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Find the *National Instruments PXI-6120* at our website: *Click HERE*

S Series Multifunction DAQ 12 or 16-Bit, 800 kS/s to 10 MS/s, 4 Analog Inputs

S Series

- 2 or 4 analog inputs; dedicated A/D converter per channel
- Analog and digital triggering
- AC or DC coupling
- 8 input ranges from ±200 mV to ±42 V
- 2 analog outputs at 4 MS/s single channel or 2.5 MS/s dual
- 8 digital I/O lines (5 V TTL/CMOS)
- Two 24-bit counter/timers

NI 6115, NI 6120

- Per-channel on/off antialias filters
- 32 or 64 Msample onboard memory
- Hardware timed and digital I/O
- Phase locking for multiboard synchronization (PXI only)

Families

- NI 6120 ***New!***
- NI 6115
- NI 6111
- NI 6110

Operating Systems

- Windows 2000/NT/XP
- Real-Time Performance with LabVIEW (page 134)
- 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

Calibration Certificate Included

See page 21.

NEW



Family	Bus	Analog Inputs	Input Resolution	Sampling Rate	Input Range	Analog Outputs	Max Output Rate	Output Range	Digital I/O	Counter/ Timers	Triggers
NI 6120	PCI, PXI	4	16 bits	800 kS/s	±0.2 to ±42 V	2	4 MS/s[1]	±10 V	8[2]	2, 24-bit	Analog, digital
NI 6115	PCI, PXI	4	12 bits	10 MS/s	±0.2 to ±42 V	2	4 MS/s[1]	±10 V	8[2]	2, 24-bit	Analog, digital
NI 6111	PCI	2	12 bits	5 MS/s	±0.2 to ±42 V	2	4 MS/s[1]	±10 V	8	2, 24-bit	Analog, digital
NI 6110	PCI	4	12 bits	5 MS/s	±0.2 to ±42 V	2	4 MS/s[1]	±10 V	8	2, 24-bit	Analog, digital

[1] 4 MS/s single channel; 2.5 MS/s on two channels [2] Hardware timed and FIFOs

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

Overview and Applications

National Instruments S Series devices combine the latest in PC technologies to deliver simultaneous-sampling, high-bandwidth capabilities for low and high-channel-count data acquisition and control systems. S Series devices are used in a variety of applications including:

- Continuous high-speed data logging at speeds in excess of 8 MS/s
- Stimulus/response applications where synchronization between high-speed analog input (AI), analog output (AO), and digital I/O required
- 42 V automotive applications
- Radar, sonar
- Transient/ballistics measurements
- Highly accurate time/frequency domain measurements – as little as 6 µV of noise, as much as 90 dB spurious-free dynamic range

Features

The NI high-performance S Series DAQ devices have the same basic features of a typical E Series device – 8 digital I/O lines, 2 counter/timers, 2 analog outputs, RTSI or PXI trigger bus for multidevice synchronization, and PFI lines for software-controlled routing of timing and triggering signals. S Series boards are also programmed with the same functions as E Series DAQ devices. S Series devices, however, exceed the analog input performance of traditional multiplexed devices with features including:

Dedicated A/D Converters per Channel – for faster sampling rates per channel, simultaneous sampling, and better dynamic accuracy for transient or frequency measurements

200 mV to 42 V Input Ranges – configure each analog input channel to read from a very wide variety of voltage ranges. The input impedance is lower for 20 and 42 V ranges, preserving the bandwidth for signals with high frequencies and large amplitudes.

AC or DC Coupling – analog inputs can be configured for AC or DC coupling on a per-channel basis. AC coupling removes the DC offset for applications only analyzing signals in the frequency domain.

Antialias Filters (NI 6115 and NI 6120) – the antialias filters are turned on from software on a per-channel basis. NI 6115 devices have 50 or 500 kHz filters for each channel, and NI 6120 devices have 100 kHz filters for each channel.

