Low-Cost E Series Multifunction DAQ
12 or 16-Bit, 200 kS/s, 16 Analog Inputs

E Series – Low-Cost

- 16 analog inputs at up to 200 kS/s, 12 or 16-bit resolution
- Up to 2 analog outputs at 10 kS/s, 12 or 16-bit resolution
- 8 digital I/O lines (TTL/CMOS); two 24-bit counter/timers
- Digital triggering
- 4 analog input signal ranges
- NI-DAQ driver simplifies configuration and measurements

Families

- NI 6036E
- NI 6034E
- NI 6025E
- NI 6024E
- NI 6023E

Operating Systems

- Windows 2000/NT/XP
- Real-time performance with LabVIEW
- Others such as Linux and Mac OS X

Recommended Software

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

Other Compatible Software

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

Driver Software (included)

- NI-DAQ 7

Calibration Certificate Included

Family	Bus	Analog Inputs	Input Resolution	Max Sampling Rate	Input Range	Analog Outputs	Output Resolution	Output Rate	Output Range	Digital I/O	Counter/Timers	Triggers
NI 6036E	PCI, PCMCIA	16 SE/8 DI	16 bits	200 kS/s	±0.05 to ±10 V	2	16 bits	10 kS/s[1]	±10 V	8	2, 24-bit	Digital
NI 6034E	PCI	16 SE/8 DI	16 bits	200 kS/s	±0.05 to ±10 V	0	-	-	-	8	2, 24-bit	Digital
NI 6025E	PCI, PXI	16 SE/8 DI	12 bits	200 kS/s	±0.05 to ±10 V	2	12 bits	10 kS/s[1]	±10 V	8	2, 24-bit	Digital
NI 6024E	PCI, PCMCIA	16 SE/8 DI	12 bits	200 kS/s	±0.05 to ±10 V	2	12 bits	10 kS/s[1]	±10 V	8	2, 24-bit	Digital
NI 6023E	PCI	16 SE/8 DI	12 bits	200 kS/s	±0.05 to ±10 V	0	-	-	-	8	2, 24-bit	Digital

[1] 10 kS/s typical when using the single DMA channel for analog out put. 1kS/s maximum when using the single DMA channel for either analog input or counter/timer operations. 1 kS/s maximum for PCMCIA DAQCards in all cases.

Table 1. NI Low-Cost E Series Model Guide

Overview and Applications

NI low-cost E Series multifunction data acquisition devices provide full functionality at a price to meet the needs of the budget-conscious user. They are ideal for applications ranging from continuous high-speed data logging to control applications to high-voltage signal or sensor measurements when used with NI signal conditioning. Synchronize the operations of multiple devices using the RTSI bus or PXI trigger bus to easily integrate other hardware such as motion control and machine vision to create an entire measurement and control system.

Highly Accurate Hardware Design

NI Low-Cost E Series DAQ devices include the following features and technologies:

Temperature Drift Protection Circuitry – Designed with components that minimize the effect of temperature changes on measurements to less than 0.0010% of reading per °C.

Resolution-Improvement Technologies – Carefully designed noise floor maximizes the resolution.

Onboard Self-Calibration – Precise voltage reference included for calibration and measurement accuracy. Self-calibration is completely software controlled, with no potentiometers to adjust.

NI DAQ-STC – Timing and control ASIC designed to provide more flexibility, lower power consumption, and a higher immunity to noise and jitter than off-the-shelf counter/timer chips.

NI MITE – ASIC designed to optimize data transfer for multiple simultaneous operations using bus mastering with one DMA channel, interrupts, or programmed I/O.

NI PGIA – Measurement and instrument class amplifier that guarantees settling times at all gains. Typical commercial off-the-shelf amplifier components do not meet the settling time requirements for high-gain measurement applications.

PFI Lines – Eight programmable function input (PFI) lines that can be used for software-controlled routing of interboard and intraboard digital and timing signals.

NATIONAL INSTRUMENTS™

Low-Cost E Series Multifunction DAQ
12 or 16-Bit, 200 kS/s, 16 Analog Inputs

		Full-Featured E Series				Low-Cost E Series		Basic
Models		NI 6030E, NI 6031E, NI 6032E, NI 6033E	NI 6052E	NI 6070E, NI 6071E	NI 6040E	NI 6034E, NI 6036E	NI 6023E, NI 6024E, NI 6025E	PCI-6013, PCI-6014
Measurement Sensitivity* (mV)		0.0023	0.0025	0.009	0.008	0.0036	0.008	0.004
Nominal Range (V)								
Positive FS	**Negative FS**	**Absolute Accuracy (mV)**						
10	-10	1.147	4.747	14.369	15.373	7.560	16.504	8.984
5	-5	2.077	0.876	5.193	5.697	1.790	5.263	2.003
2.5	-2.5	–	1.190	3.605	3.859	–	–	–
2	-2	0.836	–	–	–	–	–	–
1	-1	0.422	0.479	1.452	1.556	–	–	–
0.5	-0.5	0.215	0.243	0.735	0.789	0.399	0.846	0.471
0.25	-0.25	–	0.137	0.379	0.405	–	–	–
0.2	-0.2	0.102	–	–	–	–	–	–
0.1	-0.1	0.061	0.064	0.163	0.176	–	–	–
0.05	-0.05	–	0.035	0.091	0.100	0.0611	0.106	0.069
10	0	0.976	1.232	6.765	7.269	–	–	–
5	0	1.992	2.119	5.391	5.645	–	–	–
2	0	0.802	0.850	2.167	2.271	–	–	–
1	0	0.405	0.428	1.092	1.146	–	–	–
0.5	0	0.207	0.242	0.558	0.583	–	–	–
0.2	0	0.098	0.111	0.235	0.247	–	–	–
0.1	0	0.059	0.059	0.127	0.135	–	–	–

Note: Accuracies are valid for measurements following an internal calibration. Measurement accuracies are listed for operational temperatures within ±1 °C of internal calibration temperature and ±10 °C of external or factory-calibration temperature. One-year calibration interval recommended. The Absolute Accuracy at Full Scale calculations were performed for a maximum range input voltage (for example, 10 V for the ±10 V range) after one year, assuming 100 pt averaging of data.*Smallest detectable voltage change in the input signal at the smallest input range.

