E Series Multifunction DAQ – 20 kS/s, 16-Bit, 16 Analog Inputs

NI 601xE

- 20 kS/s, 16-bit resolution, 16 analog inputs
- Two 12-bit analog outputs
- 8 digital I/0 lines (5 V/TTL); two 24-bit counter/timers
- Digital triggering
- Available for PCI, PCMCIA, and ISA
- NI–DAQ driver software simplifies configuration and measurements

Model

NI 6011E
- PCI-MIO-16XE-50
- AT-MIO-16XE-50

NI 6012E
- DAQCard-AI-16XE-50

NI Application Software

- LabVIEW
- Measurement Studio
- VI Logger

Operating System Compatibility

Windows 2000/NT/Me/9x*
Mac OS – not for all hardware

Accessories

See page 256

Calibration Certificate Included

See page 24

*Visit *ni.com/info* and enter winxp for the latest operation system information.

Ordering Information

NI 6011E
PCI-MIO-16XE-50 777385-01
AT-MIO-16XE-50* 776910-01
NI 6012E
DAQCard-AI-16XE-50.....777231-01

Includes NI-DAQ driver software.
*Windows only

For information on extended warranty and value-added services, see page 22.

Recommended Configurations

Family	DAQ Device	Accessory	Cable
NI 6011E	PCI-MIO-16XE-50	SCB-68 (776844-01)	SH6868-EP (184749-01)
	AT-MIO-16XE-50	SCB-68 (776844-01)	SH6868-EP (184749-01)
NI 6012E	DAQCard-AI-16XE-50	SCB-68 (776844-01)	PSHR68-68 (777293-01)

For E Series accessory and cable information, see page256.

Overview

The NI 6011E and NI 6012E DAQ devices use E Series technology to deliver reliable data acquisition capabilities to meet a wide range of application requirements. You get up to 20 kS/s, 16-bit performance on 16 analog inputs. Depending on your hard drive, these devices can also stream to disk at rates up to 20 kS/s. The NI 601x devices feature digital triggering capability, as well as two 12-bit analog outputs; two 24-bit, 20 MHz counter/timers; and 8 digital I/O channels. All E Series devices include NI-DAQ driver software.

For a detailed hardware overview, see the E Series Multifunction DAQ Overview on page 230.

INFO CODES

For more information or to order products online, visit *ni.com/info* and enter:

pcimio16e1
pxi6070e
atmio16e1
daqpad6070e
pci6071e
pxi6071e

BUY ONLINE!

Family	Bus	Analog Inputs	Resolution	Sampling Rate	Input Range	Analog Outputs	Resolution	Output Rate	Output Range	Digital I/O	Counter/ Timers	Triggers
NI 6011E	PCI, ISA, Parallel	16 SE/8 DI	16 bits	20 kS/s	±0.1 to ±10 V	2	12 bits	20 kS/s	±10 V	8	2, 24-bit	Digital
NI 6012E	PCMCIA	16 SE/8 DI	16 bits	20 kS/s	±0.1 to ±10 V	–	–	–	–	8	2, 24-bit	Digital

Table 1. NI 601xE Channel, Speed, and Resolution Specifications (See page 271 for detailed specifications.)

E Series Multifunction DAQ – 20 kS/s, 16-Bit, 16 Analog Inputs

	Nominal Range (V)	Absolute Accuracy: % of Reading 24 Hrs	% of Reading 90 Days	% of Reading 1 Year	Offset (µV)	Noise + Quantization (µV) Single Pt.	Noise + Quantization (µV) Averaged	Temp Drift (%/°C)	Absolute Accuracy at Full Scale (mV)	Relative Accuracy Resolution (µV) Single Pt.	Relative Accuracy Resolution (µV) Averaged
PCI, AT, and DAQPad	±10.0	0.0058	0.0078	0.0100	397.2	526.4	45.8	0.0002	1.443	602.7	60.3
	±5.0	0.0208	0.0228	0.0250	200.6	263.2	22.9	0.0007	1.474	301.4	30.1
	±1.0	0.0208	0.0228	0.0250	43.3	52.6	4.6	0.0007	0.298	60.3	6.0
	±0.1	0.0408	0.0428	0.0450	7.9	8.4	0.7	0.0012	0.054	9.6	1.0
	0 to 10	0.0058	0.0078	0.0100	244.6	263.2	22.9	0.0002	1.268	301.4	30.1
	0 to 5	0.0208	0.0228	0.0250	124.3	131.6	11.4	0.0007	1.386	150.7	15.1
	0 to 1	0.0208	0.0228	0.0250	28.1	26.3	2.3	0.0007	0.280	30.1	3.0
	0 to 0.1	0.0408	0.0428	0.0450	6.4	7.0	0.6	0.0012	0.052	8.4	0.8
DAQCard	±10.0	0.0075	0.0095	0.0117	815.4	1029.1	91.6	0.0005	2.077	1205.4	120.5
	±5.0	0.0225	0.0245	0.0267	409.7	514.6	45.8	0.0010	1.791	602.7	60.3
	±1.0	0.0225	0.0245	0.0267	85.1	102.9	9.2	0.0010	0.361	120.5	12.1
	±0.1	0.0425	0.0445	0.0467	12.1	12.2	1.1	0.0015	0.060	14.5	1.4
	0 to 10	0.0075	0.0095	0.0117	591.2	514.6	45.8	0.0005	1.807	602.7	60.3
	0 to 5	0.0225	0.0245	0.0267	297.6	257.3	22.9	0.0010	1.656	301.4	30.1
	0 to 1	0.0225	0.0245	0.0267	62.7	51.5	4.6	0.0010	0.334	60.3	6.0
	0 to 0.1	0.0425	0.0445	0.0467	9.9	8.0	0.7	0.0015	0.057	9.6	1.0

Note: Accuracies are valid for measurements following an internal E Series Calibration. Averaged numbers assume dithering and averaging of 100 single-channel readings. 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. See overview on page 234 for example calculations.

Table 2. NI 601xE Analog Input Accuracy Specifications

Nominal Range (V) Positive FS	Nominal Range (V) Negative FS	Absolute Accuracy: % of Reading 24 Hrs	% of Reading 90 Days	% of Reading 1 Year	Offset (mV)	Temp Drift (%/°C)	Absolute Accuracy at Full Scale (mV)
10	-10	0.014	0.016	0.018	5.408	0.0002	7.208
10	0	0.014	0.016	0.018	2.966	0.0002	4.766

Note: Temp Drift applies only if ambient is greater than ±10 °C of previous external calibration. See page 234 for example calculations.

Table 3. NI 601xE Analog Output Accuracy Specifications.

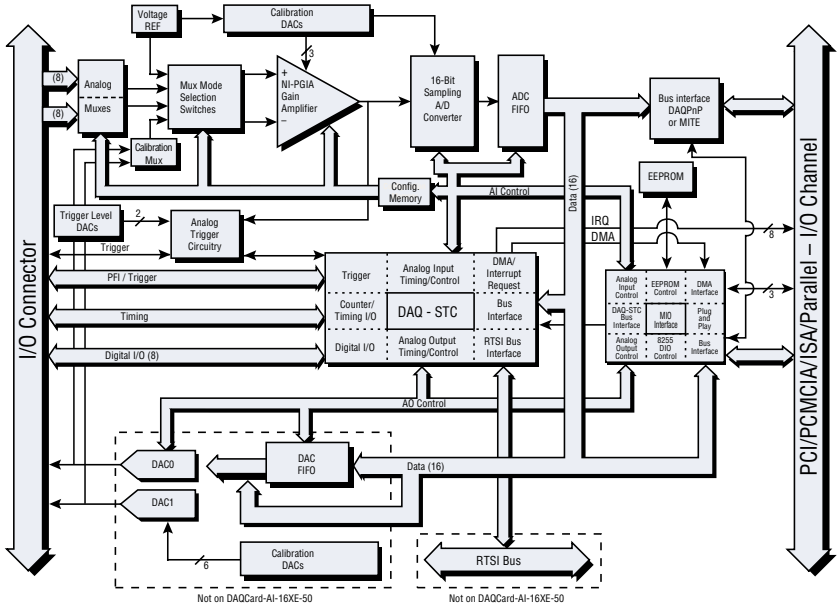


Figure 1. NI 601xE Hardware Block Diagram

See page 233 in the E Series Multifunction DAQ Overview for I/O connector diagrams.

See page 271 for more detailed specifications.

E Series Multifunction DAQ Accessories

Selection Guide

Step 1. Select your E Series device.

Step 2. Using Tables 1 and 2 as a guide, determine which accessories are appropriate for that device. Select an accessory. Table 3 provides descriptions for E Series device accessories.

Step 3. Using Tables 1 and 2, determine which cable is required to connect your selected device and accessory.

