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

Overview
The NI 6070E and NI 6071E data acquisition (DAQ) devices use E Series technology to deliver high performance and reliable data acquisition capabilities to meet a wide range of application requirements. You get up to 1.25 MS/s, 12-bit performance across multiple bus systems, and you choose from either 16 or 64 single-ended analog inputs. Depending on your type of hard drive, these devices can stream to disk at rates up to 1.25 MS/s. These E Series devices feature both analog and digital triggering capability, as well as two 12-bit analog outputs; two 24-bit, 20 MHz counter/timers; and eight digital I/O lines.

DAQPad Configurations
The DAQPad-6070E for IEEE 1394 is available in two different configurations. Both configurations feature 250 V functional isolation from the PC and a low-profile package that fits under your laptop.

The mass termination version features a 68-pin shielded connector to connect signals either from the SCC Series modular signal conditioning products or from our CA-1000 custom-connectivity enclosure.

The BNC termination version features shielded BNC connectors for eight differential-ended analog inputs, two analog outputs, and five auxiliary lines. You access other signals through built-in screw terminal connections. It is ideal for applications where portability and quick connectivity are needed, such as in-vehicle automotive testing or laboratory measurements.

DAQPad-6070E Power
The DAQPad-6070E can be powered by any 9 to 25 VDC power supply, such as a car battery using a cigarette lighter socket. The unit comes with a universal desktop AC-to-DC power supply that can power the DAQPad-6070E from any standard AC power outlet anywhere in the world. You can also use the optional BP-1 rechargeable battery pack to power the DAQPad-6070E for up to 2.5 hours.

See the E Series Multifunction DAQ Overview on page 230 for a detailed hardware overview.

Table 1. NI 607xE Channel, Speed, and Resolution Specifications

<table>
<thead>
<tr>
<th>Family</th>
<th>Bus</th>
<th>Analog Inputs</th>
<th>Resolution</th>
<th>Sampling Rate</th>
<th>Input Range</th>
<th>Analog Outputs</th>
<th>Resolution</th>
<th>Output Rate</th>
<th>Output Range</th>
<th>Digital I/O</th>
<th>Counter/Timers</th>
<th>Triggers</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 6070E</td>
<td>PCI, PXI/CompactPCI, ISA</td>
<td>16 SE/8 DI</td>
<td>12 bits</td>
<td>1.25 MS/s</td>
<td>±0.05 to ±10 V</td>
<td>2</td>
<td>12 bits</td>
<td>1 MS/s</td>
<td>±10 V</td>
<td>8</td>
<td>2, 24-bit</td>
<td>Analog and Digital</td>
</tr>
<tr>
<td>NI 6071E</td>
<td>PCI, PXI/CompactPCI, ISA</td>
<td>64 SE/32 DI</td>
<td>12 bits</td>
<td>1.25 MS/s</td>
<td>±0.05 to ±10 V</td>
<td>2</td>
<td>12 bits</td>
<td>1 MS/s</td>
<td>±10 V</td>
<td>8</td>
<td>2, 24-bit</td>
<td>Analog and Digital</td>
</tr>
</tbody>
</table>
E Series Multifunction DAQ – 1.25 MS/s, 12-Bit, 16 or 64 Analog Inputs

Figure 2. The DAQPad-6070E fits snugly under laptop PCs for portable applications. By connecting two or more DAQPad-6070E units together with an IEEE 1394 cable, you can use several devices with one PC.

Consider our SCC Series for adding signal and sensor connectivity and signal conditioning to your DAQPad-6070E.

Visit ni.com/siQcon/scc.htm for more information.

Figure 3. Choose the NI BP-1 battery pack to power your DAQPad-6070E for up to 2.5 hours.

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

See page 266 for detailed specifications.

Ordering Information

NI 6070E
- PCI-MIO-16E-1 ........................................... 777305-01
- PXI-6070E ............................................... 777060-01
- DAQPad-6070E¹ for IEEE 1394 with
  Mass termination, AC adapter², and IEEE 1394 Cable
  U.S. 120 VAC ......................................... 777867-01
  Universal Euro 240 VAC ........................... 777867-04
  United Kingdom 240 VAC ......................... 777867-06
- BNC termination, AC adapter², and IEEE 1394 cable
  U.S. 120 V ............................................ 777803-01
  Universal Euro 240 VAC ........................... 777803-04
  United Kingdom 240 VAC ......................... 777803-06
- AT-MIO-16E-1³ ........................................... 777142-01
NI 6071E
- PCI-6071E ............................................... 777515-01
- PXI-6071E ............................................... 777676-01
Includes NI-DAQ driver software. IEEE 1394 products include 1 m IEEE 1394 cable.
¹Windows 2000/Me/98 only
²The AC adapter is universal. The difference between these kits is the power cable.
³Windows 2000/NT/Me/9x only

Accessories

BP-1 Rechargeable battery pack
- 120 VAC charger ...................................... 776896-01
- 230 VAC charger ...................................... 776896-31

DAQPad Accessories
- Rack-mount kit ....................................... 777665-01
- Stacking kit ........................................... 777666-01
- PCI-to-IEEE 1394 adapter ......................... Please call
- Cardbus-to-IEEE 1394 adapter .................... Please call

