

DEVICE SPECIFICATIONS

NI PXIe-4463

DSA Analog Output

Français	Deutsch	日本語	한국어	简体中文
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This document lists specifications for the NI PXIe-4463 Dynamic Signal Acquisition (DSA) analog output module. All specifications are subject to change without notice. Visit ni.com/manuals for the most current specifications and product documentation.

Terminology

Maximum and minimum specifications characterize the warranted performance of the instrument within the recommended calibration interval and under the stated operating conditions. These specifications are verified in production or are guaranteed by design.

Typical specifications are specifications met by the majority of the instruments within the recommended calibration interval and under the stated operating conditions, based on measurements taken during production verification and/or engineering development. These specifications are not warranted.

Supplemental specifications describe the basic function and attributes of the instrument established by design and are not subject to production verification. They provide information that is relevant for the adequate use of the instrument that is not included in the previous definitions.

All performance specifications are *typical* unless otherwise noted. These specifications are valid within the full operating temperature range. Accuracy specifications are valid within $\pm 5^\circ\text{C}$ of the self-calibration or over the full operating range as specifically noted.

Output Characteristics

Number of simultaneously sampled output channels.....	2
Output configuration.....	Differential or pseudodifferential (50 Ω between negative output and chassis ground), each channel independently software-selectable
Output coupling	DC

D/A converter (DAC) resolution 24 bits

DAC type Delta-sigma

Sample rates (f_s)

 Range 100 S/s to 51.2 kS/s

 Resolution¹ $\leq 45.5 \mu\text{S/s}$

DAC oversampled rate..... 520.833 kS/s

FIFO buffer size 1,023 samples

Data transfers Direct memory access (DMA), programmed I/O

Signal Range

Attenuation (dB)	Output Voltage Full-Scale Range*, Min	
	V _{pk}	V _{rms} [†]
0	±10.0	7.071
17	±1.4142	1.0
37	±0.14142	0.1

* Each output channel attenuation is independently software-selectable.

† Sine output.

Output Current Drive, Min	
A _{pk}	A _{rms} [*]
± 0.1	0.07071

* Sine output.

Output Impedance

Output Terminals	Output Configuration	
	Differential	Pseudodifferential
Between positive output (+) and chassis ground	2.5 kΩ	87 Ω
Between negative output (-) and chassis ground	2.5 kΩ	50 Ω
Between positive (+) and negative (-) outputs	40 Ω	40 Ω

¹ Depends on the sample rate. Refer to the *NI DAQmx Help* for more information.

Protection

Output Terminals	Short-Circuit Duration	Overvoltage (V_{pk}), Min
Between positive output (+) and chassis ground	Indefinite	± 42.4
Between negative output (-) and chassis ground	Indefinite	± 42.4
Between positive (+) and negative (-) outputs	Indefinite	± 42.4

Transfer Characteristics

Offset (Residual DC)

Attenuation (dB)	Offset (mV), Max, $T_{cal}^* \pm 5^\circ\text{C}$	Offset (mV), Max, Over Full Operating Temperature Range
0	± 0.5	± 5.0
17	± 0.3	± 3.0
37	± 0.2	± 2.0
* T_{cal} = device temperature at which the last self-calibration was performed.		

Gain Amplitude Accuracy

1 kHz output tone

$T_{cal} \pm 5^\circ\text{C}$ ± 0.02 dB max

(T_{cal} = device temperature at which the last self-calibration was performed.)

Over full operating temperature range..... ± 0.1 dB max

Stability

Gain drift..... ± 110 ppm/ $^\circ\text{C}$

Offset drift

0 dB attenuation..... ± 21 $\mu\text{V}/^\circ\text{C}$

17 dB attenuation..... ± 13 $\mu\text{V}/^\circ\text{C}$

37 dB attenuation..... ± 10 $\mu\text{V}/^\circ\text{C}$

Dynamic Characteristics

Passband and Image Rejection

Passband.....	DC to $0.454 f_s$
Image rejection	115 dBc min, $0.546 f_s < f_{\text{image}} < (520.833 \text{ kHz} - 0.546 f_s)$ 75 dBc min, $f_{\text{image}} > (520.833 \text{ kHz} - 0.546 f_s)$

Filter Delay

Output delay ¹ (samples)	
$0.1 \text{ kS/s} \leq f_s \leq 5.0 \text{ kS/s}$	64
$5.0 \text{ kS/s} < f_s \leq 10.0 \text{ kS/s}$	66
$10.0 \text{ kS/s} < f_s \leq 14.0 \text{ kS/s}$	68
$14.0 \text{ kS/s} < f_s \leq 19.0 \text{ kS/s}$	70
$19.0 \text{ kS/s} < f_s \leq 24.0 \text{ kS/s}$	72
$24.0 \text{ kS/s} < f_s \leq 29.0 \text{ kS/s}$	74
$29.0 \text{ kS/s} < f_s \leq 35.0 \text{ kS/s}$	76
$35.0 \text{ kS/s} < f_s \leq 39.0 \text{ kS/s}$	78
$39.0 \text{ kS/s} < f_s \leq 44.0 \text{ kS/s}$	80
$44.0 \text{ kS/s} < f_s \leq 51.2 \text{ kS/s}$	83

Flatness

Output Configuration	$f_s = 51.2 \text{ kS/s}$	
	Flatness (dB) ^{*,†} , Max (Typical)	
	$f_{\text{out}} = 20 \text{ Hz to } 20 \text{ kHz}$	$f_{\text{out}} = 20 \text{ Hz to } 22.4 \text{ kHz}$
Differential	$\pm 0.007 (\pm 0.002)$	$\pm 0.009 (\pm 0.003)$
Pseudodifferential	$\pm 0.008 (\pm 0.003)$	$\pm 0.010 (\pm 0.004)$
* Relative to 1 kHz.		
† All attenuation settings.		

