI Measurement Hardware DDK is a development kit for the creation of custom drivers using register-level programming.

Note: Not all drivers work with all devices.
Visit **ni.com/support/daq/versions** to check compatibility.

NI-DAQmx Driver Software

NI-DAQmx is full-featured, high-performance driver software that maximizes productivity and performance through an intuitive programming interface and included measurement services. It works with broad ranges of programming languages, devices, buses, sensors, and even mixed-signal types. NI-DAQmx is the best option almost everytime for Windows and Linux development.

Note: National Instruments recommends using the latest version of NI-DAQmx driver software for application development in NI LabVIEW, LabWindows™/CVI, and Measurement Studio 7.x or later on Windows and Linux.

Included Measurement Services[1]

NI-DAQmx includes a collection of measurement services designed to save data acquisition system developers time and money. A few of these services include:

Measurement & Automation Explorer (MAX) – software for configuring, calibrating, testing, and managing your hardware

DAQ Assistant – software for creating configuration-based data acquisition tasks and automatic code generation in popular application development environments

LabVIEW SignalExpress LE – free software specifically designed for basic data-logging applications

NI Device Monitor – software that provides a true plug-and-play experience for developers using USB DAQ modules

[1] *Windows version only.*

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NI-DAQmx Base Driver Software

NI-DAQmx Base offers a subset of NI-DAQmx functionality on Windows, Linux, Mac OS X, Windows Mobile, and Windows CE OSs. This driver software includes ready-to-use LabVIEW VIs and C function examples similar to those included in the full-featured NI-DAQmx software. National Instruments built NI-DAQmx Base driver software using the Measurement Hardware DDK and developed the software almost entirely in the multiplatform LabVIEW graphical development environment. This lightweight, agile architecture makes it possible to quickly develop NI-DAQmx Base for additional OSs and devices in the future. Developers creating applications for Windows or Linux systems should consider using the latest in full-featured NI-DAQmx.

Measurement Hardware DDK

The Measurement Hardware DDK (Driver Development Kit) provides development tools and a register-level programming interface for the development of custom driver software. Designed for OEM customers developing applications that require nonstandard OSs, it offers access to the full device register map and provides examples for completing common measurement and control functions. The Measurement Hardware DDK works with a selection of NI multifunction, analog output, digital I/O, and counter/timer I/O devices, including M Series, E Series, and S Series devices. Standard phone and e-mail support are not available for Measurement Hardware DDK users. Developers considering the Measurement Hardware DDK should also study the advantages of industry-leading NI-DAQmx and NI-DAQmx Base software.

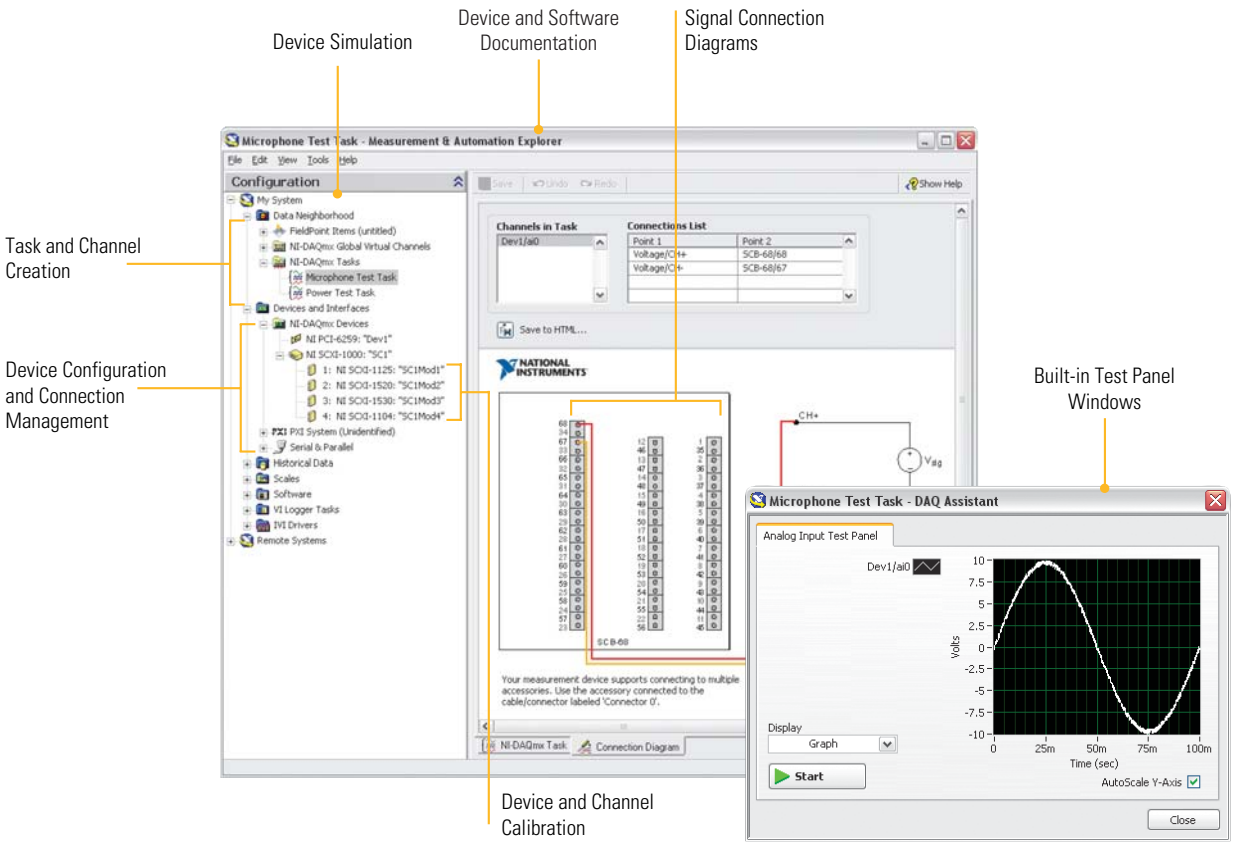


Figure 1. NI-DAQmx driver software includes measurement services software designed for simplified testing, configuration, and data logging.

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Data Acquisition (DAQ) Software Comparison

	NI-DAQmx High-Performance Multithreaded Driver	NI-DAQmx Base Basic DAQ Driver	Measurement Hardware DDK Custom Driver Development Tools	Traditional NI-DAQ Legacy DAQ Driver
Bus and OS Support				
PCI/PXI/PCI Express/PXI Express	Windows Vista x64, Windows Vista x86/XP/2000, Linux	Basic DAQ Driver	Linux, Mac OS X, RTX, QNX, Intime	Windows 2000/NT/XP
USB	Windows Vista x64, Windows Vista x86/XP/2000	Linux, Mac OS X, Windows Mobile/CE	Linux, Mac OS X, QNX, Windows Mobile/CE	Windows 2000/XP
PCMCIA	Windows XP/2000	Windows Mobile	Windows Mobile	Windows 2000/NT/XP
CompactFlash	–	Windows Mobile	–	
Programming Languages				
Programming Languages	LabVIEW, ANSI C/C++, C#, Visual Basic .NET, and Visual Basic	LabVIEW, ANSI C	LabVIEW, ANSI C	LabVIEW, ANSI C, and Visual Basic
LabVIEW Interface	Complete Polymorphic VIs and Property Nodes	Limited polymorphic VIs	Register-Level VIs	Full Set of VIs
Additional Measurement Services				
Development Speed	●	◑	○	◑
DAQ Assistant Code Generation	●	–	–	–
Multithreaded I/O Performance	●	–	–	–
Driver Footprint	○	◑	●	○
Test Panels	●	◑	–	●
Automatic Scaling to Engineering Units	●	–	–	●
Single Programming Interface for All Hardware and I/O Types	●	●	–	●
Measurement Examples	>3000	~30	~30	~1000
Hardware Support (Complete Listing)				
X Series	•	•	•	–
M Series	•	•	•	–
S Series	•	•	•	•
E Series	•	•	•	•
B Series	•	•	•	•
USB DAQ	•	•	•	•
NI CompactDAQ	•	–	–	–
SC Series	•	–	–	–
SCXI	•	–	–	•
DSA	•	•	•	•
Digital I/O	•	•	•	•
Counter/Timers	•	–	–	•
AO Devices	•	•	•	•

KEY: ●Best, ◑Better, ○Good, • Some devices supported.

DAQ Application Development Environment Comparison

	LabVIEW Development Systems	LabVIEW SignalExpress	LabWindowsTM/CVI	Measurement
Operating Systems	Windows Vista x64, Windows Vista x86/XP/2000, Linux, Mac OS X	Windows Vista x64, Windows Vista x86/XP/2000	Windows Vista x64, Windows Vista x86/XP/2000, Linux	Windows Vista x64, Windows Vista x86/XP/2000
Programming Environment	Graphical	No Programming	ANSI C	Visual C#, Visual Basic, Visual C++
Analog I/O	●	●	●	●
Digital I/O	●	◑	●	●
Counter/Timer I/O	●	◑	●	●
Configuration-Based DAQ Assistant	●	◑	●	●
Event-Driven Programming	●		●	●
Signal Processing Analysis	●	◑	●	●
Mathematical Analysis	●	○	●	●
PID Control	●		●	○
Statistical Analysis	●	◑	●	●
Database Connectivity	●		●	●
Sound and Vibration Analysis	●	●		
Order Analysis	●			
Integrated Data Management Tools	●			
Cross-Platform Compatibility	●			
Ease-of-Use Programming	●	No Programming		

KEY: ●Best, ◑Better, ○Good, • Some devices supported.

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NI X Series – Multifuction DAQ with PCI Express/PXIExpress

X Series devices are the most advanced multifunction data acquisition (DAQ) devices ever designed by National Instruments. Using the easy-to-use NI-DAQmx driver software, X Series incorporates high-performance enhancements that address the needs of the most demanding data acquisition applications. With NI-STC3 timing and synchronization technology, high-throughput PCI Express buses, and multicore-ready driver software, X Series offers a new level of excellence for PC-based multifunction I/O.

- Four Enhanced Counters
- 100 MHz Timebase
- Independent Timing Engines for Analog and Digital I/O
- Enhancements for High Throughput and Low Latency



NI CompactDAQ

NI CompactDAQ provides the plug-and-play simplicity of USB to sensor and electrical measurements on the benchtop, in the field, or on the production line. By combining the ease of use and low cost of a data logger with the performance and flexibility of modular instrumentation, NI CompactDAQ provides fast, accurate measurements in a small, simple, and affordable system. Flexible software options make it easy to use NI CompactDAQ to log data for simple experiments or to develop a fully automated test or control system. The modular design can measure up to 256 channels of electrical, physical, mechanical, or acoustical signals in a single system. In addition, per-channel analog-to-digital converters and individually isolated modules ensure fast, accurate, and safe measurements.

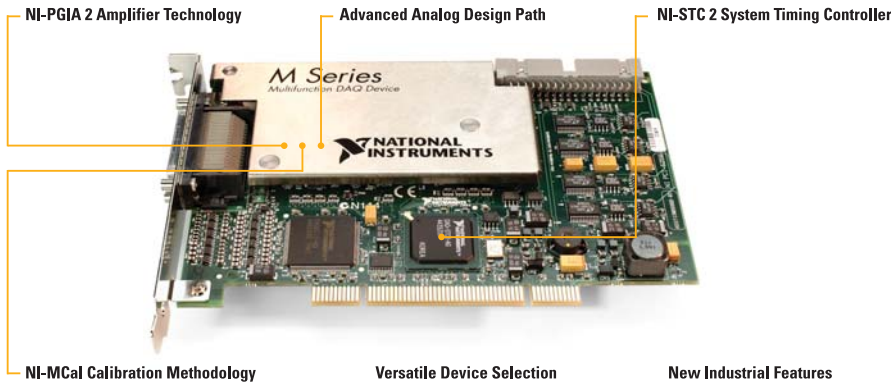


Figure 1. NI CompactDAQ packs USB DAQ, signal conditioning, and sensor connectivity for up to 256 channels in a 25 by 9 by 9 cm package.

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NI M Series – Multifunction DAQ with More Performance, More I/O, More Value

M Series data acquisition devices set a new standard for performance, I/O capability, safety, and value. M Series DAQ features an advanced analog front-end design, NI-STC 2 system timing controller, NI-PGIA 2 instrumentation class amplifier technology, NI-MCal calibration methodology, USB signal streaming technology, and improved safety and accuracy with high-speed digital isolators. M Series devices combine the functionality of multiple instruments into a single device. They are ideal for applications in test, control, and design.



NI Wi-Fi DAQ - Wireless and Ethernet Data Acquisition

National Instruments Wi-Fi data acquisition (DAQ) devices combine IEEE 802.11 wireless or Ethernet communication, direct sensor connectivity, and the flexibility of NI LabVIEW software for remote monitoring of electrical, physical, mechanical, and acoustical signals. With built-in signal conditioning and the highest commercially available network security, NI Wi-Fi DAQ devices stream data in real time for easy-to-use, high-performance remote measurements.

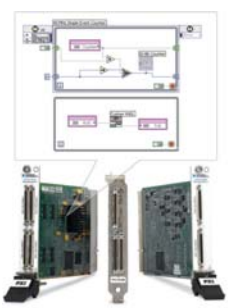


S Series – Simultaneous Sampling DAQ



The dedicated analog-to-digital converter per channel on S Series devices provides a much higher aggregate sampling rate compared to traditional multiplexed data acquisition devices. This architecture is particularly important for preserving the phase/timing relationship between all analog input channels.

R Series – Intelligent DAQ



Intelligent DAQ is multifunction data acquisition that features user-defined, onboard processing for complete system timing and triggering flexibility. Instead of a fixed ASIC for controlling device functionality, intelligent DAQ uses an FPGA-based system timing controller to make all analog and digital I/O configurable for application-specific operations.

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Finding the Right Data Acquisition Product

National Instruments provides a variety of multifunction DAQ products to suit your price and performance needs. They all offer quality measurements, superior software integration, and award-winning service and support. Use Table 1 to choose the right series of products for your application. Then turn to the page listed in the bottom row of the column for your selected series to narrow down the series to the correct devices.



Features	Handheld/USB	M Series – Multifunction DAQ	S Series – Simultaneous-Sampling DAQ	R Series – Intelligent DAQ	SC Series – DAQ with Integrated Signal Conditioning
Analog Input					
Channels/device, maximum	32	80	8	8	8
Sampling rate, maximum	1.25 MS/s[1]	1.25 MS/s[1]	10 MS/s/ch	200 kS/s/ch	200 kS/s
DC accuracy	Better	Best	Better	Better	Better
Dynamic accuracy	Better	Better	Best	Better	Better
Gain settings, maximum	15	7	8	–	10
Simultaneous sampling	◑	–	●	●	◑
Integrated signal conditioning	◑	◑	◑	–	●
Signal conditioning compatibility	◑	●	●	●	–
Isolation	◑	◑	◑	–	●
Voltage measurements	●	●	●	●	●
Current measurements	–	◑	–	–	–
Analog Output					
Channels/device, maximum	4	4	4	8	0
Update rate, maximum	2.8 MS/s	2.8 MS/s	4 MS/s	1 MS/s	–
Accuracy	Better	Best	Better	Better	–
Waveform output capability	Better	Better	Best	Best	–
External voltage reference	◑	◑	–	–	–
Voltage generation	●	●	●	●	–
Current generation	–	◑	–	–	–
Digital I/O					
Channels/device, maximum	48	48	8	160	0
TTL/CMOS digital levels	●	●	●	●	–
24 V digital levels	–	◑	–	–	–
Hardware-timed	◑	◑	◑	●	–
Counter/Timers					
Channels/device, maximum	2	2	2	User-defined up to 96	0
Resolution, maximum	32 bits	32 bits	24 bits	64 bits	–
Timebase, maximum	80 MHz	80 MHz	20 MHz	80 MHz	–
Calibration					
Self-calibration	◑	●	●	●	●
Onboard calibration at all ranges	◑	●	●	●	–
NIST-traceable calibration certificate	◑	●	●	●	●
Timing and Triggering					
Onboard routing for timing and triggering	◑	●	●	●	●
Device-to-device synchronization bus	–	●	●	●	●
Digital triggering	◑	●	●	●	●
Analog triggering	◑	◑	◑	●	–
Bus Interface					
Buses	USB, PCMCIA, CompactFlash	USB, PCI, PCI Express, PXI, PXI Express	PCI, PXI	PCI, PXI	PXI
DMA channels, maximum	4[2]	6	3	3	1
AI onboard memory (samples), maximum	4096	4096	32,000,000	96,000	512
Measurement Services and Driver Software					
NI-DAQmx	◑	●	●	–	●
NI-DAQmx Base	◑	◑	◑	–	–
Measurement Hardware DDK	–	◑	◑	●[3]	–
Page	156	145	150	152	180

KEY: ●Best, ◑Better, ○Good,

[1] Aggregate sampling rate. [2] High-speed USB signal streams. [3] Programmed with LabVIEW FPGA.

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Multifunction Data Acquisition Overview

Model	Bus	Analog Inputs[1]	Sampling Rate (S/s)	Input Resolution (bits)	Integrated Signal Conditioning	Max Input Range	Analog Triggering	Analog Outputs	Output Resolution (bits)	DIO	DIO Levels[2]
M Series - Multifunction DAQ											
NI 6289	PCI, PXI	32 SE/16 DI	625 k	18	Lowpass filters	±10 V	✓	4	16	48	TTL/CMOS
NI 6284	PCI, PXI	32 SE/16 DI	625 k	18	Lowpass filters	±10 V	✓	0	-	48	TTL/CMOS
NI 6281	PCI, PXI	16 SE/8 DI	625 k	18	Lowpass filters	±10 V	✓	2	16	24	TTL/CMOS
NI 6280	PCI, PXI	16 SE/8 DI	625 k	18	Lowpass filters	±10 V	✓	0	-	24	TTL/CMOS
NI 6259	USB, PCI, PCIe[3], PXI, PXIe[4]	32 SE/16 DI	1.25 M	16	-	±10 V	✓	4	16	48	TTL/CMOS
NI 6255	USB, PCI, PXI	80 SE/40 DI	1.25 M	16	-	±10 V	✓	2	16	24	TTL/CMOS
NI 6254	PCI, PXI	32 SE/16 DI	1.25 M	16	-	±10 V	✓	0	-	48	TTL/CMOS
NI 6251	USB, PCI, PCIe[3], PXI, PXIe[4]	16 SE/8 DI	1.25 M	16	-	±10 V	✓	2	16	24	TTL/CMOS
NI 6250	PCI, PXI	16 SE/8 DI	1.25 M	16	-	±10 V	✓	0	-	24	TTL/CMOS
NI 6239	PCI, PXI	8 DI	250 k	16	Bank isolation	±20 mA	-	2	16	10	24 V sink
NI 6238	PCI, PXI	8 DI	250 k	16	Bank isolation	±20 mA	-	2	16	10	24 V source
NI 6236	PCI, PXI	4 DI	250 k	16	Bank isolation	±20 mA	-	4	16	10	TTL/CMOS
NI 6233	PCI, PXI	16 SE/8 DI	250 k	16	Bank isolation	±10 V	-	2	16	10	24 V sink
NI 6232	PCI, PXI	16 SE/8 DI	250 k	16	Bank isolation	±10 V	-	2	16	10	24 V source
NI 6230	PCI, PXI	8 SE/4 DI	250 k	16	Bank isolation	±10 V	-	4	16	10	TTL/CMOS
NI 6229	USB, PCI, PXI	32 SE/16 DI	250 k	16	-	±10 V	-	4	16	48	TTL/CMOS
NI 6225	USB, PCI, PXI	80 SE/40 DI	250 k	16	-	±10 V	-	2	16	24	TTL/CMOS
NI 6224	PCI, PXI	32 SE/16 DI	250 k	16	-	±10 V	-	0	-	48	TTL/CMOS
NI 6221	USB, PCI, PXI	16 SE/8 DI	250 k	16	-	±10 V	-	2	16	24	TTL/CMOS
NI 6221(37-Pin)	PCI	16 SE/8 DI	250 k	16	-	±10 V	-	2	16	10	TTL/CMOS
NI 6220	PCI, PXI	16 SE/8 DI	250 k	16	-	±10 V	-	0	-	24	TTL/CMOS
NI 6218	USB	32 SE/16 DI	250 k	16	Bank isolation	±10 V	-	2	16	16	TTL/CMOS
NI 6215	USB	16 SE/8 DI	250 k	16	Bank isolation	±10 V	-	2	16	8	TTL/CMOS
NI 6211	USB	16 SE/8 DI	250 k	16	-	±10 V	-	2	16	8	TTL/CMOS
NI 6210	USB	16 SE/8 DI	250 k	16	-	±10 V	-	0	-	8	TTL/CMOS
S Series - Simultaneous-Sampling Multifunction DAQ											
NI 6115	PCI, PXI	4 SS	10 M/ch	12	Antialiasing filters	±42 V	✓	2	12	8	TTL/CMOS
NI 6120	PCI, PXI	4 SS	800 k/ch	16	Antialiasing filters	±42 V	✓	2	16	8	TTL/CMOS
NI 6110	PCI	4 SS	5 M/ch	12	-	±42 V	✓	2	12	8	TTL/CMOS
NI 6111	PCI	2 SS	5 M/ch	12	-	±42 V	✓	2	12	8	TTL/CMOS
NI 6124	PXIe	4 SS	4 M/ch	16	-	±10 V	✓	2	16	24	TTL/CMOS
NI 6123	PCI, PXI	8 SS	500 k/ch	16	-	±10 V	✓	0	-	8	TTL/CMOS
NI 6122	PCI, PXI	4 SS	500 k/ch	16	-	±10 V	✓	0	-	8	TTL/CMOS
NI 6133	PCI, PXI	8 SS	2.5 M/ch	14	-	±10 V	✓	0	-	8	TTL/CMOS
NI 6132	PCI, PXI	4 SS	2.5 M/ch	14	-	±10 V	✓	0	-	8	TTL/CMOS
NI 6154	PCI	4 SS	250 k	16	Ch-ch isolation	±10 V	-	4	16	10	TTL/CMOS
NI 6143	PCI, PXI	8 SS	250 k/ch	16	-	±5 V	-	0	-	8	TTL/CMOS
R Series - Intelligent DAQ											
NI 7830R	PCI, PXI	4 SS	200 k/ch	16	-	±10 V	✓	4	16	56	TTL/CMOS
NI 7831R	PCI, PXI	8 SS	200 k/ch	16	-	±10 V	✓	8	16	96	TTL/CMOS
NI 7833R	PCI, PXI	8 SS	200 k/ch	16	-	±10 V	✓	8	16	96	TTL/CMOS
E Series - Multifunction DAQ											
NI 6062E	PCMCIA	16 SE/8 DI	500 k	12	-	±10 V	✓	2	12	8	TTL/CMOS
NI 6036E	PCMCIA	16 SE/8 DI	200 k	16	-	±10 V	-	2	16	8	TTL/CMOS
NI 6024E	PCI, PCMCIA	16 SE/8 DI	200 k	12	-	±10 V	-	2	12	8	TTL/CMOS
B Series - Basic Multifunction DAQ											
NI 6008	USB	8 SE/4 DI	10 k	12	-	±10 V	-	2	12	12	TTL/CMOS
NI 6009	USB	8 SE/4 DI	48 k	14	-	±10 V	-	2	12	12	TTL/CMOS
NI 6010	PCI	16 SE/8 DI	200 k	16	-	±5 V	-	2	16	10	TTL/CMOS
NI 6004	CF	4 SE	200 k	14	-	±5 V	-	0	-	4	TTL/CMOS
SC Series - PXI DAQ with Signal Conditioning											
NI 4224	PXI	8 DI	200 k	16	CAT I isolation (60 V)	±10 V	-	0	-	0	-
NI 4220	PXI	2	200 k	16	Strain gage inputs	±10 V	-	0	-	0	-
NI 4204	PXI	8 DI	200 k	16	High-voltage attenuation	±100 V	-	0	-	0	-

[1]SS - Simultaneous sampling, SE - Single Ended, DI - Differential; [2]TTL/CMOS - Compatible with 3.3 and 5 V TTL/CMOS; [3]PCI Express; [4]PXI Express.

Table 2. Multifunction DAQ Selection Guide

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X Series Multifunction DAQ - up to 160bit, up to 2 MS/s, up to 32 Analog Inputs

NI X Series

New Features
- PCIe/PXIe Interface
- Analog and digital triggering and advanced timing with NI-STC3 technology
- Enhancements for High Throughput and Low Latency
- Parallel Processing on Multicore PCs
- Independent Timing Engines for Analog and Digital I/O

Analog Inputs
- 16-bit resolution
- Multiplexed H/W
  - Up to 32 analog inputs
  - Up to 2MS/s

Analog Output
- Up to 4 analog outputs
- 16-bit resolution
- Up to 3.33 MS/s

Digital and Timing
- Up to 48 digital I/O lines (32 hardware-timed lines up to 10 MHz)
- Four 100MHz 32-bit counter/timers

Operating Systems
- Windows 7/Vista/XP/2000

Recommended Software
- LabVIEW
- Measurement Studio
- LabWindows/CVI

Measurement Services Software (included)
- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility
- VI Logger Lite data-logging software
- DAQ Assistant for development without programming



	Model	Bus	Analog Inputs	Input Resolution (bits)	Max Sampling Rate	Input Range	Analog Outputs	Max Output Rate(S/s)	Output Range	DIO	Timed DIO Lines	HW Timed DIO
Multiplexed	NI 6320	PCIe	16	16	250 kS/s	±10 V	-	-	±10 V	24	8	1 MHz
	NI 6321	PCIe	16	16	250 kS/s	±10 V	2	900 kS/s	±10 V	24	8	1 MHz
	NI 6323	PCIe	32	16	250 kS/s	±10 V	4	900 kS/s	±10 V	48	32	1 MHz
	NI 6341	PCIe, PXIe	16	16	500 kS/s	±10 V	2	900 kS/s	±10 V	24	8	1 MHz
	NI 6343	PCIe	32	16	500 kS/s	±10 V	4	900 kS/s	±10 V	48	32	1 MHz
	NI 6351	PCIe	16	16	1.25 MS/s	±10 V	2	2.86 MS/s	±10 V	24	8	10 MHz
	NI 6353	PCIe	32	16	1.25 MS/s	±10 V	4	2.86 MS/s	±10 V	48	32	10 MHz
	NI 6361	PCIe, PXIe	16	16	2 MS/s	±10 V	2	2.86 MS/s	±10 V	24	8	10 MHz
	NI 6363	PCIe, PXIe	32	16	2 MS/s	±10 V	4	2.86 MS/s	±10 V	48	32	10 MHz
Simultaneous	NI 6356	PXIe	8	16	1.25 MS/s/ch	±10 V	2	3.33 MS/s	±10 V	24	8	10 MHz
	NI 6358	PXIe	16	16	1.25 MS/s/ch	±10 V	4	3.33 MS/s	±10 V	48	32	10 MHz
	NI 6366	PXIe	8	16	2 MS/s/ch	±10 V	2	3.33 MS/s	±10 V	24	8	10 MHz
	NI 6368	PXIe	16	16	2 MS/s/ch	±10 V	4	3.33 MS/s	±10 V	48	32	10 MHz

Table 1. S Series Selection Guide

Overview

X Series devices are the most advanced multifunction data acquisition (DAQ) devices ever designed by National Instruments. Using the easy-to-use NI-DAQmx driver software, X Series incorporates high-performance enhancements that address the needs of the most demanding data acquisition applications. With NI-STC3 timing and synchronization technology, high-throughput PCI Express buses, and multicore-ready driver software, X Series offers a new level of excellence for PC-based multifunction I/O.

NI-STC3 Timing and Synchronization Technology

All multifunction data acquisition hardware requires onboard timing circuitry to control analog, digital, and counter I/O lines, and the evolution of timing ASIC technology occurred over decades. After three years in development, the X Series DAQ family features new NI-STC3 technology that provides four enhanced counters, a 100 MHz timebase, and additional options for I/O timing and triggering.

Four Enhanced Counters

The original NI-STC ASIC, featured on E Series devices, included two 20 MHz counters with 24-bit resolution. In 2004, the NI-STC2

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ASIC was introduced on M Series devices and offered two 80 MHz counters with 32-bit resolution. New NI-STC3 technology takes counter channels one step further, offering four 100 MHz counters with 32-bit resolution. Not only are there four counters on a single X Series device, but operations that previously required two counters, can now be done with a single counter channel. If you were controlling a stepper motor, for example, you would often need to generate a finite number of digital pulses and, in the past this would involve using one counter to continuously generate pulses and a second counter to gate pulses being sent to the motor. The NI-STC3 counters could accomplish this task with a single counter, meaning a single X Series device could control up to four stepper motors.

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 use the timebase as an onboard reference to generate clock frequencies and latch digital edges. NI-STC3 technology uses a new 100 MHz timebase for all analog and digital timing, which is 5X faster than any previously released NI DAQ device. This means that sampling frequencies are 5X 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

NI-STC3 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 the analog input sample clock. With NI-STC3 technology on new X Series DAQ boards, analog channels no longer require the use of counters to implement retriggerable acquisitions and triggers can independently rearm themselves without software intervention.

Enhancements for High Throughput and Low Latency

X Series devices incorporate several enhancements for high-throughput applications; that is, those applications that pass large amounts of data to and from the device and PC memory.

With the introduction of PCI Express and its integration into the PXI Express standard, the data bottlenecks that once existed in a measurement system are disappearing. In contrast to the shared 132 MB/s bandwidth of PCI, PCI Express provides dedicated serial lanes to each device and a theoretical bandwidth of 250 MB/s in each direction.



X Series also includes eight DMA channels to stream data directly between the device and PC memory without CPU interaction or additional programming effort. These eight channels provide parallel data streams for the analog I/O, digital I/O, and all four counter/timers.

As is true with most internal buses, PCI Express has very low latency, making it ideal for closed-loop control applications. X Series devices also expand the capabilities of hardware-timed single point performance on all the subsystems of the device.

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M Series Multifunction DAQ – up to 18-Bit, up to 1.25 MS/s, up to 80 Analog Inputs, Isolation

NI M Series

Analog Input
- Up to 18-bit resolution
- NI-MCal calibration methodology for self-calibration at all ranges
- NI-PGIA 2 amplifier technology for improved accuracy and fast scanning
- Programmable lowpass filters[1]

Analog Output
- Up to 4 analog outputs
- Up to 2.8 MS/s at 16 bits
- Programmable offsets[1] and ranges

Digital and Timing
- Up to 48 protected digital I/O lines
- High-speed (clocked) digital up to 10 MHz
- Two 80 MHz, 32-bit counter/timers with quadrature encoder inputs

New Industrial Features
- 1,400 V_{rms}/1,950 VDC channel-to-bus transient isolation
- 60 VDC continuous bank isolation
- Analog current I/O; 24 V logic digital I/O

Operating Systems
- Windows 7/Vista/XP/2000
- Max OS X
- Linux®

Recommended Software
- LabVIEW
- Measurement Studio
- LabWindows/CVI
- SignalExpress
- Analog Waveform Editor
- Digital Waveform Editor

Measurement Services Software(included)[2]
- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility
- VI Logger Lite data-logging software
- DAQ Assistant for development without programming

[1] *Available on NI 628x devices*



	Model	Bus	Analog Inputs	Input Resolution (bits)	Max Sampling Rate (S/s)	Analog Triggering	Integrated Signal Conditioning	Analog Outputs	Max Output Rate (S/s)	Output Range (V)	DIO	DIO Features
High-Accuracy	NI 6289	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	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	USB, PCI, PCIe, PXI, PXIe	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	USB, PCI, PCIe, PXI, PXIe	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
Isolated	NI 6239	PCI, PXI	8 I	16	250 k	-	Bank isolation	2 I	500 k	0 tu 20 mA	10	24 V, sinking
	NI 6238	PCI, PXI	8 I	16	250 k	-	Bank isolation	2 I	500 k	0 tu 20 mA	10	24 V, sourcing
	NI 6236	PCI, PXI	4 I	16	250 k	-	Bank isolation	4	500 k	±10	10	5 V TTL, static
	NI 6233	PCI, PXI	16	16	250 k	-	Bank isolation	2	500 k	±10	10	24 V, sinking
	NI 6232	PCI, PXI	16	16	250 k	-	Bank isolation	2	500 k	±10	10	24 V, sourcing
	NI 6230	PCI, PXI	8	16	250 k	-	Bank isolation	4	500 k	±10	10	5 V TTL, static
Low-Cost	NI 6229	USB, PCI, PXI	32	16	250 k	-	-	4	833 k	±10	48	5 V TTL, 1 MHz
	NI 6225	USB, PCI, PXI	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	USB, 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
USB Bus-Powered	NI 6218	USB	32	16	250 k	-	Bank isolation	2	250 k	±10	16	5 V TTL, static
	NI 6215	USB	16	16	250 k	-	Bank isolation	2	250 k	±10	8	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	-	±10	8	5 V TTL, static

Table 1. M Series Selection Guide

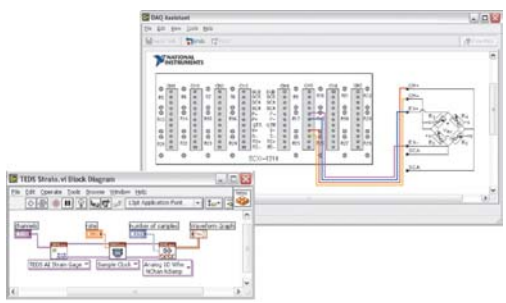
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Product Description

New technologies power M Series DAQ devices with more performance, more I/O channels, and more value. At the digital heart of every M Series device is the NI-STC 2 system timing controller. It implements high-speed clocked digital I/O, provides six dedicated DMA data highways, and improves timing and synchronization between onboard signals and with other devices in the same system. To ensure accurate analog measurements at all signal ranges, NI-MCal technology compensates for nonlinearity error during self-calibration, and stores calibration information for all input ranges. This improves analog measurement accuracy by up to 5X compared to NI E Series devices. The new isolated M Series devices integrate with new commercial off-the-shelf digital isolators to offer increased accuracy and performance, as well as remove common-mode voltages and ground loops.

Key Features

- Analog input resolution up to 18 bits (64X resolution compared to 12-bit devices)
- Integrated high-speed digital isolation
- NI-MCal self-calibration technology improves accuracy up to 5X
- NI-PGIA 2 amplifier technology for fast, accurate measurements at high scanning rates
- NI-STC 2 system timing controller provides six DMA data high ways for high-speed data through put
- NI patent-pending USB signal streaming for high-speed data transfer and control
- Voltage or current I/O
- High-speed, clocked digital I/O up to 10 MHz
- TTL/CMOS or 24 V digital logic levels
- 80 MHz, 32-bit counter/timers with quadrature encoder capabilities and digital debouncing filters
- RTSI bus for synchronization between clock sources and trigger signals within a device or between multiple devices in the system
- Phase-locked-loop (PLL) circuitry for signal timing with 12.5 ns resolution
- Universal signal and sensor connectivity with SCXI and SCC signal conditioning
- Extended external calibration interval on most devices





NI Measurement Services Software

Every M Series device features more than basic device driver software. NI measurement services software includes Measurement & Automation Explorer (MAX), an interactive configuration and testing utility. With MAX, you have point-and-click system verification, device calibration, and channel measurements. Measurement services software also includes DAQ Assistant, an interactive wizard in LabVIEW, LabWindows/CVI, and Measurement Studio, that performs menu-based data acquisition configuration and automatic data scaling. DAQ Assistant can also automatically generate application code for LabVIEW, LabWindows/CVI, and Measurement Studio.

NI-DAQmx includes powerful device drivers for the most popular programming environments, including LabVIEW, LabWindows/CVI, Measurement Studio for Visual Studio .NET, Visual Basic, C++, and C#. NI-DAQmx is a multithreaded environment in which multiple data acquisition routines can be executed simultaneously by the PC processor. In addition, it provides fast execution of single-point measurements at rates more than 20X faster than Traditional NI-DAQ(Legacy) and other device drivers.

M Series for Test, Control, and Design

National Instruments M Series devices are optimized for test, control, design, data logging, and sensor measurement. For test applications, including electronic test and component characterization, M Series devices provide up to 18-bit resolution (equivalent to more than 5.5 digits) and analog input rates above 1 MS/s. You can use the onboard 10 MHz digital I/O lines and 80 MHz counter/timers to clock digital components and generate patterns up to 32 bits wide. Isolation can reduce problems caused by common-mode voltages and ground loops, as well as ensuring safety from transient voltages.

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Control

For control applications, M Series digital lines can drive 24 mA for relay and actuator control and can connect directly to 24 V digital sensors and actuators. You can also use the digital lines to generate pulse-width-modulated (PWM) signals to control valves and actuators. M Series devices also have up to four analog outputs at 16-bit, 2.8 MS/s and current I/O channels to connect to 0 to 20 mA signals. You can use these channels to control motor drives or as control outputs from up to four PID, fuzzy logic, or other control algorithm loops. If your application requires more control loops, you can combine M Series devices with National Instruments analog output devices for 32, 64, or more control loops. For motion and position feedback, the counter/timers have quadrature encoder inputs with digital debouncing filters and Z-indexing. With the NI Soft Motion Development Module for LabVIEW, you can create a custom motion controller with an M Series device.

Design

For design applications, you can use the wide range of I/O, from 80 analog inputs to 48 digital I/O lines, to measure and verify prototype designs. Isolation can provide protection for your measurement system from transient voltages that may occur during prototype design testing. M Series devices and NI SignalExpress bring benchtop measurements to the PC. SignalExpress uses interactive configuration-based steps to quickly create tests used in design verification. The high-speed acquisition and generation rates of M Series devices, used with SignalExpress, provide on-the-fly analysis of designs. Once your design is tested and verified, the SignalExpress projects can be converted to LabVIEW applications for immediate use in subsequent testing, thus bridging the gap between design and test applications.

Data Logging and Sensor Measurements

M Series devices are also ideal for sensor measurements and data logging. The 18-bit inputs deliver 4X better resolution, 5X better sensitivity, and 3X better accuracy than the best 16-bit DAQ devices for low-level sensors such as thermocouples. Most M Series devices are fully compatible with NI SCXI and SCC signal conditioning, which provide amplification, filtering, and power for virtually any type of sensor. These systems are also compliant with IEEE 1451.4 smart TEDS sensors, which provide digital storage for sensor data sheet information. Isolated M Series devices offer voltage or current I/O channels, and 5 V TTL/CMOS or 24 V logic digital I/O channels for direct connection to industrial sensors.



M Series Performance on USB

With recent speed and bandwidth improvements, USB has evolved into a core bus of choice for measurement and automation applications. USB adds portability and ease of use with plug-and-play compatibility. With USB M Series, you can deliver a high-performance portable system using an available USB port on a laptop computer or other portable computing platforms. NI designed an innovative patent-pending signal streaming technology with which you can sustain four high-performance data streams over USB. This new technology greatly improves over all USB data acquisition performance by providing high-speed data paths for USB control and data transfer. The USB M Series modules also come with built-in screw terminals for direct signal connectivity, eliminating the need for external cabling and connector blocks.

Hybrid-Slot-Compatible PXI Modules

PXI M Series modules are hybrid slot compatible so that they can be used in both PXI slots and the hybrid slots found in new PXI Express chassis. The PXI Systems Alliance specifies that hybrid-slot-compatible PXI modules use modified slot connectors to mechanically fit in both PXI slots and hybrid slots. This mechanical change:

- Provides compatibility to past, current, and future PXI chassis
- Maintains existing product specifications
- Requires no software changes (application or driver)
- Maintains speed and capability of all PXI communication (PXI Express signaling is not provided)

However, hybrid-slot-compatible PXI modules do not include the pins used to implement PXI local bus communication, which is used for backplane SCXI control from the right most PXI slot in PXI/SCXI combination chassis (PXI-1011, PXI-1050, and PXI-1052). For these applications, NI provides unmodified PXI M Series modules that maintain the required local bus capabilities. Refer to the SCXI Control of PXI/SCXI Combination Chassis section within the Ordering Information for part numbers.

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M Series	Feature	Connect to...	Connector	Cable	Cable Adapter	Accessory
68-pin devices	Noise-reducing	SCC portable signal conditioning	0 or 1	SHC68-68-EPM	-	SCC-68
	Noise-reducing	SCXI high-performance signal conditioning	0 only	SHC68-68-EPM	-	-
	Noise-reducing	Screw terminals	0 or 1	SHC68-68-EPM	-	SCC-68, SCB-68, or TBX-68
	Noise-reducing	Screw terminals (PXI only)	0 only	-	-	TB-2706
	Noise-reducing	BNC terminal block	0 or 1	SHC68-68-EPM	-	BNC-2110, BNC-2111, BNC-2120, or BNC-2090
	Noise-reducing	50-pin connector	0 or 1	SHC68-68-EPM	68M-50F-MIO	50-pin accessories
	Basic shielding	Screw terminals	0 or 1	SHC68-68	-	SCB-68, CB-68LP, CB-68LPR
	Low-cost	Screw terminals	0 or 1	RC68-68	-	CB-68LP or CB-68LP
	Custom connectivity	Board mounting connectors	0 or 1	SHC68-68-EPM	-	PCB mounting connectors
	Custom connectivity	68-pin female connector	0 or 1	SHC68-68M-EPM	-	Custom-built or third-party
	Custom connectivity	Unterminated	0 or 1	SHC68-NT-S	-	Custom-built or third-party
37-pin devices	150 V CAT II, DIN rail	Screw terminals	0 only	SH37F-37M	-	CB-37F-HVD
	High-performance	Screw terminals	0 only	DB37M-DB37F-EP	-	CB-37F-HVD, CB-37FH, or CB-37FV
	DIN rail	Screw terminals	0 only	SH37F-37M or R37F-37M-1	-	CB-37FH or CB-37FV
	Custom connectivity	Unterminated	0 only	SH37F-P-4	-	Custom-built or third-party
	Custom connectivity	Crimp and poke termination	0 only	-	-	TB-37F-37CP
	Custom connectivity	Solder cup termination	0 only	-	-	TB-37F-37SC
	Low-cost	Screw terminals	0 only	-	-	CB-37F-LP

Table 2. Recommended Accessories

Isolation

Isolated M Series devices use digital isolation technology based on chip-scale transformers for increased signal bandwidth; they feature 60 VDC continuous bank isolation and 1,400 V_{rms}/1,950 VDC of channel-to-bus isolation with stand for up to 5 s. Isolation provides three main benefits in measurement and automation applications.

Safety from High-Voltage Transients

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

Common-Mode Voltage Rejection

A voltage common to both sides of a differential circuit pair is called common-mode voltage. The differential voltage across the circuit pair is the desired signal, where as the common voltage signal is the unwanted signal that may have been coupled into the transmission line. Isolated M Series devices can measure signals from lines with signal plus common mode of up to 60 VDC.

Ground Loop Removal

Ground loops are one of the most common sources of noise in data acquisition applications. They occur when two connected terminals in a circuit are at different ground potentials, causing current to flow between the two points. When a ground loop exists, the measured voltage is the sum of the signal voltage and the potential difference that exists between the signal source ground and the measurement system ground. This potential is generally not a DC level; therefore, the result is a noisy measurement system, often showing power-line frequency (60 Hz) components in the readings. Isolation technologies prevent ground loops by offering an isolated floating ground on the front end.

Recommended Accessories

Signal conditioning is required for sensor measurements or voltage inputs greater than 10 V. National Instruments SCXI is a versatile, high-performance signal conditioning platform, optimized for high-channel-count applications. NI SCC provides portable, flexible signal conditioning options on a per-channel basis. Both signal conditioning platforms are designed to increase the performance and reliability of your DAQ system, and are up to 10X more accurate than terminal blocks (visit **ni.com/signalconditioning** for more details).

Recommended Training and Services

To ensure product life time and measurement accuracy, all M Series devices are available with additional warranty and calibration services. For new data acquisition programmers, NI recommends the "Data Acquisition: 7 Steps to Success Tutorial Kit." This tutorial kit helps shorten development time for data acquisition applications by describing the various stages of getting started with data acquisition applications including system definition, setup, test, and application programming.



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Ordering Information

PCI

NI PCI-6220	779065-01
NI PCI-6221	779066-01
NI PCI-6221 (37-Pin)	779418-01
NI PCI-6224	779067-01
NI PCI-6225	779295-01
NI PCI-6229	779068-01
NI PCI-6230	779615-01
NI PCI-6232	779617-01
NI PCI-6233	779619-01
NI PCI-6236	779621-01
NI PCI-6238	779623-01
NI PCI-6239	779625-01
NI PCI-6250	779069-01
NI PCI-6251	779070-01
NI PCI-6254	779071-01
NI PCI-6255	779546-01
NI PCI-6259	779072-01
NI PCI-6280	779108-01
NI PCI-6281	779109-01
NI PCI-6284	779110-01
NI PCI-6289	779111-01

PCI Express

NI PCIe-6251	779512-01
NI PCIe-6259	779513-01

PXI

NI PXI-6220	779112-01
NI PXI-6221	779629-01
NI PXI-6224	779114-01
NI PXI-6225	779296-01
NI PXI-6229	779630-01
NI PXI-6230	779616-01
NI PXI-6232	779618-01
NI PXI-6233	779620-01
NI PXI-6236	779622-01
NI PXI-6238	779624-01
NI PXI-6239	779626-01
NI PXI-6250	779116-01
NI PXI-6251	779631-01
NI PXI-6254	779118-01
NI PXI-6255	779547-01
NI PXI-6259	779632-01
NI PXI-6280	779120-01
NI PXI-6281	779121-01
NI PXI-6284	779122-01
NI PXI-6289	779639-01

PXI Express[1]

NI PXIe-6251	779777-01
NI PXIe-6259	779778-01

PXI for SCXI Control in PXI/SCXI Combination Chassis

NI PXI-6221	779113-01
NI PXI-6229	779115-01
NI PXI-6251	779117-01
NI PXI-6259	779119-01
NI PXI-6289	779123-01

USB[1]

NI USB-6210	779675-01
NI USB-6211	779676-01
NI USB-6215	779677-01
NI USB-6218	779678-01
NI USB-6221	779808-0P[2]
NI USB-6229	779810-0P[2]
NI USB-6251	
Screw terminal	779628-0P[2]
Mass terminal	779694-0P[2]
NI USB-6259	
Screw terminal	779627-0P[2]
Mass terminal	779695-0P[2]
USB-6225	
Screw terminal	779973-01
Mass terminal	779974-01
USB-6255	
Screw terminal	779958-01
Mass terminal	779959-01

[1]Windows only.

[2]P is 1 (U.S. 120 VAC); 2 (Swiss 220 VAC); 3 (Australian 240 VAC); 4 (Universal Euro 240 VAC); 6 (UK 240 VAC), 7 (Japanese 100 VAC)

Includes NI-DAQmx driver software.

For more information on extended warranty and value-added services, visit ni.com/services.