Device	Accessory			
	TBX-68, CB-68LP, CB-68LPR, DAQ Signal Accessory, CA-1000, BNC-2110, BNC-2120, BNC-2090, SCB-68	TB-2705	SCXI, Signal Conditioning	SCC Modular
	Cables			
68-pin E Series (except DAQCard)	SH68-68-EP (shielded) R6868 (unshielded)	Connects directly to the device (PXI only)	See page 385 for SCXI Signal Conditioning details	See page 461 for SCC Modular Signal Conditioning details
Latching DAQCards NI 6024E, NI 6062E	SHC68-68-EP (shielded) RC68-68 (unshielded)	N/A	See page 385 for SCXI Signal Conditioning details	See page 461 for SCC Modular Signal Conditioning details
Nonlatching DAQCards AI-16E-4, AI-16XE-50	PSHR68-68 (shielded) PR68-68F (unshielded)	N/A	See page 385 for SCXI Signal Conditioning details	See page 461 for SCC Modular Signal Conditioning details

Table 1. Accessories and Cables for 68-Pin and DAQCard E Series Devices

Device	Accessory					
	TBX-68, CB-68LP, CB-68LPR, DAQ Signal Accessory, CA-1000, BNC-2110, BNC-2120, BNC-2090, SCB-68	BNC-2115	TBX-68, CB-68LP CB-68LPR, CA-1000, SCB-68	SCB-100	SCXI Signal Conditioning	SCC Modular Signal Conditioning
	Cables					
100-pin E Series with 64 AI channels NI 6071E, NI 6031E, NI 6033E AT-MIO-64E-3	SH1006868 (shielded); splits into two 68-pin connectors; these accessories are used with the first 68-pin connector. See Figure 16 on page 260.	SH1006868 (shielded); splits splits into two 68-pin connectors;these accessories are used with the second 68-pin connector.	SH1006868 (shielded); splits into two 68-pin connectors; these accessories are used with the second 68-pin connector.	SH100100 (shielded)	See page 385 for SCXI Signal Conditioning details	See page 461 for SCC Modular Signal Conditioning details
100-pin E Series with 16 AI channels and 32 DIO lines PCI-6025E, AT-6021E	SH1006868 (shielded); splits ino two 68-pin connectors; these accessories are used with the first 68-pin connector. See Figure 16 on page 260.	SH1006868 (shielded); splits splits into two 68-pin connectors;these accessories are used with the second 68-pin connector.	SH1006868 (shielded); splits into two 68-pin connectors; these accessories are used with the second 68-pin connector.	SH100100 (shielded)	See page 385 for SCXI Signal Conditioning details	See page 461 for SCC Modular Signal Conditioning details

Table 2. Accessories and Cables for 100-Pin and DAQCard E Series Devices

Accessory	Description	Page
SCXI Signal Conditioning	High channel-count signal conditioning platform	385
SCC Modular Signal Conditioning	Single or dual channel signal conditioning modules	461
AMUX-64T, 5B, SSR, ER, and SC-204x Signal Conditioning	External signal conditioning accessories	478
BNC-2110	BNC accessory for 68-pin E Series devices	257
BNC-2115	BNC accessory for extended I/O on 100-pin E Series devices	257
BNC-2120	BNC accessory with function generator (for 68-pin E Series devices)	257
BNC-2090	Rack-mountable BNC accessory (for 68-pin E Series devices)	257
CA-1000 enclosure	Configurable connectivity enclosure	257
TB-2705	Latching screw terminal block for PXI E Series modules	258
SCB-100	100-pin, shielded screw terminal block with breadboard areas	258
SCB-68	68-pin, shielded screw terminal block with breadboard areas	258
TBX-68	68-pin, DIN rail-mountable screw terminal block	258
CB-68LP, CB-68LPR	68-pin, low-cost screw terminal block	258
Signal Source and Demo Accessory	DAQ signal accessory to demo and test analog, digital and counter/timer functions	259

For complete and up-to-date information about accessories, visit ***ni.com/catalog***

Table 3. Overview of E Series DAQ Accessories

E Series Multifunction DAQ Accessories

SCXI High-Performance Signal Conditioning (see Figure 1)

SCXI is a modular high-performance signal conditioning platform that you use as a front end to your E Series DAQ device. With the SCXI multiplexing architecture, you can expand your analog inputs to 3,072 channels. Additionally, SCXI offers a variety of modules for connecting to thermocouples, RTDs, strain gauge transducers, LVDT position sensors, ICP-compatible accelerometers/microphones, thermistors, millivolt inputs, voltage inputs up to 1000 V, current inputs (0-20mA), frequency inputs or dynamic signals.

See page 385 for details on SCXI Signal Conditioning.

Figure 1. SCXI High-Performance Signal Conditioning

SCC Series – Modular Signal Conditioning for Low-Channel Count Applications (see Figure 2)

The SCC Series modular signal conditioning system consists of SCC modules that plug into a low-profile SC-2345 shielded carrier. SCC modules give you single or dual-channel signal conditioning for up to 16 analog input channels and eight digital I/O lines of your plug-in E Series DAQ device. The SCC Series offers signal conditioning for a variety of inputs, including thermocouples, RTDs, strain gauges, ICP-compatible accelerometers, accelerators, analog inputs requiring isolation, high voltage (up to 100 V), current (0-20mA), and optically isolated digital I/O. Lowpass filtering and bread boarding modules are also available.

See page 461 for details on SCC Signal Conditioning.

Figure 2. SCC Portable, Modular Signal Conditioning

Connector Blocks

BNC-2100 Series Connector Blocks (see Figure 3)

Shielded connector blocks with signal-labeled BNC connectors for easy connectivity of your analog input, analog output, digital I/O and counter/timer signals to your E Series device. The BNC-2110 and BNC-2120 work with all E Series devices. The BNC-2120 also provides a function generator, quadrature encoder, temperature reference, thermocouple connector and LED so that you can test the functionality of your hardware. The BNC-2115 has 24 BNC inputs for connecting to the extended I/O channels of our 100-pin E Series DAQ devices.

BNC-2110.....777643-01
Dimensions – 20.3 by 11.2 by 5.5 cm (8.0 by 4.4 by 2.2 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.)

Figure 3. BNC-2100 Series Connector Blocks

Figure 4. BNC-2090 Shielded BNC Adapter Chassis

BNC-2090 Shielded BNC Adapter Chassis (see Figure 4)

Shielded, rack-mountable adapter with signal-labeled BNC connectors, spring terminal blocks, and component locations for passive signal conditioning. Consists of 22 BNC connectors and 28 spring terminals to simplify connection to your analog, digital, trigger and counter/timer signals. The BNC-2090 has silk-screened component locations that you use to develop simple signal conditioning circuits. For added flexibility, you can connect any E Series DAQ device to the BNC-2090 from the front or rear through dual 68-pin connectors.

BNC-2090 777270-01
Dimensions – 48.3 by 4.4 by 18.8 cm (19.0 by 1.7 by 7.4 in.)

Figure 5. CA-1000 Configurable Signal Conditioning Enclosure

E Series Multifunction DAQ Accessories

Figure 6. TB-2705 Terminal Block

Figure 7. SCB-68 and SCB-100 Shielded I/O Connector Blocks

Figure 8. TBX-68 I/O Connector Block

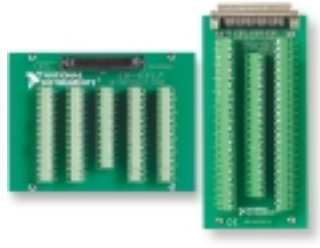


Figure 9. CB-68LP and CB-68LPR I/O Connector Blocks

Figure 10. DAQ Signal Accessory

CA-1000 Configurable Signal Conditioning Enclosure (see Figure 5)

Configurable enclosure that gives you maximum user-defined connectivity and flexibility through customized panelettes. Each enclosure can accommodate up to 9 panelettes.

Dimensions – 30.7 by 25.4 by 4.3 cm (21.1 by 10 by 1.7 in.)

See page 263 for more information about the CA-1000.

TB-2705 Terminal Block for 68-pin PXI E Series Devices (see Figure 6)

Screw terminal block for PXI that works with your PXI E Series DAQ devices. Latches to the front of your PXI module with locking screws and provides strain relief as well as easy access to your analog, digital, trigger and counter/timer signals through screw terminals.

TB-2705 778241-01

Dimensions – 8.43 by 10.41 by 2.03 cm (3.32 by 4.1 by 0.8 in.)

SCB-68 and SCB-100 Shielded I/O Connector Blocks (see Figure 7)

Shielded I/O connector blocks for rugged, very low-noise signal termination for connecting to 68-pin or 100-pin E Series DAQ devices, respectively. Silk-screened component locations for easy addition of simple signal-conditioning circuitry for your analog input channels. They also include general-purpose breadboard areas (two on the SCB-68; three on the SCB-100) as well as 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.)