Large Onboard Memory (NI 6115 and NI 6120) – NI 6120 devices feature a 64 Msample onboard memory and NI 6115 devices feature a 64 or 32 Msample onboard memory. With the extra memory, which requires no extra programming, you can capture high-bandwidth signals over long periods of time, even if multiple devices are sharing the same PCI or PXI bus.

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S Series Multifunction DAQ 12 or 16-Bit, 800 kS/s to 10 MS/s, 4 Analog Inputs

		High-Performance S Series		
Models		NI 6120	NI 6115	NI 6110, NI 6111
Measurement Sensitivity* (mV)		0.0023	0.051	0.046
Nominal Range (V)				
Positive FS	**Negative FS**	**Absolute Accuracy (mV)**		
42	-42	101.5	211	293.56
20	-20	33	69.4	123.42
10	-10	5.28	10.22	17.51
5	-5	2.66	4.61	6.36
2	-2	1.07	2.26	2.63
1	-1	0.55	1.23	1.38
0.5	-0.5	0.3	0.71	0.76
0.2	-0.2	0.14	0.39	0.36

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

Table 2. S Series Analog Input Absolute Accuracy Specifications

		High-Performance S Series		
Models		NI 6120	NI 6115	NI 6110, NI 6111
Nominal Range (V)				
Positive FS	**Negative FS**	**Absolute Accuracy (mV)**		
10	-10	0.305	4.88	8.133

Table 3. S Series Analog Output Absolute Accuracy Specifications

Hardware-Timed Digital I/O – the digital I/O lines can synchronize with the analog input, analog output, counter/timer I/O, or an external clock for mixed signal measurement applications. Using the onboard FIFO, you can achieve reliable data transfers to 10 MBytes/s.

Phase Locking (PXI only) – multiple devices can be synchronized to a common PXI backplane clock to preserve the phase between measurements across multiple device analog input channels.

Worldwide Support and Services

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

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

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

Calibration – includes NIST-traceable basic calibration certificates, services for ANSI/NCSL-Z540 and periodic calibration – ***ni.com/calibration***

Extended Warranty – meet project life-cycle requirements and maintain optimal performance in a cost-effective way – ***ni.com/services***

Data Acquisition Training – instructor-led courses – ***ni.com/training***

Professional Services – feasibility, consulting, and integration through our Alliance Program members – ***ni.com/alliance***

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

Ordering Information

NI PCI-6120 (64 Msample buffer) 778397-01
NI PXI-6120 (64 Msample buffer) 778396-01
NI PCI-6115 with
  32 Msample buffer 778534-01
  64 Msample buffer 778554-01
NI PXI-6115 with
  32 Msample buffer 778194-01
  64 Msample buffer 778204-01
NI PCI-6110 777475-01
NI PCI-6111 777530-01

Includes NI-DAQ driver software and calibration certificate

Recommended Configurations

DAQ Device	Accessory	Cable
PCI-6120	BNC-2110 (777643-01)	SH68-68-EP (184749-01)
PXI-6120	TB-2705 (778241-01)	–
PCI-6115	BNC-2110 (777643-01)	SH68-68-EP (184749-01)
PXI-6115	TB-2705 (778241-01)	–
PCI-6110	BNC-2110 (777643-01)	SH68-68-EP (184749-01)
PCI-6111	BNC-2110 (777643-01)	SH68-68-EP (184749-01)