Table 2. Low-Cost E Series Analog Input Absolute Accuracy Specifications

		Full-Featured E Series				Low-Cost E Series		Basic
Models		NI 6030E, NI 6031E, NI 6032E, NI 6033E	NI 6052E	NI 6070E, NI 6071E	NI 6040E	PCI-6036E	PCI-6024E, NI 6025E,	NI 6013, NI 6014
Nominal Range (V)								
Positive FS	**Negative FS**	**Absolute Accuracy (mV)**						
10	-10	1.43	1.405	8.127	8.127	2.417	8.127	3.835
10	0	1.201	1.176	5.685	5.685	–	–	–

Table 3. Low-Cost E Series Analog Output Absolute Accuracy Specifications

RTSI or PXI Trigger Bus – Used to share timing and control signals between multiple devices to synchronize operations.

RSE Mode – In addition to differential and nonreferenced single-ended modes, NI low-cost E Series devices offer referenced single-ended (RSE) mode for use with floating signal sources in applications with channel counts higher than eight.

Onboard Temperature Sensor – Included for monitoring the operating temperature of the device to ensure that it is operating within the specified range.

High-Performance, Easy-to-Use Driver Software

NI-DAQ is the robust driver software that makes it easy to access the functionality of your data acquisition hardware, whether you are a beginning or advanced user. Helpful features include:

Automatic Code Generation – The DAQ Assistant is an interactive guide that steps you through configuring, testing, and programming measurement tasks and generates the necessary code automatically for LabVIEW, LabWindows/CVI, or Measurement Studio.

Cleaner Code Development – Basic and advanced software functions have been combined into one easy-to-use yet powerful set to help you build cleaner code and move from basic to advanced applications without replacing functions.

High-Performance Driver Engine – Software-timed single-point input (typically used in control loops) with NI-DAQ achieves rates of up to 50 kHz. NI-DAQ also delivers maximum I/O system throughput with a multithreaded driver.

Test Panels – With NI-DAQ, you can test all of your device functionality before you begin development.

Scaled Channels – Easily scale your voltage data into the proper engineering units using the NI-DAQ Measurement Ready virtual channels by choosing from a list of common sensors and signals or creating your own custom scale.

LabVIEW Integration – All NI-DAQ functions create the waveform data type, which carries acquired data and timing information directly into more than 400 LabVIEW built-in analysis routines for display of results in engineering units on a graph.

For information on device support in NI-DAQ 7, visit **ni.com/dataacquisition**

Visit **ni.com/oem** ***for quantity discount information.***

Low-Cost E Series Multifunction DAQ
12 or 16-Bit, 200 kS/s, 16 Analog Inputs

Worldwide Support and Services

NI provides you with a wealth of resources to help you get your application up and running more quickly, including:

Technical Support – Purchase of NI hardware or software gives you access to application engineers all over the world as well as Web resources with more than 3,000 measurement examples and more than 9,000 KnowledgeBase entries. – **ni.com/support**

NI Factory Installation Services (FIS) – Software and hardware installed in PXI and PXI/SCXI systems, tested and ready to use – **ni.com/advisor**

Calibration – Includes NIST-traceable basic calibration certificates, 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**

Professional Services – Feasibility, consulting, and integration through our Alliance Partners – **ni.com/alliance**

For more information on NI services and support, please visit **ni.com/services**

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 (please visit **ni.com/sigcon** for more details). Refer to the table below for more information:

Sensor/Signals (>10 V)

System Description	DAQ Device	Signal Conditioning	Page
High performance	PCI-60xxE, PXI-60xxE, DAQCard-60xxE	SCXI	270
Low-cost, portable	PCI-60xxE, PXI-60xxE, DAQCard-60xxE	SCC	251

Signals (<10 V)[1]

System Description	DAQ Device	Terminal Block	Cable	Page
Shielded	PCI-60xxE	SCB-68	SH6868-EP	214
Shielded	PXI-60xxE	TB-2705	SH6868-EP	214
Shielded	DAQCard-60xxE	SCB-68	SHC6868-EP	214
Low-cost	PCI-6025E/PXI-6025E	Two TBX-68s	SH1006868	214
Low-cost	PCI-60xxE/PXI-60xxE	CB-68LP	R6868	214
Low-Cost	DAQCard-60xxE	CB-68LP	RC6868	214

[1] Terminal Blocks do not provide signal conditioning (ie. filtering, amplification, isolation, etc.), which may be necessary to increase the accuracy of your measurements.

Table 4. Recommended Accessories

Ordering Information

NI PCI-6036E.....778465-01
NI DAQCard-6036E.....778561-01
NI PCI-6034E.....778075-01
NI PXI-6025E.....777798-01
NI PCI-6025E.....777744-01
NI DAQCard-6024E.....778269-01
NI PCI-6024E.....777743-01
NI PCI-6023E.....777742-01

Includes NI-DAQ driver software and calibration certificate.

