PXIe-4468 Specifications

2023-06-15

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PXIe-4468 Specifications

Reference

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty. Warranted specifications account for measurement uncertainties, temperature drift, and aging. Warranted specifications are ensured by design or verified during production and calibration.

Characteristics describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- **Typical** specifications describe the performance met by a majority of models.
- **Nominal** specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are **Typical** unless otherwise noted.

Conditions

Specifications are valid for the range 0 °C to 55 °C unless otherwise noted.

Input Characteristics

Number of simultaneously sampled input channels	2
Input configuration	Differential or pseudodifferential (50 Ω between negative input and chassis ground), each channel independently software-selectable

Input coupling	AC or DC, each channel independently software selectable
A/D converter (ADC) resolution	24 bits
ADC type	Delta-sigma
Sample rates	
Range	100 S/s to 250 kS/s
Resolution	Refer to Figure 1 for additional information.
ADC modulator sample rate	8.125 MS/s
FIFO buffer size	1,023 samples
Data transfers	Direct memory access (DMA), programmed I/O

Overvoltage Protection

All input configurations	±42.4 V peak, minimum/warranted

Input Signal Range

Gain (dB)	Full-Scale Range, Minimum	
	V peak	V RMS (Sine Input)
30	±0.316	0.224
20	±1.00	0.707
10	±3.16	2.24
0	±10.0	7.07
-10	±31.6	22.4

Gain (dB)	Full-Scale Range, Minimum	
	V peak	V RMS (Sine Input)
-20	±42.4	30.0
Each input channel gain is independently software-selectable.		

Common-Mode Range

Gain (dB)	Input	Configuration	
		Differential (V peak)	Pseudodifferential (V peak)
0, 10, 20, 30	Positive input (+)	±12	±12
	Negative input (-)	±12	±10
-10, -20	Positive input (+)	±42.4	±42.4
	Negative input (-)	±42.4	±10
Voltages with respect to chassis ground.			

Gain Amplitude Accuracy

1 kHz input tone	
T_{cal} ±5 °C	±0.025 dB maximum/warranted
Over full operating temperature range	±0.05 dB maximum/warranted

Input Transfer Characteristics

Offset (Residual DC)

Table 1. Offset, Maximum/Warranted

Gain (dB)	DC-Coupled Offset (±mV), T_{cal} ±5 °C	DC-Coupled Offset (±mV), Over Full Operating Temperature Range	AC-Coupled Offset (±mV), Over Full Operating Temperature Range
30	0.1	0.3	3.0

Gain (dB)	DC-Coupled Offset (±mV), T_{cal} ±5 °C	DC-Coupled Offset (±mV), Over Full Operating Temperature Range	AC-Coupled Offset (±mV), Over Full Operating Temperature Range
20	0.1	0.3	3.0
10	0.2	1.0	3.0
0	0.5	3.0	4.0
-10	2.0	10.0	10.0
-20	5.0	50.0	50.0

Source impedance ≤ 50 Ω.

Listed accuracy is valid for 30 days following a self-calibration.

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

Input Amplifier Characteristics

Input Impedance

Input Impedance	Configuration	
	Differential	Pseudodifferential
Between positive input and chassis ground	1 MΩ || 210 pF	1 MΩ || 210 pF
Between negative input and chassis ground	1 MΩ || 210 pF	50 Ω

Common-Mode Rejection Ratio (CMRR)

Gain (dB)	Differential Configuration	
	DC-Coupled CMRR (dBc), f_{in} ≤ 1 kHz	AC-Coupled CMRR (dBc), f_{in} = 50 Hz or 60 Hz
30	120	90
20	110	

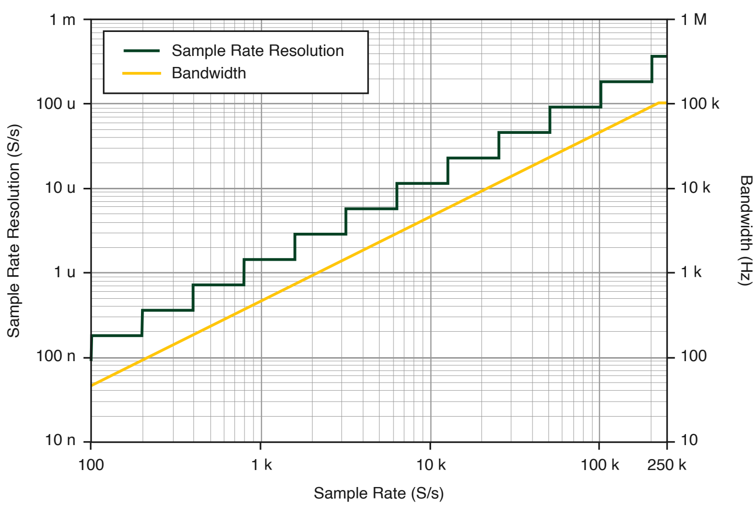
Gain (dB)	Differential Configuration	
	DC-Coupled CMRR (dBc), $f_{in} \leq 1$ kHz	AC-Coupled CMRR (dBc), f_{in} = 50 Hz or 60 Hz
10	100	
0	90	80
-10, -20	60	75

Input Dynamic Characteristics

Bandwidth and Alias Rejection

Alias-free bandwidth (BW) (passband)	DC to lesser of 0.454 * f_s or 101.536 kHz
Alias rejection	105 dBc

Figure 1. Sample Rate Resolution and Bandwidth



AI Filter Delay

Digital filter delay	Adjustable
Analog filter delay	

0 dB gain	708 ns
10 dB gain	715 ns
20 dB gain	737 ns
30 dB gain	777 ns

AC Coupling

-3 dB cutoff frequency	0.8 Hz
-0.1 dB cutoff frequency	5.2 Hz

Figure 2. AC-Coupled Voltage Measurement Magnitude Response vs. Frequency

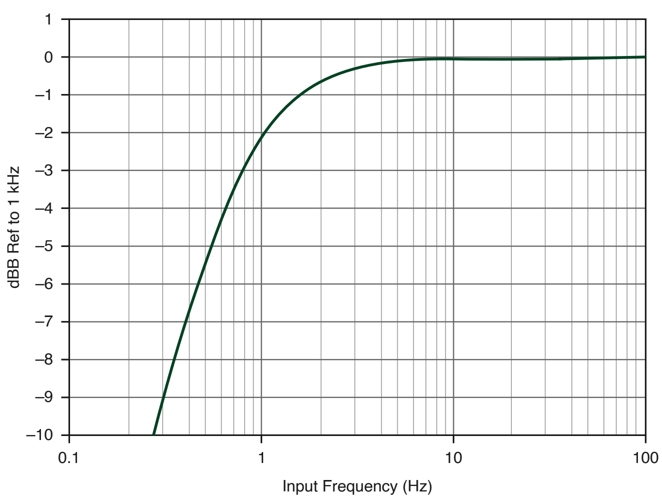
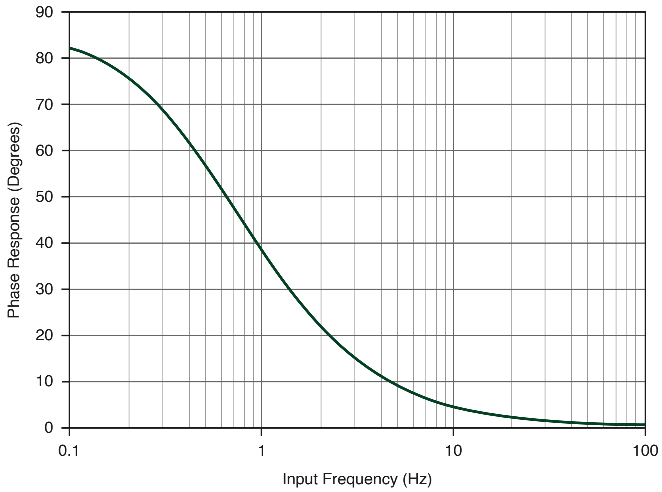


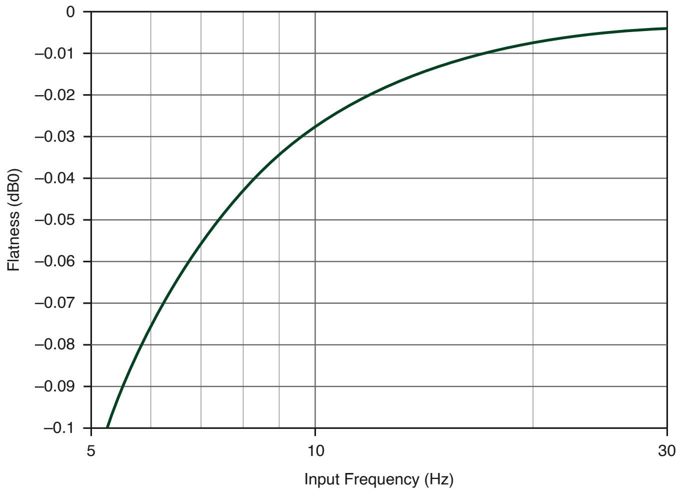
Figure 3. AC-Coupled Voltage Measurement Phase Response vs. Frequency



AI Flatness

Gain (dB)	f_s = 250 kS/s						
	DC-Coupled Flatness (dB)			AC-Coupled Flatness (dB)			
	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 45 kHz	f_{in} > 45 kHz to 100 kHz	f_{in} > 30 Hz	f_{in} > 30 Hz to 20 kHz	f_{in} > 20 kHz to 45 kHz	f_{in} > 45 kHz to 100 kHz
0, 10, 20, 30, (Maximum / Warranted)	±0.006	±0.025	±0.080	Refer to the following figure.	±0.006	±0.025	±0.080
0, 10, 20, 30, (Typical)	±0.005	±0.020	±0.070		±0.005	±0.020	±0.070
-10, -20, (Maximum / Warranted)	±0.20	±0.60	±1.00		±0.20	±0.60	±1.00
-10, -20, (Typical)	±0.10	±0.33	±0.55		±0.10	±0.33	±0.55
Relative to 1 kHz.							

Figure 4. AI AC-Coupled Flatness (Typical)



AI Interchannel Gain Mismatch

Gain (dB)	AC/DC Coupled Mismatch (dB)			AC-Coupled Mismatch (dB)	
	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 45 kHz	f_{in} > 45 kHz to 100 kHz	f_{in}= 5 Hz	f_{in} = 10 Hz
30 (Maximum/ Warranted)	0.008	0.009	0.020	0.010	0.005
30 (Typical)	0.002	0.004	0.010	0.005	0.002
20 (Maximum/ Warranted)	0.007	0.009	0.016	0.010	0.005
20 (Typical)	0.002	0.004	0.010	0.005	0.002
10 (Maximum/ Warranted)	0.007	0.009	0.015	0.010	0.005
10 (Typical)	0.002	0.004	0.010	0.005	0.002
0 (Maximum/ Warranted)	0.007	0.009	0.015	0.010	0.005
0 (Typical)	0.002	0.004	0.010	0.005	0.002
-10, -20 (Maximum/ Warranted)	0.100	0.250	0.400	0.010	0.005
-10, -20 (Typical)	0.050	0.125	0.200	0.005	0.002

Gain (dB)	AC/DC Coupled Mismatch (dB)			AC-Coupled Mismatch (dB)	
	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 45 kHz	f_{in} > 45 kHz to 100 kHz	f_{in}= 5 Hz	f_{in} = 10 Hz
Identical channel configurations. Operating temperature within ±5 °C of the last self-calibration temperature.					

