

NI 6115/6120 Specifications

Français Deutsch 日本語 한국어 简体中文 ni.com/manuals

This document lists the specifications for the NI 6115/6120. For the most current edition of this document, refer to ni.com/manuals. Refer to the *DAQ Getting Started Guide* for more information about accessing documents on the NI-DAQ media.

The following specifications are typical at 25 °C unless otherwise noted.

Analog Input

Input Characteristics

Number of channels	4 pseudodifferential	AI + to AI GND	
Type of ADC		NI 6115	100 GΩ in parallel with 100 pF
Resolution		NI 6120	100 GΩ in parallel with 100 pF
NI 6115	12 bits, 1 in 4,096		
NI 6120	16 bits, 1 in 65,536		
Pipeline		Input bias current	±300 pA
NI 6115	2	Input offset current	±200 pA
NI 6120	0	Input coupling	DC/AC
Sampling rate		Max working voltage for all analog input channels	
Maximum		Positive input (AI +)	±42 V for ±20 V and ±42 V ranges; ±11 V for other ranges
NI 6115	10 million S/s	Negative input (AI -)	±2.5 V
NI 6120	800 kS/s	Overvoltage protection	
Minimum		(AI +, AI -)	±42 V
NI 6115	20 kS/s	Input current during	
NI 6120	No minimum	overvoltage conditions	±20 mA max
Input impedance		Input FIFO size	16 or 32 MS
AI + to AI -		Data transfers	DMA, interrupts, programmed I/O
Range ≤ ±10 V	1 MΩ in parallel with 100 pF	DMA mode	Scatter-gather
Range > ±10 V	10 kΩ in parallel with 40 pF		
AI - to AI GND			
NI 6115	100 GΩ in parallel with 10 nF		
NI 6120	100 GΩ in parallel with 100 pF		

DC Transfer Characteristics

INL

NI 6115	±0.35 LSB typ, ±1 LSB max
NI 6120	±2.5 LSB max

DNL

NI 6115	±0.25 LSB typ, ±1 LSB max
NI 6120	0.75 LSB typ, no missing codes

Offset, gain errorRefer to Tables 1 and 2¹

Table 1. NI 6115 Analog Input DC Accuracy Information

Nominal Range at Full Scale (V)	Absolute Accuracy						Relative Accuracy		
	% of Reading		Offset* (mV)	Noise + Quantization (mV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	Resolution (mV)	
	24 Hours	1 Year		Single Point	Averaged			Single Point	Averaged
±42	0.35	0.35	33	42	3.6	0.023	210.0	48	4.8
±20	0.27	0.27	13	17	1.4	0.023	69	19	1.9
±10	0.026	0.028	6.7	8.3	0.72	0.0006	10	10	1.0
±5	0.016	0.018	3.4	4.2	0.36	0.0006	4.7	4.8	0.48
±2	0.036	0.038	1.3	1.8	0.16	0.0006	2.2	2.0	0.20
±1	0.043	0.045	0.68	1.1	0.09	0.0006	1.2	1.2	0.12
±0.5	0.058	0.060	0.35	0.69	0.061	0.0006	0.71	0.80	0.080
±0.2	0.10	0.11	0.15	0.43	0.039	0.0006	0.40	0.51	0.051

* The offset might degrade by 2.25 LSB with filter enabled.

¹ 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.

Table 2. NI 6120 Analog Input DC Accuracy Information

Nominal Range at Full Scale (V)	Absolute Accuracy						Relative Accuracy		
	% of Reading		Offset* (μV)	Noise + Quantization (μV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	Resolution (μV)	
	24 Hours	1 Year		Single Point	Averaged			Single Point	Averaged
±42	0.16	0.16	8,400	6,100	550	0.011	87	7,200	720
±20	0.14	0.14	3,300	2,400	220	0.011	31	2,900	290
±10	0.033	0.034	1,700	1,200	110	0.0006	5.1	1,400	140
±5	0.035	0.037	840	750	69	0.0006	2.7	900	90
±2	0.039	0.041	370	340	31	0.0006	1.2	410	41
±1	0.077	0.079	280	200	18	0.0006	1.1	240	24
±0.5	0.10	0.10	180	110	10	0.0006	0.69	130	13
±0.2	0.12	0.12	93	54	5.1	0.0006	0.34	68	6.8

* The offset might degrade by 8 LSB with filter enabled and by 1 LSB when sampling above 500 kS/s.