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

Recommended Configurations

<table>
<thead>
<tr>
<th>Family</th>
<th>DAQ Device</th>
<th>Accessory</th>
<th>Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 6070E</td>
<td>PCI-MIO-16E-1</td>
<td>SCB-68 (776844-01)</td>
<td>SH6866-EP (184748-01)</td>
</tr>
<tr>
<td></td>
<td>PXI-6070E</td>
<td>TB-2705 (778241-01)</td>
<td>SH6866-EP (184748-01)</td>
</tr>
<tr>
<td></td>
<td>AT-MIO-16E-1</td>
<td>SCB-68 (776844-01)</td>
<td>SH6866-EP (184748-01)</td>
</tr>
<tr>
<td></td>
<td>DAQPad-6070E (Mass termination)</td>
<td>CA-1000 (777664-01)</td>
<td>SH6866-EP (184748-01)</td>
</tr>
<tr>
<td></td>
<td>DAQPad-6070E (BNC termination) none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>NI 6071E</td>
<td>PCI-6071E</td>
<td>SCB-100 (776990-01)</td>
<td>SH100100 (182953-01)</td>
</tr>
<tr>
<td></td>
<td>PXI-6071E</td>
<td>Two TBX-68s (777141-01)</td>
<td>SH100268 (182948-01)</td>
</tr>
</tbody>
</table>

¹See page 258 for information on CA-1000.

For E Series accessory and cable information, see page 256.
E Series Multifunction DAQ – 1.25 MS/s, 12-Bit, 16 or 64 Analog Inputs

Table 2. NI 607xE Analog Input Accuracy Specifications.

<table>
<thead>
<tr>
<th>Nominal Range (V)</th>
<th>Absolute Accuracy</th>
<th>Relative Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of Reading</td>
<td>Offset (mV)</td>
</tr>
<tr>
<td>Positive FS</td>
<td>Negative FS</td>
<td>24 Hrs</td>
</tr>
<tr>
<td>10 -10</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>5 -5</td>
<td>0.0272</td>
<td>0.0314</td>
</tr>
<tr>
<td>2.5 -2.5</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>1 -1</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>0.5 -0.5</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>0.25 -0.25</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>0.1 -0.1</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>0.05 -0.05</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>10 0</td>
<td>0.0272</td>
<td>0.0314</td>
</tr>
<tr>
<td>5 0</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>2 0</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>1 0</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>0.5 0</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>0.2 0</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
<tr>
<td>0.1 0</td>
<td>0.0672</td>
<td>0.0714</td>
</tr>
</tbody>
</table>

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 page 234 for example calculations.

Table 3. NI 607xE Analog Output Accuracy 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.

---

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

<table>
<thead>
<tr>
<th>Device</th>
<th>Accessory</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>68-pin E Series (except DAQCard)</td>
<td>SH68-68-EP (shielded)</td>
<td>Connects directly to the device (PXI only)</td>
<td>See page 385 for SCXI Signal Conditioning details</td>
</tr>
<tr>
<td>Latching DAQCards</td>
<td>SHC88-88-EP (shielded)</td>
<td>N/A</td>
<td>See page 385 for SCXI Signal Conditioning details</td>
</tr>
<tr>
<td>Nonlatching DAQCards</td>
<td>PSHR68-68 (shielded)</td>
<td>N/A</td>
<td>See page 385 for SCXI Signal Conditioning details</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Device</th>
<th>Accessory</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-pin E Series with 64 AI channels</td>
<td>SH1006868 (shielded)</td>
<td>Connects directly to the device (PXI only)</td>
<td>See page 385 for SCXI Signal Conditioning details</td>
</tr>
<tr>
<td>100-pin E Series with 16 AI channels and 32 DIO lines</td>
<td>SH1006868 (shielded)</td>
<td>Connects directly to the device (PXI only)</td>
<td>See page 385 for SCXI Signal Conditioning details</td>
</tr>
</tbody>
</table>

---

#### Table 3. Overview of E Series DAQ Accessories

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCXI Signal Conditioning</td>
<td>High channel-count signal conditioning platform</td>
<td>385</td>
</tr>
<tr>
<td>SCC Modular Signal Conditioning</td>
<td>Single or dual channel signal conditioning modules</td>
<td>461</td>
</tr>
<tr>
<td>AMUX-64T, 5B, SSR, ER, and SC-204x Signal Conditioning</td>
<td>External signal conditioning accessories</td>
<td>478</td>
</tr>
<tr>
<td>BNC-2110</td>
<td>BNC accessory for 68-pin E Series devices</td>
<td>257</td>
</tr>
<tr>
<td>BNC-2115</td>
<td>BNC accessory for extended I/O on 100-pin E Series devices</td>
<td>257</td>
</tr>
<tr>
<td>BNC-2120</td>
<td>BNC accessory with function generator (for 88-pin E Series devices)</td>
<td>257</td>
</tr>
<tr>
<td>BNC-2090</td>
<td>Rack-mountable BNC accessory (for 68-pin E Series devices)</td>
<td>257</td>
</tr>
<tr>
<td>CA-1000 enclosure</td>
<td>Configurable connectivity enclosure</td>
<td>257</td>
</tr>
<tr>
<td>TB-2705</td>
<td>Latching screw terminal block for PXI E Series modules</td>
<td>258</td>
</tr>
<tr>
<td>SCB-100</td>
<td>100-pin, shielded screw terminal block with breadboard areas</td>
<td>258</td>
</tr>
<tr>
<td>SCB-88</td>
<td>88-pin, shielded screw terminal block with breadboard areas</td>
<td>258</td>
</tr>
<tr>
<td>TBB-68</td>
<td>68-pin, DIN rail-mountable screw terminal block</td>
<td>258</td>
</tr>
<tr>
<td>CB-68LP, CB-68LPR</td>
<td>68-pin, low-cost screw terminal block</td>
<td>258</td>
</tr>
<tr>
<td>Signal Source and Demo Accessory</td>
<td>DAQ signal accessory to demo and test analog, digital and counter/timer functions</td>
<td>259</td>
</tr>
</tbody>
</table>