AI Interchannel Phase Mismatch

Gain (dB)		AC/DC Coupled Mismatch			AC-Coupled Mismatch	
		f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 45 kHz	f_{in} > 45 kHz to 100 kHz	f_{in}= 5 Hz	f_{in} = 10 Hz
30	Maximum/ Warranted	0.12°	0.27°	0.60°	0.24°	0.12°
	Typical	0.06°	0.13°	0.30°	0.12°	0.06°
20	Maximum/ Warranted	0.06°	0.14°	0.30°	0.24°	0.12°
	Typical	0.03°	0.07°	0.15°	0.12°	0.06°
10	Maximum/ Warranted	0.06°	0.12°	0.25°	0.24°	0.12°
	Typical	0.03°	0.06°	0.12°	0.12°	0.06°
0	Maximum/ Warranted	0.05°	0.11°	0.23°	0.24°	0.12°
	Typical	0.02°	0.06°	0.12°	0.12°	0.06°
-10, -20	Maximum/ Warranted	1.20°	1.40°	2.00°	0.24°	0.12°
	Typical	0.60°	0.70°	1.00°	0.12°	0.06°
Identical channel configurations.						

Note Listed gain and phase mismatch specifications are valid for measurements made on channels on the same module. For measurements made on channels 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 Calibration section for the specified warm-up time.
- For phase matching, all modules must be synchronized to a common timebase. To the listed specifications, add the following error: 360° × f_{in} × clock skew. Refer to the Timing and Synchronization section for the maximum intermodule clock skew.
- Gain specification applies only for two channels on the same board. For channels on different boards, gain mismatch is $\sqrt{2} \times (\text{Gain error} + \text{flatness})$.

AI Phase Linearity

Gain (dB)	Linearity (deg)	
	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 Hz to 100 kHz
0, 10, 20, 30	±0.005°	±0.03°
-20, -10	±0.1°	±1°

AI Idle Channel Noise

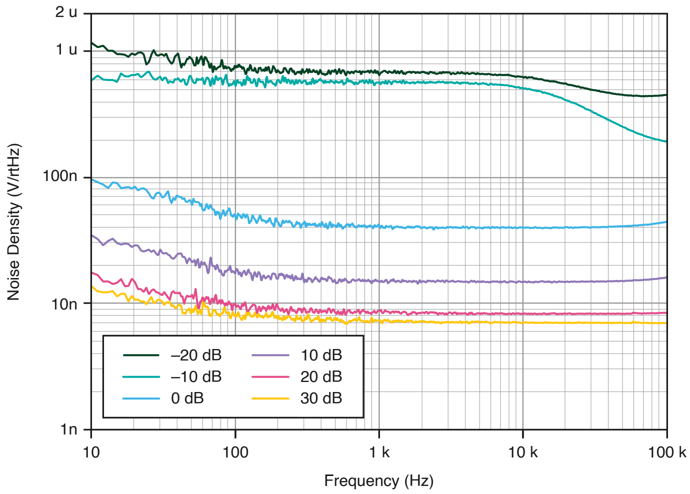
Gain (dB)		Idle Channel Noise (µV RMS)			
		f_s = 51.2 kS/s		f_s = 250 kS/s	
		20 Hz to 20 kHz	0.1 Hz to 23.2 kHz	20 Hz to 20 kHz	0.1 Hz to 101.563 kHz
30	Maximum/ Warranted	1.3	1.6	1.3	2.8

Gain (dB)		Idle Channel Noise (μV RMS)			
		f_s = 51.2 kS/s		f_s = 250 kS/s	
		20 Hz to 20 kHz	0.1 Hz to 23.2 kHz	20 Hz to 20 kHz	0.1 Hz to 101.563 kHz
20	Maximum/ Warranted	1.5	1.6	1.5	3.4
	Typical	1.1	1.2	1.1	2.4
10	Maximum/ Warranted	2.8	3.0	2.8	7.0
	Typical	1.3	1.4	1.3	2.9
0	Maximum/ Warranted	8.0	9.0	8.0	18.0
	Typical	2.3	2.5	2.3	5.2
-10	Maximum/ Warranted	99.0	103.0	99.0	144.0
	Typical	6.3	6.8	6.3	14.0
-20	Maximum/ Warranted	133.0	140.0	133.0	250.0
	Typical	74.0	80.0	74.0	108.0
	Typical	94.0	100.0	94.0	170.0
Source impedance ≤50 Ω.					

AI Spectral Noise Density

AI spectral noise density	7 nV/ $\sqrt{Hz}$ at 30 dB gain, 1 kHz

Figure 5. AI Spectral Noise Density



AI Dynamic Range

Gain (dB)		Dynamic Range (dBFS)			
		f_s = 51.2 kS/s		f_s = 250 kS/s	
		Audio BW (20 Hz to 20 kHz)	Full BW (0.1 Hz to 23.2 kHz)	Audio BW (20 Hz to 20 kHz)	Full BW (0.1 Hz to 101.563 kHz)
30	Minimum/ Warranted	105	104	105	98
	Typical	106	105	106	99
20	Minimum/ Warranted	113	112	113	106
	Typical	115	114	115	108
10	Minimum/ Warranted	118	117	118	110
	Typical	119	119	119	113
0	Minimum/ Warranted	119	117	119	111
	Typical	121	120	121	114
-10	Minimum/ Warranted	107	106	107	103
	Typical	109	109	109	106

Gain (dB)		Dynamic Range (dBFS)			
		f_s = 51.2 kS/s		f_s = 250 kS/s	
		Audio BW (20 Hz to 20 kHz)	Full BW (0.1 Hz to 23.2 kHz)	Audio BW (20 Hz to 20 kHz)	Full BW (0.1 Hz to 101.563 kHz)
-20	Minimum/ Warranted	107	106	107	101
	Typical	110	109	110	105
1 kHz input tone, -60 dBFS input amplitude. Source impedance ≤50 Ω.					

Representative Measurement FFTs (1 kHz)

Test conditions for all FFTs: Unaveraged computation of 65,536 samples, differential input configuration.

Figure 6. FFT of -1 dBFS, 1 kHz Tone Acquired at 51.2 kS/s, 0 dB Gain

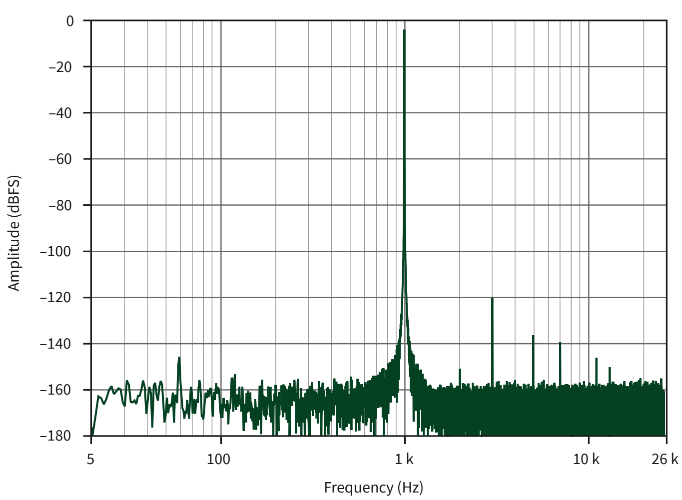


Figure 11. FFT of -1 dBFS, 1 kHz Tone Acquired at 51.2 kS/s, 10 dB Gain

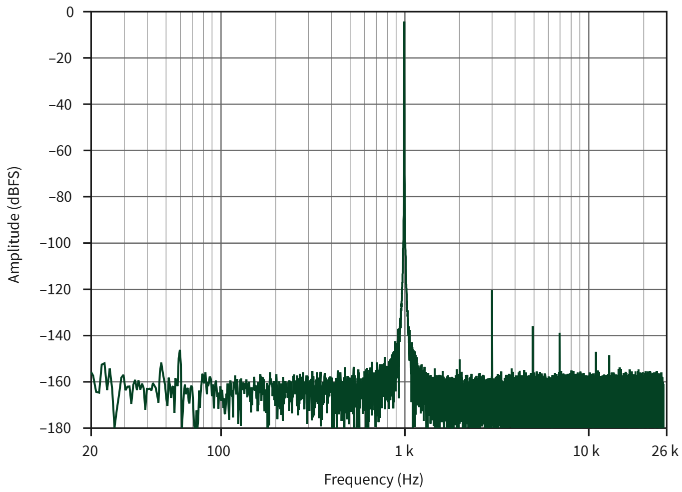


Figure 12. FFT of -1 dBFS, 1 kHz Tone Acquired at 51.2 kS/s, 20 dB Gain

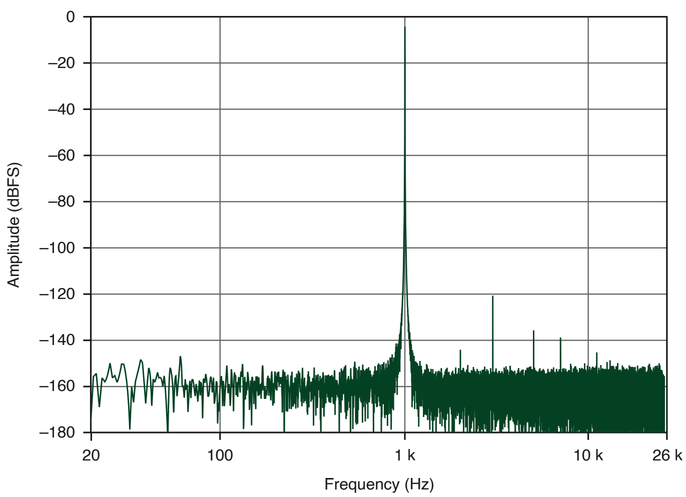
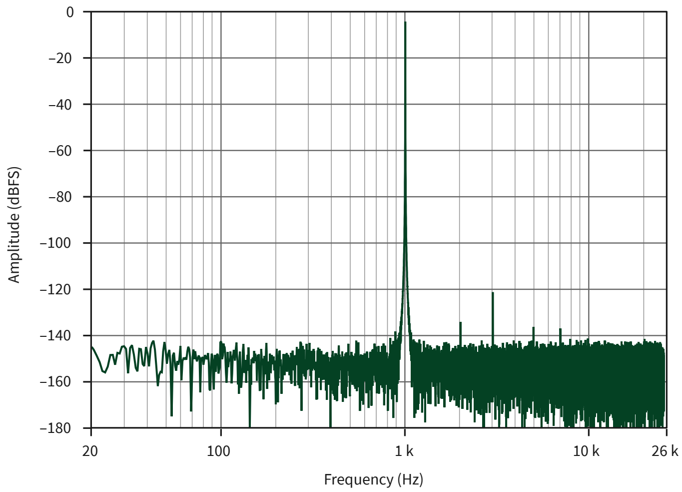


Figure 13. FFT of -1 dBFS, 1 kHz Tone Acquired at 51.2 kS/s, 30 dB Gain



Representative Measurement FFTs (10 kHz)

Test conditions for all FFTs: Unaveraged computation of 262,144 samples, differential input configuration.