BUY ONLINE!
Visit **ni.com/dataacquisition**

Multifunction DAQ Overview

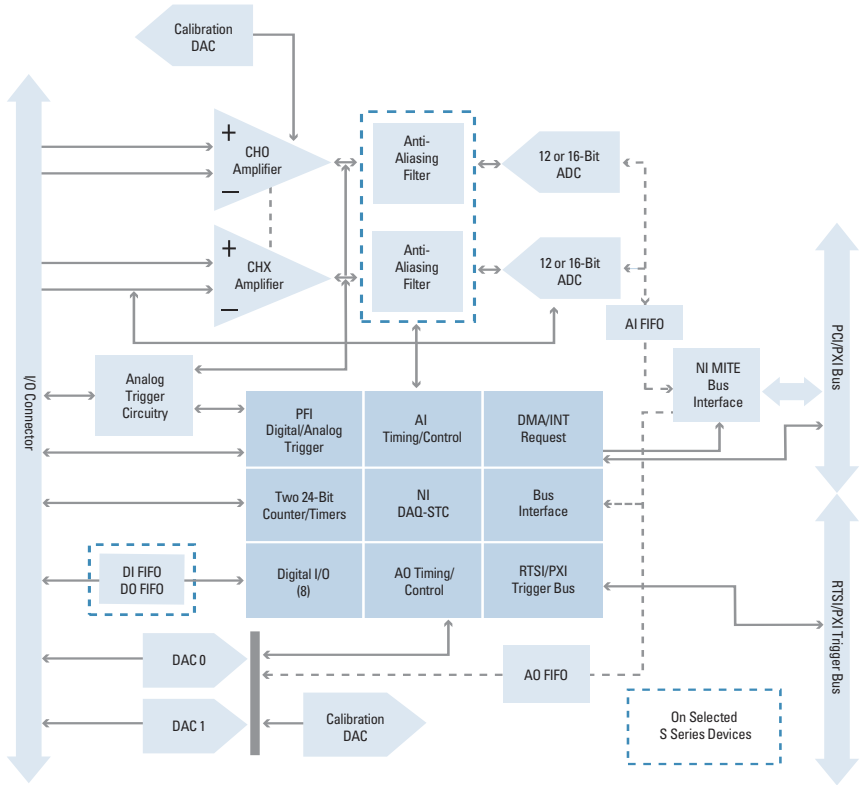


Figure 1. S Series Hardware Block Diagram

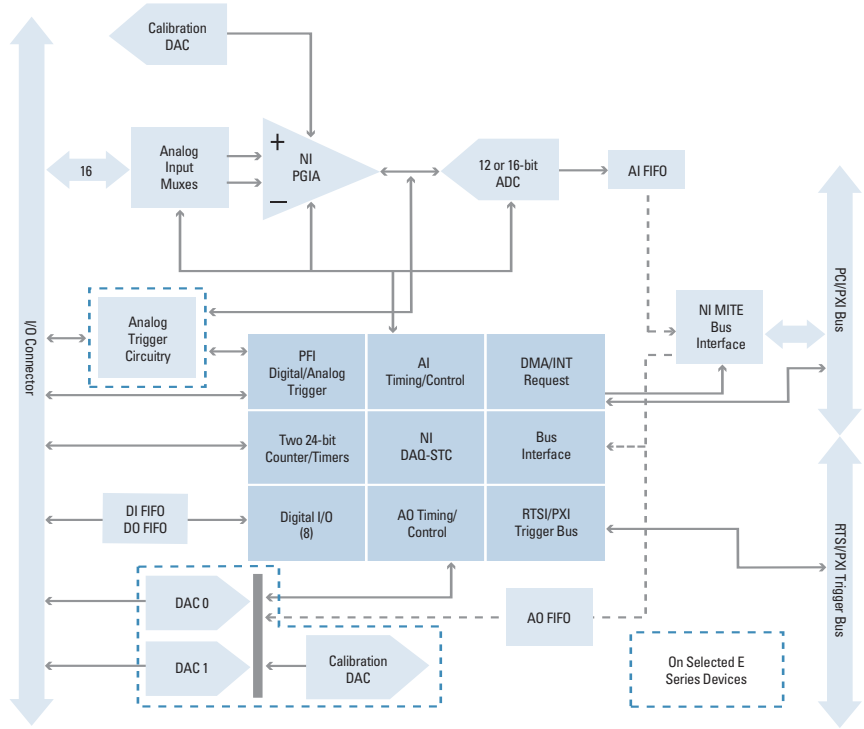


Figure 2. E Series Hardware Block Diagram

12-Bit E Series Multifunction DAQ Specifications

Specifications – NI 607xE, NI 6062E, NI 6040E, NI 602xE

These specifications are typical for 25 °C unless otherwise noted.

Analog Input

Input Characteristics

Number of Channels

6070E 6062E 6040E 602xE	16 single-ended or 8 differential (software selectable per channel)
6071E	64 single-ended or 32 differential (software selectable per channel)

Resolution..... 12 bits, 1 in 4,096

Maximum Sampling Rate

607xE	1.25 MS/s
6062E	500 kS/s
6040E	500 kS/s single-channel scanning 250 kS/s multichannel scanning
6023E 6024E 6025E	200 kS/s
6020E	100 kS/s

Input Signal Ranges

Device	Range (Software Selectable)	Bipolar Input Range	Unipolar Input Range
607xE	20 V	±10 V	–
6062E	10 V	±5 V	0 to 10 V
6040E	5 V	±2.5 V	0 to 5 V
6020E	2 V	±1 V	0 to 2 V
	1 V	±500 mV	0 to 1 V
	500 mV	±250 mV	0 to 500 mV
	200 mV	±100 mV	0 to 200 mV
	100 mV	±50 mV	0 to 100 mV
6023E	20 V	±10 V	–
6024E	10 V	±5 V	–
6025E	1 V	±500 mV	–
	100 mV	±50 mV	–

Input coupling..... DC

Maximum working voltage
(signal + common mode)..... Input should remain within ±11 V of ground

Overvoltage Protection

Device	Powered On	Powered Off
607xE 6062E 6040E	±25 V	±15 V
6023E 6024E 6025E	±40 V	±25 V
6020E	±35 V	±25 V

Inputs Protected

6070E 6062E, 6040E 602xE	AI <0..15>, AI SENSE
6071E	AI <0..63>, AI SENSE, AI SENSE2

FIFO Buffer Size

DAQCard-6062E	8,192 samples
DAQPad-6020E	4,096 samples
DAQPad-6070E DAQCard-6024E	2,048 samples
PCI/PXI-6070E 6071E, 6040E PCI-6023E, NI 6025E, PCI-6024E	512 samples

Data transfers
- PCI, PXI, DAQPad for FireWire..... DMA, interrupts, programmed I/O
- DAQCard, DAQPad for USB..... Interrupts, programmed I/O

DMA modes
- PCI, PXI, DAQPad for FireWire..... Scatter-gather (single-transfer, demand transfer)

Configuration memory size..... 512 words

Transfer Characteristics

Relative Accuracy

Device	Typical Dithered	Maximum Undithered
607xE 6062E 6040E 6023E 6024E 6025E	±0.5 LSB	±1.5 LSB
6020E	±0.2 LSB	±1.5 LSB

DNL

Device	Typical	Maximum
607xE 6040E 6023E PCI-6024E 6025E	±0.5 LSB	±1.0 LSB
6020E	±0.2 LSB	±1.0 LSB
6062E DAQCard-6024E	±0.75 LSB	-0.9, +1.5 LSB

No missing codes..... 12 bits, guaranteed

12-Bit E Series Multifunction DAQ Specifications

Specifications – NI 607xE, NI 606xE, NI 6040E, NI 602xE (continued)

Amplifier Characteristics

Input Impedance

Device	Normal Powered On	Powered Off	Overload
6070E 6062E 6040E PCI-6071E PXI-6071E	100 GΩ in parallel with 100 pF	820 Ω	820 Ω
6023E, 6024E, 6025E	100 GΩ in parallel with 100 pF	4.7 kΩ	4.7 kΩ
6020E	100 GΩ in parallel with 50 pF	3 kΩ	3 kΩ

Input bias current ..... ±200 pA
Input offset current ..... ±100 pA

CMRR, DC to 60 Hz

Device	Range	CMRR (dB)
607xE	20 V	95
	10 V	100
	100 mV to 5 V	106
6040E	10 to 20 V	85
6062E	5 V	95
	100 mV to 2 V	100
6023E	10 to 20 V	85
6024E	100 mV to 1 V	90
6025E		
6020E	100 mV to 20 V	90

