

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

## E Series – Portable

- 16 analog inputs at up to 1.25 MS/s, 12 or 16-bit resolution
- Up to 2 analog outputs at up to 1 MS/s, 12 or 16-bit resolution
- 8 digital I/O lines (TTL/CMOS); two 24-bit counter/timers
- Analog and digital triggering
- 4 analog input signal ranges
- NI-DAQ driver simplifies configuration and measurements

## Models

- NI DAQCard-6036E for PCMCIA<sup>1</sup>
- NI DAQCard-6062E for PCMCIA
- NI DAQCard-6024E for PCMCIA<sup>1</sup>
- NI DAQPad-6052E for FireWire
- NI DAQPad-6070E for FireWire
- NI DAQPad-6020E for USB<sup>1</sup>

## Operating Systems

- Windows 2000/NT/XP
- Others such as Linux and Mac OS X (page 187)

## Recommended Software

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

## Other Compatible Software

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

## Driver Software (included)

- NI-DAQ 7

<sup>1</sup>Digital triggering only

## Calibration Certificate Included

See page 21.



Family	Bus	Analog Inputs	Input Resolution	Max Sampling Rate	Input Range	Analog Outputs	Output Resolution	Output Rate	Output Range	Digital I/O	Counter/Timers	Triggers
DAQCard-6036E	PCMCIA	16 SE/8 DI	16 bits	200 kS/s	±0.05 to ±10 V	2	16 bits	1 kS/s	±10 V	8	2	Digital
DAQCard-6062E	PCMCIA	16 SE/8 DI	12 bits	500 kS/s	±0.05 to ±10 V	2	12 bits	850 kS/s	±10 V	8	2	Analog, digital
DAQCard-6024E	PCMCIA	16 SE/8 DI	12 bits	200 kS/s	±0.05 to ±10 V	2	12 bits	1 kS/s	±10 V	8	2	Digital
DAQPad-6052E	IEEE 1394	16 SE/8 DI	16 bits	333 kS/s	±0.05 to ±10 V	2	16 bits	333 kS/s	±10 V	8	2	Analog, digital
DAQPad-6070E	IEEE 1394	16 SE/8 DI	12 bits	1.25 MS/s	±0.05 to ±10 V	2	12 bits	1 MS/s	±10 V	8	2	Analog, digital
DAQPad-6020E	USB	16 SE/8 DI	12 bits	100 kS/s	±0.05 to ±10 V	2	12 bits	100 kS/s	±10 V	8	2	Digital

Table 1. NI Portable E Series Model Guide (See page 228 for detailed specifications.)

## Overview and Applications

National Instruments portable E Series DAQ products deliver the same functionality available in PCI and PXI E Series DAQ devices – in a portable format. The DAQPad devices are hot swappable and available in up to three different configurations. The 15 cm enclosure is ideal for desktop or portable applications and features a 68-pin shielded connector. The 30 cm enclosure with mass termination offers a low-profile package that fits under your laptop computer. It features a 68-pin shielded connector to connect signals from our SCC modular signal conditioning products or from our CA-1000 custom connectivity enclosure. The 30 cm enclosure with BNC connectivity is ideal for applications where portability and quick connectivity are needed, such as in-vehicle automotive or aircraft testing and portable data logging.

NI DAQCards are Type II, PC Card compliant and provide performance equivalent to their PCI or PXI counterparts. However, due to their compact design, they can be used in applications where space constraints are an important concern, such as field service and research.

## Highly Accurate Hardware Design

NI portable E Series DAQ devices provide the functionality of E Series data acquisition devices in a portable format:

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

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

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

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

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

# Portable E Series Multifunction DAQ

## 12 or 16-Bit, up to 1.25 MS/s, 16 Analog Inputs

Portable E Series Multifunction DAQ

Models		NI 6052E	NI 6070E	DAQCard-6062E	DAQPad-6020E	DAQCard-6036E,	DAQCard-6024E
Measurement Sensitivity* (mV)		0.0025	0.009	0.010	0.006	0.004	0.009
Nominal Range (V)		Absolute Accuracy (mV)					
Positive FS	Negative FS						
10	-10	4.747	14.369	17.945	14.826	8.653	19.012
5	-5	0.876	5.193	6.983	4.671	2.357	6.517
2.5	-2.5	1.190	3.605	4.502	3.719	–	–
1	-1	0.479	1.452	1.813	1.498	–	–
0.5	-0.5	0.243	0.735	0.917	0.757	0.454	0.0972
0.25	-0.25	0.137	0.379	0.474	0.387	–	–
0.1	-0.1	0.064	0.163	0.203	0.165	–	–
0.05	-0.05	0.035	0.091	0.113	0.091	0.067	0.119
10	0	1.232	6.765	8.55	5.721	–	–
5	0	2.119	5.391	6.288	5.619	–	–
2	0	0.850	2.167	2.528	2.258	–	–
1	0	0.428	1.092	1.274	1.137	–	–
0.5	0	0.242	0.558	0.653	0.577	–	–
0.2	0	0.111	0.235	0.274	0.241	–	–
0.1	0	0.059	0.127	0.149	0.129	–	–

Note: Accuracies are valid for measurements following an internal Calibration. Measurement accuracies are listed for operational temperatures within  $\pm 1$  °C of internal calibration temperature and  $\pm 10$  °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  $\pm 10$  V range) after one year, assuming 100 pt averaging of data.\*Smallest detectable voltage change in the input signal at the smallest input range.