SCB-100 776990-01

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

TBX-68 I/O Connector Block with DIN-Rail Mounting (see Figure 8)

Termination accessory with 68 screw terminals for easy connection of field I/O signals to 68-pin DAQ devices. Includes 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.)

CB-68LP and CB-68LPR I/O Connector Blocks (see Figure 9)

Low-cost termination accessory with 68 screw terminals for easy connection of field I/O signals to 68-pin E Series DAQ devices. Includes one 68-pin male connector for direct connection to 68-pin cables. The connector blocks include 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 is used with the CA-1000 (see page 263).

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.)

E Series Multifunction DAQ Accessories and Cables

Signal Source and Demo Accessory (see Figure 10)

The DAQ Signal Accessory demonstrates and tests the use of analog, digital, and counter/timer functions of DAQ devices. You can connect the DAQ Signal Accessory directly to your 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. The DAQ Signal Accessory works with all E Series DAQ devices.

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

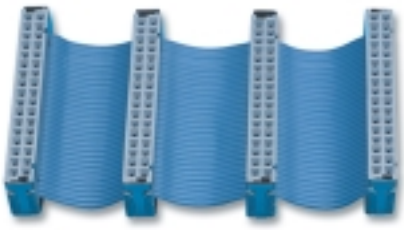


Figure 11. RTSI Bus Cable

RTSI Bus Cables (see Figures 11 and 12)

Use RTSI bus cables to connect timing and synchronization signals among Measurement, Vision, Motion, and Controller Area Network (CAN) boards for PCI and ISA and DAQPad 6070E boards. 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
3 external boards.....186464-01

Figure 12. Extended RTSI Bus Cable

Shielded I/O Cables

SH68-68-EP Shielded Cable (see Figure 13)

Shielded 68-conductor cable terminated with two 68-pin female 0.050 series D-type connectors. Features individually-shielded analog twisted pairs for reduced crosstalk with high-speed devices. This cable works with all 68-pin E Series devices (except latching DAQCards). If you need a right-angle connector, the SH68-68R1-EP shielded cable is fully compatible.

1 m.....184749-01
2 m.....184749-02

Figure 13. SH68-68-EP Shielded Cable

SH68-68R1-EP Shielded Cable (see Figure 14)

Shielded 68-conductor cable; one end terminates with a 68-pin female 0.050 series D-type connector and the other end terminates with a right-angle 68-pin female 0.050 series D-type connector.

1 m.....187051-01

Figure 14. SH68-68R1-EP Shielded Cable

SH100100 Shielded Cable (see Figure 15)

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

Figure 15. SH100100 Shielded Cable

E Series Multifunction DAQ Accessories and Cables

Figure 16. SH1006868 Shielded Cable

SH1006868 Shielded Cable (see Figure 16)

Shielded cable that connects to 100-pin E Series devices and terminates with two female 68-pin 0.050 series D-type connectors. See Table 2 on page 256 for accessories compatible with each 68-pin connector.

1 m 182849-01
2 m 182849-02

Figure 17. SHC68-68-EP Shielded Cable

SHC68-68-EP and SHC68U-68-EP Shielded Cables for Latching E Series DAQCards (see Figure 17)

These cables connect a latching E Series DAQCard (NI 6062E and NI 6024E) to standard 68-pin accessories. Latching screws secure the shielded connector to the PCMCIA DAQCard. The SHC68-68-EP is a shielded 68-conductor cable terminated with a VHDCI 68-pin male connector at one end and a 68-pin female 0.050 series D-type connector at the other. The SHC68U-68-EP is identical to the SHC68-68-EP except it uses an inverted VHDCI 68-pin male connector. Use the SH68U-68-EP for a DAQCard located in the bottom PCMCIA slot in your laptop. Use the SHC68-68-EP cable with a DAQCard inserted in the upper PCMCIA slot in your laptop. When using two E Series DAQCard PCMCIA devices in adjacent slots, you must use one SHC68-68-EP and one SHC68U-68-EP.

SHC68-68-EP
0.5 m 186838-0R5
1 m 186838-01
SHC68U-68-EP
0.5 m 187406-0R5
1 m 187406-01

Figure 18. PSHR68-68 Shielded Cable Kit

PSHR68-68 Shielded Cable Kit for Nonlatching DAQCards (see Figure 18)

Shielded cable for use in connecting non-latching E Series DAQCards (AI-16E-4 and AI-16XE-50) with 68-pin accessories. The kit contains the PSHR68-68M, the PCMCIA Strain-Relief Adapter and a 1 m SH68-68-EP cable.

1 m 777293-01

Figure 19. PSHR68-68M Shielded Cable

PSHR68-68M Shielded Cable for Nonlatching DAQCards (see Figure 19)

Shielded cable for use in connecting non-latching E Series DAQCards (AI-16E-4 and AI-16XE-50) with custom cables and other 68-pin cable assemblies.

0.1 m 183569-01

Figure 20. R6868 Ribbon Cable

E Series Multifunction DAQ Accessories and Cables

Ribbon I/O Cables

R6868 Ribbon Cable for E Series Devices (see Figure 20)

68-conductor flat ribbon cable terminated with two 68-pin connectors. Use this cable to connect a 68-pin E Series device to 68-pin accessories.

1 m 182482-01

RC68-68 Ribbon Cable for Latching DAQCards (see Figure 21)

Ribbon cable that connects to a latching E Series DAQCard (NI 6062E, NI 6024E) and is terminated with a 68-pin female connector that attaches directly to 68-pin accessories. Two RC68-68 cables can be used together in adjacent PCMCIA slots.

0.25 m 187252-0R25

1 m 187252-01

Figure 21. RC68-68 Ribbon Cable

PR68-68F for Non-Latching DAQCards (see Figure 22)

Ribbon cable that connects to a non-latching E Series DAQCard (AI-16E-4, AI-16XE-50) and is terminated with a 68-pin female connector that attaches directly to 68-pin accessories.

0.2 m 183646-0R2

1 m 183646-01

Figure 22. PR68-68F Ribbon Cable

Custom Connectivity Components

68-Pin Custom Cable Connector/Backshell Kit (see Figure 23)

68-pin female mating connector and backshell kit for use in making custom cables. Solder-cup contacts are available for soldering of cable wires to the connector.

68-pin connector/backshell kit 776832-01

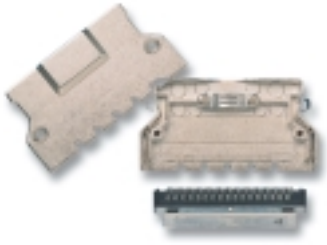


Figure 23. 68-Pin Custom Cable Connector/Backshell Kit

PCB Mounting Connectors for Custom Accessories (see Figure 24)

PCB connectors for use in building custom accessories that connect to 68-conductor or 100-conductor shielded and ribbon cables. Two connectors are available, one for right-angle and one for vertical mounting onto a PCB.

68-position, male, right-angle mounting 777600-01

68-position, male, vertical mounting 777601-01

100-position, female, right-angle mounting 777778-01

100-position, female, vertical mounting.....777779-01

Figure 24. PCB Mounting Connectors for Custom Accessories

PCMCIA Strain-Relief Accessory (see Figure 25)

Accessory that attaches to the bottom of your notebook computer and provides adjustable strain relief for one or two PCMCIA cables attached to the installed PCMCIA card(s). Used with non-latching E Series DAQCards (AI-16E-4, AI-16XE-50).

PCMCIA Strain-Relief Accessory 777550-01

Figure 25. PCMCIA Strain-Relief Accessory

E Series Multifunction DAQ Accessories and Cables

Figure 26. USB Cable

USB Cable (see Figure 26)

Cable that connects DAQPad devices for the Universal Serial Bus (USB) to a USB port. The USB cables have a USB B-type connector and a USB A-type connector.

1 m 184125-01
2 m 184125-02

Figure 27. IEEE 1394 Cable

IEEE 1394 Cable (see Figure 27)

Cable that connects DAQPad devices for IEEE 1394 (FireWire) to an IEEE 1394 port.

1 m (latching) 185798-01
2 m (latching) 185798-02

Use Interactive Online Catalog Configurator for Quick Product Selection

You can now easily configure NI multifunction data acquisition (DAQ) measurement systems using a new, interactive feature of our online catalog. The interactive online catalog offers a better, easier way to select and purchase measurement solutions from National Instruments. Based on user imput, the interactive online catalog suggests products and then suggests the appropriate cables and accessories for those products. This new automated tool helps eliminate ordering mistakes and product-compatibility errors.