Dynamic Characteristics

Bandwidth

Device	Small Signal (-3 dB)	Large Signal (1% THD)
607xE	1.6 MHz	1 MHz
6062E	1.3 MHz	250 kHz
6040E	600 kHz	350 kHz
6023E	500 kHz	225 kHz
PCI-6024E		
6025E		
DAQCard-6024E	500 kHz	265 kHz
DAQPad-6020E	150 kHz	200 kHz

Settling Time to Full-Scale Step

		Accuracy		
Device	Range	±0.012% (±0.5 LSB)	±0.024% (±1 LSB)	±0.098% (±4 LSB)
6070E	20 V	2 µs typical	1.5 µs typical	1.5 µs typical
		3 µs maximum	2 µs maximum	2 µs maximum
	10 V	2 µs typical	1.5 µs typical	1.3 µs typical
		3 µs maximum	2 µs maximum	1.5 µs maximum
	200 mV to 5 V	2 µs typical	1.5 µs typical	0.9 µs typical
		3 µs maximum	2 µs maximum	1 µs maximum
	100 mV	2 µs typical	1.5 µs typical	1 µs typical
		3 µs maximum	2 µs maximum	1.5 µs maximum
6071E	20 V	3 µs typical	1.9 µs typical	1.9 µs typical
		5 µs max	2.5 µs maximum	2 µs maximum
	10 V	3 µs typical	1.9 µs typical	1.2 µs typical
		5 µs maximum	2.5 µs maximum	1.5 µs maximum
	200 mV to 5 V	3 µs typical	1.9 µs typical	1.2 µs typical
		5 µs maximum	2.5 µs maximum	1.3 µs maximum
	100 mV	3 µs typical	1.9 µs typical	1.2 µs typical
		5 µs maximum	2.5 µs maximum	1.5 µs maximum
6062E	All	2.5 µs typical	2.5 µs typical	2 µs typical
		4 µs maximum	3 µs maximum	2.5 µs maximum
	All	4 µs typical	4 µs maximum	4 µs maximum
		8 µs maximum		
	All	5 µs typical	5 µs maximum	5 µs maximum
	All	10 µs maximum	10 µs maximum	10 µs maximum

System Noise (LSB_{rms}, Not Including Quantization)

Device	Range	Dither Off	Dither On
6070E	1 to 20 V	0.25	0.5
6071E	500 mV	0.4	0.6
	200 mV	0.5	0.7
	100 mV	0.8	0.9
6062E	1 to 20 V	0.25	0.6
	500 mV	0.4	0.75
	200 mV	0.5	0.8
	100 mV	0.8	1.0
6040E	1 to 20 V	0.2	0.5
	500 mV	0.25	0.5
	200 mV	0.5	0.7
	100 mV	0.9	1.0
6023E	1 to 20 V	0.1	0.6
PCI-6024E, 6025E	100 mV	0.7	0.8
DAQCard-6024E	10 to 20 V	0.1	0.65
	1 V	0.45	0.65
	100 mV	0.70	0.90
6020E	1 to 20 V	0.07	0.5
	500 mV	0.12	0.5
	200 mV	0.25	0.6
	100 mV	0.5	0.7

Crosstalk, DC to 100 KHz

Device	Adjacent Channels	All Other Channels
607xE, 6062E, 6040E	-75 dB	-90 dB
602xE	-60 dB	-80 dB

12-Bit E Series Multifunction DAQ Specifications

Specifications – NI 607xE, NI 606xE, NI 6040E, NI 602xE (continued)

Analog Output

Output Characteristics

Number of Channels	
607xE 6062E 6040E 6020E 6024E 6025E	2 voltage outputs
6023E	None

Resolution ..... 12 bits, 1 in 4,096

Maximum update rate

Waveform Generation

	FIFO Mode		Non-FIFO Mode	
Device	Internally Timed	Externally Timed	1 Channel	2 Channels
607xE 6040E	1 MS/s	950 kS/s	800 kS/s, system dependent	400 kS/s, system dependent
6062E	850 kS/s	850 kS/s	800 kS/s, system dependent	400 kS/s, system dependent
6023E PCI-6024E 6025E	N/A	N/A	10 kS/s with DMA 1 kS/s with interrupts system dependent	10 kS/s with DMA 1 kS/s with interrupts system dependent
DAQCard-6024E	N/A	N/A	1 kS/s with interrupts system dependent	1 kS/s with interrupts system dependent
DAQPad-6020E	N/A	N/A	20 S/s, system dependent	20 S/s, system dependent

FIFO Buffer Size	
607xE, 6062E	2,048 samples
6040E	512 samples
602xE	None

Data transfers

- PCI, PXI, DAQPad for IEEE 1394 ..... DMA, interrupts, programmed I/O
- DAQCard, DAQPad for USB ..... Interrupts, programmed I/O

DMA modes

- PCI, PXI, DAQPad ..... Scatter-gather (single transfer, demand transfer)

Transfer Characteristics

Relative accuracy

- After calibration
  - 6062E, DAQCard-6024E ..... ±0.5 LSB typical, ±1.0 LSB maximum
  - All others ..... ±0.3 LSB typical, ±0.5 LSB maximum
- Before calibration ..... ±4 LSB maximum

DNL

- After calibration
  - 6062E, DAQCard-6024E ..... ±0.5 LSB typical, ±1.0 LSB maximum
  - All others ..... ±0.3 LSB typical, ±1.0 LSB maximum
- Before calibration ..... ±3 LSB maximum

Monotonicity ..... 12 bits, guaranteed after calibration

Gain error (relative to external reference)

- 6062E, 6020E ..... ±0.5% of output maximum, not adjustable
- 607xE, 6040E ..... 0 to 0.67% of output maximum, not adjustable

Voltage Output

Output coupling ..... DC

Output impedance ..... 0.1 Ω maximum

Ranges	
607xE, 6040E, 6020E	±10 V, 0 to 10 V, ±EXT REF, 0 to EXT REF; software selectable
6062E	±10 V, ±EXT REF, software selectable
6024E, 6025E	±10 V

Current drive ..... ±5 mA maximum

Protection ..... Short-circuit to ground

Power-on state ..... 0 V (±200 mV)

External Reference Input

- Range ..... 11 V
- Overvoltage protection
  - 607xE, 6062E, 6040E ..... ±25 V powered on, ±15 V powered off
  - 6020E ..... ±35 V powered on, ±25 V powered off
- Input impedance ..... 10 kΩ
- Bandwidth (-3 dB)
  - 607xE, 6040E ..... 1 MHz
  - 6062E ..... 50 kHz
  - 6020E ..... 300 kHz

Dynamic Characteristics

Device	Settling Time for Full-Scale Step	Slew Rate
607xE 6062E 6040E	3 µs to ±0.5 LSB accuracy	20 V/µs
602xE	10 µs to ±0.5 LSB accuracy	10 V/µs