Figure 10. FFT of -1 dBFS, 10 kHz Tone Acquired at 250 kS/s, 0 dB Gain

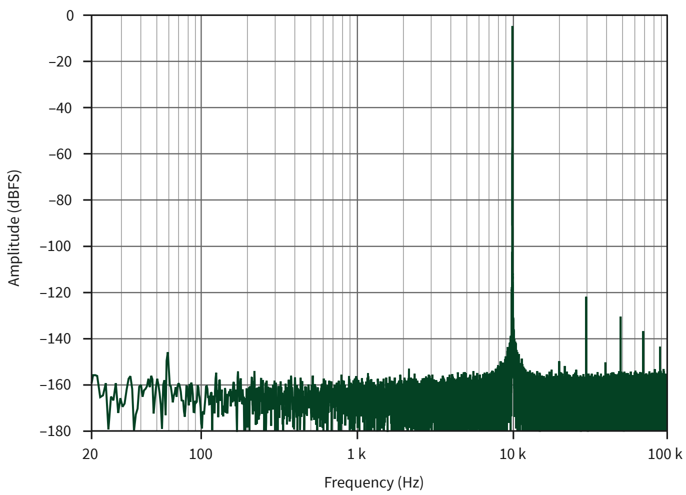


Figure 11. FFT of -1 dBFS, 10 kHz Tone Acquired at 250 kS/s, 10 dB Gain

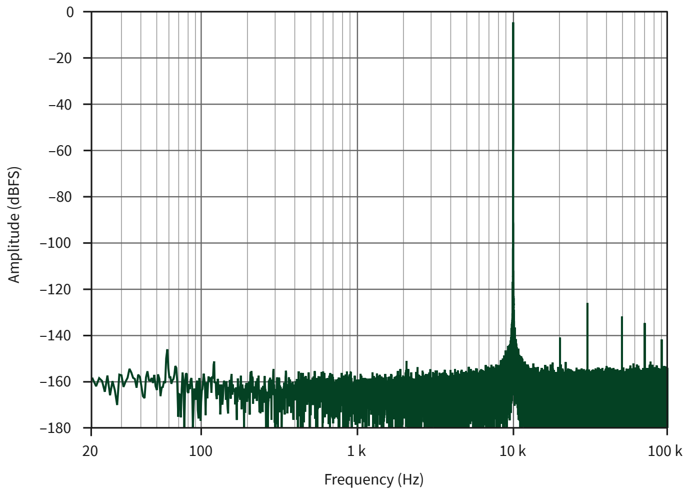


Figure 12. FFT of -1 dBFS, 10 kHz Tone Acquired at 250 kS/s, 20 dB Gain

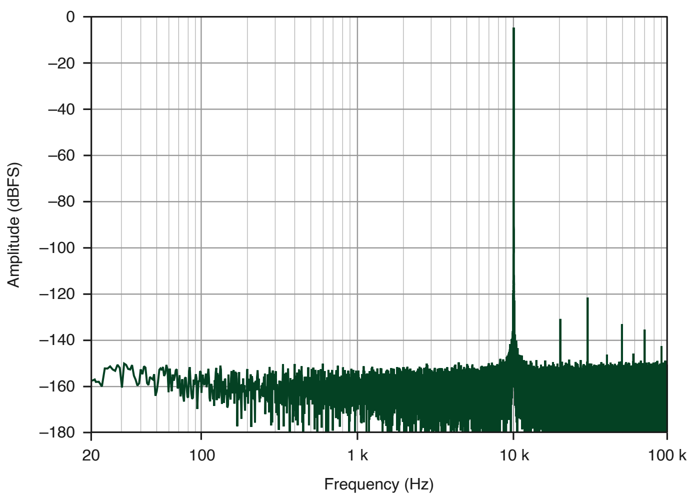
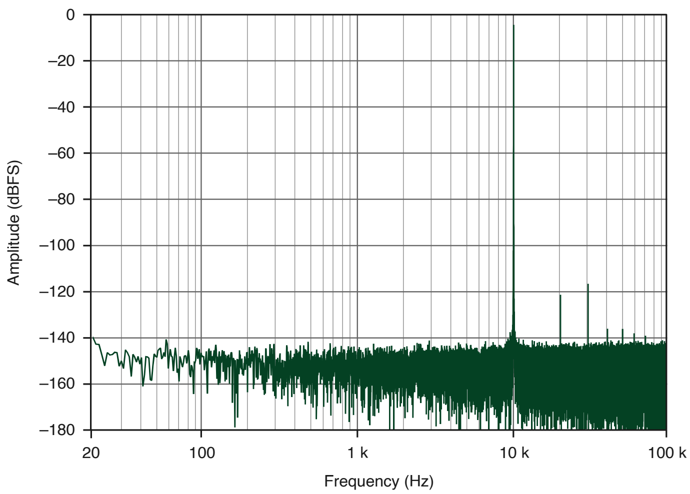


Figure 13. FFT of -1 dBFS, 10 kHz Tone Acquired at 250 kS/s, 30 dB Gain



AI Spurious Free Dynamic Range (SFDR) with Harmonics

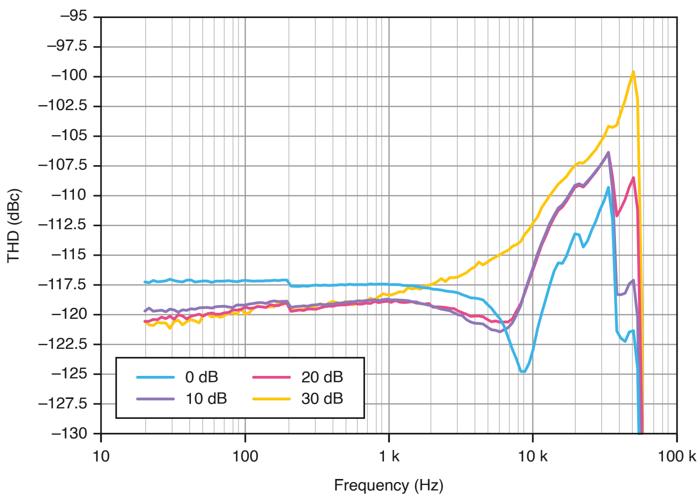
Gain (dB)	SFDR (dBc), Differential Configuration
	$\mathbf{f_s}$ = 51.2 kS/s and $\mathbf{f_s}$ = 250 kS/s
30	111
20	117
10	117
0	116
-10	126
-20	126
1 kHz input tone, input amplitude is the lesser of -1 dBFS or 8.91 V peak. Includes harmonics.	

AI Total Harmonic Distortion (THD), Balanced Source

Gain (dB)	THD (dBc)				
	f_s = 51.2 kS/s		f_s = 250 kS/s		
	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 100 kHz
30	-115	-115	-115	-102	-97

Gain (dB)	THD (dBc)				
	f_s = 51.2 kS/s		f_s = 250 kS/s		
	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 100 kHz
20	-116	-115	-116	-106	-105
10	-116	-115	-116	-107	-107
0	-115	-116	-115	-111	-107
-10	-115	-116	-115	-107	-107
-20	-115	-110	-115	-115	-107
Input amplitude is the lesser of -1 dBFS or 8.91 V peak, differential configuration.					

Figure 14. AI THD (Balanced Source with Differential Configuration, 250 kS/s, 0/10/20/30 dB Gain)



AI THD, Unbalanced Source

Gain (dB)	THD (dBc)				
	f_s = 51.2 kS/s		f_s = 250 kS/s		
	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 100 kHz
30	-115	-107	-115	-101	-94
20	-116	-113	-116	-105	-100
10	-116	-115	-116	-107	-104

Gain (dB)	THD (dBc)				
	f_s = 51.2 kS/s		f_s = 250 kS/s		
	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 100 kHz
0	-111	-102	-111	-96	-89
-10	-115	-104	-115	-100	-99
-20	-115	-104	-115	-100	-99
Input amplitude is the lesser of -1 dBFS or 8.91 V peak, pseduodifferential configuration.					

AI THD Plus Noise (THD+N), Balanced Source

Gain (dB)	THD + N (dBc)				
	f_s = 51.2 kS/s, Measurement BW = 0.1 Hz to 23.2 kHz		f_s = 250 kS/s, Measurement BW = 0.1 Hz to 101.563 kHz		
	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 100 kHz
30	-102	-102	-95	-94	-93
20	-110	-110	-103	-101	-100
10	-112	-111	-108	-104	-104
0	-113	-112	-109	-107	-105
-10	-97	-97	-94	-94	-94
-20	-95	-94	-90	-90	-90
Input amplitude is the lesser of -1 dBFS or 8.91 V peak, differential configuration.					

AI THD+N, Unbalanced Source

Gain (dB)	THD + N (dBc)				
	f_s = 51.2 kS/s, Measurement BW = 0.1 Hz to 23.2 kHz		f_s = 250 kS/s, Measurement BW = 0.1 Hz to 101.563 kHz		
	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} = 1 kHz	f_{in} = 20 Hz to 20 kHz	f_{in} > 20 kHz to 100 kHz
30	-102	-101	-94	-93	-91
20	-110	-109	-103	-101	-98
10	-112	-111	-108	-104	-101
0	-110	-102	-108	-95	-89
-10	-97	-97	-94	-93	-92
-20	-94	-94	-90	-90	-89
Input amplitude is the lesser of -1 dBFS or 8.91 V peak, pseudodifferential configuration.					

AI Intermodulation Distortion (IMD)

IMD	
30 dB gain	-109 dBc
20 dB gain	-112 dBc
10 dB gain	-117 dBc
0 dB gain	-117 dBc
-10 dB gain	-117 dBc
-20 dB gain	-115 dBc

Crosstalk, Input Channel Separation

Gain (dB)	Channel Crosstalk (dBc)	
	f_{in} = 1 kHz Signal	f_{in} = 100 kHz
30	-140	-110
20	-145	-110
10	-145	-110
0	-145	-110
-10	-110	-80
-20	-110	-80
Input amplitude is the lesser of -1 dBFS or 8.91 V peak. Source impedance ≤ 50 Ω.		

Integrated Electronic Piezoelectric (IEPE)

Current Setting		IEPE Range
OFF	Typical	0 mA
4 mA	Minimum	3.858 mA
	Typical	4.031 mA
	Maximum/Warranted	4.205 mA
10 mA	Minimum	9.655 mA
	Typical	10.087 mA
	Maximum/Warranted	10.523 mA
20 mA	Minimum	19.247 mA
	Typical	20.107 mA
	Maximum/Warranted	20.976 mA

Each channel independently software-selectable.

Voltage compliance	24 V

Note Use the following equation to make sure that your configuration meets the IEPE voltage compliance range:
$\mathbf{V_{common\text{-}mode}} + \mathbf{V_{bias}} \pm \mathbf{V_{full\text{-}scale}} + (\mathbf{I_{IEPE}} \times 50\ \Omega)$ must be 0 V to 24 V

where

$\mathbf{V_{common\text{-}mode}}$ is the common-mode voltage seen by the input channel,

$\mathbf{V_{bias}}$ is the DC bias voltage of the sensor,

$\mathbf{V_{full\text{-}scale}}$ is the AC full-scale voltage of the sensor, and

$\mathbf{I_{IEPE}}$ is the selected excitation setting.

