

12-Bit E Series Multifunction DAQ Specifications

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

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

Analog Input

Accuracy specifications See page 228.

Input Characteristics

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

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

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

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

Input coupling..... DC

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

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

Inputs Protected	
6070E	AI <0.15>, AI SENSE
6062E, 6040E	
602xE	
6071E	AI <0.63>, AI SENSE, AI SENSE2

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

Data transfers

PCI, PXI, DAQPad for FireWire DMA, interrupts, programmed I/O
DAQCard, DAQPad for USB Interrupts, programmed I/O

DMA modes

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

Configuration memory size 512 words

Transfer Characteristics

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

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

No missing codes 12 bits, guaranteed

12-Bit E Series Multifunction DAQ Specifications

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

Amplifier Characteristics

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

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

CMRR, DC to 60 Hz		
Device	Range	CMRR (dB)
607xE	20 V	95
	10 V	100
	100 mV to 5 V	106
6040E	10 to 20 V	85
6062E	5 V	95
	100 mV to 2 V	100
6023E	10 to 20 V	85
6024E	100 mV to 1 V	90
6025E		
6020E	100 mV to 20 V	90

Dynamic Characteristics

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

Settling Time to Full-Scale Step

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

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

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

Crosstalk, DC to 100 KHz

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

12-Bit E Series Multifunction DAQ Specifications

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

Analog Output

Output Characteristics

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

Resolution 12 bits, 1 in 4,096

Maximum update rate

Waveform Generation

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

FIFO Buffer Size

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

Data transfers

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

DMA modes

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

Transfer Characteristics

Relative accuracy

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

DNL

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

Monotonicity 12 bits, guaranteed after calibration

Gain error (relative to external reference)

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

Voltage Output

Output coupling DC

Output impedance 0.1 Ω maximum

Ranges

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

Current drive ±5 mA maximum

Protection Short-circuit to ground

Power-on state 0 V (±200 mV)

External Reference Input

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

Dynamic Characteristics

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

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

Glitch Duration (At Mid-Scale Transition)

607xE	1.5 μs
6040E	
6024E	2 μs
6025E	
6020E	3 μs
6062E	

Noise 200 μV_{rms}, DC to 1 MHz

Glitch energy magnitude (at mid-scale transition)

Stability

Gain temperature coefficient (except 6024E, 6025E)

External reference ±25 ppm/°C

12-Bit E Series Multifunction DAQ Specifications

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

Digital I/O

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

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

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

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

Level	Minimum (V)	Maximum (V)
Input low voltage	0	0.8
Input high voltage	2.2	5.0
Output low voltage (I _{out} = 2.5 mA)	–	0.4
Output high voltage (I _{out} = -2.5 mA)	3.7	–

Data Transfers

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

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

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

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

Timing I/O

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

*Except DAQCard and USB DAQPad

Triggers

Analog Triggers

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

Purpose

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

Source All analog input channels, PFI 0/AI START TRIG

Level

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

Slope Positive or negative; software selectable

Resolution 8 bits, 1 in 256

Bandwidth (-3 dB)

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

Hysteresis Programmable

Digital Triggers (All Devices)

Purpose

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

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

Compatibility 5 V/TTL

Response Rising or falling edge

Pulse width 10 ns minimum

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

Impedance

6062E 12 kΩ

607xE, 6040E 10 kΩ

Coupling DC

Protection

Digital trigger -0.5 to V_{cc} + 0.5 V

Calibration

Recommended warm-up time 15 minutes; 30 minutes for DAQCard and DAQPad

Calibration interval 1 year

Onboard calibration reference

DC level 5.000 V (±3.5 mV) over full operating temperature, actual value stored in EEPROM

Temperature coefficient ±5 ppm/°C maximum

Long-term stability ±15 ppm/√1000 h

12-Bit E Series Multifunction DAQ Specifications

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

RTSI Bus (PCI and FireWire only)

Trigger lines ¹	
PCI	7
FireWire (DAQPad)	4

PXI Trigger Bus (PXI only)

Trigger lines	6
Star trigger	1

Bus Interface

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

Power Requirements²

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

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

*Excludes power consumed through I/O connector

Discharge time with BP-1 battery pack

FireWire (DAQPad)	2.5 hours, typical
USB (DAQPad)	3 hours, typical

Physical²

Dimensions (Not Including Connectors)

PCI	17.5 by 10.7 cm (6.9 by 4.2 in.)
PXI	16.0 by 10.0 cm (6.3 by 3.9 in.)

DAQPad (30 cm enclosure).....	25.4 by 30.7 by 4.3 cm (10 by 12.1 by 1.7 in.)
DAQPad (15 cm enclosure).....	14.6 by 21.3 by 3.8 cm (5.8 by 8.4 by 1.5 in.)
DAQCard.....	Type II PC Card

I/O Connector

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

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

¹Refer to RTSI specifications for available RTSI trigger lines. RTSI not available on DAQCards.

²See page 134 for RT Series devices, power requirements and physical parameters.