Device	Reglitching Disabled	Reglitching Enabled
607xE, 604xE	±20 mV	±4 mV
PCI-6024E 6025E	±42 mV	N/A
DAQCard-6024E	±13 mV	N/A
6020E	±100 mV	N/A
6062E	±80 mV	±30 mV

Glitch Duration (At Mid-Scale Transition)	
607xE 6040E	1.5 µs
6024E 6025E	2 µs
6020E 6062E	3 µs

Noise ..... 200 μV_{rms}, DC to 1 MHz

Glitch energy magnitude (at mid-scale transition)

Stability

Gain temperature coefficient (except 6024E, 6025E)

- External reference ..... ±25 ppm/°C

12-Bit E Series Multifunction DAQ Specifications

Specifications – NI 607xE, NI 606xE, NI 6040E, NI 602xE (continued)

Analog Output

Output Characteristics

Number of Channels	
607xE 6062E 6040E 6020E 6024E 6025E	2 voltage outputs
6023E	None

Resolution ..... 12 bits, 1 in 4,096

Maximum update rate

Waveform Generation

	FIFO Mode		Non-FIFO Mode	
Device	Internally Timed	Externally Timed	1 Channel	2 Channels
607xE 6040E	1 MS/s	950 kS/s	800 kS/s, system dependent	400 kS/s, system dependent
6062E	850 kS/s	850 kS/s	800 kS/s, system dependent	400 kS/s, system dependent
6023E PCI-6024E 6025E	N/A	N/A	10 kS/s with DMA 1 kS/s with interrupts system dependent	10 kS/s with DMA 1 kS/s with interrupts system dependent
DAQCard-6024E	N/A	N/A	1 kS/s with interrupts system dependent	1 kS/s with interrupts system dependent
DAQPad-6020E	N/A	N/A	20 S/s, system dependent	20 S/s, system dependent

FIFO Buffer Size	
607xE, 6062E	2,048 samples
6040E	512 samples
602xE	None

Data transfers

- PCI, PXI, DAQPad for IEEE 1394 ..... DMA, interrupts, programmed I/O
- DAQCard, DAQPad for USB ..... Interrupts, programmed I/O

DMA modes

- PCI, PXI, DAQPad ..... Scatter-gather (single transfer, demand transfer)

Transfer Characteristics

Relative accuracy

- After calibration
  - 6062E, DAQCard-6024E ..... ±0.5 LSB typical, ±1.0 LSB maximum
  - All others ..... ±0.3 LSB typical, ±0.5 LSB maximum
- Before calibration ..... ±4 LSB maximum

DNL

- After calibration
  - 6062E, DAQCard-6024E ..... ±0.5 LSB typical, ±1.0 LSB maximum
  - All others ..... ±0.3 LSB typical, ±1.0 LSB maximum
- Before calibration ..... ±3 LSB maximum

Monotonicity ..... 12 bits, guaranteed after calibration

Gain error (relative to external reference)

- 6062E, 6020E ..... ±0.5% of output maximum, not adjustable
- 607xE, 6040E ..... 0 to 0.67% of output maximum, not adjustable

Voltage Output

Output coupling ..... DC

Output impedance ..... 0.1 Ω maximum

Ranges	
607xE, 6040E, 6020E	±10 V, 0 to 10 V, ±EXT REF, 0 to EXT REF; software selectable
6062E	±10 V, ±EXT REF, software selectable
6024E, 6025E	±10 V

Current drive ..... ±5 mA maximum

Protection ..... Short-circuit to ground

Power-on state ..... 0 V (±200 mV)

External Reference Input

- Range ..... 11 V
- Overvoltage protection
  - 607xE, 6062E, 6040E ..... ±25 V powered on, ±15 V powered off
  - 6020E ..... ±35 V powered on, ±25 V powered off
- Input impedance ..... 10 kΩ
- Bandwidth (-3 dB)
  - 607xE, 6040E ..... 1 MHz
  - 6062E ..... 50 kHz
  - 6020E ..... 300 kHz

Dynamic Characteristics

Device	Settling Time for Full-Scale Step	Slew Rate
607xE 6062E 6040E	3 µs to ±0.5 LSB accuracy	20 V/µs
602xE	10 µs to ±0.5 LSB accuracy	10 V/µs

Device	Reglitching Disabled	Reglitching Enabled
607xE, 604xE	±20 mV	±4 mV
PCI-6024E 6025E	±42 mV	N/A
DAQCard-6024E	±13 mV	N/A
6020E	±100 mV	N/A
6062E	±80 mV	±30 mV

Glitch Duration (At Mid-Scale Transition)	
607xE 6040E	1.5 µs
6024E 6025E	2 µs
6020E 6062E	3 µs

Noise ..... 200 μV_{rms}, DC to 1 MHz

Glitch energy magnitude (at mid-scale transition)

Stability

Gain temperature coefficient (except 6024E, 6025E)

- External reference ..... ±25 ppm/°C

12-Bit E Series Multifunction DAQ Specifications

Specifications – NI 607xE, NI 606xE, NI 6040E, NI 602xE (continued)

Digital I/O

Number of Channels	
6025E	32 input/output
All others	8 input/output

Compatibility ..... 5 V TTL
Power-on state ..... Input; (high-impedance)
Digital logic levels
P0.<0..7>

Level	Minimum (V)	Maximum (V)
Input low voltage	0	0.8
Input high voltage	2.0	5.0
Output low voltage (I_{out} = 24 mA)	–	0.4
Output high voltage (I_{out} = -13 mA)	4.35	–

P1.<0..7>, P2.<0..7>, P3.<0..7>

Level	Minimum (V)	Maximum (V)
Input low voltage	0	0.8
Input high voltage	2.2	5.0
Output low voltage (Iout = 2.5 mA)	–	0.4
Output high voltage (Iout = -2.5 mA)	3.7	–

Data Transfers	
6025E	Interrupts, programmed I/O
All others	Programmed I/O

Transfer rate (1 word = 8 bits)
Maximum with NI-DAQ, system dependent

Transfer Rate	
DAQPad-6070E	5 kwords/s
All others	50 kwords/s

Constant sustainable rate ..... 1 to 10 kwords/s, system dependent

Timing I/O

Number of channels
Up/down counter/timers 2
Frequency scaler 1
Resolution
Up/down counter/timers ..... 24 bits
Frequency scaler ..... 4 bits
Compatibility ..... 5 V/TTL
Base clocks available
Up/down counter/timers ..... 20 MHz and 100 kHz
Frequency scaler ..... 10 MHz and 100 kHz
Base clock accuracy ..... ±0.01%
Maximum source frequency
Up/down counter/timers ..... 20 MHz
Minimum source pulse duration ..... 10 ns, edge-detect mode
Minimum gate pulse duration ..... 10 ns, edge-detect mode
Data transfers ..... DMA*, interrupts, programmed I/O