To take advantage of the online catalog for multifunction DAQ devices, visit ***ni.com/catalog***

From the Products and Services menu, select Data Acquisition, then select Multifunction I/O. The online catalog prompts you with a series of questions regarding preferences for operating system, computer bus, number of channels, and maximum sampling rate. The online catalog then recommends several appropriate DAQ devices. You can review specifications on each device and select your preferred product. Next, the catalog suggests the preferred accessory and cable solution designed to work with the selected DAQ device. You have the option of choosing the preferred configuration or choosing from a separate list of accessories and cables that also work with the selected DAQ device. You can purchase the selected items online.

Figure 28. Use the interactive configuration tool in the NI online catalog to select and purchase multifunction DAQ solutions.

Configurable Signal Conditioning Enclosure

CA-1000

- Versatile connector/enclosure system
- Houses signal conditioning and connector block accessories
- Wide variety of I/O connectivity and panelette options
- Holds maximum of 18 connectivity/interface panelettes
- Low profile enclosure
- Rack-mount and stacking kits available

I/O Connectivity

- BNC
- Thermocouple
- Banana jack
- LEMO® connector (B-Series)
- MIL-Spec
- SMB
- Dual 9-pin D-Sub
- Strain relief

Interface Panelettes

- Momentary pushbutton switch
- Potentiometer
- Toggle switch
- Rocker switch
- LED

Overview

The National Instruments CA-1000 is a configurable signal conditioning enclosure designed for maximum user-defined I/O connectivity and flexibility. The CA-1000 is a portable enclosure for laptop, desktop, and rack-mount applications. In the CA-1000, you can install many NI signal conditioning accessories, such as the SC-204x signal conditioning products, and the SCB-68, CB-68LPR, and CB-50LP terminal blocks. The result is a compact, portable, flexible, and comprehensive signal conditioning/interconnection system. The CA-1000 also facilitates quick connection and disconnection with standard I/O connectors for easy system integration and reconfiguration. By adding interface panelettes, such as toggle switches, potentiometers, and LEDs, you can locally control and verify system operation.

Description

The CA-1000 system includes four components: 1) CA-1000 enclosure, 2) I/O and interface panelettes, 3) signal conditioning or measurement accessories installed in the CA-1000, and 4) for 50-pin accessories, an internal cable adapter to connect the signal conditioning accessory to the cable attached to the CA-1000.

CA-1000 Enclosure

The metal enclosure provides a low-profile, portable housing for signal conditioning and connector accessories. You can place the enclosure under a laptop PC, on a benchtop, or in a 19 in. rack. You can also stack two or more enclosures with the stacking kit. The CA-1000 enclosure includes five cable entry locations, so you can place the 68-pin or 50-pin connector that you cable to your measurement device on either the side or the rear of the CA-1000 enclosure. Please note, the CA-1000 is shipped without any panelettes, signal conditioning accessories, connector blocks, or cables. Order all of these components separately.

INFO CODES

For more information or to order products online, visit *ni.com/info* and enter:

ca1000

BUY ONLINE!

Internal Accessories

The CA-1000 houses a variety of signal conditioning and data acquisition accessories, including the SC-204x, SCB-68, CB-68LPR, and CB-50LP (Table 1 on page 264). You mount these accessories to the bottom panel of the CA-1000 enclosure.

I/O Panelettes

The CA-1000 includes a user-configurable signal connection scheme. This connectivity flexibility is achieved with interchangeable panelettes. The panelettes, which come with standard signal connectors – for example, BNC, SMB, banana jack, thermocouple plugs, and LEMO, MIL-Spec, and 9-pin D-Sub connectors – mount in the front of the CA-1000 enclosure. The CA-1000 front panel offers nine panelette slots. The rear panel can also be removed offering nine more panelette slots. However, this option is not available if you are using the SCB-68 inside the CA-1000. You can mix and match different types of panelettes. Each panelette (except for the strain-relief panel) includes lead wires that you connect to the screw terminals of the accessory mounted inside the CA-1000. You can therefore connect the panelettes to any I/O signal available on the accessory.

Configurable Signal Conditioning Enclosure

Interface Panelettes

National Instruments also offers interface panelettes, which expand the functionality of the CA-1000. Interface panelettes include traditional interface controls and displays, such as rocker switches, toggle switches, momentary switches, potentiometers, and LEDs. Using interface panelettes, which are mounted alongside I/O panelettes, you can change hardware inputs, trigger events, or verify operational status. Each interface panelette includes lead wires for connection to the screw terminals of the accessory mounted inside the CA-1000.

Cabling

The cabling needed to connect the CA-1000 to the measurement device depends on the accessories installed in the CA-1000 and the measurement device used. Some accessories installed in the CA-1000 require internal cabling to connect the accessory to the CA-1000 wall. Use Table 1 to determine what cabling components you need, including the cable to your measurement device.

The CA-1000 also provides the flexibility of five external interconnection locations, giving convenient cabling for laptop applications by aligning the I/O connector with the location of the PCMCIA slots on laptop computers. With the five external interconnection locations, you can also customize desktop and rack-mount applications for added convenience.

Device	Connector Blocks		
	SC-204x Series	CB-50LP	CB-68LPR or SCB-68
68-pin E Series DAQ Devices (except DAQCards)	R68M-50F and SH68-68-EP[1]	N/A	SH68-68-EP[1]
100-pin E Series DAQ Devices[3]	Applicable for one leg	N/A	SH1006868
Latching E Series DAQCards:	R68M-50F and SHC68-68-EP	N/A	SHC68-68-EP
DAQCard-6062E, DAQCard-6024E	–	–	–
Nonlatching E Series DAQCards:	R68M-50F and PSHR68-68 Shielded Cable Kit[2]	N/A	PSHR68-68 Shielded Cable Kit[2]
DAQCard-AI-16E-4, DAQCard-AI-16XE-50			
68-pin Digital I/O and Counter/Timer Devices (except DAQCards)	N/A	N/A	SH68-68-D1
PCI-DIO-32HS, PXI-6533, AT-DIO-32HS,	–	–	–
NI 6534, NI 660x	–	–	–
Nonlatching 68-pin Digital I/O DAQCards:	N/A	N/A	PSHR68-68-D1 Shielded Cable Kit
DAQCard-6533	–	–	–
Simultaneous Sampling Multifunction DAQ Devices	N/A	N/A	SH68-68-EP[1]
PCI-6503	N/A	R50M-50F and SH50-50	N/A
PC-DIO-24	–	–	–
DAQCard-DIO-24	N/A	R50M-50F and PSH27-50F-D1	N/A
NI 6527[3], PCI-DIO-96[3], PXI-6508[3], DAQPad-6508[3]	N/A	Two R50M-50F and R1005050 [4]	N/A
PC-DIO-96[3]	N/A	Two R50M-50F and NB5[4]	N/A

[1]You can also use the SH68-68R1-EP or R6868. [2]You can also use the PR68-68F. [3]You can use two CA-1000 enclosures with one of these devices. Please note: If you are using a NI 435x series data logger, please see Figure 1 on page 298 for information on cabling to a CB-68T and CA-1000. [4]Splits into two 50-pin connectors. See page 319 for information on using the CA-1000 with signal source products.

Table 1. CA-1000 Cabling

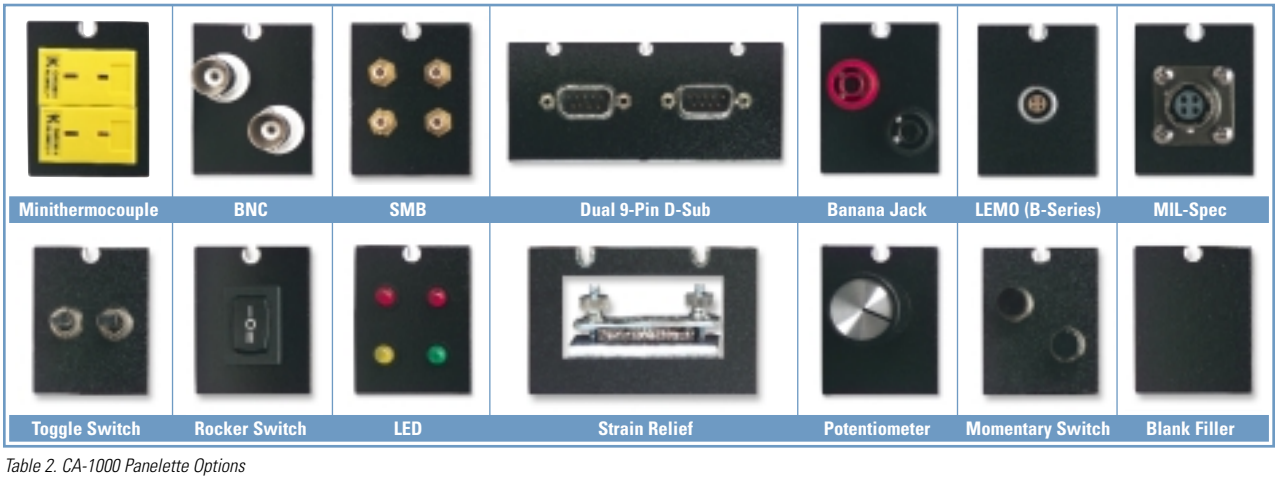


Table 2. CA-1000 Panelette Options

Configurable Signal Conditioning Enclosure

Panelette	Description	Connectors/Units per Panelette	Slot Width
Minithermocouple Jack	J-type	2	1
	K-type	2	1
	Uncompensated	2	1
Thermocouple Jack	J-type	1	1
	K-type	1	1
	Uncompensated	1	1
BNC	BNC connector	2	1
SMB	SMB connector	4	1
Banana Jack	Banana Jack	2	1
LEMO	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 Pushbutton 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 kW	1	1
Strain Relief	Screw clamp	1	2
Blank	Filler panel	–	1

Table 3. CA-1000 Panelette descriptions

Ordering Information

CA-1000 (enclosure only) 777664-01
Dimensions – 30.7 by 25.4 by 4.3 cm (21.1 by 10.3 by 1.7 in.)