Dynamic Characteristics

Analog filters

Number

NI 6115 2
 NI 6120 1

Type

NI 6115 3-pole Bessel
 NI 6120 5-pole Bessel

Frequency

NI 6115 50 kHz and 500 kHz
 (software-enabled)
 NI 6120 100 kHz
 (software-enabled)

Crosstalk -80 dB, DC to 100 kHz

Table 3. NI 6115 Analog Input Dynamic Characteristics

Input Range	Bandwidth* (MHz)	SFDR Typ[†] (dB)	CMRR[‡] (dB)	System Noise** (LSB_{rms})
±42 V	5.5	78	34	0.35
±20 V	4.4	78	40	0.45
±10 V	7.2	81	46	0.35
±5 V	4.8	81	52	0.35
±2 V	4.8	85	60	0.45
±1 V	4.4	85	66	0.60
±500 mV	4.4	85	70	0.80
±200 mV	4.1	81	72	1.3

* -3 dB frequency for input amplitude at 96% of the input range (-0.3 dB)
[†] Measured at 100 kHz with twelfth-order bandpass filter after signal source
[‡] DC to 60 Hz
** LSB_{rms}, not including quantization

Table 4. NI 6120 Analog Input Dynamic Characteristics

Input Range	Bandwidth* (MHz)	SFDR Typ[†] (dB)	CMRR[‡] (dB)	System Noise** (LSB_{rms})
±42 V	1.0	95	60	1.2
±20 V	1.0	96	68	1.2
±10 V	1.0	95	76	1.2
±5 V	1.0	95	82	1.5
±2 V	1.0	96	90	1.7
±1 V	1.0	94	95	2.0
±500 mV	1.0	90	100	2.2
±200 mV	1.0	85	105	2.8

* -3 dB frequency for input amplitude at 10% of the input range (-20 dB)
[†] Measured at 100 kHz with twelfth-order bandpass filter after signal source
[‡] DC to 60 Hz
** LSB_{rms}, not including quantization

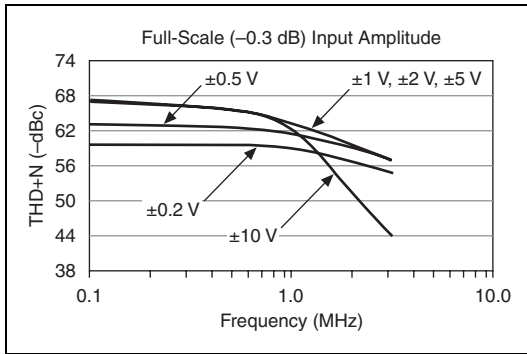


Figure 1. NI 6115 Total Harmonic Distortion Plus Noise (THD+N)