*Except DAQCard and USB DAQPad

Triggers

Analog Triggers

Number of Triggers	
607xE 6062E 6040E	1
602xE	None

Purpose
Analog input ..... Start and stop trigger, gate, clock
Analog output ..... Start trigger, gate, clock
General-purpose counter/timers ..... Source, gate
Source ..... All analog input channels, PFI 0/AI START TRIG
Level
Internal source, AI<0..15/63> ..... ±Full-scale
External source, PFI 0/AI START TRIG ..... ±10 V
Slope ..... Positive or negative; software selectable
Resolution ..... 8 bits, 1 in 256
Bandwidth (-3 dB)

Device	Internal Source	External Source
607xE	2 MHz	7 MHz
6062E	500 kHz	2.5 MHz
6040E	650 kHz	3 MHz

Hysteresis ..... Programmable

Digital Triggers (All Devices)

Purpose
Analog input ..... Start and stop trigger, gate, clock
Analog output ..... Start trigger, gate, clock
General-purpose counter/timers ..... Source, gate
Source ..... PFI <0..9>, RTSI <0..6>
Compatibility ..... 5 V/TTL
Response ..... Rising or falling edge
Pulse width ..... 10 ns minimum

External Input For Digital Or Analog Trigger (PFI0/TRIG1)

Impedance
6062E ..... 12 kΩ
607xE, 6040E ..... 10 kΩ
Coupling ..... DC
Protection
Digital trigger ..... -0.5 to V_{cc} + 0.5 V

Calibration

Recommended warm-up time ..... 15 minutes; 30 minutes for DAQCard and DAQPad
Calibration interval ..... 1 year
Onboard calibration reference
DC level ..... 5.000 V (±3.5 mV) over full operating temperature, actual value stored in EEPROM
Temperature coefficient ..... ±5 ppm/°C maximum
Long-term stability ..... ±15 ppm/$\sqrt{1000\ h}$

12-Bit E Series Multifunction DAQ Specifications

Specifications – NI 607xE, NI 606xE, NI 6040E, NI 602xE (continued)

RTSI Bus (PCI and FireWire only)

Trigger lines[1]
- PCI 7
- FireWire (DAQPad) 4

PXI Trigger Bus (PXI only)

Trigger lines 6
Star trigger 1

Bus Interface

PCI, PXI, FireWire (DAQPad) ..... Master, slave
USB (DAQPad) ..... Slave
PCMCIA (DAQCard) ..... Slave

Power Requirements[2]

Device	+5 VDC (±5%)*	Power Available at I/O Connector
PCI-607xE, PXI-607xE	1.1 A	+4.65 to +5.25 VDC, 1 A
6040E	1.0 A	+4.65 to +5.25 VDC, 1 A
DAQCard-6062E	340 mA typical 750 mA maximum	+4.65 to +5.25 VDC, 250 mA
DAQCard-6024E	270 mA typical 750 mA maximum	+4.65 to +5.25 VDC, 250 mA
6023E, 6025E, PCI-6024E	0.7 A	+4.65 to +5.25 VDC, 1 A

Device	Power*	Power Available at I/O Connector
DAQPad-6020E	15 W, +9 to +30 VDC	+4.65 to +5.25 VDC, 1 A
DAQPad-6070E	17 W, +9 to +25 VDC	+4.65 to +5.25 VDC, 1 A

*Excludes power consumed through I/O connector

Discharge time with BP-1 battery pack
FireWire (DAQPad) ..... 2.5 hours, typical
USB (DAQPad) ..... 3 hours, typical

Physical[2]

Dimensions (Not Including Connectors)

PCI ..... 17.5 by 10.7 cm (6.9 by 4.2 in.)
PXI ..... 16.0 by 10.0 cm (6.3 by 3.9 in.)
DAQPad (30 cm enclosure) ..... 25.4 by 30.7 by 4.3 cm (10 by 12.1 by 1.7 in.)
DAQPad (15 cm enclosure) ..... 14.6 by 21.3 by 3.8 cm (5.8 by 8.4 by 1.5 in.)
DAQCard ..... Type II PC Card

I/O Connector	
6070E 6040E 6020E 6023E PCI-6024E	68-pin male 0.050 D-type
DAQCard-6062E, DAQCard-6024E	68-pin female VHDCI
6071E 6025E	100-pin female 0.050 D-type

Environment

Operating temperature ..... 0 to 55 °C
0 to 40 °C for DAQCard-6062E and DAQCard-6024E with a maximum internal temperature of 70 °C as measured by onboard temperature sensor; case temperature should not exceed 55 °C for any DAQCard
Storage temperature ..... -20 to 70 °C
Relative humidity ..... 10 to 90%, noncondensing

Certifications and Compliances

CE Mark Compliance CE

[1]Refer to RTSI specifications for available RTSI trigger lines. RTSI not available on DAQCards.
[2]See page 134 for RT Series devices, power requirements and physical parameters.

Multifunction DAQ Cable and Accessory Selection Guides

NI Cable Design Advantages

The SH68-68-EP cable is the most commonly used E Series and S Series cable. The cable is designed to work specifically with the NI Multifunction DAQ devices to preserve signal integrity through these technologies:

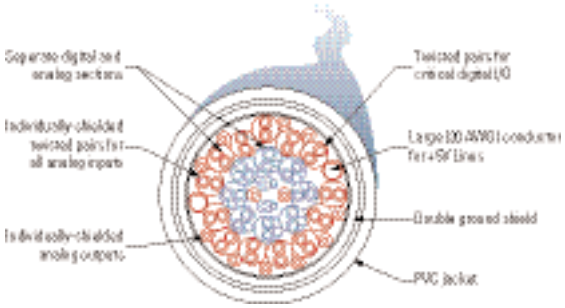


Figure 1. SH68-68-EP Cable

A variety of cabling and accessory options are available for your needs. Use the following tables to choose the most appropriate cables and accessories.

