NI 6115/6120 Specifications

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 CD.

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

Analog Input

Input Characteristics

Number of channels .... 4 pseudodifferential

Type of ADC
  Resolution
    NI 6115 .... 12 bits, 1 in 4,096
    NI 6120 .... 16 bits, 1 in 65,536
  Pipeline
    NI 6115 2
    NI 6120 0

Sampling rate
  Maximum
    NI 6115 .... 10 million S/s
    NI 6120 .... 800 kS/s
  Minimum
    NI 6115 .... 20 kS/s
    NI 6120 .... No minimum

Input impedance
  AI + to AI –
    Range ≤ ±10 V .... 1 MΩ in parallel with 100 pF
    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
  AI + to AI GND
    NI 6115 .... 100 GΩ in parallel with 100 pF
    NI 6120 .... 100 GΩ in parallel with 100 pF

Input bias current .... ±300 pA

Input offset current .... ±200 pA

Input coupling .... DC/AC

Max working voltage for all analog input channels
  Positive input (AI +) .... ±42 V for ±20 V and ±42 V ranges; ±11 V for other ranges
  Negative input (AI –) .... ±2.5 V

Overvoltage protection
(AI +, AI –) .... ±42 V

Input current during
overvoltage conditions .... ±20 mA max

Input FIFO size .... 16 or 32 MS

Data transfers .... DMA, interrupts, programmed I/O

DMA mode .... Scatter-gather

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 error ....Refer to Tables 1 and 2[1]

Table 1. NI 6115 Analog Input DC Accuracy Information

Nominal Range (V)	Absolute Accuracy							Relative Accuracy	
	% of Reading			Noise + Quantization (mV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	Resolution (mV)	
Full Scale	24 Hours	1 Year	Offset* (mV)	Single Pt.	Averaged			Single Pt.	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.									

Table 2. NI 6120 Analog Input DC Accuracy Information

Nominal Range (V)	Absolute Accuracy							Relative Accuracy	
	% of Reading			Noise + Quantization (µV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	Resolution (µV)	
Full Scale	24 Hours	1 Year	Offset* (µV)	Single Pt.	Averaged			Single Pt.	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.									

[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.

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

§ LSBrms, 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

Table 4. NI 6120 Analog Input Dynamic Characteristics (Continued)

Input Range	Bandwidth[*] (MHz)	SFDR Typ[†] (dB)	CMRR[‡] (dB)	System Noise[§] (LSB$_{rms}$)
±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

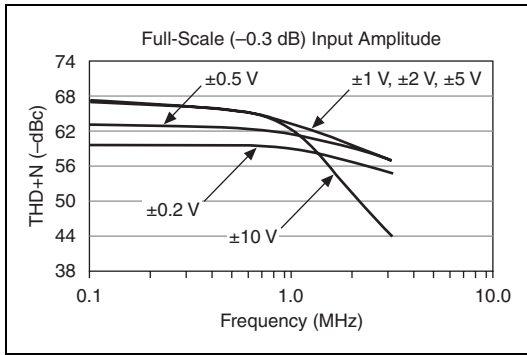[§] LSB$_{rms}$, not including quantization

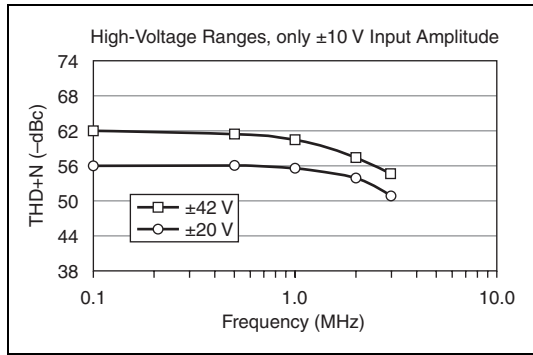**Figure 1.** NI 6115 Total Harmonic Distortion Plus Noise (THD+N)