¹ Output delay includes digital filter delay + analog backend delay.

Flatness Performance

Measurement Instrument: HP3458A, AC Voltage, Synchronous Sub-Sampled Mode.
Figures 1 through 4 show the spread of typical flatness performance.

Figure 1. Flatness (0 dB and 37 dB Attenuation, Differential Configuration)

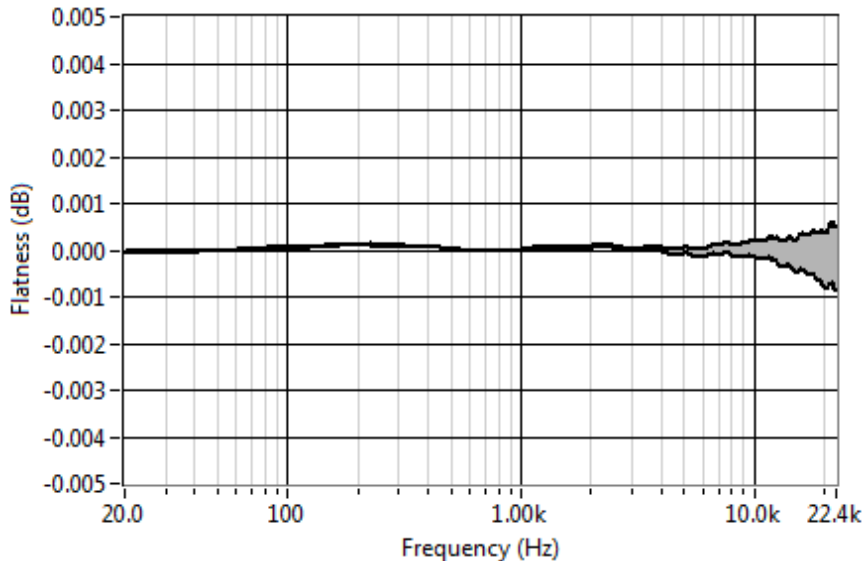


Figure 2. Flatness (17 dB Attenuation, Differential Configuration)

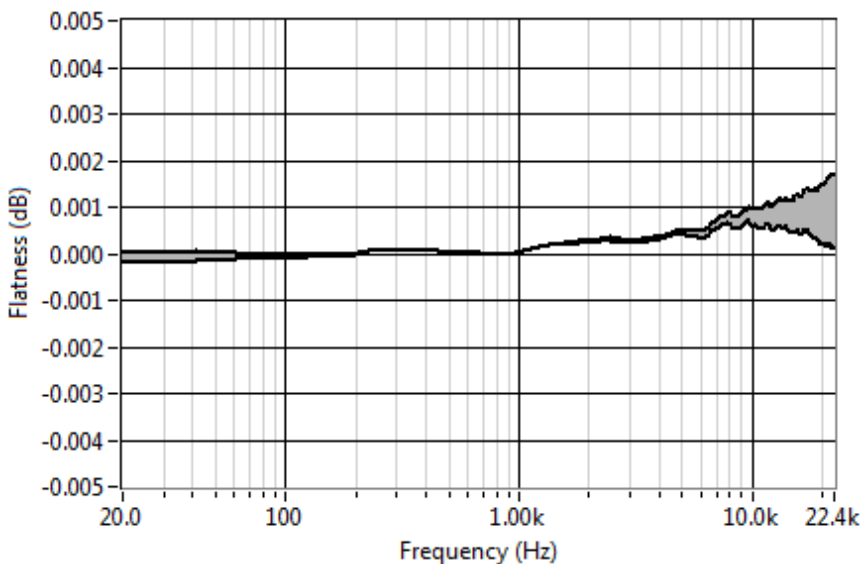


Figure 3. Flatness (0 dB and 37 dB Attenuation, Pseudodifferential Configuration)

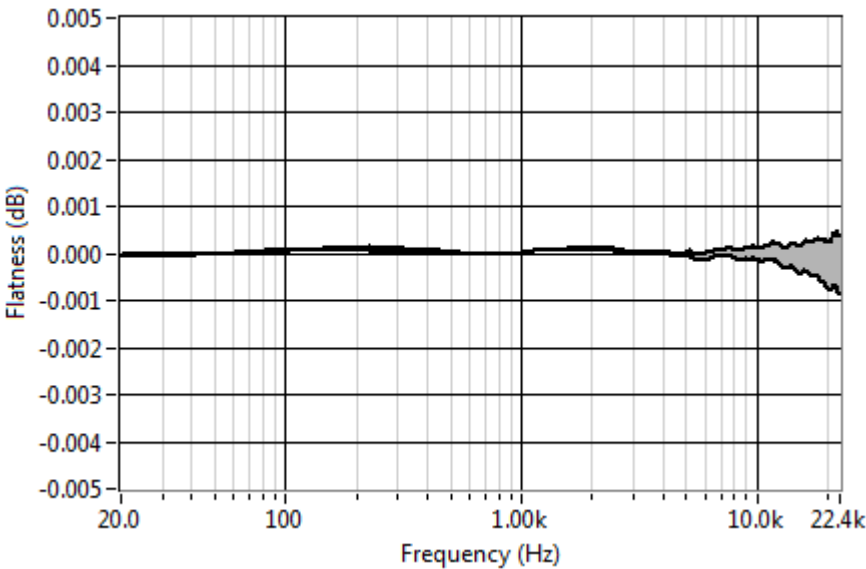
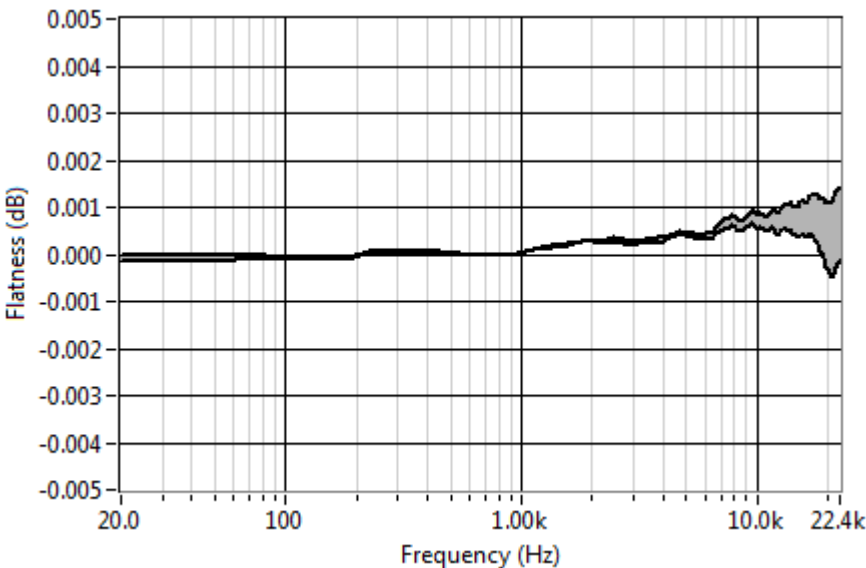