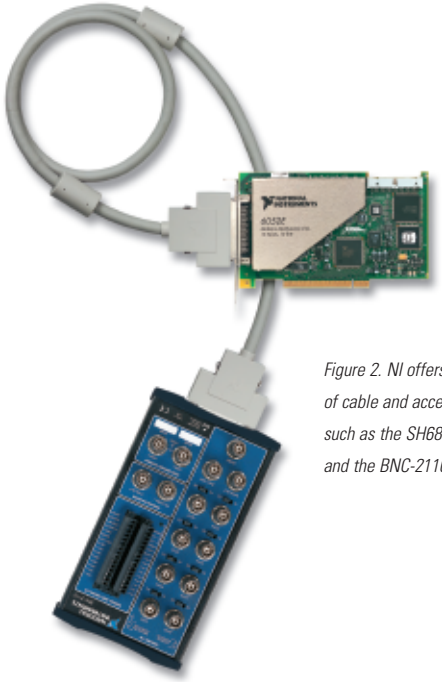


Figure 2. NI offers a wide variety of cable and accessory options, such as the SH68-68-EP cable and the BNC-2110 terminal block.

Platform	Shielding	Connect to ...	Cable	Adapter	Accessory
PCI/PXI/USB/FireWire					
	Shielded	SCC portable signal conditioning per channel	SH68-68-EP	–	SC-2345 and modules, page 251
	Shielded	SCXI high-performance signal conditioning	SCXI-1349	–	SCXI Chassis and Modules, page 270
	Shielded	Screw terminals [1]	SH68-68-EP or SH68-68R1-EP	–	SCB-68
	Shielded	BNC terminal block	SH68-68-EP	–	BNC-2110, BNC-2120, BNC-2090
	Shielded	50-pin connector	SH6850	–	CB50, custom or 3rd party
	Shielded	Configurable connectivity box	SH68-68-EP	–	CA-1000, page 351
	Unshielded	Screw terminals [1]	R6868	–	TBX-68, CB-68LP, CB-68LPR, DAQ signal accessory
	Unshielded	50-pin connector	R6850	–	CB50, custom or 3rd party
PXI only					
	Shielded	Front-mounted screw terminals	N/A	–	TB-2705
PCMCIA					
	Shielded	Screw terminals [1]	SHC68-68-EP or SHC68U-68-EP [2]	–	SCB-68, CA-1000
	Shielded	50-pin connector	SHC68-68-EP or SHC68U-68-EP [2]	68M-50F MIO	CB50, custom or 3rd party
	Unshielded	Screw terminals [1]	RC68-68		TBX-68, CB-68LP, CB-68LPR, DAQ signal accessory
	Unshielded	50-pin connector	RC68-68	68M-50F MIO	CB50, custom or 3rd party

[1] Unshielded cables can connect to shielded accessories and vice-versa. [2] In adjacent PCMCIA slots, both cables types are required because the same cable would cause mechanical hindrance.

Table 1. Cable Connection Specifications for 16-Channel E Series Devices and Basic Multifunction DAQ (except NI 6025E, which is on the next page)

Multifunction DAQ Cable and Accessory Selection Guides

AI 0-	34	68	AI 0+
AI 1+	33	67	AI 0 GND
AI 1 GND	32	66	AI 1-
AI 2-	31	65	AI 2+
AI 3+	30	64	AI 2 GND
AI 3 GND	29	63	AI 3-
NC	28	62	NC
NC	27	61	NC
NC	26	60	NC
NC	25	59	NC
NC	24	58	NC
NC	23	57	NC
AO 0	22	56	NC
AO 0	21	55	AO GND
EXT REF	20	54	AO GND
P0.4	19	53	D GND
D GND	18	52	P0.0
P0.1	17	51	P0.5
P0.6	16	50	D GND
D GND	15	49	P0.2
+5 V	14	48	P0.7
D GND	13	47	P0.3
D GND	12	46	AI HOLD
PFI 0/AI START	11	45	EXT STROBE
PFI 1/REF TRIG	10	44	D GND
D GND	9	43	PFI 2/AI CONV
+5 V	8	42	PFI 3/CTR 1 SRC
D GND	7	41	PFI 4/CTR1 GATE
PFI 5/AO SAMP	6	40	CTR 1 OUT
PFI 6/AO START	5	39	D GND
D GND	4	38	PFI 7/AI SAMP
PFI 9/CTR 0 GATE	3	37	PFI 8/CTR 0 SRC
CTR 0 OUT	2	36	D GND
F OUT	1	35	D GND

Figure 3. S Series Devices Connector

[1]No connects for boards that do not support AO or use an external reference with the SH1006868 cable.

AI 8	34	68	AI 0
AI 1	33	67	AI GND
AI GND	32	66	AI 9
AI 10	31	65	AI 2
AI 3	30	64	AI GND
AI GND	29	63	AI 11
AI 4	28	62	AI SENSE
AI GND	27	61	AI 12
ACH13	26	60	AI 5
ACH6	25	59	AI GND
AIGND	24	58	AI 14
ACH15	23	57	AI 7
AO 0[1]	22	56	AI GND
AO 1[1]	21	55	AO GND
EXT REF[1]	20	54	AO GND
P0.4	19	53	D GND
D GND	18	52	P0.0
P0.1	17	51	P0.5
P0.6	16	50	D GND
D GND	15	49	P0.2
+5 V	14	48	P0.7
D GND	13	47	P0.3
D GND	12	46	AI HOLD
PFI 0/AI START	11	45	EXT STROBE
PFI 1/REF TRIG	10	44	D GND
D GND	9	43	PFI 2/AI CONV
+5 V	8	42	PFI 3/AI CTR 1 SRC
D GND	7	41	PFI 4/AI CTR 1 GATE
PFI 5/AO SAMP	6	40	CTR 1 OUT
PFI 6/AO START	5	39	D GND
DGND	4	38	PFI 7/AI SAMP
PFI 9/CTR 0 GATE	3	37	PFI 8/CTR 0 SRC
CTR 0 OUT	2	36	D GND
F OUT	1	35	D GND

Figure 4. I/O Connector for 16-Channel E Series and Basic Multifunction DAQ Devices, except NI 6025E