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S Series Multifunction DAQ – up to 16-Bit, up to 10 MS/s, up to 8 Simultaneous Analog Inputs

NI S Series

- Simultaneous-sampling, dedicated A/D converter per channel
- Channel-to-channel isolation (PCI-6154)
- Differential inputs
- Analog and digital triggering
- Up to 4 high-speed analog outputs
- Up to 10 digital I/O lines (TTL/CMOS)
- Up to two 32-bit counter/timers
- Onboard self-calibration at every gain
- Up to 64 MS onboard memory
- Integrated multidevice synchronization bus
- NI measurement services that simplify configuration and measurements

Operating Systems

- Windows 7/Vista/XP/2000
- Mac OS X
- Linux®
- LabVIEW Real-Time

Recommended Software

- LabVIEW 7.x or higher
- LabWindows/CVI 7.x or higher
- Measurement Studio 7.x or higher
- SignalExpress 1.x or higher

Other Compatible Software

- VI Logger 2.x or higher
- Visual Studio .NET
- Visual Basic, C/C++, C#
- Digital Waveform Editor
- Analog Waveform Editor

Measurement Services Software (included)[1]

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility
- VI Logger Lite data-logging software



Family	Bus	Analog Inputs	Sampling Rate per Channel (S/s)[1]	Input Resolution (bits)	Input Range (V)	Input Ranges	Analog Outputs	Output Resolution (bits)	Output Rate (S/s)	Digital I/O	Counter/ Timers	Triggering	Isolation
NI 6115	PCI, PXI	4	10 M	12	±42 to ±0.2	8	2	12	4 M[3]	8[4]	2, 24-bit	Digital, analog	–
NI 6120	PCI, PXI	4	1[2] M	16	±42 to ±0.2	8	2	16	4 M[3]	8[4]	2, 24-bit	Digital, analog	–
NI 6110	PCI	4	5 M	12	±42 to ±0.2	8	2	12	4 M[3]	8	2, 24-bit	Digital, analog	–
NI 6111	PCI	2	5 M	12	±42 to ±0.2	8	2	12	4 M[3]	8	2, 24-bit	Digital, analog	–
NI 6124	PXIe	4	4M	16	±10 V to 1.0	4	2	14	4M[3]	24	2, 24-bit	Digital, analog	–
NI 6123	PCI, PXI	8	500 k	16	±10 to ±1.25	4	0	–	–	8	2, 24-bit	Digital, analog	–
NI 6122	PCI, PXI	4	500 k	16	±10 to ±1.25	4	0	–	–	8[4]	2, 24-bit	Digital, analog	–
NI 6133	PCI, PXI	8	3[5] M	14	±10 to ±1.25	4	0	–	–	8[4]	2, 24-bit	Digital, analog	–
NI 6132	PCI, PXI	4	3[5] M	16	±10 to ±1.25	4	0	–	–	8[4]	2, 24-bit	Digital, analog	–
NI 6143	PCI, PXI	8	250 k	16	±5	1	0	–	–	8[4]	2, 24-bit	Digital	–
NI 6154	PCI	4	250 k	16	±10 to ±1.0	4	4	16	250 k	10	2, 32-bit	Digital	✓

[1]Each channel has a separate analog-to-digital converter. [2]800 kS/s with NI-DAQmx; 1 MS/s with additional download. Special conditions apply. [3]4 MS/s single channel; 2.5 MS/s on two channels.
[4]Hardware-timed digital I/O up to 10 MHz. [5]2.5 MS/s with NI-DAQmx; 3 MS/s with additional download. Special conditions apply.

Table 1. S Series Selection Guide

Product Description

National Instruments S Series devices feature an analog-to-digital converter (ADC) per-channel architecture to achieve the highest performance of National Instruments multifunction data acquisition hardware. With features such as simultaneous sampling, channel-to-channel isolation, deep onboard memory, extended voltage ranges, and high sampling rates per channel, S Series devices are very flexible and can handle a variety of applications. The dedicated ADC per channel preserves the phase/timing relationship between all analog input channels as well as guaranteeing the highest overall device through put among multifunction DAQ devices. Channnel-to channel isolation offers transient over voltage protection and eliminates problems due to common-mode voltages and groundloops. S Series devices are ideal for applications such as transient analysis; ultrasonic, radar, and sonar measurements; 42 V automotive applications; and industrial measurement and control.

Synchronize the operations of two or more devices using the RTSI bus or PXI trigger bus and easily integrate other hardware such as motion control and machine vision to create an entire measurement and control system.

Family	Onboard Memory(samples)	Antialias Filters[1]	Signal Coupling	Input Configuration	DIO
NI 6115	32 M or 64 M	3-pole Bessel 50 and 500 kHz	AC and DC	Pseudodifferential	Hardware-timed
NI 6120	64 M	5-pole Bessel, 100 kHz	AC and DC	Pseudodifferential	Hardware-timed
NI 6110	8,192	–	AC and DC	Pseudodifferential	Software-timed
NI 6111	8,192	–	AC and DC	Pseudodifferential	Software-timed
NI 6123	2,046	–	DC	Differential	Software-timed
NI 6122	16 M	–	DC	Differential	Hardware-timed
NI 6133	16 or 32 M	–	DC	Differential	Hardware-timed
NI 6132	16 M	–	DC	Differential	Hardware-timed
NI 6143	2,046	–	DC	Differential	Hardware-timed
NI 6154	8190	–	DC	Differential	Software-timed

[1]Filter can be bypassed.

Table 2. S Series Special Features

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Key Features

Hardware Design for Accurate Measurements with:

- Dedicated ADC per channel
- High-speed (clocked) digital I/O up to 10 MHz
- Channel-to-channel isolation
- Onboard self-calibration at all ranges
- Optimized AC measurement capability
- Analog and digital triggering
- PFI lines for software-controlled routing of digital and timing signals
- RTSI and PXI trigger bus to synchronize operations between two or more devices
- Onboard temperature sensor

For information on our custom designs and quantity discounts for OEM customers, visit ni.com/oem.

NI Measurement Services Software

NI-DAQmx is a high-performance, multithreaded driver at the heart of the measurement services software included with National Instruments DAQ devices. Additional measurement services shipped with NI-DAQmx include Measurement & Automation Explorer (MAX) for configuring, interacting with, and testing your hardware; DAQ Assistant for creating configuration-based data acquisition tasks; and VI Logger Lite, software specifically designed for data logging. Collectively, these measurement services provide more power, flexibility, and ease of use than any basic device driver software.

Easier Multidevice Programming

NI-DAQmx driver software now handles multidevice tasks for S Series. Synchronizing channels on multiple devices using the RTSI bus or PXI trigger bus is now as simple as configuring a single data acquisition device. This capability, which greatly reduces the time and complexity involved with multidevice application programming, is now available for any combination of S Series devices.

Recommended Accessories

National Instruments offers a variety of connectivity options based on the needs of your application. Connector blocks with BNC connectivity are popular for signals that need shielding and are connected and disconnected often. Shielding in the connector block and the cabling facilitates superior accuracy by rejecting noise and other environmental factors. For PXI S Series devices, the new TB-2708 and TB-2709 offer direct SMB connectivity for high-speed, high-resolution, or high-density data acquisition, along with anauxiliary connector for advanced timing and triggering. Several low-cost 37-pin accessories are available for the isolated PCI-6154 board.

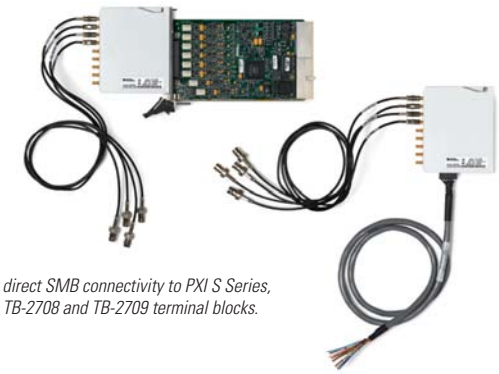


Figure 1. For direct SMB connectivity to PXI S Series, use the new TB-2708 and TB-2709 terminal blocks.

Ordering Information

PCI

NI PCI-6115 with	
32 MS buffer	778534-01
64 MS buffer	778554-01
NI PCI-6120	778397-01
NI PCI-6110	777475-01
NI PCI-6111	777530-01
NI PCI-6123 with	
16 MS buffer	779409-01
32 MS buffer	779408-01
NI PCI-6122	779407-01
NI PCI-6133 with	
16 MS buffer	779420-01
32 MS buffer	779421-01
NI PCI-6132	779422-01
NI PCI-6143	778913-01
NI PCI-6154	779340-01

PXI

NI PXI-6115 with	
32 MS buffer	778194-01
64 MS buffer	778204-01
NI PXI-6120	778396-01
NI PXI-6123 with	
16 MS buffer	779181-01
32 MS buffer	779180-01
NI PXI-6122	779179-01
NI PXI-6133 with	
16 MS buffer	778771-01
32 MS buffer	779129-01
NI PXI-6132	779127-01
NI PXI-6143	779063-01

PXIe

NI PXIe-6124	780536-01

Includes data acquisition driver software.

For more information on extended warranty and value-added services, visit ni.com/services.

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R Series - Intelligent DAQ with Onboard Processing

NI R Series

- Onboard FPGA chip, programmable with the LabVIEW FPGA Module
- User-defined triggering, timing, and decision making in hardware with 25 ns resolution
- Up to 8 analog inputs, independent sampling rates up to 750 kHz, 16-bit resolution
- Up to 8 analog outputs, independent update rates up to 1 MHz, 16-bit resolution
- Up to 160 digital lines configurable as inputs, outputs, counters, or custom logic at rates up to 40 MHz
- Direct memory access (DMA) channels for high-speed data streaming
- Implement custom control logic, inline signal processing, and digital communication protocols

Operating Systems

- Windows 7/Vista/XP/2000
- LabVIEW Real-Time

Recommended Software

- LabVIEW
- LabVIEW FPGA Module
  - LabVIEW code compiler for FPGAs
  - Emulated debugging mode
- LabVIEW Real-Time Module

Driver Software (included)

- NI-RIO



Product	Bus/Form Factor	FPGA	16-Bit Analog Inputs	Max Sampling Rate per Channel (kS/s)	16-Bit Analog Outputs	Max Update Rate per Channel (MS/s)	Digital I/O
Multifunction R Series							
NI 7851R	PCI Express, PXI	Virtex-5 LX30	8	750	8	1	96
NI 7852R	PCI Express, PXI	Virtex-5 LX50	8	750	8	1	96
NI 7853R	PXI	Virtex-5 LX85	8	750	8	1	96
NI 7854R	PXI	Virtex-5 LX110	8	750	8	1	96
NI 7841R	PCI Express, PXI	Virtex-5 LX30	8	200	8	1	96
NI 7842R	PCI Express, PXI	Virtex-5 LX50	8	200	8	1	96
NI 7830R	PCI, PXI	Virtex-II 1M Gates	4	200	4	1	56
NI 7831R	PCI, PXI	Virtex-II 1M Gates	8	200	8	1	96
NI 7833R	PCI, PXI	Virtex-II 3M Gates	8	200	8	1	96
Digital R Series							
NI 7811R	PCI, PXI	Virtex-II 1M Gates	–	–	–	–	160
NI 7813R	PCI, PXI	Virtex-II 3M Gates	–	–	–	–	160

Table 1. R Series Selection Guide

Overview

Intelligent DAQ is multifunction data acquisition that features user-defined onboard processing as well as complete flexibility of I/O timing and triggering. You can configure all device functionality by creating NI LabVIEW block diagrams with the LabVIEW FPGA Module. Your block diagram executes in hardware, giving you direct, immediate control of all I/O signals on the PXI or PCI device. With R Series and LabVIEW FPGA, you can configure user-defined hardware for a wide variety of applications requiring precise timing and control such as:

- Data acquisition with flexible triggering and onboard processing
- High-speed analog and discrete control loops
- Pulse-width modulation (PWM) and encoder interfacing
- User-defined digital communication protocols
- Custom counters with up to 64-bit resolution
- Hardware-timed decision making at 40 MHz

Key Features

Through programming in LabVIEW FPGA, you can control each of the I/O signal lines independently or synchronize a line with other channels. You can configure the digital I/O lines as custom counter/timers, PWM channels, or communication buses for user-defined protocols. All multifunction R Series devices have dedicated analog-to-digital converters/digital-to-analog converters on every analog I/O channel. This offers specialized functionality such as multirate sampling and individual channel triggering, which are beyond the capabilities of typical data acquisition hardware. You can sample every analog input channel on an R Series device simultaneously at rates up to 750 kHz, and you can program every analog output on an R Series device to update simultaneously at rates up to 1 MHz. You can also store your compiled LabVIEW FPGA application in the onboard flash memory of any R Series device and configure it for automatic loading and/or execution at power up.

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New Virtex-5 FPGAs

The new NI PXI-784x and PXI-785x R Series modules use new Virtex-5 field-programmable gate arrays (FPGAs) with improved optimization capabilities that provide faster code execution and increased code capacity. These Virtex-5 FPGAs feature a new six-input look-up table (LUT) architecture for substantially improved resource utilization as well as DSP48 slices that make it possible for you to implement more complex digital signal processing at faster rates. Previous-generation Virtex-II FPGAs use four-input LUTs for up to 16 combinations of digital logic values. The new Virtex-5 FPGAs use six-input LUTs for up to 64 combinations, increasing the amount of logic that you can implement per slice. In addition, the slices themselves are placed in closer proximity to each other to reduce the propagation delay of electrons and increase overall execution rates. The single-cycle timed loop structure in LabVIEW FPGA takes full advantage of six-input LUTs for substantially improved resource utilization. This means you can optimize more LabVIEW FPGA code to fit within Virtex-5 FPGAs and perform more operations per clock cycle.

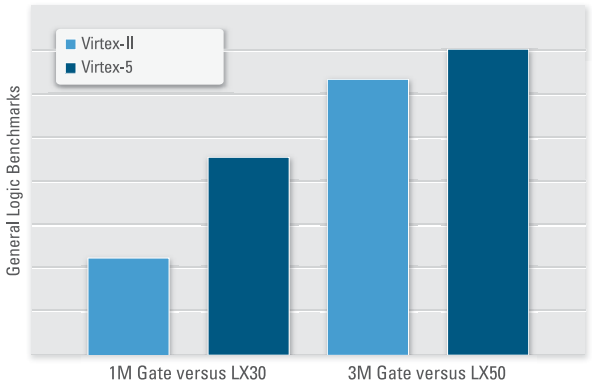


Figure 1. General logic benchmarks show that Virtex-5 FPGAs offer larger sizes when compared to Virtex-II FPGAs.

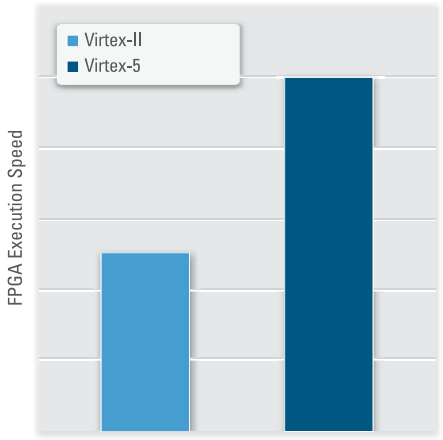


Figure2. Execution speed benchmarks show that Virtex-5 FPGAs feature faster processing capabilities when compared to Virtex-II FPGAs.

For more information on LabVIEW FPGA benchmarks for Virtex-5 FPGAs, visit **ni.com/infoand** enter lvfpgabenchmarks.

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Recommended Accessories

High Performance

SHC68-68-RMIO – High-performance shielded 68-conductor cable terminated with a VHDCI 68-pin male connector at one end and a 68-pin female 0.050 D-type connector at the other end that has been specifically designed for the multifunction I/O connector on R Series intelligent DAQ devices.

1 m..... 189588-01
2 m..... 189588-02

SHC68-68-RDIO – High-performance shielded 68-conductor cable terminated with a VHDCI 68-pin male connector at one end and a 68-pin female 0.050 D-type connector at the other end that has been specifically designed for the digital I/O connector on R Series intelligent DAQ devices.

1 m..... 191667-01

SCB-68 – Shielded I/O connector block for rugged, very low-noise signal termination for connecting to 68-pin devices. The SCB-68 also includes two general-purpose breadboard areas.

Dimensions – 19.5 by 15.2 by 4.5 cm (7.7 by 6.0 by 1.8 in.)

SCB-68 776844-01

Low Cost

SH68-C68-S – General-purpose shielded cable that connects any type of R Series connector to 68-pin connector blocks.

0.5 m.....186381-0R5
1 m..... 186381-01
2 m..... 186381-02

Custom Cabling

SHC68-NT-S – Shielded 68-conductor cable terminated with a 68-pin male VHDCI connector at one end and unterminated bare wires at the other. Use this cable, ideal for OEM applications, to create custom cabling solutions for R Series devices.

2 m..... 189041-02

NSC68-262650 – Shielded cable terminated with a VHDCI 68-pin male connector at one end and two 26-pin ribbon connectors and one 50-pin ribbon connector on the other; designed to connect the R Series MIO connector to standard ribbon cable accessories.

1 m..... 189151-01

NSC68-5050 – Shielded cable terminated with a VHDCI 68-pin male connector at one end and two 50-pin ribbon connectors on the other; designed to connect R Series RDIO connectors to standard ribbon cable accessories.

1 m..... 189152-01

Required Software for R Series Intelligent DAQ

- NI 781xR and 783xR devices require the LabVIEW FPGA Module 7.1 or later, and NI-RIO driver software 1.3 or later.
- NI 784xR and 785xR devices require the LabVIEW FPGA Module 8.5.1 or later, and NI-RIO driver software 2.4 or later.

Ordering Information

PCI

NI PCI-7813R..... 779370-01
NI PCI-7830R..... 779361-01
NI PCI-7831R..... 778797-01
NI PCI-7833R..... 779359-01

PXI

NI PXI-7811R..... 778800-01
NI PXI-7813R..... 779362-01
NI PXI-7830R..... 779364-01
NI PXI-7831R..... 778668-01
NI PXI-7833R..... 779360-01
NI PXI-7841R..... 780337-01
NI PXI-7842R..... 780338-01
NI PXI-7851R..... 780339-01
NI PXI-7852R..... 780340-01

Includes NI-RIO driver software.

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E Series Multifunction DAQ – 12 or 16-Bit, up to 1.25 MS/s, up to 64 Analog Inputs

NI E Series

- Up to 64 analog inputs
- Up to two 16-bit analog output sat up to 1 MS/s
- Analog and digital triggering
- Up to 32 digital I/O lines (TTL/CMOS)
- Two 24-bit counter/timers
- NI measurement services software simplifies configuration and measurements
- Temperature-drift-protection circuitry
- Onboard self-calibration
- Integrated multidevice synchronization bus
- Instrument-class amplifier

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio
- SignalExpress
- Analog Waveform Editor

Measurement Services Software (included)[1]

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility
- VI Logger Lite data-logging software

Operating Systems

- Windows 7/Vista/XP/2000
- Mac OS X
- Linux®

NI recommends M Series data acquisition for improved performance and bettervalue.



Family	Bus	Analog Inputs[1]	Aggregate Sampling Rate (S/s)[2]	Input Resolution (bits)	Input Range (V)	Input Ranges	Analog Outputs	Output Resolution (bits)	Output Rate (S/s)	Digital I/O	Counter/ Timers	Triggering
Full-Featured E Series												
NI 6071E	PCI, PXI	64 SE/32 DI	1.25 MS/s	12	±10 to ±0.05	15	2	12	1 M	8	2, 24-bit	Digital, analog
NI 6070E	PCI, PXI	16 SE/8 DI	1.25 MS/s	12	±10 to ±0.05	15	2	12	1 M	8	2, 24-bit	Digital, analog
NI 6062E	PCMCIA	16 SE/8 DI	500 kS/s	12	±10 to ±0.05	15	2	12	850 k	8	2, 24-bit	Digital, analog
NI 6052E	PCI, PXI	16 SE/8 DI	333 kS/s	16	±10 to ±0.05	15	2	16	333 k	8	2, 24-bit	Digital, analog
NI 6040E	PCI, PXI	16 SE/8 DI	500/250 kS/s[3]	12	±10 to ±0.05	15	2	12	1 M	8	2, 24-bit	Digital, analog
NI 6033E	PCI	64 SE/32 DI	100 kS/s	16	±10 to ±0.1	14	0	–	–	8	2, 24-bit	Digital, analog
NI 6032E	PCI	16 SE/8 DI	100 kS/s	16	±10 to ±0.1	14	0	–	–	8	2, 24-bit	Digital, analog
NI 6031E	PCI, PXI	64 SE/32 DI	100 kS/s	16	±10 to ±0.1	14	2	16	100 k	8	2, 24-bit	Digital,analog
NI 6030E	PCI, PXI	16 SE/8 DI	100 kS/s	16	±10 to ±0.1	14	2	16	100 k	8	2, 24-bit	Digital, analog
Low-Cost E Series												
NI 6036E	PCI, PCMCIA	16 SE/8 DI	200 kS/s	16	±10 to ±0.05	4	2	16	10 k[4]	8	2, 24-bit	Digital
NI 6034E	PCI	16 SE/8 DI	200 kS/s	16	±10 to ±0.05	4	0	–	–	8	2, 24-bit	Digital
NI 6025E	PCI, PXI	16 SE/8 DI	200 kS/s	12	±10 to ±0.05	4	2	12	10 k[4]	32	2, 24-bit	Digital
NI 6024E	PCI, PCMCIA	16 SE/8 DI	200 kS/s	12	±10 to ±0.05	4	2	12	10 k[4]	8	2, 24-bit	Digital
NI 6023E	PCI	16 SE/8 DI	200 kS/s	12	±10 to ±0.05	4	0	–	–	8	2, 24-bit	Digital

[1]SE – Single-ended, DI – Differential; [2]All channels share one analog-to-digital converter; [3]Single channel and multichannel rates; [4]10 kS/s is typical when using the single DMA channel for analog output. 1 kS/s maximum when using the single DMA channel for either analog input or counter/timer operations. 1 kS/s maximum for PCMCIA DAQCard devices in all cases.

Table 1. E Series Selection Guide

Product Description

National Instruments E Series data acquisition devices were introduced in 1995 and set the standard for data acquisition. However, new M Series boards now deliver higher performance, more features, and better accuracy for a lower price. Consider M Series data acquisition products for USB, PCI, PCI Express, PXI, or PXI Express data acquisition applications requiring up to 80 analog input channels, up to 18-bit resolution, up to 48 digital I/O lines, up to 1.25 MS/s sampling rates, and integrated digital isolation.

E Series	M Series	Similar price, and you get …
NI 6071E NI 6070E	NI 625x	16-bit analog input/output, faster analog output
NI 6052E	NI 628x	Faster analog input/output, 18-bit analog input
NI 6040E NI 6062E	NI 625x	Faster, 16-bit analog input/output
NI 6033E NI 6032E NI 6031E NI 6030E	NI 628x	Faster analog input/output, 18-bit analog input
NI 6036E NI 6034E NI 6025E NI 6024E NI 6023E	NI 622x	Faster, 16-bit analog input/output

Table 2. Recommended Migration Path from E Series to M Series

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Analog Input	Analog Output	Digital I/O	CTR	General
5X better AI calibration (NI-MCal)	Up to 4 channels	Correlated, clocked DIO up to 10 MHz	Two 32-bit, 80 MHz clock	Optional extended warranty
2-year calibration interval (625x/628x)	Programmable offsets and ranges	Up to 48 digital I/O	Quadrature encoder support	More routing options (16 PFI, 8 RTSI)
Up to 80 channels	2.8 MS/s waveform generation	20 V protection on DIO lines	PFI/RTSI debouncing filters	6 DMA channels
4X better resolution (18-bit ADC)	±10 V or 0 to 20 mA	More current sink and source	Frequency generator	USB, PCI Express, PXI Express
Programmable lowpass filters	–	5 V TTL/CMOS or 24 V logic	–	Phase-locked looping (PLL)
±10 V or ±20 mA inputs	–	Programmable power-up states	–	USB signal streaming

Table 3. Feaures Added by Upgrading to M Series

NI Measurement Services Software

NI measurement services, built around NI-DAQmx, controls every aspect of your DAQ system, from configuration to programming to low-level OS and device control. NI measurement services includes:

- NI-DAQmx multithreaded device driver
- Automatic code generation from a configuration screen
- Analog, digital, and counter/timer test panels
- Pinpoint error diagnostics
- Scaling to real-world units
- Advance calibration
- VI Logger Lite data-logging software

Recommended Accessories

Signal conditioning is required for sensor measurements or voltage inputs greater than 10 V. National Instruments SCXI is a versatile, high-performance signal conditioning platform, intended for high-channel-count applications. NI SCC products provide portable, flexible signal conditioning options on a per-channel basis. Both signal conditioning platforms are designed to increase the performance and reliability of your DAQ system, and are up to 10X more accurate than terminal blocks (visit **ni.com/signalconditioning** for more details). See Table 4 for more information.

Ordering Information

PCI

NI PCI-6071E	777515-01
NI PCI-6070E	777305-01
NI PCI-6052E	777745-01
NI PCI-6040E	777383-01
NI PCI-6033E	777516-01
NI PCI-6032E	777422-01
NI PCI-6031E	777514-01
NI PCI-6030E	777384-01
NI PCI-6036E	778465-01
NI PCI-6034E	778075-01
NI PCI-6025E	777744-01
NI PCI-6024E	777743-01
NI PCI-6023E	777742-01

PXI

NI PXI-6071E	777676-01
NI PXI-6070E	777060-01
NI PXI-6052E	777962-01
NI PXI-6040E	777484-01
NI PXI-6031E	777636-01
NI PXI-6030E	777555-01
NI PXI-6025E	777798-01

PCMCIA

NI DAQCard-6062E[1]	777976-01
NI DAQCard-6036E[1]	778561-01
NI DAQCard-6024E[1]	778269-01

[1]Windows only.
Includes NI-DAQmx driver software.

For more information on extended warranty and value-added services, visit ni.com/services.

Model	Cable		Signal Connectivity			
			Sensors/Signals >10 V		Signals <10 V	
	Low-Cost Ribbon	Noise-Reducing	Low-Cost Portable	High-Performance	Low-Cost Unshielded	Noise-Reducing
NI 6071E, NI 6031E NI 6033E, NI 6025E	–	SH1006868	SCC	SCXI	–	SCB-100
NI 6062E DAQCard-6024E DAQCard-6036E	RC68-68	SHC68-68-EP	SCC	SCXI	CB-68LP	SCB-68[2]
NI 6070E[1], NI 6023E NI 6052E[1] NI 6040E, PCI-6036E NI 6034E, PCI-6024E	RC68-68	SHC68-68-EP	SCC	SCXI	CB-68LP	SCB-68[2]

[1]These devices also have integrated BNC connectivity options.

Table 4. E Series Accessory Selection Guide

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Handheld and USB Data Acquisition – 12 to 24-Bit, up to 1.25 MS/s, up to 16 Analog Inputs

NI Handheld and USB DAQ

- Up to 32 analog inputs, sampling at up to 1.25 MS/s
- 12 to 24-bit input resolution
- Up to 48 digital I/O lines
- USB and CompactFlash products
- Built-in signal connectivity on most products
- Integrated signal conditioning such as isolation, on some products
- Multifunction and single-function
- Self and bus-powered
- OEM versions available

Operating Systems

- Windows 7/Vista/XP/2000
- Mac OS X
- Linux®
- Windows Mobile for Pocket PC

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger
- SignalExpress

Measurement Services Software (included)[1]

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility
- VI Logger Lite data-logging software



Product	Bus	Analog Inputs[1]	Input Resolution (bits)	Max Aggregate Sampling Rate (S/s)	Max Input Range(V)	Integrated Signal Conditioning[2]	Analog Outputs	Output Resolution (bits)	Output Rate (S/s)	Max Output Range (V)	Digital I/O	Counter/ Timers	Power Source
USB-6259	USB	32 SE/16 DI	16	1.25 M	±10	–	4	16	2.8 M	±10	48 (32 at 1 MHz)	2	External
USB-6251	USB	16 SE/8 DI	16	1.25 M	±10	–	2	16	2.8 M	±10	24 (8 at 1 MHz)	2	External
USB-6229	USB	32 SE/16 DI	16	250 k	±10	–	4	16	833 k	±10	48 (8 at 1 MHz)	2	External
USB-6225	USB	80 SE/40 DI	16	250 k	±1	–	2	16	833 k	±1	24 (8 at 1MHz)	2	External
USB-6221	USB	16 SE/8 DI	16	250 k	±10	–	2	16	833 k	±10	24 (8 at 1 MHz)	2	External
USB-6218	USB	32 SE/16 DI	16	250 k	±10	CAT I, 60 V, ISO	2	16	250 k	±10	8 DI/8 DO	2	Bus
USB-6216	USB	16 SE/8 DI	16	400 k	±1	CAT I, 60 V, ISO	2	16	250 k	±1	32 DIO	2	Bus
USB-6215	USB	16 SE/8 DI	16	250 k	±10	CAT I, 60 V, ISO	2	16	250 k	±10	4 DI/4 DO	2	Bus
USB-6212	USB	16 SE/8 DI	16	400 k	±1	–	2	16	250 k	±1	32 DIO	2	Bus
USB-6211	USB	16 SE/8 DI	16	250 k	±10	–	2	16	250 k	±10	4 DI/4 DO	2	Bus
USB-6210	USB	16 SE/8 DI	16	250 k	±10	–	–	–	–	± –	4 DI/4 DO	2	Bus
USB-9233	USB	4 SE	24	50 k/ch	±5	SS, IEPE	–	–	–	–	–	–	Bus
USB-9221	USB	8 SE	12	800 k	±60	High-voltage attenuation, isolation	–	–	–	–	–	–	Bus
USB-9201	USB	8 SE	12	500 k	±10	Isolation	–	–	–	–	–	–	Bus
USB-9215A	USB	4 DI	16	100 k/ch	±10	SSH, isolation	–	–	–	–	–	–	Bus
USB-9215[3]	USB	4 DI	16	20 k	±10	SSH, isolation	–	–	–	–	–	–	Bus
USB-9211A	USB	4 DI	24	12	±0.08	TC, isolation	–	–	–	–	–	–	Bus
USB-9211[3]	USB	4 DI	24	12	±0.08	TC, isolation	–	–	–	–	–	–	Bus
USB-6009	USB	8 SE/4 DI	14	48 k	±10	–	2	12	150	+5	12	1	Bus
USB-6008	USB	8 SE/4 DI	12	10 k	±10	–	2	12	150	+5	12	1	Bus
CF-6004[4]	Compact Flash	4 SE	14	200 k	±5	–	–	–	–	–	4	–	Bus

[1]SE = Single Ended, DI = Differential; [2]SS = Simultaneous Sampling, SSH = Simultaneous Sample-and-Hold, TC = Thermocouple Inputs, IEPE = Integrated Electronic Piezoelectric; [3]Mac OS X and Linux only device; [4]For Pocket PC/Windows Mobile/Windows CE handheld devices.

Table 1. Handheld and USB DAQ Selection Guide

Product Description

National Instruments USB and handheld data acquisition devices provide superior measurement capabilities for space-constrained or mobile applications using desktop, laptop PCs, PDAs,or other portable computing devices. These devices range from basic functionality with the NI USB-600x devices to high performance with the new USB high-speed M Series USB-6259. Many devices also are available in special kits for OEMs.

Key Features

- Plug-and-play connectivity for quick and easy setup
- Up to 1.25 MS/s
- Waveform output
- Bus-powered devices available for high mobility
- Small size for portability
- 12 to 24-bit analog input resolution
- Integrated signal conditioning on all USB-92xx devices
- DAQ Assistant for rapid prototyping
- FREE data-logging software

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NI Measurement Services Software

NI-DAQmx is the high-performance, multithreaded driver at the heart of the measurement services software included with National Instruments DAQ devices. Additional measurement services software shipped with NI-DAQmx include Measurement & Automation Explorer (MAX) for configuring, interacting with, and testing your hardware; DAQ Assistant for creating configuration-based data acquisition tasks; and VI Logger Lite, software specifically designed for data logging. Collectively, these measurement services provide more power, flexibility, and ease of use than any basic device driver software.

NI-DAQmx Base Driver Software

NI-DAQmx Base (available at **ni.com/downloads**) offers Mac OS X, Linux®, and Pocket PC users a programming interface similar to NI-DAQmx. It includes ready-to-run LabVIEW VIs and C function examples similar to those included in NI-DAQmx driver software.

Recommended Accessories

National Instruments offers a variety of connectivity options based on the needs of your application. For your convenience, many portable data acquisition devices, such as some of the USB modules, have integrated screw terminals. For mass termination USB modules and the CF-6004, NI offers low-cost, portable connectivity options and high-performance, noise-reducing options. See Tables 2 and 3 for recommended accessories for each device.

	Cable		Signal Connectivity		
			Sensors/	Signals <10 V	
Model	Low-Cost Ribbon	Noise-Reducing	Signals >10 V	Low-Cost	Noise-Reducing
Mass Termination USB M Series	R6868	SH68-68-EP	SCC	CB-68LP	SCC-68

Table 2. USB DAQ Accessory Selection Guide

	Cable		Signal Connectivity	
Model	Shielded, bare wires	Shielded, D-Sub connector	DIN-rail mountable	Compact, shielded
CF-6004	SH-15-15-B	SH-15-15	CB-15	SCB-15

Table 3. CompactFlash DAQ Accessory Selection Guide

Ordering Information

USB – M Series

High-Speed
- NI USB-6259
  - Screw terminal ..... 779627-0P[1]
  - Mass terminal ..... 779695-0P[1]
- NI USB-6251
  - Screw terminal ..... 779628-0P[1]
  - Mass terminal ..... 779695-0P[1]

Low-Cost
- NI USB-6229 ..... 779810-0P[1]
- NI USB-6225
  - Screw terminal 779973-0P
  - Mass terminal 779974-0P
- NI USB-6221 ..... 779808-0P[1]

[1]P is 1 (U.S.120 VAC); 2 (Swiss 220 VAC); 3 (Australian 240 VAC); 4 (Universal Euro 240 VAC); 6 (UK 240 VAC), 7 (Japanese 100 VAC)
Includes data acquisition driver software, 1 m USB cable, and AC adapter.

Bus-Powered
- NI USB-6210 779675-01
- NI USB-6211 779676-01
- NI USB-6212
  - Screw terminal 780107-01
  - Mass terminal 780169-01
- NI USB-6215 779677-01
- NI USB-6216
  - Screw terminal 780108-01
  - Mass terminal 780170-01
- NI USB-6218 779678-01

Includes data acquisition driver software and 1 m USB cable.

USB – Signal Conditioning

- NI USB-9233 779365-01
- NI USB-9221
  - Screw terminal 779439-01
  - D-Sub connector 779440-01
- NI USB-9215A (Windows)
  - Screw terminal 779434-01
  - BNC terminal 779435-01
- NI USB-9215 (Mac OS/Linux)[2] 778977-01
- NI USB-9211A (Windows) 779436-01
- NI USB-9211 (Mac OS/Linux)[2] 778976-01
- NI USB-9201
  - Screw terminal 779437-01
  - D-Sub connector 779438-01

[2]Requires NI-DAQmx Base driver software.Includes data acquisition driver software and 1 m USB cable.

USB – Signal Conditioning

- NI USB-6009 779026-01
- NI USB-6008 779051-01

Includes data acquisition driver software and 1 m USB cable.

CompactFlash

- NI CF-6004 779174-01

Accessories

- BP-1 rechargeable battery pack for USB M Series
  - 120 VAC charger 776896-01
  - 230 VAC charger 776896-31
- Strain relief for DAQCard devices 777550-01
- NI USB-6008/09 accessory kit 779371-01
- NI USB-6008/09 prototyping kit 779511-01

For more information on extended warranty and value-added service, visit ni.com/service.

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NI Data Acquisition for OEMs

- Competitive quantity pricing
- Free evaluation kits available
- Detailed driver and register-level documentation
- Application support/training
- Extended warranties

Operating Systems

- Windows 7/Vista/XP/2000
- Linux®
- Mac OS X
- QNX, VxWorks
- Palm OS/Pocket PC
- Others via NI Measurement Hardware DDK

Programming Languages

- C/C++/C# (.NET)
- Visual Basic
- LabVIEW

Driver Software

- NI-DAQmx



Product	Bus	Analog Inputs[1]	Input Resolution (bits)	Max Aggregate Sampling Rate (S/s)	Max Input Range(V)	Integrated Signal Conditioning[2]	Analog Outputs	Output Resolution (bits)	Output Rate (S/s)	Max Output Range (V)	Digital I/O	Counter/ Timers	Power Source
USB-6259 OEM	USB	32 SE/16 DI	16	1.25 M	±10	–	4	16	2.8 M	±10	48	2	External
USB-6251 OEM	USB	16 SE/8 DI	16	1.25 M	±10	–	2	16	2.8 M	±10	24	2	External
USB-6009 OEM	USB	8 SE/4 DI	14	48 k	±10	–	2	12	150	+5	12	1	Bus
USB-6008 OEM	USB	8 SE/4 DI	12	10 k	±10	–	2	12	150	+5	12	1	Bus
PCI-6221 (37-Pin)	PCI	16 SE/8 DI	16	250 k	±10	–	2	16	833 k	±10	10	2	Bus
PCI-6010	PCI	16 SE/8 DI	16	200/33 k[3]	±10	–	2	16	Static	±5	10	3	Bus
USB-6501	USB	–	–	–	–	–	–	–	–	–	24	1	Bus
USB-6211 OEM	USB	16 SE/8 DI	16	250 k	±10	-	2	16	250 k	±10	4 DI/4 DO	2	Bus
USB-6212 OEM	USB	16 SE/8 DI	16	400 k	±10	-	2	16	250 k	±10	32	2	Bus
USB-6216 OEM	USB	16 SE/8 DI	16	400 k	±10	CAT I, 60 V, ISO	2	16	250 k	±10	32	2	Bus
USB-6218 OEM	USB	32 SE/16DI	16	4250 k	±10	CAT I, 60 V, ISO	2	16	250 k	±10	8 DI/8 DO	2	Bus
USB-6229 OEM	USB	32 SE/16DI	16	4250 k	±10	-	4	16	833 k	±10	48 (32 at 1MHz)	2	External
USB-6225 OEM	USB	80 SE/ 40 DI	16	250 k	±10	-	2	16	833 k	±10	24 (8 at 1MHz)	2	External
USB-6255 OEM	USB	80 SE/ 40 DI	16	1.25 M/750 k[3]	±10	-	2	16	2.8 M	±10	24 (8 at 1MHz)	2	External
USB-6289 OEM	USB	32 SE/16DI	18	625/500 k[3]	±10	-	4	16	2.8 M	±10	48 (32 at 1MHz)	2	External
USB-6281 OEM	USB	16 SE/8 DI	18	625/500 k[3]	±10	-	2	16	2.8 M	±10	24 (8 at 1MHz)	2	External

[1]SE = Single Ended, DI = Differential; [2]SS = Simultaneous Sampling, SSH = Simultaneous Sample-and-Hold; [3]Single-Channel/Multichannel

Table 1. OEM Data Acquisition Devices Selection Guide

Overview

By providing competitive quality discount pricing and top-notch application support, National Instruments is a leading worldwide OEM supplier of data acquisition and other measurement and automation products. NI recognizes that OEMs have different needs from end-user customers. OEMs need cost-effective, high-quality, stable products and experienced support that helps them get to market faster and stay there longer.

A market leader in PC-based data acquisition and modular instrumentation, NI offers the most complete family of data acquisition and I/O devices for PCI, PCI Express, CompactPCI, PXI, PXI Express, PCMCIA, USB, and CompactFlash, with OEM drivers for Windows, Win CE, Mac OS X, Linux, and other OSs. For custom designs, you can also incorporate NI data acquisition products by licensing hardware designs.

Support

NI OEM customers benefit from FREE phone support, product lifetime assurance, expedited repair service, and periodic design reviews to maximize product efficiency.

Pricing

OEM customers can take advantage of aggressive OEM price discounts on NI products.

Customization

In some cases, NI can modify products to meet OEM needs. More than 10 percent of NI product designs are based on customer requests. Ask about special OEM variations of standard NI products.

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Time to Market and Long-Term Support

National Instruments data acquisition products deliver quality, ease of use, and competitive quantity pricing for OEM applications. Therefore, you can achieve shorter time to market with NI components that are cost-effective long-term solutions. National Instruments can support your application with specialized training, consulting services, and local support. Because of National Instruments global manufacturing operations and product lifetime commitments, you can be assured of the availability and deliverability of NI data acquisition products now and in the future. NI also offers expedited repair service for OEM customers, with repair facilities in the U.S. and Europe.

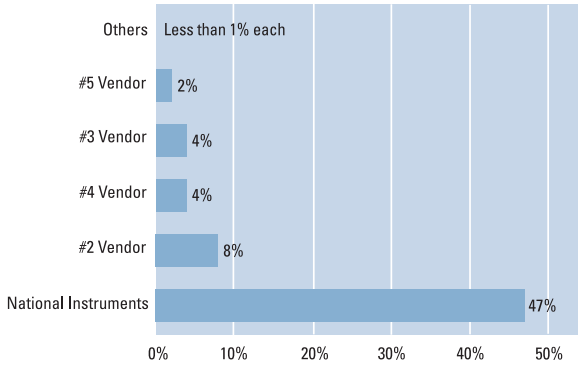


Figure 1. Preferred Vendor for Data Acquisition (based on July 2006 survey by Sensors magazine readers (www.sensorsmag.com))

The National Instruments OEM Elite Program

National Instruments is a leading worldwide OEM supplier of data acquisition, GPIB, and other products for measurement and automation. NI recognizes that OEMs need products and support that they can trust to get to market quickly with a high-quality product. But they also need cost-effective products for large deployment. NI has designed the OEM Elite Program with OEM needs in mind. Elite Program members enjoy benefits such as:

- FREE elite support
- Periodic design reviews
- Product customization
- OEM pricing
- Roadmap discussions (under a nondisclosure agreement)

For more information about the OEM Elite Program and how to join, visit ni.com/oem.



Ordering Information

USB M Series DAQ for OEM

NI USB-6259 OEM	194929-01
NI USB-6251 OEM	194929-03
USB-6211 OEM	196203-03
USB-6212 OEM	197504-03
USB-6216 OEM	197504-01
USB-6218 OEM	196203-01
USB-6229 OEM	195959-01
USB-6225 OEM	197294-01
USB-6255 OEM	197201-01
USB-6289 OEM	197596-01
USB-6281 OEM	197596-03

USB Low-Cost DAQ for OEM

NI USB-6009 OEM	779026-01
NI USB-6008 OEM	779051-01

PCI DAQ for OEM

NI PCI-6221 (37-Pin)	779618-01
NI PCI-6010	779348-01
NI PCI-6010 50-Board Package	779348-50

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Analog Output Overview

Analog Output

National Instruments analog voltage and current output devices cover a full spectrum of applications from basic software-timed output to complex high-speed waveform generation.

Analog output (AO) is accomplished using a digital-to-analog converter (DAC). In hardware, the DAC is given a binary value, which it converts to an analog level that is within a given voltage or current range. A common voltage range is ±10 V. DACs come with set resolution – commonly 12 or 16 bits. A 12-bit DAC can produce 4,096 voltage steps within its range. A 16-bit DAC can produce 65,536. Taking advantage of NI measurement services software, you can define named analog output channels and update their values based on voltage levels or other defined engineering scales.

AO capabilities fall into two categories – software-timed analog output and high-speed waveform generation.

Software-Timed Outputs

All National Instruments AO devices can generate software-timed single-point values. Software-timed updates are typical for nondeterministic control applications. NI 6704 devices, for example, are software-timed devices that feature 32 channels of 16-bit AO that are updated by software commands. NI 672x devices offer simultaneous software-timed single-point updates across many channels for control applications.

Waveform Generation

Select AO devices are capable of high-speed or waveform output, and can offer performance similar to an arbitrary waveform generator. Such devices typically have a FIFO and use DMA, so they can perform waveform generation at high rates without deep onboard memory. For example, NI 671x, NI 672x, and NI 673x devices use both FIFOs and DMA to generate dynamic signals. You can use high-speed updates to generate simple waveforms, such as sine, square, and triangle waves, or more complex user-defined waveforms.



AO devices come in several configurations including options such as channel count, resolution, update speed, output voltage range, digital I/O lines, and counter/timers.

Applications for waveform generation AO include stimulus for circuit testing, automotive component testing, audio signal generation, stimulus for vibration testing, and much more.

Multidevice Synchronization

Each AO device offers integration technologies such as the RTSI bus, PXI trigger bus, and PFI pins to trigger and synchronize to a wide variety of I/O types. These I/O types range from image acquisition, motion control, and high-speed digitizers to multifunction data acquisition (DAQ) devices. Using these integration infrastructures, engineers/scientists can create powerful, custom test systems with ease.

Real-Time Control

You can use AO devices with LabVIEW Real-Time to deliver real-time, deterministic control loop execution. You can integrate these densely packed AO device scan be integrated with other DAQ devices to serve a wide range of control needs.

Product	Bus	Analog Outputs	Output Resolution	Update Rate (S/s)	Maximum Output Range	Digital I/O	Counter/ Timers	Current Source	Triggers
NI 6733	PCI, PXI	8	16 bits	740 k to 1 M[1]	±10 V	8[3]	2, 24-bit	–	✓
NI 6731	PCI	4	16 bits	1 M	±10 V	8[3]	2, 24-bit	–	✓
NI 6713	PCI, PXI	8	12 bits	740 k to 1 M[1]	±10 V	8	2, 24-bit	–	✓
NI 6715	PCMCIA	8	12 bits	100 k to 1 M[1]	±10 V	8	2, 24-bit	–	✓
NI 6711	PCI, PXI	4	12 bits	1 M	±10 V	8	2, 24-bit	–	✓
NI 6723	PCI, PXI	32	13 bits	45 to 800 k[1]	±10 V	8	2, 24-bit	–	✓
NI 6722	PCI, PXI	8	13 bits	182 to 800 k[1]	±10 V	8	2, 24-bit	–	✓
NI 6704	PCI, PXI	32[4]	16 bits	Static	±10 V, 0 to 20 mA[2]	8	–	✓	–
NI 6703	PCI	16	16 bits	Static	±10 V	8	–	–	–

[1]Maximum update rate can vary with the number of channels used. [2]The current output varies when set between 0 and 100 µA. [3]Static DIO or high-speed pattern generation and acquisition.
[4]16 voltage and 16 current channels.

Table 1. Analog Voltage and Current Output Product Selection Guide

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High-Speed Voltage Output – up to 1 MS/s/Channel, up to 16-Bit, up to 32 Channels

NI 673x, NI 671x, NI 672x

- Low-cost arbitrary waveform generation
- High channel density
- Integrated multidevice synchronization bus
- Easy real-time control with LabVIEW Real-Time
- Digital triggering and external clocking
- Simultaneous updates
- 8 digital I/O lines (TTL/CMOS)
- Two 24-bit counter/timers
- NI measurement services software simplifies configuration and measurements

Operating Systems

- Windows 7/Vista/XP/2000
- Mac OS X
- Linux

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio
- SignalExpress
- Analog Waveform Editor

Other Compatible Software

- Visual Studio .NET
- Visual Basic, C/C++, C#

Measurement Services Software (included)[1]

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility



Family	Bus	Analog Outputs	Update Rate Per Channel (S/s)[1]	Output Resolution	Maximum Output Range (V)	External Voltage Reference	Digital I/O	Timers	Counters/ Triggering
NI 6733	PCI, PXI	8	740 k to 1 M	16	±10	✓	8[2]	2, 24-bit	Digital
NI 6731	PCI	4	1 M	16	±10	✓	8[2]	2, 24-bit	Digital
NI 6713	PCI, PXI	8	740 k to 1 M	12	±10	✓	8	2, 24-bit	Digital
NI 6715	PCMCIA	8	100 k to 1 M	12	±10	✓	8	2, 24-bit	Digital
NI 6711	PCI, PXI	4	1 M	12	±10	✓	8	2, 24-bit	Digital
NI 6723	PCI, PXI	32	45 k to 800 k	13	±10	–	8	2, 24-bit	Digital
NI 6722	PCI, PXI	8	182 k to 800 k	13	±10	–	8	2, 24-bit	Digital

[1]Update rate can vary depending on the number of channels used. [2]Static or hardware-timed pattern generation and acquisition up to 10 MHz.

Table 1. High-Speed Voltage Output Product Selection Guide

Product Description

National Instruments high-speed voltage output modules combine the latest in commercial technologies to deliver simultaneous, multichannel updates for control and waveform output applications.

Recommended Accessories

National Instruments offers a variety of connectivity options, such as connector blocks with BNC connectivity for signals that need shielding and are connected and disconnected often, and shielding in the connector block and the cabling for superior accuracy in noisy environments. If budget is your main concern, we offer low-cost unshielded cables and connector blocks.