Figure 4. Flatness (17 dB Attenuation, Pseudodifferential Configuration)



Interchannel Gain Mismatch^{1, 2}

20 Hz to 22.4 kHz..... ±0.03 dB (±0.01 dB typical)

Interchannel Phase Mismatch

20 Hz to 22.4 kHz..... ±0.03° (±0.01° typical)



Note Listed gain and phase mismatch specifications are valid for output signals generated on two channels of the same module. For output signals generated on different modules, the listed gain and phase mismatch specifications still apply, but are subject to the following conditions:

- For gain matching, all modules must be properly warmed up and then self calibrated. Refer to the *Environmental Specifications* section for the specified warm-up time.
- For phase matching, all modules must be properly warmed up and then self calibrated and synchronized to a common timebase. To the listed specifications, add the following error: $360^{\circ} \times f_{out} \times clock\ skew$. Refer to the *General Specifications* section for the maximum intermodule clock skew.

Phase Linearity²

20 Hz to 22.4 kHz..... ±0.005°

¹ Device temperature within ±5 °C of the last self-calibration temperature.

² All attenuation settings, all output configurations.

Idle Channel Noise

Attenuation (dB)	Idle Channel Noise (μV_{rms}) [*] , Max (Typical)	
	$f_s = 51.2 \text{ kS/s}$	
	Differential	Pseudodifferential
0	11.2 (6.6)	11.4 (6.7)
17	2.7 (1.9)	3.1 (2.2)
37	1.8 (1.3)	2.5 (1.8)
* Measurement Bandwidth = 20 Hz to 22.4 kHz using the described bandwidth-limiting filter.		

Dynamic Range

Attenuation (dB)	Dynamic Range (dBFS) ^{*,†} , Min (Typical)	
	$f_s = 51.2 \text{ kS/s}$	
	Differential	Pseudodifferential
0	116.4 (121.0)	116.3 (120.9)
17	111.5 (114.5)	110.1 (113.1)
37	94.7 (97.7)	92.1 (95.1)
* 1 kHz output tone, -60 dBFS output amplitude.		
† Measurement Bandwidth = 20 Hz to 22.4 kHz using the described bandwidth-limiting filter.		

Spectral Noise Density

Attenuation (dB)	Spectral Noise Density ($\text{nV} / \sqrt{\text{Hz}}$) [*] , Typical	
	$f_s = 51.2 \text{ kS/s}$	
	Differential	Pseudodifferential
0	44.7	45.1
17	13.5	15.9
37	9.2	12.4
* Spectral noise density at 1 kHz.		

Spectral Noise Density Performance

Measurement Instrument: NI PXI-4461, 30 dB gain, differential input configuration.
Acquisition: 10 cross-correlation averages of 204,800 samples acquired at 204.8 kS/s.

Figure 5. Spectral Noise Density (Differential Configuration)

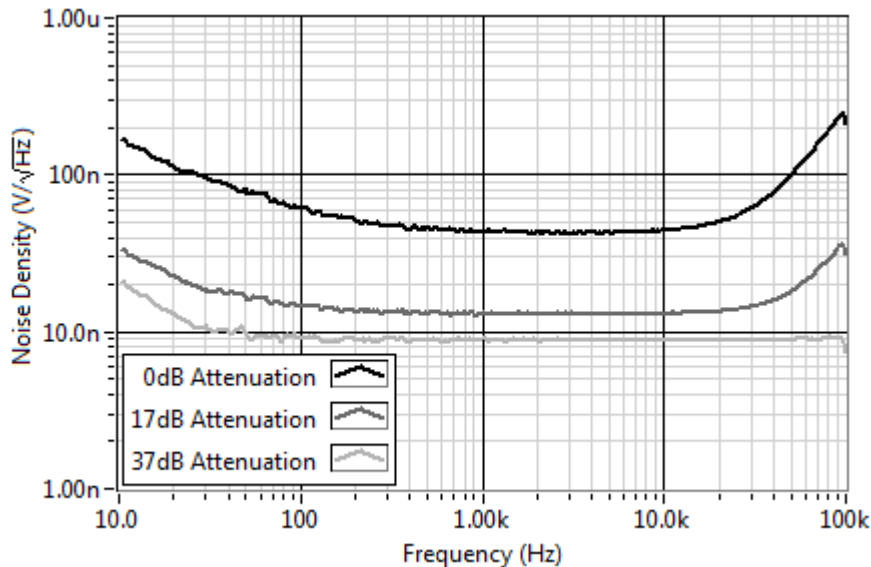
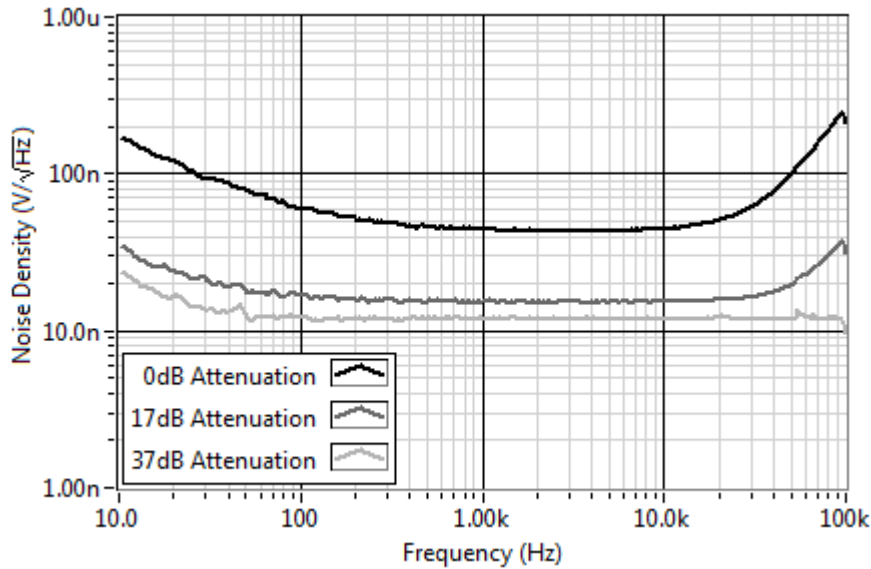