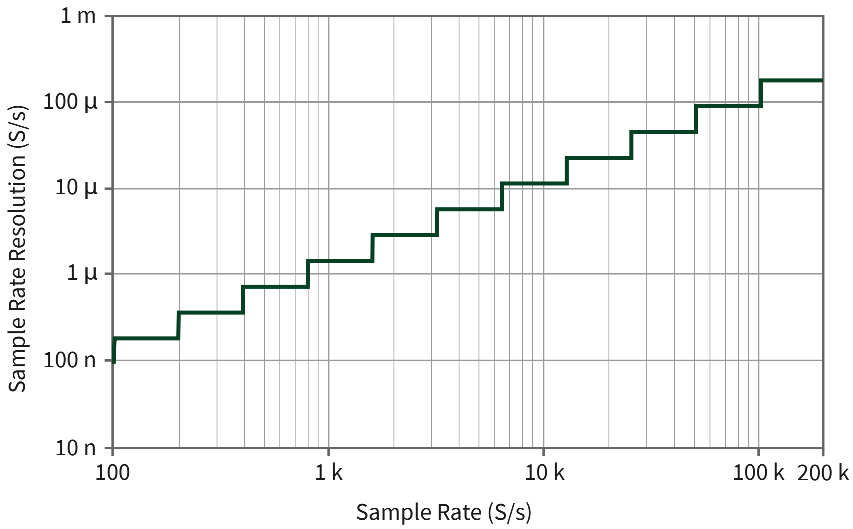
Sensor open detection (software-readable)	
4 mA	27.3 V
10 mA	26.9 V
20 mA	26.4 V
Sensor short detection (software-readable)	
4 mA	1.4 V
10 mA	1.1 V
20 mA	0.6 V
Channel input impedance with IEPE enabled	1 MΩ || 270 pF, pseudodifferential

Output Characteristics

All analog output specifications are in 40 Ω termination mode unless otherwise noted.

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 200 kS/s
Resolution	Refer to the following figure.

Figure 15. Sample Rate Resolution



FIFO buffer size	1,023 samples
Data transfers	Direct memory access (DMA), programmed I/O

AO Common-Mode Offset Control

Resolution	16 bits
Sample rate	Static
Range	0 V to 5 V

Output Signal Range

Table 2. Output Signal Range, Minimum/Warranted

Attenuation (dB)	Output Voltage Full-Scale Range	
	V peak	V RMS (Sine Output)
0	±10.0	7.07
10	±3.16	2.24

Attenuation (dB)	Output Voltage Full-Scale Range	
	V peak	V RMS (Sine Output)
20	±1.0	0.707
30	±0.316	0.224
Each output channel attenuation is independently software-selectable.		

Output load	600 Ω, minimum/warranted

Output Impedance

Output Terminals	40 Ω Termination Mode		600 Ω Termination Mode
	Differential	Pseudodifferential	Differential
Positive (+) to GND	2.6 kΩ	88 Ω	2.8 kΩ
Negative (-) to GND	2.6 kΩ	50 Ω	2.8 kΩ
Positive (+) to negative (-)	40 Ω	40 Ω	600 Ω
Each output channel impedance is independently software-selectable.			

Overvoltage Protection

Output Terminals	Short-Circuit Duration	Overvoltage (V peak), Minimum/Warranted
AO+ to chassis GND	Indefinite	±42.4
AO- to chassis GND	Indefinite	±42.4
AO+ to AO-	Indefinite	±42.4

Output Transfer Characteristics

AO Offset (Residual DC)

Table 3. Offset, Maximum/Warranted

Attenuation (dB)	Differential		Common Mode
	T_{cal} ±5 °C (mV)	Full Operating Temperature Range (mV)	T_{cal} ±5 °C (mV)
0	±1.0	±10.0	±6.0
10	±0.5	±5.0	
20	±0.2	±2.0	
30	±0.2	±1.0	
T_{cal} = device temperature at which the last self-calibration was performed.			

Common Mode Rejection Ratio (CMRR)	80 dB, typical

Gain (Amplitude Accuracy)

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

Differential	±0.03 dB (T_{cal} ±5 °C), maximum/warranted; ±0.08 dB (full operating temperature range), maximum/warranted
Common mode	±0.075% (T_{cal} ±5 °C), maximum/warranted

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

Output Dynamic Characteristics

> **Note**
> The following specifications apply to PXIe-4468 revision C, and later, of the mLXR and BNC variants. For the PXIe-4468 mXLR variant revision B

(Part Number 131136B-21L) specifications, refer to https://www.ni.com/r/4468revb.

Passband and Image Rejection

Passband	DC to 0.454 * f_s
Image rejection	100 dB minimum, 0.546 * f_s < f_{image}< (1.625 MHz - 0.546 * f_s)

AO Filter Delay

Output delay (samples)	
0.1 kS/s ≤ f_s ≤ 10.0 kS/s	65
10.0 kS/s < f_s ≤ 20.0 kS/s	67
20.0 kS/s < f_s ≤ 30.0 kS/s	69
30.0 kS/s < f_s ≤ 40.0 kS/s	71
40.0 kS/s < f_s ≤ 50.0 kS/s	73
50.0 kS/s < f_s ≤ 60.0 kS/s	75
60.0 kS/s < f_s ≤ 70.0 kS/s	77
70.0 kS/s < f_s ≤ 80.0 kS/s	80
80.0 kS/s < f_s ≤ 90.0 kS/s	82

90.0 kS/s < f_S ≤ 100.0 kS/s	84
100.0 kS/s < f_S ≤ 110.0 kS/s	85
110.0 kS/s < f_S ≤ 120.0 kS/s	87
120.0 kS/s < f_S ≤ 130.0 kS/s	90
130.0 kS/s < f_S ≤ 140.0 kS/s	92
140.0 kS/s < f_S ≤ 150.0 kS/s	94
150.0 kS/s < f_S ≤ 160.0 kS/s	97
160.0 kS/s < f_S ≤ 170.0 kS/s	99
170.0 kS/s < f_S ≤ 180.0 kS/s	101
180.0 kS/s < f_S ≤ 190.0 kS/s	103
190.0 kS/s < f_S ≤ 200.0 kS/s	106

AO Gain Flatness

Flatness, f_S = 200 kS/s, maximum/warranted	
20 Hz to 20 kHz	±0.008 dB
20 Hz to 90.6 kHz	±0.1 dB

AO Interchannel Gain Mismatch

20 Hz to 90.6 kHz	±0.1 dB, maximum/warranted; ±0.03 dB, typical

AO Interchannel Phase Mismatch

20 Hz to 20 kHz	0.03°, maximum/warranted; 0.01°, typical
20 Hz to 90.6 kHz	0.5°, maximum/warranted; 0.2°, typical

Note Listed gain and phase mismatch specifications are valid for measurements made on channels on the same module. For measurements made on channels 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. Refer to the Calibration section for the specified warm-up time.
- For phase matching, all modules must be synchronized to a common timebase. To the listed specifications, add the following error: 360° × f_{in} × clock skew. Refer to the Timing and Synchronization section for the maximum intermodule clock skew.
- Gain specification applies only for two channels on the same board. For channels on different boards, gain mismatch is $\sqrt{2} \times \text{(Gain error + flatness)}$.

AO Phase Linearity

AO phase linearity for all attenuation settings and all output configurations.

20 Hz to 20 kHz	±0.01°
20 Hz to 90.6 kHz	±1.0°

AO Idle Channel Noise

Table 4. AO Idle Channel Noise, Differential

Range		Noise (µV RMS)		
		20 Hz to 22.4 kHz	20 Hz to 100 kHz	20 Hz to 500 kHz
0 dB	Maximum/ Warranted	8.5	22.0	220.0
	Typical	5.0	11.0	200.0
10 dB	Maximum/ Warranted	2.7	8.0	130.0
	Typical	1.7	4.0	62.0
20 dB	Maximum/ Warranted	1.2	4.0	40.0
	Typical	0.8	2.0	20.0
30 dB	Maximum/ Warranted	0.8	3.0	15.0
	Typical	0.6	1.2	7.0

Table 5. AO Idle Channel Noise, Pseudodifferential

Range		Noise (µV RMS)		
		20 Hz to 22.4 kHz	20 Hz to 100 kHz	20 Hz to 500 kHz
0 dB	Maximum/ Warranted	8.5	22.6	220.0
	Typical	5.0	11.3	200.0
10 dB	Maximum/ Warranted	4.0	13.0	140.0
	Typical	2.6	5.7	70.0
20 dB	Maximum/ Warranted	3.1	11.0	50.0

Range		Noise (µV RMS)		
		20 Hz to 22.4 kHz	20 Hz to 100 kHz	20 Hz to 500 kHz
	Typical	2.2	4.7	40.0
30 dB	Maximum/ Warranted	3.0	10.0	45.0
	Typical	2.1	4.5	35.0

Dynamic Range

Table 6. AO Dynamic Range, Differential

Range		Dynamic Range (dB)		
		20 Hz to 22.4 kHz	20 Hz to 100 kHz	20 Hz to 500 kHz
0 dB	Minimum/ Warranted	118	110	90
	Typical	123	116	91
10 dB	Minimum/ Warranted	118	108	84
	Typical	122	114	91
20 dB	Minimum/ Warranted	115	104	84
	Typical	118	110	90
30 dB	Minimum/ Warranted	108	97	83
	Typical	111	105	90

Table 7. AO Dynamic Range, Pseudodifferential

Range		Dynamic Range (dB)		
		20 Hz to 22.4 kHz	20 Hz to 100 kHz	20 Hz to 500 kHz
0 dB	Minimum/ Warranted	118	109	90
	Typical	123	115	91
10 dB	Minimum/ Warranted	114	104	84
	Typical	118	111	90

Range		Dynamic Range (dB)		
		20 Hz to 22.4 kHz	20 Hz to 100 kHz	20 Hz to 500 kHz
20 dB	Minimum/ Warranted	107	96	83
	Typical	110	103	86
30 dB	Minimum/ Warranted	97	86	73
	Typical	100	93	76

Spectral Noise Density

Attenuation (dB)	Spectral Noise Density (nV / √Hz)	
	f_S = 200 kS/s	
	Differential	Pseudodifferential
0	37.0	39.0
10	13.0	19.0
20	5.1	15.0
30	3.5	15.0
Spectral noise density at 1 kHz.		

AO Spectral Noise Density Performance

Measurement Instrument: PXIe-4480, 0.5V range, differential input configuration. Acquisition: 128 cross-spectrum averages of 1,048,576 samples acquired at 1.25 MS/s.