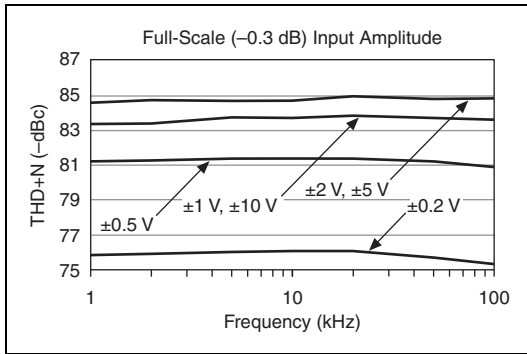**Figure 3.** NI 6115 High-Voltage THD+N

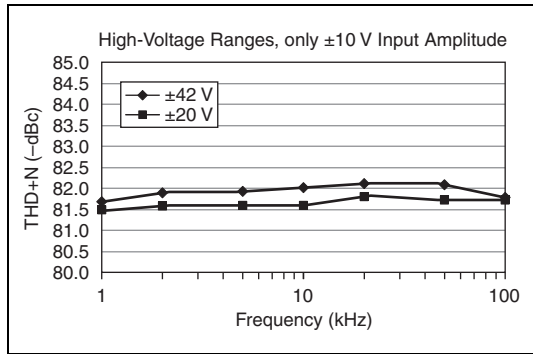**Figure 2.** NI 6120 Total Harmonic Distortion Plus Noise (THD+N)
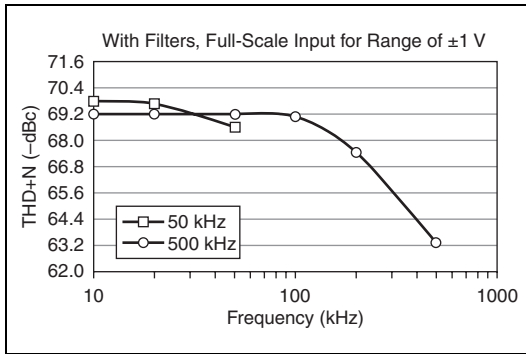

Figure 4. NI 6120 High-Voltage THD+N
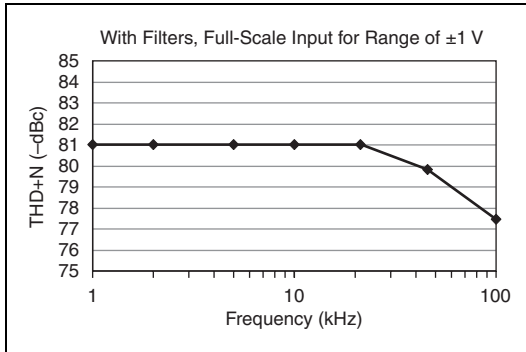
Figure 5. NI 6115 THD+N with Filters

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 .... ±12 µV/°C

NI 6120 .... ±1.5 µV/°C

Postgain

NI 6115 .... ±64 µV/°C

NI 6120 .... ±2.1 LSB/°C

Gain temperature coefficient

NI 6115 .... ±21.3 ppm/°C

NI 6120 .... ±22.2 ppm/°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

Output buffer size .... 16 or 32 MS

Data transfers .... DMA, interrupts, programmed I/O

DMA modes .... Scatter-gather

DC Transfer Characteristics

INL

NI 6115 .... ±0.5 LSB typ, ±2 LSB max

NI 6120 .... ±0.35 LSB typ, ±1 LSB max

DNL

NI 6115 .... ±0.25 LSB typ, ±1 LSB max

NI 6120 .... ±0.2 LSB typ, ±1 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 (%/°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 (%/°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 drive...................................±5 mA min

Output stability ....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/$\sqrt{1,000\ h}$

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

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 visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Electromagnetic Compatibility

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

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

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

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 73/23/EEC; Low-Voltage Directive (safety)
- 89/336/EEC; Electromagnetic Compatibility Directive (EMC)

> **Note** Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain 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.

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`.

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