NI PXI-4461 Specifications

This document lists specifications for the NI PXI-4461 Dynamic Signal Acquisition (DSA) device. These specifications are typical at 25 °C unless otherwise stated. The operating range is 0 °C to 55 °C. All specifications are subject to change without notice. Visit `ni.com/manuals` for the most current specifications and product documentation.

Analog Input

This section lists the NI PXI-4461 analog input specifications.

Input Characteristics

Number of input channels ..... 2, simultaneously sampled

Input configuration ..... Differential or pseudodifferential (50 Ω between negative input and chassis ground), per input channel selectable

Input coupling ..... AC or DC, each channel independently software selectable

ADC Resolution ..... 24 bits

ADC type ..... Delta-sigma

Sample rates (f_s) ..... 1 kS/s to 204.8 kS/s in 181.9 µS/s increments

Oversampling, for sample rate

- 1.0 kS/s ≤ f_s < 51.2 kS/s ..... 128 f_s
- 51.2 kS/s ≤ f_s < 102.4 kS/s ..... 64 f_s
- 102.4 kS/s ≤ f_s ≤ 204.8 kS/s ..... 32 f_s

FIFO buffer size ..... 1,023 samples

Data transfers ..... Direct memory access (DMA)

NATIONAL INSTRUMENTS

Input Common Mode Range

Gain (dB)	Input	Differential[1]	Pseudodifferential[1]
≥0	+	±12 V_{pk}	±12 V_{pk}
	–	±12 V_{pk}	±10 V_{pk}
<0	+	±42.4 V_{pk}	±42.4 V_{pk}
	–	±42.4 V_{pk}	±10 V_{pk}

[1] Voltages with respect to ground

Input Overvoltage Protection

Differential configuration .....±42.4 V_{pk}

Pseudodifferential configuration, positive.....±42.4 V_{pk}

Pseudodifferential configuration, negative (shield) .....±10.0 V_{pk}

Input Signal Range

Gain (dB)	Full Scale Range (V_{pk})[1]
30	±0.316
20	±1.00
10	±3.16
0	±10.0
–10	±31.6
–20	±42.4

[1] Each input channel gain is independently software selectable.

Transfer Characteristics

AI Offset (Residual DC)

Gain (dB)	Maximum Offset[1], 24 Hr, T_{cal}[2] ±5 °C (±mV)	Maximum Offset[1], 0 °C to 55 °C (±mV)
30	0.1	1
20	0.2	2
10	0.5	3
0	0.7	7
–10	5	30
–20	7	70

[1] Source impedance ≤50 Ω
[2] T_{cal} = ambient temperature at which last calibration was performed

AI Gain Amplitude Accuracy

1 kHz input tone

T_{cal} ±5 °C ..... ±0.03 dB max
0 °C to 55 °C ..... ±0.2 dB max

Amplifier Characteristics

Typical Input Impedance

Input Impedance	Differential Configuration	Pseudodifferential Configuration
Between positive input and chassis ground	1 MΩ ‖ 217 pF	1 MΩ ‖ 217 pF
Between negative input and chassis ground	1 MΩ ‖ 229 pF	50 Ω

Common Mode Rejection Ratio (CMRR)

Gain (dB)	Typical CMRR (dBc)[1, 2]
30	105
20	101
10	90
0	80
–20, –10	60

[1] 1 kHz input tone
[2] Differential configuration, DC coupling

Dynamic Characteristics[1]

Alias free
bandwidth (BW) (passband).....DC to 0.4535 f_s

Alias rejection.....120 dBc min

0.5465 f_s < frequency input < 127.4535 f_s,
where 1.0 kS/s ≤ f_s ≤ 51.2 kS/s

0.5465 f_s < frequency input < 63.4535 f_s,
where 51.2 kS/s < f_s ≤ 102.4 kS/s

0.5465 f_s < frequency input < 31.4535 f_s,
where 102.4 kS/s < f_s ≤ 204.8 kS/s

–3 dB BW .....0.491 f_s

ADC filter delay .....63/f_s seconds

AC coupling BW

–3 dB cutoff frequency.....3.4 Hz typical

–0.1 dB cutoff frequency.....22.6 Hz typical

[1] Test system equipped with a liquid crystal display (LCD) monitor for AI noise and distortion measurements to avoid possible magnetic interference caused by cathode ray tube (CRT)-based monitors.