Figure 16. Spectral Noise Density (Differential Configuration)

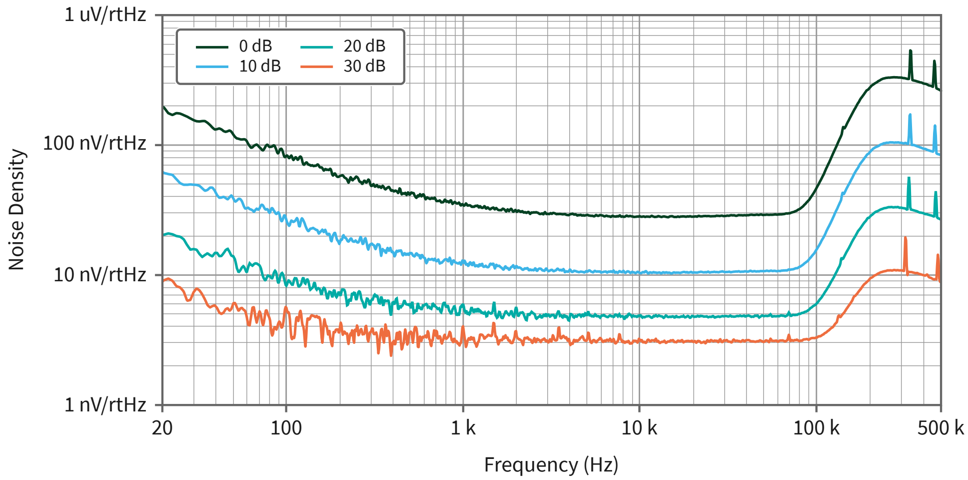
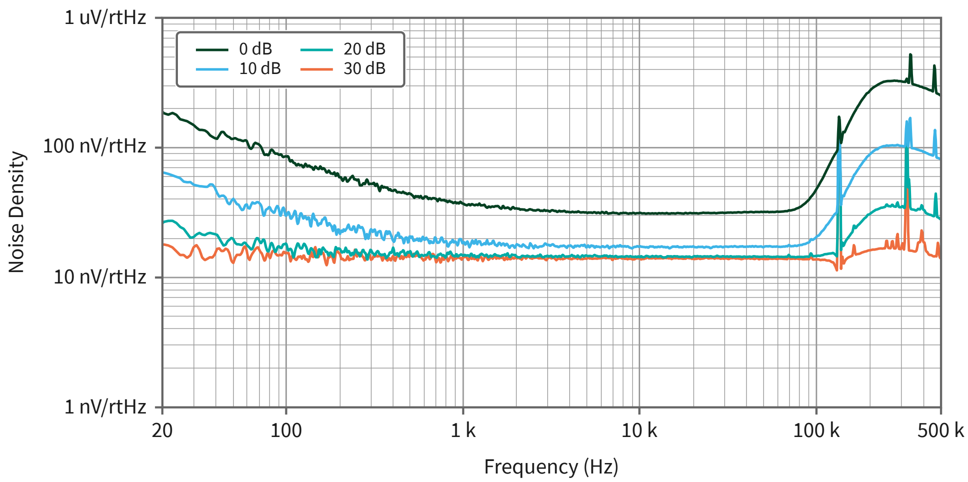


Figure 17. Spectral Noise Density (Pseudodifferential Configuration)



Spurious Free Dynamic Range (SFDR) with Harmonics

All attenuation settings, 20 Hz to 100 kHz, f_s = 200 kS/s, differential	109 dBc

AO Representative Performance FFTs

Measurement Instrument: Audio Precision APx555 audio analyzer, differential input configuration.

Acquisition: high-performance sine mode, 16 averages of 1.2 MS at 1.24 MS/s, AP equiripple window.