I/O Connector Panelettes

Minithermocouple, J-type (2 included) 184736-01
Minithermocouple, K-type (2 included) 184736-02
Minithermocouple, uncompensated (2 included) 184736-03
Thermocouple, J-type 187597-01
Thermocouple, K-type 187597-02
Thermocouple, uncompensated 187597-03
BNC (2 included) 184737-01
Banana jack (2 included) 186405-01
LEMO connector (B-Series)
Dual 2-pin, female 187585-01
4-pin, female 187585-02
6-pin, female 187585-03
MIL-C-26482 (Series 1)
MS3112E8-2 S.....187591-01
MS3112E8-4 S.....187591-02
MS3112E10-6 S.....187591-03
SMB (4 included) 185505-01

Ordering Information (continued)

Strain relief.....184721-01
9-Pin D-Sub
Single male.....184738-01
Dual male.....184738-02
Single female.....184738-03
Dual female.....184738-04
Blank 184483-01

Interface Panelettes

Momentary pushbutton switch (2 included) 185380-01
Rocker switch (on/off/on).....185379-01
Toggle switch (on/off/on – 2 included) 185378-01
Potentiometer (10 kΩ, single turn) 185377-01
LED 4 – (Includes: 1 green,
1 red, 1 orange, 1 yellow) 185376-01

External Cables

SH68-68-EP, 1 m 182419-01
SH68-68-D1, 1 m.....183432-01
SH68-68R1-EP, 1 m 187051-01
SH50-50, 1 m 777720-01
R6868, 1 m 182482-01
R1005050, 1 m 182762-01
NB5, 1 m 181304-10
SH1006868, 1 m 182849-01
PSHR68-68 Shielded Cable Kit 777293-01
PSHR68-68-D1 Shielded Cable Kit 777420-01
PR68-68F, 1 m 183646-01
PSH27-50F-D1, 1 m.....776989-01
SHC68-68-EP, 1 m 186838-01

Internal Cables

R50M-50F ribbon cable.....184526-0R3
R68M-50F MIO bulkhead ribbon cable 777660-0R3

Accessories

CA-1000 Rack-Mount Kit (1U) 777665-01
CA-1000 Stacking Kit.....777666-01
CA-1000 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.

For information on extended warranty and value added services, see page 22.

E Series Multifunction DAQ Overview

Self-Calibration Using an Internal Reference

The E Series analog inputs and outputs have calibration circuitry to correct gain and offset errors. You can calibrate the device in software to avoid analog I/O errors caused by time and temperature drift at run time. No external circuitry is necessary; an internal reference ensures high accuracy and stability over time and temperature. Factory-calibration constants are permanently stored in an onboard EEPROM and cannot be modified. A modifiable section of the EEPROM stores user-modifiable constants. You can return the devices to their initial factory calibration by accessing the unmodified factory constants. Included with all E Series devices is an NIST-traceable and ISO-9002 certified calibration certificate. Visit ***ni.com/calibration*** for more information.

I/O Interface – MITE and DAQ-PnP

All of the PCI and PXI E Series use the MITE ASIC as a bus master interface to the PCI bus. The E Series products for ISA use an ASIC that fully implements the Plug and Play ISA Specification, so that the DMA level, interrupt channels, and base I/O address are all software configurable. All other E Series devices are inherently Plug and Play compatible. Visit ***ni.com/info*** and enter *exniev* to download a technical paper on bus mastering.

RTSI Bus Interface

All E Series devices except DAQCards, USB DAQPads, and PXI modules are interfaced to the National Instruments RTSI bus with an embedded cross-matrix switch in the DAQ-STC. This switch synchronizes several DAQ devices by sending timing signals to them on the RTSI bus. Using RTSI bus, a single master device can control one or more slave devices for both single and multiple A/D conversions. The PXI Trigger bus serves the same purpose for PXI systems as RTSI bus.

E Series Multifunction DAQ Software

NI-DAQ

NI-DAQ, our driver software bundled with every E Series multifunction DAQ device, provides access to the features of your DAQ hardware, so that you can easily develop powerful measurement solutions.

You can use NI-DAQ to perform single-point and buffered analog I/O, digital I/O, and counter/timer input operations. You can perform those operations individually, or program your device to perform multiple operations simultaneously. To facilitate integration of signal conditioning in your system, NI-DAQ provides you with a single interface for programming both the E Series device and signal conditioning modules. Using NI-DAQ, you can also synchronize your E Series multifunction DAQ device with other measurement devices, to build measurement systems customized to your particular needs.

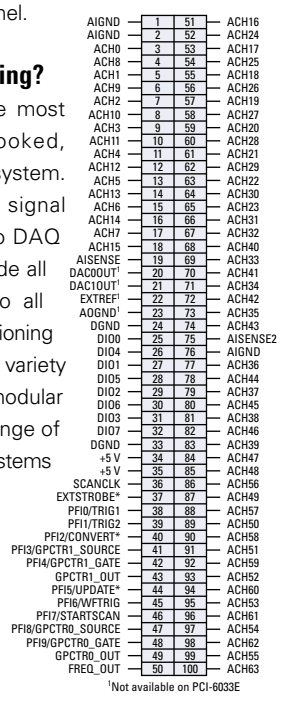
Measurement & Automation Explorer

NI Measurement & Automation Explorer (MAX) software, which is bundled with every E Series multifunction DAQ device, guides you through hardware configuration, channel scaling, and sensor set-up. You can also test the basic operation of your E Series device and signal connections using a test panel.

What About Signal Conditioning?

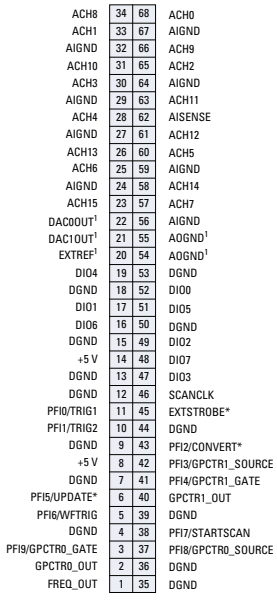
Signal conditioning is one of the most important, and most overlooked, components of a data acquisition system. Many sensors require special signal conditioning technology, and no DAQ device has the capability to provide all types of signal conditioning to all sensors. Using NI signal conditioning products, you can measure a wide variety of signals and sensors. These modular conditioning devices come in a range of sizes, from rack-mountable SCXI systems to portable SCC systems.