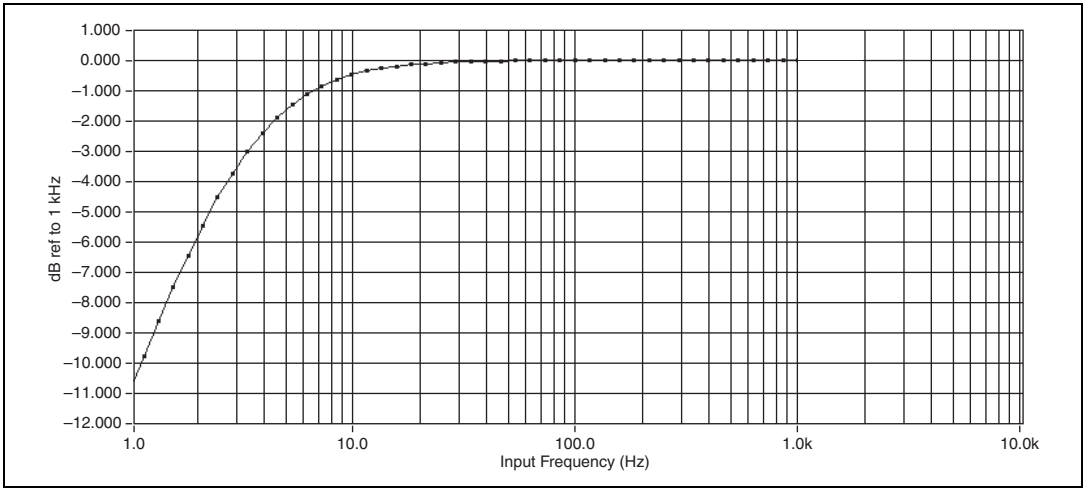

Figure 1. Magnitude Response of AC Coupling Circuit (1 Hz to 1 kHz)

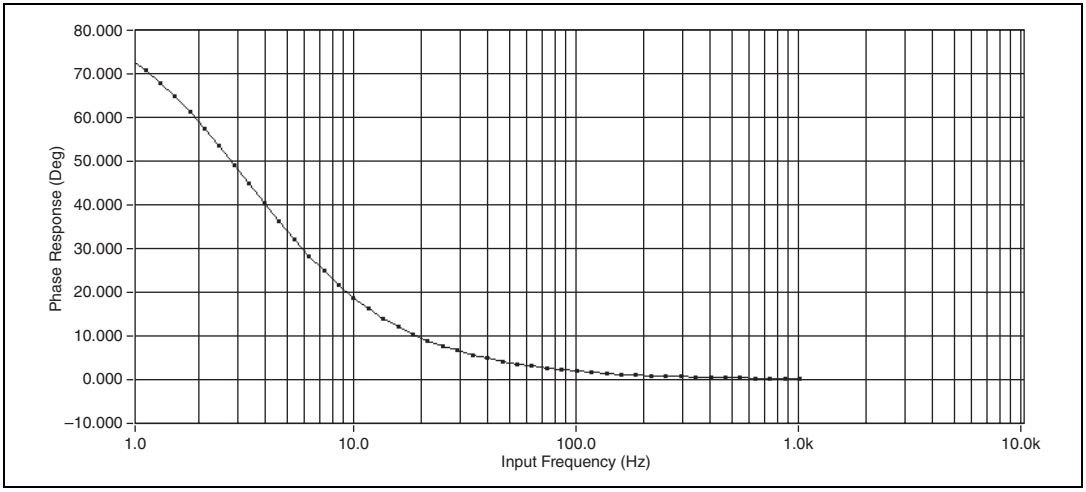

Figure 2. Phase Response of AC Coupling Circuit (1 Hz to 1 kHz)

AI Flatness

Gain (dB)	Flatness[1, 2] (dB), Max (Typical)		
	20 Hz to 20 kHz	20 Hz to 45 kHz	20 Hz to 92.2 kHz
0, 10, 20, 30	±0.006 (±0.003)	±0.03 (±0.02)	±0.1 (±0.08)
–20, –10	±0.2 (±0.1)	±0.6 (±0.33)	±1 (±0.55)

[1] Relative to 1 kHz
[2] DC coupling

AI Spectral Noise Density

AI spectral noise density.....8 nV/$\sqrt{\text{Hz}}$ typical at 30 dB gain, 1 kHz