Model	Shielding	Connect to …	Cable	Accessory
NI 673x, PCI-671x, PXI-671x	Shielded	BNC	SH68-68-EP	BNC-2110
		Screw terminals	SH68-68-EP	SCB-68 or TBX-68
		Screw terminals	–	TB-2705 (PXI)
		Custom	SH68-68-EP	CA-1000
	Unshielded	Screw terminals	R6868	CB-68LP or CB-68LPR
NI 6723	Shielded	BNC	2 SH68-C68-S	BNC-2110 and BNC-2115
		Screw terminals	2 SH68-C68-S	2 SCB-68 or TBX-68
		Custom	2 SH68-C68-S	2 CA-1000
NI 6722	Shielded	BNC	SH68-C68-S	BNC-2110
		Screw terminals	SH68-C68-S	SCB-68
		Custom	SH68-C68-S	CA-1000
	Unshielded	Screw terminals	RC68-68	CB-68 LP or CB-68LPR
DAQCard -6715	Shielded	BNC	SHC68-68-EPM	BNC-2110
		Screw terminals	SHC68-68-EPM	SCB-68
		Custom	SHC68-68-EPM	CA-1000
	Unshielded	Screw terminals	RC68-68	CB-68LP or CB-68LPR

Table 2. USB DAQ Accessory Selection Guide

Ordering Information

PCI

NI PCI-6711 777740-01
NI PCI-6713 777741-01
NI PCI-6722 778705-01
NI PCI-6723 778701-01
NI PCI-6731 778511-01
NI PCI-6733 778510-01

PXI

NI PXI-6711 777794-01
NI PXI-6713 777795-01
NI PXI-6722 778999-01
NI PXI-6723 778998-01
NI PXI-6733 778512-01

PCMCIA

NI DAQCard-6715 778146-01

Includes NI-DAQmx driver software.

For more information on extended warranty and value-addedservices, visit ni.com/services.

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Software-Timed Analog Output – 16-Bit, 16 or 32 Channels

NI 670x

- 16 voltage and 16 current outputs
- 16-bit resolution
- 8 (5 V TTL/CMOS) lines
- User-defined power-up states
- Measurement services that simplify configuration and measurements

Operating Systems

- Windows 7/Vista/XP/2000

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio

Other Compatible Software

- Visual Studio .NET
- Visual Basic, C/C++, and C#

Measurement Services Software (included)

- NI-DAQmx driver
- Measurement & Automation Explorer configuration utility

Calibration Certificate Available



Product	Bus	Analog Outputs	Resolution	Output Rate	Output Range	Digital I/O	Counter/Timers	Current Sinks	Triggers
NI 6703	PCI	16 voltage	16 bits	Static	±10 V	8	–	–	–
NI 6704	PCI	16 voltage	16 bits	Static	±10 V,	8	–	3	–
	PXI	16 current			0 to 20 mA[1]				

1The current output varies when set between 0 and 100 µA.

Table 1. Channel, Speed, and Resolution Specifications

Overview

NI 670x devices are software-timed voltage and current output devices for PCI and PXI. With NI 6704 devices, you get 16 voltage outputs and 16 current outputs that you can use at the same time independently, as well as eight digital I/O (DIO) lines. You can independently set each output from ±10 V or 0 to 20 mA. The NI 6703 delivers 16 voltage outputs in addition to eight DIO lines.

Hardware

Voltage Output Channels All 16 voltage outputs on the NI 6703 and NI 6704 are identical. You can set each channel for a bipolar voltage output of ±10 V. Each output is accurate to ±1 mV.

I/O Connector

The analog outputs are available at a 68-pin SCSI II shielded connector. VCH<0..15> are the voltage output channels. ICH<16..31> are the current output channels. Each channel is referenced to a ground line, AO GND<0...31>, which is shared between a voltage and current channel. A fused 5 VDC power signal from the PCI or PXI bus is available at the I/O connector as well.

Recommended Accessories

National Instruments offers a variety of connectivity options based on the needs of your application. Shielding in the connector block and the cabling facilities superior accuracy by rejecting noise and other environmental factors. If budget is your main concern, we offer low-cost unshielded cables and connector blocks.

Model	Shielding	Connected to..	Cable	Accessory
NI 6703	Shielded	Screw terminals	SH68-68-D1	SCB-68
NI 6704		Custom	SH68-68-D1	CA-1000
	Unshielded	Screw terminals	R6868	CB-68LP or CB-68LPR

Ordering Information

PCI

NI PCI-6704..... 777306-01
NI PCI-6703..... 778316-01

PXI

NI PXI-6704..... 777796-01

Includes data acquisition driver software.

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Digital I/O Overview

Digital I/O devices are used in a wide variety of applications from automotive designs, industrial factory automation, and machine control to aerospace, laboratory research, and biomedical applications. You can connect NI digital I/O devices to limit and proximity switches, photoelectric sensors, level gauges, pressure switches, gas detectors, pumps, motors, solid-state relays, electromechanical relays, digital data buses, and more.
You can install NI digital I/O devices in desktop or industrial computers with the PCI or ISA bus, connect them via USB, or install them in laptop computers with PCMCIA slots. For improved reliability and mechanical ruggedness, NI offers PXI/CompactPCI digital I/O modules.



Choose Your Digital I/O Hardware

Software-Timed

Software-timed digital I/O – also referred to as unstrobed or static digital I/O – implies that the writing to digital output lines and reading from digital input lines is performed by software command. The maximum speed for software-timed digital I/O operations depends on the computer processor speed, communication bus, and operating system.

Hardware-Timed

Hardware-timed digital I/O – also referred to as high-speed digital I/O – implies that the writing and reading of digital lines is controlled by an external or internally generated clock signal. The clock signal latches the digital data into or out of a buffer, which can be streamed at high speed to the computer.

Isolation

Industrial applications often involve sensors and actuators that can cause ground loops in your system because they work at different voltage levels. Ground loops can damage the data acquisition system and ruin measurement reliability. To improve performance and protect circuitry, make sure you have some form of isolation. Bank isolation isolates circuitry on the module in banks of eight channels. Channel-to-channel isolation ensures that every channel on the module has a separate ground line. Both types of isolation include system-to-channel isolation, which protects the computer in case of damage to the plug-in digital I/O device.

Voltage Range

Your digital I/O device must meet the operating voltage levels of your sensors and actuators. Typical ranges are 5, 30, 60, and 240 VDC.

Logic Levels

Depending on the voltage thresholds that the digital I/O device uses to differentiate between a high or a low signal, your application may use 3.3 V, 5 V, TTL, CMOS, or 24 V logic levels. The IEC-61131-2 defined 24 V logic levels are very popular for industrial sensors. 5 V, TTL, and CMOS logic levels are used in most laboratory and research applications.

Sink/Source Output

Depending on whether your sensor or actuator needs the digital I/O device to provide a path for current to ground or needs to provide power/positive potential, you should choose a device that has sinking or sourcing outputs.

Maximum Current Drive

If you connect your device to actuators that draw a high current, you need to know the maximum current drive that the digital I/O device can provide. Typical ranges include 2, 24, 150, 300 mA, 2 A, and higher.

Industrial Feature Set

NI digital I/O devices have specialized industrial features with NI-DAQmx technology for very high reliability:

- Programmable input filters remove pulses too small in width, effectively removing mechanical relay chatter and thus glitches and spikes in the system.
- Change detection helps trigger your application and perform a read operation after a digital event with minimal processor usage.
- Watchdog timers can detect a variety of computer fault conditions, such as an application crash, and automatically respond by setting the outputs to a user-configured safe state.
- Programmable power-up states ensure that actuators such as pumps, valves, motors, and relays begin in a known state any time you turn on the device.
- Industrial certifications from CE, FCC, C-Tick, UL, and VDE ensure EMI compliance in most regions of the world and certify that the system is safe to operate.

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Number of Channels

Your devices must provide as many digital I/O channels as required by your application. The greater your channel count per device, the lower your total system cost.

Cost/Channel

Cost is always an important factor in choosing components of a system. Cost per channel typically depends on the form of isolation and the voltage ranges on the device. Typical U.S. cost/channel is approximately $3 for devices with no isolation, $5 with bank optical isolation, and $12 with channel-to-channel isolation.

Signal Conditioning Options for NI Digital I/O Devices

For bank or channel-to-channel optical isolation NI recommends using the NI 651x and NI 652x devices, which have built-in signal conditioning with a high voltage range and optical isolation. If you need signal conditioning for NI 650x devices, you can connect them to SCXI-116x modules to provide optical bank isolation. For lower channel counts, the SC-206x accessories provide eight optically isolated inputs/outputs with channel-to-channel isolation. Another option is SSR modules, which provide channel-to-channel isolation in 8, 16, 24, or 32-channel backplanes. For electromechanical relay outputs, the NI 6520 and 6521 devices are available.

Accessories

For shielded screw-terminal connections to your 100-pin SCSI device, use the SCB-100 connector block and shielded SH100-100-F cable. Unshielded connector blocks and cables are also available such as the CB-100 kit, which includes an unshielded ribbon cable and DIN-rail-mounting terminal blocks. For custom connectivity, you can use the CA-1000 accessory enclosure for convenient connection to push button/rocker switches, banana jack cables/probes, and LED indicators.

For connectivity to NI 37-pin D-Sub devices, use the CB-37F Series connector blocks and cables.

		Product Families							
Application	Mode of Operation	NI 650x 5 V TTL/ CMOS DIO	NI 651x 30 V Bank-Isolated DIO	NI 652x 60 or 150 V Ch-Ch-Isolated DIO	PXI-25xx PXI Switches	SCXI-11xx SCXI Conditioning and Switching	NI 656x, NI-655x Digital Waveform Generator/Analyzers	NI 654x Digital Waveform Generator/Analyzers	NI 653x Pattern I/O and Handshake
Perform basic digital I/O at 5 V	Software-timed	✓	–	–	–	–	✓	✓	✓
Connect to devices with 24 V logic levels with optical isolation	Software-timed	–	✓	–	–	–	–	–	–
Connect to up to 150 V devices with channel-channel optical isolation	Software-timed	–	–	✓	–	–	–	–	–
Switch up to 240 V devices with optical isolation	Software-timed	–	–	–	✓	✓	–	–	–
Transfer data with fixed timing between points (with a clock)	Waveformor pattern I/O	✓[1]	–	–	–	–	✓	✓	✓
Set voltage levels with 10 mV resolution	Programmable voltage levels	–	–	–	–	–	✓	–	–
Transfer data where both the device under test and measurement devices can pause the transfer	Handshaking I/O	✓[1]	–	–	–	–	✓	✓	✓
Output safe states if program fails to respond after a specified time	Watchdog timer	✓[2]	✓	✓[3]	–	–	–	–	–
Run a user-defined software routine when a user-defined DIO event occurs	Change detection	✓[2]	✓	✓[3]	–	–	✓	✓	✓
Filter noise/chatter on digital signals from relays	Input filters	✓[2]	✓	✓[3]	–	–	–	–	–
Ensure user-defined output states when you boot up the computer	Power-up states	✓[2]	✓	✓[3]	–	–	✓	✓	✓

[1]NI 6508 only. [2]NI 6509 only. [3]Not applicable to NI 6527.

Table 1. Digital I/O Product Selection Guide

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Digital I/O - 5 V TTL/CMOS

NI 650x

- 24 or 96 digital input/output lines
- 5 V TTL/CMOS
- Known power-up states
- NI measurement services software simplifies configuration and measurements

Industrial Feature Set

- Programmable power-up status
- Watchdog timer
- Programmable input filters
- Change detection
- High-current drive

Operating Systems

- Windows 7/Vista/XP/NT/2000
- Mac OS X
- Linux
- LabVIEW Real-Time

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio

Measurement Services Software (included)

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility



Family	Bus	Digital I/O Lines	Counter/Timer	Device Type	Logic Level	Industrial Feature Set	Pattern Matching
NI 6509	USB, PCI, PXI	96	-	Software-timed	5 V TTL/CMOS	✓	-
NI 6503	PCI, PCMCIA, ISA	24	-	Software-timed	5 V TTL/CMOS	-	✓
NI 6501	USB	24	1	Software-timed	5 V TTL/CMOS	-	-

Table 1. NI 650x Specifications Overview

Overview and Applications

National Instruments 6509 devices offer 96 digital I/O lines for PCI and PXI. NI 6501 and 6503 devices are 24-bit parallel DIO interfaces for USB, PCI, PCMCIA, and ISA. All NI 650x devices are designed for 5 V TTL/CMOS I/O signals. NI 6509 devices offer the industrial feature set, including watchdog timers, change detection, programmable power-up states, input filters and high current drive.

Recommended Accessories

Family	Device	Accessory	Cable
NI 6509	PCI-6509	SCB-100 (776990-01) CB-100 kit (777812-01)	SH100-100-F (185095-02) Cable included in kit
NI 6503	PCI-6503 DAQCard-DIO-24 PC-DIO-24	CB-50LP (777101-01)	NB1 (180524-10) or PSH27-50F-D1 (776989-01)
NI 6501	USB-6501	USB-6501 Accessory Kit	-

Ordering Information

PCI

NI PCI-6509 778792-01
NI PCI-6509 Bundle 778936-01
NI PCI-6503 777690-01

PXI

NI PXI-6509 778858-01

ISA

NI PC-DIO-96 777271-01
NI PC-DIO-24 777368-01

PCMCIA

NI DAQCard-DIO-24 776912-01

USB

NI USB-6501 779205-01
NI USB-6509 779975-01

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Low-Cost Industrial Digital I/O – 30 V, Bank Isolated

NI 651x

- 32 or 64-bank optically isolated inputs and outputs
- ±30 VDC maximum input range
- 0 to 30 VDC maximum output range
- Direct connection to industrial sensors and actuators
- NI measurement services software for highest productivity and performance

Industrial Feature Set

- Isolation
- Programmable power-up states
- Watchdog timers
- Programmable input filters
- Change detection

Operating Systems

- Windows 7/Vista/XP/NT/2000
- LabVIEW Real-Time
- Linux®

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio

Other Compatible Software

- C, C++, C#, Visual Basic
- Microsoft Visual Studio .NET 2003

Measurement Services Software (included)

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility



Product	Bus	Input Lines	Output Lines	Isolation	Low Input Thresh. (VDC)	High Input Thresh. (VDC)	Output Current (mA)[1]	Industrial Feature Set
NI 6510	PCI	32 source/sink	–	Bank	±4	11 to 30, -11 to -30	–	✓
NI 6511	PCI, PXI	64 source/sink	–	Bank	±4	11 to 30, -11 to -30	–	✓
NI 6512	PCI, PXI	–	64 source	Bank	–	–	350 (75) source	✓
NI 6513	PCI, PXI	–	64 sink	Bank	–	–	500 (120) sink	✓
NI 6514	PCI, PXI	32 source/sink	32 source	Bank	±4	11 to 30, -11 to -30	350 (75) source	✓
NI 6515	PCI, PXI	32 source/sink	32 sink	Bank	±4	11 to 30, -11 to -30	500 (120) sink	✓
NI 6516	PCI	–	32 source	Bank	–	–	350 (75) source	✓
NI 6517	PCI	–	32 sink	Bank	–	–	475 (125) sink	✓
NI 6518	PCI	16 source/sink	16 source	Bank	±4	11 to 30, -11 to -30	350 (75) source	✓
NI 6519	PCI	16 source/sink	16 sink	Bank	±4	11 to 30, -11 to -30	475 (125) sink	✓

[1]When using all lines at a 100% duty cycle, the maximum drive current for the NI 6512, NI 6514, NI 6516, and NI 6518 is 75 mA. It is 120 mA for the NI 6513, NI 6515, NI 6517, and NI 6519. When using only one output line in each bank at a 100 percent duty cycle, the maximum drive current for the NI 6512, NI 6514, NI 6516, and NI 6518 is 350 mA. It is 500 mA for the NI 6513, NI 6515, NI 6517, and NI 6519.

Table 1. NI 650x Specifications Overview

Overview and Applications

National Instruments 651x devices are industrial 32 or 64-line isolated digital I/O interfaces for PCI and PXI/CompactPCI systems. You can wire each input bank in a source or sink configuration. You can input digital levels up to ±30 VDC and output levels from 0 to 30 VDC, with high current switching capability. NI 651x devices are ideal for general-purpose data acquisition applications, as well as industrial control and automated manufacturing test. With high current drive and isolation, you can connect the digital I/O directly to a wide array of 24 V electronic devices, sensors, and actuators.

Hardware

High-Reliability Industrial Feature Set

NI 651x devices offers a set of high-reliability features designed to automate even the most demanding applications:

- Isolation provides an extended voltage range and safe operation in industrial environments
- Programmable power-up states provide safe operation when connected to pumps/valves/motors/relays
- Digital I/O watchdogs detect computer or application errors and ensure safe recovery
- Change detection triggers your application and returns I/O data after a digital event with minimal processor usage
- Programmable input filters eliminate glitches/spikes and remove noise

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Connect Sensors Directly with Isolation

Isolation is a form of built-in signal conditioning that provides several advantages, such as an extended voltage range and direct connection to industrial sensors and actuators. Isolation also improves signal quality and protects computer circuitry. Isolation physically and electrically separates two parts of a circuit, which breaks ground loops, improves common-mode voltage and noise rejection, and permits the two parts of the circuit to be at different voltage levels. Many industrial applications require isolation to protect the electronics from transient voltage spikes and provide greater common-mode noise rejection in electrically noisy environments containing machinery and inductive loads.

Industrial Feature Set

Glitch-Free Startup with Programmable Power-Up States

With programmable power-up states, you can configure the initial output states of the digital I/O board in software to ensure glitch-free operations when connected to industrial actuators such as pumps, valves, motors, and relays. The digital I/O device holds these I/O states after receiving power, so your computer can boot and your software application can begin running.

Detect and Recover with Watchdog Timers

Watchdog timers are an innovative technology that provides protection against a wide variety of fault conditions:

- Computer crash – total OS crash
- Application crash – software application ceases to respond
- PCI bus failure – communications cease to respond; in a fault condition, outputs are set to a programmed safe state

Trigger Your Application with Change Detection

With change detection, you can monitor digital events with minimal processor usage. You can also automatically trigger your software application to perform a digital read operation upon a digital change of state. No polling is necessary because the digital I/O device generates an interrupt to automatically wake up your application.

Recommended Accessories

Family	Accessory	Cable
100-Pin Devices		
NI 6511 NI 6512 NI 6513 NI 6514 NI 6515	SCB-100 (776990-01) CB-100 kit (777812-01)	SH100-100-F (185095-02) Cable included in kit
37-Pin Devices		
NI 6510 NI 6516	CB-37F-V (778672-01) or CB-37F-H (778673-01)	SH37F-37M (778621-01) or (778621-02)
NI 6517 NI 6518 NI 6519	SH37F-P-4 (778620-04) or CB-37F-LP (779353-01) or TB-37F-37CP (779185-01) or TB-37F-37SC (779184-01)	Optional R37F-37M-1 (779195-01)

Ordering Information

PCI

NI PCI-6510	779081-01
NI PCI-6511	778966-01
NI PCI-6511 Bundle[1]	778972-01
NI PCI-6512	778968-01
NI PCI-6512 Bundle[1]	778973-01
NI PCI-6513	778970-01
NI PCI-6513 Bundle[1]	778974-01
NI PCI-6514	778836-01
NI PCI-6514 Bundle[1]	778939-01
NI PCI-6515	778835-01
NI PCI-6515 Bundle[1]	778938-01
NI PCI-6516	779082-01
NI PCI-6517	779083-01
NI PCI-6518	779084-01
NI PCI-6519	779085-01

[1]Bundles include CB-100 accessory.

PXI

NI PXI-6511	778967-01
NI PXI-6512	778969-01
NI PXI-6513	778971-01
NI PXI-6514	778965-01
NI PXI-6515	778964-01

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Low-Cost Industrial Digital I/O – 60 or 150 V, Channel-Channel Isolated

NI 652x

- SSRs switch up to 150 mA
- 8 mechanical relays switch up to 2 A
- NI measurement services software simplifies configuration and measurements

Industrial Feature Set

- Programmable power-up states
- Watchdog timers
- Programmable input filters
- Change detection
- High current drive

Operating Systems

- Windows 7/Vista/XP/NT/2000
- LabVIEW Real-Time
- Linux®

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio

Other Compatible Software

- Visual Basic
- C/C++, C#
- Microsoft Visual Studio .NET

Measurement Services Software (included)

- NI-DAQmx driver software
- Measurement & Automation Explorer



Family	Bus	Input Lines	Output Lines	Relay Type	Isolation	Input: Max Range (VDC)	Input: Low Threshold (VDC)	Input: High Threshold (VDC)	Output Current	Industrial Feature Set
NI 6529	PXI	48	-	Mechanical	Channel-channel	±60 VDC	1	3.2	-	✓
NI 6528	PCI, PXI	24	24	SSR	Channel-channel	±60	1	3.2	150 mA	✓
NI 6525	USB	8	8	SSR	Channel-channel	±60 VDC, 30 V_{rms}	-	-	500 mA	-
NI 6521	PCI, PXI	8	8	Mechanical	Channel-channel	±30 in, ±150 out	±4	±11	2 A	✓
NI 6520	PCI	8	8	Mechanical	Channel-channel	±30 in, ±60 out	±4	±11	2 A	✓

Table 1. NI 652x Selection Guide

Overview and Applications

National Instruments 6528 devices have 24 digital input and 24 solid-state relay output lines with channel-to-channel isolation and the high-reliability industrial feature set. The digital outputs of 6528 devices can switch up to ±60 VDC or 30 V_{rms} with 150 mA per channel current drive. The digital inputs of 6528 devices can sense up to ±60 VDC, with logic low from -60 to 1 VDC and logic high from 3.2 to 60 VDC.

NI 6520 and 6521 devices have eight digital input and eight nonlatching mechanical relay output lines with channel-to-channel isolation and the high-reliability industrial feature set. The CAT II UL-listed digital outputs of NI 6521 devices can switch up to 150 VDC/VAC with up to 2 A per channel current drive and a maximum power rating of 60 W per channel. NI 6520 digital outputs can switch up to 60 VDC, 30 V_{rms} with up to 2 A per channel current drive and a maximum power rating of 60 W perchannel. NI 6521 and 6520 digital inputs can sense up to ±30 VDC, with logic low from -4 to +4 VDC and logic high from -30 to -11 VDC and 11 to 30 VDC.

NI Measurement Services Software

NI-DAQmx is a high-performance, multithreaded driver at the heart of the measurement services software included with National Instruments DAQ devices. Additional measurement services shipped with NI-DAQmx include Measurement & Automation Explorer (MAX) for configuring, interacting with, and testing your hardware; and DAQ Assistant for creating configuration-based data acquisition tasks. Collectively, these measurement services provide more power, flexibility, and ease of use than any basic device driver software.

Family	Accessory	Cable
NI 6528	CB-100 kit (777812-01)	Cable included in kit
NI 6521	CB-37F-HVD (779491-01) (PXI only) TB-2621 (779444-01) TB-37F-37CP (779185-01)	SH37F-37M (778621-01) or (778621-02)
NI 6520	CB-37F-V (778672-01) or CB-37F-H (778673-01)	SH37F-37M (778621-01) or (778621-02)
	SH37F-YP-4 (778620-04) or	Optional R37F-37M-1 (779195-01)
	CB-37F-LP (779353-01) or	–
	TB-37F-37CP (779185-01) or	–
	TB-37F-37SC (779184-01)	–

Ordering Information

PCI

NI PCI-6521 779312-01
NI PCI-6520 779443-01
NI PCI-6528 778833-01

PXI

NI PXI-6521 779313-01
NI PXI-6528 778543-01
NI PXI-6529 779949-01

USB

NI USB-6525 779640-01
Includes data acquisition driver software.

For more information on extended warranty and value-added services, visit ni.com/services.

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Counter/Timer Overview

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

The NI 660x counter/timers use the NI-TIO, a National Instruments ASIC chip specifically designed to meet the counting and timing requirements of measurement applications that are beyond the capabilities of off-the-shelf components. The wider functionality and simple programming interface make the NI 660x your best choice for counting and timing applications.

Example applications include frequency measurement, position measurement, generation of retriggerable pulses, frequency shift-keying, two-signal edge separation measurements, continuous buffered event counting, and continuous buffered pulse train measurements. The NI 660x counter/timer devices are readily integrated into measurement systems that require synchronization across multiple hardware devices because they are equipped with the National Instruments PXI trigger bus or the RTSI bus.

In addition to counter/timer functionality, the NI 660x products include TTL/CMOS-compatible digital I/O ports that are bit configurable for input or output.



Counter/Timer Considerations

Number of Counter/Timers

The counter/timer is a basic unit of hardware functionality on a measurement device. The more counter/timers there are on a device, the more counting/timing operations that device can simultaneously perform. The number of DMA channels determines how many buffered, high-speed operations can be simultaneously performed.

Counter/Timer Size or Number of Bits

The counter size or number of bits indicates how high a counter can count. For example, a 32-bit counter can count up to 2^{32}-1 or 4, 294, 967, 295 before it rolls over. A high number of bits is beneficial in cases such as pulse width measurements where a wide dynamic range is required. For example, if you measure pulse widths with a 12.5 ns resolution (80 MHz timebase) using a counter/timer with 32 bits, you can measure pulse widths up to 53 s [(2^{32}-1) x 12.5 ns)] with 12.5 ns resolution.

Maximum Source Frequency

Maximum source frequency represents the speed of the fastest signal the counter can count. If you use a higher source frequency, you can achieve higher resolution. For example, an 80 MHz counter can count pulses that are 12.5 ns ($1/80 \times 10^{9}$) apart. You can use prescalers to increase the maximum source frequency for event counting and frequency measurement.

Family	Bus	Counter/ Timers	Size	Max Source Frequency	Compatibility	Digital I/O	Pulse Generation	Buffered Operations	Debouncing/ Glitch Removal	Oscillator Stability	GPS Synchr.	Buffered Operations[2]	
												DMA	Interrupt
NI 6601	PCI	4	32 bits	20 MHz[1]	5 V TTL/CMOS	Up to 32	✓	✓	✓	50 ppm	–	1	3
NI 6602	PCI PXI	8	32 bits	80 MHz[1]	5 V TTL/CMOS	Up to 32	✓	✓	✓	50 ppm	–	3	5
NI 6608	PXI	8	32 bits	80 MHz[1]	5 V TTL/CMOS	Up to 32	✓	✓	✓	75 ppb	✓	3	5
NI 6624	PCI, PXI	8	32 bits	20 MHz	TTL	0	✓	✓	✓	50 ppm	–	3	5

[1]Max Source Frequency with prescalers is 60 MHz for the NI 6601 and 125 MHz for the NI 6602 and NI 6608. These frequencies are dependent on drive strength of input signal and cable length. Consider these speeds to be the maximum. [2]DMA transfers have higher throughput than interrupt transfers.

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Signal Compatibility

Signal compatibility indicates the signal levels a counter/timer can measure or output, such as TTL/CMOS.

Buffered Operations and DMA

The National Instruments counter/timers can capture numerous data points without dead times. These types of measurements, called buffered operations, are valuable in applications that range from statistical analysis on production lines to experiments in molecular chemistry. For instance, when you configure a counter for buffered period measurement, data is moved from the counter into a buffer. Each edge that initiates a measurement also causes a transfer of the count into the buffer, as shown in Figure 1. With buffered operations, data is transferred to the computer memory using DMA or interrupts. DMA offers a considerable performance advantage; if your application requires this performance simultaneously on multiple counter/timers, you must know how many DMA channels are available on a particular counter/timer device. For example, if adevice contains three DMA channels and eight counter/timers, you can simultaneously perform three high-speed and five lower-speed, interrupt-based, buffered operations. On NI 660x devices, National Instruments implements DMA with the NI MITE chip, which is optimized for measurement applications.

Timebase Stability

Timebase stability can be important when you need to make high-quality measurements. Crystal oscillators typically form the basis of electrical circuits used to drive timing of a measurement application. In an ideal case, the oscillation frequency would be constant, but inreality, many factors influence the behavior of an oscillator. A commonly used measure of quality for an oscillator is stability.

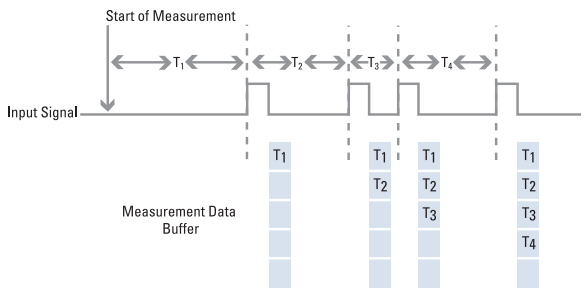


Figure 1. Buffered Period Measurement with Counter/Timers

Units used for stability are typically parts per million (ppm) and parts per billion (ppb). For example, the frequency of a 10 MHz oscillator with 10 ppm stability can be 10 MHz ±100 Hz; with 100 ppb stability it can be 10 MHz ±1 Hz.

The best technique for improving oscillator stability is to precisely control its temperature as is done in an oven-controlled crystal oscillator (OCXO). The PXI-6608 features such an oscillator.

Debouncing and Glitch Removal Noisy signals containing glitches and/or bouncing effects pose special challenges for some counter/timer measurements. Noise maybe introduced in the source of the signal, such as with electromechanical relays, or in the connection if there are strong sources of interference in the vicinity of the system. NI 660x devices contain programmable digital filters that eliminate measurement errors caused by spurious spikes and bouncing. Figure 2 shows an example of digital filtering.

Calibration

Calibration is a key component of any measurement solution. In the case of counter/timers, timebase calibration ensures that the frequency and time measurements are accurate. Calibration certificates enclosed with the National Instruments counter/timers and periodic calibration satisfy your ISO-9000 requirements, certifying that your instrument has been properly calibrated.

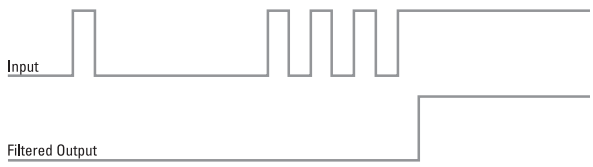


Figure 2. Debouncing and Glitch Removal

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32-Bit Counter/Timers

NI 660x, NI 6624

- Up to eight 32-bit counter/timers
- 80 MHz maximum source frequency (125 MHz with prescalers)
- Debouncing and glitch removal
- High-stability timebase (PXI-6608 only)
- GPS-based synchronization (PXI-6608 only)
- 48 V channel-to-channel isolation (NI 6624 only)
- NI measurement services software simplifies configuration and measurements

Operating Systems

- Windows 7/Vista/XP/NT/2000

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio

Measurement Services Software (included)

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility



Family	Bus	Counter/ Timers	Size (bits)	Max Source Frequency (MHz)	Max Range (V)	Optical Isolation	Digital I/O	Pulse Generation	Buffered Operations	Debouncing /Glitch Removal	Oscillator Stability	GPS Synchr	Buffered Operations[2]	
													DMA	Interrupt
NI 6601	PCI	4	32	20[1]	5	-	Up to 32	✓	✓	✓	50 ppm	-	1	3
NI 6602	PCI, PXI	8	32	80[1]	5	-	Up to 32	✓	✓	✓	50 ppm	-	3	5
NI 6608	PXI	8	32	80[1]	5	-	Up to 32	✓	✓	✓	75 ppm	✓	3	5
NI 6624	PCI, PXI	8	32	20	48	✓	-	✓	✓	✓	50 ppm	-	3	5

Table 1. NI 66xx Selection Guide

Overview and Applications

NI 660x devices are timing and digital I/O (DIO) modules for PCI and PXI. They offer up to eight 32-bit counter/timers and up to 32 lines of 5 V TTL/CMOS-compatible digital I/O at rates up to 20 MHz. You can perform a wide variety of buffered measurements or other counter/timer tasks with NI 660x devices, including position or quadrature encoder measurement, event counting, period measurement, pulse-width measurement, frequency measurement, pulse generation, and pulse-train generation. NI 6624' devices also feature high-voltage range (400 kHz I/O at 48 V) and channel-to-channel isolation for direct connection to high-voltage sensors and actuators.

Recommended Accessories

Family	DAQ Device	Accessory	Cable
NI 6601	PCI-6601	CB-68LP (777145-01)	SH68-68-D1 (183432-01)
NI 6602	PCI-6602	BNC-2121 (778289-01)	SH68-68-D1 (183432-01)
	PXI-6602	TB-2715 (778242-01)	None required
NI 6608	PXI-6608	TB-2715 (778242-01)	None required
NI 6624	PCI-6624	SCB-100 (776990-01)	SH100-100-F (185095-02)
	PXI-6624	CB-100 kit (777812-01)	Cable included in kit

Ordering Information

PCI

NI PCI-6601 777918-01
NI PCI-6602 777531-01
NI PCI-6624 778834-01

PXI

NI PXI-6602 777557-01
NI PXI-6608 777937-01
NI PXI-6624 778975-01

Includes data acquisition driver software.

For more information on extended warranty and value-added services, visit ni.com/services.

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NI Cable Design Advantages

National Instruments offers many different high-performance shielded cables that have been specially designed for specific NI multifunction DAQ devices. Each type of cable features improved signal integrity using the following technologies:

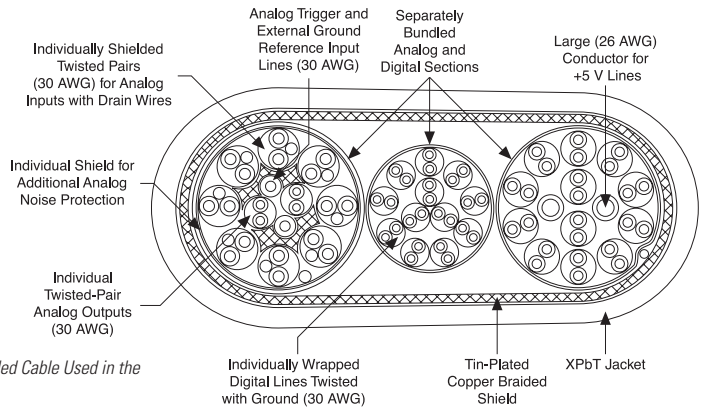


Figure 1. Enhanced-Peformance Shielded Cable Used in the SHC68-68-EPM Cable

Multifunction DAQ Accessories

M Series	Feature	Connect to …	Connector[1]	Cable[2,5]	Accessory
68-pin devices	Noise-reducing	SCC portable signal conditioning	0 or 1	SHC68-68-EPM	See page 249 or SCC-68
	Noise-reducing	SCXI high-performance signal conditioning	0 only	SHC68-68-EPM	See page 256
	Noise-reducing	Screw terminals	0 or 1	SHC68-68-EPM	SCC-68, SCB-68, or TBX-68
	Noise-reducing	Screw terminals (PXI only)	0 only	–	TB-2706
	Noise-reducing	BNC terminal block	0 or 1	SHC68-68-EPM	BNC-2110, BNC-2111, BNC-2120, or BNC-2090
	Noise-reducing	50-pin connector	0 or 1	SHC68-68-EPM[4]	50-pin accessories
	Basic shielding	Screw terminals	0 or 1	SHC68-68	SCB-68, CB-68LP, CB-68LPR
	Low-cost	Screw terminals	0 or 1	RC68-68	CB-68LP or CB-68LPR
	Custom connectivity	Board mounting connectors	0 or 1	SHC68-68-EPM	PCB mounting connectors
	Custom connectivity	68-pin female connector	0 or 1	SHC68-68M-EPM	Custom-built or third-party
	Custom connectivity	Unterminated	0 or 1	SHC68-NT-S	Custom-built or third-party
37-pin devices	150 V CAT II, DIN rail	Screw terminals	0 only	SH37F-37M	CB-37F-HVD
	High-voltage isolated	Screw terminals	0 only	DB37M-DB37F-EP[3]	CB-37F-HVD, CB-37FH, or CB-37FV
	DIN rail	Screw terminals	0 only	SH37F-37M or R37F-37M-1	CB-37FH or CB-37FV
	Custom connectivity	Unterminated	0 only	SH37F-P-4	Custom-built or third-party
	Custom connectivity	Crimp and poke termination	0 only	–	TB-37F-37CP
	Custom connectivity	Solder cup termination	0 only	–	TB-37F-37SC
	Low-cost	Screw terminals	0 only	–	CB-37F-LP

[1]Connector 0 is found on all M Series devices. 0 and 1 require two cables and accessories; [2]For NI 6225 and NI 6255, use SHC68-68-EPM on connector 0 and SHC68-68 on connector 1;
[3]Cable works with only NI 6230 and NI 6236; [4]Use the 68M-50F-MIO with the SHC68-68-EPM when connecting to 50-pin accessories; [5]For USB M Series mass-terminated modules, use SH68-68-EP.

S Series	Feature	Connect to …	Connector	Cable	Accessory
NI 6115 NI 6120	Noise-reducing	SMB terminal block (PXI only)	0 only	–	TB-2708 or TB-2709[5]
NI 6123 NI 6133	Noise-reducing	Screw terminals (PXI only)	0 only	–	TB-2705
NI 6122 NI 6132	Noise-reducing	Screw terminals	0 only	SH68-68-EP	SCB-68
NI 6110 NI 6111	Noise-reducing	BNC terminal block	0 only	SH68-68-EP	BNC-2110, BNC-2120, or BNC-2090A
	Low-cost	Screw terminals	0 only	R6868	CB-68LP or CB-68LPR
NI 6143	Noise-reducing	Screw terminals (PXI only)	0 only	–	TB-2706
	Noise-reducing	Screw terminals	0 only	SHC68-68-EPM	SCB-68
	Low-cost	Screw terminals	0 only	RC68-68	CB-68LP or CB-68LPR
NI 6154	High-voltage isolated	Screw terminals	0 only	DB37M-DB37F-EP	CB-37F-HVD, CB-37FH, or CB-37FV

[5]TB-2708 for use with PXI-6115 and PXI-6120; TB-2709 for use with PXI-6122, PXI-6223, PXI-6232, and PXI-6133.

R Series	Feature	Connect to …	Connector	Cable	Accessory
NI 7833R	Noise reducing	Screw terminals	0	SHC68-68-RMIO	SCB-68
NI 7831R			1 or 2	SHC68-68-RDIO	
NI 7830R	Signal conditioning and I/O expansion	C Series modules	1 or 2	SHC68-68-RDIO	cRIO-9151 R Series expansion chassis
NI 7813R	Noise reducing	Screw terminals	0, 1, 2 or 3	SHC68-68-RDIO	SCB-68
NI 7811R	Signal conditioning and I/O expansion	C Series modules	0, 1, 2 or 3	SHC68-68-RDIO	cRIO-9151 R Series expansion chassis

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DAQ Accessories Selection Guide

Product	Feature	Connect to …	Cable	Accessory
68-Pin E Series (except DAQCard devices)				
NI 6070E NI 6032E	Noise-reducing	SCC portable signal conditioning	SH68-68-EP	See page 249 or SCC-68
NI 6052E NI 6030E		SCXI high-performance signal conditioning	SH68-68-EP	See page 256
NI 6040E NI 6024E		Screw terminals	SH68-68-EP	SCB-68 or TBX-68
NI 6036E NI 6023E		BNC terminal block	SH68-68-EP	BNC-2110, BNC-2111, BNC-2120, or BNC 2190
NI 6034E		50-pin connector	SH6850	Custom-built or third-party
	Low-cost	Screw terminals	R6868CB-68	LP or CB-68LPR
100-Pin E Series				
NI 6071E	Noise-reducing	Screw terminals	SH100100	SCB-100
NI 6033E		Screw terminals	SH1006868	2 SCB-68
NI 6031E		BNC terminal block	SH1006868	BNC-2115, BNC-2110, BCN-2111, BNC-2120, or BNC-2190
NI 6025E		50-pin connector	SH1005050	Custom-built or third-party
	Low-cost	Screw terminals	SH1006868	CB-68LP and/or CB-68LPR
B Series				
NI 6010	Low-cost	Screw terminals	SH37F-37M-1	CB-37F-LP1, CB-37FH, CB-37FV

Analog Output Accessories

Model	Shielding	Connect to …	Cable	Accessory
NI 673x,	Shielded	BNC	SH68-68-EP	BNC-2110
PCI-671x,		Screw terminals	SH68-68-EP	SCB-68 or TBX-68
PXI-671x		Screw terminals	–	TB-2705 (PXI)
		Custom	SH68-68-EP	CA-1000
	Unshielded	Screw terminals	R6868	CB-68LP or CB-68LPR
NI 6723	Shielded	BNC	2 SH68-C68-S	BNC-2110 and BNC-2115
		Screw terminals	2 SH68-C68-S	2 SCB-68 or TBX-68
		Custom	2 SH68-C68-S	2 CA-1000
NI 6722	Shielded	BNC	SH68-C68-S	BNC-2110
		Screw terminals	SH68-C68-S	SCB-68
		Custom	SH68-C68-S	CA-1000
	Unshielded	Screw terminals	RC68-68	CB-68LP or CB-68LPR
NI 6703,	Shielded	Screw terminals	SH68-68-D1	SCB-68
NI 6704		Custom	SH68-68-D1	CA-1000
	Unshielded	Screw terminals	R6868	CB-68LP or CB-68LPR
DAQCard-6715	Shielded	BNC	SHC68-68-EPM	BNC-2110
		Screw terminals	SHC68-68-EPM	SCB-68
		Custom	SHC68-68-EPM	CA-1000
	Unshielded	Screw terminals	RC68-68	CB-68LP or CB-68LPR

DIO Accessories

Model	Feature	Connect to …	Cable	Accessory
100-Pin				
NI 6509, NI 6511, NI 6512, NI 6513, NI 6514,	Noise-reducing	Screw terminals	SH100-100-F	SCB-100
NI 6515, NI 6527, NI 6528, PC-DIO-96	Low-cost	Screw terminals	Cable included in kit	CB-100 kit
50-Pin				
NI 6503, USB-6501 OEM,	Noise-reducing	Screw terminals	PSH27-50F-D1	CB-50, CB-50LP
PC-DIO-24, DAQCard-DIO-24	Low-cost	Screw terminals	NB1	CB-50, CB-50LP
37-Pin				
NI 6510, NI 6516, NI 6517, NI 6518,	High-voltage	Screw terminals	SH37F-37M	CB-37F-HVD
NI 6519, NI 6520, NI 6521	High-voltage	Screw terminals	–	TB-2621 (PXI only)
	Noise-reducing	Screw terminals	SH37F-37M	CB-37FH, CB-37FV
	Low-cost	Screw terminals	R37F-37M-1	CB-37FH, CB-37FV
	Low-cost	Screw terminals	–	CB-37F-LP
	Custom connectivity	37-pin female connector	–	TB-37F-37CP, TB-37F-37SC
	Custom connectivity	37-pin female connector	SH37F-P-4	–

Counter/Timer Accessories

100-Pin				
NI 6624	Noise-reducing	Screw terminals	SH100-100F	SCB-100
	Low-cost	Screw terminals	Cable included in kit	CB-100 kit
68-Pin				
NI 6601, NI 6602, NI 6608	Noise-reducing	Screw terminals	SH68-68-D1	SCB-68
	Noise-reducing	BNC connectors	SH68-68-D1	BNC-2121
	Noise-reducing	Screw terminals	–	TB-2715
	Low-cost	Screw terminals	R6868	CB-68LP
	Low-cost	Screw terminals	R6868	TBX-68

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100-Pin Accessories

Cables

SH100100 – Shielded 100-conductor cable terminated with 100-pin male 0.050 series D-type connectors. This cable connects the 100-pin E Series devices to 100-pin accessories.

1 m..... 182853-01
2 m..... 182853-02

SH1006868 – Shielded cable that connects to 100-pin E Series devices and terminates with two female 68-pin 0.050 series D-type connectors.

1 m..... 182849-01
2 m..... 182849-02

SH100-100-F – Shielded 100-conductor cable for connecting 100-pin DIO and TIO devices to 100-pin accessories.

2 m..... 185095-02

R1005050 – Connects 100-pin E Series, DIO, and TIO devices to standard 50-pin third-party or custom connectors.

1 m..... 182762-01
2 m..... 182762-02

Connector Blocks

SCB-100 – Shielded I/O connector block for rugged, low-noise signal termination with 100-pin E Series, DIO, and TIO devices. It also includes general-purpose breadboard are as and an IC temperature sensor for cold-junction compensation in temperature measurements.

SCB-100.....776990-01
Dimensions – 19.5 by 15.2 by 4.5 cm (7.7 by 6.0 by 1.8 in.)

CB-100 – Includes two CB-50 I/O connector blocks and an R1005050 ribbon cable for connecting to any devices with a 100-pin SCSI I/O connector. Each CB-50 block includes hardware for mounting the accessory on a standard DIN-rail or panel.

CB-100 with 1 m R1005050 cable..... 777812-01

PCB Mounting Connectors for Custom Accessories – Build custom accessories that connect to 100-conductor shielded and ribbon cables using these connectors.

100-pin, female, right-angle mounting..... 777778-01
100-pin, female, vertical mounting..... 777779-01

68-Pin Accessories

Cables

SHC68-68-EPM – A high-performance shielded 68-conductor cable terminated with a VHDCI 68-pin male connector at one end and a 68-pin female 0.050 D-type connector at the other end for connecting M Series, DAQCard, and select S Series devices to standard 68-pin accessories.

0.5 m..... 192061-0R5
1 m..... 192061-01
2 m..... 192061-02
5 m..... 192061-05
10 m..... 192061-10

SHC68-68 – A low-cost cable for connecting M Series DAQ devices to 68-pin accessories and signal conditioning systems. It features individually twisted cable pairs, but does not have shields between the analog and digital signals. For improved noise rejection, consider the SHC68-68-EPM.

1 m..... 191945-01
2 m..... 191945-02

SHC68-68-RMIO, SHC68-68-RDIO – High-performance shielded 68-conductor cables terminated with a VHDCI 68-pin male connector at one end, and a 68-pin female 0.050 D-type connector at the other end; specifically designed for the MIO and DIO connectors on R Series devices.

SHC68-68-RMIO
1 m..... 189588-01
2 m..... 189588-02
SHC68-68-RDIO
1 m..... 191667-01

SH68-C68-S – Basic shielded cable featuring twisted pairs and additional ferrites for connecting NI 672x analog output devices to 68-pin accessories.

2 m..... 186381-02


SCB-100


SHC68-68-EPM


SHC68-68-RMIO


SHC68-68-RDIO


SHC68-68


SH68-C68-S

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SHC68U-68-EP – Shielded 68-conductor cable terminated with an inverted VHDCI 68-pin male connector at one end and a 68-pin female 0.050 series D-type connector at the other. When using two E Series DAQCard devices in adjacent slots, use one SHC68-68-EPM and one SHC68U-68-EP.

0.5 m..... 187406-0R5
1 m..... 187406-01

SH68-68-EP, SH68-68R1-EP – Shielded 68-conductor cable terminated with two 68-pin female 0.050 series D-type connectors. They connect to 68-pin mass-terminated USB M Series, E Series, S Series, and B Series devices. If you need a right-angle connector, use the SH68-68R1-EP.

SH68-68-EP
1 m..... 184749-01
2 m..... 184749-02
5 m..... 184749-05
10 m..... 184749-10

SH68-68R1-EP
1 m..... 187051-01

SH68-68-D1 – Shielded 68-conductor cable terminated with two 68-pin female 0.050 series D-type connectors. This cable connects counter/timerand NI670x analog output devices to 68-pin accessories.

1 m..... 183432-01
2 m..... 183432-02

SH6850 – A shielded cable that connects a 68-pin E Series, S Series (except NI 6143), or B Series multifunction DAQ product to a third-party or custom standard 50-pin accessory. The cable provides a screw-latching 68-pin female connector on one side and a standard 50-pin female connector on the other side.

1 m..... 776784-01
2 m..... 776784-02

SHC68-68M-EPM – A shielded cable used to connect M Series devices with custom-built accessories. One end terminates with a 68-pin VHDCI male connector and the other, with a 0.050 D-type male connector.

0.3 m..... 192288-0R3

SHC68-NT-S – A shielded 68-conductor cable terminated with a 68-pin male VHDCI connector at one end and open to bare wires at the other. The cable connects M Series, NI 6143, and R Series devices to custom accessories through bare wires.

2 m..... 189041-02

RC68-68 – A 68-conductor ribbon cable that connects a DAQCard, M Series device, or NI 6143 directly to 68-pin accessories. You can use two RC68-68 cables together in adjacent PCMCIA slots or on 2-connector M Series devices.

0.25 m..... 187252-0R25
0.5 m..... 187252-0R5
1 m..... 187252-01

R6868 – A low-cost, 68-conductor flat ribbon cable terminated with two 68-pin connectors. Use this cable to connect a 68-pin E Series, S Series (except NI6143), or B Series multifunction DAQ device to 68-pin accessories.

1 m..... 182482-01

R6850 – Combines a 68F-50M cable adapter and a standard 50-pin cable with female connectors on both ends. It is designed to adapt a 68-pin E Series, S Series, or B Series multifunction DAQ device to a third-party or custom 50-pin accessory.