Table 2. NI Portable E Series Analog Input Absolute Accuracy Specifications

Models		NI 6052E	NI 6070E	DAQCard-6062E	DAQPad-6020E	DAQCard-6036E,	DAQCard-6024E
Nominal Range (V)		Absolute Accuracy (mV)					
Positive FS	Negative FS						
10	-10	1.405	8.127	10.568	8.133	2.547	10.568
10	0	1.176	5.685	–	5.691	–	–

Table 3. NI Portable E Series Analog Output Absolute Accuracy Specifications

Data Acquisition and Signal Conditioning

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

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

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

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

**Analog and Digital Triggering** – Some portable E Series devices provide the ability to set a trigger based on the level of an analog signal, in addition to the ability to trigger off an edge of a digital signal.

### High-Performance, Easy-to-Use Driver Software

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

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

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

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

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

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

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

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

Portable E Series Multifunction DAQ

## Worldwide Support and Services

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

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

**Calibration** – Includes NIST-traceable basic calibration certificates, services for ANSI/NCSL-Z540 and periodic calibration – [ni.com/calibration](http://ni.com/calibration)

**Extended Warranty** – Meet project life-cycle requirements and maintain optimal performance in a cost-effective way – [ni.com/services](http://ni.com/services)

For more information on NI services and support, please visit [ni.com/services](http://ni.com/services)

Visit [ni.com/oem](http://ni.com/oem) for information on our quantity discounts.

For information on device support in NI-DAQ 7, visit [ni.com/dataacquisition](http://ni.com/dataacquisition)

## Recommended Accessories

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

Sensor/Signals (>10 V)				
System Description	DAQ Device	Signal Conditioning	Page	
High performance	DAQCard-60xxE, DAQPad-60xxE	SCXI	270	
Low-Cost, portable	DAQCard-60xxE, DAQPad-60xxE	SCC	251	

  

Signals (<10 V) <sup>1</sup>				
System Description	DAQ Device	Terminal Block	Cable	Page
Shielded	DAQPad-60xxE	SCB-68	SH6868-EP	214
Shielded	DAQCard-60xxE	SCB-68	SHC6868-EP	214
Low-Cost	DAQPad-60xxE	CB-68LP	R6868	214
Low-Cost	DAQCard-60xxE	CB-68LP	RC6868	214

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

Table 4. Recommended Accessories

Data Acquisition and  
Signal Conditioning

## Ordering Information

NI DAQCard-6036E .....	778561-01
NI DAQCard-6062E .....	777976-01
NI DAQCard-6024E .....	778269-01
NI DAQPad-6052E <sup>1</sup> for FireWire (IEEE 1394) with Mass termination, AC Adapter <sup>2</sup> , and 4 m FireWire cable	
US 120 VAC .....	778535-01
Universal Euro 240 VAC .....	778535-04
United Kingdom 240 VAC .....	778535-06
BNC termination, AC Adapter <sup>2</sup> , and 4 m FireWire cable	
US 120 VAC .....	778536-01
Universal Euro 240 VAC .....	778536-04
United Kingdom 240 VAC .....	778536-06
NI DAQPad-6070E for FireWire <sup>1</sup> (IEEE 1394) with Mass termination, AC Adapter <sup>2</sup> , and 4 m FireWire cable	
US 120 VAC .....	777867-01
Universal Euro 240 VAC .....	777867-04
United Kingdom 240 VAC .....	777867-06
BNC termination, AC Adapter <sup>2</sup> , and 4 m FireWire cable	
US 120 VAC .....	777803-01
Universal Euro 240 VAC .....	777803-04
United Kingdom 240 VAC .....	777803-06
NI DAQPad-6020E for USB <sup>1</sup> in 15 cm enclosure with AC Adapter <sup>2</sup> , and 1 m USB cable	
US 120 VAC .....	777474-01
Universal Euro 240 VAC .....	777474-04
United Kingdom 240 VAC .....	777474-06
Japan 120 VAC .....	777474-07

30 cm enclosure with mass termination, AC Adapter <sup>2</sup> , and 1 m USB cable	
US 120 VAC .....	777704-01
Universal Euro 240 VAC .....	777704-04
United Kingdom 240 VAC .....	777704-06
Japan 120 VAC .....	777704-07
30 cm enclosure with BNC termination AC Adapter <sup>2</sup> , and 1 m USB cable	
US 120 VAC .....	777703-01
Universal Euro 240 VAC .....	777703-04
United Kingdom 240 VAC .....	777703-06
Japan 120 VAC .....	777703-07

Includes NI-DAQ driver software and calibration certificate.