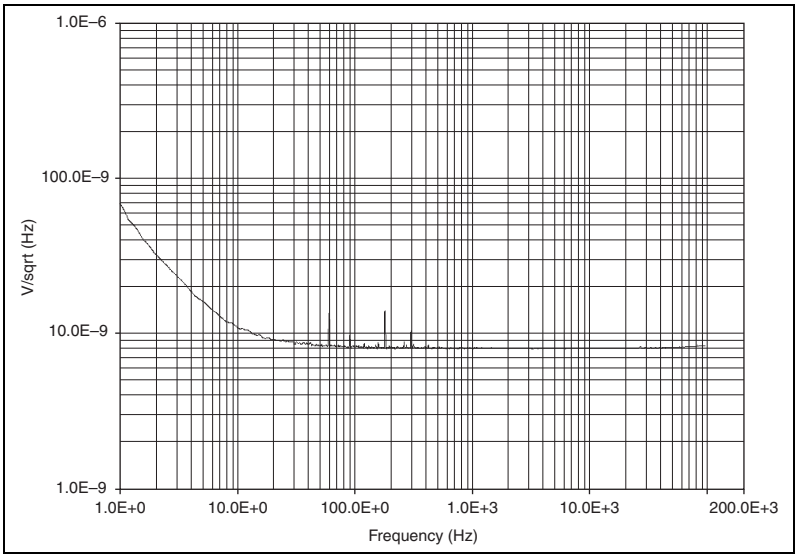

Figure 3. AI Spectral Noise Density (30 dB Gain)

AI Idle Channel Noise

Gain (dB)	Maximum Idle Channel Noise[1]					
	1 kS/s ≤ f_s ≤ 51.2 kS/s		51.2 kS/s < f_s ≤ 102.4 kS/s		102.4 kS/s < f_s ≤ 204.8 kS/s	
	dBV_{rms}	μV_{rms}	dBV_{rms}	μV_{rms}	dBV_{rms}	μV_{rms}
30	–118	1.3	–115	1.8	–111	2.8
20	–115	1.8	–112	2.5	–108	4.0
10	–108	4.0	–105	5.6	–100	10
0	–99	11	–96	16	–91	28
–10	–80	100	–78	126	–75	178
–20	–77	141	–74	200	–70	316

[1] Source impedance ≤50 Ω

AI Spurious Free Dynamic Range (SFDR)

Gain Setting (dB)	SFDR (dBc), Typical[1, 2]
30	106
0, 10, 20	108
–20, –10	110

[1] f_s = 204.8 kS/s
[2] 1 kHz input tone, input amplitude is the lesser of –1 dBFS or 8.91 V_{pk}

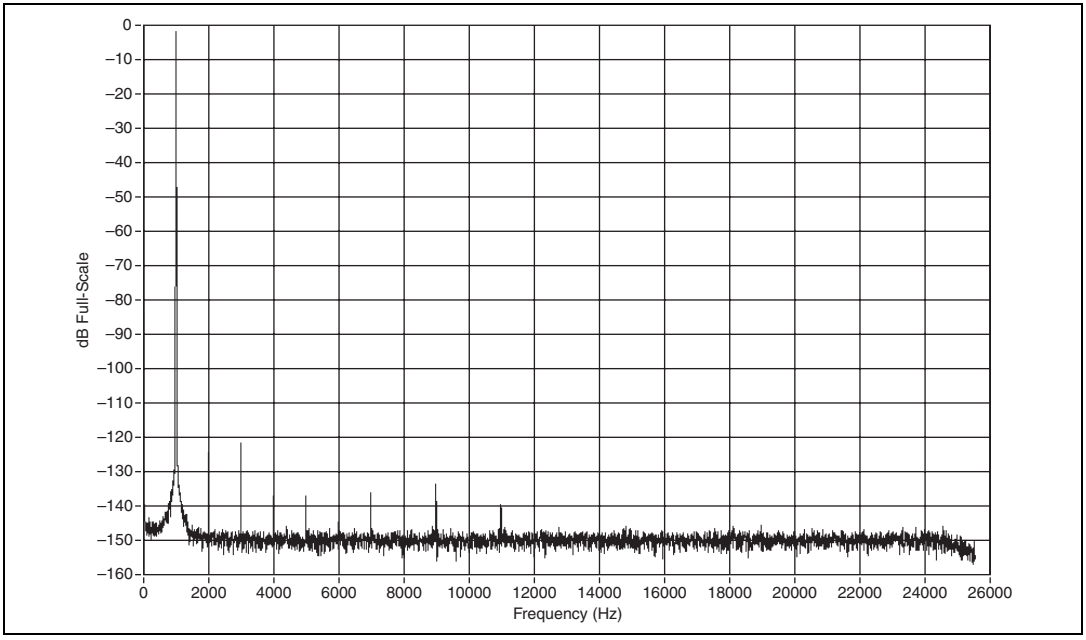

Figure 4. SFDR 51.2 kS/s (–1 dBFS, 0 dB Gain)