For complete and up-to-date information about accessories, visit [ni.com/catalog](http://ni.com/catalog).
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.

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.

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.)

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.)
E Series Multifunction DAQ Accessories

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.)

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 ..................................................................... 777562-06
- 3 external boards ......................................................................... 184749-01

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

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

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
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

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 SHC68U-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.

<table>
<thead>
<tr>
<th>Length</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 m</td>
<td>186838-0R5</td>
</tr>
<tr>
<td>1 m</td>
<td>186838-01</td>
</tr>
</tbody>
</table>

SHC68U-68-EP

<table>
<thead>
<tr>
<th>Length</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 m</td>
<td>187406-0R5</td>
</tr>
<tr>
<td>1 m</td>
<td>187406-01</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Length</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m</td>
<td>777293-01</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Length</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 m</td>
<td>183569-01</td>
</tr>
</tbody>
</table>
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

**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

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

**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

**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
E Series Multifunction DAQ Accessories and Cables

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

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 input, 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.
Configurable Signal Conditioning Enclosure

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.

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.

Table 1. CA-1000 Cabling

<table>
<thead>
<tr>
<th>Device</th>
<th>Connector Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>88-pin E Series DAQ Devices (except DAQCards)</td>
<td>N/A</td>
</tr>
<tr>
<td>100-pin E Series DAQ Devices</td>
<td>N/A</td>
</tr>
<tr>
<td>Latching E Series DAQCards: DAQCard-6036E, DAQCard-6024E</td>
<td>N/A</td>
</tr>
<tr>
<td>Nonlatching E Series DAQCards: DAQCard-6033</td>
<td>N/A</td>
</tr>
<tr>
<td>88-pin Digital I/O and Counter/Timer Devices (except DAQCards)</td>
<td>N/A</td>
</tr>
<tr>
<td>PCI-DIO-32HS, PXI-8533, AT-DIO-32HS, NI 6534, NI 66Bx</td>
<td>N/A</td>
</tr>
<tr>
<td>Simultaneous Sampling Multifunction DAQ Devices</td>
<td>N/A</td>
</tr>
<tr>
<td>PCI-6693</td>
<td>N/A</td>
</tr>
<tr>
<td>PC-DIO-24</td>
<td>N/A</td>
</tr>
<tr>
<td>DAQCard-DIO-24</td>
<td>N/A</td>
</tr>
<tr>
<td>NI 65272, PCI-DIO-96, PXI-6508, PXI-6508, DAQPad-6508</td>
<td>N/A</td>
</tr>
<tr>
<td>PC-DIO-96</td>
<td>N/A</td>
</tr>
</tbody>
</table>

1You can also use the SH68-68R1-EP or R6868. 2You can also use the PR68-68F. 3You 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. 4Splits into two 50-pin connectors. See page 319 for information on using the CA-1000 with signal source products.

Table 2. CA-1000 Panelette Options

<table>
<thead>
<tr>
<th>Minithermocouple</th>
<th>BNC</th>
<th>SMB</th>
<th>Dual 9-Pin D-Sub</th>
<th>Banana Jack</th>
<th>LEMO (B-Series)</th>
<th>MIL-Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toggle Switch</td>
<td>Rocker Switch</td>
<td>LED</td>
<td>Strain Relief</td>
<td>Potentiometer</td>
<td>Momentary Switch</td>
<td>Blank Filler</td>
</tr>
</tbody>
</table>

Table 2. CA-1000 Panelette Options
### Configurable Signal Conditioning Enclosure

#### Table 3. CA-1000 Panelette descriptions

<table>
<thead>
<tr>
<th>Panelette Description per Panelette Width</th>
<th>Minithermocouple Jack</th>
<th>Thermocouple Jack</th>
<th>BNC</th>
<th>SMB</th>
<th>Banana Jack</th>
<th>LEMO 2-pin female</th>
<th>MIL-Spec 2-pin female</th>
<th>9-pin D-sub</th>
<th>Momentary Pushbutton Switch</th>
<th>Toggle Switch</th>
<th>Rocker Switch</th>
<th>LED</th>
<th>Potentiometer</th>
<th>Strain Relief</th>
<th>Blank</th>
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</thead>
<tbody>
<tr>
<td>J-type</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On – off</td>
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<td></td>
<td></td>
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<td></td>
<td>1</td>
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<tr>
<td>K-type</td>
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<td></td>
<td>1</td>
</tr>
<tr>
<td>Uncompensated</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(On – off – on)</td>
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<td>1</td>
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<td></td>
<td></td>
<td></td>
<td>A red, green, yellow, and orange LED</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>K-type</td>
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<td>Uncompensated</td>
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<td>Screw clamp</td>
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<tr>
<td>Single (female)</td>
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<td>Dual (male)</td>
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<td>3</td>
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<tr>
<td>Dual (female)</td>
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<tr>
<td>2-pin male</td>
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</tr>
<tr>
<td>2, 4-pin male</td>
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<td>1</td>
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<tr>
<td>2, 4-pin female</td>
<td>2</td>
<td>1</td>
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<tr>
<td>9-pin D-sub</td>
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<td>6-pin female</td>
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<tr>
<td>2, 6-pin female</td>
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<td>1</td>
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</table>