<sup>1</sup>Windows 2000/XP only for DAQCards

<sup>2</sup>The AC Adapter is universal. The difference between these kits is the power cable.

## DAQPad Accessories

BP-1 rechargeable battery pack	
120 VAC charger .....	776896-01
230 VAC charger .....	776896-31
Rack-mount kit .....	777665-01
Stacking kit .....	777666-01
PCI-to-IEEE 1394 adapter .....	Please call
CardBus-to-IEEE 1394 adapter .....	Please call

## BUY ONLINE!

Visit [ni.com/dataacquisition](http://ni.com/dataacquisition)

# Multifunction DAQ Absolute Accuracy Specifications

## Specifications (continued)

Nominal Range (V)	Absolute Accuracy					Relative Accuracy		
	% of Reading		Offset (mV)	Noise + Quantization (mV)		Temp Drift (%/°C)	Resolution (mV)	
	24 Hours	1 Year		Single Point	Averaged		Single Point	Averaged
<b>NI 607xE Analog Input Accuracy – 12-bit, 1.25 MS/s, Up to 64 Analog Inputs</b>								
±10	0.0672	0.0714	6.38	6.10	0.846	0.0010	7.37	1.11
±5.0	0.0272	0.0314	3.20	3.05	0.423	0.0005	3.68	0.557
±2.5	0.0672	0.0714	1.61	1.53	0.211	0.0010	1.84	0.278
±1.0	0.0672	0.0714	0.653	0.610	0.085	0.0010	0.737	0.111
±0.5	0.0672	0.0714	0.335	0.305	0.042	0.0010	0.368	0.056
±0.25	0.0672	0.0714	0.176	0.208	0.024	0.0010	0.238	0.032
±0.1	0.0672	0.0714	0.081	0.098	0.011	0.0010	0.111	0.015
±0.05	0.0672	0.0714	0.049	0.071	0.007	0.0010	0.082	0.009
10 to 0	0.0272	0.0314	3.20	3.05	0.423	0.0005	3.68	0.557
5 to 0	0.0672	0.0714	1.61	1.53	0.211	0.0010	1.84	0.278
2 to 0	0.0672	0.0714	0.653	0.610	0.085	0.0010	0.737	0.111
1 to 0	0.0672	0.0714	0.335	0.305	0.042	0.0010	0.368	0.056
0.5 to 0	0.0672	0.0714	0.176	0.208	0.024	0.0010	0.238	0.032
0.2 to 0	0.0672	0.0714	0.081	0.098	0.011	0.0010	0.111	0.015
0.1 to 0	0.0672	0.0714	0.049	0.071	0.007	0.0010	0.082	0.009
<b>NI 6040 E Analog Input Accuracy – 12-bit, 500 kS/s, 16 Analog Inputs</b>								
±10.0	0.0672	0.0714	7.380	4.640	0.846	0.0010	6.270	1.110
±5.0	0.0272	0.0314	3.700	2.320	0.423	0.0005	3.140	0.557
±2.5	0.0672	0.0714	1.860	1.160	0.211	0.0010	1.570	0.278
±1.0	0.0672	0.0714	0.757	0.464	0.085	0.0010	0.627	0.111
±0.5	0.0672	0.0714	0.389	0.269	0.042	0.0010	0.339	0.056
±0.25	0.0672	0.0714	0.205	0.134	0.021	0.0010	0.169	0.028
±0.1	0.0672	0.0714	0.095	0.076	0.010	0.0010	0.088	0.013
±0.05	0.0672	0.0714	0.058	0.056	0.006	0.0010	0.064	0.008
10 to 0	0.0272	0.0314	3.700	2.320	0.423	0.0005	3.140	0.557
5 to 0	0.0672	0.0714	1.860	1.160	0.211	0.0010	1.570	0.278
2 to 0	0.0672	0.0714	0.757	0.464	0.085	0.0010	0.627	0.111
1 to 0	0.0672	0.0714	0.389	0.269	0.042	0.0010	0.339	0.056
0.5 to 0	0.0672	0.0714	0.205	0.134	0.021	0.0010	0.169	0.028
0.2 to 0	0.0672	0.0714	0.095	0.076	0.010	0.0010	0.088	0.013