Figure 6. Spectral Noise Density (Pseudodifferential Configuration)



Spurious Free Dynamic Range (SFDR)

Attenuation (dB)	SFDR (dBc) ^{*,†}
	$f_s = 51.2 \text{ kS/s}$
0	123
17	121
37	119

* 1 kHz output tone, -1 dBFS output amplitude.
† Measurement Bandwidth = 20 Hz to 22.4 kHz.

Representative Performance FFTs

Measurement Instrument: NI PXI-4461, differential input configuration.
Input Filter: Differential twin-T notch passive filter.
Acquisition: 10 cross-correlation averages of 204,800 samples acquired at 204.8 kS/s.

Figure 7. FFT of -1 dBFS, 1 kHz Tone, 0 dB Attenuation

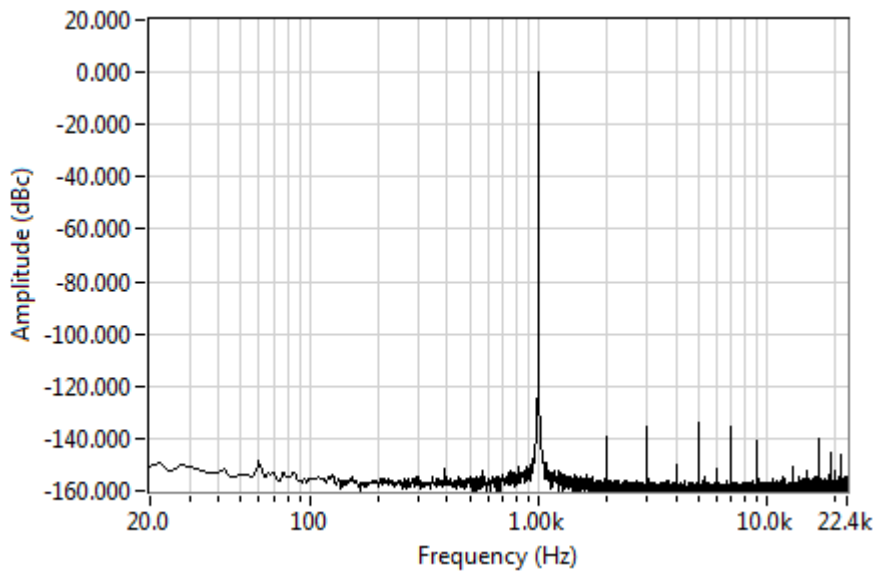


Figure 8. FFT of -1 dBFS, 1 kHz Tone, 17 dB Attenuation

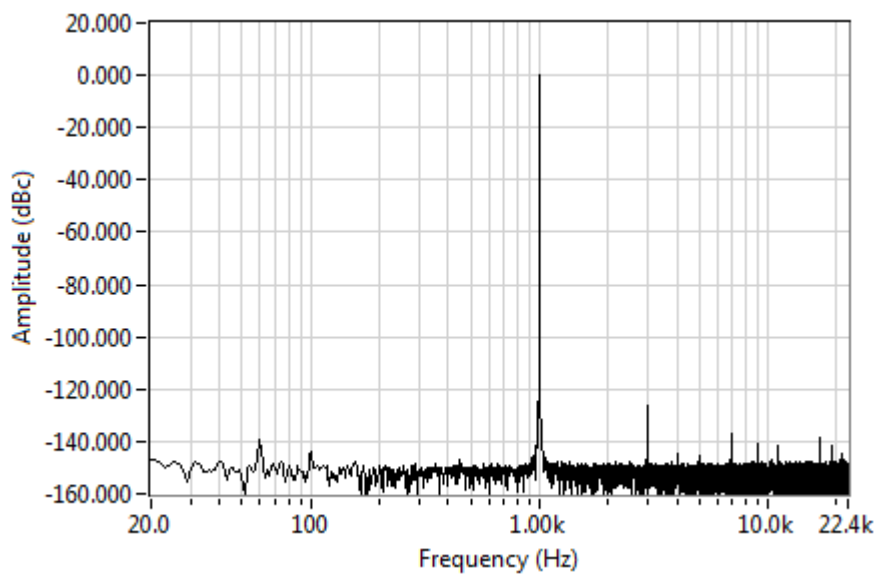
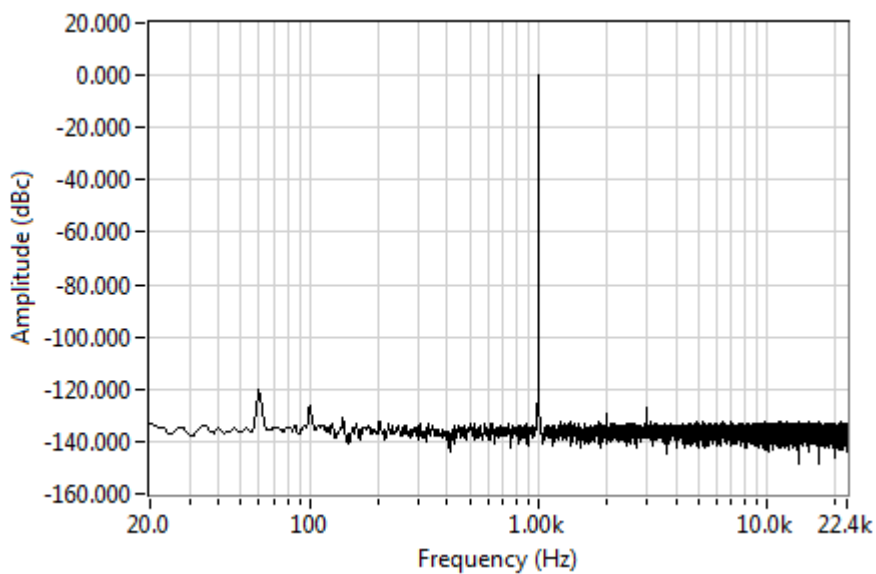


Figure 9. FFT of -1 dBFS, 1 kHz Tone, 37 dB Attenuation



Total Harmonic Distortion (THD)

Measurement Bandwidth	THD (dBc) ^{*,†,‡} , 25 °C ±5 °C			