**Ordering Information** (continued)

| Strain relief                            | 184721-01              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| 9-Pin D-Sub                              | 184738-01              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| 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                            | 777729-01              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| R6868, 1 m                              | 182482-01              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| R1005050, 1 m                           | 182762-01              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| N5B, 1 m                                | 181304-10              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| SH1006868, 1 m                          | 182849-01              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| PSHR68-68 Shielded Cable Kit            | 777793-01              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| 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                        | 187407-01              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| 1You 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 enxiev 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.
### E Series Multifunction DAQ Specifications

**Specifications – 12-Bit E Series** (NI 607xE, NI 606xE, NI 604xE, NI 602xE)

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

#### Analog Input

Accuracy specifications …………………. See tables in E Series Product pages.

#### Input Characteristics

<table>
<thead>
<tr>
<th>Number of channels</th>
<th>6070E</th>
<th>6066E, 6062E</th>
<th>604xE</th>
<th>602xE</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 single-ended or 8 differential (software selectable per channel)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>64 single-ended or 32 differential (software selectable per channel)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Type of ADC………………………… Successive approximation

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

Maximum sampling rate

<table>
<thead>
<tr>
<th>6070E</th>
<th>1.25 MS/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>6066E, 6062E</td>
<td>500 kS/s</td>
</tr>
<tr>
<td>604xE</td>
<td>250 kS/s</td>
</tr>
<tr>
<td>602xE</td>
<td>100 kS/s</td>
</tr>
</tbody>
</table>

Streaming-to-disk rate (system dependent)

<table>
<thead>
<tr>
<th>6070E</th>
<th>1.25 MS/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>6066E, 6062E</td>
<td>500 kS/s</td>
</tr>
<tr>
<td>604xE</td>
<td>250 kS/s</td>
</tr>
<tr>
<td>602xE</td>
<td>100 kS/s</td>
</tr>
</tbody>
</table>

Overvoltage protection

<table>
<thead>
<tr>
<th>Device</th>
<th>Powered On</th>
<th>Powered Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE</td>
<td>±25 V</td>
<td>±15 V</td>
</tr>
<tr>
<td>6066E, 6062E</td>
<td>±40 V</td>
<td>±25 V</td>
</tr>
<tr>
<td>602xE</td>
<td>±35 V</td>
<td>±25 V</td>
</tr>
</tbody>
</table>

Inputs protected

<table>
<thead>
<tr>
<th>Device</th>
<th>6070E, 6060E</th>
<th>6062E, 604xE</th>
<th>602xE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADH&lt;0..15&gt;, AISENSE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6071E, 6041E</td>
<td>ACH&lt;0..63&gt;, AISENSE, AISENSE2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIFO buffer size

<table>
<thead>
<tr>
<th>Device</th>
<th>AT-MIO-16E-1, DAQCard-6020E</th>
<th>DAQPad-6020E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8,192 samples</td>
<td>4,096 samples</td>
</tr>
<tr>
<td>6066E, 6061E</td>
<td>6070E, 6071E, 6040E, 6024E, 6025E</td>
<td></td>
</tr>
<tr>
<td>6041E</td>
<td>1,024 samples</td>
<td>512 samples</td>
</tr>
</tbody>
</table>

Data transfers

PCI, PXI, AT, DAQPad for IEEE 1394… DMA, interrupts, programmed I/O

DAQCard, DAQPad for USB………… Interrupts, programmed I/O

DMA modes

PCI, PXI, DAQPad for IEEE 1394…… Scatter-gather (single-transfer, demand transfer)

AT …………………………………… Single transfer, demand transfer

Configuration memory size……………… 512 words

### Transfer Characteristics

#### Relative accuracy

<table>
<thead>
<tr>
<th>Device</th>
<th>Typical Dithered</th>
<th>Maximum Undithered</th>
</tr>
</thead>
<tbody>
<tr>
<td>6070E</td>
<td>±0.5 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>6066E</td>
<td>±0.5 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>604xE</td>
<td>±0.5 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>6023E</td>
<td>±0.5 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>6024E</td>
<td>±0.5 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>6025E</td>
<td>±0.5 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>6020E</td>
<td>±0.2 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>6021E</td>
<td>±0.2 LSB</td>
<td>±1.5 LSB</td>
</tr>
</tbody>
</table>