See page 383 for more information on Signal Conditioning,



[1]Not available on PCI-6033E

Figure 2. 100-Pin I/O Connector for NI 6071E, NI 6061E, NI 6031E, NI 6033E Devices



[1] Not available on AT-AI-16XE-10, PCI-6032E, DAQCard-AI-16E-4, DAQCard-AI-16XE-50

Figure 3. 68-Pin I/O Connector for NI 6070E, NI 6060E, NI 6062E, NI 6052E, NI 6041E, NI 6040E, NI 6036E, NI 6035E, NI 6034E, NI 6032E, NI 6030E, NI 6024E, NI 6023E, NI 6020E, NI 6012E and NI 6011E Devices

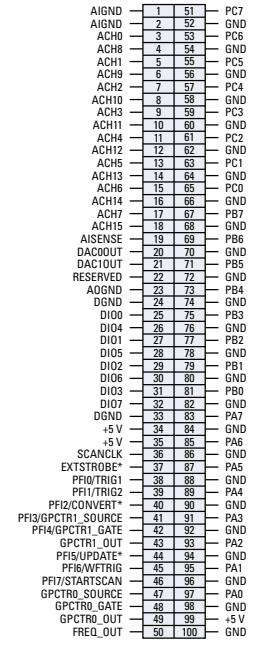


Figure 4. 100-Pin I/O Connector for NI 6021E and NI 6025E Devices

E Series Multifunction DAQ Specifications

Specifications – 16-Bit E Series NI 6052E, NI 603xE, and NI 601xE

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

Analog Input

Accuracy specifications ..... See tables in E Series product pages

Input Characteristics

Number of channels

6052E 6030E 6032E 6034E 6035E 6036E 601xE	16 single-ended or 8 differential (software selectable per channel)
6031E 6033E	64 single-ended or 32 differential (software selectable per channel)

Type of ADC..... Successive approximation
Resolution ..... 16 bits, 1 in 65,536

Maximum sampling rate

6052E	333 kS/s
6034E 6035E 6036E	200 kS/s
6030E 6031E 6032E 6033E	100 kS/s
601xE	20 kS/s; 200 kS/s single-channel sampling with the DAQCard™-AI-16XE-50

Streaming-to-disk rate (system dependent)[1]

6052E	333 kS/s
6034E 6035E 6036E	200 kS/s
6030E 6031E 6032E 6033E	100 kS/s
601xE	20 kS/s

[1]Streaming-to-disk rates do not apply to RT Series devices

Input signal ranges

Device	Range Software Selectable	Bipolar Input Range	Unipolar Input Range
6052E	20 V	±10 V	–
	10 V	±5 V	0 to 10 V
	5 V	±2.5 V	0 to 5 V
	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
6030E	20 V	±10 V	–
6031E	10 V	±5 V	0 to 10 V
6032E	5 V	–	0 to 5 V
6033E	4 V	±2 V	–
	2 V	±1 V	0 to 2 V
	1 V	±500 mV	0 to 1 V
	500 mV	–	0 to 500 mV
	400 mV	±200 mV	–
	200 mV	±100 mV	0 to 200 mV
	100 mV	–	0 to 100 mV
6034E	20 V	±10 V	–
6035E	10 V	±5 V	–
6036E	1 V	±500 mV	–
	100 mV	±50 mV	–
601xE	20 V	±10 V	–
	10 V	±5 V	0 to 10 V
	5 V	–	0 to 5 V
	2 V	±1 V	–
	1 V	–	0 to 1 V
	200 mV	±100 mV	–
	100 mV	–	0 to 100 mV

Input coupling ..... DC
Maximum working voltage
(signal + common mode) ..... Each input should remain within ±11 V of ground
Overvoltage protection
Powered on ..... ±25 V
Powered off..... ±15 V

Inputs protected

6052E 6030E 6032E 6034E 6035E 6036E 601xE	ACH<0..15>, AISENSE
6031E 6033E	ACH<0..63>, AISENSE, AISENSE2

FIFO buffer size ..... 512 samples, (1024 samples for DAQCard; 2048 for PCI-MIO-16XE-50)
Data transfers
PCI, PXI, AT ..... DMA, interrupts, programmed I/O
DAQCard ..... Interrupts, programmed I/O
DMA modes
PCI, PXI ..... Scatter-gather (single transfer, demand transfer)
AT ..... Single transfer, demand transfer
Configuration memory size..... 512 words

E Series Multifunction DAQ Specifications

16-Bit E Series NI 6052E, NI 603xE, and NI 601xE (continued)

Transfer Characteristics

Relative accuracy (dithered)

Device	Typical	Maximum
6052E 6034E 6035E 6036E	±1.5 LSB	±3 LSB
6030E 6031E 6032E 6033E	±0.75 LSB	±1 LSB
6011E	±0.5 LSB	±1 LSB
6012E	±1.5 LSB	±2 LSB

DNL

Device	Typical	Maximum
6052E 603xE 6011E	±0.5 LSB	±1 LSB
6012E	+1.5 to -0.75 LSB	+2.25 to -1.0 LSB

No missing codes ..... 16 bits, guaranteed

Amplifier Characteristics

Input impedance

Device	Normal Powered On	Powered Off	Overload
6052E 603xE	100 GΩ in parallel with 100 pF	820 Ω	820 Ω
601xE	7 GΩ in parallel with 100 pF	820 Ω; 1 kΩ for DAQCard	820 Ω; 1 kΩ for DAQCard

Input bias and offset current

Device	Bias Current	Offset Current
6052E 6034E 6035E 6036E	±200 pA	±100 pA
6030E 6031E 6032E 6033E	±1 nA	±2 nA
6011E	±10 nA	±20 nA
6012E	±10 nA	±14 nA

CMRR, DC to 60 Hz

		CMRR	
Device	Range	Bipolar	Unipolar
6052E	20 V	92 dB	–
	10 V	97 dB	97 dB
	5 V	101 dB	101 dB
	2 V	104 dB	104 dB
	100 mV to 1 V	105 dB	105 dB
6030E	20 V	92 dB	–
6031E	10 V	97 dB	92 dB
6032E	5 V	–	97 dB
6033E	4 V	101 dB	–
	2 V	104 dB	101 dB
	1 V	105 dB	104 dB
	100 mV to 500 mV	105 dB	105 dB
6034E	20 V	85 dB	–
6035E	10 V	85 dB	–
6036E	1 V	96 dB	–
	100 mV	96 dB	–
601xE	20 V	80 dB	–
	10 V	86 dB	80 dB
	5 V	–	86 dB
	2 V	100 dB	–
	1 V	–	100 dB
	200 mV	120 dB	–
	100 mV	–	120 dB

Dynamic Characteristics

Bandwidth

Device	Range	Small Signal (-3 dB)
6052E	All ranges	480 kHz
6030E 6031E 6032E 6033E	All ranges	255 kHz
6034E 6035E 6036E	All ranges	413 kHz
6011E	5 to 20 V 1 to 2 V 100 to 200 mV	63 kHz 57 kHz 33 kHz
6012E	5 to 20 V 1 to 2 V 100 to 200 mV	69 kHz 66 kHz 39 kHz

System noise (LSB_{rms}, including quantization)

Device	Range	Bipolar	Unipolar
6052E	2 to 20 V	0.95	0.95
	1 V	1.1	1.1
	500 mV	1.3	1.3
	200 mV	2.3	2.3
	100 mV	4.2	4.2
6030E	2 to 20 V	0.6	0.8
6031E	1 V	0.7	0.8
6032E	400 to 500 mV	1.1	1.1
6033E	200 mV	2.0	2.0
	100 mV	–	3.8
6034E	10 to 20 V	0.8	–
6035E	1 V	1.0	–
6036E	100 mV	5.6	–
6010E	1 to 20 V	0.5	0.5
	100 to 200 mV	0.8	1.4
6011E	1 to 20 V	1.0	1.0
	100 to 200 mV	1.2	1.6

Settling time to full-scale step

		Accuracy				
Device	Range	±0.00076% (±0.5 LSB)	±0.0015% (±1 LSB)	±0.0031% (±2 LSB)	±0.0061% (±4 LSB)	±0.024% (±16 LSB)
6052E	2 to 20 V	20 µs typical	10 µs max	5 µs max	4 µs max	3 µs typical
	1 V	20 µs typical	15 µs max	5 µs max	4 µs max	3 µs typical
	200 to 500 mV	20 µs typical	15 µs max	8 µs max	4 µs max	3 µs typical
	100 mV	20 µs typical	15 µs max	10 µs max	4 µs max	3 µs typical
6030E 6032E	All	40 µs max	20 µs max	–	10 µs max	–
6031E 6033E	All	50 µs max	25 µs max	–	10 µs max	–
6034E	1 to 20 V	–	–	5 µs max	–	–
6035E	100 mV	–	–	–	5 µs typical	–
6036E						
6011E	1 to 20 V	–	50 µs max	–	50 µs max	–
	200 mV (bipolar), 100 mV (unipolar)		75 µs max 75 µs max		50 µs max 50 µs max	
6012E	1 to 20 V	–	–	50 µs max	50 µs max	–
	200 mV (bipolar), 100 mV (unipolar)			60 µs max 60 µs max	50 µs typical 50 µs typical	

Crosstalk

Device	Adjacent Channels	All Other Channels
6052E 603xE	-75 dB	-90 dB
601xE	-85 dB	-100 dB

E Series Multifunction DAQ Specifications

16-Bit E Series NI 6052E, NI 603xE, and NI 601xE (continued)

Analog Output

Output Characteristics

Number of channels

6052E 6030E 6031E 6035E 6036E 6011E	2 voltage outputs
6032E 6033E 6034E 6012E	None

Resolution

6052E 6036E 6030E 6031E	16 bits, 1 in 65,536
6035E 6011E	12 bits, 1 in 4,096

Maximum update rate

6052E	333 kS/s
6035E 6036E	10 kS/s, system dependent
6030E 6031E	100 kS/s
6011E	20 kS/s, system dependent