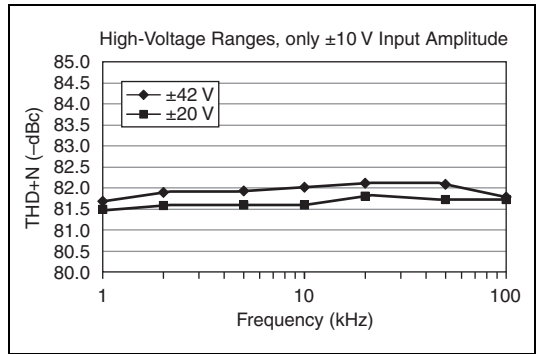


Figure 4. NI 6120 High-Voltage THD+N

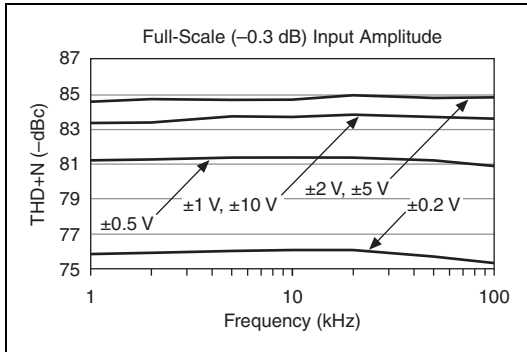


Figure 2. NI 6120 Total Harmonic Distortion Plus Noise (THD+N)

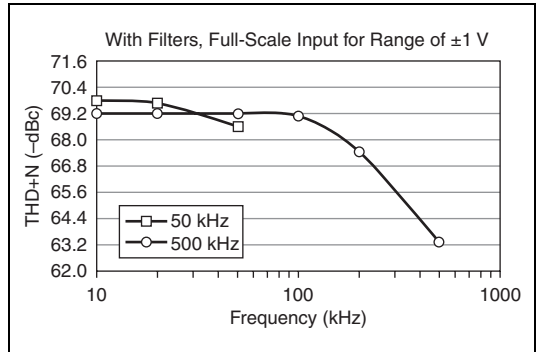


Figure 5. NI 6115 THD+N with Filters

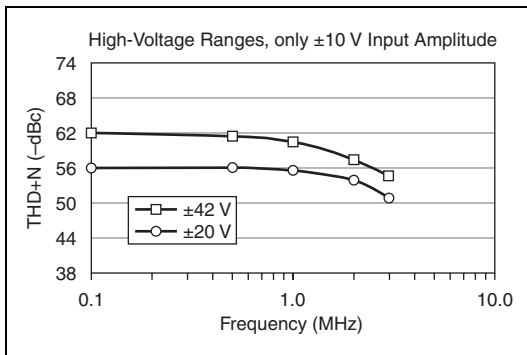


Figure 3. NI 6115 High-Voltage THD+N

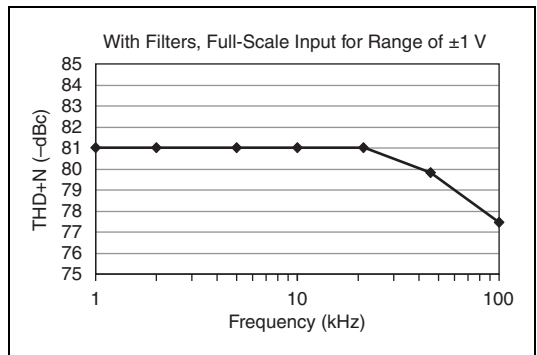


Figure 6. NI 6120 THD+N with Filters

Stability

Recommended warm-up time 15 min

Calibration interval..... 1 year

Offset temperature coefficient

Pregain

NI 6115..... $\pm 12 \mu\text{V}/^\circ\text{C}$

NI 6120..... $\pm 1.5 \mu\text{V}/^\circ\text{C}$

Postgain

NI 6115..... $\pm 64 \mu\text{V}/^\circ\text{C}$

NI 6120..... $\pm 2.1 \text{ LSB}/^\circ\text{C}$

Gain temperature coefficient

NI 6115 $\pm 21.3 \text{ ppm}/^\circ\text{C}$

NI 6120 $\pm 22.2 \text{ ppm}/^\circ\text{C}$

Analog Output

Output Characteristics

Number of channels..... 2 voltage

Resolution

NI 6115 12 bits, 1 in 4,096

NI 6120 16 bits, 1 in 65,536

Max update rate

1 channel 4 MS/s, system dependent*

2 channel 2.5 MS/s, system dependent*

* Update rates above 1 MS/s may degrade the analog output slew rate.