#### DNL

<table>
<thead>
<tr>
<th>Device</th>
<th>Typical</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>6070E</td>
<td>±0.5 LSB</td>
<td>±1.0 LSB</td>
</tr>
<tr>
<td>6066E</td>
<td>±0.5 LSB</td>
<td>±1.0 LSB</td>
</tr>
<tr>
<td>604xE</td>
<td>±0.5 LSB</td>
<td>±1.0 LSB</td>
</tr>
<tr>
<td>6023E</td>
<td>±0.2 LSB</td>
<td>±1.0 LSB</td>
</tr>
<tr>
<td>6024E</td>
<td>±0.2 LSB</td>
<td>±1.0 LSB</td>
</tr>
<tr>
<td>6025E</td>
<td>±0.75 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>6020E</td>
<td>±0.75 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>6021E</td>
<td>±0.75 LSB</td>
<td>±1.5 LSB</td>
</tr>
<tr>
<td>DAQCard-6024E</td>
<td>±0.75 LSB</td>
<td>±1.5 LSB</td>
</tr>
</tbody>
</table>

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

### Input signal ranges

<table>
<thead>
<tr>
<th>Device</th>
<th>Range (Software Selectable)</th>
<th>Input Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipolar</td>
<td>Unipolar</td>
<td></td>
</tr>
<tr>
<td>6070E</td>
<td>20 V</td>
<td>±10 V</td>
</tr>
<tr>
<td>6066E</td>
<td>10 V</td>
<td>±5 V</td>
</tr>
<tr>
<td>604xE</td>
<td>5 V</td>
<td>±2.5 V</td>
</tr>
<tr>
<td>6020E</td>
<td>2 V</td>
<td>±1 V</td>
</tr>
<tr>
<td>6021E</td>
<td>1 V</td>
<td>±500 mV</td>
</tr>
<tr>
<td>6023E</td>
<td>20 V</td>
<td>±10 V</td>
</tr>
<tr>
<td>6024E</td>
<td>10 V</td>
<td>±5 V</td>
</tr>
<tr>
<td>6025E</td>
<td>1 V</td>
<td>±500 mV</td>
</tr>
<tr>
<td>6020E</td>
<td>±100 mV</td>
<td></td>
</tr>
<tr>
<td>6021E</td>
<td>±50 mV</td>
<td></td>
</tr>
</tbody>
</table>

Input coupling …………………… DC

Maximum working voltage (signal + common mode) ……………… Input should remain within ±11 V of ground
## E Series Multifunction DAQ Specifications

### Specifications – 12-Bit E Series (NI 607xE, NI 606xE, NI 604xE, NI 602xE)

#### Amplifier Characteristics

- **Input impedance**
  - 100 GΩ in parallel with 100 pF
  - 1 MΩ

- **Input bias current**
  - ±200 pA

- **Input offset current**
  - ±100 pA

- **CMRR, DC to 60 Hz**

#### Dynamic Characteristics

- **Bandwidth**

<table>
<thead>
<tr>
<th>Device</th>
<th>Range</th>
<th>Small Signal (-3 dB)</th>
<th>Large Signal (1% THD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE</td>
<td>1.6 MHz</td>
<td>1.0 kHz</td>
<td>250 kHz</td>
</tr>
<tr>
<td>606xE</td>
<td>1.3 MHz</td>
<td>1.0 kHz</td>
<td>500 kHz</td>
</tr>
<tr>
<td>604xE</td>
<td>800 kHz</td>
<td>1.0 kHz</td>
<td>1.0 kHz</td>
</tr>
<tr>
<td>602xE</td>
<td>200 kHz</td>
<td>1.0 kHz</td>
<td>1.0 kHz</td>
</tr>
<tr>
<td>DACCard-6024E</td>
<td>500 kHz</td>
<td>250 kHz</td>
<td>250 kHz</td>
</tr>
<tr>
<td>6021E</td>
<td>100 kHz</td>
<td>250 kHz</td>
<td>250 kHz</td>
</tr>
</tbody>
</table>

- **Settling time to full-scale step**

<table>
<thead>
<tr>
<th>Device</th>
<th>Range</th>
<th>Dither Off</th>
<th>Dither On</th>
</tr>
</thead>
<tbody>
<tr>
<td>6070E</td>
<td>20 V</td>
<td>0.25</td>
<td>0.5</td>
</tr>
<tr>
<td>PCI-6070E</td>
<td>500 mV</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>PXI-6070E</td>
<td>200 mV</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>6080E</td>
<td>100 mV</td>
<td>0.7</td>
<td>0.9</td>
</tr>
<tr>
<td>6090E</td>
<td>200 mV</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>6061E</td>
<td>100 mV</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>6062E</td>
<td>100 mV</td>
<td>0.25</td>
<td>0.6</td>
</tr>
<tr>
<td>6045E</td>
<td>100 mV</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>6021E</td>
<td>100 mV</td>
<td>0.7</td>
<td>1.0</td>
</tr>
<tr>
<td>6045E</td>
<td>100 mV</td>
<td>0.25</td>
<td>0.6</td>
</tr>
<tr>
<td>6021E</td>
<td>100 mV</td>
<td>0.5</td>
<td>0.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Device</th>
<th>Range</th>
<th>Dither Off</th>
<th>Dither On</th>
</tr>
</thead>
<tbody>
<tr>
<td>6070E</td>
<td>20 V</td>
<td>0.25</td>
<td>0.5</td>
</tr>
<tr>
<td>PCI-6070E</td>
<td>500 mV</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>PXI-6070E</td>
<td>200 mV</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>6080E</td>
<td>100 mV</td>
<td>0.7</td>
<td>0.9</td>
</tr>
<tr>
<td>6090E</td>
<td>200 mV</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>6061E</td>
<td>100 mV</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>6062E</td>
<td>100 mV</td>
<td>0.25</td>
<td>0.6</td>
</tr>
<tr>
<td>6045E</td>
<td>100 mV</td>
<td>0.5</td>
<td>0.7</td>
</tr>
<tr>
<td>6021E</td>
<td>100 mV</td>
<td>0.7</td>
<td>1.0</td>
</tr>
</tbody>
</table>