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Multifunction DAQ Overview

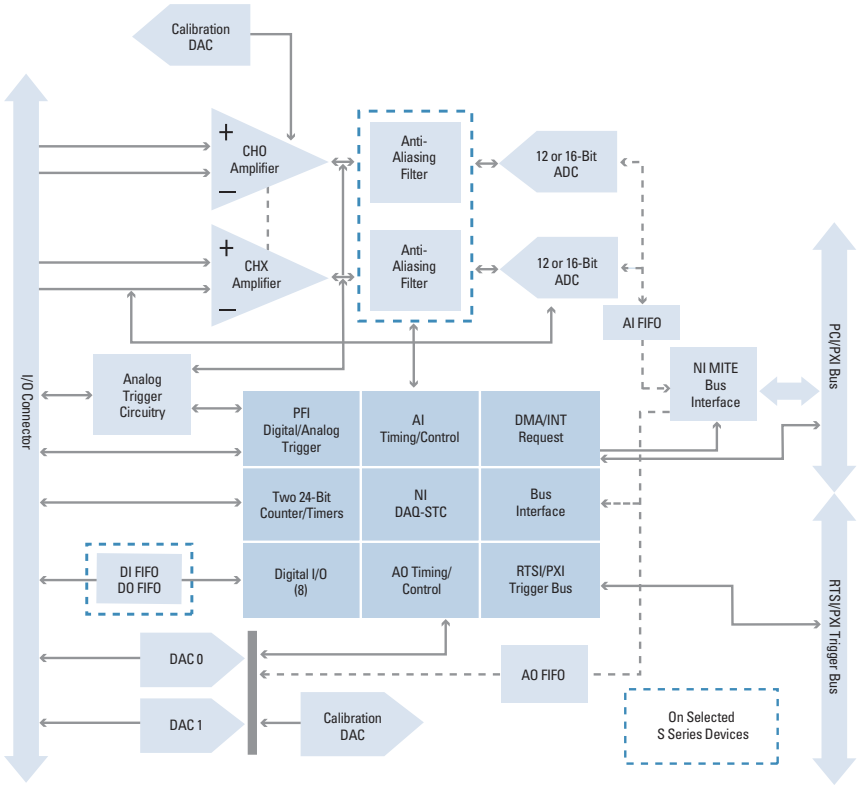


Figure 1. S Series Hardware Block Diagram

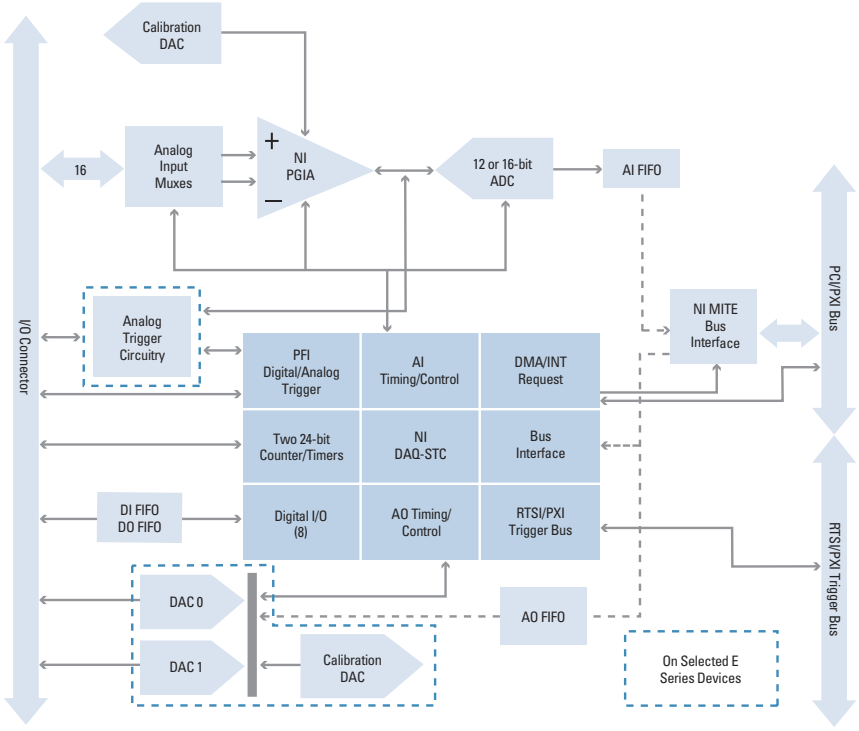


Figure 2. E Series Hardware Block Diagram

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S Series Multifunction DAQ Specifications