0.1 to 0	0.0672	0.0714	0.058	0.056	0.006	0.0010	0.064	0.008
<b>NI PCI-6034, NI PCI-6036 Analog Input Accuracy – 16-bit, 200 kS/s, 16 Analog Inputs</b>								
±10.0	0.0546	0.0588	±1.601	±0.933	±0.082	0.0010	1.0850	0.1085
±5.0	0.0146	0.0188	±0.811	±0.467	±0.041	0.0005	0.5420	0.0522
±0.5	0.0546	0.0588	±0.100	±0.056	±0.005	0.0010	0.0663	0.0066
±0.05	0.0546	0.0588	±0.028	±0.028	±0.002	0.0010	0.0362	0.0036
<b>NI DAQCard-6036E Analog Input Accuracy – 16-bit, 200 kS/s, 16 Analog Inputs</b>								
±10	0.0549	0.0591	2.602	1.500	0.137	0.0010	1.808	0.180
±5	0.0149	0.0191	1.311	0.750	0.068	0.0005	0.904	0.090
±0.5	0.0549	0.0591	0.150	0.084	0.007	0.0010	0.102	0.010
±0.05	0.0549	0.0591	0.033	0.032	0.003	0.0010	0.042	0.004
<b>NI 6023E, PCI-6024E, and NI 6025E Analog Input Accuracy – 12-bit, 200 kS/s, 16 Analog Inputs</b>								
±10.0	0.0872	0.0914	6.380	3.910	0.975	0.0010	5.890	1.280
±5.0	0.0272	0.0314	3.200	1.950	0.488	0.0005	2.950	0.642
±0.5	0.0872	0.0914	0.340	0.195	0.049	0.0010	0.295	0.064
±0.05	0.0872	0.0914	0.054	0.063	0.006	0.0010	0.073	0.008
<b>DAQCard-6024E Analog Input Accuracy – 12-bit, 200 kS/s, 16 Analog Inputs</b>								
±10.0	0.0872	0.0914	8.830	3.910	1.042	0.0010	5.890	1.370
±5.0	0.0272	0.0314	4.420	1.950	0.521	0.0005	2.950	0.686
±0.5	0.0872	0.0914	0.462	0.452	0.052	0.0010	0.516	0.069
±0.05	0.0872	0.0914	0.066	0.063	0.007	0.0010	0.073	0.009
<b>DAQCard-6062E Analog Input Accuracy – 12-bit, 500 kS/s, 16 Analog Inputs</b>								
±10.0	0.0672	0.0714	9.83	6.100	0.975	0.0010	7.370	1.280
±5.0	0.0272	0.0314	4.92	3.050	0.488	0.0005	3.680	0.642
±2.5	0.0672	0.0714	2.47	1.530	0.244	0.0010	1.840	0.321
±1.0	0.0672	0.0714	1.001	0.610	0.098	0.0010	0.737	0.128
±0.5	0.0672	0.0714	0.511	0.305	0.049	0.0010	0.368	0.064
±0.25	0.0672	0.0714	0.266	0.208	0.029	0.0010	0.238	0.039
±0.1	0.0672	0.0714	0.119	0.098	0.012	0.0010	0.111	0.016
±0.05	0.0672	0.0714	0.070	0.071	0.008	0.0010	0.082	0.010
10 to 0	0.0272	0.0314	4.920	3.050	0.488	0.0005	3.68	0.642
5 to 0	0.0672	0.0714	2.470	1.530	0.244	0.0010	1.84	0.321
2 to 0	0.0672	0.0714	1.001	0.610	0.098	0.0010	0.737	0.128
1 to 0	0.0672	0.0714	0.511	0.305	0.049	0.0010	0.368	0.064
0.5 to 0	0.0672	0.0714	0.266	0.208	0.029	0.0010	0.238	0.039
0.2 to 0	0.0672	0.0714	0.119	0.098	0.012	0.0010	0.111	0.016
0.1 to 0	0.0672	0.0714	0.070	0.071	0.008	0.0010	0.082	0.010

Note: Accuracies are valid for measurements following an internal 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.

# 16-Bit E Series Multifunction DAQ Specifications

## Specifications – NI 6052E and NI 603xE

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

### Analog Input

Accuracy specifications ..... See page 228.