Output buffer size 16 or 32 MS

Data transfers DMA, interrupts, programmed I/O

DMA modes..... Scatter-gather

DC Transfer Characteristics

INL

NI 6115..... $\pm 0.5 \text{ LSB typ,}$
 $\pm 2 \text{ LSB max}$

NI 6120..... $\pm 0.35 \text{ LSB typ,}$
 $\pm 1 \text{ LSB max}$

DNL

NI 6115..... $\pm 0.25 \text{ LSB typ,}$
 $\pm 1 \text{ LSB max}$

NI 6120..... $\pm 0.2 \text{ LSB typ,}$
 $\pm 1 \text{ LSB max}$

Offset, gain error

NI 6115..... Refer to Table 5

NI 6120..... Refer to Table 6

Table 5. NI 6115 Analog Output DC Accuracy Information

Nominal Range at Full Scale (V)	Absolute Accuracy					Relative Accuracy	
	% of Reading			Offset (mV)	Temp Drift ($\%/^\circ\text{C}$)	Absolute Acc. at Full Scale (mV)	Theoretical Resolution (mV)
	24 Hours	90 Days	1 Year				
± 10	0.045	0.047	0.049	8.9	0.0008	14	4.9

Table 6. NI 6120 Analog Output DC Accuracy Information

Nominal Range at Full Scale (V)	Absolute Accuracy					Relative Accuracy	
	% of Reading			Offset (μV)	Temp Drift ($\%/^\circ\text{C}$)	Absolute Acc. at Full Scale (mV)	Theoretical Resolution (μV)
	24 Hours	90 Days	1 Year				
± 10	0.051	0.052	0.053	1,900	0.0006	6.7	310

Voltage Output

Ranges	±10 V
Output coupling	DC
Output impedance	50 Ω ±5%
Current drivability	Any passive load
Protection	Short-circuit to ground
Power-on output voltage (before software loads calibration values)	
NI 6115	±400 μV
NI 6120	±80 μV
Initial power-up glitch	
Magnitude	±2 V
Duration	200 ms

Dynamic Characteristics

Slew rate	
NI 6115	300 V/μs
NI 6120	15 V/μs
Noise	
NI 6115	600 μV _{rms} , DC to 5 MHz
NI 6120	100 μV _{rms} , DC to 1 MHz
Glitch energy at midscale transition	
NI 6115	±30 mV for 1 μs
NI 6120	±10 mV for 1 μs
Settling time	
NI 6115	300 ns to 0.01%
NI 6120	4 μs to ±1 LSB

Stability

Offset temperature coefficient	
NI 6115	±35 μV/°C
NI 6120	±35 μV/°C
Gain temperature coefficient	
NI 6115	±56.9 ppm/°C
NI 6120	±6.5 ppm/°C

Calibration

Level	5.000 V (±2.5 mV) (actual value stored in EEPROM)
Temperature coefficient	±2.0 ppm/°C max
Long-term stability	±6 ppm/√(1,000 h)

Digital I/O

Number of channels	8 input/output
Compatibility	TTL/CMOS

Table 7. Digital Logic Levels

Level	Min	Max
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	—

Power-on state	Input (high-impedance)
Data transfers	DMA, interrupts, programmed I/O
Input buffer	2,048 bytes
Output buffer	2,048 bytes
Transfer rate (1 word = 8 bits)	10 Mwords/s

Timing I/O

Number of channels	2 up/down counter/timers, 1 frequency scaler
Resolution	
Counter/timers	24 bits
Frequency scaler	4 bits
Compatibility	TTL/CMOS
Base clocks available	
Counter/timers	20 MHz, 100 kHz
Frequency scaler	10 MHz, 100 kHz
Base clock accuracy	±0.01%
Max source frequency	20 MHz
Min source pulse duration	10 ns, edge-detect mode
Min gate pulse duration	10 ns, edge-detect mode
Data transfers	DMA, interrupts, programmed I/O
DMA modes	Scatter-gather