Figure 18. FFT -1 dBFS 1 kHz Tone 0 dB Attenuation

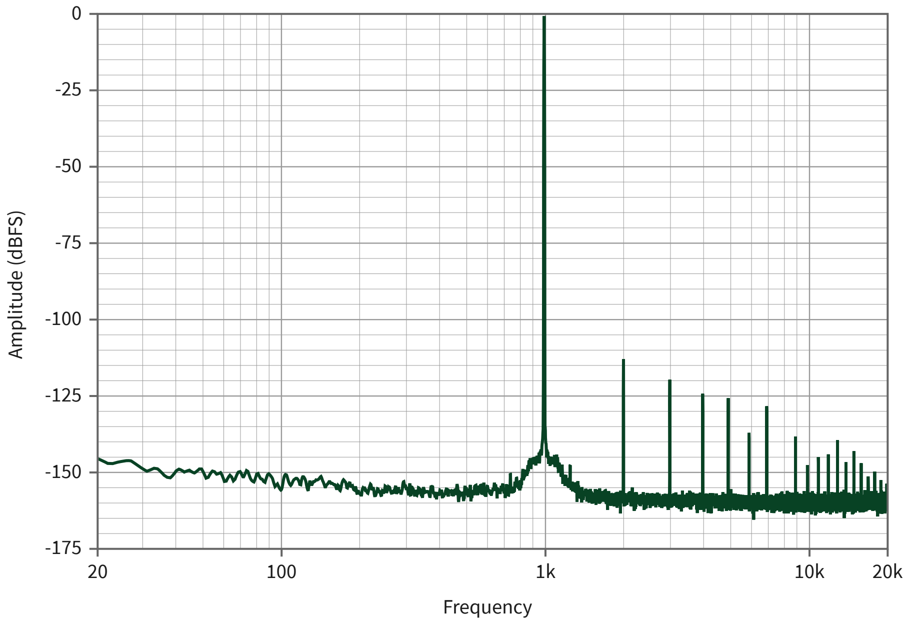


Figure 19. FFT -1 dBFS 1 kHz Tone 10 dB Attenuation

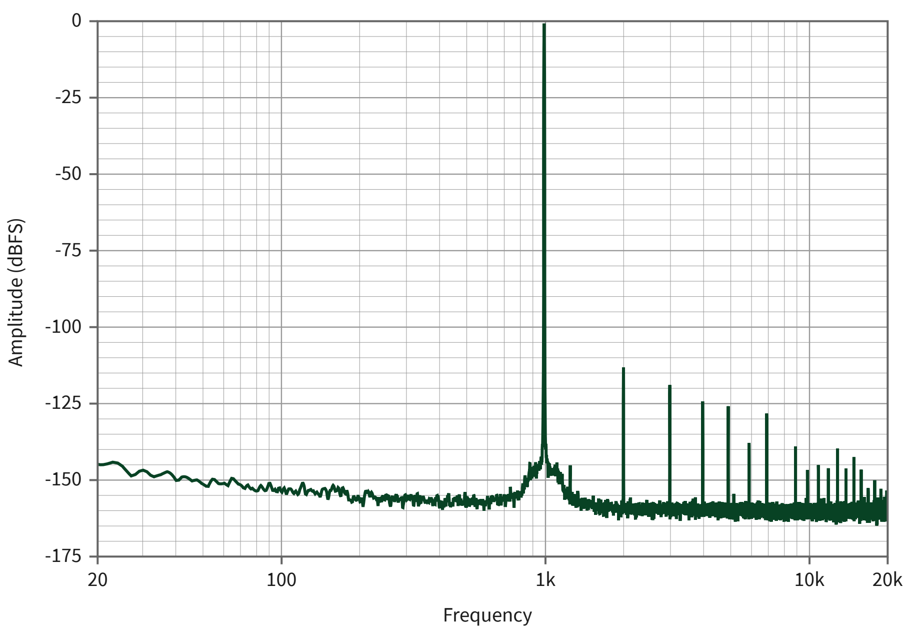


Figure 20. FFT -1 dBFS 1 kHz Tone 20 dB Attenuation

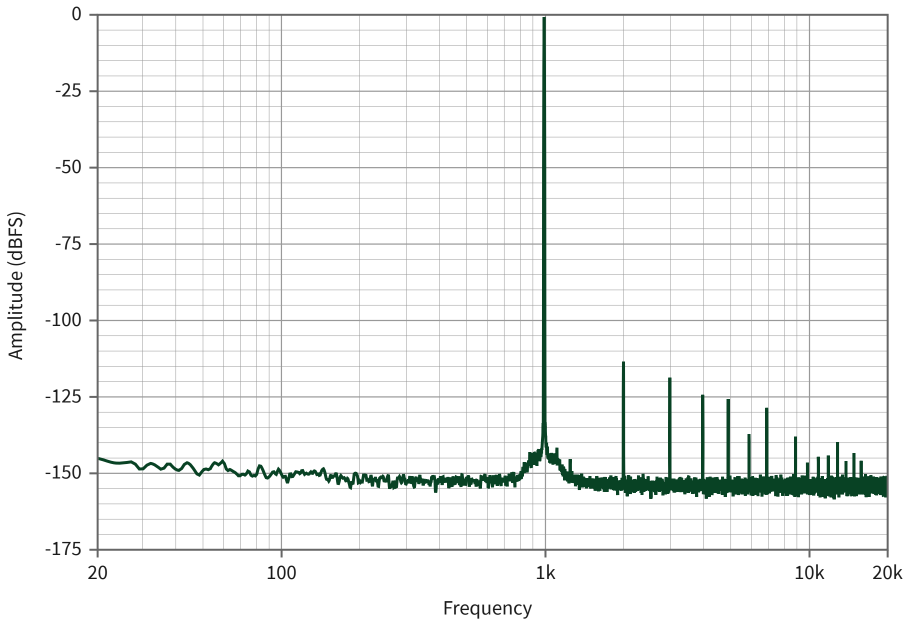


Figure 21. FFT -1 dBFS 1 kHz Tone 30 dB Attenuation

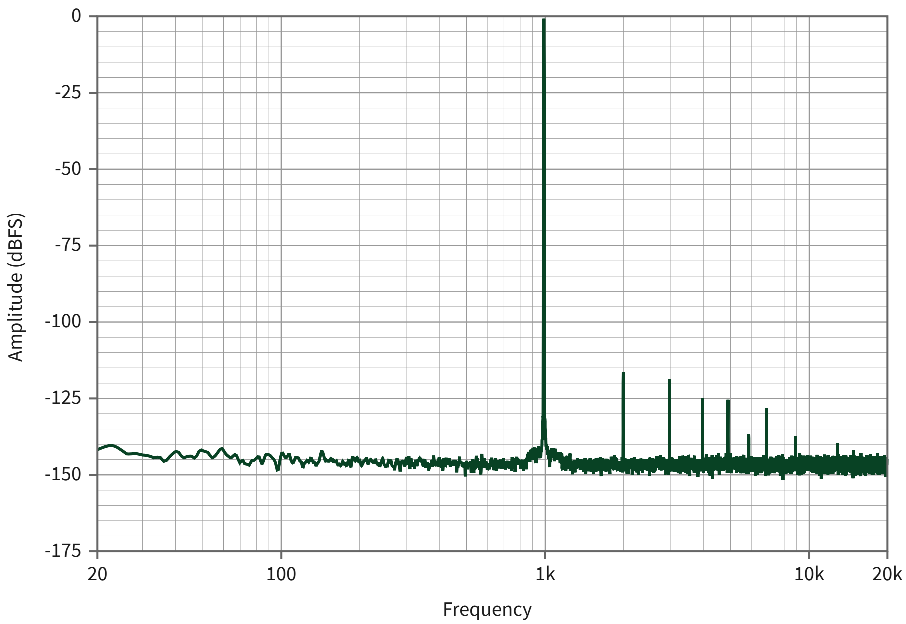


Figure 22. FFT -1 dBFS 10 kHz Tone 0 dB Attenuation

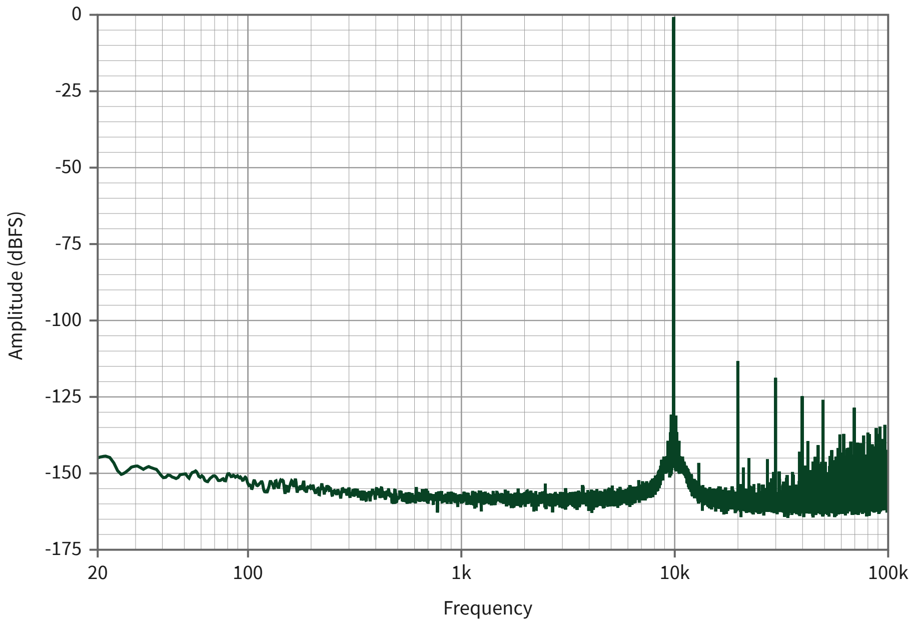


Figure 23. FFT -1 dBFS 10 kHz Tone 10 dB Attenuation

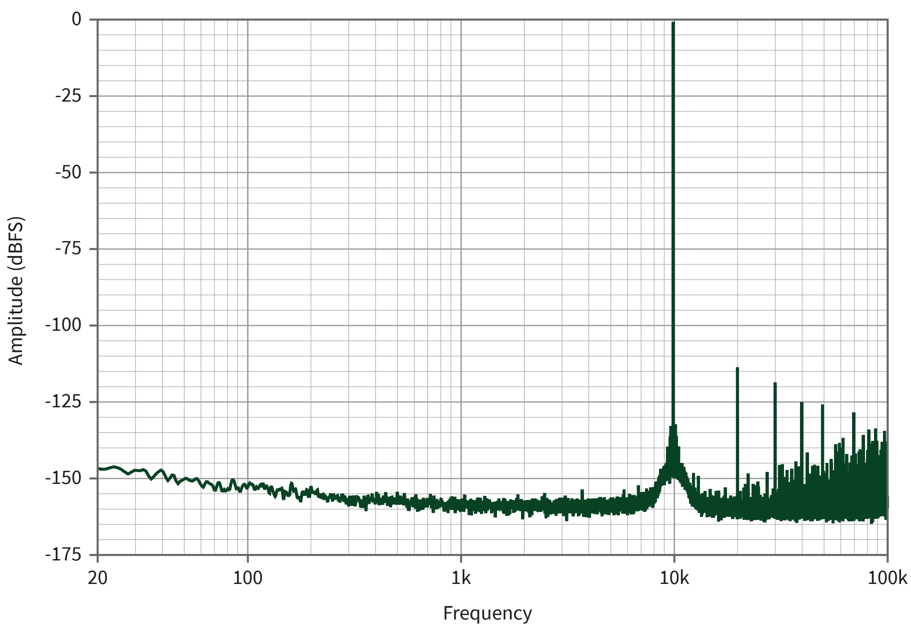


Figure 24. FFT -1 dBFS 10 kHz Tone 20 dB Attenuation

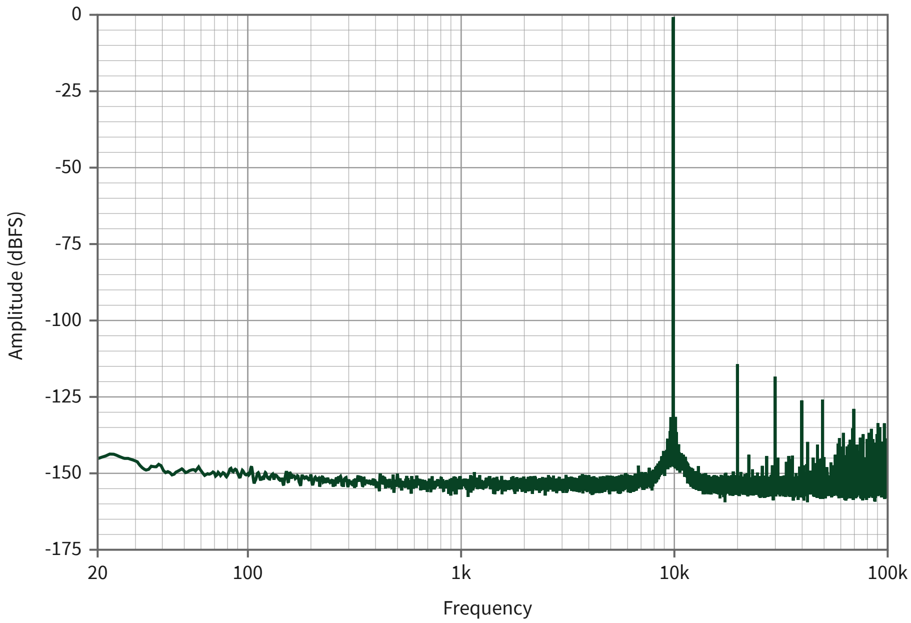
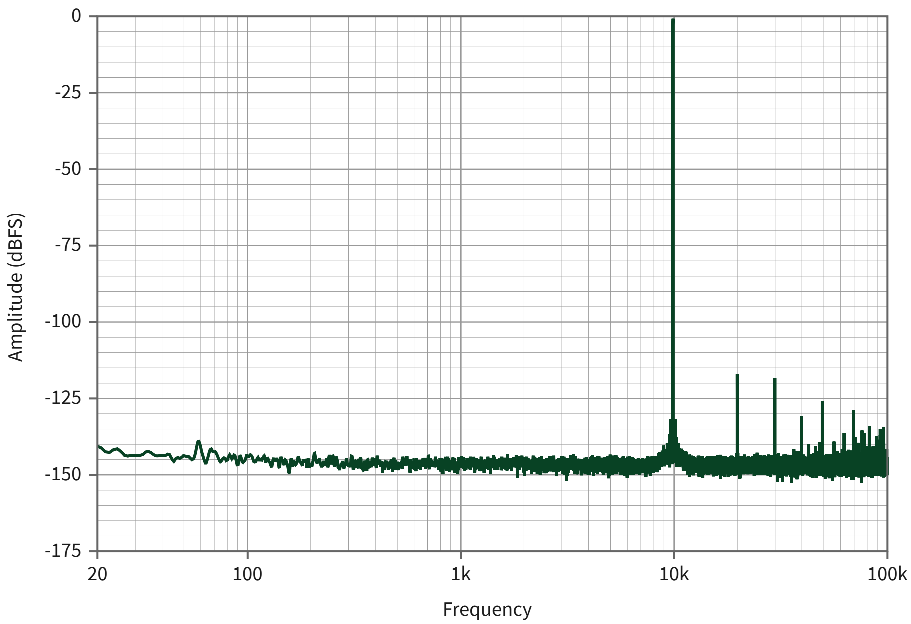


Figure 25. FFT -1 dBFS 10 kHz Tone 30 dB Attenuation



Total Harmonic Distortion (THD)

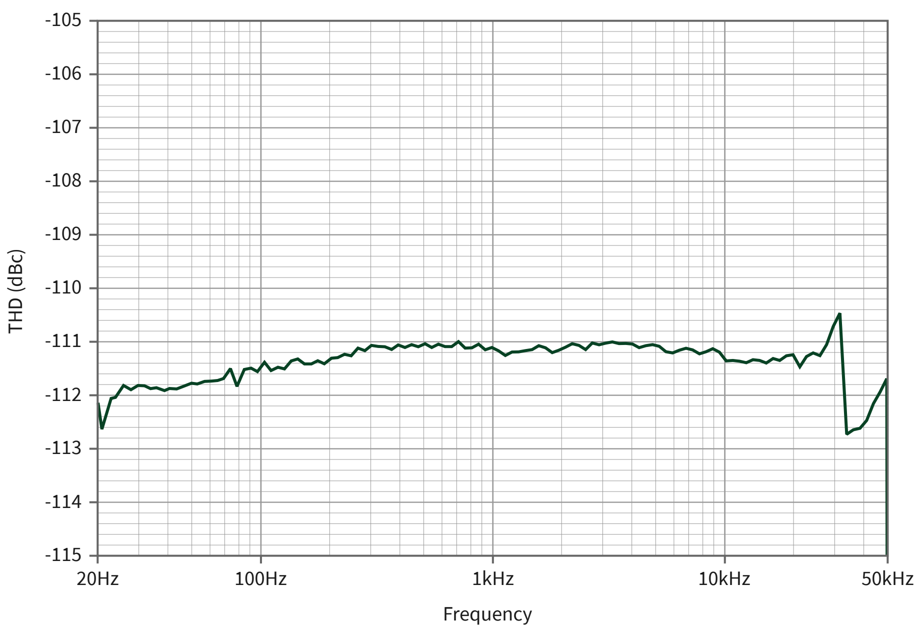
Attenuation (dB)	THD (dBc), 25 °C ±5 °C				
	f_s = 200 kS/s				
	20 Hz to 22.4 kHz Bandwidth		20 Hz to 100 kHz Bandwidth		
	1 kHz	20 Hz to 10 kHz	1 kHz	20 Hz to 20 kHz	20 Hz to 100 kHz
0, 10, 20, 30	-109	-106	-109	-106	-106

-1 dBFS output amplitude.

Includes the 2nd through the 11th harmonics.

All 40 Ω output configurations.

Figure 26. AO THD vs Frequency



AO Total Harmonic Distortion (THD) plus Noise

Table 8. AO THD+N, Differential

Attenuation (dB)	THD+N (dBc), 25 °C ±5 °C					
	f_S = 200 kS/s					
	20 Hz to 22.4 kHz Bandwidth		20 Hz to 100 kHz Bandwidth			20 Hz to 500 kHz Bandwidth
	f_{out} = 1 kHz	f_{out} = 20 Hz to 10 kHz	f_{out} = 1 kHz	f_{out} = 20 Hz to 20 kHz	f_{out} = 20 Hz to 90.6 kHz	f_{out} = 20 Hz to 90.6 kHz
0	-108	-107	-108	-107	-106	-93
10	-108	-107	-108	-107	-106	-93
20	-106	-105	-106	-105	-105	-93
30	-103	-100	-99	-98	-98	-87
-1 dBFS output amplitude						

Table 9. AO THD+N, Pseudodifferential

Attenuation (dB)	THD+N (dBc), 25 °C ±5 °C					
	f_S = 200 kS/s					
	20 Hz to 22.4 kHz Bandwidth		20 Hz to 100 kHz Bandwidth			20 Hz to 500 kHz Bandwidth
	f_{out} = 1 kHz	f_{out} = 20 Hz to 20 kHz	f_{out} = 1 kHz	f_{out} = 20 Hz to 20 kHz	f_{out} = 20 Hz to 90.6 kHz	f_{out} = 20 Hz to 90.6 kHz
0	-107	-107	-107	-107	-104	-92
10	-106	-106	-106	-106	-106	-90
20	-105	-105	-100	-100	-100	-90
30	-98	-85	-90	-90	-90	-77
-1 dBFS output amplitude						

AO Intermodulation Distortion (IMD)

IMD	-106 dBc

Crosstalk, Output-to-Output Channel Separation

All attenuation settings	
1 kHz signal	-135 dBc
90.6 kHz signal	-110 dBc

Crosstalk, Output-to-Input Channel Separation

AI Gain (dB)	Channel Crosstalk (dBc)	
	f_{out} = 1 kHz Signal	f_{out} = 90.6 kHz
All	-140	-100

Pure Tone Sine Generator Characteristics

Frequency range	10 Hz to 22 kHz
Frequency resolution	<1 mHz
Settling time	90 cycles + 1 ms

Pure Tone Spurious Free Dynamic Range (SFDR) with Harmonics

SFDR	
6.3 V RMS	130 dB
2.0 V RMS	130 dB

0.63 V RMS	130 dB
0.2 V RMS	120 dB

Pure Tone Representative Performance FFTs

Measurement Instrument: Audio Precision APx555 audio analyzer, differential input configuration.