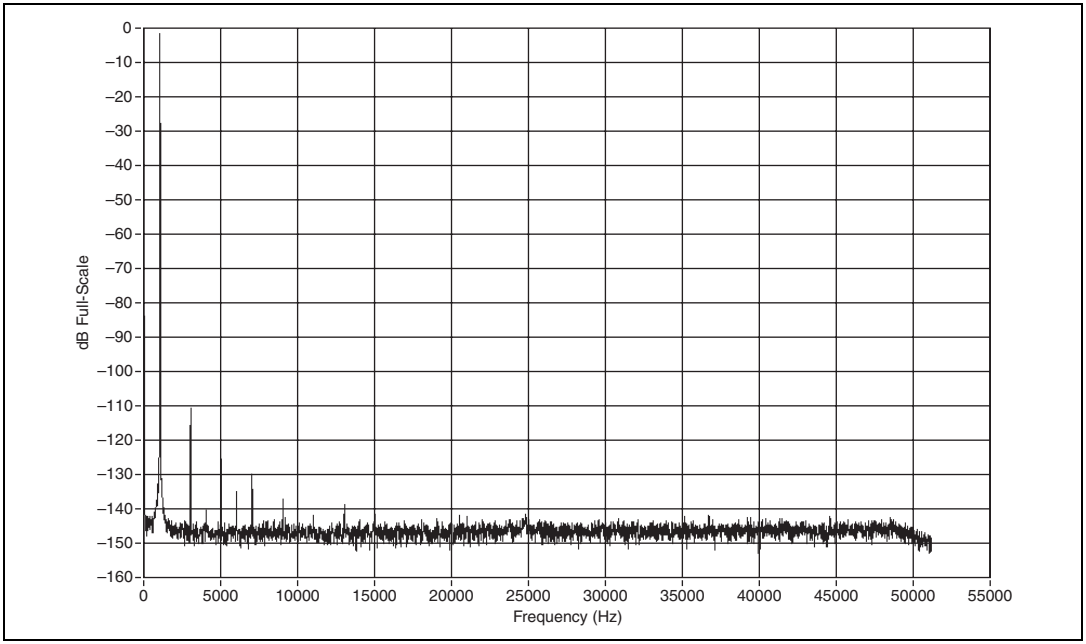

Figure 5. SFDR 102.4 kS/s (–1 dBFS, 0 dB Gain)

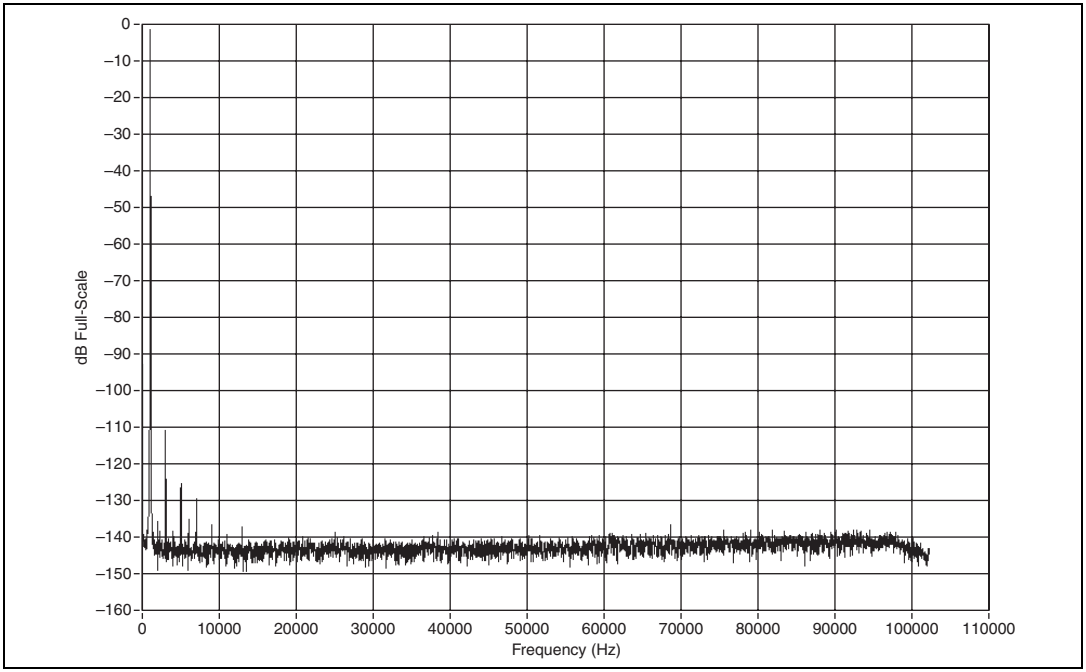

Figure 6. SFDR 204.8 kS/s (–1 dBFS, 0 dB Gain)