1 m..... 776842-01

68-Pin Custom Cable Connector/Backshell Kit – A kit used to make custom cables for devices with 68-pin SCSI 2 connectors. Solder-cup contacts are available for soldering cable wires to the connector.

68-pin connector/backshell kit..... 776832-01

Connector Blocks

SCC-68 – High-performance I/O terminal block for M Series and E Series DAQ devices that provides four slots for analog input and digital SCC signal conditioning modules, general-purpose breadboard areas, an IC temperature sensor for cold-junction compensation, and 68 screw terminals for direct I/O connectivity.

SCC-68..... 779475-01
Dimensions – 24.46 by 17.78 by 5.30 cm (9.63 by 7.0 by 2.09 in.)


SH68-68-EP


SH68-68-D1


SHC68-68M-EPM


SCC-68


RC68-68

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SCB-68 –Shielded I/O connector block for rugged, low-noise signal termination with 68-pin DAQ devices. It includes general-purpose breadboard areas and an IC temperature sensor for cold-junction compensation in temperature measurements.
SCB-68..... 776844-01
Dimensions – 19.5 by 15.2 by 4.5 cm (7.7 by 6.0 by 1.8 in.)

BNC-21xx – Shielded connector blocks with BNC connectors for easy connectivity to I/O signals. The BNC-2110 and BNC-2120 (for 68-pin M Series, S Series, and B Series) have BNC inputs for eight differential analog input signals, analog output signals, and some digital I/O signals. Other digital I/O signals are accessible through screw terminals. The BNC-2120 also provides a function generator, quadrature encoder, temperature reference, thermocouple connector, and LEDs for digital I/O signals. The BNC-2111 (for 68-pin M Series and B Series) has BNC inputs for 16 single-ended analog input signals, analog output signals, and some digital I/O signals. The unshielded version of the BNC-2111 is suitable for OEM applications. The BNC-2115 has BNC connectors for the extended I/O channels of 100-pin E Series devices (NI 6025E/6031E/6033E/6071E).
BNC-2110..... 777643-01
Dimensions – 29.3 by 11.2 by 5.5 cm (8.0 by 4.4 by 2.2 in.)
BNC-2111, shielded..... 779347-01
BNC-2111, unshielded..... 779347-02
Dimensions – 19.05 by 10.5 by 3.5 cm (7.4 by 3.5 by 2.0 in.)
BNC-2115..... 777807-01
Dimensions – 20.3 by 11.2 by 5.5 cm (8.0 by 4.4 by 2.2 in.)
BNC-2120..... 777960-01
Dimensions – 26.7 by 11.2 by 6.0 cm (10.5 by 4.4 by 2.4 in.)

BNC-2090 – A shielded, rack-mountable adapter with 22 signal-labeled BNC connectors and 28 spring terminal blocks to simplify connections to your I/O signals. The BNC-2090 includes component locations for passive signal conditioning and connects to any 68-pin M Series, S Series, E Series, or B Series DAQ device.
BNC-2090..... 777270-01
Dimensions – 48.3 by 4.4 by 18.8 cm (19.0 by 1.7 by 7.4 in.)

SC-2075 – Connector block with breadboard area for prototyping, as well as BNC and spring terminal connectivity for 68-pin M Series, E Series, and B Series multifunction DAQ devices. The built-in ±15 V or adjustable 0 to 5 V power supply and LEDs for digital lines make the SC-2075, ideal for academic laboratories.
SC-2075.....778147-90
Dimensions – 26.7 by 20.7 by 4.4 cm (10.5 by 8.2 by 1.7 in.)

TBX-68 – Connector block for easy connection offield I/O signals to 68-pin DAQ devices. The TBX-68 includes 68 screw terminals and one 68-pin male connector for direct connection to 68-pin cables. The TBX-68 is mounted in a protective plastic base with hardware for mounting on a standard DIN rail.
TBX-68..... 777141-01
Dimensions – 12.50 by 10.74 cm (4.92 by 4.23 in.)

TB-270x – TB-270x devices are 68-pin shielded accessories with screw terminals for I/O signals that mount directly to the front panel of 68-pin PXI DAQ modules. The TB-2705 works with PXI-6030E/6040E/6052E/6070E E Series modules and PXI-6115/612x/613x S Series modules. The TB-2706 works with 68-pin PXI M Series modules and the PXI-6143. The TB-2708 and TB-2709 provide nine SMB connectors for direct access to simultaneous sampling I/O, and an auxiliary connector for advanced timing and triggering with the MFIT-Pigtail cable. The TB-2708 works with the PXI-6115/6120 S Series modules. The TB-2709 works with the PXI-612x/613x S Series modules.
TB-2705..... 778241-01
TB-2706..... 779183-01
TB-2708..... 778823-01
TB-2709..... 779554-01
Dimensions – 10.7 by 8.6 by 2.0 cm (4.2 by 3.4 by 0.8 in.)

TB-2715 – Terminal block for PXI counter/timer devices with which you can connect signals directly without additional cables. Screw terminals provide easy connection of I/O signals. The TB-2715 latches to the front of your PXI module with locking screws and provides strain relief.
TB-2715..... 778242-01
Dimensions – 8.43 by 10.41 by 2.03 cm (3.32 by 4.1 by 0.8 in.)


SCB-68


BNC-2110


BNC-2111


BNC-2115


BNC-2120


TB-2706


TB-2708/9

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CB-68LP, CB-68LPR – Low-cost termination accessories with 68 screw terminals for easy connection of I/O signals to 68-pin M Series, E Series, S Series, or B Series multifunction DAQ devices. They include one 68-pin male connector for direct connection to 68-pin cables and standoffs for use on a desktop or for mounting in a custom panel. The CB-68LP has a vertical-mounted 68-pin connector. The CB-68LPR has a right-angle mounted connector, and can be used with the CA-1000.

CB-68LP..... 777145-01
Dimensions – 14.35 by 10.74 cm (5.65 by 4.23 in.)
CB-68LPR 777145-02
Dimensions – 7.62 by 16.19 cm (3.00 by 6.36 in.)

DAQ Signal Accessory – For demonstration of analog, digital, and counter/timer functions of DAQ devices. You can use the DAQ Signal Accessory with any 68-pin M Series, E Series, or B Series DAQ device. It features a built-in function generator, quadrature encoder, solid-state relay, IC temperature sensor, noise generator, microphone jack, thermocouple jack, four LEDs, and a digital trigger button.

DAQ Signal Accessory..... 777382-01
Dimensions – 12.7 by 12.7 cm (5.0 by 5.0 in.)

PCB Mounting Connectors for Custom Accessories – Build custom accessories that connect to 68-conductor shielded and ribbon cables using these connectors.

68-pin, male, right-angle mounting..... 777600-01
68-pin, male, vertical mounting..... 777601-01

50-Pin Accessories

Cables

SH50-50 – Shielded 50-conductor cable that connects to a PCI-6503 or PC-DIO-24 device and terminates with a 50-pin connector. The kit includes the shielded cable and a 3 in. ribbon cable for connection flexibility.

1 m..... 777720-01
2 m..... 777720-02

68M-50F – Adapter that connects a 68-pin NI shielded cable to a standard 0.1 by 0.1 in. 50-pin connector on third-party or custom accessories. Use the 68M-50F MIO with the SHC68-68-EPM, SH68-68-EP, SHC68-68-EP, SHC68U-68-EP, or the multifunction I/O portion of the SH1006868. Use The 68M-50F Extended I/O cable adapter for the extended I/O portion of the SH1006868.

68M-50F MIO..... 184670-01
68M-50F Extended I/O..... 184670-02

NB1 Cable – 50-conductor ribbon cable that connects the PCI-6503 to 50-pin accessories.

1 m..... 180524-10
2 m..... 180524-20

Connector Blocks

CB-50 – Termination accessory with 50 screw terminals for easy connection of field I/O signals to NI 650x, and to 100-pin SCSI devices using a R1005050 ribbon cable. Includes one 50-pin header for direct connection to 50-pin cables. The CB-50 includes a protective plastic base and hardware for mounting the accessory on either a standard DIN rail or flush on a wall or panel.

CB-50..... 776164-90
Dimensions – 13.5 by 7.3 cm (5.3 by 2.9 in.)

CB-50LP – Termination board with 50 screw terminals for easy connection of field I/O signals to NI 6503, and to 100-pin SCSI devices using a R1005050 ribbon cable. Includes one 50-pin header for direct connection to 50-pin cables. The CB-50LP includes metal standoffs for use on a desktop or for mounting on a custom panel.

CB-50LP..... 777101-01
Dimensions – 13.26 by 7.19 cm (5.22 by 2.83 in.)


CB-68LP, CB-68LPR


DAQ Signal Accessory


SH50-50


68M-50F


NB-1


CB-50LP

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37-Pin Accessories

Cables

DB37M-DB37F-EP – High-performance shielded 37-pin female to male D-Sub cable with separate analog input, analog output, and digital sections designed to reduce noise. This cable is for use with the new isolated S Series (PCI-6154) and select isolated M Series (NI 6230 and NI 6236) devices.
1 m..... 193737-01

SH37F-37M – 37-pin D-Sub female-to-male shielded I/O cables.
1 m 778621-01
2 m 778621-02

SH37F-P-4 – 37-pin D-Sub shielded female-to-pigtail cable for custom wiring.
4 m 778620-04

R37F-37M – 37-pin D-Sub female-to-male ribbon I/O cable.
1 m..... 779195-01

Connector Blocks

CB-37F-HVD – UL-listed (150 V, 2A) 37-pin female D-Sub horizontal terminal block that mounts in line with the DIN rail.
CB-37F-HVD..... 779491-01

CB-37F-LP – Direct mountable connector block for 37-pin data acquisition devices. Easily accessible screw terminals and low-cost make this accessory ideal for OEM applications.
CB-37F-LP..... 779353-01

CB-37FV – 37-pin female D-Sub vertical terminal block that mounts perpendicular to the DIN rail.
CB-37FV 778672-01

CB-37FH – 37-pin female D-Sub horizontal terminal block that mounts in line with the DIN rail.
CB-37FH 778673-01

TB-2621 – 37-pin front-mounting PXI terminal block. High-voltage, UL listed for CAT II, 150 VDC/VAC.
TB-2621..... 779444-01

TB-37F-37CP – 37-pin female D-Sub crimp and poke termination accessory for custom cabling.
TB-37F-37CP 779185-01

TB-37F-37SC – 37-pin female D-Sub solder cup termination accessory for custom cabling.
TB-37F-37SC..... 779184-01

37-Pin HV Safety Kit – Accessories for modifying two connector swith safety keying for use in high-voltage data acquisition with devices such as NI 6521.
37-Pin HV Safety Kit..... 779445-01

Specialty Accessories

CA-1000 – A configurable enclosure that gives you maximum user-defined connectivity and flexibility through customized panelettes. Each enclosure can accommodate up to nine panelettes.
Dimensions – 30.7 by 25.4 by 4.3 cm (21.1 by 10 by 1.7 in.)

USB Accessory Kits – Connectors, labels, and screw drivers for use with USB-6008/6009 multifunction DAQ and USB-6501 digital I/O devices.
USB-6008/6009 Analog I/O Accessory Kit..... 779371-01
USB Digital I/O Accessory Kit..... 779376-01

Hi-Speed USB Cables – Designed to connect any USB data acquisition device to the USB port of your computer. They feature a B-type connector for the device-side connection, and an A-type connector for the host-side connection.
1 m..... 184125-01
2 m..... 184125-02

PSH27-50F-D1 – Shielded cable that connects to the DAQCard-DIO-24 and is terminated with a 50-pin female connector that attaches directly to 50-pin accessories.
0.5 m..... 776989-0R5
1 m..... 776989-01


SH37F-37M


SH37F-37-P-4


CB-37F-LP


CB-37FV


CB-37F-HVD


TB-2621

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SH-15-15, SH-15-15B – Shielded 15-conductor cables for use with the NI CF-6004. The SH-15-15 terminates in a 15-pin D-Sub connector, while the SH-15-15B terminates in bare wires for custom connectivity.
SH-15-15..... 191067-0R5
SH-15-15B..... 191070-0R5

SCB-15 – A shielded compact connector block for use with NI CF-6004.
SCB-15..... 779197-01

CB-15 – DIN-rail mountable connector block for use with the NI CF-6004. Easily accessible screw terminals make this accessory great for prototyping.
CB-15..... 779198-01

MFIT-PIGTAIL – Shielded 14-conductor cable terminated with a 14-position MFIT female connector at one end and unterminated bare wires at the other end. It connects to the auxiliary connector of the TB-2708 and TB-2709 for access to digital I/O and trigger lines on various S Series PXI modules.
1 m..... 194123-01

Strain-Relief Accessory – Attaches to the bottom of your notebook computer or DAQPad and provides adjustable strain relief for one or two PCMCIA cables attached to DAQCard devices, or a USB cable attached to a DAQPad device.
Strain-relief accessory..... 777550-01

RTSI Bus Cables – Connect timing and synchronization signals among data acquisition, M Series, E Series, S Series, vision, motion, and CAN boards for PCI. For systems using long and short boards, order the extended RTSI cable.
2 boards..... 776249-02
3 boards..... 776249-03
4 boards..... 776249-04
5 boards..... 776249-05
Extended, 5 boards..... 777562-05

Signal Conditioning

SCC – A portable modular signal conditioning system consisting of modules that plug into a low-profile shielded carrier. Choose from a variety of signal conditioning options including sensor, input, isolation, and filtering modules. SCC is compatible with M Series, E Series, and some B Series and portable devices.
SCC Signal Conditioning

SCXI – A high-performance modular signal conditioning platform that provides a front end to your M Series or E Series DAQ device. You can expand your analog inputs to 3,072 channels. SCXI offers a variety of modules for sensor conditioning, amplification, filtering, and other modules.
SCXI Signal Conditioning

R Series Expansion Chassis – The NI cRIO-9151 is a chassis that connects directly to any digital connector on R Series intelligent DAQ devices and houses up to four C Series I/O modules for low-cost signal conditioning, I/O channel expansion, and direct connectivity. Many types of C Series modules are available, including 24-bit thermocouple inputs, IEPE accelerometer inputs, current and voltage output modules, 24 V industrial digital I/O modules and electromechanical relay modules.
C Series Signal Conditioning


SH-15-15


CB-15


Strain-Relief Accessory


MFIT-PIGTAIL


RTSI Bus Cable


SCC Portable, Modular Signal Conditioning


SCXI High-Performance Signal Conditioning

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SC Series – DAQ with Integrated Signal Conditioning

SC Series

- Tightly integrated measurement-specific signal conditioning on a single data acquisition device
- Direct sensor/signal connectivity
- 333 kS/s, 16-bit resolution
- Self-calibration for accuracy over time
- NI-PGIA custom instrumentation amplifier for accurate measurements
- Temperature drift protection circuitry
- PXI trigger bus to synchronize operations between two or more modules
- Digital triggering

Operating Systems

- Windows 7/Vista/XP/NT/2000
- LabVIEW Real-Time

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio

Other Compatible Software

- Visual Basic, C/C++, and C#

Measurement Services Software (included)

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility



Product	Analog Inputs	Resolution (bits)	Aggregate Sampling Rate (kS/s)[1]	Input Range (V)	Isolation (V)	Simultaneous Sampling	Digital Triggers	Filter Settings per Channel
PXI-4204	8 DI	16	200	±0.5 to ±100	–	✓	Digital (2)	2-pole Butterworth (6 Hz or 10 kHz)
PXI-4220	2quarter, half, or full-bridge	16	200	±0.01 to ±10	–	✓	Digital (2)	4-pole Butterworth (10 Hz, 100 Hz, 1 kHz, 10 kHz, bypass)
PXI-4224	8 DI	16	200	0 to ±10	42, CAT I	–	Digital (2)	

[1] All channels share one analog-to-digital converter.

Table 1. SC Series Product Selection Guide

Family	Bus	Analog Inputs	Resolution (bits)	Sampling Rate (S/s)	Input Range (V)	Simultaneous Sampling	Digital Triggers	Filter Settings per Channel
NI 4472	PXI, PCI	8 IEPE[1]	24	102.4 k	±10	✓	Analog and digital	Tracking filter (.5465 fs)
NI 435x	PXI, PCI, USB	16 DI thermocouple, RTD, or resistance	24	60	±15	–	–	20 Hz bandwidth

[1]Integrated Electronic Piezoelectric Accelerometers and Microphones

Table 2. Other NI Data Acquisition Devices with Built-In Signal Conditioning

Overview

National Instruments SC Series data acquisition (DAQ) modules expand the measurement capability of PXI by integrating measurement-specific signal conditioning on to a 16-bit PXI data acquisition module. With this tight integration of signal conditioning and data acquisition functionality, the SC Series delivers high-performance sensor-specific measurements at a lower cost per channel than leading solutions, such as SCXI DAQ systems, for low-to-medium channel counts.

Features

SC Series modules feature an integrated architecture that combines the high-performance functionality of NI 16-bit DAQ devices with the accuracy improvements of signal conditioning. With this integrated architecture, SC Series PXI modules deliver higher-performance measurements, taking advantage of the many inherent benefits of the rugged PXI platform. In particular, with the PXI trigger bus, you can synchronize SC Series modules with one another and with other PXI measurement modules to provide tight integration between measurement types in a single data acquisition system. In addition, SC Series modules feature temperature-drift-protection circuitry that minimizes the effect of ambient temperature changes to ensure accuracy in all environments. SC Series modules also feature the NI-PGIA, an instrument-class amplifier that guarantees settling times at all gains, ensuring that you take advantage of the full 16-bit resolution of the amplifier. Each SC Series module also features an onboard precision voltage source for self-calibration, and digital triggering for precise acquisition control.

Related Products

For high-channel-count or portable applications requiring signal conditioning, please refer to **ni.com/sigcon**.

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Channel-to-Channel Isolated DAQ
16-Bit, 200 kS/s, 8 Isolated Analog Inputs

NI PXI-4224

- 8 analog inputs at 333 kS/s,16-bit resolution
- ±10 V input range
- 42 V CAT I channel-to-channel isolation
- 15 kHz bandwidth per channel
- Programmable gains (1 and 10) per channel
- Screw-terminal direct connectivity
- NI measurement services software that simplifies configuration and measurements

Operating Systems
- Windows 7/Vista/9x/Me/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio for Visual Basic

Other Compatible Software
- Visual Basic
- C/C++

Measurement Services Software (included)
- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility



Product	Analog Inputs	Resolution (bits)	Aggregate Sampling Rate (kS/s)	Input Range (V)	Isolation (V)	Triggers	Filter Settings per Channel
PXI-4224	8 DI	16	200[1]	0 to ±10	42, CAT I	Digital (2)	15 kHz

[1] 333 kS/s for a Single Channel

Table 1. SC Series Product Selection Guide

Overview and Applications

The National Instruments PXI-4224 module is the newest member of the SC Series of PXI data acquisition (DAQ) modules with built-in signal conditioning. The NI PXI-4224 provides channel-to-channel isolation to ensure accurate, safe measurements even in the presence of high common-mode voltages. You can use it in a broad variety of applications including:

- Isolated thermocouple measurements
- Multichannel data-logging applications
- Fuel cell and battery test applications

Features

The PXI-4224 is a full-featured measurement module with channel-to-channel isolation, ±10 V input range, and 16-bit accuracy, making it ideal for applications requiring highly accurate measurements with high common-mode voltages. In addition, channel-to-channel isolation prevents ground potential loops that may exist between your measured signal and data acquisition system, ensuring maximum measurement accuracy. The PXI-4224 provides 42 V, CAT I channel-to-channel isolation. The module delivers programmable gain settings per channel to ensure maximum measurement accuracy. In addition, the module is designed to work with LabVIEW 7 Express and NI-DAQmx. In LabVIEW 8.20, you can use DAQ Assistant to configure the PXI-4224 and acquire data through a menu-based window, eliminating the need to manually program the device.

For high-channel-count measurements requiring isolation, view NI signal conditioning hardware at ni.com/sigcon.

NI-DAQmx Measurement Services Software

NI-DAQmx controls every aspect of your DAQ system, from configuration to programming to low-level OS and device control. The new NI-DAQmx software includes:

- Automatic code generation from a configuration screen
- Analog, digital, and counter/timer test panels
- Error diagnostic pinpointing
- Real-world unit scaling
- Advanced calibration

Ordering Information

NI PXI-4224..... 779182-01
Includes NI-DAQmx driver software.

Terminal Block
NI TB-2725..... 779167-01

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DAQ for High-Voltage Measurements
16-Bit, 200 kS/s, 8 Analog Inputs

NI PXI-4204

- 8 analog inputs at 200 kS/s, 16-bit resolution
- ±100 V input range
- Programmable gain (0.5, 1, 10, 100) per channel
- Programmable 2-pole Butterworth filter (6 Hz or 10 kHz) per channel
- Differential simultaneous sampling inputs
- Combicon screw terminal direct connectivity
- NI-DAQ driver simplifies configuration and measurements

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio for Visual Studio.NET

Other Compatible Software
- Visual Basic, C/C++, and C#

Driver Software (Included)
- NI-DAQ 7



Device	Bus	Analog Inputs	Resolution	Sampling Rate	Input Range	Triggers	Filter Settings
PXI-4204	PXI	8 DI	16 bits	200 kS/s	±0.5 to ±100 V	Digital (2)	2-pole Butterworth (6Hz or 10 kHz)

Table 1. NI PXI-4204 Channel, Speed, and Resolution Specifications

Overview and Applications

The National Instruments PXI-4204 module delivers accurate data acquisition for input ranges up to 100 V. With this module you can handle a broad variety of applications including:

- 42 V automotive applications
- High-voltage, multichannel data logging applications
- Fuel cell and battery test applications

Features

The NI PXI-4204 is a full-featured data acquisition module with a ±100 V input range, 16-bit accuracy, and software-selectable filter and gain settings per channel. Programmable filter and gain settings ensure that the PXI-4204 achieves maximum accuracy over the entire ±100 V input range. In addition, the PXI-4204 is designed to work with LabVIEW 7 Express and NI-DAQmx. The DAQ Assistant in LabVIEW 7 can configure the PXI-4204 and acquire data through a menu-based window, eliminating the need to manually program the device.

For high-channel-count, high-voltage applications, explore NI signal conditioning hardware. Visit ni.com/sigcon.

Driver Software

NI-DAQ 7 is the robust driver software included with all National Instruments data acquisition and signal conditioning products. This easy-to-use software tightly integrates the full functionality of your DAQ hardware to LabVIEW, LabWindows/CVI, and Measurement Studio for Visual Studio.NET. High-performance features include multidevice synchronization, networked measurements, and DMA data management. Bundled with NI-DAQ 7, the Measurement & Automation Explorer (MAX) utility simplifies the configuration of your measurement hardware with device test panels, interactive measurements, and scaled I/O channels. NI-DAQ also provides numerous example programs for LabVIEW and other application development environments to get you started with your application quickly.

Ordering Information

NI PXI-4204..... 778745-4204
Includes NI-DAQ driver software.

For more information on extended warranty and value-added services, visit ni.com/services.

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Universal Strain Data Acquisition - 16-Bit, 200 kS/s/ch, 2 Strain Gage Input

NI PXI-4220

- 2 bridge inputs at 200 kS/s, 16-bit resolution
- Programmable excitation (0 to 10 V) per channel
- Programmable gain (1 to 1000) per channel
- Programmable 4-pole Butterworth filter (10 Hz, 100 Hz, 1 kHz, 10 kHz, or bypass) per channel
- Quarter, half, and full-bridge completion
- Differential simultaneous sampling inputs (programmable)
- 9-pin D-Sub connector per channel
- 2 shunt calibration circuits per channel
- Remote sensing NI measurement services software simplifies configuration and measurements

Operating Systems
- Windows 7/Vista/XP/NT/2000
- LabVIEW Real-Time
- Linux®

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio

Other Compatible Software
- Visual Basic, C/C++, and C#

Meaurement Services Software (included)
- NI-DAQmx driver
- Measurement & Automation Explorer
- VI Logger Lite data-logging software



Product	Analog Inputs	Resolution (bits)	Aggregate Sampling Rate (kS/s)	Input Range (V)	Isolation (V)	Simultaneous Sampling	Digital Triggers	Filter Settings per Channel
PXI-4220	2	16	200	±0.01 to ±10	-	✓	2	4-pole Butterworth (10 Hz, 100 Hz, 1 kHz, 10 kHz, bypass)

Table 1. PXI-4220 Specifications Overview

Overview and Applications

The National Instruments PXI-4220 module delivers accurate data acquisition for strain gage measurements up to 200 kS/s. With this module you can handle a broad variety of applications including:

- High-speed data logging for strain, load, pressure, and torque measurements
- Impact and dynamic load testing
- High-speed structural test
- Dynamic wind tunnel pressure testing

Key Features

The NI PXI-4220 is a full-featured data acquisition module with two 16-bit input channels for quarter, half, and full-bridge strain sensors. Bridge configuration, excitation, amplification, and filtering are fully programmable per channel. The PXI-4220 also provides simultaneous sample-and-hold capability to eliminate phase delay between channels.

Signal Compatibility			
Strain Gage	**Quarter-Bridge**	**Half-Bridge**	**Full-Bridge**
120 Ω	6.25 V	6.9 V	3.125 V
350 Ω	10.00 V	10.0 V	10.000 V

Table 2. Signal Compatibility

Each channel of the PXI-4220 has an independent voltage excitation source. You can program each excitation channel to one of 1024 voltage excitation levels from 0 to 10 V. These sources can drive a 350 Ω full bridge to the maximum 10 V level. Each excitation channel incorporates remote-sensing circuitry to compensate for voltage drops due to lead resistance.

NI Measurement Services Software

NI measurement services software, based on the NI-DAQmx driver, controls every aspect of your DAQ system, from configuration to programming to low-level OS and device control. NI measurement services software includes:

- Automatic code generation from a configuration screen
- Analog, digital, and counter/timer test panels
- Pinpoint error diagnostics
- Scaling to real-world units
- Advance calibration

Automatic Null Compensation

Each input channel of the PXI-4220 includes a circuit to remove bridge offset voltage. Driver software nulls the offset voltage to zero, eliminating the need to manually adjust potentiometers. By removing the offset at the inputs, rather than adjusting in software, you can increase your system gain for improved measurement sensitivity and resolution.

Ordering Information

NI PXI-4220..... 778745-4220
Includes NI-DAQmx driver software.

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NI 435x

- Temperature and voltage loggers
- Accuracy – ±0.42 °C for J-type thermocouples, ±0.03 °C for thermistors, ±0.12 °C for RTDs
- 16 voltage or 12 thermocouple inputs; up to 60 reading s/s
- 8 digital I/O lines (TTL)
- Autozero and cold-junction compensation

Operating Systems
- Windows 7/Vista/XP/NT/2000
- LabVIEW Real-Time

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger Full

Driver Software (included)
- NI 435x instrument driver
- Traditional NI-DAQ(legacy)



Overview

The National Instruments 4350 and 4351 are precision computer-based digitizers designed specifically for high-accuracy temperature measurements (thermocouples, RTDs, thermistors), resistance measurements, chromatography measurements, and for measuring low-frequency analog signals within ±15 V. The NI 435x devices are available for PCI, PXI/CompactPCI, and USB. They feature ±0.42 °C, J-type thermocouple accuracy, ±0.12°C RTD accuracy (NI 4351), ±0.03 °C thermistor accuracy, 5½-digit voltage measurements, power line noise rejection filters, and precision current source for RTD and thermistor excitation. The NI 435x devices combine the functionality of stand-alone temperature and voltage meters and chromatographs with the flexibility and benefits of your computer, so you can build highly capable computer-based data-logging systems. As with all computer-based digitizers, the NI 435x devices can easily integrate into your Internet-based applications.

Family	Bus	Voltage/ (Thermocouple) Channels	RTD Accuracy (°C)	Thermistor Accuracy (°C)	Resistance Measurementa
NI 4350	USB	16/(14)	1.14	0.03	Good
NI 4351	PCI, PXI	16/(14)	0.12	0.03	Excellent

Table 1. High-Precision DAQ Selection Guide

Hardware

Precision Analog Input

NI 435x devices have 16 differential analog inputs. Each device has a 24-bit analog-to-digital converter (ADC) and six possible reading rates – 10, 50, and 60 readings/s in single-channel acquisition mode and 2.8, 8.8, and 9.7 total readings/s in multiple-channel acquisition mode. For channel speed, divide the total readings/s by the number of channels acquired. Digital filters automatically reject 50, 60, and 400 Hz noise, based on the reading rate. The input circuitry delivers ±42 V over voltage protection and per-channel lowpass, antialiasing filters. NI 435x devices feature software-selectable ground referencing on a channel-by-channel basis, so you can measure both floating and ground-referenced signals together; they also feature per-channel open-thermocouple detection. When open-thermocouple detection is enabled, the input channel is connected to +2.5 VDC through a 10 M Ω resistor.

When a thermocouple breaks or is disconnected, the reading rapidly increases to 100 mV or more, indicating an open-circuit condition.

Precision Current Excitation

NI 435x devices feature a 25 µA precision current source for excitation of RTDs, thermistors, or other resistive devices. The source excites the total system resistance of up to 600 kΩ. NI 4351 devices also feature an additional 1 mA precision current source for RTDs or other resistive devices for total system resistance of up to 15 kΩ.

Digital I/O and Alarm Outputs

NI 435x devices have eight 5 V/TTL digital lines. You can individually configure each line as an input or an output. You can use the lines as general-purpose digital I/O or as control lines for alarms. Each line sinks or sources 8 mA. With the TBX-68T or CB-68T, you can increase the sinking and sourcing capability of these digital lines to 64 mA and 15 mA, respectively.

With digital signal conditioning accessories, such as the ER-8, SSR Series, and the SC-206x, you can use the NI 435x products to control relays and drive optically isolated digital I/O.

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High-Precision Data Acquisition Accessories and Software

I/O Connector

NI 435x devices have a 68-pin shielded latched male connector. ACH ±<0..7/15> are the 8/16 differential analog input channels. AGND is the analog ground. IEX±<0..1> are for the current excitation sources (25 µA and 1 mA). DIO<0..3/7> are the TTL linesand are referenced to DGN.

Software

Instrument Driver

Use the NI 435x instrument driver to integrate a device into your test software. The instrument driver works with:

- NI LabVIEW
- NI Measurement Studio
- Visual C/C++
- Visual Basic

In addition to the instrument driver, interactive data logging software is included with NI 435x devices. It is a multichannel data logger for recording and displaying low-frequency signals, such as temperature, pressure, resistance, and voltage. The software controls NI 435x devices with no programming required. You use the data logging software as you would use a stand-alone data logger, but you benefit from the processing, display, and storage capabilities of your computer.

With computer-based NI 435x devices, you can create distributed measurement system with ease, taking full advantage of the Web.

Interactive Control for Temperature and Voltage Measurement

In addition to the instrument driver, NI includes interactive data-logging software with NI 435x devices. You can use this multichannel data-logging software for recording and displaying low-frequency signals, such as temperature, pressure, resistance, and voltage. The software controls NI 435x devices with no programming required. You use the data-logging software as you would use a stand-alone data logger, but you benefit from the processing, display, and storage capabilities of your computer.

Recommended Accessories

Several accessories are available to accurately measure temperature, voltage, or resistance. Use this table to choose from recommended accessories.

Measurement Type	NI 435x Platforms	Accessory
Thermocouple only	PCI, PXI, USB	TC-2190 and SH6868 cable
Voltage, resistance, chromatography only	PCI, PXI, USB	TBX-68 and SH6868 cable
Temperature, voltage, resistance, chromatography	PCI, PXI, USB	TBX-68T and SH6868 cable; CB-68T with CA-1000 and SH6868 cable

Table 2. NI 435x Accessory Selection Guide

Ordering Information

NI PCI-4351 777789-01
NI PXI-4351 777790-01
NI USB-4350[1] 777225-01

Includes instrument driver and data-logging software.
[1]Includes 1 m USB cable; no power supply required; requires Windows 2000/XP.

For more information on extended warranty and value-added services, visit ni.com/services.

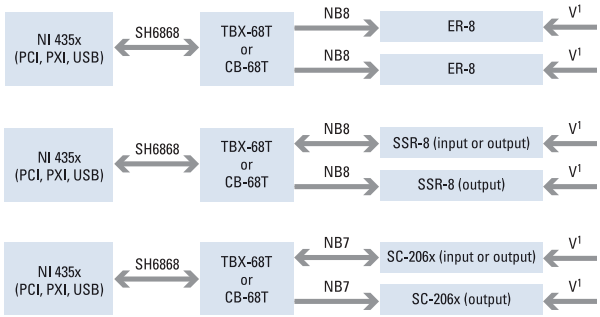
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TC-2190 – Shielded, rack-mount adapter with 14 thermocouple miniconnectors, spring terminals for four digital I/O lines, isothermal construction, a cold-junction sensor on channel 0, and autozeroing circuitry on channel 1. Use with the SH6868 shielded cable.
TC-2190..... 777510-01

TBX-68T, CB-68T – 68-pin, DIN-rail mountable terminal blockwith screw terminals for 14 unconditioned temperature, voltage, or resistance signals as well as for excitation. The TBX-68T also has eight digital I/O lines, isothermal design for cold-junction compensation, and autozeroing circuitry on channel 1.
The CB-68T is similar to the TBX-68T but is designed to mount inside the CA-1000 custom connectivity enclosure.
Both the TBX-68T and CB-68T provide circuitry to increase your sinking and sourcing capabilities to 64 and 15 mA, respectively. They also have two 26-pin connectors to which you can connect digital signal conditioning accessories such as the SSR-8, ER-8, and the SC-206x.
TBX-68T..... 777232-01
CB-68T..... 777926-01

TBX-68 – General-purpose terminal block to which you can connect up to 16 unconditioned analog signals as well as excitation and digital signals. Use the TBX-68 with the SH6868 shielded cable
TBX-68..... 777141-01

SH6868 – 68-pin shielded cable terminated with two 68-pin 0.050 series D-type connectors. The cable is used to connect USB-4350 or NI 4351 device to 68-pin accessories such as the TC-2190, TBX-68T, TBX-68, and CB-68T.
1 m..... 182419-01
2 m..... 182419-02



There are eight digital I/O lines available. If you use two digital signal conditioning accessories at the same time, a digital input signal conditioning accessory also drives the equivalent line on the digital output signal conditioning accessory. Do not use two digital input accessories at the same time.


TC-2190


TBX-68T


CB-68T and CA-1000


TBX-68

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Signal Conditioning Overview



Key Components of a Data Acquisition System

Data acquisition (DAQ) systems come in many different configurations, and address a variety of applications. While each DAQ system is uniquely defined by its application requirements, every system shares a common goal of acquiring, analyzing, and presenting information from a signal or sensor. For sensor measurements, a DAQ system must incorporate the following four components:

- Sensor (transducer)
- Signal conditioning
- Data acquisition device
- Software

Sensors Plug&Play

A new standard for sensors, specified by IEEE 1451.4, reduces the time and challenges associated with sensor configuration. The standard establishes a universally accepted method of making sensors plug and play, similar to the way a USB mouse is plug and play with a computer. IEEE 1451.4 defines a mechanism for adding self-describing behavior to sensors with an analog signal interface. This mixed-mode interface combines the traditional analog sensor signal with a low-cost serial digital link to access a transducer electronic data sheet (TEDS) embedded in the sensor. Several new hardware products and NI-DAQmx measurement services software include the required circuitry and functions to measure smart TEDS sensors. Benefits include:

- Quicker system setup by eliminating manual data entry
- Improved accuracy with detailed calibration information
- Better reliability by storing data sheets electronically
- Simplified asset management by eliminating paper data sheets

Signal Conditioning

Signal conditioning is an often forgotten yet fundamentally important component of every DAQ system. Many signals must be measured with sensors, most of which require some form of signal conditioning in order to be accurately read by a data acquisition device. For some sensors such as signal amplification, isolation, filtering, and multiplexing.

NI has developed a number of signal conditioning platforms to fit your particular DAQ system featuring flexible signal connectivity options, modularity, and software configurability. These options range from compact signal conditioning systems for portable applications (SCC) to rugged, multichannel systems for large, high-channel-count applications (SCXI). Select the right signal conditioning platform for your DAQ system using the Signal Conditioning Selection Guide below.

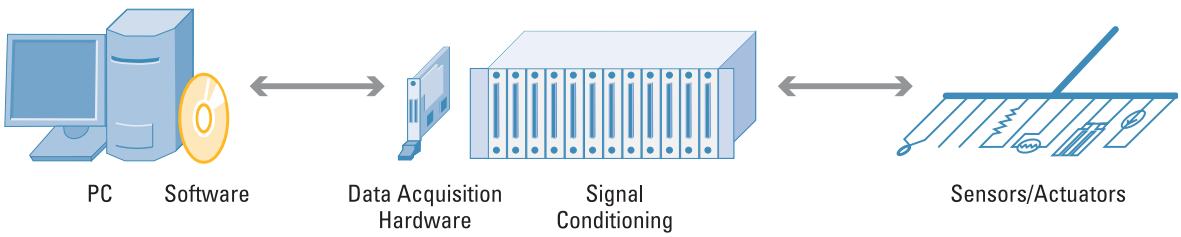


Figure 1. Typical National Instruments Data Acquisition System

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	NI CompactDAQ	SCC	SCXI	SC Series	5B	Compact FieldPoint
Signal types	○	◑	●	○	◑	◑
Expandability	◑	○	●	●	○	◑
Connectivity	●	●	◑	●	○	◑
Acquisition	●	●	●	●	●	○
System	●	◑	●	●	○	◑
Channel density	◑	○	●	◑	○	◑
Portability	●	●	◑	◑	○	○
Rugged/industrial	●	○	●	●	◑	●
Distributable	○	○	○	○	○	●
TEDS capability	◑	●	●	–	–	–

Good ○ Better ◑ Best ●

Table 1. Signal Conditioning Selection Guide-System Considerations

	NI CompactDAQ	SCC	SCXI	SC Series	5B	Compact FieldPoint
Millivolts/volts	✓	✓	✓	✓	✓	✓
Medium voltage (60 V)	✓	✓	✓	✓	–	✓
Current (0 to 20 mA)	–	✓	✓	✓	✓	✓
Frequency input	–	✓	✓	–	✓	✓
Thermocouples	✓	✓	✓	✓	✓	✓
RTDs/thermistors	–	✓	✓	✓	✓	✓
Strain gages	✓	✓	✓	✓	✓	✓
Force/load/torque	–	✓	✓	✓	–	✓
LVDTs/RVDTs/resolvers	✓	–	✓	–	–	–
Accelerometers	✓	✓	✓	✓	–	–
Analog output	✓	✓	✓	✓	✓	✓
TTL/CMOS	✓	✓	✓	–	–	✓
Switching	–	✓(RLY)	✓	–	–	–

Table 2. Signal Conditioning Selection Guide-Compatible Sensors

NI CompactDAQ

NI CompactDAQ combines high-speed digitizers, signal conditioning, and Hi-Speed USB plug and play to create a simple, complete data acquisition system in a small, portable package. NI features measurement modules that acquire analog and digital signals from DC to 10 MHz.

SCC

For portable low-channel-count applications - up to 16 analog input channels and eight digital I/O lines - SCC offers modular, flexible signal conditioning on a per-channel basis. SCC provides signal conditioning for a variety of inputs, including thermocouples, RTDs, accelerometers, pressure/force/tongue sensors, strain gages, analog inputs requiring isolation, high voltage (up to 60 V), current (0 to 20 mA), and optically isolated digital I/O. Lowpass filtering and breadboard modules are also available. These modules plug into a low-profile SC-2345 shielded carrier or SC-2350 shielded carrier with configurable TEDS connectors (capable of holding up to 20 modules), both of which cable directly to an M Series or E Series multifunction DAQ device.

SCXI

SCXI is a versatile, high-performance signal conditioning platform. You can use it as a complete DAQ system with a built-in USB digitizer, or as a signal conditioning front end for plug-in DAQ devices. SCXI is designed for applications requiring medium-to-large channel counts, rugged packaging, and a wide range of high-performance signal conditioning and switching options.

SC Series - DAQ with Integrated Signal Conditioning

NI SC Series data acquisition (DAQ) devices expand the measurement capability of PXI by integrating measurement-specific signal conditioning onto a 16-bit PXI data acquisition module. With this tight integration of signal conditioning and data acquisition functionality, the SC Series delivers high-performance sensor-specific measurements at a lower cost per-channel than leading solutions, such as SCXI DAQ systems, for low-to-medium channel counts.

5B Series

The 5B Series is a family of isolated analog signal conditioning modules that provide versatile, reliable signal conditioning for plug-in DAQ devices. The 5B Series is well suited for low-channel-count applications requiring up to 16 channels.

Signal Conditioning Accessories

NI offers several analog signal conditioning accessories for low-cost applications. The SC-204x devices are 8-channel conditioning devices that you cable directly to a DAQ device. Your options include SC-2040 for simultaneous sampling, SC-2042-RTD for RTDs, and SC-2043-SG for strain gages. You can also choose the AMUX-64T to inexpensively expand the channel count of your E Series DAQ device to 64 channels.

NI also offers a variety of low-cost digital signal conditioning accessories that can optically isolate digital I/O, translate signal levels to and from TTL, and provide relays for switching applications. Products for digital signal conditioning applications include:

- ER-8/16 electromechanical relay modules
- SSR Series digital I/O modules
- SC-206x digital I/O and relay boards

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Modular USB Data Acquisition System

NI CompactDAQ

- Available in 4-(cDAQ-9174)or 8-slot (cDAQ-9178)
- Run analog input modules at different rates with multiple timing engines
- Four general-purpose 32-bit counter/timers built into chassis (access through a digital module)
- NI-DAQmx driver with LabVIEW SignalExpress LE
- Hi-Speed USB with NI signal streaming technology
- Strain relief from the USB cable
- BNC trigger lines
- Three status LEDs
- Screw terminal power connector

NI C Series Modules

- Screw terminal power connector
- Up to 24-bit resolution
- Up to 256 channels per chassis

Operating Systems

- Windows 7/Vista/XP/2000

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio
- SignalExpress
- VI Logger

Measurement Services Software (included)

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility
- VI Logger Lite data-logging software
- DAQ Assistant for development without programming



Overview

The NI cDAQ-9174 and cDAQ-9178 chassis represent the next generation of NI CompactDAQ USB data acquisition systems. These two chassis build on the original feature set of NI CompactDAQ by incorporating user feedback and the latest technology from NI data acquisition, NI-STC 3 technology.

New Physical Features

Because of reduced physical component space needed by NI-STC 3 technology, users have two chassis options for NI CompactDAQ systems: the 4-slot cDAQ-9174 and the 8-slot cDAQ-9178. The chassis are made of the same grade of A380 aluminum for added ruggedness. The most notable physical difference in the 8-slot chassis is the addition of two front BNC connectors for external clocks and triggers. These triggers make it easier to synchronize an NI CompactDAQ system with external devices or systems.



Figure 1. NI CompactDAQ has two new options for mixed system development.

Several NI CompactDAQ systems are deployed in environments more rugged than a lab or engineering benchtop. The cDAQ-9174 and cDAQ-9178 chassis were designed with this in mind and offer an improvement on the USB cable strain relief with a captive USB cable. This special USB cable, which connects much like a VGA monitor cable, is included with the chassis. To make it easier to use alternate power supplies, both new chassis also offer the option of screw terminals for the power connection. The power supply is shipped with a connector already wired for simple setup, but it is also shipped with an empty connector plug with open screw terminals for alternate power supply use. The image below shows some of the new physical features of the cDAQ-9178.

Multiple Timing Engines for Multiple Acquisition Rates

With the cDAQ-9174/78 chassis, you can install a thermocouple module next to an accelerometer measurement module and acquire from both simultaneously at different rates. The cDAQ-9174/78 chassis have multiple analog input timing engines, which means you can group all of your analog input modules in up to three sets of

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modules. These sets, known as tasks, can all run at different rates because each one has its own timing engine in the chassis backplane. This alleviates the need to decimate or parse lower-speed data from the higher-speed data as you need to do in the original cDAQ-9172 chassis. Figure 2 shows a screenshot of a LabVIEW program that acquires from multiple modules at multiple rates.



Figure 2. This image shows different AI tasks running at different rates in the same chassis.

With the original cDAQ-9172, there were no digital input or output timing engines requiring the use of another subsystem such as a counter or analog clock. This type of digital task is referred to as being correlated. The cDAQ-9174/78 chassis now provide the ability to use internal timing, inherent to the digital task, to run digital input or output as hardware timed. This leaves more resources open to perform other operations in parallel. Table 1 lists some of the benefits associated with the multiple timing engines and NI-STC 3 technology.

Features	Benefits
3 AI Timing Engines	Run multiple AI tasks at different rates
1 DI Timing Engine	Run DI task without external clock
1 DO Timing Engine	Run DO task without external clock
1 AO Timing Engine	Run AO task without external

Table 1. Simultaneously run all different systems with the new chassis.

Advanced Counter Functionality from NI-STC 3 Technology

The original cDAQ-9172 chassis has two counters. However, the cDAQ-9174/78 chassis now have the new feature of four, full-function 32-bit counters. These counters are inherently different from the counters in the cDAQ-9172 chassis in that each now has its own embedded counter. These improved counters make it possible to run many advanced counter tasks using one counter instead of cascading two. The cDAQ-9174/78 chassis can now output finite pulse trains with the use of only one counter. Table 2 highlights some of the new benefits of the counters from NI-STC 3 technology.

Features	Benefits
Four counters	Multiple counter tasks compare to two onboard counters on the previous cDAQ-9172
Separate counter for correlated DIO	Saves counter usage
Buffered sample clock frequency measurement with one counter	Saves counter usage
Route DIO and PFI line to any slot	Can do correlated DIO in any slots compared to previous cDAQ-9172, where it can be done only in slots 1 and 4 and PFI lines from 5 and 6

Table 2. This table lists some of the new benefits of counters from NI-STC 3 technology.

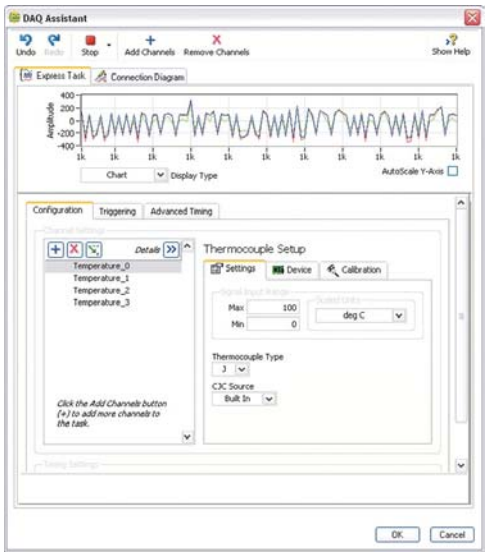
Mixed Measurement Systems

Whether you are testing a kitchen appliance, game controller, hybrid electric vehicle, or even a simple flashlight, you most likely need multiple types of sensors because the vast majority of test systems, even simple ones, are composed of more than one type of I/O. Many devices can measure temperature, voltage, or bridge-based sensors, but NI CompactDAQ can integrate all of these measurements and more into a single device that outputs all of the data via the same bus interface, such as USB. An NI CompactDAQ system can mix multiplexed voltage input signals, simultaneously sampled accelerometers, low-speed thermocouples, and TTL digital I/O all in the same 4- or 8-slot chassis using the same driver, NI-DAQmx. NI CompactDAQ makes programming easier because the same driver is used for all measurements. This solution saves space and simplifies service and support. With NI CompactDAQ, there is only one box on your lab bench and if there are problems with any of the measurements or equipment, National Instruments award-winning support will be the only contact for all instrumentation needs.

Ease of Use

NI CompactDAQ was designed with ease of use in mind from both hardware and software perspectives. All of the modules are automatically detected when installed into the chassis, which means the system knows exactly what type of module is installed and what type of measurements the module can make. Modules are hot swappable, meaning you can insert or remove them with the chassis powered on. Even if NI CompactDAQ is up and running another test, new modules that you insert are automatically detected and configured without interruption to ongoing tasks. This is a feature not only of convenience, but of robust design as well, because the hot-swapping feature eliminates possible hardware failure from improper installation or power-up procedures. Programming NI CompactDAQ with NI LabVIEW software and the DAQ Assistant provides one of the easiest ways to deliver data from external hardware into the PC. The DAQ Assistant is a quick wizard style setup that configures your measurement and even shows you how to connect your sensor to the module.