Acquisition: high-performance sine mode, 16 averages of 1.2 MS at 1.24 MS/s, AP equiripple window.

Figure 27. FFT 1 kHz, 0.2 V RMS

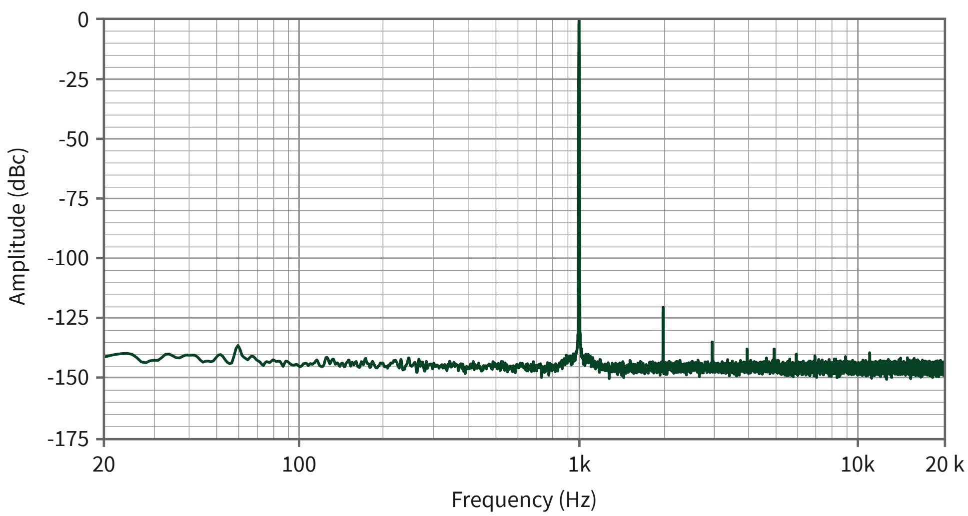


Figure 28. FFT 1 kHz, 0.63 V RMS

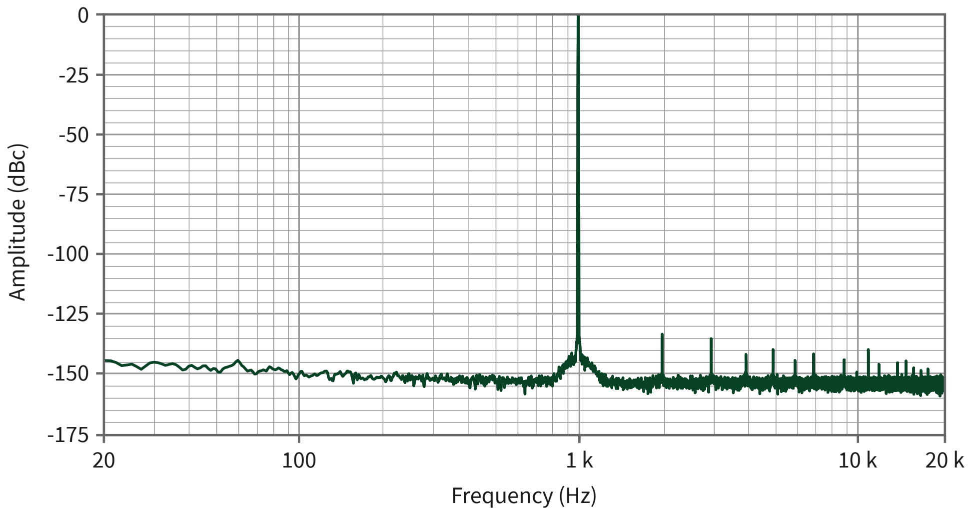


Figure 29. FFT 1 kHz, 2 V RMS

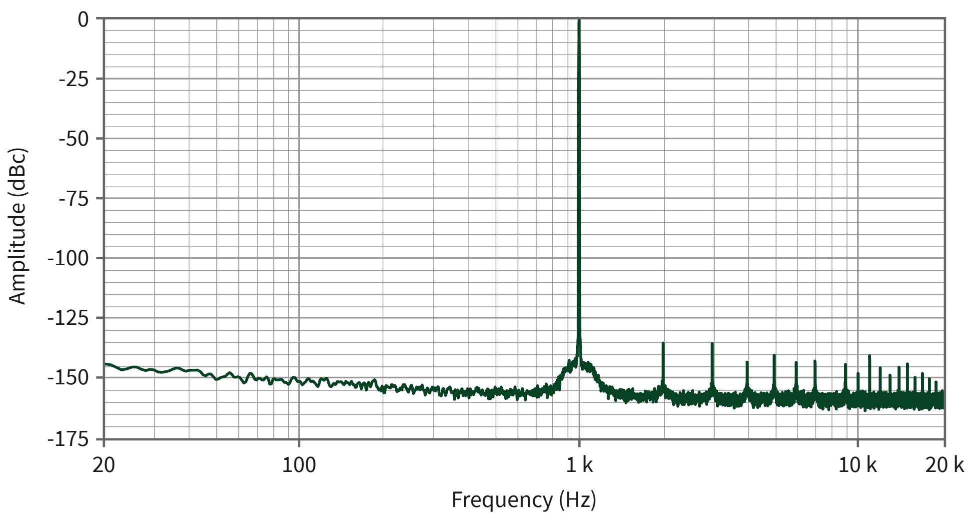


Figure 30. FFT 1 kHz, 6.3 V RMS

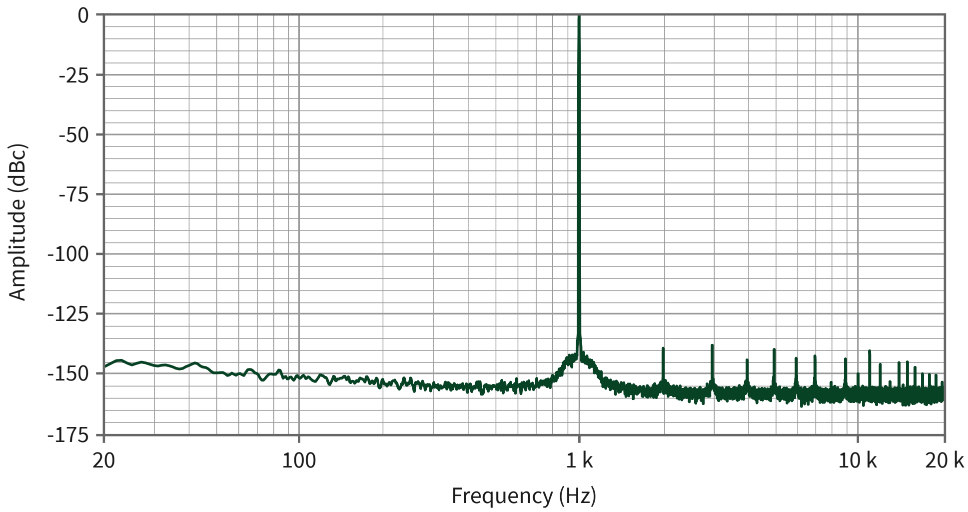


Figure 31. FFT 10 kHz, 0.2 V RMS

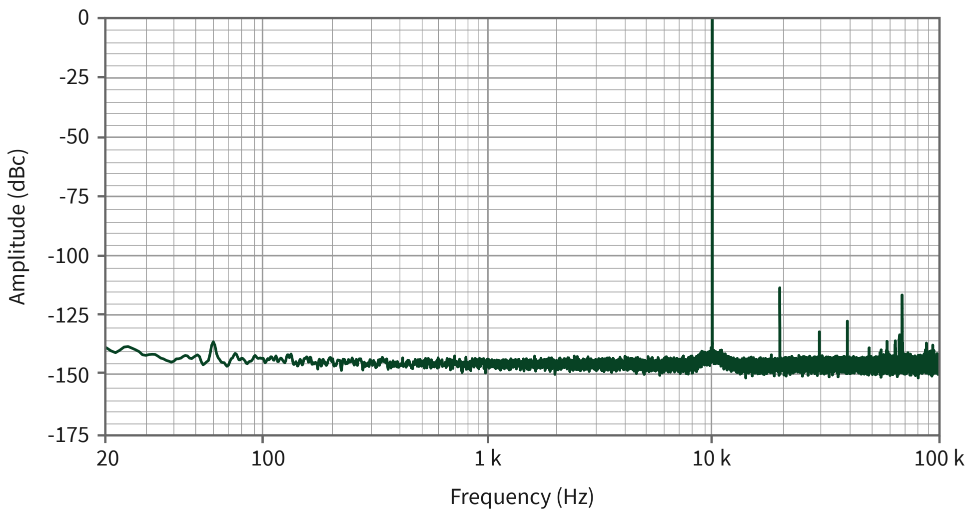


Figure 32. FFT 10 kHz, 0.63 V RMS

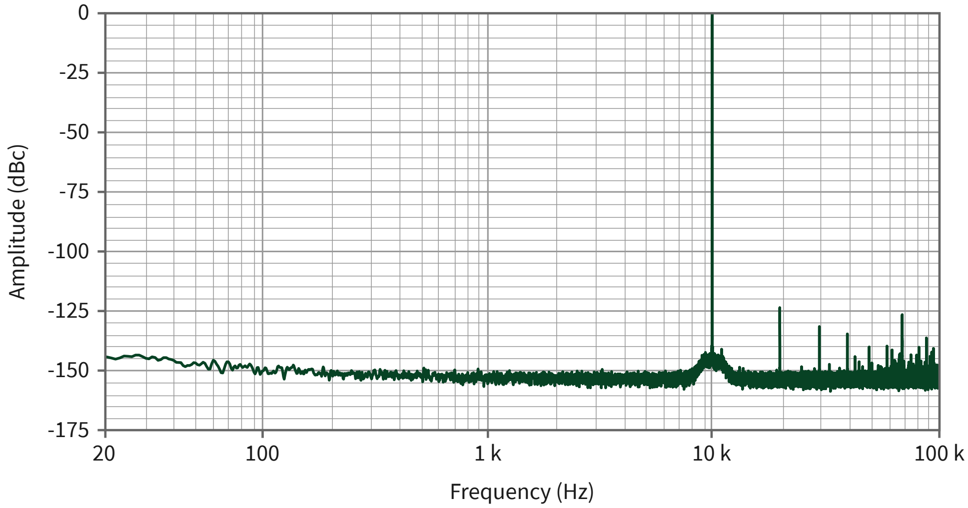


Figure 33. FFT 10 kHz, 2 V RMS

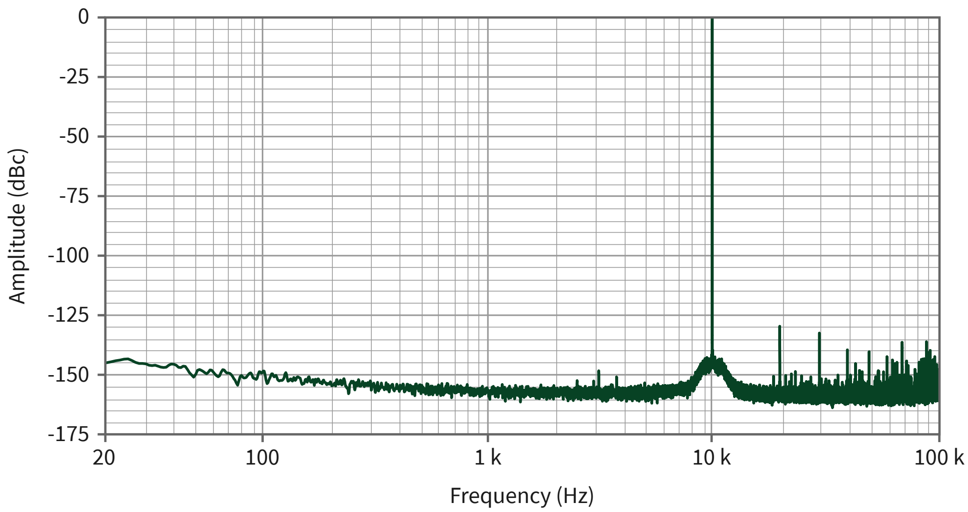
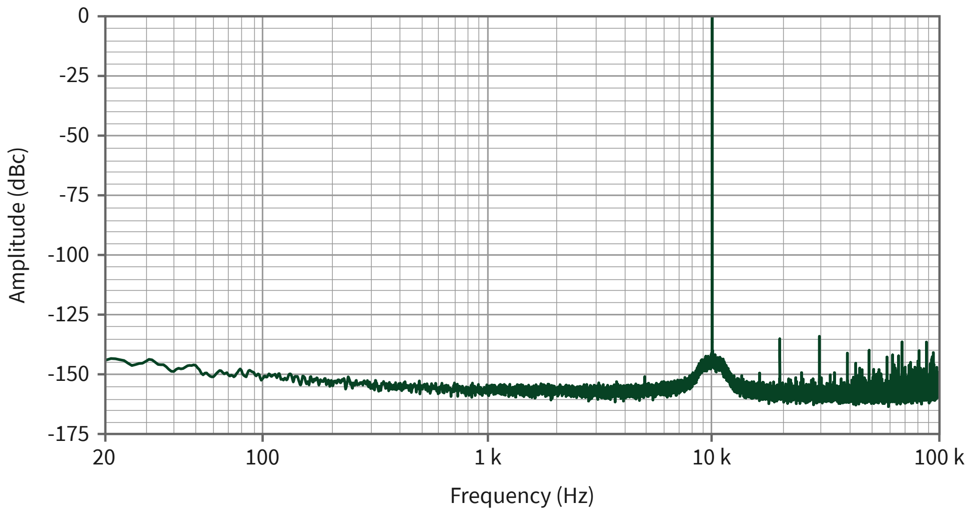


Figure 34. FFT 10 kHz, 6.3 V RMS



Pure Tone Total Harmonic Distortion (THD)

V out	THD (dBc)		
	f_{out} = 1 kHz	f_{out} = 10 Hz to 22 kHz	