Type of DAC ..... Double buffered, multiplying

FIFO buffer size

6052E 6030E 6031E	2,048 samples
6035E 6036E 6011E	None

Data transfers
- PCI, PXI, AT ..... DMA, interrupts, programmed I/O
- DAQCard ..... Interrupts, programmed I/O

DMA modes
- PCI, PXI ..... Scatter-gather (single transfer, demand transfer)
- AT ..... Single transfer, demand transfer

Transfer Characteristics

Relative accuracy

6052E	±0.35 LSB typical, ±1 LSB max
6030E 6031E	±0.5 LSB typical, ±1 LSB max
6035E	±0.3 LSB typical, ±0.5 LSB max
6036E	±2 LSB max
6011E	±0.5 LSB max

DNL ..... ±1.0 LSB max

Monotonicity

6052E 6036E 6030E 6031E	16 bits, guaranteed
6035E 6011E	12 bits, guaranteed

Voltage Output

Ranges

6052E	±10 V, 0 to 10 V, ±EXTREF, 0 to EXTREF; software selectable
6030E 6031E	±10 V, 0 to 10 V; software selectable
6035E 6036E 6011E	±10 V

Output coupling ..... DC
Output impedance ..... 0.1 Ω max
Current drive ..... ±5 mA max
Protection ..... Short-circuit to ground

Power-on state

6052E 6030E 6031E	0 V (±20 mV)
6035E	0 V (±200 mV)
6036E	0 V (±21 mV)
6011E	0 V (±85 mV)

External reference input (6052E only)
- Range ..... ±11 V
- Overvoltage protection ..... ±25 V powered on, ±15 V powered off
- Input impedance ..... 10 kΩ
- Bandwidth (-3 dB) ..... 3 kHz
- Slew rate ..... 0.3 V/µs

Dynamic Characteristics

Settling time and slew rate

Device	Settling Time for Full-Scale Step	Slew Rate
6052E	3.5 µs to ±1 LSB accuracy	15 V/µs
6030E 6031E	10 µs to ±1 LSB accuracy	5 V/µs
6035E	10 µs to ±0.5 LSB accuracy	10 V/µs
6036E	5 µs to ±1 LSB accuracy	15 V/µs
6011E	50 µs to ±0.5 LSB accuracy	2 V/µs

Noise

6052E 6030E 6031E	60 μV_{rms}, DC to 1 MHz
6035E	200 μV_{rms}, DC to 1 MHz
6036E	110 μV_{rms}, DC to 400 kHz
6011E	40 μV_{rms}, DC to 1 MHz

Glitch energy (at mid-scale transition)

Digital I/O

Number of channels ..... 8 input/output
Compatibility ..... 5 V/TTL

Device	Magnitude	Duration
6052E	±10 mV	1 µs
6030E 6031E	N/A	N/A
6035E	±12 mV	2 µs
6036E	±10 mV	1 µs
6011E	±30 mV	10 µs

Power-on state ..... Input (high impedance)
Data transfers ..... Programmed I/O
Digital logic levels

Level	Minimum	Maximum
Input low voltage	0 V	0.8 V
Input high voltage	2 V	5 V
Output low voltage (Iout = 24 mA)	–	0.4 V
Output high voltage (Iout = 13 mA)	4.35 V	–

E Series Multifunction DAQ Specifications

Specifications – 16-Bit E Series NI 6052E, NI 603xE, and NI 601xE (continued)

Timing I/O

General-Purpose Up/Down Counter/Timers

Number of channels 2
Resolution ..... 24 bits (1 in 16, 777, 216)
Compatibility ..... 5 V/TTL

Digital logic levels

Level	Minimum	Max
Input low voltage	0.0 V	0.8 V
Input high voltage	2.0 V	5.0 V
Output low voltage (Iout = 5 mA)	–	0.4 V
Output high voltage (Iout = 3.5 mA)	4.35 V	–

Base clocks available ..... 20 MHz and 100 kHz
Base clock accuracy ..... ±0.01%
Maximum source frequency ..... 20 MHz
External source selections ..... PFI0..PFI9, RTSI0..RTSI6, analog trigger; software selectable
External gate selections ..... PFI0..PFI9, RTSI0..RTSI6, analog trigger; software selectable
Minimum source pulse duration ..... 10 ns
Minimum gate pulse duration ..... 10 ns, edge-detect mode
Data transfers
  PCI, PXI, AT ..... DMA, interrupts, programmed I/O
  DAQCard ..... Interrupts, programmed I/O
DMA modes
  PCI, PXI ..... Scatter-gather (single transfer, demand transfer)
  AT ..... Single transfer, demand transfer

Frequency Scaler

Number of channels 1
Resolution ..... 4 bits
Compatibility ..... 5 V/TTL

Digital logic levels

Level	Minimum	Max
Input low voltage	0.0 V	0.8 V
Input high voltage	2.0 V	5.0 V
Output low voltage (Iout = 5 mA)	–	0.4 V
Output high voltage (Iout = 3.5 mA)	4.35 V	–

Base clocks available ..... 10 MHz, 100 kHz
Base clock accuracy ..... ±0.01%
Data transfers ..... Programmed I/O

Triggers

Analog Triggers

Number of triggers

6052E 6030E 6031E 6032E 6033E	1
6034E 6035E 6036E 601xE	None

Purpose
  Analog input ..... Start and stop trigger, gate, clock
  Analog output ..... Start trigger, gate, clock
  General-purpose counter/timers ..... Source, gate

Source

6052E 6030E 6032E	ACH<0..15>, PF10/TRIG1
6031E 6033E	ACH<0..63>, PF10/TRIG1

Level
  Internal source, ACH<0..15/63> ..... ±Full-scale
  External source, PFI0/TRIG1 ..... ±10 V
Slope ..... Positive or negative; software selectable
Resolution ..... 12 bits, 1 in 4,096
Hysteresis ..... Programmable
Bandwidth (-3 dB)
Accuracy ..... ±1% of full-scale range max

Device	Internal source ACH<0..15/63>	External Source PFI0/TRIG1
6052E	700 kHz	700 kHz
6030E, 6031E, 6032E, 6033E	255 kHz	4 MHz

Digital Triggers (all devices)

Number of triggers 2
Purpose
  Analog input ..... Start and stop trigger, gate, clock
  Analog output ..... Start trigger, gate, clock
  General-purpose counter/timers ..... Source, gate

Source ..... PFI0..PFI9, RTSI0..RTSI6
Slope ..... Positive or negative; software selectable
Compatibility ..... 5 V/TTL
Response ..... Rising or falling edge
Pulse width ..... 10 ns minimum

E Series Multifunction DAQ Specifications

16-Bit E Series NI 6052E, NI 603xE, and NI 601xE (continued)

External Input for Digital or Analog Trigger (PFI0/TRIG1)

Impedance ..... 10 kΩ
Coupling ..... DC
Protection
  Digital trigger ..... -0.5 to (Vcc + 0.5) V
  Analog trigger
    On/Off/Disabled ..... ±35 V

Calibration

Recommended warm-up time ..... 15 minutes; 30 minutes for DAQCard
Calibration Interval ..... 1 year
Onboard calibration reference
  DC Level

6052E 6030E 6031E 6032E 6033E 6012E	5.000 V (±1.0 mV)	Over full operating temperature, actual value stored in EEPROM
6034E 6035E 6036E	5.000 V (±3.5 mV)	
6011E	5.000 V (±3.0 mV)	

Temperature coefficient

6052E 6030E 6031E 6032E 6033E	±0.6 ppm/°C max
6012E 6034E 6035E 6036E	±5.0 ppm/°C max
6011E	±2.0 ppm/°C max

Long-term stability

6052E 6030E 6031E 6032E 6033E	±6.0 ppm/$\sqrt{1000\ h}$
6034E 6035E 6036E 601xE	±15.0 ppm/$\sqrt{1000\ h}$

RTSI (PCI and ISA only)

Trigger lines 7

PXI Trigger Bus (PXI only)

Trigger lines 6
Star Trigger 1

Bus Interface

PCI, PXI ..... Master, slave
AT, DAQCard ..... Slave

Power Requirements[1]

Device	+5 VDC (±5%)	Power Available at I/O Connector
6052E	1.3 A	+4.65 to +5.25 VDC, 1 A
603xE (PCI, PXI); except 6034E/6035E	1.5 A	+4.65 to +5.25 VDC, 1 A
6034E 6035E 6036E	0.9 A	+4.65 to +5.25 VDC, 1 A
603xE (AT)	1.2 A	+4.65 to +5.25 VDC, 1 A
PCI-MIO-16XE-50	1.1 A	+4.65 to +5.25 VDC, 1 A
DAQCard-A1-16XE-50	230 mA	+4.65 to +5.25 VDC, 250 mA
AT-MIO-16XE-50	750 mA	+4.65 to +5.25 VDC, 1 A

Physical[1]

Dimensions (not including connectors)[1]

PCI ..... 17.5 by 10.6 cm (6.9 by 4.2 in.)
PXI ..... 16.0 by 10.0 cm (6.3 by 3.9 in.)
ISA (long) ..... 33.8 by 9.9 cm (13.3 by 3.9 in.)
ISA (short) ..... 17.5 by 9.9 cm (6.9 by 4.2 in.)
DAQCard ..... Type II PC Card

I/O connectors

6052E 6030E 6032E 6034E 6035E 6036E 6011E	68-pin male SCSI-II type
6031E 6033E	100-pin female 0.050 D-type
6012E	68-pin female PCMCIA

Environment

Operating temperature ..... 0 to 55 °C; DAQCards should not exceed 55 °C while in PCMCIA slot
Storage temperature ..... -20 to 70 °C
Relative humidity ..... 10 to 90%, noncondensing

Certifications and Compliances

CE Mark Compliance CE

[1]See page 148 for RT Series devices power requirements and physical parameters.