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For other programming languages, NI-DAQmx features an API and hundreds of examples for use in C+, C#, Visual Basic 6.0, and .NET. Whatever programming language or interface you choose, NI CompactDAQ provides you with an easy programming experience.

Rugged Design

NI CompactDAQ and all C Series modules are constructed from A380 cast aluminum for a rugged system that can withstand operating temperatures from -20 to 55 °C, and up to 30 g of shock. NI CompactDAQ was built to be used in the lab but not to necessarily stay there. With a rugged, flexible system such as NI CompactDAQ, you can reconfigure and move a single test system from place to place without having to purchase different equipment for every lab or test stand. The C Series modules are equally rugged and designed with spring loaded latches to lock into place when installed in the chassis. The shock and vibration specifications are all tested on an NI CompactDAQ system with modules installed, so there is no worry of a module falling out or coming undocked under the specified conditions. For cable strain relief, a locking USB cable with thumbscrew is included to prevent accidental disconnections during use. The rugged features of NI CompactDAQ help you to quickly begin testing because less time is needed to prepare the instrumentation for the rigors of field testing.

Accuracy/NIST Traceable

All C Series modules for NI CompactDAQ are NIST traceable and available for factory calibration and verification. In addition to the standardized testing, accuracy specifications for NI CompactDAQ are reported over a 10 °C temperature window, helping to ensure that the reported accuracy you see in the datasheets and manuals is the accuracy you can expect when you actually put the system to use. Maximum specifications are also noted for guaranteed results anywhere within the operational envelope.

Included Data-Logging Software

NI ships NI CompactDAQ, along with every other data acquisition (DAQ) device, with a driver kit that includes

- Measurement & Automation Explorer (MAX) – This configuration utility is for quick measurement debugging or system diagnostic test via the "device self-test."
- NI-DAQmx – Driver and API for all NI DAQ devices. This installer includes interfaces to LabVIEW, C, C++, C#, Visual Basic, .NET, as well as hundreds of example programs for LabVIEW and text-based languages.
- LabVIEW SignalExpress LE – With configuration-based data-logging, you can get up and running out of the box without programming. SignalExpress LE lets you acquire data from the hardware, build a custom user interface (UI), and log data to technical data management streaming (TDMS) files or to Microsoft Excel for graphing and postprocessing. LabVIEW SignalExpress is available for purchase and includes analysis and processing blocks for use within the data-logging environment.

C Series Platform

The NI C Series platform consists of more than 50 measurement modules and several different chassis for deployment. Configurations can range in size and complexity from simple 4-channel temperature loggers to high-channel-count, ultrahigh-speed control systems.



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C Series Modules

Currently, there are more than 50 C Series modules for different measurements including thermocouple, voltage, resistance temperature detector (RTD), current, resistance, strain, digital (TTL and other), accelerometers, and microphones. Channel counts on the individual modules range from three to 32 channels to accommodate a wide range of system requirements. C Series modules combine signal conditioning, connectivity, and data acquisition into a small module for each specific measurement type. You can insert these modules into any of the C Series family of chassis to create a variety of systems. You can create a mix of channel counts and measurement types within one system by selecting the desired modules and installing them into one of several C Series systems. For this reason, systems built on the C Series platform are highly customizable.



Figure 3. More than 50 C Series measurement modules are available

Automatic Synchronization of Modules and Channels

Because NI CompactDAQ is a modular system, you can add more measurement types and channels to the system by simply plugging in additional modules. All modules are hot swappable and autodetect once you insert them into a CompactDAQ chassis. All modules are automatically synchronized, and a single NI CompactDAQ system can simultaneously stream high-speed analog input, analog output, digital input, and digital output over a single USB connection

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C Series Modules for NI CompactDAQ

Type of Signal	Signal	Module	Channels	Special Features
Analog Input	Small voltage (±80 mV)	NI 9205	32	16-bit, ±200 mV to ±10 V, 250 kS/s, 32 SE or 16 DIFF channels, isolation
		NI 9219	4	24-bit, 100S/s/ch, simultaneous, Ch-Ch Isolated Universal AI Module (±125 mV to ±60 V, ±25 mA, TC, 3 and 4-wire RTD, 1/4, 1/2, and Full-Bridge)
	Medium voltage (±10 V)	NI 9201	8	12-bit, 500 kS/s, single-ended, isolation
		NI 9205	32	16-bit, ±200 mV to ±10 V, 250 kS/s, 32 SE or 16 DIFF channels, isolation
		NI 9215	4	16-bit, 100 kS/s/ch, simultaneous, differential
	Medium voltage (±10 V) with high isolation	NI 9206	16	16-bit, ±200 mV to ±10 V, 250 kS/s, 600 VDC (US)/400 VDC (EU) Cat I bank isolation
		NI 9219	4	24-bit, 100 S/s/ch, Ch-Ch Isolated Universal AI Module (±10 V, A, TC, RTD, Bridge)
		NI 9239	4	24-bit, ±10 V, 50 kS/s, simultaneous, anti-aliasing, 250 V_{rms} ch-ch isolation
	High voltage (±60 V)	NI 9219	4	24-bit, 100 S/s/ch, Ch-Ch Isolated Universal AI Module (±60 V, A, TC, RTD, Bridge)
		NI 9221	8	12-bit, 800 kS/s, single-ended, isolation
		NI 9229	4	24-bit, ±60 V, 50 kS/s/ch, simultaneous, anti-aliasing, 250 V_{rms} ch-ch isolation
	High voltage (±300 V)	NI 9225	3	24-bit, 300 V_{rms}, 50 KS/s/ch, 600 V_{rms} ch-ch isolation
	Thermocouple	NI 9211	4	24-bit delta-sigma, 15 S/s, differential
		NI 9213	16	24-bit, 1200 S/s, isolation
		NI 9219	4	24-bit, 100S/s/ch, Ch-Ch Isolated Universal AI Module (TC, V, A, RTD, Bridge)
	RTD	NI 9217	4	24-Bit, 400 S/s, 0 to 400 Ω RTD support, 3 & 4-wire measurements
		NI 9219	4	24-bit, 100S/s, Ch-Ch Isolated Universal AI Module (3 and 4-Wire RTD, V, A, TC, Bridge)
	IEPE Sensors (Accelerometer/Microphone)	NI 9233	4	24-bit, ±5 V, 50 kS/s/ch, simultaneous, IEPE conditioning, built-in anti-aliasing
		NI 9234	4	24-bit, ±5 V, 51.2 kS/s/ch, IEPE, Software-selectable AC/DC coupling
	Bridge-Based Sensors (Strain Gauges/Load Cells)	NI 9219	4	24-bit, 100S/s/ch, Ch-Ch Isolated Universal AI Module (1/4, 1/2, and Full-Bridge, V, A, TC, RTD)
		NI 9235	8	24-bit, 10KS/s/ch, simultaneous, 2V excitation, quarter-bridge(120Ω), isolation
		NI 9236	8	24-bit, 10KS/s/ch, simultaneous, 3.32V excitation, quarter-bridge(350Ω), isolation
		NI 9237	4	24-bit, 50 kS/s/ch, simultaneous, full/half/quarter-bridge, anti-aliasing
	Current Input	NI 9203	8	16-bit, 200 kS/s, ±20 mA
		NI 9219	4	24-bit, 100S/s/ch, Ch-Ch Isolated Universal AI Module (±25 mA, V, TC, RTD, Bridge)
		NI 9227	4	24-bit, 50KS/s/ch, ±5 A_{rms}, anti-aliasing, ch-ch isolation
Analog Output	Medium voltage (±10 V)	NI 9263	4	16-bit, 100 kS/s/ch, simultaneous
		NI 9264	16	16-bit, 25 kS/s/ch, simultaneous, 250 V_{rms} Isolation
	Medium Current (0 - 20 mA)	NI 9265	4	16-bit, 100 kS/s/ch, simultaneous, ±36 V protection
Digital Input	Bidirectional 5 V TTL	NI 9401	8	100 ns, 5 V TTL, ultra high-speed, bidirectional, 30 V protection
		NI 9402	4	55 ns, LV TTL, ultra high-speed, 30 V protection
		NI 9403	32	7 µs, 5 V TTL, bidirectional, 30 V protection
	24 V sinking	NI 9421	8	100 µs, up to 30 V, 40 V protection connectivity
		NI 9422	8	100 µs, up to 60 V, 250 V channel-to-channel isolation
		NI 9423	8	1 µs, high-speed, up to 30 V, 35 V protection
		NI 9425	32	7 µs, up to 30 V (60 V for 8 channels), 60 V protection
	24 V sourcing	NI 9422	8	100 µs, up to 60 V, 250 V channel-to-channel isolation
		NI 9426	32	7 µs, up to 30 V (60 V for 8 channels), 60 V protection
	250 AC/DC universal	NI 9435	4	3 ms, ±5 to 250 VDC, 10 to 250 VAC, universal, sink/source
	Differential or TTL	NI 9411	6	500 ns, ±5 to 24 V, single-ended TTL or differential, regulated 5 V supply output
Digital Output	Bidirectional 5 V TTL	NI 9401	8	100 ns, 5 V TTL, ultra high-speed, bidirectional, 30 V protection
		NI 9402	4	55 ns, LV TTL, ultra high-speed, 30 V protection
		NI 9403	32	7 µs, 5 V TTL, bidirectional, 30 V protection
	24 V sourcing	NI 9472	8	100 µs, 6 to 30 V, 750 mA max per ch, 30 V protection, short-circuit-proof
		NI 9474	8	1 µs, high-speed, 5 to 30 V, 1 A max per ch, 30 V protection, short-circuit-proof
		NI 9476	32	500 µs, 6 to 36 V, 40 V protection, short-circuit-proof
	24 V sinking	NI 9477	32	8 µs, 5 to 60 V, sinking, isolation, up to 20 A per module
Relay Output	Form A (SPST)	NI 9481	4	1 s, 30 VDC (2 A), 60 VDC (1 A), 250 VAC (2 A) electromechanical form A (SPST)
	Solid State Relay	NI 9485	8	60 VDC, SSR form A, up to 750 mA per ch, 5 ms set and reset time, ch-to-ch isolation
Counter, Pulse Generation	Counter/timer (24 V)	NI 9423	8	1 µs, high-speed, up to 30 V, 35 V protection
		NI 9425	32	7 µs, up to 30 V (60 V for 8 channels), 60 V protection
		NI 9426	32	7 µs, up to 30 V (60 V for 8 channels), 60 V protection
	Counter/timer (TTL)	NI 9401	8	100 ns, 5 V TTL, ultra high-speed, bidirectional, 30 V protection
		NI 9402	4	55 ns, LV TTL, ultra high-speed, 30 V protection
		NI 9403	32	7 µs, 5 V TTL, bidirectional, 30 V protection
		NI 9411	6	500 ns, ±5 to 24 V, single-ended TTL or differential, regulated 5 V supply output
	Quadrature encoder (differential)	NI 9411	2	500 ns, ±5 to 24 V, six digital inputs for two encoders (phase A, phase B, and index inputs)
	PWM/Pulse Generation (24 V)	NI 9472	8	100 µs, 6 to 30 V logic, 750 mA max per ch, 30 V protection, short-circuit-proof
		NI 9474	8	1 µs, high-speed, 5 to 30 V logic, 1 A max per ch, 30 V protection, short-circuit-proof
		NI 9476	32	500 µs, 6 to 36 V, 40 V protection, short-circuit-proof
		NI 9477	32	8 µs, 5 to 60 V, sinking, isolation, up to 20 A per module
	PWM/Pulse Generation (TTL)	NI 9401	8	100 ns, 5 V TTL, ultra high-speed, bidirectional, 30 V protection
		NI 9402	4	55 ns, LV TTL, ultra high-speed, 30 V protection
		NI 9403	32	7 µs, 5 V TTL, bidirectional, 30 V protection

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NI ENET-9211, NI ENET-9215, NI ENET-9215 BNC NI ENET-9219, NI ENET-9234, NI ENET-9237

- 10/100 BASE-T/X Ethernet port
- Up to 100 m cabling distance per segment
- Streaming measurements at more than 50 kS/s with 24-bit resolution
- C Series signal conditioning for thermocouples, RTDs, accelerometers, microphones, strain gages, current, and more
- Two digital PFI lines for triggering and sample clock import/export
- 0 to 55 °C temperature range
- 9 to 30 VDC power supply
- Panel and DIN-rail mounting kits available

Operating Systems
- Windows 7/Vista/XP/2000

Software Support
- LabVIEW
- LabWindows™/CVI
- Measurement Studio
- ANSI C/C++
- C# and Visual Basic .NET
- Visual Basic 6.0

Measurement Services Software (included)
- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility
- LabVIEW SignalExpress LE data-logging software



	Model	Signal Conditioning	Channels	Rate	Connectivity
Analog	ENET-9211	Thermocouple, 24-bit	4	14 S/s	Screw terminal
	ENET-9213	Thermocouple, 24-bit	16	1,200 S/s	Screw terminal
	ENET-9205	±200 mV to ±10 V, 16-Bit	32	250 kS/s	Spring Terminal, D-Sub
	ENET-9206	±200 mV to ±10 V, 16-bit for Fuel Cells	16	250 kS/s	Spring Terminal
	ENET-9215	Simultaneous sampling, 16-bit	4	100 kS/s/ch	Screw terminal, BNC
	ENET-9219	Universal (11 modes)	4	100 kS/s/ch	Spring terminal
	ENET-9234	IEPE (sound and vibration), 24-bit	4	51.2 kS/s/ch	BNC
	ENET-9237	Bridge completion, 24-bit	4	50 kS/s/ch	RJ50
Digital	ENET-9421	24 V Logic, , Sinking Digital Input	8	100 µs	Screw-terminal, D-Sub
	ENET-9472	24 V Logic, Sourcing Digital Output	8	100 µs	Screw-terminal, D-Sub
	ENET-9481	Relay [30 VDC(2A), 60VDC(1A), 250VAC(2A)]	4	10 ms	Screw Terminal

NI Ethernet Data Acquisition Devices

Simple, Secure Ethernet Data Acquisition

Ethernet data acquisition is an extension of PC-based data acquisition to measurement applications distributed over a large area or network. NI Ethernet data acquisition (DAQ) devices combine industry-standard Ethernet communication; direct sensor connectivity; and the flexibility of NI LabVIEW software for remote monitoring of electrical, physical, mechanical, and acoustical signals. NI Ethernet DAQ devices can stream data on each channel at more than 50 kS/s with 24 bits of resolution. With the flexibility of LabVIEW graphical programming and the ubiquity of Ethernet networking infrastructure, NI Ethernet DAQ makes it easy to incorporate remote connectivity into new or existing PC-based measurement or control systems.

NI ENET-9163 and C Series Hardware

Each National Instruments Ethernet DAQ device is a combination of an NI ENET-9163 wireless carrier and an NI C Series measurement module. The ENET-9163 provides IEEE 802.3 Ethernet connectivity back to a host PC. You can synchronize an ENET-9163 with other devices by using two onboard individually programmable digital trigger lines to export or import sample clocks, start triggers, pause triggers, and reference triggers.

C Series modules provide direct sensor connectivity and built-in signal conditioning for a variety of measurements, including temperature, strain, acceleration, current, voltage, and more. In addition to the ENET-9163, they may be used interchangeably for measurement and control applications with different chassis, including NI CompactDAQ and CompactRIO, and the NI carriers. You may purchase ENET-9163 carriers and select C Series modules separately or together in a kit as ENET-9xxx devices. See the table for alist of compatible devices.

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Recommended Software

NI Ethernet DAQ devices use the same NI-DAQmx API as hundreds of other NI PCI, PXI, and USB DAQ devices, so incorporating an NI Ethernet DAQ device into a new or existing measurement system is easy. 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 software. 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 the following:

- A configuration-based interface 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 C#, Visual Studio .NET, ANSI C/C++, or Visual Basic using Measurement Studio
- Multithreaded streaming technology for 1,000 times performance improvements
- More than 3,000 free software downloads that are available at **ni.com/zone** to jump-start your project
- A single programming interface for hundreds of PCI, PXI, USB, Wi-Fi, and Ethernet data acquisition hardware devices

NI Ethernet DAQ devices are compatible with the following versions (or later) of NI application software: LabVIEW 7.1, LabWindows/CVI 7.x, and Measurement Studio 7.x. They are also compatible with ANSI C/C++, C#, Visual Basic .NET, and Visual Basic 6.0.

Ordering Information

NI ENET-9163 carrier only 780501-01

Combined NI ENET-9163 and C Series Module Kits

NI ENET-9211 780502-01
NI ENET-9215 780503-01
NI ENET-9215 BNC 780504-01
NI ENET-9219 780505-01
NI ENET-9234 780508-01
NI ENET-9237 780506-01

Power Cord (Required)

North America, 240 VAC 763068-01
UK, 240 VAC 763064-01
Australia, 240 VAC 763066-01
Europe, 240 VAC 763067-01
Switzerland, 220 VAC 763065-01
Japan, 100 VAC 763634-01

Industrial Ethernet Switches (Optional)

NI UES-3880, unmanaged 780038-01
NI MES-3980, managed 780039-01

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NI WLS-9211, NI WLS-9215, NI WLS-9215 BNC NI WLS-9219, NI WLS-9234, NI WLS-9237

- IEEE 802.11b/g (Wi-Fi) wireless communication interface
- 30 m indoor, 100 m line of sight wireless signal range (typical)
- Advanced security with 128-bit AES data encryption and IEEE 802.11i (WPA2) support
- 10/100 BASE T/X Ethernet port
- Streaming measurements at more than 50 kS/s with 24-bit resolution
- C Series signal conditioning for thermocouples, RTDs, accelerometers, microphones, strain gages, current, and more
- Two digital PFI lines for triggering and sample clock import/export
- 0 to 55 °C temperature range
- 9 to 30 VDC power supply
- Panel and DIN-rail mounting kits available

Operating Systems

- Windows 7/Vista/XP/2000

Software Support

- LabVIEW
- LabWindows™/CVI
- Measurement Studio
- ANSI C/C++
- C# and Visual Basic .NET
- Visual Basic 6.0

Measurement Services Software (included)

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility
- LabVIEW SignalExpress LE data-logging software



	Model	Signal Conditioning	Channels	Rate	Connectivity
Analog	WLS-9211	Thermocouple, 24-bit	4	14 S/s	Screw terminal
	WLS-9213	Thermocouple, 24-bit	16	1,200 S/s	Screw terminal
	WLS-9205	±200 mV to ±10 V, 16-Bit	32	250 kS/s	Spring Terminal, D-Sub
	WLS-9206	±200 mV to ±10 V, 16-bit for Fuel Cells	16	250 kS/s	Spring Terminal
	WLS-9215	Simultaneous sampling, 16-bit	4	100 kS/s/ch	Screw terminal, BNC
	WLS-9219	Universal (11 modes)	4	100 kS/s/ch	Spring terminal
	WLS-9234	IEPE (sound and vibration), 24-bit	4	51.2 kS/s/ch	BNC
	WLS-9237	Bridge completion, 24-bit	4	50 kS/s/ch	RJ50
Digital	WLS-9421	24 V Logic, , Sinking Digital Input	8	100 µs	Screw-terminal, D-Sub
	WLS-9472	24 V Logic, Sourcing Digital Output	8	100 µs	Screw-terminal, D-Sub
	WLS-9481	Relay [30 VDC(2A), 60VDC(1A), 250VAC(2A)]	4	10 ms	Screw Terminal

NI Wi-Fi Data Acquisition Devices

Simple, Secure Wi-Fi Data Acquisition

Wi-Fi data acquisition is an extension of PC-based data acquisition to measurement applications where cables are inconvenient or uneconomical. NI Wi-Fi data acquisition (DAQ) devices combine IEEE 802.11b/g wireless or Ethernet communication; direct sensor connectivity; and the flexibility of NI LabVIEW software for remote monitoring of electrical, physical, mechanical, and acoustical signals. NI Wi-Fi DAQ devices can stream data on each channel at more than 50 kS/s with 24 bits of resolution. In addition, built-in NIST-approved 128-bit AES encryption and advanced network authentication methods offer the highest commercially available network security. With the flexibility of LabVIEW graphical programming and the ubiquity of 802.11 network infrastructure, NI Wi-Fi DAQ makes it easy to incorporate wireless connectivity into new or existing PC-based measurement or control systems.

NI WLS-9163 and C Series Hardware

Each National Instruments Wi-Fi DAQ device is a combination of an NI WLS-9163 wireless carrier and an NI C Series measurement module. The WLS-9163 provides both IEEE 802.11b/g and Ethernet connectivity back to a host PC. You can synchronize a WLS-9163 with other devices by using two onboard individually programmable digital trigger lines to export or import sample clocks, start triggers, pause triggers, and reference triggers.

C Series modules provide direct sensor connectivity and built-in signal conditioning for a variety of measurements, including temperature, strain, acceleration, current, voltage, and more. In addition to the WLS-9163, they may be used interchangeably for measurement and control applications with different chassis, including NI CompactDAQ and CompactRIO, and the NI USB-9162 and NI ENET-9163 carriers.

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You may purchase WLS-9163 carriers and select C Series modules separately or together in a kit as WLS-9xxx devices. See the table for a list of compatible devices.

Wireless Security

NI Wi-Fi DAQ devices implement the highest commercially available wireless network security standard, IEEE 802.11i (commonly known as WPA2), including network authentication and data encryption. Authentication ensures that only authorized devices have network access, and encryption prevents data packets from being intercepted. NI Wi-Fi DAQ devices support multiple Extensible Authentication Protocol (EAP) methods that provide for mutual authentication between the data acquisition devices and wireless access points (WAPs). These devices also support the Advanced Encryption Standard (AES), a 128-bit cryptographic algorithm endorsed by the National Institute of Standards and Technology for use in many U.S. government facilities. By using standard security protocols, NI Wi-Fi DAQ devices make it easy to add wireless measurements to existing IT networks safely.

Recommended Software

NI Wi-Fi DAQ devices use the same NI-DAQmx API as hundreds of other NI PCI, PXI, and USB DAQ devices, so incorporating an NI Wi-Fi DAQ device into a new or existing measurement system is easy. 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 software. 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 the following:

- A configuration-based interface 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 C#, Visual Studio .NET, ANSI C/C++, or Visual Basic using Measurement Studio
- Multithreaded streaming technology for 1,000 times performance improvements
- More than 3,000 free software downloads that are available at **ni.com/zone** to jump-start your project
- A single programming interface for hundreds of PCI, PXI, USB, Ethernet, and Wi-Fi data acquisition hardware devices

NI Wi-Fi DAQ devices are compatible with the following versions (or later) of NI application software: LabVIEW 7.1, LabWindows/CVI 7.x, and Measurement Studio 7.x. They are also compatible with ANSI C/C++, C#, Visual Basic .NET, and Visual Basic 6.0.

Ordering Information

NI WLS-9163 carrier only	780495-01
Combined NI WLS-9163 and C Series Module Kits	
NI WLS-9211	780496-01
NI WLS-9215	780497-01
NI WLS-9215 BNC	780498-01
NI WLS-9219	780499-01
NI WLS-9234	780507-01
NI WLS-9237	780500-01
Power Cord (Required)	
U.S., 120 VAC	763000-01
North America, 240 VAC	763068-01
UK, 240 VAC	763064-01
Australia, 240 VAC	763066-01
Europe, 240 VAC	763067-01
Switzerland, 220 VAC	763065-01
Japan, 100 VAC	763634-01
Industrial IEEE 802.11 Access Points (Optional)	
NI WAP-3701, North America	780036-01
NI WAP-3701, International	780037-01

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Portable Modular DAQ Systems
SCC Signal Conditioning Overview

NI SCC

- Signal conditioning for DAQ systems
- Up to:
  - 16 analog inputs
  - 8 digital I/O lines
  - 2 unconditioned counter/timers
- Measurement type and connectivity selectable on a per-channel basis
- Low-profile carriers for portable, rack-mount, and desktop applications
- NI-DAQ driver software simplifies configuration, measurement, and scaling

Sensors/Signals

- Thermocouples
- RTDs
- Strain gauges
- Force/load/torque/pressure sensors
- IEPE accelerometers
- Isolated voltage/current input
- Frequency input
- Lowpass filtering
- Isolated voltage/current output
- Isolated digital I/O
- Relay switching

Connectivity Options

- BNC
- Minithermocouple
- Thermocouple
- LEMO (B-series)
- MIL-Spec
- 9-pin D-Sub
- Banana jack
- SMB
- Momentary pushbutton switch
- Toggle switch
- Rocker switch
- LED
- Potentiometer
- Strain relief



Overview

National Instruments SCC provides portable, modular signal conditioning to your DAQ system. SCC conditions a variety of analog I/O and digital I/O signals. With this modular design, you choose your conditioning on a per-channel basis. SCC systems offer custom options for various sensors or signal connection types. While the low-profile carrier is perfect for use with PCMCIA DAQCards and DAQPads for portable applications, you can also use the system for rack-mounted or desktop applications. SCC modules works with all E Series and Basic multifunction DAQ devices.

SCC DAQ Systems

SCC DAQ systems consist of an SC-2345 Series shielded carrier, SCC modules, a DAQ device, and a cable. Each carrier can hold up to 20 SCC modules. Conditioned analog signals are passed directly to the inputs of the DAQ device. SCC modules can also provide up to 300 V of working isolation to voltage and current input/output signals from the DAQ device. Optically isolated digital I/O modules can condition digital lines from the DAQ device or you can access them directly using the 42-pin screw terminal mounted inside the box. Relay modules add switching to your SCC DAQ system, and you can access Analog Input, Analog Output, Digital I/O, Counter/Timer signals as well as timing and triggering signals from the DAQ device using feed through modules.

SCC Features

SCC offers flexibility, customization, and ease of use in a single, low-profile package.

Flexible I/O Options

SCC signal conditioning modules are either single or dual-channel modules that condition analog or digital signals. SCC modules are available for thermocouples, RTDs, strain gauges, force/load/torque /pressure sensors, accelerometers, voltage and current input, isolated voltage and current output frequency-to-voltage conversion, lowpass filtering, isolated digital I/O, relay switching and breadboarding for your custom circuitry.



Figure 1. SC-2345 with Configurable Connectors

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SCC Configuration Guide



SCC Configuration Guide

Step 1 - Select Your SCC Modules (Table 1)
Analog input, analog output, and digital I/O modules have dedicated slots. You can select up to eight noncascaded modules for analog input and eight modules for digital I/O. You can install feedthrough modules in any slot, but they are especially useful for accessing counter/timers on your M Series, E Series, or B Series multifunction DAQ device.

Step 2 - Choose an SCC Carrier (Table 2)
SCC carriers are available either with a hinged lid or with configurable connectors using panelettes. Hinged lids provide quick access to the modules. Configurable connectors provide custom signal- interface options.

Step 3 - Select Your Panelettes (Table 3)
If you have chosen an SCC carrier with configurable connectors, you can also select connector and interface panelettes. Different carriers offer different numbers of panelette slots. Also, some panelettes occupy more than one slot.



			Signal Types														
	Module	Number of Channels	Millivolts/Volts	Current (0 to 20 mA)	Frequency-to-Voltage	Thermocouples	RTD	Strain Gages	Force, Load, Torque, Pressure	Accelerometer	TTL/CMOS	Description	Gain	Signal Range	Filtering	Isolation	Excitation Sources	Excitation Values
Analog Input	SCC-AI0x	2 ISO	✓	-	-	-	-	-	-	-	-	Isolation amplifier	0.2 to 200	±50 mV to ±42 V	10 kHz	✓	-	-
	SCC-AI1x	2 ISO	✓	-	-	-	-	-	-	-	-	Isolation amplifier	1.2	±10V, ±5 V	4 Hz	✓	-	-
	SCC-A10	2 DI	✓	-	-	-	-	-	-	-	-	Attenuator	0.1	±60 V	-	✓	-	-
	SCC-LP01	2 DI	✓	-	-	-	-	-	-	-	-	Lowpassfilter	0.5	±10 V	25 Hz	-	-	-
	SCC-LP02	2 DI	✓	-	-	-	-	-	-	-	-	Lowpassfilter	0.5	±10 V	50 Hz	-	-	-
	SCC-LP03	2 DI	✓	-	-	-	-	-	-	-	-	Lowpassfilter	0.5	±10 V	150 Hz	-	-	-
	SCC-LP04	2 DI	✓	-	-	-	-	-	-	-	-	Lowpassfilter	0.5	±10 V	1 kHz	-	-	-
	SCC-FV01	2 RSE	✓	-	✓	-	-	-	-	-	-	Frequency- to-voltage	1	0 to 100 Hz		-	-	-
	SCC-TC01	1 DI	✓	-	-	✓	-	-	-	-	-	Thermocouple input	100	±100 mV	2 Hz	-	-	-
	SCC-TC02	1 DI	✓	-	-	✓	-	-	-	-	-	Thermocouple input	100	±100 mV	2 Hz	-	-	-
	SCC-RTD01	2 DI	✓	-	-	-	✓	-	-	-	-	RTD input	25	±400 mV	30 Hz	-	1 current	1 mA
	SCC-SG01	2 DI	✓	-	-	-	-	✓	✓	-	-	Strain (1/4-bridge,120 Ω)	100	±100 mV	41.6 kHz	-	1 voltage	2.5 V
	SCC-SG02	2 DI	✓	-	-	-	-	✓	✓	-	-	Strain (1/4-bridge,350 Ω)	100	±100 mV	41.6 kHz	-	1 voltage	2.5 V
	SCC-SG03	2 DI	✓	-	-	-	-	✓	✓	-	-	Strain (1/2-bridge)	100	±100 mV	21.6 kHz	-	1 voltage	2.5 V
	SCC-SG04	2 DI	✓	-	-	-	-	✓	✓	-	-	Strain (full-bridge)	100	±100 mV	1.6 kHz	-	1 voltage	2.5 V
	SCC-SG24	2 DI	✓	-	-	-	-	-	✓	-	-	Full bridge input (350 Ω)	100	±100 mV	1.6 kHz	-	1 voltage	10 V
	SCC-SG11	2 DI	-	-	-	-	-	✓	✓	-	-	Strain shunt calibration	-	-	-	-	-	-
	SCC-ACC01	1 DI	✓	-	-	-	-	-	-	✓	-	IEPE accelerometer input	2	±5 V	19 kHz	-	1 current	4 mA
	SCC-CI20	2 DI	-	✓	-	-	-	-	-	-	-	Current input	-	0 to 20 mA	-	-	-	-
Output	SCC-A010	1 ISO	✓	-	-	-	-	-	-	-	-	Isolated voltage output	-	±10 V	-	✓	-	-
	SCC-CO20	1 ISO	-	✓	-	-	-	-	-	-	-	Isolated current output	-	0 to 20 mA	-	✓	-	-
DIO/ CTR	SCC-DI01	1 ISO	-	-	-	-	-	-	-	-	✓	Isolated digital input	-	±24 VDC	-	✓	-	-
	SCC-DO01	1 ISO	-	-	-	-	-	-	-	-	✓	Isolated digital output	-	30 VDC	-	✓	-	-
	SCC- RLY01	1	✓	✓	-	-	-	-	-	-	-	SPDT Relay	-	5 A at 30 VDC 250 VAC	-	-	-	-
	SCC-CTR01	1 ISO	-	-	-	-	-	-	-	-	✓	Isolated counter/timer	-	0 to 48 VDC	-	✓	-	-
	SCC-FT0I	2 SE/I 01	-	-	-	-	-	-	-	-	-	Feedthrough	-	-	-	-	-	-

Table 1. SCC Module Selection Guide

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Step 4 - Determine Your Power Option (Table 4)

You can power an SCC system using a +5 VDC, 120/240 VAC, or 7 to 42 VDC external power source. To indicate the power option for your SCC system, select 01, 02, or 03 as the last two digits of the part number of the SC-2345 or SC-2350 carrier.

Please note that if you choose power option 01, it is possible to power your SCC system using the internal power source of your DAQ device. For DAQCard and DAQPad devices, the total power required by your SCC modules must be less than 800 mW (490 mW of analog power). For PCI or PXI, M Series or E Series multifunction DAQ devices, the total power required by your SCC modules must be less than 4.55 W (1.74 W for analog modules). Additional power modules are sold separately. To determine the power requirements of the modules in your SCC DAQ system, use the online SCC Advisor at **ni.ccm/advisors**.

SC-2345 and SC-2350 Carriers



Description	Number of Panelette Slots
SCC carrier with a hinged lid	-
SCC carrier with configurable connectors (side 68-pin interface)	18
SCC carrier with configurable connectors (rear 68-pin interface)	15

Table 2. SCC Carriers

Panelettes



Panelette	Description	Connectors/Units per Panelette	Slot Width
Minithermocouple jack	J or K-type	2	1
	or uncompensated	2	1
Thermocouple jack	J or K-type	1	1
	or uncompensated	1	1
BNC	BNC connector	2	1
SMB	SMB connector	4	I
Banana jack	Banana jack	2	1
LEMO (B Series)	2-pin female	2	1
	4, 6-pin female	1	1
MIL-C-26482	2, 4, or 6-pin female	1	1
9-pin D-Sub	Single (male - female)	1	2
	Dual (male - female)	2	3
Momentary switch	On - off	2	1
Toggle switch	On - off- on	2	1
Rocker switch	On - off- on	1	1
LED	A red, green, yellow, and orange LED	4	1
Potentiometer	1 turn, 10 kΩ	1	1
Strain relief	Small	1	-
Blank	Filler panel	-	-

Table 3. Panelettes

Step 5 - Select Your DAQ Device and Cable (Table 5)

Select the DAQ device to control your system.

Step 6 - Select Your Accessories

Choose from rack/panel-mount kits and stacking kits. You can also select additional power kits separately if your application requires multiple power configurations.

Power Options

Power Type	Power Supplied By	Power Option
+5 VDC	DAQCard/DAQPad (800 mW maximum) PCI/PXI (4.55 W maximum)	-01
120 VAC, 240 VAC	External [1]	-02
7 to 42 VDC	External [2]	-03

[1] AC transformer included. However, you must purchase a separate power cord to match your country's power requirements.

[2] External power supply not included.

Table 4. SC-2345/SC-2350 Power Options

Recommended DAQ Devices



Product	Multifunction I/O Features	Bus	Cabling to
M Series	Multifunction I/O	PCI, PXI	SHC68-68-EP
DAQCard-6036E	16-bit, 200 kHz	PCMCIA	SHC68-68-EP
DAQPad-6020E	12-bit, 100 kHz	USB	SH68-68-EP
DAQPad-6070E	12-bit, 1 MHz	IEEE 1394	SH68-68-EP
68-pin PCI/PXI E Series	Multifunction I/O	PCI, PXI	SH68-68-EP
100-pin PCI/PXI E Series	Multifunction I/O	PCI, PXI	SH1006868
B Series	Multifunction I/O	PCI	SH68-68-EP

Table 5. National Instruments DAQ Devices

For more assistance in configuring your see system, visit the SCC Advisor at ni.com/advisors.

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Portable, Shielded SCC Module Carriers

NI SC-2345 Series, NI SC-2350

- Accept up to 20 SCC modules
- Portable, low-profile packaging
- Cable directly to an M Series, E Series, or B Series multifunction device
- Powered by DAQ device (additional power options available)

SC-2345 Connector Block
- Screw-terminal connectivity

SC-2345 with Configurable Connectors
- Panelettes for direct sensor connectivity, control, and display
- Blank panelettes for filler

SC-2350
- Accepts up to 16 channels of TEDS Class II smart sensors
- Panelettes for direct sensor connectivity

Operating Systems
- Windows 7/Vista/XP/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- Lookout
- VI Logger

Other Compatible Software
- Visual Basic
- C/C++, C#

Measurement Services Software
- NI-DAQmx



Overview

The National Instruments SC-2345 Series consists of two types of carriers, the NI SC-2345 connector block and the SC-2345 with configurable connectors. The SC-2350 is a similar carrier with configurable TEDS (transducer electronic data sheet) connectors for connecting to smart TEDS sensors. These enclosures for SCC signal conditioning modules connect directly to 68-pin DAQ devices. They include sockets for SCC modules, along with screw terminals for convenient connection to digital I/O and counter/timer (GPCTR) signals from the DAQ device. These carriers offer three power options to increase the flexibility of deployment.

SC-2345 Connector Block

The SC-2345 includes 20 SCC sockets, labeled J1 through J20 (see Figure 1). Sockets J1 through J8 accommodate SCC modules for conditioning signals on the analog input channels of the DAQ device. For example, an SCC module plugged into socket J1 conditions signals for channels 0 and 8 of the device.

You can use sockets J9 through J16 for either digital I/O modules or dual-stage analog input conditioning. When using dual-stage conditioning of analog inputs (for applicable modules only in the SC-2345 series carriers), wire your input signal to the first-stage module (in sockets J9 through J16). The SC-2345 routes the output signal of the first-stage SCC module to the input of the second stage SCC module internally (see Figure 2). When using sockets J9 through J16 for digital I/O, simply plug in a digital SCC module or the SCC-FT01 for custom digital applications. You can use any combination of SCC digital input or digital output modules. The digital I/O lines of M Series, E Series, or B Series DAQ devices are configurable for input and output on a line-by-line basis. You can also access the DIO lines of the DAQ device using the screw-terminal block.

Sockets J17 through J20 access the two analog output channels and the GPCTR channels 0 and 1.

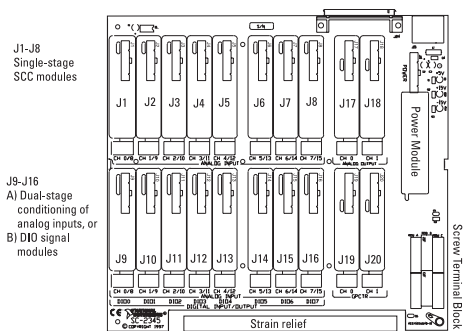


Figure 1. SC-2345 Connector Block Socket Diagram

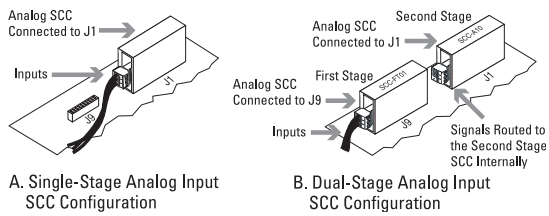


Figure 2. SCC Configuration for Single-Stage and Dual-Stage Analog Input

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SC-2345 with Configurable Connectors

The SC-2345 with Configurable Connectors is electrically and functionally identical to the SC-2345 connector block. The only differences are the orientation of some modules and the addition of I/O connector and interface panelettes. This carrier is available with either a side 68-pin connector (recommended for DAQCard products) or a rear 68-pin connector (recommended for DAQPad products). The SC-2345 with Configurable Connectors handles dual-stage conditioning and digital I/O modules. It also offers custom connectivity by adding panelettes along its front and rear panels. Select up to 18 panelettes for side-mount 68-pin versions, or 15 panelettes for rear-mount 68-pin versions. With I/O panelettes, you can connect your sensor directly to the SCC system. With interface panelettes, you can add hardware controls and displays to your system. Blank panelettes are also available to fill unused positions or for modification to fit your custom application needs.

SC-2350

The SC-2350 includes 10 SCC module sockets, labeled J1 through J8, J17, and J18 (see Figure 3). Sockets J1 through J8 accommodate SCC modules for conditioning signals on the analog input channels of the DAQ device. For example, an SCC module plugged into socket J1 would condition signals for channels 0 and 8 of the device. You can use sockets J17 and J18 for SCC modules that condition analog signals on the output channels of the DAQ device.

The SC-2350 contains a TEDS microcontroller with two digital lines per analog input channel for communication with Class II smart TEDS sensors. For more information on smart TEDS sensors, see **ni.com/sensors**.

Sensors Plug&Play

The IEEE 1451.4 standard delivers plug-and-play capability to analog sensors. End users, systems integrators, and developers can automate the configuation of measurement systems for analog sensors. By defining an easy add-on approach that brings TEDS benefits to all types of sensors, the standard makes data acquisition systems easier to set up, configure, and maintain. The TEDS structure is compact and flexible enough to handle a wide range of sensor requirements.

Smart TEDS Sensors

An IEEE 1451.4 smart TEDS sensor consists of the analog components and an embedded memory chip, which together provide the mixed-mode interface for analog and digital signals.
A smart TEDS sensor identifies and describes itself - providing the manufacturer, sensor model number, serial number, measurement range, sensitivity, and calibration information. TEDS information resides on a memory chip (EEPROM) within the sensor and is accessed by measurement systems such as the SC-2350 via a simple low-cost serial interface. To determine the cabling needed for your configuration, see Table 2.

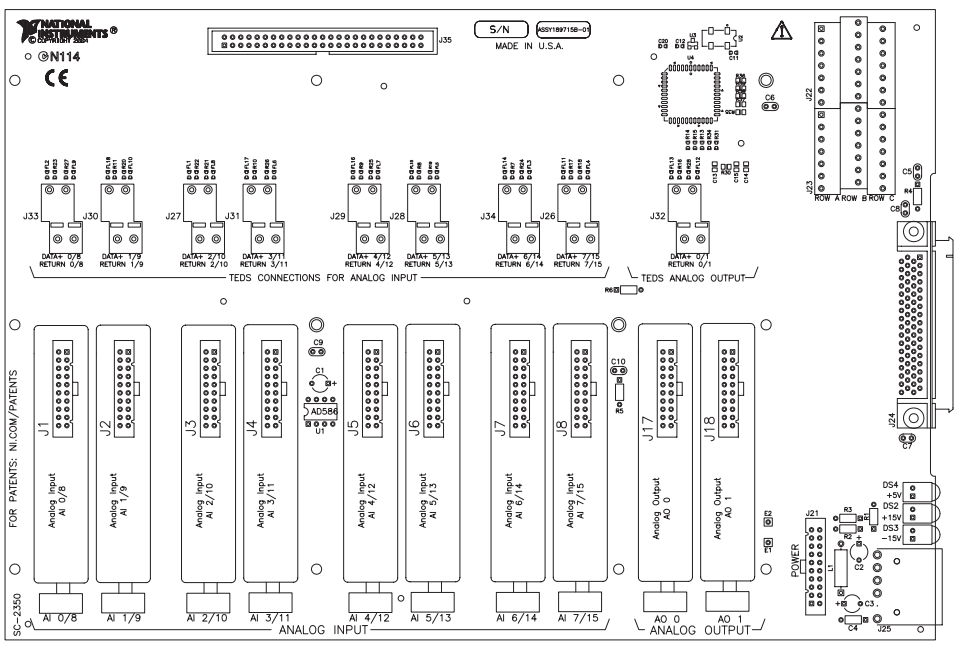


Figure 3. SC-2350 Socket Diagram

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Panelette	Description	Connectors/Units per Panelette	Slot Width
Minithermocouple jack	J or K-type	2	1
	or uncompensated	2	1
Thermocouple jack	J or K-type	1	1
	or uncompensated	1	1
BNC	BNC connector	2	1
SMB	SMB connector	4	1
Banana jack	Banana jack	2	1
LEMO (B Series)	2-pin female	2	1
	4, 6-pin female	1	1
MIL-Spec	2, 4, 6-pin female	1	1
9-pin D-Sub	Single (male)	1	2
	Single (female)	1	2
	Dual (male)	2	3
	Dual (female)	2	3
Momentary switch	On - off	2	1
Toggle switch	(On - off - on)	2	1
Rocker switch	(On - off - on)	1	1
LED	Red, green, yellow, and orange LEDs	4	1
Potentiometer	1 turn, 10 Ω	1	1
Strain relief	Small	1	2
Blank	Filler panel	-	-

Table 1. SC-2345/SC-2350 Panelette Options

Panelettes

If you choose either of the two versions of the SC-2345 with configurable connectors or the SC-2350 as your carrier, then you can install connectivity and interface panelettes to customize your SCC system. Panelette options (see Table 1, Figure 4) include BNC, SMB, LEMO (B Series), MIL-Spec, banana jack, thermocouple plug, 9-pin D-Sub connectors, rocker switches, toggle switches, momentary switches, potentiometers, and LEDs. Please note, some panelettes occupy more than one panelette slot. All panelettes except for the strain-relief options include lead wires that you connect to the screw terminals of any SCC module or to the 42-pin screw-terminal block inside the SC-2345 or SC-2350. The thermocouple and mini thermocouple jack connector wires are made of the appropriate metals to avoid forming unwanted cold junctions.

Screw Terminals

Each SC-2345 and SC-2350 shielded carrier includes a 42-position screw terminal block for easy access to digital lines of the M Series or E Series DAQ device, including P0<3,5,6,7>, PFI<0 .. 9>, CTR 0,1, +5 V, D GND, AI SENSE, FREQ OUT, EXTSTROBE, and AI HOLD COMP.

Accessories

The SC-2345 with configurable connectors and SC-2350 offer two optional accessories. For 19 in. rack systems, choose the rack-mount kit. If you are using two SCC systems, or a single SCC system with a DAQPad device, choose the stacking kit to mechanically attach both systems.

Power Options

SC-2345 and SC-2350 carriers have three power options:

- SCC-PWR01 - 5 VDC from the DAQ device or an external supply
- SCC-PWR02 - universal AC external supply
- SCC-PWR03 - 7 to 42 VDC external supply module (power supply not included)

One power module is included with your carrier. Power modules are sold separately in case you want to use your SC-2345 or SC-2350 in two or more configurations.

If you choose the SCC-PWR01, it is possible to power your SCC system with the internal power source of your DAQ device.

NI DAQCard and DAQPad devices provide 800 mW of total power (480 mW of analog power) from their internal source. NI PCI and PXI devices provide 4.50 W of total power (1.74 W of analog power) from their internal source. If the power draw from your SCC modules is greater than the power available from your DAQ device, then you must use an external power source. The SCC-PWR02 includes an AC transformer. However, you must purchase an additional power cord to match your country's power requirements.

The SCC-PWR03 does not include a transformer but can be used with an external transformer that provides 7 to 42 VDC. To determine the valid power options for the modules in your SCC DAQ system, use the online SCC Advisor at **ni.com/advisors**.


Minithermocouple


BNC


SMB


9-Pin D-Sub


Banana Jack


LEMO (B Series)


MIL-Spec


Toggle Switch


Rocker Switch


Strain Relief


LED


Potentiometer


Momentary Switch

Figure 4. SC-2345/SC-2350 Panelettes

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Cabling

You connect your SC-2345 or SC-2350 to your DAQ device using standard cables. To determine the cabling needed for your configuration, see Table 2.