Specifications – NI 61xx

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

Analog Input

Accuracy specifications – See tables, page 228

Input Characteristics

Number of channels
- NI 6110, NI 6115, NI 6120 ..... 4 pseudodifferential
- NI 6111 ..... 2 pseudodifferential

ADC resolution
- NI 6110, NI 6111, NI 6115 ..... 12 bits, 1 in 4,096
- NI 6120 ..... 16 bits, 1 in 65,536

ADC pipeline
- NI-6110, NI 6111 3
- NI 6115 4
- NI 6120 0

Maximum sampling rate
- NI 6110, NI 6111 ..... 5 MS/s
- NI 6115 ..... 10 MS/s
- NI 6120 ..... 800 kS/s

Minimum sampling rate
- NI 6110, NI 6111 ..... 1 kS/s
- NI 6115 ..... 20 kS/s
- NI 6120 ..... No minimum.

Input signal ranges
- (selectable by channel)..... ±42, ±20, ±10, ±5, ±2, ±1, ±0.5, ±0.2 V

Input coupling..... AC or DC

Max working voltage for all analog input channels

NI 6110, NI 6111

Input Channels	Range	Maximum Working Voltage (Signal + Common Mode)
ACH <0..3>+	±20 V, ±42 V, others	±42 V ±11 V
ACH <0..3>-	All	±11 V

NI 6115, NI 6120

Input Channels	Range	Maximum Working Voltage (Signal + Common Mode)
ACH <0..3>+	±20 V, ±42 V, others	±42 V ±11 V
ACH <0..3>-	All	±2.5 V

Overvoltage protection
- (ACH+, ACH-) ..... ±42 V

Input FIFO buffer
- NI 6110, NI 6111 ..... 8,192 samples
- NI 6115, NI 6120 ..... 16 Msamples or 32 Msamples

Data transfers ..... DMA (scatter-gather), interrupts, programmed I/O

Transfer Characteristics

INL
- NI 6110, NI 6111 ..... ±0.5 LSB typical, ±1 LSB maximum
- NI 6115 ..... ±0.35 LSB typical, ±1 LSB maximum
- NI 6120 ..... ±2.5 LSB maximum

DNL
- NI 6110, NI 6111 ..... ±0.3 LSB typical, ±0.75 LSB maximum
- NI 6115 ..... ±0.25 LSB typical, ±1 LSB maximum
- NI 6120 ..... ±0.75 LSB typical, No missing codes

Dynamic Characteristics

Interchannel skew..... 1 ns typical (f_{in} = 100 kHz, input range = ±10 V)

NI 6110, NI 6111

Input Range (V)	Bandwidth (MHz)[1]	SFDR (dB)[2]	CMRR (dB)[3]	System Noise (LSB_{rms})[4]
±42	5.5	78	34	0.5
±20	4.4	78	40	0.5
±10	7.2	81	46	0.5
±5	4.8	81	52	0.5
±2	4.8	85	60	0.5
±1	4.4	85	66	0.5
±0.5	4.4	85	70	0.6
±0.2	4.1	81	72	1.0

[1]-3 dB frequency for input amplitude at 96% of the input range (-0.3 dB) [2]Measured at 100 kHz [3]DC to 60 Hz
[4]Not including quantization

NI 6115

Input Range (V)	Bandwidth (MHz)[1]	SFDR (dB)[2] Typ	CMRR (dB)[3]	System Noise (LSB_{rms})[4]
±42	5.5	78	34	0.35
±20	4.4	78	40	0.45
±10	7.2	81	46	0.35
±5	4.8	81	52	0.35
±2	4.8	85	60	0.45
±1	4.4	85	66	0.60
±0.5	4.4	85	70	0.80
±0.2	4.1	81	72	1.30

[1]-3 dB frequency for input amplitude at 96% of the input range (-0.3 dB) [2]Measured at 100 kHz [3]DC to 60 Hz
[4]Not including quantization