### Input Characteristics

	Number of Channels
6052E 6030E 6032E 6034E 6036E	16 single-ended or 8 differential (software selectable per channel)
6031E 6033E	64 single-ended or 32 differential (software-selectable per channel)

Resolution..... 16 bits, 1 in 65,536

	Maximum Sampling Rate
6052E 6034E 6036E	333 kS/s 200 kS/s
6030E 6031E 6032E 6033E	100 kS/s

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	–
		10 V	±5 V	0 to 10 V
5 V		–	0 to 5 V	
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	–	
	10 V	±5 V	–	
	1 V	±500 mV	–	
6036E	10 V	±5 V	–	
	1 V	±500 mV	–	
	100 mV	±50 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 6036E	AI<0..15>, AI SENSE
6031E 6033E	AI<0..63>, AI SENSE, AI SENSE2

FIFO buffer size ..... 512 samples, (1024 samples for DAQCard)

Data transfers

PCI, PXI ..... DMA, interrupts, programmed I/O

DAQCard ..... Interrupts, programmed I/O

DMA modes

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

Configuration memory size ..... 512 words

### Transfer Characteristics

Relative accuracy (dithered)

Device	Typical	Maximum
6052E 6034E PCI-6036E	±1.5 LSB	±3 LSB
6030E 6031E 6032E 6033E	±0.75 LSB	±1 LSB
DAQCard-6036E	±3.0 LSB	±6 LSB

DNL

Device	Typical	Maximum
6052E 603xE (except DAQCard-6036E)	±0.5 LSB	±1 LSB
DAQCard-6036E	±1.0 LSB	+4, -2 LSB

No missing codes

DAQCard 6036E ..... 15 bits, guaranteed

Others ..... 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

Input bias and offset current

Device	Bias Current	Offset Current
6052E 6034E PCI-6036E	±200 pA	±100 pA
6030E 6031E 6032E 6033E	±1 nA	±2 nA
DAQCard-6036E	±800 pA	±100 pA

# 16-Bit E Series Multifunction DAQ Specifications

## Specifications – NI 6052E and NI 603xE (continued)

CMRR, DC to 60 Hz

Device	Range	CMRR	
		Bipolar (dB)	Unipolar (dB)
6052E	20 V	92	–
	10 V	97	97
	5 V	101	101
	2 V	104	104
	100 mV to 1 V	105	105
6030E	20 V	92	–
6031E	10 V	97	92
6032E	5 V	–	97
6033E	4 V	101	–
	2 V	104	101
	1 V	105	104
	100 mV to 500 mV	105	105
6034E	20 V	85	–
6036E	10 V	85	–
	1 V	96	–
	100 mV	96	–

## Dynamic Characteristics

Bandwidth

Device	Range	Small Signal (-3 dB)
6052E	All ranges	480 kHz
6030E, 6031E, 6032E, 6033E	All ranges	255 kHz
6034E, 6036E	All ranges	413 kHz

System noise (LSB<sub>rms</sub>, 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	2.7	2.7
	100 mV	5.0	5.0
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	–
PCI-6036E	1 V	1.0	–
	100 mV	6.2	–
DAQCard-6036E	10 to 20 V	1.5	–

Settling time to full-scale step

Device	Range	Accuracy				
		±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	–	10 µs max	5 µs max	4 µs max	3 µs max
	1 V	–	15 µs max	5 µs max	4 µs max	3 µs max
	200 to 500 mV	–	15 µs max	10 µs max	4 µs max	3 µs max
	100 mV	–	15 µs typical	10 µs typical	4 µs max	3 µs max
6030E	All	40 µs max	20 µs max	–	10 µs max	–
6032E						
6031E	All	50 µs max	25 µs max	–	10 µs max	–
6033E						
6034E	1 to 20 V	–	–	5 µs max	–	–
6036E	100 mV	–	–	–	5 µs typical	–
DAQCard-6036E	10 V	–	–	5 µs max	–	–

Crosstalk

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

## Analog Output

### Output Characteristics

Number of Channels	
6052E	2 voltage outputs
6030E	
6031E	
6036E	
6032E, 6033E, 6034E	None

Resolution	
6052E	16 bits, 1 in 65,536
6036E	
6030E	
6031E	

Maximum Update Rate	
6052E	333 kS/s
PCI-6036E	10 kS/s, system dependent
6030E	100 kS/s
6031E	
DAQCard-6036	1 kS/s, system dependent

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

FIFO Buffer Size	
6052E, 6030E, 6031E	2,048 samples
6036E	None

Data transfers

PCI, PXI ..... DMA, interrupts, programmed I/O  
DAQCard ..... Interrupts, programmed I/O

DMA modes

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

### Transfer Characteristics

Relative Accuracy	
6052E	±0.35 LSB typical, ±1 LSB maximum
6030E	±0.5 LSB typical, ±1 LSB maximum
6031E	
6036E	±2 LSB maximum

DNL..... ±1.0 LSB maximum

Monotonicity	
6052E	16 bits, guaranteed
6036E	
6030E	
6031E	

### 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
6036E	±10 V

Output coupling ..... DC

Output impedance ..... 0.1 Ω maximum

Current drive ..... ±5 mA maximum

Protection ..... Short-circuit to ground

Power-On State	
6052E	0 V (±20 mV)
6030E	
6031E	
PCI-6036E	0 V (±44 mV)
DAQCard-6036E	0 V (±60 mV)