AI Dynamic range

Gain Setting (dB)	Dynamic Range (dBFS)[1], Min (Typical)		
	1 kS/s ≤ f_s ≤ 51.2 kS/s	**51.2 kS/s < f_s ≤ 102.4 kS/s**	**102.4 kS/s < f_s ≤ 204.8 kS/s**
30	103 (105)	100 (102)	96 (98)
20	111 (113)	108 (110)	104 (106)
10	114 (117)	111 (114)	106 (110)
0	116 (118)	113 (114)	107 (110)
–10	107 (108)	104 (105)	101 (102)
–20	105 (107)	102 (104)	98 (101)

[1] 1 kHz input tone, –60 dBFS input amplitude

AI Total Harmonic Distortion (THD), Balanced Source

Gain (dB)	Typical THD (dBc)[1, 2]	
	20 Hz to 20 kHz	20 Hz to 92.2 kHz
30	–100	–97
20	–109	–106
0, 10	–107	–104
–10	–108	–107
–20	–107	–106

[1] f_s = 204.8 kS/s, 92.8 kHz BW, differential configuration
[2] Input amplitude is the lesser of –1 dBFS or 8.91 V_{pk}

AI THD, Unbalanced Source

Gain (dB)	Typical THD (dBc)[1, 2]	
	20 Hz to 20 kHz	20 Hz to 92.2 kHz
30	–100	–93
20	–106	–94
10	–105	–92
0	–97	–87
–10	–90	–88
–20	–91	–89

[1] f_s = 204.8 kS/s, 92.8 kHz BW
[2] Input amplitude is the lesser of –1 dBFS or 8.91 V_{pk}

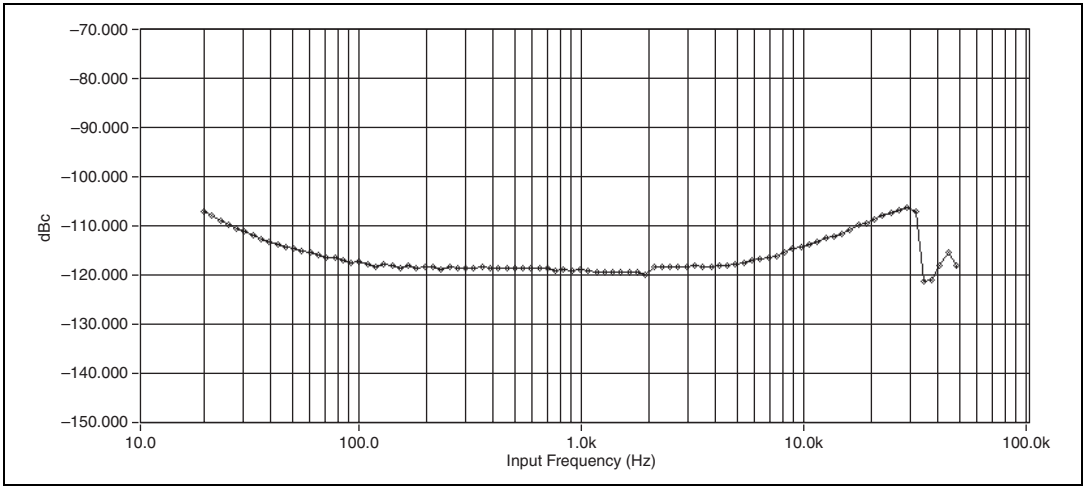

Figure 7. AI THD (Balanced Source with Differential Configuration, 204.8 kS/s, 0 dB Gain)

AI Total Harmonic Distortion Plus Noise (THD+N), Balanced Source

Gain (dB)	Typical THD+N (dBc)[1]	
	51.2 kS/s 20 Hz to 20 kHz[2]	204.8 kS/s 20 Hz to 92.2 kHz[3]
30	–103	–94
20	–107	–95
10	–108	–96
0	–107	–96
–10	–96	–91
–20	–94	–88

[1] Input amplitude is the lesser of –1 dBFS or 8.91 V_{pk}, differential configuration
[2] 23.2 kHz measurement BW
[3] 92.8 kHz measurement BW