	$f_s = 51.2 \text{ kS/s}$			
	$f_{\text{out}} = 1 \text{ kHz}$	$f_{\text{out}} = 20 \text{ Hz to } 20 \text{ kHz}$		
	Load ≥ 60 Ω	Load ≥ 600 Ω	Load ≥ 100 Ω	Load ≥ 60 Ω
20 Hz to 22.4 kHz	-120	-119	-116	-113
20 Hz to 44.8 kHz		-114	-111	-108
20 Hz to 89.6 kHz		-109	-106	-103

* -1 dBFS output amplitude.

† Includes the 2nd through the 11th harmonics.

‡ All output configurations.

THD Performance

Measurement Instrument: NI PXI-4461, 30 dB gain, differential input configuration.

Input Filter: Differential twin-T notch passive filter.

Acquisition: 10 cross-correlation averages of 204,800 samples acquired at 204.8 kS/s.

THD measurements include 2nd through 11th harmonics.

Figure 10. THD of -1 dBFS Tone, 0 dB Attenuation, Load ≥600 Ω, 20 Hz to 22.4 kHz BW

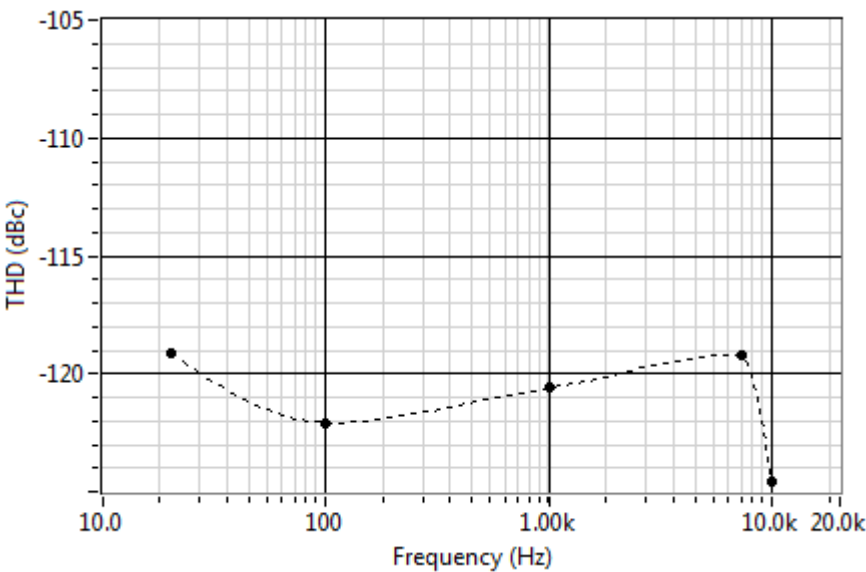


Figure 11. THD of -1 dBFS Tone, 0 dB Attenuation, Load $\geq 600\ \Omega$, 20 Hz to 44.8 kHz BW