# 16-Bit E Series Multifunction DAQ Specifications

## Specifications – NI 6052E and NI 603xE (continued)

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	10 μs to ±1 LSB accuracy	5 V/μs
6031E		
PCI-6036E	5 μs to ±1 LSB accuracy	15 V/μs
DAQCard-6036E	5 μs to ±4.5 LSB accuracy	5 V/μs

### Noise

6052E	60 μV <sub>rms</sub> , DC to 1 MHz
6030E	
6031E	
PCI-6036E	110 μV <sub>rms</sub> , DC to 400 kHz
DAQCard-6036E	160 μV <sub>rms</sub> , DC to 400 kHz

Glitch energy (at mid-scale transition)

Device	Magnitude	Duration
6052E	±10 mV	1 μs
PCI-6036E	±10 mV	1 μs

### Digital I/O

Number of channels.....	8 input/output
Compatibility.....	5 V/TTL/CMOS
Power-on state.....	Input (high impedance)
Data transfers.....	Programmed I/O
Digital logic levels	

Level	Minimum	Maximum
Input low voltage	0.0 V	0.8 V
Input high voltage	2.0 V	5.0 V
Output low voltage (I <sub>out</sub> = 5 mA)	–	0.4 V
Output high voltage (I <sub>out</sub> = -3.5 mA)	4.35 V	–

### Timing I/O

#### General-Purpose Up/Down Counter/Timers

Number of channels	
Up/down counter/timers.....	2
Frequency Scaler.....	1
Resolution	
Up/down counter/timers.....	24 bits
Frequency Scaler.....	4 bits
Compatibility.....	5 VTTL/CMOS
Digital logic levels	
Base clocks available	
Up/down counter/timers.....	20 MHz and 100 kHz
Frequency Scaler.....	10 MHz and 100 kHz
Base clock accuracy.....	±0.01%
Maximum external source frequency	
Up/down counter/timers.....	20 MHz
External source selections.....	PFI <0..9>, RTSI <0..6>, analog trigger; software selectable
External gate selections.....	PFI <0..9>, RTSI <0..6>, analog trigger; software selectable
Minimum source pulse duration.....	10 ns, edge-detect mode
Minimum gate pulse duration.....	10 ns, edge-detect mode
Data transfers	
PCI/PXI Up/down counter/timer.....	DMA (scatter-gather), interrupts, programmed I/O
DAQCard Up/down counter/timer.....	Interrupts, programmed I/O
Frequency Scaler.....	Programmed I/O

## Triggers

### Analog Triggers

	Number of Triggers
6052E	1
6030E	
6031E	
6032E	
6033E	
6034E	None
6036E	

Purpose

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

### Source

6052E	AI<0..15>, PFI 0/AI START TRIG
6030E	
6032E	
6031E	AI<0..63>, PFI 0/AI START TRIG
6033E	

Level

Internal source, AI<0..15/63>.....	±full-scale
External source, PFI 0/AI START TRIG.....	±10 V

Slope..... Positive or negative; software-selectable

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

Hysteresis..... Programmable

Bandwidth (-3 dB)

Device	Internal Source AI<0..15/63>	External Source PFI 0/AI START TRIG
6052E	700 kHz	700 kHz
PCI-6030E, PCI-6031E, 6032E, 6033E	255 kHz	4 MHz
PXI-6030E, PXI-6031E	255 kHz	255 kHz

Accuracy..... ±1% of full-scale range maximum

### Digital Triggers (all devices)

Purpose

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

Source..... PFI <0..9>, RTSI <0..6>

Compatibility..... 5 VTTL

Response..... Rising or falling edge

Pulse width..... 10 ns minimum

# 16-Bit E Series Multifunction DAQ Specifications

## Specifications – NI 6052E and NI 603xE (continued)

### External Input for Digital or Analog Trigger (PFI 0/AI START TRIG) (6052E, 6033E, 6032E, 6031E, 6030E only)

Impedance.....	10 k $\Omega$
Coupling.....	DC
Protection	
Digital trigger.....	-0.5 to Vcc + 0.5 V
Analog trigger	
On/off/disabled.....	$\pm$ 35 V

### Calibration

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

#### DC Level

Device	DC Level	Notes
6052E, 6030E	5.000 V ( $\pm$ 1.0 mV)	Over full operating temperature, actual value stored in EEPROM
6031E, 6032E, 6033E		
6034E, 6036E	5.000 V ( $\pm$ 3.5 mV)	

#### Temperature Coefficient

Device	Temperature Coefficient
6052E, 6030E, 6031E, 6032E, 6033E	$\pm$ 0.6 ppm/ $^{\circ}$ C max
6034E, 6036E	$\pm$ 5.0 ppm/ $^{\circ}$ C max