AI THD+N, Unbalanced Source

Gain (dB)	Typical THD + N (dBc)[1]	
	51.2 kS/s 20 Hz to 20 kHz[2]	204.8 kS/s 20 Hz to 92.2 kHz[3]
30	–103	–91
20	–107	–93
10	–108	–91
0	–104	–87
–10	–94	–86
–20	–93	–86

[1] Input amplitude is the lesser of –1 dBFS or 8.91 V_{pk}
[2] 23.2 kHz measurement BW
[3] 92.8 kHz measurement BW

AI Intermodulation Distortion (IMD)

Gain (dB)	Typical IMD (dBc)[1]
20, 30	–109
10	–107
0	–104
–20, –10	–111

[1] CCIF 14 kHz + 15 kHz, each tone amplitude is the lesser of –6 dBFS or 5 V_{pk}

Crosstalk (Input Channel Separation)

Gain (dB)	Typical Crosstalk (dBc)[1, 2]	
	1 kHz Signal	92.2 kHz
30	–130	–110
20	–138	–114
10	–135	–114
0	–131	–109
–20, –10	–98	–65

[1] Source impedance ≤50 Ω
[2] Input amplitude is the lesser of –1 dBFS or 8.91 V_{pk}

Crosstalk (Output to Input Channel Separation)

Gain (dB)	Typical Crosstalk (dBc)[1, 2]	
	1 kHz Signal	92.2 kHz
30	–151	–118
20	–150	–118
10	–144	–115
0	–137	–111
–20, –10	–87	–51

[1] Source impedance ≤50 Ω
[2] Output amplitude is the lesser of –1 dBFS or 8.91 V_{pk}

AI Interchannel Gain Mismatch

Gain (dB)	Typical Mismatch (dB)[1]	
	20 Hz to 20 kHz	20 Hz to 92.2 kHz
0, 10, 20, 30	±0.01	±0.01
–20, –10	±0.10	±0.20

[1] Identical channel configurations

AI Interchannel Phase Mismatch

Gain (dB)	Typical Mismatch (deg)[1]	
	20 Hz to 20 kHz	20 kHz to 92.2 kHz
30	±0.10	±0.20
0, 10, 20	±0.10	±0.10
–20, –10	±0.10	±1.50

[1] Identical channel configurations

AI Phase Linearity

Gain (dB)	Typical Linearity (deg)	
	20 Hz to 20 kHz	20 Hz to 92.2 kHz
30	±0.20	±0.60
0, 10, 20	±0.10	±0.60
–10	±0.20	±2.90
–20	±0.20	±3.10

Onboard Calibration Reference

DC level ..... 5.000 V ±2.5 mV

Temperature coefficient ..... ±5 ppm/°C max

Long-term stability ..... ±15 ppm/$\sqrt{1000\ \text{hr}}$

Integrated Electronic Piezoelectric (IEPE)

Current ..... 0 to 20 mA ±5%, 20 µA resolution, each channel independently software selectable

Compliance ..... 24 V min

Channel input impedance with IEPE enabled ..... 1 MΩ ‖ 240 pF typical, pseudodifferential

Current noise ..... <300 pA/$\sqrt{\text{Hz}}$ typical

Analog Output

This section lists the NI PXI-4461 analog output specifications.

Output Characteristics

Number of output channels ..... 2, simultaneously sampled

Output configuration ..... Differential or pseudodifferential (50 Ω to chassis ground on shield), each channel independently software selectable

DAC resolution ..... 24 bits

DAC type ..... Delta-sigma

Update rates (f_s) ..... 1 kS/s to 204.8 kS/s in 181.9 μS/s increments

Oversampling, for update rate

- 1.0 kS/s ≤ f_s < 1.6 kS/s ..... 8192 f_s
- 1.6 kS/s ≤ f_s < 3.2 kS/s ..... 4096 f_s
- 3.2 kS/s ≤ f_s < 6.4 kS/s ..... 2048 f_s
- 6.4 kS/s ≤ f_s < 12.8 kS/s ..... 1024 f_s
- 12.8 kS/s ≤ f_s < 25.6 kS/s ..... 512 f_s
- 25.6 kS/s ≤ f_s < 51.2 kS/s ..... 256 f_s
- 51.2 kS/s ≤ f_s < 102.4 kS/s ..... 128 f_s
- 102.4 kS/s ≤ f_s ≤ 204.8 kS/s ..... 64 f_s

FIFO buffer size ..... 1,023 samples

Data transfers ..... DMA

Output Signal Range

Attenuation (dB)	Full Scale Range (V_{pk})[1]
40	±0.1
20	±1.0
0	±10.0

[1] Each output channel is independently software selectable

Transfer Characteristics

AO Offset (Residual DC)

Attenuation (dB)	Maximum Offset, 24 Hr, T_{cal} ±5 °C (±mV)	Maximum Offset, 0 °C to 55 °C (±mV)
20, 40	1	2
0	1	10

Gain (Amplitude Accuracy)

Specifications valid at any attenuation setting with a 1 kHz output signal.