#### Crosstalk, DC to 100 kHz

<table>
<thead>
<tr>
<th>Device</th>
<th>Adjacent Channels</th>
<th>All Other Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>6070E, 6060E, 6045E</td>
<td>-75 dB</td>
<td>-90 dB</td>
</tr>
<tr>
<td>6021E</td>
<td>-90 dB</td>
<td>-90 dB</td>
</tr>
</tbody>
</table>
## E Series Multifunction DAQ Specifications

### Analog Output

#### Output Characteristics

<table>
<thead>
<tr>
<th>Device</th>
<th>Resolution</th>
<th>Type of DAC</th>
<th>Maximum update rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE, 6060E, 6061E, 6040E</td>
<td>12 bits, 1 in 4,096</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
<tr>
<td>6023E, 6024E, 6025E</td>
<td>None</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
<tr>
<td>6041E, 6023E</td>
<td>None</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
<tr>
<td>6020E</td>
<td>None</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
<tr>
<td>6021E</td>
<td>None</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
<tr>
<td>6040E</td>
<td>None</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
<tr>
<td>6024E, 6025E</td>
<td>None</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
<tr>
<td>607xE, 6060E, 6061E</td>
<td>None</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
<tr>
<td>6025E</td>
<td>None</td>
<td>Double buffered, multiplying</td>
<td></td>
</tr>
</tbody>
</table>

#### Waveform Generation

<table>
<thead>
<tr>
<th>Device</th>
<th>FIFO Mode</th>
<th>Non-FIFO Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE</td>
<td>Internally Timed</td>
<td>Externally Timed</td>
</tr>
<tr>
<td>6060E, 6061E, 6040E</td>
<td>1 MHz/s</td>
<td>800 k/s, system dependent</td>
</tr>
<tr>
<td>6023E, 6024E, 6025E</td>
<td>850 k/s</td>
<td>800 k/s, system dependent</td>
</tr>
<tr>
<td>DAQCard-6024E</td>
<td>N/A</td>
<td>10 k/s with DMA</td>
</tr>
<tr>
<td>6023E, except DAQPad-6024E</td>
<td>N/A</td>
<td>1 k/s with interrupts</td>
</tr>
<tr>
<td>DAQPad-6024E</td>
<td>N/A</td>
<td>20 S/s, system dependent</td>
</tr>
</tbody>
</table>

#### FIFO buffer size

<table>
<thead>
<tr>
<th>Device</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE, 6060E</td>
<td>2,048 samples</td>
</tr>
<tr>
<td>6040E</td>
<td>512 samples</td>
</tr>
<tr>
<td>6020E</td>
<td>None</td>
</tr>
</tbody>
</table>

#### Data transfers

<table>
<thead>
<tr>
<th>Device</th>
<th>PCI, PXI, AT, DAQPad for IEEE 1394</th>
<th>DMA, interrupts, programmed I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE, 6060E, 6061E, 6040E</td>
<td>DAQCard, DAQPad for USB</td>
<td>Interrupts, programmed I/O</td>
</tr>
</tbody>
</table>

#### Transfer Characteristics

<table>
<thead>
<tr>
<th>Device</th>
<th>Relative accuracy</th>
<th>Monotonicity</th>
<th>Voltage Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>6062E, DAQCard-6024E</td>
<td>±0.5 LSB typical, ±1.0 LSB max</td>
<td>±20 mV/°C</td>
<td>±10 V, 0 to 10 V, ±EXTREF, 0 to EXTREF, software selectable</td>
</tr>
<tr>
<td>6062E, DAQCard-6024E</td>
<td>±0.5 LSB typical, ±1.0 LSB max</td>
<td>±20 mV/°C</td>
<td>±10 V, 0 to 10 V, ±EXTREF, 0 to EXTREF, software selectable</td>
</tr>
<tr>
<td>6062E, DAQCard-6024E</td>
<td>±0.5 LSB typical, ±1.0 LSB max</td>
<td>±20 mV/°C</td>
<td>±10 V, 0 to 10 V, ±EXTREF, 0 to EXTREF, software selectable</td>
</tr>
<tr>
<td>6062E, DAQCard-6024E</td>
<td>±0.5 LSB typical, ±1.0 LSB max</td>
<td>±20 mV/°C</td>
<td>±10 V, 0 to 10 V, ±EXTREF, 0 to EXTREF, software selectable</td>
</tr>
</tbody>
</table>