E Series DAQ Accuracy Specifications

Every Measurement Counts

There is no room for error in your measurements. From sensor to software, your system must deliver accurate results. NI provides detailed specifications for our products so that you do not have to guess how they will perform. Along with traditional data acquisition specifications, our E Series multifunction data acquisition (DAQ) devices also include accuracy tables to assist you in selecting the appropriate hardware for your application. These tables are found on the product pages and include specifications for both absolute and relative accuracy.

Absolute Accuracy

Absolute accuracy is the specification you use to determine the overall maximum error of your measurement. Absolute accuracy specifications apply only to a successfully calibrated DAQ device. There are four components of an absolute accuracy specification:

Percent of Reading is a percent of the actual input voltage.
Offset is a constant offset applied to all measurements.
Noise + Quantization is based on noise and depends on the number of points averaged for each measurement.
Drift is based on variations in your ambient temperature.

Based on these components, the formula for calculating absolute accuracy is:

Absolute Accuracy = ±[(Input Voltage X % of Reading) + (Offset + Noise + Quantization + Drift)]

Drift is already accounted for unless your ambient temperature is outside +15 to +35 °C. For instance, if your ambient temperature is at 45 °C, you must account for 10 °C of drift. This is calculated by:

Drift = Temperature Difference X % Drift per °C X Input Voltage

Absolute Accuracy at Full Scale is a calculation of absolute accuracy for a specific voltage range using the maximum voltage within that range taken one year after calibration, the Accuracy Drift Reading, and the Noise + Quantization averaged value.

Below is the **Absolute Accuracy at Full Scale** calculation for the PCI-MIO-16XE-50 after one year using the ±10 V input range while averaging 100 samples of a 10 V input signal. In all the Absolute Accuracy at Full Scale calculations, we assume that the ambient temperature is between 15 and 35 °C. You can see on the next page that the calculation for the ±10 V input range for Absolute Accuracy at Full Scale yields 1.443 mV. This calculation is done using the parameters in the same row for one year Absolute Accuracy Reading, Offset and Noise + Quantization as well as a value of 10 V for the input voltage value. You can then see that the calculation is as follows:

Absolute Accuracy = ±[(10 X 0.0001) + 397.2 µV + 45.8 µV] = ±1.443 mV

The following example assumes the same conditions except that the ambient temperature is 45 °C. You can begin with the calculation above and add in the Drift calculation using the % Drift per °C from the table on the next page (see Table 1).

Absolute Accuracy = 1.443mV + ((45 °C – 35 °C) X 0.000002 /°C X 10 V) = ±1.643 mV

If you are making single-point measurements, use the Single-Point Noise + Quantization specification from the accuracy tables. If you are averaging multiple points for each measurement, the value for Noise + Quantization changes. The Averaged Noise + Quantization in the accuracy tables assumes that you average 100 points per measurement. If you are averaging a different number of points, use the following equation to determine your Noise + Quantization:

Noise + Quantization for x averaged points = Averaged Noise + Quantization from table X $\sqrt{100/X}$

For example, if you are averaging 1000 points per measurement with the PCI-MIO-16XE-50 in the ±10 V input range, the Noise + Quantization is determined by:

Noise + Quantization = 45.7 µV X $\sqrt{100/1000}$ *= 14.5 µV*

The Noise + Quantization specifications assume that dithering is disabled for single-point measurements and enabled for averaged measurements.

See page 24 or visit ni.com/calibration for more information on the importance of calibration on DAQ device accuracy.

To calculate the accuracy of NI measurement products, visit *ni.com/measurements/accuracy*

E Series DAQ Accuracy Specifications

Relative Accuracy

Relative accuracy is the specification that compares the difference between two or more measurements. It indicates the degree to which two or more measurements can be distinguished from each other. The two major contributors to relative accuracy are the resolution of the device's analog-to-digital Converter (ADC) and the system noise. The accuracy tables show both single-point and averaged relative accuracy, which include both ADC resolution and system noise effects. Averaging will improve your relative accuracy for DC measurements.

As an example, assume you are monitoring a voltage once per second using the ±10 V range on the PCI-MIO-16XE-50 and averaging 100 points for each measurement. Using the accuracy table on page 255 (reprinted below for your convenience), we find:

Averaged Relative Accuracy = 60.3 µV

This means that a measurement taken at time t_2 would have to be 60.3 µV greater or less than the measurement taken at time t_1 in order to detect a difference in the input voltage. Relative accuracy does not depend on DAQ device calibration.

Detailed Specifications

The pages starting at page 266 contain detailed specifications for all National Instruments E Series multifunction devices. Devices can be identified by their family number. For instance, if you want to determine the common-mode rejection ratio (CMRR) in the 10 V range for the PCI-6052E in unipolar range, you would look at the 16-bit E Series Multifunction DAQ specification on page 272. For the 10 V range, the CMRR specification for the NI 6052E devices is 97 dB.

		Absolute Accuracy								Relative Accuracy	
	Nominal	% of Reading			Offset	Noise + Quantization (µV)		Temp	Absolute Accuracy	Resolution (µV)	
	Range (V)	24 Hrs	90 Days	1 Year	(µV)	Single Pt.	Averaged	Drift (%/°C)	at Full Scale (mV)	Single Pt.	Averaged
PCI, AT, and DAQPad	±10	0.0058%	0.0078%	0.0100%	397.2	526.4	45.8	0.0002	1.443	602.7	60.3
	±5	0.0208%	0.0228%	0.0250%	200.6	263.2	22.9	0.0007	1.474	301.4	30.1
	±1	0.0208%	0.0228%	0.0250%	43.3	52.6	4.6	0.0007	0.298	60.3	6.0
	±0.1	0.0408%	0.0428%	0.0450%	7.9	8.4	0.7	0.0012	0.054	9.6	1.0
	0 to 10	0.0058%	0.0078%	0.0100%	244.6	263.2	22.9	0.0002	1.268	301.4	30.1
	0 to 5	0.0208%	0.0228%	0.0250%	124.3	131.6	11.4	0.0007	1.386	150.7	15.1
	0 to 1	0.0208%	0.0228%	0.0250%	28.1	26.3	2.3	0.0007	0.280	30.1	3.0
	0 to 0.1	0.0408%	0.0428%	0.0450%	6.4	7.0	0.6	0.0012	0.052	8.4	0.8
DAQCard	±10	0.0075%	0.0095%	0.0117%	815.4	1029.1	91.6	0.0005	2.077	1205.4	120.5
	±5	0.0225%	0.0245%	0.0267%	409.7	514.6	45.8	0.0010	1.791	602.7	60.3
	±1	0.0225%	0.0245%	0.0267%	85.1	102.9	9.2	0.0010	0.361	120.5	12.1
	±0.1	0.0425%	0.0445%	0.0467%	12.1	12.2	1.1	0.0015	0.060	14.5	1.4
	0 to 10	0.0075%	0.0095%	0.0117%	591.2	514.6	45.8	0.0005	1.807	602.7	60.3
	0 to 5	0.0225%	0.0245%	0.0267%	297.6	257.3	22.9	0.0010	1.656	301.4	30.1
	0 to 1	0.0225%	0.0245%	0.0267%	62.7	51.5	4.6	0.0010	0.334	60.3	6.0
	0 to 0.1	0.0425%	0.0445%	0.0467%	9.9	8.0	0.7	0.0015	0.057	9.6	1.0

Note: Accuracies are valid for measurements following an internal E Series Calibration. Averaged numbers assume dithering and averaging of 100 single-channel readings. 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. See Overview on page 234 for an example calculation of this type.

Table 1. NI 601xE Analog Input Accuracy Specifications