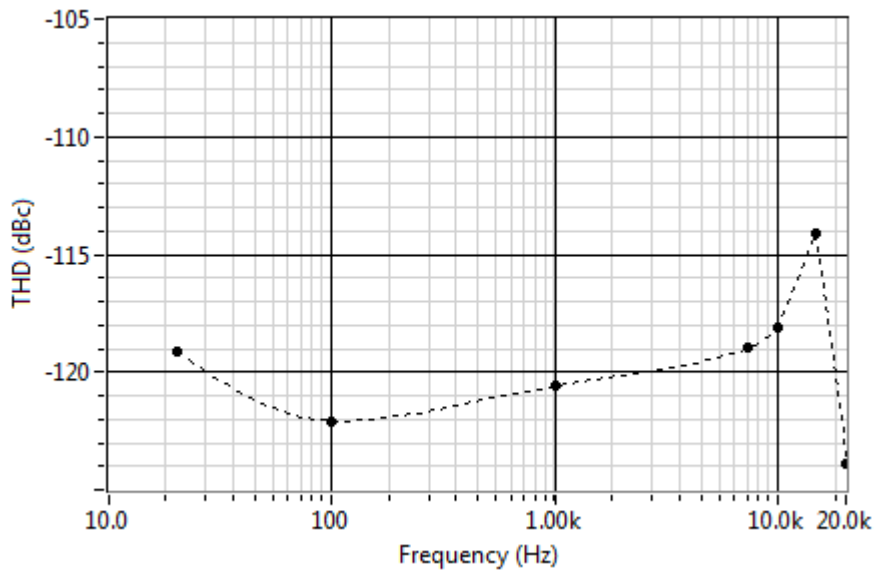


Figure 12. THD of -1 dBFS Tone, 0 dB Attenuation, Load $\geq 600\ \Omega$, 20 Hz to 89.6 kHz BW

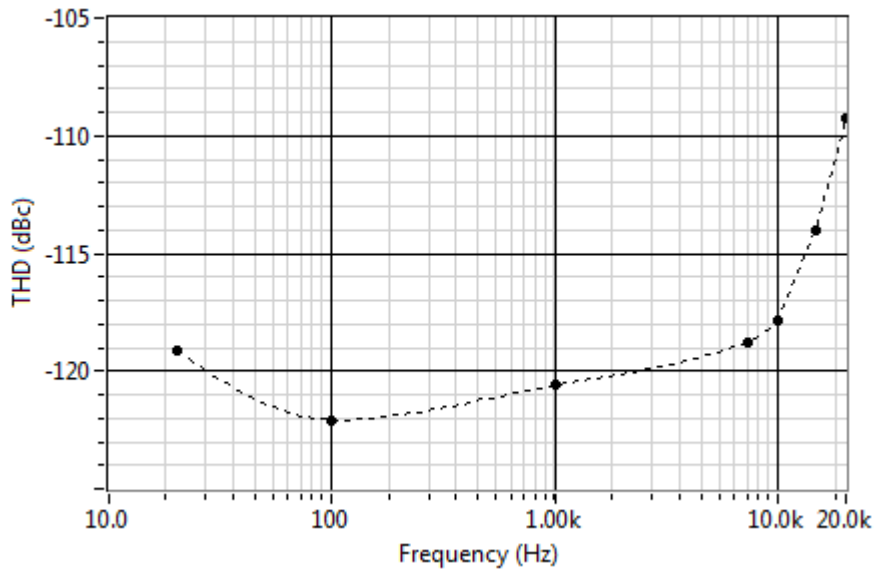
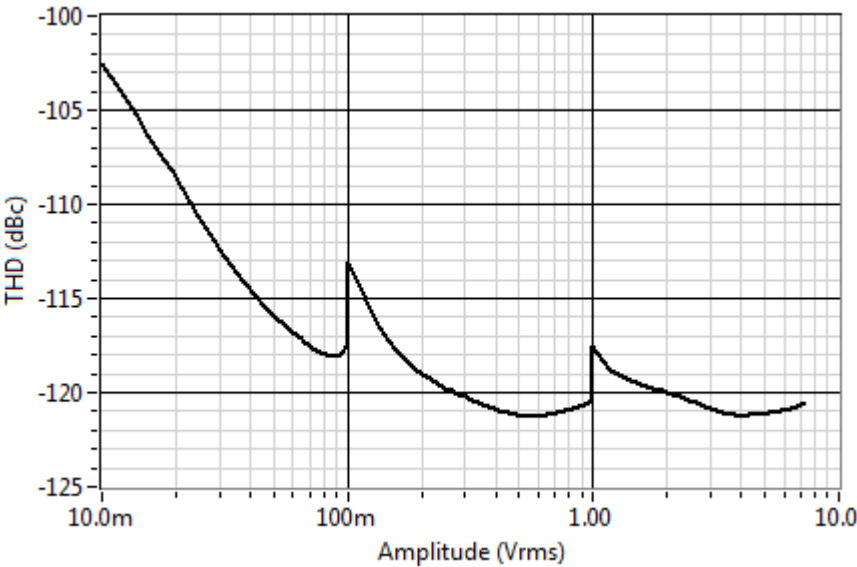


Figure 13. THD of 1 kHz Tone Amplitude Sweep¹, Load ≥ 60 Ω



Total Harmonic Distortion Plus Noise (THD+N)

Output Configuration	THD+N ¹ , 25 °C ±5 °C		
	$f_s = 51.2 \text{ kS/s}$		
	0 dB Attenuation		
	$f_{\text{out}} = 1 \text{ kHz}$	$f_{\text{out}} = 20 \text{ Hz to } 20 \text{ kHz}$	
	Load ≥ 60 Ω	Load ≥ 600 Ω	Load ≥ 60 Ω
Differential	-119 dBc + 6.6 μV	-110 dBc + 6.6 μV	-109 dBc + 6.6 μV
Pseudodifferential	-119 dBc + 6.7 μV	-110 dBc + 6.7 μV	-109 dBc + 6.7 μV
* Measurement Bandwidth = 20 Hz to 22.4 kHz using the described bandwidth-limiting filter.			

¹ THD of low amplitude tones is limited by output noise.

THD+N Performance

Measurement Instrument: NI PXI-4461, 30 dB gain, differential input configuration.

Input Filter: Differential twin-T notch passive filter.

Acquisition: 10 cross-correlation averages of 204,800 samples acquired at 204.8 kS/s.

Measurement Bandwidth: 20 Hz to 22.4 kHz using the described bandwidth-limiting filter.