NI 6120

Input Range (V)	Bandwidth (MHz)[1]	SFDR (dB)[2] Typ	CMRR (dB)[3]	System Noise (LSB_{rms})[4]
±42	1.0	90	60	1.2
±20	1.0	90	68	1.2
±10	1.0	90	76	1.2
±5	1.0	90	82	1.5
±2	1.0	90	90	1.7
±1	1.0	90	95	2.0
±0.5	1.0	85	100	2.2
±0.2	1.0	80	105	2.8

[1]-3 dB frequency for input amplitude at 96% of the input range (-0.3 dB) [2]Measured at 100 kHz [3]DC to 60 Hz
[4]Including quantization

ENOB
- NI 6110, NI 6111 ..... 11.0 bits, DC to 100 kHz

Crosstalk..... -80 dB, DC to 100 kHz

Analog filter type
- NI 6115 ..... 3-pole Bessel
- NI 6120 ..... 5-pole Bessel

Analog filter frequency
- NI 6115 ..... 50 and 500 kHz
- NI 6120 ..... 100 kHz

Amplifier Characteristics

Input impedance (ACH+ to ACH–)
- NI 6110, NI 6111
  - Normal powered on..... 1 MΩ in parallel with 100 pF
  - Powered off ..... 1 MΩ minimum
  - Overload..... 1 MΩ
- NI 6115, NI 6120
  - Input Range ±20 V, ±42 V ..... 10 kΩ in parallel with 40 pF
  - Input Range (others) ..... 1 MΩ in parallel with 100 pF

Input impedance (ACH– to ACHGND)
- NI 6110, NI 6111, NI 6115 ..... 100 GΩ in parallel with 10 nF
- NI 6120 ..... 100 GΩ in parallel with 100 pF

Input impedance (ACH+ to ACHGND)
- NI 6115, NI 6120 ..... 100 GΩ in parallel with 100 pF

Input bias current ..... ±300 pA

Input offset current ..... ±200 pA

Input current during overvoltage conditions
- NI 6115, NI 6120 ..... ±20 mA maximum

Analog Output

Output Characteristics

Number of channels..... 2 voltage

Resolution
- NI 6110, NI 6111, NI 6120 ..... 16 bits, 1 in 65536
- NI 6115 ..... 12 bits, 1 in 4,096

Max update rate
- 1 channel ..... 4 MS/s
- 2 channel ..... 2.5 MS/s

Output FIFO buffer size
- NI 6110, NI 6111 ..... 2,048 samples
- NI 6115, NI 6120 ..... 16 or 32 Msamples

Data transfers ..... DMA (scatter-gather), interrupts, programmed I/O

Transfer Characteristics

INL
- NI 6110, NI 6111 ..... ±4 LSB typical, ±8 LSB maximum
- NI 6115 ..... ±0.5 LSB typical, ±2 LSB maximum
- NI 6120 ..... ±0.35 LSB typical, ±1 LSB maximum

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S Series Multifunction DAQ Specifications

Specifications – NI 61xx (continued)

DNL
- NI 6110, NI 6111 ..... ±2 LSB typical, ±8 LSB maximum
- NI 6115 ..... ±0.25 LSB typical, ±1 LSB maximum
- NI 6120 ..... ±0.2 LSB typical, ±1 LSB maximum

Voltage Output

Ranges ..... ±10 V
Output coupling ..... DC
Output impedance ..... 50 Ω ±5%
Current drive ..... ±5 mA minimum
Output stability ..... Any passive load
Protection ..... Short-circuit to ground
Power-on output voltage (before software loads calibration values)
- NI 6110, NI 6111, NI 6115 ..... 0 V, ±400 mV
- NI 6120 ..... 0 V, ±80 mV

Dynamic Characteristics

Settling time
- NI 6110, NI 6111, NI 6115 ..... 300 ns to ±0.01%
- NI 6120 ..... 4 µs to ±1 LSB