DAQ Device	SC-2345/SC-2350
M Series	SHC68-68-EP
68-pin E Series or B Series	SH68-68-EP [1]
100-pin E Series	SH100686 [2]
Latching E Series DAQCard-6062E/6036E/6024E	SHC68-68-EP

[1] Can also use the SH68-68R1 or R6868 [2] Only the first 68 pins will interface to an SC-2345

Table 2. Cabling Options

Ordering Information

NI SC-2345 with
- SCC-PWR01 777458-01
- SCC-PWR02 777458-02
- SCC-PWR03 777458-03

NI SC-2345 with Configurable Connectors (side 68-pin) with
- SCC-PWR01 777722-01
- SCC-PWR02 777722-02
- SCC-PWR03 777722-03

NI SC-2345 with Configurable Connectors (rear 68-pin) with
- SCC-PWR01 778018-01
- SCC-PWR02 778018-02
- SCC-PWR03 778018-03

SC-2350 with
- SCC-PWR01 778990-01
- SCC-PWR02 778990-02
- SCC-PWR03 778990-03

Separate Power Modules

SCC-PWR01 183971-01
SCC-PWR02 183971-02
SCC-PWR03 183971-03

Power Cords for the SCC-PWR-02

U.S. 120 VAC 763000-01
Japanese 100 VAC 763634-01
United Kingdom 240 VAC 763064-01
Swiss 220 VAC 763065-01
Australian 240 763066-01
Universal Euro 240 VAC 763067-01
North American 240 VAC 763068-01

Panelettes

Minithermocouple
- J-type (accepts 2 thermocouples) 184736-01
- K-type (accepts 2 thermocouples) 184736-02
- Uncompensated (accepts 2 thermocouples) 184736-03

Thermocouple, J -type 187597-01
Thermocouple, K-type 187597-02
Thermocouple, uncompensated 187597-03
BNC (2 connectors) 184737-01
Banana jack (2 jacks) 186405-01
LEMO (B Series)
- 2-pin, female 187585-01
- 4-pin, female 187585-02
- 6-pin, female 187585-03

MIL-C-26482 (Series 1)
- MS 3112 E 8-2 S 187591-01
- MS 3112 E 8-2 S 187591-02
- MS 3112 E 8-4 S 187591-03

Panelettes (continued)

SMB (4 included) 185505-01
9-pin D-Sub
- 1 male 184738-01
- 2 male 184738-02
- 1 female 184738-03
- 2 female 184738-04

Strain relief (small) 184721-01
Blank 184483-01
Momentary push-button switches (2 included) 185380-01
Rocker switch (on/off/on) 185379-01
Toggle switches (on/off/on, 2 included) 185378-01
Potentiometer (10 kΩ, single-turn) 185377-01
LEDs (4 included - 1 green, 1 red, 1 orange, 1 yellow) 185376-01

Cables

SH6868-EP
- 1 m 184749-01
- 2 m 184749-02

SH68-68R1-EP 187051-01
R6868 182482-01
SH1006868
- 1 m 182849-01
- 2 m 182849-02

PSHR68-68 shielded cable kit 777293-01
SHC6868-EP 186838-01

Accessories

Rack-mount kit (1U) 777665-01
Stacking kit 777666-01
Panel-mount kit 187243-01
Strain-relief kit [1] 187407-01

[1] You cannot use the strain relief kit in conjunction with the rack-mount, panel-mount, or stacking kits.

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Modular DAQ Systems – SCXI Signal Conditioning Overview

NI SCXI

Critical Technologies for Measurement and Automation
- Programmable channel configuration
- NIST-traceable calibration services
- Direct sensor and signal connectivity
- Software integration with LabVIEW, LabWindows/CVI, and Measurement Studio
- Rugged packaging
- Shielded design

Signal Conditioning for DAQ Systems
- Wide variety of analog and digital I/O options
- Expandable to 3,072 channels per DAQ device
- Up to 333 kS/s scanning rates in multiplexed mode
- Up to 1.2 MS/s scanning rates in parallel mode

Front-End Switching System for Instruments
- Multiplexer, matrix, and general-purpose switching options
- 2-wire handshaking with external instruments
- NI-SWITCH IVI-compliant switch driver

USB Connectivity
- USB data acquisition module
  - 16-bit, 200 kS/s
  - Autodetection by PC



Modular Signal Conditioning and Switching

National Instruments SCXI provides high-performance signal conditioning and switching to your DAQ system. Using SCXI you can measure sensor outputs and raw signals, generate voltages or currents, monitor digital lines, or route signals with switching in a single integrated system.

An SCXI DAQ system consists of multichannel signal conditioning modules installed in one or more rugged chassis. You can choose from a wide offering of analog input, analog output, digital I/O, and switching modules to customize your system and match your application needs. You can deploy SCXI in desktop, portable, or rack-mount DAQ systems.

Conditioning Options

SCXI offers analog input signal conditioning modules for the most common sensors, including thermocouples, RTDs, strain gages, load cells, accelerometers, and LVDTs. SCXI also offers common signal conditioning technologies including amplification, attenuation, isolation, excitation, simultaneous sampling, programmable filtering, and frequency-to-voltage conversion. Finally, you can integrate SCXI modules for analog output, digital I/O, and switching options into the same system as your application demands.

Software

Develop your system quickly and easily with NI-DAQmx measurement services software. First, configure your system with NI Measurement & Automation Explorer, with which you autodetect your SCXI modules. Next, create named channels with built-in scaling for various sensors. Test each channel to confirm proper acquisition. Finally, develop your application with the same tools you use for your DAQ device, such as DAQ Assistant with automatic code generation.

SCXI DAQ System Benefits

An effective DAQ system should incorporate the critical signal conditioning technologies you need without sacrificing the measurement accuracy, power, or flexibility of your custom solution. You can configure an SCXI DAQ system to accept a wide variety of sensor and signal types and easily reconfigure or expand it for future application demands.

Analog Inputs

Thermocouples
- RTDs/thermistors
- Strain/force/load/torque/pressure sensors
- Accelerometers
- LVDTs/RVDTs/resolvers
- Millivolts
- High voltage (up to 1000 V, CAT I)
- Current (4 to 20 mA)
- Frequency-to-voltage

Analog Outputs
- Voltage
- Current (4 to 20 mA)

Switch Topologies
- General-purpose
- Multiplexer
- Matrix

Digital I/O
- TTL
- High voltage (up to 240 V)

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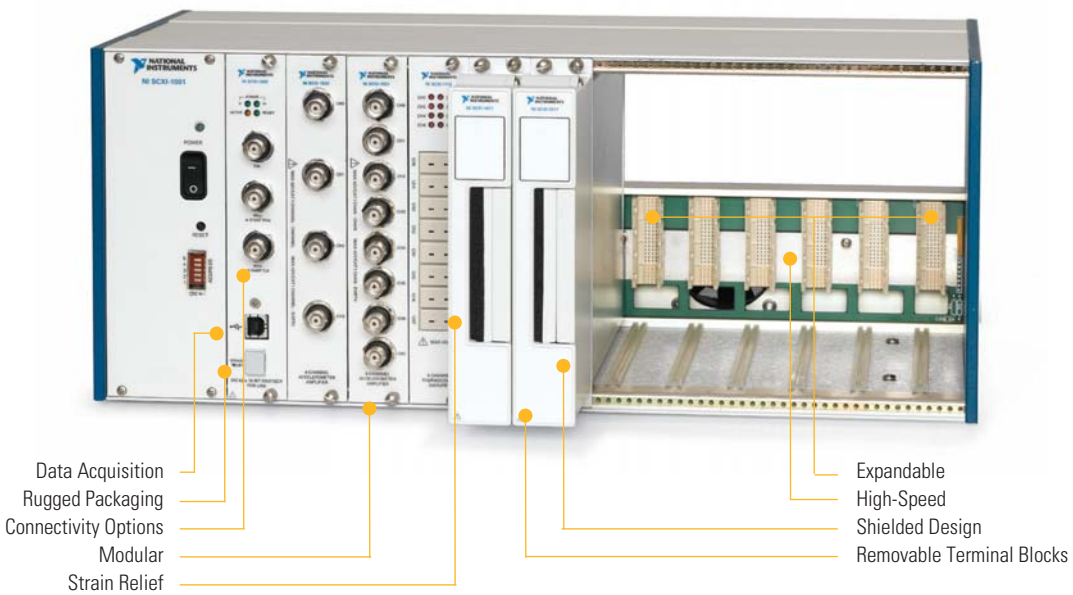
Signal Conditioning

- Amplification/attenuation
- Isolation
- Filtering
- Cold-junction compensation
- Transducer excitation
- Remote sensing
- Open-thermocouple detection
- Bridge completion
- Shunt calibration
- Offset nulling
- Simultaneous sampling

System Operation

SCXI is a programmable signal conditioning system designed for measurement and automation applications. Using the intricate timing and triggering of SCXI, you can sample analog input channels across all modules in all chassis at rates up to 333 kS/s in multiplexed mode. You can sample up to 1.2 MS/s in parallel mode. Expanding your system to include more signal conditioning options, such as analog output, digital I/O, or switching, is as simple as plugging in another module.

SCXI modules offer two modes of operation - multiplexed and parallel. In multiplexed mode, each SCXI analog input module multiplexes its input channels to a common analog line. Multiplexed mode is very cost-effective for high-channel-count systems. The SCXI USB data acquisition module operates in multiplexed mode. In parallel mode, each SCXI module is controlled by an independent DAQ device. Channels are conditioned and passed through independently. In this mode of operation, you can acquire at rates as fast as your DAQ device can sample. Parallel mode is ideal for applications that require high acquisition rates.



Characteristic	Benefit
Autodetection	USB DAQ module provides complete autodetection of all modules and chassis.
Modularity	Select your analog, digital, and switching conditioning technologies on a per module basis.
Broad Conditioning Options	With SCXI, choose from conditioning for various transducers, large or small voltages, current, frequency signals, digital I/O, switching, filtering, or simultaneous sampling.
Programmability	Configure each channel for the gain, filtering, and excitation level you need.
Expandability	Expand your SCXI system to 3,072 channels per DAQ device, meeting present and future application demands.
NIST-Traceable Calibration Servicce	NI delivers calibration certificates with selected SCXI modules, guaranteeing your module performs accurately upon receipt. Some modules include onboard calibration.
Direct Sensor Connectivity	Choose from SCXI modules with BNC, thermocouple, SMA, or SMB connections directly on the module. Choose various terminal block options to simplify module removal without tedious signal rewiring.
System Protection	Incorporate isolated I/O modules to protect your system from improper wiring, ground loops, accidental faults, and large transient signals.
Easy-to-Use Configuration	Software features such as module autodetection, named channels with built-in scaling, programmable channel settings, and signal test panels simplify system installation and configuration.
High-Bandwidth	With the high-speed SCXIbus, you can acquire analog signals at rates up to 333 kS/s. This technology is critical for high-speed or high-channel-count applications.
Hardware Integration	Combine analog input, analog output, digital I/O, and switching technologies into a single, unified platform.
Software Integration	Configure, develop, and test your SCXI-based system with the same tools as your DAQ device or instrument.
Rugged Design	SCXI modules are individually shielded, and installed into a rugged chassis, maintaining signal integrity in a robust package.
Open System	Include SCXI modules from third-party vendors or build your own custom signal conditioning for SCXI with custom module development tools.

Table 1. SCXI System Benefits

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SCXI Configuration Guide

Interactively Build Your SCXI System Online

Use the SCXI Advisor to quickly and easily specify and configure your SCXI measurement system online. The SCXI Advisor leads you step by step through the selection of the modules, terminal blocks, chassis, measurement device, and cabling you need for your application.

After building your system, you can review an online quotation to see the total price of your complete system in your local currency. When you are satisfied with your SCXI system configuration, you can order your system through our online store. Visit **ni.com/advisor** to use the SCXI Advisor.

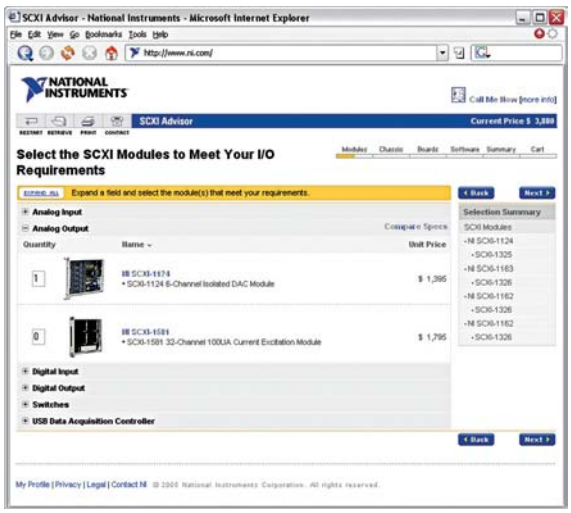


Figure 1. Use the SCXI Advisor to quickly configure your system

An SCXI DAQ system consists of six basic components - SCXI modules, terminal blocks, chassis, measurement device, cable assembly, and accessories. Use the steps below to choose the correct components to build your SCXI DAQ system.

Step 1 - SCXI Modules

SCXI modules condition analog and digital signals and sensors. Select the SCXI analog input, analog output, digital I/O, and switching modules to meet your I/O requirements. See Table 3 for module descriptions.

Step 2 - SCXI Terminal Blocks

Connect your I/O signals to SCXI modules using terminal blocks. You can choose from front-mounting, rack-mount, or DIN-rail-mount terminal block styles. Select one terminal block for each SCXI module, if the module requires it.

Step 3 - Chassis

SCXI chassis provide power to the SCXI modules, and handle all signal routing between your SCXI modules and your digitizer. Select your chassis for the number of modules you have chosen. You can use multichassis adapters to connect up to eight SCXI chassis together. See Table 1 to select the appropriate chassis.

Step 4 - Measurement Devices

Each SCXI system requires a measurement/control device. The SCXI-1600 provides analog-to-digital conversion and controls analog output and digital I/O modules. It connects to the PC by USB. If you are not using the SCXI-1600, the chassis must be cabled to and controlled by a plug-in DAQ device. The most popular plug-in DAQ devices are listed in Table 2.

Step 5 - Cable Assemblies

SCXI cable assemblies are only required if you are not using the SCXI-1600. SCXI cable assemblies connect the SCXI chassis in your system to the measurement devices. Select one SCXI cable assembly for each measurement device in your system. Multichassis systems require additional multichassis adapters for each SCXI chassis.

Single-chassis systems in a PXI-1050 or PXI-1052 chassis do not require an SCXI cable assembly.

Step 6 - Accessories

Choose from a wide variety of accessories to complete your system, including rack-mount adapters and filler panels.

Chassis	SCXI Slots	PXI Slots	Power
SCXI-1000[1]	4	-	AC
SCXI-1000DC	4	-	DC
SCXI-1001[1]	12	-	AC
PXI-1050[1]	4	8	AC
PXI-1052[1]	8	4	AC

[1]AC/DC converters can be used with AC chassis listed above.

Table 1. SCXI Chassis

Measurement Device	Cable Assembly	System Configuration	Length (m)
SCXI-1600	USB cable	Single-chassis	1, 2
M Series	SCXI-1349 [1]	Single-chassis	0.5, 1, 2
PCI 68-pin E Series	SCXI-1349 [2]	Single-chassis	1, 2, 5, 10
DAQCard-6036E	SCXI-1349 [3]	Single-chassis	0.5, 1, 2
DAQCard-6062E	SCXI-1349 [4]	Single-chassis	0.5, 1, 2
Any E Series device	SCXI-1346 [2]	Multichassis	1, 2, 5, 10
NI 4060, NI 407x	SCXI-1357	Single 4-slot SCXI	1, 2 chassis
NI 4060, NI 407x	SCXI-1358	Single 12-slot SCXI	1, 2 chassis[1]

[1] Requires SHC68-68-EPM cable (sold seperately). [2] SH68-68-EP cable (sold separately).
[3] Requires SHC68-68-EP cable (sold seperately). [4] Requires PSHR68-68 cable (sold separately).

Table 2. SCXI Cable Assemblies

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	Module	Channels	Signal Types: Millivolts/Volts	Medium Voltage (60 V)	High Voltage (300 V/1000 V8)	Current (4 to 20 mA)	High Current (5 A)	Frequency-to-Voltage	Thermocouples	RTDs/Thermistors	Strain Gages	Force, Load, Torque, Pressure	LVDTs, RVDTs, Resolvers	Accelerometers	TTL/CMOS	Description	Gain	Ranges/ Signal Types	Filtering	Isolation	Excitation Values	Parallel Mode
USB	SCXI-1600	1 DI	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	⊘	USB digitizer	1 to 200	±0.05 to ±10 V	-	-	-	-
Analog Input	SCXI-1100	32 DI	✓	-	-	✓	-	-	✓ ✓	-	-	-	-	-	-	Multiplexer amplifier	1 to 2000 (program)	±2.5 mV to ±10 V, 4 to 20 mA	4 Hz, 10 kHz, bypass	-	-	-
	SCXI-1102	32 DI	⊘	-	-	⊘	-	-	⊘	⊘	-	-	-	-	-	Thermocouple amplifier	1 or 100 (per channel)	±100 mV to ±10 V 4 to 20 mA	2 Hz	-	-	-
	SCXI-1102B, SCXI-1102C	32 DI	⊘	-	-	✓	-	-	-	-	-	-	-	-	-	Multiplexer amplifier	1 or 100 (per channel)	±100 mV to ±10 V 4 to 20 mA	1102B - 200 Hz 1102C - 10 kHz	-	-	-
	SCXI-1104, SCXI-1104C	32 DI	✓	⊘	-	-	-	-	-	-	-	-	-	-	-	Multiplexer	0.1	±60 VDC; ±42 VAC	1104 - 2 Hz 1104C - 10 kHz	-	-	-
	SCXI-1112	8 DI	-	-	-	-	-	-	⊘	-	-	-	-	-	-	Thermocouple input	100	TC	2 Hz	-	-	-
	SCXI-1120	8 ISO	✓	✓	✓	✓	-	-	✓	-	-	-	-	-	-	Isolation amplifier	1 or 2000 (per channel)	±2.5 mV to ±1000 V 4 to 20 mA	4 Hz, 10 kHz (per channel)	250 V_{rms} (CAT II)	-	✓
	SCXI-1120D	8 ISO	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	Wide band isolation amplifier	1 to 1000	±50 mV to ±1000 V (per channel)	4.5 kHz, 22.5 kHz (per channel)	250 V_{rms} (CAT II)	-	✓
	SCXI-1121	4 ISO	✓	✓	✓	✓	-	-	✓	✓	✓	✓	-	-	-	Isolation	1 or 2000 (per channel)	±2.5 mV to ±250 V 4 to 20 mA; TC	4 Hz, 10 kHz (per channel)	250 V_{rms} (CAT II)	3.33 V, 10 V 0.15 mA 0.45 mA	✓
	SCXI-1122	16 ISO	✓	✓	✓	✓	-	-	✓	✓	✓	✓	-	-	-	Isolation multiplexer amplifier	1 or 2000 (program)	±2.5 mV to ±250 V 4 to 20 mA	4 Hz, 4 kHz	480 V_{rms} (CAT II)	3.33 V, 1 mA	-
	SCXI-1125	8 ISO	⊘	⊘	⊘	⊘	-	-	⊘	-	-	-	-	-	-	Isolation amplifier	1 or 2000 (per channel)	±2.5 mV to ±1000 V 4 to 20 mA; TC4	4 Hz, 10 kHz (per channel)	300 V_{rms} (CAT II)	-	✓
	SCXI-1126	8 ISO	✓	✓	✓	✓	-	⊘	-	-	-	-	-	-	-	Programmable isolated F-to-V	-	±50 mV to ±1000 V 15 Hz to 128 kHz	-	250 V_{rms} (CAT II)	-	✓
	SCXI-1140	8 DI	✓	-	-	-	-	-	-	-	-	-	-	-	-	SSH7 amplifier	1 to 500 (per channel)	±10 mV to ±10 V	-	-	-	✓
	SCXI-1141, SCXI-1142, SCXI-1143	8 DI	✓	-	-	-	-	-	-	-	-	-	-	-	-	Programmable Lowpass Filter	1 or 100 (per channel)	±50 mV to ±5 V	10 Hz to 25 kHz	-	-	✓
	SCXI-1503	16 DI	-	-	-	-	-	-	⊘	⊘	-	-	-	-	-	Voltage or resistive input	1 or 100 (per channel)	±100 mV or ±10V	5Hz	-	100uA	-
	SCXI-1520	8 DI	✓	-	-	-	-	-	-	-	⊘	⊘	-	-	-	Programmable strain input module w/SSH7	1 or 1000 (per channel)	±10 mV to ±10 V strain gage	10 Hz to 10 kHz (program per channel)	-	0 to 10 V (17 settings)	✓
	SCXI-1521, SCXI-1521B	24 DI	-	-	-	-	-	-	-	-	✓	-	-	-	-	Programmable strain input	42	0 to 250 mV strain gage	10 Hz	-	0, 1.25, 2.5, 5 V programmable	-
	SCXI-1530, SCXI-1531	4/8 SE or DI	✓	-	-	-	-	-	-	-	-	-	-	⊘	-	Programmable accelerometer input w/SSH7	1 or 100 (per channel)	±50 mV to ±5 V AC coupled accelerometer	2.5 to 20 kHz (program per channel)	-	4 mA (program per channel)	✓
	SCXI-1540	8 DI	-	-	-	-	-	-	-	-	-	-	⊘	-	-	Programmable LVDT input	0.8 to 25	±0.5 to ±6 V_{rms} (per channel)	250 Hz (per channel)	-	1 to 3 V_{rms} 2.5 to 10 kHz	-
Analog Output	SCXI-1124	6 ISO output	⊘	-	-	⊘	-	-	-	-	-	-	-	-	-	Isolated output	Voltage/current (per channel)	±1 to ±10 V, 1 to 10 V, 0 to 20 mA	-	250 V (CAT II)	-	-
	SCXI-1581	32	-	-	-	-	-	-	-	⊘	-	-	-	-	-	Current excitation	-	-	-	-	100 µA	-
DIO/CTR	SCXI-1162, SCXI-1162HV	32	-	-	✓	-	-	-	-	-	-	-	-	-	⊘	Isolated digital input	-	TTL/CMOS ±240 VAC/VDC	-	300 V_{rms}	-	✓
	SCXI-1163	32	-	-	-	-	-	-	-	-	-	-	-	-	⊘	Isolated digital output	-	TTL/CMOS	-	300 V_{rms}	-	✓

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SCXI Data Acquisition Systems – 16-Bit, 200 kS/s USB Data Acquisition Module

NI SCXI-1600

- 200 kS/s for up to 352 channels
- 16-bit resolution
- Controller and digitizer for SCXI chassis
- ±10 V input range
- USB 2.0 connectivity to PC
- BNC connectors for:
  - Digital start trigger
  - External clock source
  - External calibration
- Internal calibration source
- NI-DAQmx to simplify configuration and measurements

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio

Measurement Services Software (included)
- NI-DAQmx



Device	Connection to PC	Analog Inputs	Resolution	Sampling Rate	Input Range	Triggers
SCXI-1600	USB 2.0 full-speed compliant	Up to 352 [1]	16 bits	200 kS/s	±0.05 to ±10 V	Digital (1)

[1] Multiplexed through a single channel analog-to-digital converter

Table 1. SCXI-1600 Channel, Speed, and Resolution Specifications

Overview

The National Instruments SCXI-1600 USB data acquisition module requires data from and controls SCXI signal conditioning modules installed in the chassis in which it resides, making the chassis a complete data acquisition system. Conditioned output signals from other SCXI modules in the chassis are automatically routed to the NI SCXI-1600, digitized, and transferred to the PC via USB. You can connect the SCXI-1600 directly to any standard USB port (1.0, 1.1, or 2.0). The SCXI-1600 is a full-featured 16-bit digitizer and control module for SCXI analog input, analog output, digital I/O, and switching modules. A Hi-Speed USB connection makes the SCXI-1600 ideal for remote applications up to 150 ft away from the PC. In addition, the SCXI-1600 features an internal calibration source and external calibration connection to ensure absolute measurement accuracy over time.

Software

NI DAQmx is the robust measurement services software included with all NI data acquisition and signal conditioning products. This easy-to-use software tightly integrates the full functionality of your DAQ hardware to LabVIEW, LabWindows/CVI, and Measurement Studio for Visual Basic. High-performance features include multidevice synchronization, networked measurements, and DMA data management. Bundled with NI-DAQmx, the Measurement & Automation Explorer (MAX) utility simplifies the configuration of your measurement hardware with device test panels, interactive measurements and scaled I/O channels. NI-DAQmx also provides numerous example programs for LabVIEW and other application development environments to get you started with your application quickly.

Services and Support/Training

As a complement to your data acquisition and signal conditioning product, consider:

- Technical Support – Included in hardware/software purchase through applications engineers worldwide, Web resources with more than 1000 example programs and more than 7000 knowledgebases, and Premier Support – **ni.com/support**
- Calibration – Includes NIST-traceable basic calibration certificate, services for ANSI/NCSL-Z540 and periodic calibration – **ni.com/calibration**
- Extended Warranty – Meet project life-cycle requirements and maintain optimal performance in a cost-effective way – **ni.com/services**
- Data Acquisition Training – Instructor-led courses – **ni.com/training**

Ordering Information

NI SCXI-1600..... 776572-1600
Includes NI-DAQmx software.

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NI SCXI-1102B/C, NI SCXI-1104/C, NI SCXI-1100

- Programmable gain settings
- Lowpass filtering
- NI-DAQmx software simplifies configuration and measurements
- ± 100 mV to ± 60 VDC or current inputs

SCXI-1102B, SCXI-1102C

- Programmatic input range from ± 100 mV to ± 10 V (per channel)
- Per-channel lowpass filter
  - 200 Hz (SCXI-1102B)
  - 10 kHz (SCXI-1102C)

SCXI-1104, SCXI-1104C

- ± 60 VDC input range
- Per-channel lowpass filters
  - 2 Hz (SCXI-1104)
  - 10 kHz (SCXI-1104C)

SCXI-1100

- 166 kS/s at full bandwidth, with gain up to 100
- 6.6 kS/s maximum, 10 kHz filter
- 3 S/s maximum, 4 Hz filter

Operating Systems

- Windows 7/Vista/XP/NT/2000

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio VI Logger

Measurement Services Software

- NI-DAQmx



Module	Channels	±100 mV to ±10 V	±60 V	0 to 20 mA
SCXI-1102B	32	✓	-	✓
SCXI-1102C	32	✓	-	✓
SCXI-1104	32	-	✓	-
SCXI-1104C	32	-	✓	-
SCXI-1100	32	✓	-	✓

Table 1. Signal Compatibility

Overview

The National Instruments SCXI-1102B/C, NI SCXI-1104/C, and the SCXI-1100 are 32-channel analog input modules with the programmable gain and filter settings ideal for conditioning a variety of millivolt, volt, and current inputs. Each 32-channel module except the SCXI-1100 has a programmable gain instrumentation amplifier and lowpass filter for each channel. The SCXI-1100 has a single amplifier and jumper-selectable filter shared by all 32 channels.

Ordering Information

NI SCXI-1102B..... 776572-02B
NI SCXI-1102C..... 776572-02C
NI SCXI-1104..... 776572-04
NI SCXI-1104C..... 776572-04C
NI SCXI-1100..... 776572-00

Accessories

SCXI current resistors (4-pack)..... 776582-01
SH96-96 shielded cable (1 m)..... 183228-01
R96-96 ribbon cable (1 m)..... 183425-01

Terminal Block	Part Number	Type	CJ Sensor	Compatible Modules	Cabling	Special Functions
SCXI-1300	777687-00	Screw terminals Front-mounting	✓	SCXI-1102B, SCXI-1102C, SCXI-1104, SCXI-1104C, SCXI-1100	-	-
SCXI-1303	777687-03	Screw terminals Front-mounting	✓	SCXI-1102B, SCXI-1102C, SCXI-1100	-	Isothermal construction Pluggable ground referencing
SCXI-1308	777687-08	Screw terminals Front-mounting	-	SCXI-1102B, SCXI-1102C, SCXI-1100	-	249 Ω socketed shunt precision ground resistor
BNC-2095	777508-01	BNC connectors Rack-mounted	-	SCXI-1102B, SCXI-1102C, SCXI-1104, SCXI-1104C[1], SCXI-1100	SH96-96 or R96-96 cable	Prewired ground referencing
TC-2095	777509-01	Thermocouple plugs, Rack-mounted	✓	SCXI-1100, SCXI-1102B, SCXI-1102C	SH96-96 or R96-96 cable	Isothermal construction Switchable ground referencing
TBX-1303	777207-03	Screw terminals DIN-rail mount	✓	SCXI-1102B, SCXI-1102C, SCXI-1104, SCXI-1104C, SCXI-1100	SH96-96 or R96-96 cable	DIN-rail mount isothermal construction Pluggable ground referencing
TBX-96	777264-01	Screw terminals DIN-rail mount	-	SCXI-1100, SCXI-1102B, SCXI-1102C, SCXI-1104,	SH96-96 or R96-96 cable	DIN-rail mount
SCXI-1310	777687-10	Solder pins Front-mounting	-	SCXI-1102B, SCXI-1102C, SCXI-1104C, SCXI-1100	-	Low-cost connector-and-shell assembly

[1] You must disable the ground referencing for use with the SCXI-1104C

Table 2. Terminal Block Options for SCXI-1100, SCXI-1102B/C, and SCXI-1104/C

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SCXI Thermocouple Input Modules

NI SCXI-1102, NI SCXI-1112

- Hardware scanning of cold-junction sensors
- 2 Hz lowpass filtering per channel
- Over voltage protection to ±42 V
- 333 kS/s maximum sampling rate
- NI measurement services software that simplifies configuration and measurements

SCXI-1102

- Programmatic input range of ±100 mV or ±10 V per channel
- Thermocouple, millivolt, volt, and current input

SCXI-1112

- Instrumentation amplifier per channel
- Random scanning
- Onboard calibration reference
- Open-thermocouple detection LEDs
- Cold-junction compensation per channel

Operating Systems

- Windows 7/Vista/XP/NT/2000

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio

Measurement Services Software

- NI-DAQmx driver software
- VI Logger Lite data-logging software



Module	Channels	Thermocouple	RTD	±100 mV	±10 V	0 to 20 mA
SCXI-1102	32	✓	✓[1]	✓	✓	✓
SCXI-1112	8	✓	–	–	–	–

[1] With SCXI-1581

Table 1. Signal Compatibility

Overview

The National Instruments SCXI-1102 and SCXI-1112 are designed for high-accuracy thermocouple measurements. The SCXI-1102 also can acquire millivolt, volt, 0 to 20 mA, and 4 to 20 mA current input signals, as well as signals from RTDs when the SCXI-1581 provides excitation. Each input channel includes an instrumentation amplifier and a 2 Hz lowpass filter. The SCXI-1112 incorporates open-thermocouple detection circuitry on each input channel. LEDs on the front of the module indicate the presence of an open thermocouple.

Ordering Information

NI SCXI-1102..... 776572-02
NI SCXI-1112..... 776572-12

Accessories

SH96-96 shielded cable 1 m..... 183228-01
R96-96 ribbon cable 1 m..... 183425-01

For information on extended warranty and value-added services, go to ni.com/signalconditioning.

Terminal Block	Part Number	Type	CJ Sensor	Compatible Modules	Cabling	Special Functions
SCXI-1300	777687-00	Screw terminals Front-mounting	✓	SCXI-1102B, SCXI-1102C, SCXI-1104, SCXI-1104C, SCXI-1100	_	IC sensor for CJC
SCXI-1303	777687-03	Screw terminals Front-mounting	✓	SCXI-1102B, SCXI-1102C, SCXI-1100	_	Isothermal construction Pluggable ground referencing
SCXI-1308	777687-08	Screw terminals Front-mounting	–	SCXI-1102B, SCXI-1102C, SCXI-1100	_	249 Ω precision shunt resistor for current measurements
TC-2095	777509-01	Thermocouple, plugs Rack-mounted	✓	SCXI-1100, SCXI-1102B, SCXI-1102C	SH96-96 or R96-96	Isothermal construction Prewired ground referencing
TBX-1303	777207-03	Screw terminals DIN-rail mount	✓	SCXI-1102B, SCXI-1102C, SCXI-1104, SCXI-1104C, SCXI-1100	SH96-96 or R96-96	DIN-rail mount Isothermal construction Pluggable ground referencing 3 terminals per channel
TBX-96	777264-01	Screw terminals DIN-rail mount	–	SCXI-1100, SCXI-1102B, SCXI-1102C, SCXI-1104,	SH96-96 or R96-96	DIN-rail mount 3 terminals per channel
SCXI-1310	777687-10	Solder pins Front-mounting	–	SCXI-1102B, SCXI-1102C, SCXI-1104, SCXI-1100	–	Low-cost connector and shell assembly

Table 2. Terminal Block Options for SCXI-1102

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SCXI Universal Bridge and Strain Gage Input Module

NI SCXI-1520

- 8 simultaneously sampled analog input channels
- Programmable excitation (0 to 10 V) per channel
- Programmable gain (1 to 1000) per channel
- Programmable 4-pole Butterworth filter (10 Hz, 100 Hz, 1 kHz, 10 kHz) per channel
- Quarter-, half-, and full-bridge completion
- 2 shunt calibration circuits per channel
- Remote sensing
- Random scanning
- Onboard calibration reference
- NI-DAQ driver software simplifies configuration, offset nulling, shunt calibration, scaling, and measurement

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows™/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQmx

Calibration Certificate (included)
ni.com/calibration



Module	Quarter-Bridge (120Ω, 350Ω)	Half-Bridge (120Ω, 350Ω)	Full-Bridge (120Ω, 350Ω)	Force, Load, Torque, Pressure
SCXI-1520	✓	✓	✓	✓

Table 1. Signal Compatibility

Overview

The NI SCXI-1520 is a fully programmable 8-channel universal strain-gage input module, with a programmable gain amplifier and a 4-pole Butterworth filter on each channel. Gains are programmatically set to one of 49 settings between 1 and 1000 to optimize measurements resolution. You can set the lowpass filter on each channel to 10Hz, 100 Hz, 1 kHz, 10 kHz, or bypass mode.

Each channel has an independent 0 to 10 V programmable excitation source with remote sense per channel to compensate for voltage drops due to lead resistance. Offset nulling and shunt calibration circuits on each channel are programmatically tuned.

The SCXI-1520 is compatible with quarter, half and full-bridge sensors. Half-bridge completion is provided in the SCXI-1520 and enables through software. RN-55 style quarter-bridge completion resistors are socketed in the SCXI-1314 and SCXI-1314T front-mounting terminal block and are programmatically engaged. The SCXI-1314T offers simpler setup and improved accuracy for smart TEDS Class II bridge-based sensors.

The SCXI-1520 samples all eight channels simultaneously, with built-in track-and-hold circuitry. This feature simulates an A/D converter per channel for a fraction of the cost, with typical interchannel skew times less than 200 ns.

Ordering Information

NI SCXI-1520..... 777966-20

Terminal Block	Part Number	Type	CJ Sensor	Compatible Modules	Cabling	Special Functions
SCXI-1314	777687-14	Screw terminals	-	SCXI-1520 front-mounting	-	Quarter-bridge completion
SCXI-1314T	777687-14T	RJ50	-	SCXI-1520 front-mounting	-	Quarter-bridge completion

Table 2. Terminal Block Options for the SCXI-1520

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SCXI Quarter-Bridge Strain Gage Input Module

NI SCXI-1521, NI SCXI-1521B

- 24 quarter-bridge strain gage inputs
  - 350 Ω (SCXI-1521)
  - 120 Ω (SCXI-1521B)
- Programmable excitation (0 to 5 V) per channel
- Programmable shunt and null calibration per channel
- 10 Hz filter per channel
- Onboard calibration references
- NI-DAQmx simplifies configuration and measurements

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio

Other Compatible Software
- Visual Basic, C, C++

Measurement Services Software (included)
- NI-DAQmx

Calibration Certificate Included

[1] *For half-bridge or full-bridge strain gage measurements, please consider the SCXI-1520.*



Overview

The National Instruments SCXI-1521 and SCXI-1521B are quarter-bridge strain gage input modules that offer all of the features you need for high-channel-count applications. Each NI SCXI-1521/B is shipped with a NIST-traceable calibration certificate. Each SCXI-1521/B module can multiplex its signals into a single channel of the controlling DAQ device, and you can add more modules to increase channel count.

Analog Input

Each ofthe 24 analog inputs of the SCXI-1521/B consists of a quarter-bridge completion resistor (350 Ω for the SCXI-1521 and 120 Ω for the SCXI-1521B), and a 10 Hz, 2-pole Butterworth filter. You can program the excitation over 1024 different levels from 0 to 5 V. The 2-pole Butterworth filters provides lowpass filtering to block noise and ensure measurement accuracy.

Calibration

The SCXI-1521/B modules provide simple yet powerful calibration capabilities. Each module has an onboard calibration EEPROM that stores calibration constants for each channel; factory calibration constants are stored in a protected area of the EEPROM. NI-DAQ traditional and NI-DAQmx transparently use the calibration constants to correct for gain and offset errors for each channel.

Null Compensation

Each input channel of an SCXI-1521/B includes a circuit to remove bridge offset voltage. Driver software nulls the offset voltage to zero in seconds. You do not need to manually adjust a potentiometer. By removing this offset through the measurement hardware, you can achieve better measurement resolution.

Shunt Calibration

Each input channel of an SCXI-1521/B includes an accurate and stable shunt calibration resistor with which you can progamatically simulate loading effects on your strain gage to compensate for strain gage errors. The shunt calibration resistors located inside of the module. You enable or disable the shunt resistors through software commands.

Ordering Information

NI SCXI-1521 777966-21
NI SCXI-1521B 777966-21B
Includes NI-DAQmx software.

For more information on extended warranty and value-added services, visit ni.com/services.

Terminal Block	Type	CJ Sensor	Compatible Modules	Cabling	Special Functions	Part Number
SCXI-1317	Screw terminals	–	SCXI-1521 & SCXI-1521B Front-mounting	–	–	777687-17

Table 1. Terminal Block Options for the SCXI-1521/B

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NI SCXI-1530, NI SCXI-1531

- Programmable gain per channel (1, 10, 100)
- Programmable lowpass 4-pole Bessel filter per channel (2.5, 5, 10 and 20 kHz)
- 4 mA current source, 24 V compliance
- IEPE conditioning – software configurable
- Simultaneous sample and hold
- BNC direct connectivity
- Autocalibration
- Multiple inputs
  - 4 channels – SCXI-1530
  - 8 channels – SCXI-1531
- Random scanning
- NI-DAQ driver software simplifies configuration, scaling, and measurement

Operating Systems

- Windows 7/Vista/XP/NT/2000

Recommended Software

- LabVIEW
- LabVIEW Sound and VibrationToolkit
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software

- NI-DAQmx



Module	Channel	Accelerometers[1]	Microphones[1]	±0.1 to ±10 V
SCXI-1530	4	✓	✓	✓
SCXI-1531	8	✓	✓	✓

[1] Integrated Electronic Piezoelectric (IEPE)

Table 1. Signal Compatibility

Overview

The National Instruments SCXI-1530/1531 signal conditioning modules are designed for Integrated Electronic Piezoelectric (IEPE) accelerometers and microphones. These modules share a common architecture in which each input channel includes a programmable AC instrumentation amplifier, 4-pole Bessel lowpass filter, and excitation current source. These modules also offer simultaneous sampling top reserve interchannel phase relationships. Each module can multiplex its signals into a single channel of the DAQ device and you can add modules to increase channel count. With random scanning capabilities, you select only the channels from which you want to acquire data as well as scan channels in any order. These modules also offer parallel-mode operation for faster scanning rates. Each module offers BNC connectors to simplify signal connection.

Analog Input

To simplify configuration and ensure measurement accuracy, the analog inputs of the NI SCXI-1530/1531 consist of programmable instrumentation amplifiers, 4-pole Bessel lowpass filters, and simultaneous sample and hold using track-and-hold (T/H) circuitry. You can program each channel individually for input ranges of ±10, ±1, or ±0.1 V. You can program the lowpass filter of each channel for 2.5, 5, 10, or 20 kHz. The 4-pole Bessel lowpass filters provide a sharp cutoff while maintaining interchannel phase information. Each channel also has a 0.2 Hz highpass filter to block the DC offset of IEPE sensors. All analog inputs offer T/H circuitry to perform simultaneous sampling.

Conditioning

Each channel of the SCXI-1530/1531 has a 4 mA, 24 V compliant current source to power IEPE accelerometers/ microphones. By using an active current source, the excitation current of the module remains constant regardless of loading by the sensor. You can programmatically disable the current source for each channel. This is helpful for measuring the system noise of your environment, or using selected input channels for other input signal types.

Ordering Information

NI SCXI-1530..... 777966-30
NI SCXI-1531..... 777966-31

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SCXI 8-Channel LVDT Input Module

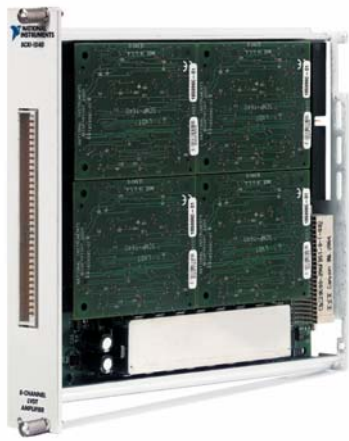
NI SCXI-1540

- Programmable input range per channel (0.05 to 6 V_{rms})
- Programmable 1 or 3 V_{rms} excitation per channel at 2.5, 3.3, 5, or 10 kHz
- Multichannel synchronization
- 333 kS/s maximum sampling rate (250 Hz output bandwidth)
- Autocalibration in case excitation required differs from level and frequency SCXI-1540 provides
- 4 or 5-wire connections
- Random scanning
- Lowpass filter (250 Hz)
- NI-DAQ driver software simplifies configuration, measurement, and scaling

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQmx



Module	Channels	LVDTs	RVDTs	Resolvers
SCXI-1540	8	✓	✓	✓

Table 1. Signal Compatibility

Overview

The National Instruments SCXI-1540 8-channel linear variable differential transformers (LVDT) module provides the necessary conditioning to measure signals from transformer-based ratiometric position sensors, including LVDTs, rotary variable differential transformers (RVDTs), and resolvers. The NI SCXI-1540 offers both 4 and 5-wire connections for LVDTs and RVDTs. In addition, this module offers autocalibration without external hardware using NI-DAQ. As part of an SCXI system, you can scan the analog input channels of the SCXI-1540 along with other modules at rates up to 333 kS/s (3 µs per channel). Each of these modules can multiplex its signals into a single channel of the data acquisition (DAQ) device, and you can add modules to increase channel count. With random scanning capabilities, you select only the channels from which you want to acquire data.

Analog Input

Each of the eight analog inputs consists of an instrumentation amplifier, a variable gain stage, a demodulation circuit, and a lowpass filter. You can program each channel individually for a full-scale input within the range 0.05 to 6.0 V_{rms}. With 31 gain settings, you can obtain the full resolution of your DAQ device for any input range. The demodulation signal originates from the local oscillator for the 4-wire mode and originates from the input signal for the 5-wire mode. Each input is protected to ±30 V. The lowpass filter bandwidth on the output is set at 250 Hz.

Excitation

Each channel of the SCXI-1540 includes an AC voltage source for exciting LVDTs, RVDTs, and resolvers. You can set the excitation at 1 or 3 V_{rms} and at a frequency of 2.5, 3.3, 5, or 10 kHz. Each excitation output is protected with surge arrestors to prevent damage from accidental external voltages. Each channel also includes a provision for synchronizing its output to the excitation of another channel. Synchronization prevents the occurrence of beat signals between channels where cable cross talk is a problem.

Calibration

You can autocalibrate the SCXI-1540 at anytime using a standard NI-DAQ function or LabVIEW VI. You need not disconnect sensor wiring to perform an autocalibration. The output is internally wrapped back to the input so that you can account for errors in both excitation and input circuitry. Correction constants from the autocalibration are stored in the EEPROMs located on each module. NI-DAQ driver software transparently uses these constants to correct for the gain and offset error of each channel.

Ordering Information

NI SCXI-1540..... 777966-40

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NI SCXI-1125, NI SCXI-1120, NI SCXI-1120D

- 333 kS/s maximum sampling rate
- Gain and lowpass filter settings per channel
- Signal inputs from ±2.5 mV to ± 1000 V_{rms} with TBX-1316
- NI-DAQmx software simplifies configuration, measurement, and scaling

SCXI-1125
- Programmable gain and filter settings
- 300 V_{rms} working isolation per channel

SCXI-1120, SCXI-1120D
- Jumper-selectable filter per channel
- 4 Hz and 10 kHz filter (SCXI-1120)
- 4.5 kHz and 22.5 kHz (SCXI-1120D)
- 250 V_{rms} working isolation per channel

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Measurement Services Software
- NI-DAQmx



Module	Channels	±2.5 mV	±5 m V to ±5 V	±10 V	1000 V	0 to 20 mA	Thermo couple
SCXI-1125	8	✓	✓	-	✓	✓	✓
SCXI-1120	8	✓	✓	-	✓	✓	✓
SCXI-1120D	8	-	✓	✓	✓	✓	✓

Table 1. Signal Compatibility

Overview

The National Instruments SCXI-1125, SCXI-1120, and SCXI-1120D are 8-channel isolated analog input modules. These modules share a common architecture, providing 250 to 300 V_{rms} of working isolation and lowpass filtering for each analog input channel. This architecture is ideal for amplification and isolation of millivolt, volt, 0 to 20 mA, 4 to 20 mA, and thermocouple signals.

Each channel on the SCXI-1125 has its own programmable-gain instrumentation amplifier, with ranges from ±2.5 mV to ±5 V. With the TBX-1316 high-voltage attenuator terminal block, the input range is extended to ±1000 V. Each channel also includes a programmatic lowpass filter that you can configure for 4 or 10kHz.

The analog inputs of the SCXI-1120/D consist of eight isolation amplifiers with jumper-configurable input ranges from ±2.5 mV to ±5 V (SCXI-1120) or ±5 mV to ±10 V (SCXI-1120D). With the TBX-1316 high-voltage attenuator terminal block, the input range is extended to ±1000 V. Each channel also includes a lowpass filter that is jumper configurable for 4 Hz or 10 kHz (SCXI-1120), or for 4.5 or 22.5 kHz (SCXI-1120D).

Ordering Information

NI SCXI-1125..... 776572-25
NI SCXI-1120..... 776572-20
NI SCXI-1120D..... 776572-20D

Accessories
SCXI current resistors (4-pack)..... 776582-01

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SCXI Isolated Universal Input Modules

NI SCXI-1121, NI SCXI-1122

- Isolated analog inputs
- Isolated voltage and current excitation
- Signal inputs from millivolts to ±250 V
- Lowpass filtering
- Shunt calibration
- NI-DAQ driver software simplifies configuration, measurements, and scaling

SCXI-1121

- 4 isolated input channels
- 4 isolated excitation channels
- 250 V_{rms} working isolation per channel
- Offset nulling and shunt calibration with SCXI-1321
- Lowpass filter, 4 Hz, 10 kHz

SCXI-1122

- 16 channels
- 100 S/s (4 kHz filter), 1 S/s (4 Hz filter)
- 2 excitation sources
- 480 V_{rms} working isolation per channel

Operating Systems

- Windows 7/Vista/XP/NT/2000

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software

- NI-DAQmx



SCXI Modules	Bridge	RTD	Thermocouple	±5 mV ±2.5 mV	0 to 20 mA to ±250 V	4 to 20 mA
SCXI-1121	✓	✓	✓	✓	✓	✓
SCXI-1122	✓	✓	✓	–	✓	✓

Table 1. Signal Compatibility

Overview

The National Instruments SCXI-1121 and SCXI-1122 modules are designed for a wide variety of sensor and signal inputs requiring isolation. The NI SCXI-1121 offers independent jumper-configurable isolation amplifiers, filters, and excitation sources for each channel. The SCXI-1122 offers an isolation amplifier, filter, and excitation source for all channels. Both SCXI-1121 and SCXI-1122 modules offer at least 250 V_{rms} working isolation and can acquire strain, RTD, thermocouple, millivolt, volt, 250 V, 0 to 20 mA, and 4 to 20 mA current input signals. The SCXI-1122 consists of 16 replay multiplexers that route the input channels to a single isolated instrumentation amplifier and lowpass filets. You can program all inputs together for a range of ±5 mV to ±250 V. With this repaly multiplexer architecture, you are limited to a maximum sampling rate of 100 S/s for the 4 kHz filter setting, and 1 S/s for the 4 Hz filter setting on all channels in your scan list.

Isolation

The SCXI-1121 and SCXI-1122 feature 250 V_{rms} CAT II working isolation between channels and channel to earth (the SCXI-1122 will withstand 480 V_{rms} from channel to earth), and 2300 V_{rms} breakdown isolation between input channels and channel to earth, as verified by a dielectric withstand test, one minute maximum.

Working isolation is the maximum voltage to which the module can be continuously subjected when operating under normal conditions. Breakdown isolation is the voltage at which, if continuously applied (for more than one minute), the module isolation barrier begins to break down.

Ordering Information

NI SCXI-1121	776572-21
NI SCXI-1122	776572-22

Accessories

SCXI current resistors (4-pack)	776582-01

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SCXI 8-Channel Isolated Frequency Input Module

NI SCXI-1126

- 8 channels
- Programmable gain and filter settings per channel
- Programmable threshold and hysteresis per channel
- 15 Hz to 128 kHz signal ranges up to ±250 V_{rms} (or 1,000 VDC with TBX-1316)
- 333 kS/s maximum sampling rate
- NI-DAQ driver software simplifies configuration and measurement

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQmx



Overview

The National Instruments SCXI-1126 is a signal conditioning module with eight isolated frequency input channels. Each channel of the NI SCXI-1126 includes a frequency-to-voltage conversion circuit with programmable input range, threshold, hysteresis, and filtering. The SCXI-1126 can measure the frequency of analog and digital signals with voltage levels as high as 1,000 VDC.