Figure 14. THD+N of -1 dBFS Tone, 0 dB Attenuation, Load $\geq 600 \Omega$

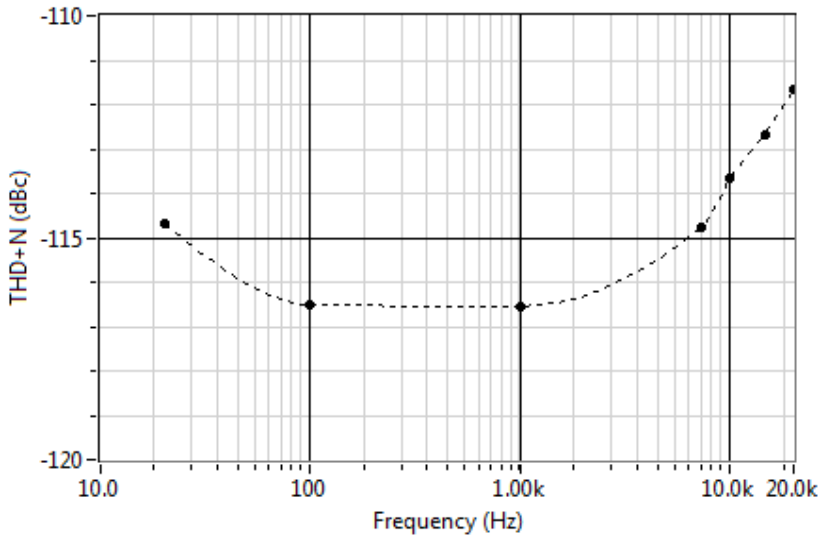
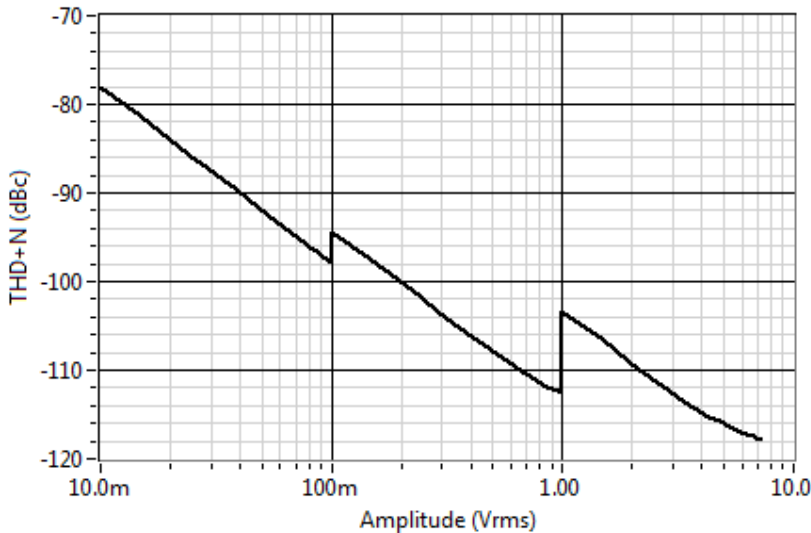


Figure 15. THD+N of 1 kHz Tone Amplitude Sweep, Load $\geq 60 \Omega$



Output Configuration	THD+N [*] , 25 °C ±5 °C			
	$f_s = 51.2 \text{ kS/s}$			
	17 dB Attenuation		37 dB Attenuation	
	$f_{\text{out}} = 1 \text{ kHz}$	$f_{\text{out}} = 20 \text{ Hz to } 20 \text{ kHz}$	$f_{\text{out}} = 1 \text{ kHz}$	$f_{\text{out}} = 20 \text{ Hz to } 20 \text{ kHz}$
Differential	-117 dBc + 1.9 μV	-111 dBc + 1.9 μV	-117 dBc + 1.3 μV	-111 dBc + 1.3 μV
Pseudodifferential	-117 dBc + 2.2 μV	-111 dBc + 2.2 μV	-117 dBc + 1.8 μV	-111 dBc + 1.8 μV
* Measurement Bandwidth = 20 Hz to 22.4 kHz using the described bandwidth-limiting filter.				

Intermodulation Distortion (IMD)

Output Configuration	IMD (dBc) ^{*†}	
	2 nd Order	2 nd and 3 rd Order
Differential	-120	-117
Pseudodifferential	-117	-114
* CCIF 14 kHz + 15 kHz, each tone amplitude is -6 dBFS.		
† Measurement Bandwidth = 20 Hz to 22.4 kHz.		

Crosstalk, Output Channel Separation

All attenuation settings, 20 Hz to 22.4 kHz

Mini-XLR version

Differential and
Pseudodifferential Typically ≤ -140 dBc

BNC version¹

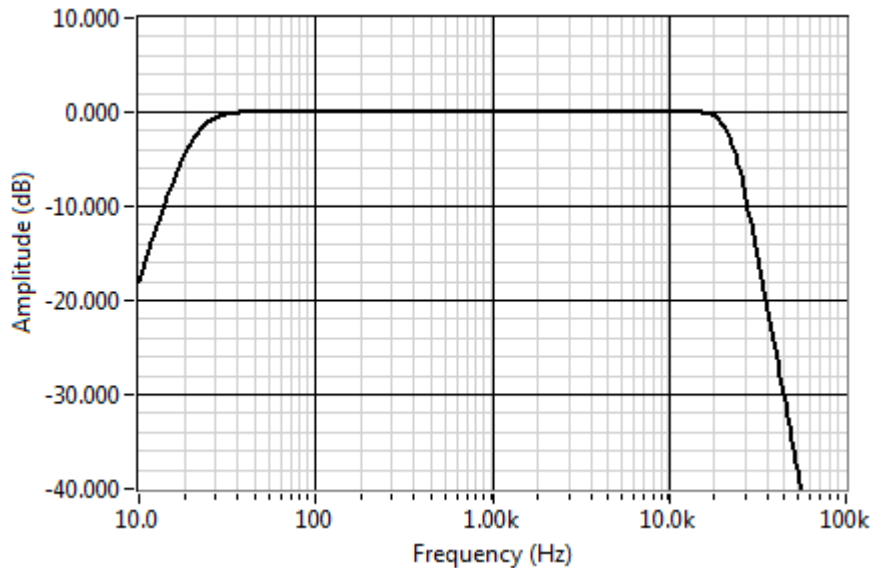
Differential Typically ≤ -100 dBc
Pseudodifferential Typically ≤ -120 dBc

¹ Crosstalk can be reduced by separation and/or shielding between coaxial cables.