AI GND	1	51	AI 16
AI GND	2	52	AI 24
AI 0	3	53	AI 17
AI 8	4	54	AI 25
AI 1	5	55	AI 18
AI 9	6	56	AI 26
AI 2	7	57	AI 19
AI 10	8	58	AI 27
AI 3	9	59	AI 20
AI 11	10	60	AI 28
AI 4	11	61	AI 21
AI 12	12	62	AI 29
AI 5	13	63	AI 22
AI 13	14	64	AI 30
AI 6	15	65	AI 23
AI 14	16	66	AI 31
AI 7	17	67	AI 32
AI 15	18	68	AI 40
AI SENSE	19	69	AI 33
AO 0	20	70	AI 41
AO 1	21	71	AI 34
EXT REF	22	72	AI 42
AO GND	23	73	AI 35
D GND	24	74	AI 43
P0.0	25	75	AI SENSE 2
P0.4	26	76	AI GND
P0.1	27	77	AI 36
P0.5	28	78	AI 44
P0.2	29	79	AI 37
P0.6	30	80	AI 45
P0.3	31	81	AI 38
P0.7	32	82	AI 46
D GND	33	83	AI 39
+5 V	34	84	AI 47
+5 V	35	85	AI 48
AI HOLD	36	86	AI 56
EXT STROBE	37	87	AI 49
PFI 0/AI START	38	88	AI 57
PFI 1/REF TRIG	39	89	AI 50
PFI 2/AI CONV	40	90	AI 58
PFI 3/CTR 1 SRC	41	91	AI 51
PFI 4/CTR 1 GATE	42	92	AI 59
CTR 1 OUT	43	93	AI 52
PFI 5/AO SAMP	44	94	AI 60
PFI 6/AO START	45	95	AI 53
PFI 7/AI SAMP	46	96	AI 61
PFI 8/CTR 0 SRC	47	97	AI 54
PFI 9/CTR 0 GATE	48	98	AI 62
CTR 0 OUT	49	99	AI 55
F OUT	50	100	AI 63

Figure 5. I/O Connector for 64-Channel E Series Devices

AI GND	1	51	P3.7
AI GND	2	52	GND
AI 0	3	53	P3.6
AI 8	4	54	GND
AI 1	5	55	P3.5
AI 9	6	56	GND
AI 2	7	57	P3.4
AI 10	8	58	GND
AI 3	9	59	P3.3
AI 11	10	60	GND
AI 4	11	61	P3.2
AI 12	12	62	GND
AI 5	13	63	P3.1
AI 13	14	64	GND
AI 6	15	65	P3.0
AI 14	16	66	GND
AI 7	17	67	P2.7
AI 15	18	68	GND
AI SENSE	19	69	P2.6
AO 0	20	70	GND
AO 1	21	71	P2.5
NC	22	72	GND
AO GND	23	73	P2.4
D GND	24	74	GND
P1.0	25	75	P2.3
P1.4	26	76	GND
P1.1	27	77	P2.2
P1.5	28	78	GND
P1.2	29	79	P2.1
P1.6	30	80	GND
P1.3	31	81	P2.0
P1.7	32	82	GND
D GND	33	83	P1.7
+5 V	34	84	GND
+5 V	35	85	P1.6
AI HOLD	36	86	GND
EXT STROBE	37	87	P1.5
PFI 0/AI START	38	88	GND
PFI 1/REF TRIG	39	89	P1.4
PFI 2/AI CONV	40	90	GND
PFI 3/CTR 1 SRC	41	91	P1.3
PFI 4/CTR 1 GATE	42	92	GND
CTR 1 OUT	43	93	P1.2
PFI 5/AO SAMP	44	94	GND
PFI 6/AO START	45	95	P1.1
PFI 7/AI SAMP	46	96	GND
PFI 8/CTR 0 SRC	47	97	P1.0
PFI 9/CTR 0 GATE	48	98	GND
CTR 0 OUT	49	99	+5 V
F OUT	50	100	GND

Figure 6. I/O Connector for the NI 6025E Device

E Series Devices (NI 6031E, NI 6033E, NI 6071E, NI 6025E)

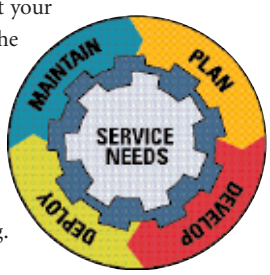
Platform	Shielding	Connect to ...	Cable	Cable Leg	Adapter	Accessory
PCI, PXI						
	Shielded	Screw terminals	SH100100	–	–	SCB-100
	Shielded	Screw terminals	SH1006868	MIO:	–	SCB-68
	Shielded		SH1006868	Extended:	–	SCB-68
	Shielded	Screw terminals[1]	SH1006868	MIO:	–	TBX-68, CB-68LP, CB-68LPR, DAQ signal accessory
	Shielded	Screw terminals[1]	SH1006868	Extended:	–	TBX-68, CB-68LP, CB-68LPR
	Shielded	BNC terminal block	SH1006868	MIO:	–	BNC-2110, BNC-2120, BNC-2090
	Shielded		SH1006868	Extended:	–	BNC-2115
	Shielded	50-pin connectors	SH1006868	MIO:	68M-50F MIO	Custom or 3rd party
	Shielded		SH1006868	Extended:	68M-50F Extended	Custom or 3rd party
	Unshielded	50-pin connector	R1005050	MIO:	–	Custom or 3rd party
	Unshielded		R1005050	Extended:	–	Custom or 3rd party

[1]Shielded cable with unshielded accessories

Table 2. Cable Connection Specifications for 64-Channel E Series Devices and the NI 6025E

NI Services and Support

NI has the services and support to meet your needs around the globe and through the application life cycle – from planning and development through deployment and ongoing maintenance. We offer services and service levels to meet customer requirements in research, design, validation, and manufacturing. Visit ni.com/services.



Training and Certification

NI training is the fastest, most certain route to productivity with our products. NI training can shorten your learning curve, save development time, and reduce maintenance costs over the application life cycle. We schedule instructor-led courses in cities worldwide, or we can hold a course at your facility. We also offer a professional certification program that identifies individuals who have high levels of skill and knowledge on using NI products. Visit ni.com/training.

Professional Services

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide NI Alliance Partner Program of more than 600 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

NATIONAL INSTRUMENTS Certified Alliance Partner

OEM Support

We offer design-in consulting and product integration assistance if you want to use our products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Local Sales and Technical Support

In offices worldwide, our staff is local to the country, giving you access to engineers who speak your language. NI delivers industry-leading technical support through online knowledge bases, our applications engineers, and access to 14,000 measurement and automation professionals within NI Developer Exchange forums. Find immediate answers to your questions at ni.com/support.

We also offer service programs that provide automatic upgrades to your application development environment and higher levels of technical support. Visit ni.com/ssp.

Hardware Services

NI Factory Installation Services

NI Factory Installation Services (FIS) is the fastest and easiest way to use your PXI or PXI/SCXI combination systems right out of the box. Trained NI technicians install the software and hardware and configure the system to your specifications. NI extends the standard warranty by one year on hardware components (controllers, chassis, modules) purchased with FIS. To use FIS, simply configure your system online with ni.com/pxiadvisor.

Calibration Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit ni.com/calibration.

Repair and Extended Warranty

NI provides complete repair services for our products. Express repair and advance replacement services are also available. We offer extended warranties to help you meet project life-cycle requirements. Visit ni.com/services.

NATIONAL INSTRUMENTS

ni.com • (800) 433 3488

National Instruments • Tel: (512) 683-0100 • info@ni.com