Input Stage

The input stage of the SCXI-1126 consists of eight isolated frequency input channels. You can input signals up to 1,000 V. For example, you can measure the frequency of TTL signals, 24 V signals, or 120/240 VAC power signals. Each channel consists of an analog trigger circuit, which compares the input waveform with a user-programmable threshold and hysteresis. You can program the threshold of each channel from -0.5 to 4.48 V. You can also program the hysteresis window from 0 to 4.98 V. You can extend the input range of the threshold and hysteresis window to 250 V with the SCXI-1327 attenuator terminal block or to 1000 VDC (608 V_{rms}) with the TBX-1316 terminal block.

Isolation

The SCXI-1126 features 250 V_{rms} CAT II working isolation between channels and channel to earth and 2,300 V_{rms} breakdown isolation between input channels and channel to earth, as verified by a dielectric withstand test, one minute maximum, Working isolatoin is the maximum voltage to which the module can be continuously subjected when operating under normal conditions. Breakdown isolation is the voltage at which, if continuously applied the module isolation barrier begins to break down.

Ordering Information

NI SCXI-1126 776572-26

Terminal Block	Part Number	Type	Cabling	Special Functions
SCXI-1320	777687-20	Screw-terminals/front-mounting	-	-
SCXI-1327	777687-27	Screw-terminals/front-mounting	-	Extended voltage input range (to 250 V_{rms})
SCXI-1305	777687-05	BNC connectors/front-mounting		AC coupling (configurable per channel)
TBX-1328	777207-28	Screw-terminals/DIN-rail mount	SH32-32-A (183230-01)	DIN-rail mount isothermal construction
TBX-1329	777207-29	Screw-terminals/DIN-rail mount	SH32-32-A (183230-01)	DIN-rail mount AC/DC coupling with removable screw terminals
SCXI-1330	777687-30	Solder pins/front-mounting		Low-cost connector and shell assembly
TBX-1316	777207-16	Screw-terminals/panel mount		Extended voltage input range to ±1000 VDC

Table 1. Terminal Block Options for SCXI-1126

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SCXI 8-Channel Simultaneous-Sampling Analog Input

NI SCXI-1140

- Switch-selectable gains per channel
- ±30 V maximum over voltage protection, powered on
- Connections for external timing signal
- Cascade with SCXI-1142 for applications requiring filtering
- NI-DAQ driver software simplifies configuration, measurement, and scaling

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQmx



Terminal Block	Part Number	Type	Special Functions
SCXI-1301	777687-01	Screw terminals/front-mounting	–
SCXI-1304	777687-04	Screw terminals/front-mounting	AC coupling signal ground referencing
SCXI-1305	777687-05	BNC Connectors/front-mounting	BNC connectors/AC coupling ground referencing
SCXI-1310	777687-10	Solder pins	Low-cost connector and shell assembly

Figure 2. Terminal Block Options for SCXI-1140

Overview

The National Instruments SCXI-1140 is an 8-channel simultaneous-sampling differential amplifier module. Each channel contains a high input impedance instrumentation amplifier with switch-selectable gain followed by a track-and-hold (T/H) amplifier. The T/H amplifiers deliver simultaneous-sample-and-hold functionality, which is useful for preserving interchannel phase relationships. You can run the T/H outputs to eight different input channels on the DAQ device in parallel mode, or you can multiplex the output of two or more modules into one channel of the DAQ device in multiplexed mode. Each analog input channel of the NI SCXI-1140 has an instrumentation amplifier with differential inputs. Using DIP switches, you can configure each channel independently for a gain of 1, 10, 100, 200, 300, 500, 600, 700, or 800. Each channel has input overvoltage protection of ±30 V powered on and ±15 V powered off.

Simultaneous Sampling

With the simultaneous-sample-and-hold feature of SCXI-1140, you can sample multiple signals with negligible skew time between channels. In track mode, the outputs of the T/H amplifiers follow their input. When put into hold mode, the amplifier outputs simultaneously freeze, holding the signal levels constant. You can then digitize these held signals with a DAQ device. The DAQ device can provide the hold trigger signal, or you can provide an external hold trigger signal through the front connector of the SCXI-1140, except when using a PXI-1010 or PXI-1011 combination chassis.

Ordering Information

NI SCXI-1140..... 776572-40

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NI SCXI-1141, NI SCXI-1142, NI SCXI-1143

- Programmable gain per channel (±50 mV to ±5 V input range)
- 8th-order programmable filter setting per module (10 Hz to 25 kHz)
- ±30 V maximum overvoltage protection, powered on
- 333 kS/s maximum sampling rate (any gain)
- Cascade with SCXI-1140 for applications requiring filtering and simultaneous sampling

SCXI-1141
- Elliptic filter response
- Recommended for sharp filter roll off

SCXI-1142
- Butterworth filter response
- Recommended for maximum flatness in the passband

SCXI-1143
- Butterworth filter response
- Recommended for maximum flatness in the passband

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQmx



Module	±50 mV to ±5 V	8th-Order Filter Type
SCXI-1141	✓	Elliptic
SCXI-1142	✓	Bessel
SCXI-1143	✓	Butterworth

Table 1. Signal Compatibility

Overview

The National Instruments SCXI-1141, SCXI-1142, and SCXI-1143 are 8-channel, programmable lowpass filter modules, ideal for antialiasing applications. You can choose from elliptic, Bessel, or Butterworth filter types. These modules have a common architecture, with a programmable instrumentation amplifier and programmable 8th-order lowpass filter on each channel. While you must set all channels to the same cutoff frequency, you can programatically bypass the lowpass filter on a per-channel basis.

Analog Inputs

These modules share a common architecture. Each channel has its own programmable instrumentation amplifier with differential inputs that you can individually program for signals ranging from ±50 mV to ±5 V. These inputs are protected to ±30 V powered on and ±15 V powered off.

In multiplexed mode, these modules multiplex all eight conditioned channels to the rear connector, to which you can connect to a single input channel of the DAQ device. Alternatively, in parallel mode, you can pass each conditioned channel directly to the analog inputs of the DAQ device to increase scanning speeds. This configuration requires a dedicated DAQ device and cable for each module.

Lowpass Filters

Each module offers different filter response characteristics. The SCXI-1141 has 8th-order elliptic filters, which provide a very sharp rolloff. Elliptic filters are ideal for blocking signals just above the Nyquist frequency. The SCXI-1142 has 8th-order Bessel filters, which maintain signal phase integrity. Bassel filters are ideal for applications requiring simultaneous sampling. Finally, the SCXI-1143 has 8th-order Butterworth filters, which have a flat passband. Butterworth filters are ideal for applications where signal amplitude must be uniform throughout the passband.

Terminal Block	Part Number	Type	Special Functions
SCXI-1304	777687-04	Screw terminals front-mounting	AC coupling Signal ground referencing
SCXI-1305	777687-05	BNC connectors front-mounting	BNC connectors AC coupling Signal ground referencing
SCXI-1310	777687-10	Solder pins shell assembly	Low-cost connector-and-shell assembly

Table 2. Terminal Block Options for SCXI-1141, SCXI-1142, and SCXI-1143

Ordering Information

NI SCXI-1141..... 776572-41
NI SCXI-1142..... 776572-42
NI SCXI-1143..... 776572-43

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SCXI 6-Channel Isolated Analog Output Module

NI SCXI-1124

- 6 isolated channels, per channel configurable for voltage or current output
- 250 V_{rms} working isolation per channel
- Software programmable ranges
- 12-bit resolution
- Combine channels for output voltages of up to ±60 V per module
- Software calibration using onboard calibration EEPROM
- 0-1, 0-5, 0-10, ±1, ±5, ±10 V voltage output ranges
- 0-20 mA current outputs
- NI-DAQ driver simplifies configuration and measurement

Operating Systems

- Windows 7/Vista/XP/NT/2000

Recommended Software

- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software

- NI-DAQmx



Module	Channels	Voltage Output (±1 to ±10 V)	Current Output (0 to 20 mA)
SCXI-1124	6	✓	✓

Table 1. Module Compatibility

Overview

The National Instruments SCXI-1124 is a 6-channel isolated source for static DC (low bandwidth) voltage or current signals. The NI SCXI-1124 includes six independently isolated,12-bit digital-to-analog-converter (DAC) channels. You can configure each channel for voltage or current output. For voltage, choose any of the available three unipolar or three bipolar ranges. For current, each channel outputs 0 to 20 mA. The module is software configurable, and includes an onboard EEPROM for storing calibration constants.

Analog Output

The SCXI module has six independently isolated analog output channels. You can software program each channel for voltage output ranges such as 0 to 1,0 to 5,0 to 10, ±1, ±5, or ±10 V. Within a single module, you can successively connect channels together to create output signals up to 60 VDC per module. Each voltage channel includes a low impedance output buffer that can drive up to 5 mA. Alternatively, you can configure any channel as a programmable 0 to 20 mA sink. Each current output channel includes a 15 V loop supply, eliminating the need for external supplies. With this 15 V loop supply, a current output channel can drive loads of up to 600 Ω. You can also use an external loop supply for higher loads.

Each output channel of the SCXI-1124 is optically isolated. You can operate the module with up to 250 V_{rms} of common-mode voltage between any two channels or between any channel and earth ground.

Isolation

The SCXI-1124 features 250 V_{rms} CAT II working isolation between channels and channel to earth and 2,300 V_{rms} breakdown isolation between input channels and channel to earth, as verified by a dielectric withstand test, one minute maximum. Working isolation is the maximum voltage to which the module can be continuously subjected when operating under normal conditions. Breakdown isolation is the voltage at which, if continuously applied (for more than one minute), the module isolation barrier begins to break down.

Terminal Block	Part Number	Type	Cable
SCXI-1325	777687-25	Screw terminals front-mounting	–
TBX-1325	777207-25	Screw terminals DIN-rail mount	SH48-48-A (183229-01)

Table 2. Terminal Block Options for SCXI-1124

Ordering Information

NI SCXI-1124..... 776572-24

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SCXI 32-Channel Current Excitation Module

NI SCXI-1581

- Use with SCXI-1102 module for high-channel-count RTD and thermistor measurements
- 32 channels of 100 µA current excitation sources
- ±0.05% accuracy per channel current source
- ±5 ppm/°C maximum temperature drift
- Screw terminal, BNC connector, and solder pin connectivity options
- NI-DAQ driver simplifies configuration and measurement

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQmx



Overview

The National Instruments SCXI-1581 provides 32 channels of 100 µA current excitation. The high accuracy and stability of these current sources make them especially well suited for measuring resistance with a high degree of accuracy. The module is ideal in any application that requires a 100 µA fixed current excitation, such as RTDs and thermistors. You can combine the NI SCXI-1581 with the SCXI-1102 to create a high-channel-count RTD measurement system.

Description

The 32 current sources on the SCXI-1581 are activated whenever the SCXI chassis is powered-on. The current sources on the SCXI-1581 are designed for ±0.05% accuracy of the specified value, with a maximum ±5 ppm/°C temperature drift.

Signal Connection

Signals from each channel of the SCXI-1581 connect to screw terminals located in the SCXI-1300 terminal block. The SCXI-1300 plugs directly into the front of the module. Alternatively, you can use the TBX-96, a DIN-rail mountable terminal block that you connect to the SCXI-1581 with the SH96-96 cable. A general-purpose 96-pin connector and shell, the SCXI-1310, is available as a low-cost alternative for custom cabling. Finally, you can select the BNC-2095, a rack-mounted accessory, for BNC applications.

Terminal Block	Part Number	Type	Cable	Special Functions	Info Code*
SCXI-1300	777687-00	Screw terminals Front-mount	–	–	scxi1300
BNC-2095	777508-01	BNC connectors Rack-mount	–	Prewired ground referencing	bnc2095
TBX-96	777264-01	Screw terminals DIN-rail mount	SH96-96 or R96-96	3 terminals per channel	tbx96
SCXI-1310	777687-10	Solder pins Front-mount	–	–	scxi1310

*For more information about any of these products, please visit **ni.com/info** and enter the info code provided.

Table 1. Terminal Block Options for SCXI-1581

Ordering Information

NI SCXI-1581 777966-81

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SCXI 32-Channel Optically Isolated Digital Input Modules

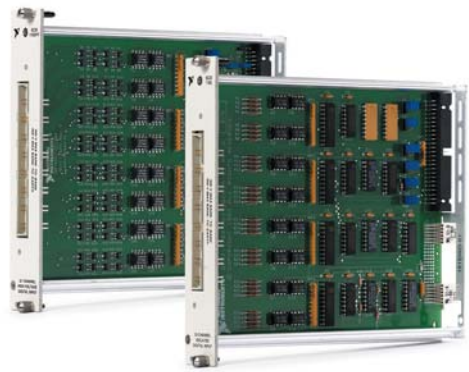
NI SCXI-1162, NI SCXI-1162HV

- 32 channels
- 8 banks of 4 lines
- 300 V_{rms} isolation per bank
- TTL and CMOS (SCXI-1162)
- Up to 240 VAC/VDC signals (SCXI-1162HV)
- NI-DAQ driver software simplifies configuration and measurement

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows™/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQmx



Overview

The National Instruments SCXI-1162 and the SCXI-1162HV are optically-isolated digital input modules. The NI SCXI-1162 has 32 channels of optically-isolated digital inputs, arranged into eight isolated banks off our input lines each. The SCXI-1162 interfaces to field digital logic signals, such as TTL and CMOS, where high common-mode voltages can be present. The SCXI-1162HV senses the presence of a wide range of AC or DC signals, from digital logic level signals up to 240 VAC/VDC signals. The optical isolation of the SCXI-1162 and SCXI-1162HV eliminates ground-loop problems and isolates the host computer from damaging voltages.

The SCXI-1162 and SCXI-1162HV are controlled by the DAQ device serially in multiplexed-mode over the SCXIbus. You can therefore easily integrate multiple SCXI-1162 and SCXI-1162HV modules into existing SCXI systems without additional DAQ devices or cabling. The modules can also operate in parallel mode when cabled directly to a DIO device.

Module	TTL/CMOS	240 VAC/VDC
SCXI-1162	✓	-
SCXI-1162H	✓	✓

Table 1. Module Compatibility

Terminal Block	Part Number	Type	Cabling
SCXI-1326	777687-26	Screw terminals Front-mounting	–
TBX-1326	777207-26	Screw terminals DIN-rail mount	SH48-48-B

Table 2. Terminal Block Options for SCXI-1162 and SCXI-1162HV

Applications

You can use an SCXI system equipped with the SCXI-1162 or the SCXI-1162HV in a variety of industrial and laboratory applications. The SCXI-1162 and SCXI-1162HV safely isolate the computer from the large common-mode voltages, ground loops, and voltage spikes that often occur in industrial and research environments. The SCXI-1162HV can monitor TTL level inputs as well as sense the presence of high-voltage AC and DC signals. For example, you can use an SCXI-1162HV to sense the on/off state of power circuits, proximity switches, pushbutton switches, thermostats, or relays. The SCXI-1162 interfaces directly to field digital logic input signals that should be isolated from the host computer.

Ordering Information

NI SCXI-1162..... 776572-62
NI SCXI-1162HV..... 776572-62H

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SCXI 32-Channel Optically Isolated Digital Output and SSR Switch Modules

NI SCXI-1163, NI SCXI-1163R

- 32 digital outputs (SCXI-1163) or relays (SCXI-1163R)
- 8 banks of 4 lines
- 300 V_{rms} isolation per bank
- TTL and CMOS (SCXI-1163)
- Switch up to 240 VAC/VDC (SCXI-1163R)
- NI-DAQ driver software simplifies configuration and measurement
- NI-SWITCH simplifies system development for even the most complex switching applications

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- VI Logger

Driver Software
- NI-DAQmx
- NI-SWITCH*

**Included with SCXI-1163R*



Overview

The National Instruments SCXI-1163 and SCXI-1163R are isolated digital output modules. The NI SCXI-1163 has 32 channels of optically-isolated digital outputs, arranged into eight isolated banks of four output lines each. The SCXI-1163 interfaces to field digital logic signals, eliminating ground-loop problems and isolating the host computer from damaging voltages. The SCXI-1163R includes 32 normally open, or Form A, solid-state relays, arranged into eight banks of four relays with one common pole for each bank. You canuse the SCXI-1163R to switch high-voltage loads, up to 240 VAC/VDC and up to 200 mA.

The SCXI-1163 and SCXI-1163R are controlled over the SCXIbus. You can therefore easily integrate SCXI-1163 and SCXI-1163R modules into existing SCXI systems without additional DAQ devices or cabling. The modules can also operate in parallel mode when cabled directly to a plug-in DIO device.

Optically Isolated Digital Channels/SSRs

The 32 channels of the SCXI-1163 and SCXI-1163R are organized into eight banks of four channels each. Each bank is optically isolated to 300 V_{rms} from each other and from the SCXI chassis earth ground. The SCXI-1163 digital outputs are open-collector outputs with 4.7 kΩ pull-up resistors. The digital outputs are compatible with most TTL and CMOS circuits. Each bank of four output lines share one +5 VDC supply voltage, V_{cc}, provided by the user.

Modes of Operation

Multiplexed

In multiplexed mode, a single DAQ device controls one or more SCXI modules through the SCXIbus using a serial data protocol. This multiplexed-mode operation uses a maximum of five digital I/O lines of the DAQ device. With MUX-mode operation, you can control several SCXI-1163 and SCXI-1163R modules, along with other SCXI modules, in one or more chassis with a single DAQ device. Multiplexed mode is a cost-efficient solution for larger systems.

Parallel

For high update speeds, you can also operate the SCXI-1163 and SCXI-1163R in parallel mode, connecting each module directly to a DIO DAQ device – 6503 (DIO-24), 6533 (DIO-32HS), 6534, and 6508 (DIO-96). In this configuration, each channel of the SCXI-1163 or SCXI-1163R module connects to a corresponding digital output line of the DIO device.

Signal Connection

Digital signals connect to screw terminals located in the SCXI-1326 terminal block, which connects directly to the front of the SCXI module, or the TBX-1326, a DIN-rail mountable terminal block, which connects to the SCXI-1163 or SCXI-1163R using the SH48-48-B shielded cable.

Module	TTL/CMOS	240 VAC/VDC
SCXI-1163	✓	–
SCXI-1163R	✓	✓

Table 1. Module Compatibility

Ordering Information

NI SCXI-1163..... 776572-63
NI SCXI-1163R..... 776572-63R

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SCXI 16-Channel RTD Module

NI SCXI-1503

- 16 channels of voltage or resistive inputs
- Ideally suited for 2-, 3-, and 4-wire RTD and thermistor measurements
- Programmable gain settings per channel
- 5 Hz filter per channel
- 100 µA current excitation
- 333 kS/s maximum sampling rate
- NI-DAQmx driver software simplifies configuration, scaling, and measurements

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows™/CVI
- Measurement Studio

Other Compatible Software
- Visual Basic, C, C++

Measurement Services Software (included)
- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility

Calibration Certificate Included



Overview

The National Instruments SCXI-1503 RTD module provides 16 differential input channels, 16 channels of 100 µA current excitation, and one cold-junction (CJ) sensor channel. The NI SCXI-1503 is ideally suited for measuring resistive transducers, such as RTDs or thermistors. Each channel has an amplifier with a selectable gain of 1 or 100 and a lowpass filter with a 5 Hz cutoff frequency to reject 50/60 Hz noise. The SCXI-1503 can programmatically connect each input to ground, which greatly improves its accuracy by enabling a self-calibration of each input to reduce offset drift errors. You can multiplex several SCXI-1503 modules and other SCXI modules into a single channel on the data acquisition device, greatly increasing the number of analog input signals that you can digitize. The SCXI-1306 is a front mounting terminal block that offers screw-terminal connectivity for the SCXI-1503.

Analog Input

Each of the 16 differential analog input channels feeds to a separate instrumentation amplifier with a programmable gain of 1 or 100. Each channel has a fixed 100 µA current excitation. Then the signal passes through a fixed two-pole, 5 Hz lowpass filter. The CJ sensor input channel reads the sensor temperature from the terminal block. The temperature sensor is for cold-junction compensation of thermocouple measurements. The CJ sensor channel also passes through a 5 Hz lowpass filter to reject unwanted noise on the SCXI-1503. Along with the other 16 input channels, the CJ sensor is multiplexed to the output buffer, where the data acquisition device can read it.

Current Source Operation SCXI-1503 current sources continuously provide 16 channels of 100 µA current excitation. These current sources are on whenever the SCXI chassis is powered on. SCXI-1503 current sources are designed to be accurate within ±0.05 percent of the specified value with a temperature drift of no more than ±5 ppm/°C. The accuracy and stability of these current sources make them especially well-suited to measuring resistance to a high degree of accuracy.

Calibration

The SCXI-1503 is shipped with a calibration certificate and is calibrated at the factory to the specifications described in NI SCXI-1503 Specifications. Calibration constants, stored inside the calibration EEPROM, provide software correction values that your application development software uses to correct the measurements for both offset and gain errors in the module.

Terminal Block	Part Number	Type
SCXI-1306	779698-01	Screw terminals/front mounting

Table 1. Terminal Block Option for SCXI-1503

Ordering Information

NI SCXI-1503..... 779638-01
NI SCXI-1306 (terminal block)..... 779698-01

For information on extended warranty and value-added services, visit ni.com/services.

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Overview

With lower system cost, more space for maximum relay density, and USB control, the SCXI platform continues to excel in high-channel-count applications. National Instruments provides SCXI modules capable of switching voltages up to 300 VDC/300 VAC, currents up to 8 A, and frequencies from DC to RF. Large matrix applications are easily addressed with matrix expansion cables and plugs, interconnecting rows and columns from multiple modules in seconds. And with the high-voltage analog bus (HVAB), you can route signals along the SCXI backplane between several modules or directly to instruments.

Switch Configurations

Topology	Maximum Voltage	Maximum Current (Switching/Carry)	Bandwidth	Scan Rate or Switching Speed	Module
Matrix Modules					
4x64 1-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 crosspoints/s	SCXI-1130
8x32 1-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 crosspoints/s	SCXI-1130
4x8 2-wire	300 V CAT II	1 A/2 A	11 MHz	10 ms	SCXI-1127
4x8 2-wire	300 V CAT II	30 mA	1.5 MHz	700 µs	SCXI-1128
4x32 2-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 crosspoints/s	SCXI-1130
4x64 2-wire	150 V CAT I	1 A/2 A	10 MHz	125 crosspoints/s	SCXI-1129
8x32 2-wire	150 V CAT I	1 A/2 A	10 MHz	125 crosspoints/s	SCXI-1129
16x16 2-wire	150 V CAT I	1 A/2 A	10 MHz	125 crosspoints/s	SCXI-1129
Quad 4x16 2-wire	150 V CAT I	1 A/2 A	10 MHz	125 crosspoints/s	SCXI-1129
Dual 4x32 2-wire	150 V CAT I	1 A/2A	10 MHz	125 crosspoints/s	SCXI-1129
Dual 8x16 2-wire	150 V CAT I	1 A/2 A	10 MHz	125 crosspoints/s	SCXI-1129
Multiplexer Modules					
Octal 4x1 1-wire	240 V CAT II	200 mA	10 MHz	2 ms	SCXI-1163R
Sixteen 16x1 1-wire	60 VDC, 30 VAC	400 mA	15 MHz	900 channels/s	SCXI-1130
Octal 32x1 1-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 channels/s	SCXI-1130
64x1 1-wire	300 V CAT II	30 mA	1.5 MHz	1,200 channels/s	SCXI-1128
64x1 1-wire	300 V CAT II	1 A/2 A	11 MHz	100 channels/s	SCXI-1127
Quad 64x1 1-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 channels/s	SCXI-1130
196x1 1-wire	100 V CAT I	1 A	20 MHz	140 channels/s	SCXI-1175
256x1 1-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 channels/s	SCXI-1130
Quad 8x1 2-wire	300 V CAT II	30 mA	1.5 MHz	1,200 channels/s	SCXI-1128
Quad 8x1 2-wire	300 V CAT II	1 A/2 A	11 MHz	100 channels/s	SCXI-1127
Dual 16x1 2-wire	300 V CAT II	30 mA	1.5 MHz	1,200 channels/s	SCXI-1128
Dual 16x1 2-wire	300 V CAT II	1 A/2 A	11 MHz	100 channels/s	SCXI-1127
Octal 16x1 2-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 channels/s	SCXI-1130
32x12-wire	300 V CAT II	30 mA	1.5 MHz	1,200 channels/s	SCXI-1128
32x1 2-wire	300 V CAT II	1 A/2 A	11 MHz	100 channels/s	SCXI-1127
Quad 32x1 2-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 channels/s	SCXI-1130
95x1 2-wire	100 V CAT I	1 A	8 MHz	140 channels/s	SCXI-1175
98x1 2-wire	100 V CAT I	1 A	8 MHz	140 channels/s	SCXI-1175
128x1 2-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 channels/s	SCXI-1130
16x1 4-wire	300 V CAT II	30 mA	1.5 MHz	1,200 channels/s	SCXI-1128
16x1 4-wire	300 V CAT II	1 A/2 A	11 MHz	100 channels/s	SCXI-1127
Quad 16x1 4-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 channels/s	SCXI-1130
64x1 4-wire	60 VDC, 30 VAC	400 mA	3 MHz	900 channels/s	SCXI-1130
General-Purpose Modules					
100-channel SPST	100 V CAT I	1 A	20 MHz	145 cycles/s	SCXI-1169
32-channel SPOT	150 VDC, 125 VAC CAT I	2 A/5 A	70 MHz	115 cycles/s	SCXI-1166
16-channel SPOT	250 V CAT II	2 A	10 MHz	14 ms	SCXI-1160
8-channel SPOT	250 V CAT II	8 A	10 MHz	15ms	SCXI-1161
50-channel DPST	100 V CAT I	1 A	20 MHz	145 cycles/s	SCXI-1169
16-channel DPDT	150 VDC, 125 VAC CAT I	2 A/5 A	70 MHz	115 cycles/s	SCXI-1166
8-channel DPDT	250 V CAT II	2 A	10 MHz	14 ms	SCXI-1160
4-channel DPDT	250 V CAT II	8 A	10 MHz	15 ms	SCXI-1161
RF Modules					
Nine 3x1 50/75 Ω coaxial	150 V CAT I	500 mA /1 A	500 MHz	100 channels/s	SCXI-1193
Quad 4x1 50 Ω coaxial	30 V	500 mA	2.5 GHz	104 ms	SCXI-1194
Quad 4x1 50 Ω coaxial	30 V	500 mA	5 GHz	104 ms	SCXI-1195
Quad 4x1 terminated 50/75 Ω coaxial	150 V CAT I	500 mA/1 A	500 MHz	100 channels/s	SCXI-1193
Quad 8x1 50/75 Ω coaxial	150 V CAT I	500 mA/1 A	500 MHz	100 channels/s	SCXI-1193
Dual 8x1 terminated 50/75 Ω coaxial	150 V CAT I	500 mA/1 A	500 MHz	100 channels/s	SCXI-1193
Dual 16x1 50/75 Ω coaxial	150 V CAT I	500 mA/1 A	500 MHz	100 channels/s	SCXI-1193
16x1 terminated 50/75 Ω coaxial	150 V CAT I	500 mA/1 A	500 MHz	100 channels/s	SCXI-1193
32x1 50/75 Ω coaxial	150 V CAT I	500 mA/1 A	500 MHz	100 channels/s	SCXI-1193
36-terminal sparse matrix 50/75 Ω coaxial	150 V CAT I	500 mA/1 A	500 MHz	100 channels/s	SCXI-1193
Relay Drivers					
32 latching (2-coil)	50 VDC	600 mA	-	-	SCXI-1167
64 nonlatching	50 VDC	600 mA	-	-	SCXI-1167

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SCXI Terminal Blocks

SCXI Terminal Blocks

- Terminal blocks for quick, easy connections
- Strain-relief clamps for reliable wiring
- Connectivity options including BNC and thermocouple plugs
- Shielded front-mount terminal blocks
- Rack and DIN-rail mount option savailable
- Terminal block options for specific measurement types
- Onboard temperature sensor for cold-junction compensation
- Isothermal construction for high-accuracy thermocouple measurements
- High-voltage attenuation
- AC/DC coupling
- Bridge offset nulling, shunt calibration
- Current inputs



Overview

National Instruments SCXI terminal blocks provide a convenient method for connecting and disconnecting signals to your system. The NI SCXI-13xx front-mount terminal blocks feature direct connections to transducers at the screw terminals located within a fully shielded enclosure or at front-mounted BNC connectors. Strain-relief clamps hold the signal wires safely in place. You can also choose either the TC-2095 or BNC-2095 rack-mount terminal blocks for minithermocouple connectors or BNC connectors. These terminal blocks are ideal solutions for high-channel-count temperature or voltage applications.

TBX DIN-rail mount terminal blocks are an alternative to the SCXI-13xx terminal blocks which attach directly to the front of an SCXI module. The TBX system includes shielded cables that connect the front I/O connector of an SCXI module to a TBX terminal block. Some terminal blocks are designed for specific input types, such as thermocouples, strain gages, and high-voltage inputs. See tables 2, 3, and 4 to determine which SCXI terminal blocks are compatible with your SCXI module.



Figure 1. Terminal Block Configuration

Terminal Block	Compatible SCXI Modules	Cabling	CJC	Special Features
TBX-1303	SCXI-1100, SCXI-1102, SCXI-1102B/C, SCXI-1181	SH96-96 or R96-96	✓	Open TC detection isothermal construction, selectable ground referencing
TBX-1316	SCXI-1120/D, SCXI-1125, SCXI-1126	SH32-32-A	–	200:1 attenuation (up to 1,000 VDC)
TBX-1325	SCXI-1124	SH48-48-A	–	High-voltage 250 VDC
TBX-1326	SCXI-1162, SCXI-1162HV, SCXI-1163, SCXI-1163R	SH48-48-B	–	High-voltage 250 VDC
TBX-1328	SCXI-1120, SCXI-1120D, SCXI-1121, SCXI-1125, SCXI-1126	SH32-32-A	✓	Sockets for current input resistors, isothermal construction, high-voltage 250 VDC
TBX-1329	SCXI-1120, SCXI-1120D, SCXI-1121, SCXI-1125, SCXI-1126	SH32-32-A	–	Selectable AC coupling (rejects up to 250 VDC)
TBX-96	SCXI-1100, SCXI-1102, SCXI-1102B/C	SH96-96 or R96-96 SCXI-1104, SCXI-1181, SCXI-1104C	–	–
TBX-24F[1]	All modules	User-supplied wiring	–	–
CB-50	SCXI-1180	NB1	–	–

[1]The TBX-24F is a general-purpose feedthrough terminal block that you can use with any SCXI module or front mounting terminal blocks.

Table 1. TBX Terminal Block Selection Guide

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TBX Terminal Block

Selection Guide

Use the following steps to select the correct combination of TBX terminal blocks and cables for your SCXI system:

1. Select the required terminal blocks – For each SCXI module, use table 1 to select the proper TBX terminal block. If a TBX-13xx terminal block is not available for your SCXI module, select the appropriate number of general-purpose TBX-24F feed through terminal blocks.

2. Select cabling – For each TBX terminal block, table 1 lists the cable needed to connect the TBX terminal block to the SCXI module. Shielded cables are available in lengths of 1, 2, and 5 m. If using the TBX-1303, you also have the option to build a custom cable using the SBS-96F backshell kit. For each TBX-1303 for which you will build a custom cable, select two SBS-96F kits. If using the TBX-24F, you will use discrete wires to connect the TBX-24F to an SCXI front-mounting terminal block. Therefore, select the appropriate SCXI front-mounting terminal block for each SCXI module that will use the TBX-24F.

3. Rack-mount accessory(optional) – If mounting for 19 in. rack enclosures is needed, use table 2 to select the appropriate number of TBX-RM1 rack-mount kits.

4. Calibration – Calibration of cold-junction sensors and attenuation terminal blocks is available for some devices. For more information, please visit **ni.com/calibration**.

Module	Terminal Blocks	CJC [1] Sensor	Other Terminal Block Functions
SCXI-1100	SCXI-1303 [2]	✓	Isothermal, signal ground referencing, and open thermocouple detection
SCXI-1102	SCXI-1300 [3]	✓	–
SCXI-1102B	SCXI-1308	–	Current input, 249 Ω resistor across each input
SCXI-1102C	BNC-2095	–	BNC connectors, signal ground referencing
	TC-2095	✓	Thermocouple plugs, signal ground referencing, isothermal
SCXI-1104/C	SCXI-1300	–	–
SCXI-1120	SCXI-1305	–	BNC connectors, AC/DC coupling and ground referencing
SCXI-1120D	SCXI-1320	✓	–
SCXI-1126	SCXI-1327	✓	Extends signal input range to 300 V_{rms}, switch configurable per channel
	SCXI-1328	✓	Isothermal, high-accuracy design for thermocouples
	SCXI-1338	✓	Current input, 249 Ω resistor across each input
SCXI-1125	SCXI-1304/5	–	BNC connectors, AC/DC coupling and ground referencing
	SCXI-1313A	✓	Extends signal input range to 150 V_{rms}, programmable per channel
	SCXI-1320	✓	–
	SCXI-1327	✓	Extends signal input range to 300 V_{rms}, switch configurable per channel
	SCXI-1328	✓	Isothermal, high-accuracy design for thermocouples
	SCXI-1338	✓	Current input, 249 Ω resistor across each input
SCXI-1121	SCXI-1320	✓	–
	SCXI-1321	✓	Offset nulling and shunt calibration for strain gages
	SCXI-1327	✓	Extends signal input range to 300 V_{rms}, switch configurable per channel
	SCXI-1328	✓	Isothermal, high-accuracy design for thermocouples
	SCXI-1305	–	BNC connectors, AC/DC coupling and signal ground referencing
SCXI-1122	SCXI-1322	✓	–
SCXI-1124	SCXI-1325	–	–
SCXI-1127	SCXI-1331	✓	–
SCXI-1128	SCXI-1332	–	Set up an 8 column by 4 row matrix
SCXI-1129	SCXI-1333	–	Configures SCXI-1129 as quad, 4x16 (2-wire) matrix
	SCXI-1334	–	Configures SCXI-1129 as 4x64 (2-wire) matrix
	SCXI-1335	–	Configures SCXI-1129 as 8x32 (2-wire) matrix
	SCXI-1336	–	Configures SCXI-1129 as 16x16 (2-wire) matrix
	SCXI-1337	–	Configures SCXI-1129 as a dual 8x16 (2-wire) matrix
	SCXI-1339	–	Configures SCXI-1129 as a dual 4x32 (2-wire) matrix
SCXI-1140	SCXI-1301	–	–
	SCXI-1304	–	AC/DC coupling and signal ground referencing (configurable per channel)
	SCXI-1305	–	BNC connectors, AC/DC coupling and signal ground referencing
SCXI-1141	SCXI-1304	–	AC/DC coupling and signal ground referencing (configurable per channel)
SCXI-1142	SCXI-1305	–	BNC connectors, AC/DC coupling and signal ground referencing
SCXI-1143	SCXI-1301	–	–
SCXI-1160	SCXI-1324	–	–
SCXI-1161	–	–	Screw terminals located in module
SCXI-1162/HV	SCXI-1326	–	–
SCXI-1163/R	–	–	–
SCXI-1180	SCXI-1302	–	50-pin terminal block
SCXI-1181	SCXI-1300	✓	–
SCXI-1181K	SCXI-1301	–	–
SCXI-1503	SCXI-1306	✓	–
SCXI-1520	SCXI-1314	–	Quarter-bridge completion/shunt resistor
SCXI-1540	SCXI-1315	–	–
SCXI-1581	SCXI-1300	–	–

[1] Cold-junction compensation (CJC) sensor for thermocouple measurements.
[2] Recommended for thermocouples; includes isothermal design and high-precision CJC sensor.
[3] Recommended for RTDs when using both SCXI-1102 and SCXI-1581.

Table 3. SCXI-13xx, TC, and BNC Selection Guide

Terminal Block	Width Required (TBX-RM1 Rack-Mount)
TBX-1303	One-half
TBX-1325, TBX-1326, TBX-1328, TBX-1329, TBX-24F, CB-50	One-third

Table 2. Rack-Mount Widths of TBX Terminal Blocks

Module	Connector and Shell Assembly
SCXI-1100, SCXI-1102B/C, SCXI-1140, SCXI-1141, SCXI-1181	SCXI-1310
SCXI-1120, SCXI-1120D, SCXI-1121, SCXI-1126, SCXI-1181	SCXI-1330

Table 4. Custom Cabling Accessories

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Figure 1. SCXI-1303 Terminal Block



Figure 2. SCXI-1305 Terminal Block



Figure 3. SCXI-1310 Connector and Shell Assembly

SCXI-1300..... 777687-00
The SCXI-1300 connects input signals to the SCXI-1100, SCXI-1102/B/C, and SCXI-1104/C modules. The SCXI-1300 is a general-purpose terminal block with an onboard temperature sensor for cold-junction compensation. Also works with SCXI-1181 and SCXI-1181K modules.

SCXI-1301..... 777687-01
20-screw terminal block for the SCXI-1140, SCXI-1181, and SCXI-1181K modules.

SCXI-1302..... 777687-02
50-screw terminal block for the SCXI-1180 feedthrough panel.

SCXI-1303 (see Figure 1)..... 777687-03
Terminal block for use with the SCXI-1100 and SCXI-1102/B/C modules. Designed especially for high-accuracy thermocouple measurements, the SCXI-1303 includes isothermal construction that minimizes errors caused by thermal gradients between terminals and the cold-junction sensor. The SCXI-1303 also includes circuitry for open-thermocouple detection as well as automatic ground referencing for floating (nongrounded) thermocouples.

SCXI-1304..... 777687-04
The SCXI-1304, for the SCXI-114x modules, includes AC coupling circuitry, with switches on each channel. Each channel also includes a switchable connection to ground through a 100 kΩ bias resistor to provide a reference for floating input sources.

SCXI-1305 (see Figure2)..... 777687-05
Includes convenient BNC connectors for use with the SCXI-1120/D, SCXI-1121, SCXI-1125, SCXI-1126, and SCXI-114x. Functionally equivalent to the SCXI-1304 terminal block, the SCXI-1305 includes switchable AC coupling circuitry and ground referencing on each channel.

SCXI-1306..... 779698-01
Terminal block for the SCXI-1503 RTD module. Provides 16 pairs of screw terminals for differential input signals and 16 pairs of screw terminals for current excitation signals. You can configure each channel for voltage or resistive measurements.

SCXI-1308..... 777687-08
Current input terminal block for the SCXI-1100 and SCXI-1102/B/C analog input modules. Each input includes a 249 Ω precision resistor so you can read 0 to 20 mA and 4 to 20 mA current inputs.

SCXI-1310 (see Figure 3)..... 777687-10
Connector and shell assembly used to create custom cabling solutions from the SCXI-1100, SCXI-1102/B/C, SCXI-1104/C, SCXI-114x, and SCXI-1181 to custom terminations. A low-cost alternative to SCXI terminal blocks, it consists of a hardened plastic enclosure and one connector with solder pins for signal connections.

SCXI-1313A..... 777687-13
Extends the input range of the SCXI-1125 to 150 V_{rms} or 150 VDC, on a per-channel basis programmatically through software commands. The SCXI-1313A also includes an onboard temperature sensor for thermocouples cold-junction compensation.

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Figure 4. SCXI-1320 Terminal Block



Figure 5. SCXI-1321 Terminal Block



Figure 6. SCXI-1327 Terminal Block



Figure 7. SCXI-1328 Terminal Block

SCXI-1314..... 777687-14
Front-mounting terminal block for the SCXI-1520 module. With factory-installed and socketed 350 Ω quarter-bridge completion resistors for each channel. Eight 120 Ω resistors for use with 120 Ω quarter-bridge strain gauges are included, but not installed. It also includes two factory-installed, socketed 100 kΩ shunt calibration resistors per channel.

SCXI-1315..... 777687-15
8-channel front-mounting terminal block for the SCXI-1540 LVDT with six terminals for each LVDT channel – CH+, CH-, EX+, EX-, Synch, and GND.

SCXI-1320 (see Figure 4)..... 777687-20
General-purpose terminal block for connecting signals to the SCXI-1120/D, SCXI-1121, SCXI-1125, and SCXI-1126 modules. It includes an onboard temperature sensor for cold-junction compensation using thermocouples, but the SCXI-1328 is recommended for precision thermocouple measurements.

SCXI-1321 (see Figure 5)..... 777687-21
Adds nulling and shunt calibration to SCXI-1121 strain guage applications. With a front-panel trimming potentiometer, you can manually null out the offset voltage of bridge transducers. Each channel includes shunt calibration circuits. When activated, a switch connects a 301 kΩ shunt resistor in parallel with the strain gauge. Both the nulling resistor and the shunt resistor are socketed for easy customization.

SCXI-1322..... 777687-22
Terminal block required to connect signals to the SCXI-1122 module that includes an onboard temperature sensor for cold-junction compensation.

SCXI-1324..... 777687-24
High-voltage terminal block with 48 screw terminals for the SCXI-1160 relay module.

SCXI-1325..... 777687-25
26-screw terminal block for the SCXI-1124 module.

SCXI-1326..... 777687-26
High-voltage terminal block with 48 screw terminals for the SCXI-1162 Series and SCXI-1163 Series modules.

SCXI-1327 (see Figure 6)..... 777687-27
With the SCXI-1327 you can extend the input range of the SCXI-1120/D, SCXI-1121 and SCXI-1125 to ±300 V_{rms}, and extend the threshold level of the SCXI-1126 module from 5 V up to 300 V. The extended input voltage range is enabled or disabled on a per-channel basis using switches located within the SCXI-1327. The SCXI-1327 also includes an onboard temperature sensor for cold-junction compensation with thermocouples. Using the SCXI-1327 reduces the input impedance of your SCXI module to 1 MΩ.

SCXI-1328 (see Figure7)..... 777687-28
Isothermal terminal block with a high-precision cold-junction sensor for high-accuracy thermocouple applications with the SCXI-1120/D, SCXI-1121, or SCXI-1125.

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Figure 8. SCXI-1331 Terminal Block

SCXI-1330..... 777687-30
Connector and shell assembly (hardened plastic enclosure and solder pins) used to create custom cabling solutions from the SCXI-1120/D, SCXI-1121, SCXI-1125, SCXI-1126, and SCXI-1181 to custom terminations.

SCXI-1331 (see Figure 8)..... 777687-31
General-purpose terminal block for the SCXI-1127 multiplexer/matrix module with 64 generic screw terminals and a cold-junction compensation sensor. For SCXI-1127 multiplexer applications or matrix configurations other than a multiple of eight columns by four rows. Includes sockets for matrix expansion cables.



Figure 9. SCXI-1332 Terminal Block

SCXI-1332 (see Figure 9)..... 777687-32
Multiplexer/matrix terminal block for the SCXI-1127 configures the SCXI-1127 as an eight column by four row switching matrix. You can connect signals to both the columns and rows using screw terminals.

SCXI-1333..... 777687-33
SCXI-1334..... 777687-34
SCXI-1335..... 777687-35
SCXI-1336..... 777687-36
SCXI-1337..... 777687-37
SCXI-1339..... 777687-39
These terminal blocks are designed for use with the SCXI-1129 high-density matrix switching module. Each of these terminal blocks gives the high-density matrix a different configuration.



Figure 10. BNC-2095

SCXI-1338..... 777687-38
Current input terminal block for the SCXI-1120/D, SCXI-1125, and SCXI-1126. Each input includes a 249 Ω precision resistor for reading 0 to 20 mA or 4 to 20 mA current inputs.

BNC-2095 (see Figure 10)..... 777508-01
The BNC-2095 has 32 labeled BNC connectors, one for each input channel of the SCXI-1100 or SCXI-1104/C. The BNC-2095 also includes circuitry for configurable signal referencing. You can enable or disable both the pull-up and pull-down resistors on a per-channel basis using switches.

TC-2095..... 777509-01
The TC-2095 has 32 miniature uncompensated thermocouple plugs, one for each input channel of the SCXI-1100 or SCXI-1102/B/C and a thermistor for accurate cold-junction compensation. In addition, the TC-2095 includes circuitry for configurable signal referencing. You can enable or disable both the pull-up and pull-down resistors on a per-channel basis using switches located on the rear of the TC-2095. The TC-2095 is not recommended for use with the SCXI-1104/C. The TC-2095 requires the SH96-96 or R96-96 for connection to an SCXI module.

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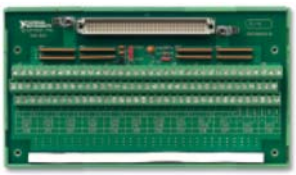


Figure 11. TBX-1303



Figure 12. TBX-1316



Figure 13. TBX-1326

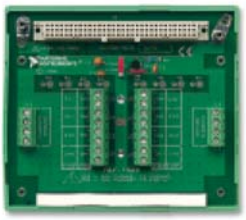


Figure 14. TBX-1328



Figure 15. TBX-1329

TBX-1303(see Figure 11)..... 777207-03
Designed for thermocouples, with cold-junction compensation sensor, isothermal construction with a plastic cover to minimize thermal gradients, open-thermocouple detection circuitry, and automatic ground-referencing circuitry. With the SCXI-1102B/C, the TBX-1303 provides a high-impedance path to ground so that systems work reliably with either floating or ground-referenced thermocouples. For applications with the SCXI-1100, you can configure the channels as ground-referenced or floating in blocks of eight channels. The TBX-1303 also works with the SCXI-1181 breadboard module.

TBX-96..... 777264-01
Mass termination terminal block that provides a generic solution for the SCXI-1100, SCXI-1102 B/C, SCXI-1104/C, and the SCXI-1140 series.

TBX-1316 (see Figure 12)..... 777207-16
High-voltage terminal block for extending the input range of the SCXI-1120/D, SCXI-1125, or SCXI-1126 modules to ±1000 VDC (680 V_{rms}). Each input channel includes a 200:1 attenuation circuit and offers a positive, negative, and ground terminal for up to 12 AWG wire. You can panel mount this enclosure or simply place it on a desktop. The hinged lid makes accessing the signals easier and key locked for safety. The TBX-1316 is rated for Category III installations.

TBX-1325..... 777207-25
Terminal block with 30 screw terminals for signal connections to the SCXI-1124 module. You cable the TBX-1325 to the SCXI-1124 with the SH48-48-A shielded cable.

TBX-1326 (see Figure13)..... 777207-26
High-voltage terminal block with 48 screw terminals for signal connections to the SCXI-1162, SCXI-1162HV, SCXI-1163, and SCXI-1163R modules. You can cable the TBX-1326 to the SCXI module with the SH48-48-B shielded cable. Warning: The TBX-1326 and SH48-48-B limit the maximum working common-mode voltage between banks or between banks and earth ground to 250 V_{rms} maximum.

TBX-1328 (see Figure 14)..... 777207-28
Terminal block for the SCXI-1120/D, SCXI-1121, SCXI-1125, and SCXI-1126 modules. The TBX-1328 includes a total of 24 screw terminals, including three terminals (CH+, CH-, and chassis ground) for each input channel and sockets for the installation of resistors for 4 to 20 mA inputs. When used with thermocouples, the TBX-1328 maximizes measurement accuracy with an isothermal construction and a plastic cover that minimizes thermal gradients across the terminal block and the resulting errors.

TBX-1329 (see Figure 15)..... 777207-29
Provides selectable AC coupling for the SCXI-1120/D, SCXI-1121, SCXI-1125, and SCXI-1126 modules.

TBX-24F..... 777276-01
The TBX-24F is a general-purpose screw terminal block with feed through connections for 24 signal lines. You connect the TBX-24F to the SCXI module with discrete wires connected to a standard SCXI terminal block.