#### Dynamic Characteristics

<table>
<thead>
<tr>
<th>Device</th>
<th>Settling Time for Full-Scale Step</th>
<th>Slew Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE</td>
<td>3 µs to ±0.5 LSB accuracy</td>
<td>20 V/µs</td>
</tr>
<tr>
<td>6060E</td>
<td>10 µs to ±0.5 LSB accuracy</td>
<td>10 V/µs</td>
</tr>
<tr>
<td>6020E</td>
<td>±25 V powered on, ±15 V powered off</td>
<td>200 µV/°C</td>
</tr>
<tr>
<td>6021E</td>
<td>±25 V powered on, ±15 V powered off</td>
<td>200 µV/°C</td>
</tr>
</tbody>
</table>

#### Stability

<table>
<thead>
<tr>
<th>Device</th>
<th>Gain temperature coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE</td>
<td>±25 ppm/°C</td>
</tr>
<tr>
<td>6060E, 6061E</td>
<td>±25 ppm/°C</td>
</tr>
<tr>
<td>6020E</td>
<td>±25 ppm/°C</td>
</tr>
<tr>
<td>6021E</td>
<td>±25 ppm/°C</td>
</tr>
</tbody>
</table>

#### Digital I/O

<table>
<thead>
<tr>
<th>Device</th>
<th>Number of channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>6021E</td>
<td>32 input/output</td>
</tr>
<tr>
<td>6020E</td>
<td>8 input/output</td>
</tr>
</tbody>
</table>
Specifications – 12-Bit E Series (NI 607xE, NI 606xE, NI 604xE, NI 602xE) (continued)

Compatibility ........................................ 5 V/TTL
Power-on state .......................................... Input; high impedance
Digital logic levels
  DI<0..7> on all devices
  PB<0..7>, PC<0..7> on remaining 24 lines of 6021E and 6025E

<table>
<thead>
<tr>
<th>Level</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input low voltage</td>
<td>0 V</td>
<td>0.8 V</td>
</tr>
<tr>
<td>Input high voltage</td>
<td>2 V</td>
<td>5 V</td>
</tr>
<tr>
<td>Output low voltage (Iout = 24 mA)</td>
<td>–</td>
<td>0.4 V</td>
</tr>
<tr>
<td>Output high voltage (Iout = 5 mA)</td>
<td>4.35 V</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input low voltage</td>
<td>0 V</td>
<td>0.8 V</td>
</tr>
<tr>
<td>Input high voltage</td>
<td>2 V</td>
<td>5 V</td>
</tr>
<tr>
<td>Output low voltage (Iout = 2.5 mA)</td>
<td>–</td>
<td>0.4 V</td>
</tr>
<tr>
<td>Output high voltage (Iout = 2.5 mA)</td>
<td>3.9 V</td>
<td>–</td>
</tr>
</tbody>
</table>

Data transfers

<table>
<thead>
<tr>
<th>Device</th>
<th>Internal Source</th>
<th>External Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE</td>
<td>2 MHz</td>
<td>7 MHz</td>
</tr>
<tr>
<td>6060E, 6061E</td>
<td>1 MHz</td>
<td>7 MHz</td>
</tr>
<tr>
<td>6062E</td>
<td>500 kHz</td>
<td>2.5 MHz</td>
</tr>
<tr>
<td>604xE</td>
<td>2 MHz</td>
<td>3 MHz</td>
</tr>
</tbody>
</table>

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

Slope: Positive or negative; software selectable
Resolution: 8 bits, 1 in 256
Bandwidth (-3 dB): Maximum with NI-DAQ, system dependent

Digital Triggers (all devices)

<table>
<thead>
<tr>
<th>Device</th>
<th>Internal Source</th>
<th>External Source</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE</td>
<td>2 MHz</td>
<td>7 MHz</td>
<td>Programmable</td>
</tr>
<tr>
<td>6060E, 6061E</td>
<td>1 MHz</td>
<td>7 MHz</td>
<td>±5% of full-scale range max</td>
</tr>
<tr>
<td>6062E</td>
<td>500 kHz</td>
<td>2.5 MHz</td>
<td>Programmable</td>
</tr>
<tr>
<td>604xE</td>
<td>2 MHz</td>
<td>3 MHz</td>
<td>Programmable</td>
</tr>
</tbody>
</table>

Hysteresis: Programmable
Accuracy: ±5% of full-scale range max

Frequency Scaler

<table>
<thead>
<tr>
<th>Device</th>
<th>Internal Source</th>
<th>External Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>607xE</td>
<td>2 MHz</td>
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<tr>
<td>604xE</td>
<td>2 MHz</td>
<td>3 MHz</td>
</tr>
</tbody>
</table>

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

Slope: Positive or negative; software selectable
Resolution: 8 bits, 1 in 256
Bandwidth (-3 dB): 10 ns minimum

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 and DAQPad
Calibration interval: 1 year
Onboard calibration reference
  DC level: 5.000 V ±3.5 mV
  Temperature coefficient: ±1 ppm/°C
  Long-term stability: ±1 ppm/°C/1000 h
## E Series Multifunction DAQ Specifications

### Specifications – 12-Bit E Series (NI 607xE, NI 606xE, NI 604xE, NI 602xE) (continued)

#### RTSI (PCI, IEEE 1394, and ISA only)
- Trigger lines¹
  - PCI, ISA ............................................... 7
  - DAQPad for IEEE 1394 .......................... 4

#### PXI Trigger Bus (PXI only)
- Trigger lines........................................... 6
- Star trigger .......................................... 1