T_{cal} ±5 °C.....±0.04 dB max

0 °C to 55 °C .....±0.1 dB max

Voltage Output

Output coupling .....DC

Short circuit protection .....Indefinite protection between positive and negative

Minimum working load .....600 Ω

Typical Output Impedance

Output Impedance	Differential Configuration	Pseudodifferential Configuration
Between positive output and chassis ground	2.4 kΩ	70 Ω
Between negative output and chassis ground	2.4 kΩ	50 Ω
Between positive and negative outputs	22 Ω	22 Ω

Dynamic Characteristics[1]

Image rejection ..... 75 dB min < 768 kHz
66 dB min > 768 kHz

–3 dB BW ..... 0.487 f_s

AO Flatness

All attenuation settings relative to 1 kHz

20 Hz to 20 kHz ..... ±0.008 dB max

20 Hz to 92.1 kHz ..... ±0.1 dB max

AO Idle Channel Noise

Attenuation (dB)	Maximum Idle Channel Noise					
	102.5 kS/s (30 kHz BW)		204.8 kS/s (80 kHz BW)		204.8 kS/s (500 kHz BW)	
	dBV_{rms}	μV_{rms}	dBV_{rms}	μV_{rms}	dBV_{rms}	μV_{rms}
40	–106	5	–101	9	–87	45
20	–106	5	–101	9	–86	50
0	–96	16	–93	22	–73	224

AO Spurious Free Dynamic Range (SFDR)

Attenuation (dB)	Typical SFDR (dBc)[1, 2]
40	87
20	94
0	98

[1] f_s = 204.8 kS/s
[2] 1 kHz output frequency, –1 dBFS output amplitude

[1] Test system equipped with a liquid crystal display (LCD) monitor for AI noise and distortion measurements to avoid possible magnetic interference caused by cathode ray tube (CRT)-based monitors.

AO Dynamic Range

Attenuation (dB)	Minimum Dynamic Range (dBFS)[1]		
	102.5 kS/s (30 kHz BW)	204.8 kS/s (80 kHz BW)	204.8 kS/s (500 kHz BW)
40	84	79	65
20	103	97	83
0	114	110	91

[1] 1 kHz output frequency

AO Total Harmonic Distortion (THD)

Attenuation (dB)	Typical THD (dBc)[1]		
	102.5 kS/s 20 Hz to 20 kHz[2]	204.8 kS/s 20 Hz to 20 kHz[3]	204.8 kS/s 20 Hz to 92.1 kHz[3]
40	–99	–92	–92
20	–98	–95	–93
0	–97	–94	–86

[1] –1 dBFS output amplitude
[2] 30 kHz measurement BW
[3] 92.8 kHz measurement BW

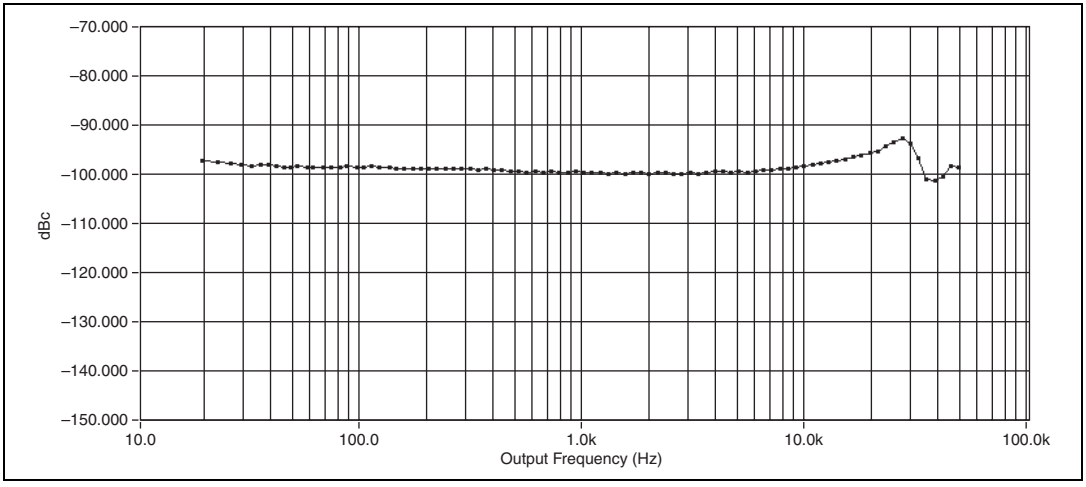

Figure 8. AO THD (204.8 kS/s, 0 dB Gain, 65,536 Samples)