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SCXI Chassis

NI SCXI-1000, NI SCXI-1000DC, NI SCXI-1001

- Shielded enclosures for SCXI modules
- Low-noise environment for signal conditioning
- Rugged, compact chassis
- Forced air cooling
- Optional USB data acquisition and control module
- Optional rack mounting
- 3 internal analog buses
- Timing circuitry for high-speed multiplexing
- AC, DC, or battery-power options
- NI-DAQmx driver software simplifies chassis configuration

Operating Systems
- Windows 7/Vista/XP/NT/2000

Recommended Software
- LabVIEW
- LabWindows/CVI
- Measurement Studio
- Lookout
- VI Logger

Driver Software[1]
- NI-DAQmx
- NI-SWITCH

[1] *Included with DAQ device or switch*



Overview

National Instruments offers rugged, low-noise SCXI chassis to house, power, and control your SCXI modules and conditioned signals. The unique SCXI chassis architecture includes the SCXIbus, which routes analog and digital signals and acts as the communication conduit between modules. Chassis control circuitry manages this bus, synchronizing the timing between each module and the DAQ device. With this architecture, you can scan input channels from several modules in several chassis at rates up to 333 kS/s for every DAQ device.

The versatility of SCXI lies in its various chassis options and expandability. You can choose from a number of different standard AC or DC power options. You can control the system by connecting directly to an M Series, E Series, B Series or USB multifunction DAQ device. You can even daisy-chain up to eight chassis for control by a single DAQ device. Regardless of your configuration, programming the system does not change. You use the same function calls you use with a DAQ device by itself. NI-DAQ or NI-SWITCH driver software handles all low-level programming.

The SCXIbus

The SCXIbus is a guarded analog and digital bus located in the backplane of the SCXI chassis. Modules inserted into the chassis connect to this backplane automatically. This bus acts as a conduit for routing signals, transferring data, programming modules, and passing timing signals.

Chassis Control Circuitry

Each SCXI chassis includes control circuitry. This circuitry handles all signal routing on the SCXIbus. During high-speed analog input operations, it controls which input signals are connected to the bus and routed back to the DAQ device. It also ensures tight synchronization between the SCXI modules and the DAQ device.

Expandability

If your initial system requires more SCXI modules than one chassis can hold, or your system requirements change, simply add another chassis. With the SCXI expandable architecture, you can daisy-chain up to eight chassis to a single multifunction DAQ device. Whether you are using a single-chassis or multichassis system, you can still acquire data at rates up to 333 kS/s.

Power Options

These SCXI chassis offer a number of standard AC power options. Simply choose the option for your country or a country compatible with your power specifications. If you move your system to another country, you can easily reconfigure the system for any ofthe other AC power configurations.

Ordering Information

NI SCXI-1000	776570-0P[1]
NI SCXI-1000DC	776570-00
NI SCXI-1001	776571-0P[1]

[1]To choose your power option, replace the "P" with the appropriate number for your country's power:

1 – U.S. 120 VAC
2 – Swiss 220 VAC
3 – Australian 240 VAC
4 – Universal Euro 240 VAC
5 – North American 240 VAC
6 – United Kingdom 240 VAC
7 – Japanese 100 VAC

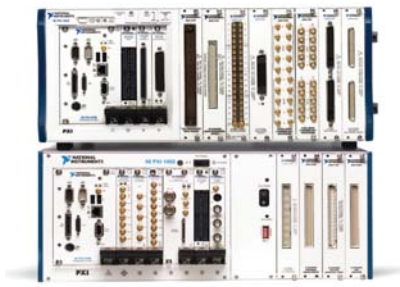
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NI PXI-1050, NI PXI-1052

- Integrated SCXI signal conditioning
- Ideal for high-channel-count data acquisition applications
- Built-in cabling to SCXI slots
- HALT tested for increased reliabilty

PXI-1050
- 8 PXI slots and 4 SCXI slots
- Multiplexed and parallel operating modes for SCXI
- Latest chassis technology

PXI-1052
- 4 PXI slots and 8 SCXI slots
- Latest chassis technology
- AUTO/HIGH fan-speed selector to optimize cooling and acoustic emissions
- Quieter operation, as low as 42 dBA
- Extended temperature range to 55 °C
- Multiplexed operating mode for SCXI
- SCXI high-voltage analog backplane integrated internally



Overview

National Instruments offers PXI chassis with integrated SCXI so you can have the benefits of SCXI and the PXI platform integrated in a single PXI chassis. The PXI platform offers a variety of modules such as multifunction I/O, digital I/O, switching, and instrument modules. With SCXI you can expand the functionality of your data acquisition system with modules for multiplexing, linearization, filtering, isolation, amplification, switching, and more. The NI PXI and SCXI combination chassis offer a complete solution for a wide range of test and measurement applications that require signal conditioning, switching and multiplexing. Visit the PXI/SCXI advisor at **ni.com/pxiadvisor** to view a complete list of SCXI modules and configure a PXI and SCXI system.

PXI-1050, PXI-1052

The PXI-1050 and PXI-1052 offer the latest chassis technology from NI. The PXI-1050 is an upgrade to the PXI-1010, and works with all NI PXI controllers. The PXI-1052 implements fan-speed control of the power supply and module fans to reduce acoustic emissions, and offers an AUTO/HIGH fan-speed selector switch. When set to AUTO, the PXI-1052 optimizes cooling and acoustic emissions based on air intake temperature.

SCXI Operating Modes

NI PXI chassis with integrated SCXI provide a built-in digital and analog bus between the right most PXI slot and the SCXI subsystem so that a DAQ or DMM module can control the SCXI subsystem in multiplexed mode without external cabling. Using the PXI-1050, you can also connect additional PXI DAQ modules to SCXI modules in parallel mode (requires additional cabling). In multiplexed mode, one DAQ module controls the entire SCXI subsystem; all measurements are multiplexed back to this one device so users can create a cost-effective high-channel-count system. SCXI handles many types of sensor measurements, including voltages, resistances, thermocouples, strain gages, accelerometers, RTDs, and LVDTs.

Ordering Information

Step 1. Select your chassis.

NI PXI-1050

120 VAC	779199-01
100 VAC	779199-02
220 VAC	779199-03
240 VAC	779199-04
NI PXI-1052 (universal input)	778693-01

Step 2. Select one or more power cords.

U.S.120 VAC	763000-01
Japan 100 VAC	763000-01
United Kingdom 240 VAC	763064-01
Swiss 220 VAC	763065-01
Australian 240 VAC	763066-01
Universal Euro 240 VAC	763067-01
North American 240 VAC	763068-01

Step 3. Select additional accessories.

SCXI-1370 Rack Mount kit for the SCXI-1001 or PXI-1050 chassis	776577-70
SCXI-1360 front filler panel	776576-60
SCXI-1361 rear filler panel	776576-61
SCXI-1374 handle kit	776577-74
PXI-1052 front rack-mount kit (for 19 in.rack)	778931-01
PXI-1052 rear rack-mount kit (for 19 in.rack)	778931-02
EMC filler panels (6 single-slot)	778700-01
Filler panels (3 double-slot and 3 single-slot)[1]	778679-01
Slot blockers (2 single-slot)[2]	778678-01

[1]Every PXI-1052 chassis comes with two single-slot filler panels.

[2]Slot blockers are optional for improved thermal performance of your PXI-1052 system. Please refer to National Instruments KnowledgeBase entry on slot blocker usage criteria on **ni.com/support** for additional information on this optional system feature.

Step 4. Select system setup and installation services.

If you are ordering this chassis as part of a system, select NI Factory Installation Services to have your hardware/software installed and receive your new PXI system ready to use right out of the box.

NI Factory Installation Services – PXI Systems	960596-01

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SCXI Cable Assemblies

Overview

NI SCXI cable assemblies connect a DAQ device to the SCXI system. They consist of high-quality, low-noise cables, which guarantee reliable communication and signal integrity at up to 10 m.

For SCXI systems operating in multiplexed mode, you need only one SCXI-1349 and shielded cable per SCXI chassis. You must choose the appropriate cable assembly for your DAQ device (see Table 1). Multichassis multiplexed systems require an additional SCXI-1346 multichassis adapter and SH68-68-EP shielded cable for each additional chassis. If your SCXI system includes modules operating in parallel mode, you need an additional SCXI cable assembly for each of these modules.

Each SCXI cable assembly includes a cable and one or more SCXI cable adapters. The shielded cables use twisted pair wiring and separately shielded analog and digital signals for maximum noise rejection. The cable adapter screws into a rear slot of the SCXI chassis to hold the cable securely in place. Each cable adapter also has a 50-pin male breakout connector, for attaching additional DAQ accessories such as the SCXI-1180 feedthrough panel or a CB-50 terminal block.



Figure 1. SCXI-1349

SCXI-1349 - Adapter for connecting SCXI systems to DAQ devices. For M Series devices, use the SCXI-1349 and the SHC68-68-EPM (two of each are required for NI 62x4 and NI 62x9). For E Series devices (except DAQCard devices), use the SCXI-1349 adapter with an SH68-68-EP shielded cable. For a DAQCard (with latching connector), use the SCXI-1349 Adapter with an SHC68-68-EP cable. For a legacy DAQCard, (with nonlatching connector), use the SCXI-1349 adapter with a PSHR68-68 cable.

Ordering Information

SCXI-1349 (adapter)..... 182671-01
SHC68-68-EPM cable
- 0.5 m..... 192061-0R5
- 1 m..... 192061-01
- 2 m..... 192061-02

SH68-68-EP cable
- 1 m..... 184749-01
- 2 m..... 184749-02

SHC68-68-EP cable
- 0.5 m..... 186838-0R5
- 1 m..... 186838-01

PSHR68-68 cable
- 1 m..... 777293-01

Terminal Block	Part Number	PXI/SCXI Combination Chassis Cabling		
		Type	Special Functions	Page
62xx (M Series)	SCXI-1349 with SHC68-68-EP	Shielded	Internal[1] or external	Internal[1]
60xxE (E Series) with 58-pin connectors	SCXI-1349 with SH68-68-EP	Shielded	Internal[1] or external	Internal[1]
DAQCard-AI-16E-4, DAQCard-AI-16XE-50	SCXI-1349 with PSHR68-68M	Shielded	N/A	N/A
DAQCard-60B2E, DAQCard-6024E	SCXI-1349 with SHC68-68-EP	Shielded	N/A	N/A
60xxE (E Series) with 100-pin connectors	SCXI-1353	Shielded	Internal[1] or external[2]	Internal[1]
PCI-DIO-32HS, AT-DIO-32HS, PXI-6533	SCXI-1355	Shielded	Internal[1] or external[2]	Internal[1]
DAQCard-6533	SCXI-1355 with PSHR68-68M	Shielded	N/A	N/A
DAQCard-DIO-24	SCXI-1351 with PSH27-50F-D1	Ribbon	N/A	N/A
PCI-DIO-96, PXI-6508	SCXI-1351 with R1005050	Ribbon	External[2]	N/A
PC-DIO-96/PnP	NB5 with SCXI-1351	Ribbon	N/A	N/A
PXI-4070, NI 4021	SCXI-1357[3], SCXI-1358[3], SCXI-1362[4]	Shielded	Internal[5] or external[6]	Internal[5] or external[6]
PCI-6534, PXI-6534	SCXI-1355	Shielded	N/A	N/A

[1]Requires no external cabling. [2]Requires same cabling as SCXI chassis. [3]For use with SCXI-1127/1128/1129. [4]For use with SCXI-1160/1161/1163R/1190/1191.
[5]Digital control only, measurements of switched signals with the PXI-4070 or NI 4060 require external cabling.

Table 1. SCXI Chassis Cabling

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SCXI Cable Assemblies and Accessories

Cable Assemblies

SCXI-1343 - A general-purpose SCXI adapter with screw terminals for custom cable solutions to external instrumentation hardware.
SCXI-1343..... 776574-43

SCXI-1346 - for connecting multiple SCXI chassis to a single DAQ device. The SCXI-1346 occupies two rear slots, and routes the analog and digital DAQ signals to the next chassis. You must purchase an SCXI-1346 for each additional chassis you want to add to your system. With each SCXI-1346, you must purchase an additional SH68-68-EP.
SCXI-1346..... 776574-46

SCXI-1351 - one-slot cable extender for connecting DAQCard-DIO-24, DIO-96 Series, PXI-6508, or SCXI-1181 devices to your SCXI system. You insert the SCXI-1351 into a rear slot next to an SCXI-1181 and use the ribbon cable provided to connect your SCXI-1181 to your SCXI system. See Table 1 for additional required cabling when using the SCXI-1351 with digital devices such as the PXI-6508.
SCXI-1351..... 776575-51

SCXI-1353 - Shielded cable for connecting 100-pin E Series devices to an SCXI chassis. The SCXI-1353 consists of an SH1006868 cable and two SCXI cable adapters with 50-pin male breakout connectors. The first adapter is identical to the SCXI-1349, while the second adapter routes the extended analog or digital signals to SCXI digital modules or breadboarding modules.
1 m..... 776575-531
2 m..... 776575-532

SCXI-1355 - Shielded cable for connecting the PCI-DIO-32HS, AT-DIO-32HS, PXI-6533, DAQCard-6533, PCI-6534 or PXI-6534 to an SCXI chassis. The SCXI-1355 consists of an SH6868-D1 cable and an SCXI cable adapter. The DAQCard-6533 requires an additional PSHR68-68M cable.
1 m..... 776575-551
2 m..... 776575-552

SCXI-1362 - for connecting the NI 4021 switch controller, an NI 407x FlexDMM, or an NI 4060 DMM to an SCXI system containing the SCXI-1160/1161/1163R/1166/1901/1191/1193. If the chassis contains the SCXI-1127/1128/1129, use the SCXI-1357 or SCXI-1358.
1 m..... 776575-621
2 m..... 776575-622

Accessories

SCXI-1180..... 776572-80
Feedthrough panel that extends the I/O signals of the DAQ device to the front of the SCXI chassis. It occupies one slot of your SCXI system and easily connects to your SCXI cable accessory.

SCXI-1181 776572-81
A breadboard module with a 13.3 by 17.8 cm. (5.25 by 7 in.) breadboard area for integrating custom circuitry into your SCXI system.

SCXI-1181K..... 776572-81K
A kit of unassembled module parts, including front and rear connectors and aluminum module housing. It is useful for custom module development with custom printed circuit boards.


SCXI-1353


SCXI-1355 Connected to Rear of SCXI Chassis


SCXI-1356


SCXI-1353


SCXI-1362


SCXI-1180


SCXI-1181

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SCXI Accessories

SCXI-1381K..... 777687-81K
A kit of unassembled terminal block components for developing custom SCXI terminal blocks. This kit includes the terminal block housing, strain-relief assembly, and 96-pin DIN connector for mating with SCXI modules.

SCXIbus Extender..... 181585-01
With the SCXIbus extender, you can operate the module outside of the chassis, which is useful for developing and debugging custom modules.

SCXI-1352..... 776575-52
A kit containing two ribbon cables (R1650 and R165050) for connecting the conditioned output of an SCXI module (operating in parallel mode) directly to the input of an adjacent module.

SCXI-1360 (front)..... 776576-60
SCXI-1361 (rear)..... 776576-61
Front filler panels cover unused chassis slots and rear filler panels cover the rear slots not occupied by cable assemblies, multichassis adapters, one-slot cable extenders, or SCXI-1357/SCXI-1358 high-voltage backplane units.

Rack-Mount Kits

Holds SCXI chassis in standard 19 in. rack-enclosures. Each kit offers multiposition capability for both recessed and flush mounting.
SCXI-1370 rack-mount kit (SCXI-1001, PXI-1050)..... 776577-70
SCXI-1371 rack-mount kit (SCXI-1000/1000DC)..... 776577-71
SCXI-1372 dual rack-mount kit (SCXI-1000/1000DC)..... 776577-72
PXI-1052 front rack-mount..... 778931-01
PXI-1052 rear rack-mount..... 778931-02

SCXI-1373..... 776577-73
Mounts any 4-slot or 12-slot chassis to a panel or wall. You can mount the chassis facing up or down, leaving clearance for front and rear cabling.

SCXI-1374..... 776577-74
A chassis handle that easily attaches to either side of the SCXI chassis or SCXI-1382 battery pack.

SCXI Process Current Resistor Kit..... 776582-01
A pack of four precision resistors for measurements of 0 to 20 mA and 4 to 20 mA current inputs. Each resistor is a 249 Ω, 0.1%, 5ppm/°C, 0.25 W high-precision resistor. For use with the terminal blocks for the SCXI-1120/D, 1121, 1140, 1141, 1142, 1143, 1100, 1102, and 1122.

SCXI-1382..... 776577-820
A 12 VDC, 25 Ah battery pack that attaches directly to the SCXI-1000DC. It can power a fully loaded chassis for a minimum of five hours. The optional dual-stage power supply battery charger can charge a completely discharged battery in 8 to 11 hours, and is sold separately (SCXI-1383).

SCXI-1383
A 13.8 VDC, 4 A power supply/float charger for the SCXI-1000DC, which accepts 100 to 240 VAC power input. The SCXI-1382 can be combined with the SCXI-1383 to operate in standby mode and provide uninterruptible power to the SCXI-1000DC chassis. The SCXI-1383 will recharge a completely discharged SCXI-1382 battery pack in 12 to 14 hours.
U.S. 120 VAC..... 776577-831
Swiss 220 VAC..... 776577-832
Australian 240 VAC..... 776577-833
Universal Euro 240 VAC..... 776577-834
North American 240 VAC..... 776577-835
United Kingdom 240 VAC..... 776577-836


SCXI-1373


SCXI-1000DC Chassis, SCXI-1382 Battery Pack and SCXI-1374 Handle Accessory

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Accessory	Description	Sensor/Signal Type
AMUX-64T	64-channel multiplexer	mV, V, thermocouple
SC-2040	8-channel simultaneous sample-and-hold	mV, V
SC-2042-RTD	8-channel RTD/thermistor accessory	RTD, thermistor
SC-2043-SG	8-channel strain gage accessory	Strain, bridge-based sensors

Table 1. Analog Accessory Compatibility Guide

Overview

National Instruments offers several different front-end signal conditioning devices for use with M Series, E Series, and B Series multifunction DAQ devices. These devices offer a low-cost solution for applications requiring only one type of signal conditioning.

Power

You can power each of these accessory devices with the 5 VDC supply on the DAQ device. Each device also offers screw terminals for connecting an externals VDC power supply. You need an external power supply only when using the SC-2043-SG with a DAQCard, or when using two or more SC-2043-SG devices with a single DAQ device.

Field Wiring

Signals from the transducers and signal sources connect to screw terminals located on each accessory.

Mounting

You can mount all of these accessories with the rack mount kit. The kit is available in either single or double height, with either an acrylic plastic cover or a metal wrap-around cover. For custom connectivity applications, you can mount the SC-2040, SC-2042-RTD, and SC-2043-SG in the CA-1000 shielded enclosure using panelettes

AMUX-64T

Analog Input

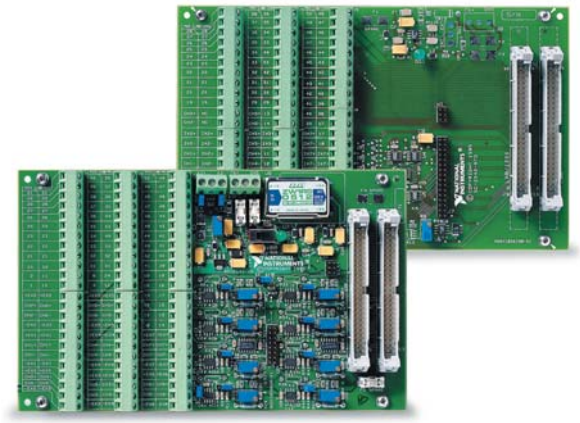
The AMUX-64T contains 16 CMOS 4x1 analog input multiplexers. The analog inputs can operate as 64 single-ended or 32 differential inputs.

Channel Expandability

You can use one AMUX-64T for 64 input channels. You can also connect up to four AMX-64T devices to a single multifunction DAQ device to provide up to 256 channels. See Table 2 for cabling options.

Thermocouple Measurements and Cold-Junction Compensation

A movable jumper connects the temperature sensor of the AMUX-64T to analog input channel 0. An AMUX-64T configured with the



temperature sensor connected has channels available for reading the temperature from 60 thermocouples in single-ended mode or 30 thermocouples in differential mode. You can cascade up to four AMUX-64T devices to increase the number of inputs to 240 in single-ended mode or 120 in differential mode.

Note: For measuring thermocouples with the AMUX-64T, National Instruments recommends 16-bit DAQ devices with a gain of 100.

SC-2040

The SC-2040 provides simultaneous sample-and-hold function ability. Each analog input channel of the SC-2040 has its own instrumentation amplifier with differential inputs. Using DIP switches, you can configure each channel independently for a gain of 1, 10, 100, 200, or 500. Each channel has input overvoltage protection of ±30 V powered on and ±15 V powered off.

SC-2042-RTD

Analog Input

The SC-2042-RTD is an 8-channel signal conditioning accessory for RTDs or thermistors. Each input channel has an independent 1 mA current excitation source and screw terminals for 4-wire RTD measurements. For 3 or 2-wire RTDs you can provide the appropriate short using screw terminals. With the SC-2056 cable adapter accessory, you can use up to four SC-2042-RTDs to interface 32 RTDs to a single NI 6031E, 6033E, 6071E, or AT-MIO-64E-3 board.

Current Excitation

Each channel of the SC-2042-RTD includes a current excitation source with outputs connected to screw terminals. Each current excitation channel produces 1 mA and can drive loads up to 8.5 kΩ.

Note: Current excitation of 1 mA can cause overheating errors with some thermistors.

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SC-2043-SG

Input Channels

The SC-2043-SG is an 8-channel low-cost strain conditioning analog input device. Each input channel of the SC-2043-SG includes an instrumentation amplifier with differential inputs and a fixed gain of 10, producing an input range of ±100 mV, which is typical for strain gages. The inputs include overvoltage protection of ±45 VDC powered on and ±30 VDC powered off. Each channel also includes a lowpass noise filter with a bandwidth of 1.6 kHz. The output of each filter is buffered to prevent settling-time delays when used with a multiplexing DAQ device. With the SC-2056 cable adapter accessory, you can use up to four boards to interface 32 strain gages to a single DAQ device, such as the NI 6031E, 6033E, or 6071E, with 32 differential inputs.

Accessory	DAQ Device	Cabling
1st AMUX-64T	68-pin E Series (except DAQCard devices)	SH68-68-EP or R6868
	100-pin E Series	SH 1006868 or R1005050
	Latching E Series DAQCard-6062E/6024E	SHC68-68-EP
	Nonlatching E Series DAQCard-AI-16E-4/AI-16XE-50	PSHR68-68 shielded cable Kit or PR68-68F
Additional AMUX-64T	-	NB1 (1 per AMUX-64T)
SC-2040	68-pin E Series (except DAQCard devices)	SH68-68-EP or R6868
	100-pin E Series	SH1006868
	Latching E Series DAQCard-6062E/6024E	SHC68-68-EP
	Nonlatching E Series DAQCard-AI-16E-4/AI-16XE-50	PSHR68-68 shielded cable Kit or PR68-68F
SC-2042-RTD or SC-2043-SG	68-pin E Series	SH6850 or R6850
	Latching E Series DAQCard-6062E/6024E	SHC68-68-EP and 68M-50F
	Nonlatching E Series DAQCard devices: DAQCard-AI-16E-4/AI-16XE-50	PSHR68-50
	AT-MIO-16DE-10, 6025E	R1005050[1]
	AT-MIO-64E-3, 6031E. 6033E, 6071E	R1005050[1] or NB1 to SC-2056[2]
Additional SC-2042-RTD or SC-2043-SG (up to 3)	AT-MIO-64E-3, 6031E, 6033E, 6071E	NB1 to SC-2056[2]

[1]With the R1005050 cable, the SC-2042-RTD connects to pins 1-50 (ACH0-ACH15) only of the 100 pin MID boards.
[2]You can connect up to four SC-2042-RTD boards or up to four SC-2043-SG boards to an SC-2056 for the AT-MID-64E-3, 6031E, 6033E, or 6071E. You cannot use SC-2042-RTD and SC-2043-SG boards together. For configuration details, visit **ni.com/siqnalconditioning**.

Table 2. AMUX-64T and SC-204x Cabling Guide

NI SC-205x Cable Adapters

These adapter boards are used for routing signals between DAQ devices and SC-204x, SC-206x, 5B Series, ER-8/16, and SSR Series signal conditioning devices.

Voltage Excitation

You can use the onboard regulated +2.5 VDC excitation source to power your strain gage bridges. You can also adjust this supply from 1.5 to 2.5 VDC using an onboard potentiometer. Optionally, you can connect an external excitation source of up to 10 VDC.

Bridge Completion

You can enable full-bridge and half-bridge completion on each channel by setting a jumper that connects the negative input of the channel to the half-bridge network, consisting of two 2.5 kΩ precision resistors.

Offset Nulling

With the postgain offset nulling circuits, you can manually adjust trim pots to null out any bridge offsets (±5 mV, referred to input) on each input channel.

Ordering Information

NI AMUX-64T 776366-90
NI SC-2040 776937-01
NI SC-2042-RTD 777095-01
NI SC-2043-SG 777096-01

Accessories

Rack-Mount Kit with Acrylic Plastic Cover
Single-height 777212-01
Double-height 777212-02
Rack-Mount Kit with Metal Wraparound Cover
Single-height 777212-11
Double-height 777212-12
Quarter-Bridge Completion Resistors (0.1%, 10 ppm/°C)
8 resistors, 120 Ω 777180-01
8 resistors, 350 Ω 777180-02

Cables

SH68-68-EP (1 m) 184749-01
R6868 (1 m) 182482-01
SH1006868 (1 m) 182849-01
R1005050 (1 m) 182762-01
PSHR68-68 (shielded cable kit) 777293-01
PR68-68F (1 m) 183646-01
R68M-50F (0.3 m) 777660-0R3
NB1 (0.5 m) 180524-05

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5B Series

- For low-channel-count systems requiring isolated input and output Temperature and strain measurements
- Voltage measurements from ± 10 mV range to ±20 V range
- Process control
- Design validation
- Require module carrier



Overview

5B Series modules perform single-channel analog signal conditioning for National Instruments M Series, E Series, and B Series multifunction DAQ devices. These modules are mounted in an 8-channel NI SC-2311 shielded carrier or an 8 or 16-channel backplane.

Model	Input Range	Bandwidth	Part Number
5B30	±10 mV	4 Hz	776228-01
	±50 mV	4 Hz	776228-05
	±100 mV	4 Hz	776228-10
5B31	±1 V	4 Hz	776229-01
	±5 V	4 Hz	776229-05
	±10 V	4 Hz	776229-10
	±20 V	4 Hz	776229-20
5B40	±10 mV	10 kHz	776230-01
	±50 mV	10 kHz	776230-05
	±100 mV	10 kHz	776230-10
5B41	±1 V	10 kHz	776231-01
	±5 V	10 kHz	776231-05
	±10 V	10 kHz	776231-10
	±20 V	10 kHz	776231-20

Table 1. 5830/31/40/41 Voltage Input

Model	Input Range	Output Range	Bandwidth	Part Number
5B32	4 to 20 mA	0 to +5 V	4 Hz	776232-01
	0 to 20 mA	0 to +5 V	4 Hz	776232-02

Table 2. 5832 Process Current Input

Model	Sensor	Range (°C)	Part Number
5B34	100 Ω Pt	-100 to 100	776233-P1
	100 Ω Pt	0 to 100	776233-P2
	100 Ω Pt	0 to 200	776233-P3
	100 Ω Pt	0 to 600	776233-P4
	10 Ω Cu (at 0°C)	0 to 120	776233-C1
	10 Ω Cu (at 25°C)	0 to 120	776233-C2
	120 Ω Ni	0 to 300	776233-N1

Table 3. 5B34 RTD Input - Isolated 2 or 3-Wire RTD

Model	Sensor	Range (°C)	Part Number
5B35	100 Ω Pt	-100 to 100	778015-01
	100 Ω Pt	0 to 100	778015-02
	100 Ω Pt	0 to 200	778015-03
	100 Ω Pt	0 to 600	778015-04

Table 4. 5B35 RTD Input - Isolated 4-Wire RTD

Model	Sensor	Range (°C)	Part Number
5B36	0 to 100 Ω	0 to +5	778016-01
	0 to 500 Ω	0 to +5	778016-02
	0 to 1 kΩ	0 to +5	778016-03
	0 to 10 kΩ	0 to +5	778016-04

Table 5. 5B36 Potentiometer Input

Model	Thermocouple Type	Temperature Range (°C)	Part Number
5B37	J	-100 to 760	776289-J
	K	-100 to 1350	776289-K
	T	-100 to 400	776289-T
	E	0 to 900	776289-E
	R	0 to 1750	776289-R
	S	0 to 1750	776289-S
	B	0 to 1800	776289-B

Table 6. 5B37 Thermocouple Input with Cold-Junction Compensation

Model	Transducer Input	Impedance	Excitation (V)	Sensitivity (mV/V)	Part Number
5B38	Full bridge	100 Ω to 10 kΩ	3.333	3 mV/V	776342-01
	Full bridge	300 Ω to 10 kΩ	10	3 mV/V	776342-02
	Half bridge	100 Ω to 10 kΩ	3.33	3 mV/V	776342-03
	Half bridge	300 Ω to 10 kΩ	10	3 mV/V	776342-04
	Full bridge	300 Ω to 10 kΩ	10	2 mV/V	776342-05

Table 7. 5B38 Strain Gage Input

Model	Input Range	Output Range	Part Number
5B39	0 to +5 V	4 to 20 mA	776365-01
5B49	±5 V	±5 V	777234-02
	±10 V	±10 V	777234-05

Table 8. 5B39/49 Current and Voltage Output

Model	Input Range	Output Range	Bandwidth	Part Number
5B42	4 to 20 mA	+1 to +5 V	100 Hz	778017-01
	0 to 20 mA	+2 to +10 V	100 Hz	778017-02

Table 9. 5B42 Process Current Input with External Regulated 20 VDC Loop

Model	Input Range	Output Range (V)	Part Number
5B45/46	0 to 500 Hz	0 to 500 Hz	776977-01
	0 to 1 kHz	0 to +5	776977-02
	0 to 2.5 kHz	0 to +5	776977-03
	0 to 5 kHz	0 to +5	776977-04
	0 to 10 kHz	0 to +5	776977-05
	0 to 25 kHz	0 to +5	776978-01
	0 to 50 kHz	0 to +5	776978-02
	0 to 100 kHz	0 to +5	776978-03

Table 10. 5B45/46 Frequency Input

Model	Thermocouple Type	Temperature Range (°C)	Accuracy (°C)	Part Number
5B47	J	0 to 760	±1.1	776234-J1
	J	-100 to 300	±0.5	776234-J2
	J	0 to 500	±0.6	776234-J3
	K	0 to 1000	±1.3	776234-K1
	K	0 to 500	±0.6	776234-K2
	T	-100 to 400	±1.4	776234-T1
	T	0 to 200	±0.5	776234-T2
	E	0 to 1000	±1.7	776234-E
	R	500 to 1750	±2.5	776234-R
	S	500 to 1750	±2.4	776234-S
	B	500 to 1800	±5.1	776234-B

Table 11. 5B47 Linearized Thermocouple Input with Cold-Junction Compensation

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Specifications

5830/31/40/41

Output range..... ±5 V
Accuracy
  5B30, 5B40..... ±0.05% FSR ± 10 µV
  5B31, 5B41..... ±0.05% FSR ±0.2 µV
CMRR (50 or 60 Hz)
  5B30, 5B31..... 160 dB
  5B40..... 100 dB
  5B41..... 90 dB
Input offset stability..... ±1 µV/°C for 5B30, 5B40
  ±20 µV/°C for 5B31, 5B41
Output offset stability..... ±20 µV/°C for 5B30, 5B31
  ±40 µV/°C for 5B40, 5B41
Gain stability..... ±25 ppm/°C for 5B30, 5B40
  ±50 ppm°C for 5B31, 5B41
Power requirement..... 30 mA at +5 VDC

5B32

Accuracy..... ±0.05% FSR
CMRR (50 or 60 Hz)..... 160 dB
Offset stability..... ±25 ppm/°C of I_z[1]
Gain stability..... ±25 ppm/°C
Resistor stability..... ± 10 ppm/°C
Power requirement..... 30 mA at +5 VDC
[1]I_z is the nominal input current that results in a 0 V output.

5B34

Output range..... 0 to +5 V
Bandwidth..... 4 Hz
Accuracy[1]..... ±0.05% FSR ±0.1 Ω
  (±0.025 Ω for 10 Ω Cu)
CMRR (50 or 60 Hz)..... 160 dB
Excitation current..... 0.25 mA (1.0 mA for 10 Ω Cu)
Input offset stability ..... ±0.02 °C/°C
Output offset stability..... ±20 µV/°C
Gain stability..... ±50 ppm/°C
Power requirement..... 30 mA at +5 VDC
[1]Includes the combined effects of repeatability, hysteresis, and nonlinearity.

5B35

Output range..... 0 to +5 V
Bandwidth..... 4 Hz
Accuracy..... ±0.05 FSR
CMRR (50 or 60 Hz)..... 190 dB
Excitation current..... 0.25 mA
Input offset stability..... ±0.01 °C/°C
Output offset stability..... ±20 mV/°C
Gain stability..... ±30 ppm/°C
Power requirement..... 15 mA at +5 VDC

5B36

Accuracy..... ±0.08% FSR
Bandwidth..... 4 Hz
CMRR (50 or 60 Hz)..... 170 dB
Input offset stability..... ±0.004 Ω/°C (for 100 Ω, 500 Ω, 1 kΩ);
  ±0.010 Ω/°C (for 10 kΩ)
Output offset stability..... ±20 mV/°C
Gain stability..... ±30 ppm/°C
Excitation current..... 0.25 mA (for 100 Ω, 500 Ω, 1 kΩ);
  0.1 mA (for 10 kΩ)
Power requirement..... 15 mA at +5 VDC

5B37

Output range..... 0 to +5 V
Bandwidth..... 4 Hz
Accuracy..... ±0.05% FSR ±10 µV + CJC sensor error
CJC sensor error..... ±0.25°C (at 25°C), ±0.5°C (5 to 45°C)
CMRR (50 or 60 Hz)..... 160 dB
Input offset stability..... ±1 µV/°C
Output offset stability..... ±20 µV/°C
Gain stability..... ±25 ppm/°C
Power requirement..... 30 mA at +5 VDC

5B38

Output range..... ±5 V
Bandwidth..... 10 kHz
Accuracy..... ±0.08% FSR ±10 µV
CMRR (50 or 60 Hz)..... 100 dB
Input offset stability..... ±1 µV/°C
Output offset stability..... ±40 µV/°C
Gain stability..... ±25 ppm/°C
Excitation stability..... ±15 ppm/°C
Power requirement..... 200 mA at +5 VDC (full load)

5B39/49

Bandwidth..... 400 Hz
Accuracy..... ±0.05% FSR
CMRR..... 90 dB
Offset stability..... ±25 ppm/°C
Gain stability..... ±20 ppm/°C
Power requirement..... 170 mA at +5 VDC

5B42

Accuracy..... ±0.05% FSR ±4 µA RTI
CMRR (50 or 60 Hz)..... 140 dB
Input offset stability..... ±0.5 µV/°C
Output offset stability..... ± 5 mV/°C
Gain stability..... ± 25 ppm/°C
Loop supply voltage..... 20 V @ 4 to 20 mA
Power requirement..... 200 mA at +5 VDC

5B45/46

Input threshold..... TTL-level and zero crossing
Input voltage (pk-pk)..... 60 V maximum, 100 mV minimum
Minimum pulse width..... 4 µs
Accuracy..... ± 0.05% FSR
CMRR (50 or 60 Hz)..... 120 dB
Offset stability..... ±40 ppm/°C
Gain stabilit..... ±40 ppm/°C
Power requirement..... 110 mA at +5 VDC

5B47

Output range..... 0 to +5 V
Bandwidth..... 4 Hz
CJC sensor error..... ±0.25 °C (at 25°C), ±0.5°C (5°C to 45°C)
CMRR (50 or 60 Hz)..... 160 dB
Input offset stability..... ±1 mV/°C
Output offset stability..... ±20 mV/°C
Gain stability..... ±25 ppm/°C
Power requirement..... 30 mA at +5 VDC

Common Module

Nonlinearity..... ±0.02% FSR
Common-mode voltage isolation
  Input to output, continuous..... 1,500 V_{rms} maximum
Normal-mode input protection..... 240 V_{rms}, continuous
Transient protection..... Meets IEEE STD 472 (SWC)
Module power..... +5 VDC
Hold down..... Captive, metric screw
Packaging..... Hard potted in plastic case
Module size..... 5.7 by 5.7 by 1.5 cm (2.25 by 2.25 by 0.60 in.)
Operating temperature..... -25 to 85°C

Certifications and Compliances

CE Mark Compliance
This product meets applicable EU directive(s) as follows :
Safety isolation..... Low voltage directive EN 61010
EMC Directive
  Immunity..... EN 50082-1:1994
  Emissions..... EN 55011:1991 Group I Class A at 10 m

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Carriers/Backplanes for 5B Series

Overview

5B Series modules must be installed in a carrier or backplane, for a power source as well as for connectivity to both the raw signals and the DAQ device. The NI SC-2311 shielded carrier cables directly to a DAQ device and offers a variety of connectivity options to signals and sensors. The SC-2311 is ideal for analog input applications because of its shielding. For analog output signal applications, you must use a 5B Series backplane.

NI SC-2311 Shielded Carrier

- Holds up to eight 5B Series analog input modules and up to eight SSR Series digital conditioning modules
- Cables directly to your M Series, E Series, or B Series multifunction DAQ device
- Custom connectivity options via panelettes
- Rack-mount accessory available
- 120/240 VAC power options



Figure 1. NI SC-2311

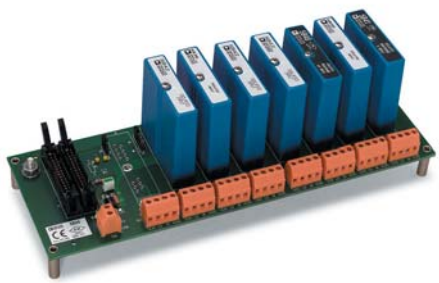


Figure 2. Backplane

5B Series Backplanes

For applications requiring analog output conditioning modules, choose an 8 or 16-channel backplane. You must provide power to the 5B Series backplanes from a 5 VDC power supply, available from NI. An optional rack-mount bracket is available for these backplanes, and it includes a space for a power supply.

Note: You must use a SC-205x adapter for some configurations.

Ordering Information

NI SC-2311
- U.S. 120 VAC..... 778192-01
- Universal Euro 240 VAC..... 778192-04
- United Kingdom 240 VAC..... 778192-06
- Japan 100 VAC..... 778192-07

Backplane/Accessories

5B Series backplanes, (without cables)
- 5B08, 8-channel..... 777309-91
- 5B01, 16-channel..... 776291-91

5B01 rack-mount accessory..... 776236-01
SC-2311 rack-mount kit (2U)..... 187374-01

Power Supply

±5 VDC, 5A
- 85 to 220 VAC..... 776237-35

Cables

NB7 (5B to SC-205x)
- 0.2 m..... 180924-02
- 0.4 m..... 180924-04

NB9 (5B to 50-pin MIO)
- 1 m..... 180555-10

68F-50M MIO adapter..... 183139-01

DAQ Device	SC-2311 Shielded Carrier	5B 8-Channel and 16-Channel Backplanes	
		Direct Cabling (used with input modules only)	Using SC-205x Adapter
68-pin E Series (expect DAQCard devices)	SH68-68-EP	SH68-68-EP, 68F-50M MIO adapter, and NB9 cable	Page 290
100-pin E Series	SH1006868	SH1006868, 68F-50M MIO adapter, and NB9 cable	Page 290
M Series, latching E Series DAQCard-6062E/6024E	SHC6868-EP	SH68-68-EP, 68F-50M MIO adapter, and NB9 cable	Page 290
Nonlatching E Series DAQCard-AI-16E-4/AI-16XE-50	PSHR68-68 shielded cable kit	PSHR68-68-M, 68F-50M MIO adapter, and NB9 cable	Page 290

Table 1. 5B Series Modules Cabling

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Digital Signal Conditioning Accessories

SSR Series

- Per-channel digital signal conditioning
- Digital input and digital output modules
- 8, 16, 24, and 32-channel backplanes
- 4000 V_{rms} Isolation

NI SC-206x

- 8 channels of isolated digital input, digital output, or electromechanical relays
- Rack-mount solutions

NI ER-8, NI ER-16

- 8 or 16 independent SPDT nonlatching relays
- Switching capacity
- 3 A at 250 V_{rms}
- 3 A at 30 VDC
- Expandable to 32 channels
- Switch motors, lamps, small fans, or solenoids



SSR Series

Input Modules

SSR input modules (SSR-IAC-5, SSR-IAC-5A, and SSR-IDC-5) sense voltages from a field source, converting AC and DC voltages to a TTL logic signal. The SSR modules use negative logic. If a voltage within the selected input range for the SSR module is present, the SSR module returns a logic low. Otherwise, the SSR module returns a logic high.

Output Modules

SSR output modules (SSR-OAC-5, SSR-OAC-5A, and SSR-ODC-5) use a logic TTL signal from a DAQ device to switch AC and DC loads. They control up to 240 VAC at 3.5 A in a manner similar to convention alrelays. If the DAQ device is sending a logic low, then the SSR module is turned on and current can flow. If the DAQ device sends a logic high, the SSR module is turned off and current is stopped.

Unlike conventional relays, SSR modules have zero voltage turn-on of the load. Also, a load voltage and minimum current must be present to maintain a SSR output module in the on state.

Note: The output modules (SSR-OAC-5, SSR-OAC-5A, and SSR-ODC 5) do not work with 6503 (DIO-24), 6508 (DIO-96), or the extended digital I/O lines of E Series devices (such as PXI-6025E).

Backplanes

Available with 8, 16, 24, or 32-channel capacity, the backplanes include a 50-pin connector for direct connection of TTL digital I/O signals to the DAQ device. Table 2 describes cabling options.

ER-8, ER-16

Relay Channels

The contacts are break-before-make when operated within the specified switching speed. Each relay provides three connections – normally open(NO), normally closed (NC), and common (COM). As a result, all three contacts are never connected at the same time.

Accessory	Description	Sensor/Signal Type
ER-8/16	8/16 channel electromechanical relay	3 A at 250 V_{rms} or 30 VDC
SC-2060	8-channel optically isolated digital input	TTL/CMOS
SC-2061	8-channel optically isolated digital output	TTL/CMOS
SC-2062	8-channel electromechanical relay	6A at 250 V_{rms} or 30 VDC
SSR	Per-channel optically isolated digital input and digital output	120 VAC, 240 VAC 3 to 32 VDC (input only) 3 to 60 VDC (output only)

Table 1. Digital Signal Conditioning Accessory Descriptions

DAQ Device	8-Channel Backplane	16-Channel Backplane	24-Channel Backplane	32-Channel Backplane
68-pin E Series	SC-205x Adapter[1]	–	–	–
100 pin, extended DIO E Series: 6025, AT-MIO-16E-10	R1005050 cable or SC-205x Adapter[1]	R1005050 cable	R1005050 cable	–
PC-DIO-24 PCI-6503	NB1 cable or SC-205x Adapter[1]	NB1	NB1	–
DAQCard-DIO-24	PSH27-50F-D1 cable or SC-205x Adapter[1]	PSH27-50F-D1 cable	PSH27-50F-D1 cable	–
PCI-DIO-32HS, PXI-6533, AT-DIO-32HS	SC-205x Adapter[1]	–	–	R6850-D1
DAQCard-6533 for PCMCIA	SC-205x Adapter[1]	–	–	PSHR68-68M and R6850-D1
6508 (DIO-96)	SC-205x Adapter[1]	SC-205 Adapter[1]	SC-205 Adapter[1]	–

Table 2. SSR Backplane Cabling Guide

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The ER-8 has eight SPDT relays controlled by eight digital lines and the ER-16 has 16 SPDT relays controlled by 16 digital lines. You can set or reset each relay without affecting the other relays or all relay scan change state at the same time. Each relay is fully isolated for a working common-mode voltage of 250 V_{rms}. The coil-to-contact breakdown voltage is 2,000 V_{rms}. The contact-to-contact breakdown voltage is 750 V_{rms}.

Power

For most applications, you can power the ER-8/16 relays from the host DAQ device. Compare the power available on the +5 V pin of the DAQ device with the power requirements of your ER-8/16 and any other SC-2060 or SSR Series devices that will connect to the DAQ device. If the DAQ device cannot provide enough power, then you must use an external 5 VDC supply.

SC-206x

SC-2060

The SC-2060 has eight optically isolated digital inputs that are routed back to NI DAQ devices. These inputs have independent voltage reference connections and use optocoupler technology to sense digital signals with up to 400 V_{rms} of common-mode voltage. A digital signal 9 V below the reference is registered as a logical low. A digital signal 3 V below the reference reads as a logical high. The maximum current rating for each input is 20 mA. For applications with higher currents, usea resistor to limit the current.

SC-2061

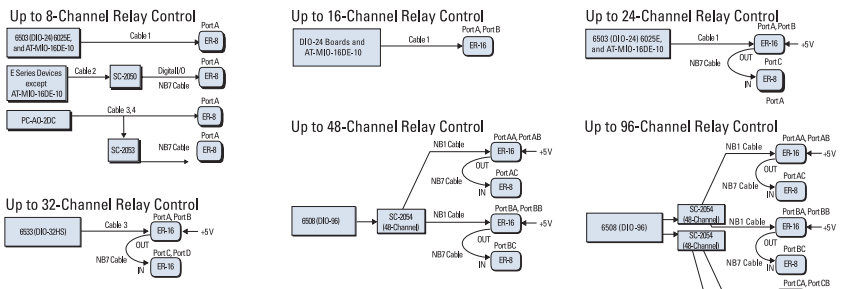
The SC-2061 has eight optically isolated digital outputs for controling high-voltage digital signals with an NI DAQ device. Each output has an independent ground reference and digital output line with 250 V_{rms} of isolation between channels and 400 V_{rms} between channel and ground. To use the SC-2061, you must supply an external +5 VDC signal with respect to your reference and a pull-up resistor (suggested 4.7 kΩ) on each output.

SC-2062

The SC-2062 (Figure 4) has eight electromechanical relays controlled by digital output signals from NI DAQ devices. These relays switch many loads that require more power than is available with DAQ device digital lines. Each SC-2062 has screw terminals connected to eight sets of SPDT relay contacts. These contacts can handle 6 A at 30 VDC or 250 V_{rms}. When the digital output line from the device is in the low (0) state, the contact labeled NC (normally closed) is connected inside the relay to the contact labeled COM (common). When the digital output line is in the high (1) state, the NO (normally open) contact is connected to the COM contact.

Compatibility

You can connect the SC-206x Series devices to any 8-bit digitalport of most National Instruments DAQ devices using the SC-205x Series cable adapter devices. The applicable DAQ devices include the 60xxE (E Series), 6503 (DIO-24) , 6533 (DIO-32HS), and 6508 (DIO-96).



1. Cable Options:
   DAQCard-DIO-24: PSH27-50F-D1 cable
   PC-DIO-24, NB-1 cable
   AT-MIO-16DE-10: R1005050 ribbon cable (pins 51-100)
   External power supply needed for DAQCards
2. Cable Options:
   All 68-pin PCI/PXI E Series devices: SH6850 shielded cable or R6850 ribbon cable
   All 100-pin E Series boards: R1005050 ribbon cable (pins 1-50)
   68-pin E Series nonlatching DAQCards (AI-16E-4, AI-16XE-50): PSHR6850 68-pin E Series latching DAQCards (6062E, 6024E): SHC6868-EP and 68M-50F
3. Cable Options:
   AT-DIO-32HS; PCI-DIO-32HS; PXI-6533; R6850-D1
   DAQCard-6533 (PCMCIA): PSHR68M and 68F-50M DIO adapter
4. DAQCard AO-2DC uses PSH 27-50F-D1, PC-AO-2DC uses NBI

Mounting

The SC-2060 Series devices have metal standoffs so that they can sit on a work bench close to the host computer. You can also mount them in rack-mount chassis that you can fit with a flat acrylic plastic cover or metal wraparound cover. The SC-206x Series and SC-205x Series devices are designed to share a single 19 in. rack-mount chassis when used together. You can ground each device to the rack through the standoffs and chassis.

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