#### Bus Interface
- PCI, PXI, DAQPad for IEEE 1394................. Master, slave
- AT, DAQCard, DAQPad for USB .................... Slave

#### Power Requirements

<table>
<thead>
<tr>
<th>Device</th>
<th>+5 VDC (±5%)*</th>
<th>Power Available at I/O Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>6070E</td>
<td>1.1 A</td>
<td>+4.65 to +5.25 VDC, 1 A</td>
</tr>
<tr>
<td>6060E, 6061E</td>
<td>1.0 A</td>
<td>+4.65 to +5.25 VDC, 1 A</td>
</tr>
<tr>
<td>6020E</td>
<td>0.7 A</td>
<td>+4.65 to +5.25 VDC, 1 A</td>
</tr>
<tr>
<td>DAQCard-6024E</td>
<td>340 mA typical</td>
<td>+4.65 to +5.25 VDC, 250 mA</td>
</tr>
<tr>
<td>DAQCard-6024E</td>
<td>270 mA typical</td>
<td>+4.65 to +5.25 VDC, 250 mA</td>
</tr>
<tr>
<td>DAQCard-Al-16E-4</td>
<td>280 mA typical</td>
<td>+4.65 to +5.25 VDC, 250 mA</td>
</tr>
</tbody>
</table>

Discharge time with BP-1 battery pack:
- *Excludes power consumed through I/O connector.

**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

### I/O Connector

<table>
<thead>
<tr>
<th>Device</th>
<th>Power Available at I/O Connector</th>
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</thead>
<tbody>
<tr>
<td>6070E</td>
<td>68-pin male 0.050 D-type</td>
</tr>
<tr>
<td>6060E</td>
<td>68-pin female VHDCI</td>
</tr>
<tr>
<td>6040E</td>
<td>100-pin female 0.050 D-type</td>
</tr>
<tr>
<td>6020E</td>
<td>DAQCard-6062E</td>
</tr>
<tr>
<td>6021E</td>
<td>DAQCard-6024E</td>
</tr>
<tr>
<td>6025E</td>
<td>DAQCard-Al-16E-4</td>
</tr>
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**Certifications and Compliances**

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</tr>
</tbody>
</table>

**Device Power Available at I/O Connector**

<table>
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<tr>
<th>Device</th>
<th>Power Available at I/O Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>6070E</td>
<td>15 W +9 to +30 VDC</td>
</tr>
<tr>
<td>6060E</td>
<td>17 W +9 to +25 VDC</td>
</tr>
<tr>
<td>6040E</td>
<td>4.65 to +5.25 VDC, 1 A</td>
</tr>
<tr>
<td>6020E</td>
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<td>280 mA typical</td>
</tr>
</tbody>
</table>

**Discharge time with BP-1 battery pack**

**Physical**

- Dimensions (not including connectors):
  - PCI ........................................... 17.5 by 9.9 cm (6.9 by 3.9 in.)
  - PXI ........................................... 16.0 by 10.0 cm (6.3 by 3.9 in.)

¹Refer to RTSI specifications for available RTSI trigger lines.
²See page 148 for RT Series devices, power requirements and physical parameters.
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:

\[
\text{Absolute Accuracy} = \pm (\text{Input Voltage} \times \% \text{ of Reading}) + (\text{Offset} + \text{Noise} + \text{Quantization} + \text{Drift})
\]

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:

\[
\text{Drift} = \text{Temperature Difference} \times \% \text{ Drift per °C} \times \text{Input Voltage}
\]

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:

\[
\text{Absolute Accuracy} = \pm (10 \times 0.0001) + 397.2 \mu V + 45.8 \mu V = 1.443 mV
\]

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).

\[
\text{Absolute Accuracy} = 1.443 mV + (45 °C - 35 °C) \times 0.000002 / °C \times 10 V = ±1.643 mV
\]

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:

\[
\text{Noise + Quantization for } x \text{ averaged points} = \sqrt[100]{\text{Averaged Noise + Quantization from table}}
\]

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:

\[
\text{Noise + Quantization} = 45.7 \mu V \times \sqrt[1000]{1000} = 14.5 \mu V
\]

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:

\[
\text{Averaged Relative Accuracy} = 60.3 \, \mu V
\]

This means that a measurement taken at time \( t_2 \) would have to be 60.3 \( \mu V \) 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.

<table>
<thead>
<tr>
<th>Nominal Range (V)</th>
<th>% of Reading</th>
<th>Absolute Accuracy</th>
<th>Relative Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 Hrs</td>
<td>90 Days</td>
<td>1 Year</td>
</tr>
<tr>
<td></td>
<td>Offset (µV)</td>
<td>Noise + Quantization (µV)</td>
<td>Temp Drift (%/°C)</td>
</tr>
</tbody>
</table>

| ±10 | 0.0058% | 0.0078% | 0.0100% | 397.2 | 626.4 | 45.8 | 0.0002 | 1.443 | 602.7 | 60.3 |
| ±5  | 0.0228% | 0.0259% | 0.0290% | 200.6 | 263.2 | 22.9 | 0.0007 | 1.474 | 301.4 | 30.1 |
| ±1  | 0.0288% | 0.0259% | 0.0290% | 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  |

The Detailed Specifications page 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.

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