#### Long-Term Stability

Device	Long-Term Stability
6052E, 6030E, 6031E, 6032E, 6033E	$\pm$ 6.0 ppm/ $\sqrt{1000}$ h
6034E, 6036E	$\pm$ 15.0 ppm/ $\sqrt{1000}$ h

### RTSI

Trigger lines	
PCI.....	7
DAQPad.....	4

### PXI Trigger Bus (PXI only)

Trigger lines.....	6
Star trigger.....	1

### Bus Interface

PCI, PXI.....	Master, slave
DAQCard.....	Slave
DAQPad.....	Master, slave, asynchronous, 400 Mb/s

### Power Requirements<sup>1</sup>

Device	+5 VDC ( $\pm$ 5%)	Power Available at I/O Connector
PCI-6052E, PXI-6052E	1.3 A	+4.65 to +5.25 VDC, 1 A
6030E, 6031E, 6032E, 6033E	1.5 A	+4.65 to +5.25 VDC, 1 A
6034E, PCI-6036E	0.9 A	+4.65 to +5.25 VDC, 1 A
DAQCard-6036E	300 mA	+4.65 to +5.25 VDC, 0.75 A

DAQPad-6052E..... 20W @ 9-24 VDC

### Physical<sup>1</sup>

#### Dimensions (not including connectors)<sup>1</sup>

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.)
DAQCard.....	Type II PC Card
DAQPad.....	30.7 by 25.4 by 4.3 cm (12.1 by 10 by 1.7 in.)

#### I/O Connectors

Device	I/O Connectors
PCI-6052E, 6030E, 6032E, 6034E, PCI-6036E	68-pin male SCSI-II type
6031E, 6033E	100-pin female 0.050 D-type
DAQCard-6036E	68-position VHDCI female
DAQPad-6052E	68-pin male SCSI-II type, or 15 BNCs and 30 removeable screw terminals

### Environment

Operating temperature	
6052E, 6036E, 6034E.....	0 to 55 $^{\circ}$ C
6030E, 6031E, 6032E, 6033E.....	0 to 50 $^{\circ}$ C
Storage temperature.....	-20 to 70 $^{\circ}$ C
Relative humidity.....	10 to 90%, noncondensing

### Certifications and Compliances

#### CE Mark Compliance

<sup>1</sup>See page 134 for RT Series device power requirements and physical parameters.



# 16-Bit Basic Multifunction DAQ Specifications

## Specifications – PCI-6013, PCI-6014

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

### Analog Input

Accuracy specifications ..... See page 230

#### Input Characteristics

Number of channels ..... 16 single-ended or 8 differential (software selectable per channel)  
 Type of ADC ..... Successive approximation  
 Resolution ..... 16 bits, 1 in 65,536  
 Maximum sampling rate ..... 200 kS/s  
 Input signal ranges .....  
 Input coupling ..... DC  
 Maximum working voltage .....

Range Software Selectable	Bipolar Input Range
20 V	±10 V
10 V	±5 V
1 V	±500 mV
100 mV	±50 mV

(signal + common mode) ..... Each input should remain within ±11 V of ground  
 Overvoltage protection  
 Powered on ..... ±25 V  
 Powered off ..... ±15 V  
 Inputs protected ..... AI<0..15>, AI SENSE  
 FIFO buffer size ..... 512 samples  
 Data transfers  
 PCI ..... DMA, interrupts, programmed I/O  
 DMA modes  
 PCI ..... Scatter-gather (single transfer, demand transfer)  
 Configuration memory size ..... 512 words

### Transfer Characteristics

Relative accuracy (dithered)

Typical	Maximum
±1.5 LSB	±3.0 LSB

DNL

Typical	Maximum
±0.5 LSB	±1.0 LSB

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

### Amplifier Characteristics

Input impedance

Device	Normal Powered On	Powered Off	Overload
6013	100 GΩ in parallel	820 Ω	820 Ω
6014	with 100 pF		

Input bias and offset current

Device	Bias Current	Offset Current
6013	±200 pA	±100 pA
6014		

CMRR, DC to 60 Hz

Device	Range	Bipolar CMRR
6013	10 V, 20 V	85 dB
6014	100 mV, 1 V	96 dB

### Dynamic Characteristics

Small signal (-3 dB) Bandwidth ..... 425 kHz

#### System noise (LSB<sub>rms</sub>, including quantization)

Device	Range	Bipolar (LSB <sub>rms</sub> )
6013, 6014	10 to 20 V	0.9
	1 V	1.1
	100 mV	6.7

Settling time to full-scale step

Device	Range	Accuracy	
		±0.0031% (±2 LSB)	±0.0061% (±4 LSB)
6013, 6014	20 V	–	5 μs typical
	1 V, 10 V	5 μs maximum	–
	100 mV	5 μs typical	–