Slew rate
- NI 6110, NI 6111, NI 6115 ..... 300 V/µs
- NI 6120 ..... 15 V/µs

Noise
- NI 6110, NI 6111 ..... 1 mV_{rms}, DC to 5 MHz
- NI 6115 ..... 600 μV_{rms}, DC to 5 MHz
- NI 6120 ..... 100 μV_{rms}, DC to 1 MHz

Glitch energy at midscale transition
- NI 6110, NI 6111, NI 6115 ..... ±30 mV for 1 µs
- NI 6120 ..... ±10 mV for 1 µs

Digital I/O

Number of channels ..... 8 input/output
Compatibility ..... TTL/CMOS
Power-on state ..... Input (high-impedence)
Data transfers
- NI 6110, NI 6111 ..... Programmed I/O
- NI 6115, NI 6120 ..... DMA (scatter-gather), interrupts, programmed I/O

Transfer rate

Digital Logic Levels

Level	Minimum	Maximum
Input low voltage	0.0 V	0.8 V
Input high voltage	2.0 V	5.0 V
Input low current (V_{in} = 0 V)	–	-320 µA
Input high current (V_{in} = 5 V)	–	10 µA
Output low voltage (I_{OL} = 24 mA)	–	0.4 V
Output high voltage (I_{OH} = -13 mA)	4.35 V	–

- NI 6115, NI 6120 ..... 10 Mbytes/s

Input buffer size
- NI 6115, NI 6120 ..... 2,048 bytes

Output buffer size
- NI 6115, NI 6120 ..... 2,048 bytes

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 ..... TTL/CMOS
Base clocks available
- Up/down counter/timers ..... 20 MHz, 100 kHz
- Frequency scaler ..... 10 MHz, 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 (scatter-gather), interrupts, programmed I/O

Calibration

Recommended warm-up time ..... 15 minutes
Calibration interval ..... 1 year
Onboard calibration reference
- DC level ..... 5.000V (± 2.5 mV); actual value stored in EEPROM
- Temperature coefficient ..... ±2.0 ppm/°C maximum
- Long-term stability ..... ±6 ppm /$\sqrt{1000\ h}$

Triggers

Analog Trigger

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, PFI0/TRIG1
Level
- Internal source, ACH<0..3> ..... ±Full-scale
- External source, PFI0/TRIG1 ..... ±10 V

Slope ..... Positive or negative; software-selectable
Resolution
- NI 6110, NI 6111, NI 6115 ..... 8 bits, 1 in 256
- NI 6120 ..... 12 bits, 1 in 4,096

Hysteresis ..... Programmable
Bandwidth (-3 dB)
- Internal source, ACH<0..3> ..... 5 MHz
- External source, PFI0/TRIG1 ..... 5 MHz

Digital Triggers

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

External Sources ..... 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 (PFI 0/AI START TRIG)

Impedance ..... 10 kΩ
Coupling ..... DC or AC
Protection
- Digital trigger ..... -0.5 to V_{cc} + 0.5 V
- Analog trigger
  - On/off/disabled ..... ±35 V

PXI Trigger Bus (PXI only)

Trigger lines 7

RTSI Bus (PCI only)

Trigger lines 7

Bus Interface

PXI or PCI ..... Master, slave

Power Requirements

Family	+5 VDC (±5%)	+3.3 V
NI 6110	2.5 A	0
NI 6111	2.0 A	0
NI 6115	2.2 A	0.8 A
NI 6120	3.0 A	0.8 A

Power available at I/O connector ..... +4.65 to +5.25 VDC at 1 A

Physical

Dimensions (not including connectors)
- PCI ..... 31.2 by 10.6 cm (12.3 by 4.2 in.)
- PXI ..... 16 by 10 cm (6.3 by 3.9 in.)

I/O connector ..... 68-pin male SCSI-II type

Environment

Operating temperature
- NI 6110, NI 6111 ..... 0 to 45 °C
- NI 6115, NI 6120 ..... 0 to 50 °C

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

Certifications and Compliances

CE Mark Compliance CE

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