Bandwidth-Limiting Filter (IEC 468 Compliant)

High-Pass: 3rd order Butterworth at 20 Hz.
Low-Pass: 5th order Butterworth at 22.4 kHz.

Figure 16. Bandwidth-Limiting Filter (IEC 468 Compliant)



Onboard Calibration References

Voltage

DC level	5.000 V
Temperature coefficient	±9 ppm/°C max
Time stability	±50 ppm/ $\sqrt{1,000}$ hr

Frequency

Oscillator	20 MHz TCXO
Temperature stability	±2.8 ppm max over full temperature range
Time stability	±1 ppm/year

Frequency Timebase Characteristics

Accuracy	
Using internal VCXO timebase	
T _{cal} ±5 °C	±12 ppm
(Listed accuracy is valid for 24 hours following a self-calibration.)	
(T _{cal} = device temperature at which the last self-calibration was performed.)	
Over full operating	
temperature range	±100 ppm max
Using external timebase	Equal to accuracy of external timebase

Triggers

Digital Trigger	
Purpose	Start trigger
Source	PFI0, PFI1, PXI_Trig<0..7>, PXI_Star, PXIe_DStar<A..B>
Polarity	Rising or falling edge, software-selectable
Minimum pulse width	100 ns for PXI_Trig<0..7>, 20 ns for others

Output Timing Signals

Sources	Start Trigger Out, Sync Pulse Out
Destinations	PFI0, PFI1, PXI_Trig<0..7>, PXIe_DStarC
Polarity	Software-selectable except for Sync Pulse Out (always active low)

PFI 0 and PFI 1(Front Panel Digital Triggers)

Input

Logic compatibility.....	3.3 V or 5 V
High, V_{IH}	2.40 V min
Low, V_{IL}	0.95 V max
Input impedance	10 k Ω
Input current ($0\text{ V} \leq V_{in} \leq 4.5\text{ V}$).....	$\leq 450\text{ }\mu\text{A}$
Overvoltage protection	$\pm 10\text{ V}_{pk}\text{ min}$

Output

High, V_{OH}	3.43 V max
Sourcing 5 mA.....	2.88 V min
Low, V_{OL}	
Sinking 5 mA.....	0.33 V max
Output impedance.....	50 Ω
Output current.....	$\pm 5\text{ mA min}$
Overvoltage protection	$\pm 10\text{ V}_{pk}\text{ min}$

General Specifications

This section lists general specification information for the NI PXIe-4463.

Bus Interface

Form factor	x1 PXI Express peripheral module, Specification rev 1.0 compliant
Slot compatibility	PXI Express only or PXI Express hybrid slots
DMA channels	2, analog output

Timing and Synchronization

Number of timing engines	2 ¹
Reference clock source	Onboard clock, backplane PXIe_CLK100
Intermodule DAC clock skew ²	
T _{tb} ±5 °C	23 ns max
(T _{tb} = device temperature at which the timebase source was last changed.)	
Over full operating temperature range	30 ns max

Power Requirements

Voltage (V)	Current (A), Max
+3.3	3.0
+12	2.0

Physical

Dimensions (not including connectors)	16 cm × 10 cm (6.3 in. × 3.9 in.) 3U CompactPCI slot
Analog output connectors	BNC female or Mini-XLR male
Digital trigger connector (PFI0 and PFI1)	SMB male
Weight	525 g (18.5 oz)
Measurement Category	I ³



Caution Do *not* use the NI PXIe-4463 for connections to signals or for measurements within Categories II, III, or IV.



Caution The protection provided by the NI PXIe-4463 can be impaired if it is used in a manner not described in this document.



Caution Clean the hardware with a soft, nonmetallic brush. Make sure that the hardware is completely dry and free from contaminants before returning it to service.

¹ Channels can be arbitrarily grouped into timing engines. Timing engines can be independently synchronized, started, and stopped. Both timing engines must use the same reference clock source.

² Valid between NI PXIe-4463 modules installed in the same chassis. Between NI PXIe-4463 modules in different chassis, add the potential skew in the PXI_CLK10 clock distribution. Refer to the appropriate chassis documentation for its clock skew specifications.

³ Measurement Categories CAT I and CAT O are equivalent. These test and measurement circuits are not intended for direct connections to the MAINS building installations of Measurement Categories CAT II, CAT III, CAT IV.

Environmental Specifications

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 (800 mbar)
Pollution Degree	2
Indoor use only.	

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 module computes gain and offset corrections relative to the high-precision internal voltage reference, timebase correction relative to the high-precision internal frequency reference, and channel-to-channel phase matching corrections.
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Self-calibration interval	Recommended whenever the current device temperature differs by more than $\pm 5\text{ }^{\circ}\text{C}$ from the device temperature at which the last self-calibration was performed.
External calibration interval.....	2 years
Warm-up time	15 minutes

Safety

This product meets 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

The NI PXIe-4463 (Mini-XLR and BNC versions) meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial locations.



Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.



Note For EMC declarations and certifications, and additional information, refer to the [Online Product Certification](#) section.

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

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* 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 the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste and Electronic Equipment, visit ni.com/environment/weee.

电子信息产品污染控制管理办法（中国 RoHS）



中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)

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