Crosstalk

Device	Adjacent Channels	All Other Channels
6013, 6014	-75 dB	-90 dB

### Analog Output

#### Output Characteristics

Device	Number of Channels
6014	2 voltage outputs
6013	None

Resolution ..... 16 bits, 1 in 65,536  
 Maximum update rate ..... 10 kS/s, system dependent  
 Type of DAC ..... Double buffered, multiplying  
 FIFO buffer size ..... None  
 Data transfers  
 PCI ..... DMA, interrupts, programmed I/O  
 DMA modes  
 PCI ..... Scatter-gather (single transfer, demand transfer)

#### Transfer Characteristics

Relative accuracy ..... ±3.0 LSB typical  
 DNL ..... ±2.0 LSB typical  
 Monotonicity ..... 15 bits

#### Voltage Output

Range ..... ±10 V  
 Output coupling ..... DC  
 Output impedance ..... 0.1 Ω maximum  
 Current drive ..... ±5 mA maximum  
 Protection ..... Short-circuit to ground  
 Power-on state ..... 0 V ±250 mV

#### Dynamic Characteristics

Settling time and slew rate  
 Noise ..... 360 μV<sub>rms</sub>, DC to 400 kHz  
 Glitch energy (at mid-scale transition)

Settling Time for Full-Scale Step	Slew Rate
8 μs to ±1 LSB accuracy	4 V/μs

### Digital I/O

Number of channels ..... 8 input/output

Magnitude	Duration
±200 mV	2 μs

Compatibility ..... 5 V TTL/CMOS  
 Power-on state ..... Input (high impedance)  
 Data transfers ..... Programmed I/O

# 16-Bit Basic Multifunction DAQ Specifications

## Specifications – PCI-6013, PCI-6014 (continued)

### Digital logic levels

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

### Timing I/O

#### Timing I/O

Number of channels	
Up/down counter/timers .....	2
Frequency scaler .....	1
Resolution	
Up/down counter/timers .....	24 bits
Frequency scaler .....	4 bits
Compatibility .....	5 V TTL/CMOS

### Digital logic levels

Level	Minimum	Maximum
Input low voltage	0.0 V	0.8 V
Input high voltage	2.0 V	5.0 V
Output low voltage ( $I_{out} = 5$ mA)	–	0.4 V
Output high voltage ( $I_{out} = -3.5$ mA)	4.35 V	–

### Base clocks available

Up/down counter/timers .....	20 MHz and 100 kHz
Frequency scaler .....	10 MHz and 100 kHz
Base clock accuracy .....	±0.01%
Maximum external source frequency	
Up/down counter/timers .....	20 MHz
External source selections .....	PFI <0..9>
External gate selections .....	PFI <0..9>
Minimum source pulse duration .....	10 ns, edge-detect mode
Minimum gate pulse duration .....	10 ns, edge-detect mode
Data transfers	
Up/down counter/timer .....	DMA (scatter-gather), interrupts, programmed I/O
Frequency Scaler .....	Programmed I/O

### Triggers

#### Digital Triggers

Purpose	
Input .....	Start and stop trigger, gate, clock
Output .....	Start trigger, gate, clock
General-purpose counter/timers .....	Source, gate
Source .....	PFI <0..9>
Slope .....	Positive or negative; software-selectable
Compatibility .....	5 V TTL
Response .....	Rising or falling edge
Pulse width .....	10 ns minimum

#### External Input for Digital Trigger (PFI0/TRIG1)

Protection	
Digital trigger .....	-0.5 to ( $V_{cc} + 0.5$ ) V

### Calibration

Recommended warm-up time .....	15 minutes
Calibration Interval .....	1 year
Onboard calibration reference	

Device	DC Level	
6013	5.000 V (±3.5 mV)	Over full operating temperature, actual value stored in EEPROM
6014		

#### Temperature Coefficient

6013	±5.0 ppm/°C maximum
6014	

#### Long-Term Stability

6013	±15.0 ppm/ $\sqrt{1000}$ h
6014	

### Bus Interface

PCI .....	Master, slave
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### Power Requirements

Device	+5 VDC (±5%)	Power Available at I/O Connector
6013	0.7 A	+4.65 to +5.25 VDC, 1 A
6014		

### Physical

#### Dimensions (not including connectors)

PCI .....	16.2 by 9.2 cm (6.4 by 3.6 in.)
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Device	I/O Connectors
6013	68-pin male SCSI-II type
6014	

### Environment

Operating temperature .....	0 to 50 °C
Storage temperature .....	-20 to 70 °C
Relative humidity .....	10 to 90%, noncondensing

### Certifications and Compliances

CE Mark Compliance 