AO Total Harmonic Distortion Plus Noise (THD+N)

Attenuation (dB)	Typical THD + N (dBc)[1]		
	102.5 kS/s 20 Hz to 20 kHz[2]	204.8 kS/s 20 Hz to 80 kHz[3]	204.8 kS/s 20 Hz to 92.1 kHz[4]
40	–83	–77	–63
20	–98	–92	–79
0	–99	–89	–68

[1] –1 dBFS output amplitude
[2] 30 kHz measurement BW
[3] 80 kHz measurement BW
[4] 500 kHz measurement BW

AO Intermodulation Distortion (IMD)

Attenuation (dB)	Typical IMD (dBc)[1]
40	–99
20	–104
0	–104

[1] CCIF 14 kHz + 15 kHz, each tone amplitude is –6 dBFS

Crosstalk (Output Channel Separation)

No measurable crosstalk

AO Interchannel Gain Mismatch

All attenuation settings

20 Hz to 92.1 kHz ..... ±0.01 dB

AO Interchannel Phase Mismatch

All attenuation settings

20 Hz to 20 kHz ..... ±0.1° typical

20 Hz to 92.1 kHz ..... ±0.2° typical

AO Phase Linearity

Attenuation (dB)	Typical Linearity (deg)	
	20 Hz to 20 kHz	20 Hz to 92.1 kHz
0	±0.1	±1.7
20	±0.1	±1.6
40	±0.1	±1.8

Internal Frequency Timebase Characteristics

Accuracy .....±20 ppm, 0 °C to 70 °C

Aging .....8 ppm in first year;
18 ppm after 10 years

Triggers

Analog Trigger

- Purpose .....Start trigger
- Source .....AI0 or AI1
- Level .....Full scale, programmable
- Slope .....Positive (rising) or negative (falling), software selectable
- Resolution.....24 bits
- Hysteresis .....Programmable

Digital Trigger

- Purpose .....Start or reference trigger
- Source .....PFI0, PXI_Trig<0..6>
- Compatibility .....Transistor-transistor logic (TTL)
- Polarity .....Rising or falling edge
- Minimum pulse width.....10 ns

General Specifications

This section lists general specification information for the NI PXI-4461.

Bus Interface

Type ..... PXI master/slave

Power Requirements

Voltage	Typical	Max
+5 V	990 mA	1,600 mA
+3.3 V	1,430 mA	1,720 mA
+12 V	170 mA	300 mA
–12 V	110 mA	170 mA

Physical

Dimensions
(not including connectors) ..... 16 cm × 10 cm (6.3 in. × 3.9 in.)
3U CompactPCI slot

Analog I/O connectors ..... BNC female

Digital trigger connector ..... SMB male

Weight ..... 241 g (8.5 oz)

Installation Category I

Environmental

Operating Environment

Ambient temperature range ..... 0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

Relative humidity range ..... 10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Altitude .....2,000 m (at 25 °C ambient temperature)

Pollution Degree (indoor use only) 2

Storage Environment

Ambient temperature range .....–20 °C to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

Relative humidity range.....5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Shock and Vibration

Operational shock .....30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)

Random vibration

Operating .....5 Hz to 500 Hz, 0.3 g_{rms}

Nonoperating .....5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Calibration

Self-calibration .....On software command, the device computes gain and offset corrections relative to high-precision internal reference.

Interval.....Recommended whenever ambient temperature differs from T_{cal} by more than ±5 °C

External calibration interval .....1 year

Warm-up time.....15 min

Safety

The NI PXI-4461 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
- CAN/CSA C22.2 No. 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

Emissions.....EN 55011 Class A at 10 m
FCC Part 15A above 1 GHz

Immunity .....EN 61326:1997 + A2:2001, Table 1

CE, C-Tick, and FCC Part 15 (Class A) Compliant

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

CE Compliance

The NI PXI-4461 meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety).....73/23/EEC

Electromagnetic Compatibility
Directive (EMC).....89/336/EEC

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.

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