Triggers

Analog Trigger

Source	All analog input channels, external trigger (PFI 0/AI START TRIG)
Level	
Internal	± full-scale
External	±10 V
Slope	Positive or negative (software-selectable)
Resolution	
NI 6115	8 bits, 1 in 256
NI 6120	12 bits, 1 in 4,096
Hysteresis	Programmable
Bandwidth (–3 dB)	5 MHz internal/external
External input (PFI 0/AI START TRIG)	
Impedance	10 kΩ
Coupling	AC/DC
Protection	–0.5 V to (V _{CC} + 0.5) V when configured as a digital signal, ±35 V when configured as an analog trigger signal or disabled, ±35 V powered off

Digital Trigger

Compatibility	TTL
Response	Rising or falling edge
Pulse width	10 ns min

RTSI Trigger Lines (PCI Only)

Trigger lines <0..6>	7
RTSI clock	1

PXI Trigger Bus (PXI Only)

Trigger lines <0..6>	7
Star trigger	1

Bus Interface

Type	Master, slave
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Power Requirement

+5 VDC (±5%)	
NI 6115	2.2 A
NI 6120	3.0 A
+3.3 V	0.8 A
Power available at I/O connector....	+4.65 to +5.25 VDC at 1 A

Physical

Dimensions (not including connectors)	
NI PCI-6115/6120	31.2 cm × 10.6 cm (12.3 in. × 4.2 in.)
NI PXI-6115/6120	16 cm × 10 cm (6.3 in. × 3.9 in.)
I/O connector	68-pin male SCSI-II type

Maximum Working Voltage

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Channel-to-earth	42 V, Measurement Category I
Channel-to-channel	42 V, Measurement Category I

Environmental

The NI 6115/6120 is intended for indoor use only.

Operating temperature	0 to 50 °C
Storage temperature	–20 to 70 °C
Humidity	10 to 90% RH, noncondensing
Maximum altitude	2,000 m
Pollution Degree	2

Safety

The NI 6115/6120 is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1



Note For UL and other safety certifications, refer to the product label or the [Online Product Certification](#) section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.



Note For EMC compliance, operate this device with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit ni.com/environment/weee.htm.

电子信息产品污染控制管理办法（中国 RoHS）



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Device Pinout

AI 0 -	34	68	AI 0 +
AI 1 +	33	67	AI 0 GND
AI 1 GND	32	66	AI 1 -
AI 2 -	31	65	AI 2 +
AI 3 +	30	64	AI 2 GND
AI 3 GND	29	63	AI 3 -
NC	28	62	NC
NC	27	61	NC
NC	26	60	NC
NC	25	59	NC
NC	24	58	NC
NC	23	57	NC
AO 0	22	56	NC
AO 1	21	55	AO GND
NC	20	54	AO GND
P0.4	19	53	D GND
D GND	18	52	P0.0
P0.1	17	51	P0.5
P0.6	16	50	D GND
D GND	15	49	P0.2
+5 V	14	48	P0.7
D GND	13	47	P0.3
D GND	12	46	AI HOLD COMP
PFI 0/AI START TRIG	11	45	EXT STROBE*
PFI 1/AI REF TRIG	10	44	D GND
D GND	9	43	PFI 2/AI CONV CLK
+5 V	8	42	PFI 3/CTR 1 SOURCE
D GND	7	41	PFI 4/CTR 1 GATE
PFI 5/AO SAMP CLK*	6	40	CTR 1 OUT
PFI 6/AO START TRIG	5	39	D GND
D GND	4	38	PFI 7/AI SAMP CLK
PFI 9/CTR 0 GATE	3	37	PFI 8/CTR 0 SOURCE
CTR 0 OUT	2	36	D GND
FREQ OUT	1	35	D GND

NC = No Connect

Figure 7. NI 6115/6120 Pinout

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