		10 Hz to 22.4 kHz Bandwidth	10 Hz to 100 kHz Bandwidth
6.3 V RMS	-129	-125	-120
2 V RMS	-128	-124	-120
0.63 V RMS	-125	-121	-116
0.2 V RMS	-120	-112	-110

-1 dBFS output amplitude.

Includes the 2nd through the 11th harmonics.

Pure Tone THD Performance

Figure 35. THD of 1 kHz Tone Amplitude Sweep

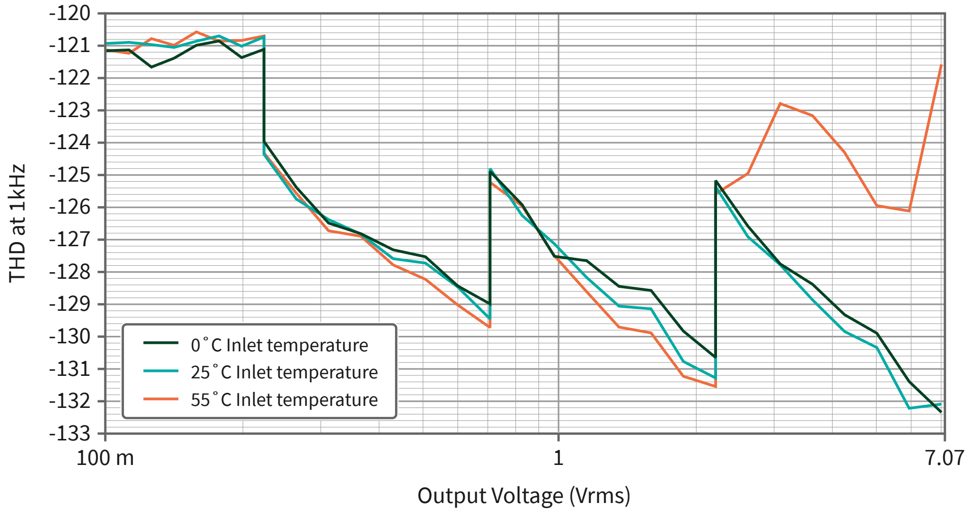


Figure 36. THD of 1 kHz Tone Temperature Sweep

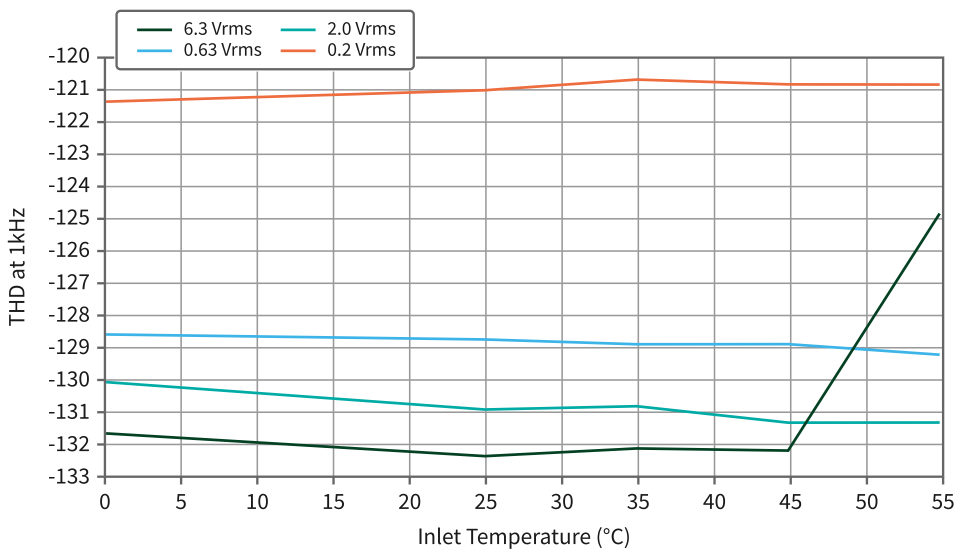


Figure 37. THD over 100 kHz bandwidth

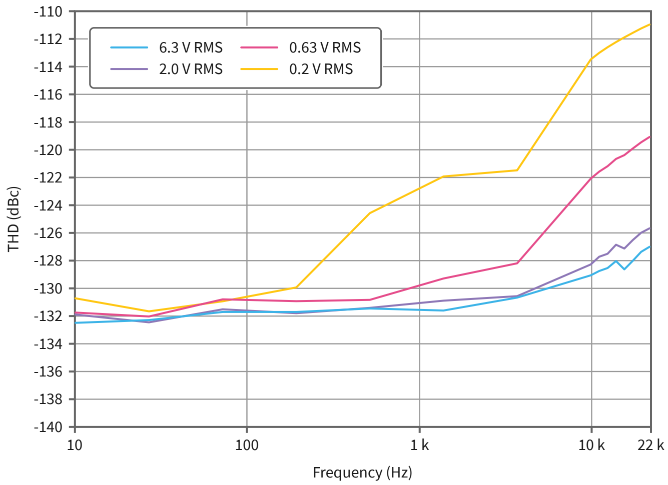


Figure 38. THD over 22.4 kHz bandwidth

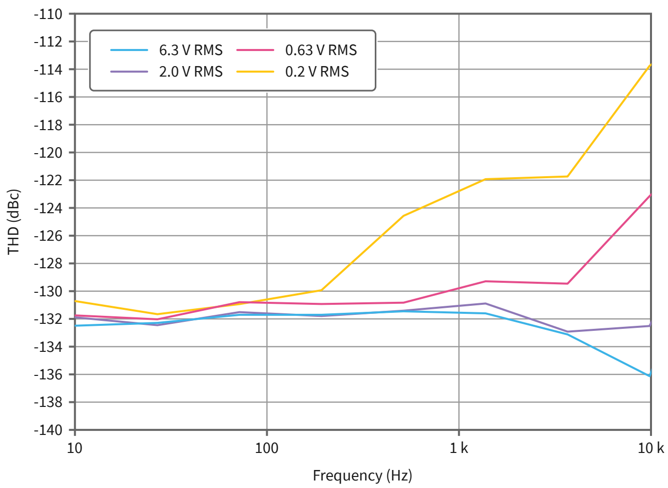


Figure 39. Pure Tone Sine Generator THD vs Frequency and Temperature 0.2 V RMS

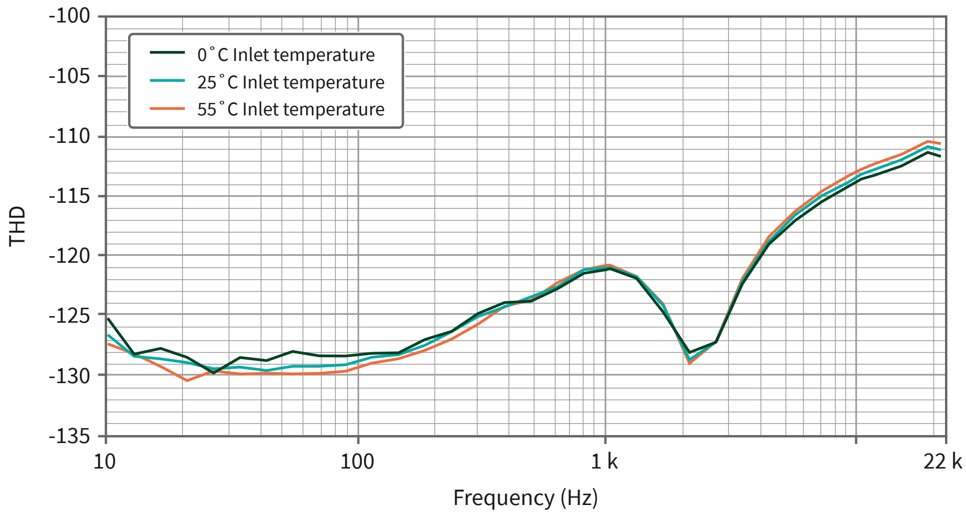


Figure 40. Pure Tone Sine Generator THD vs Frequency and Temperature 0.63 V RMS

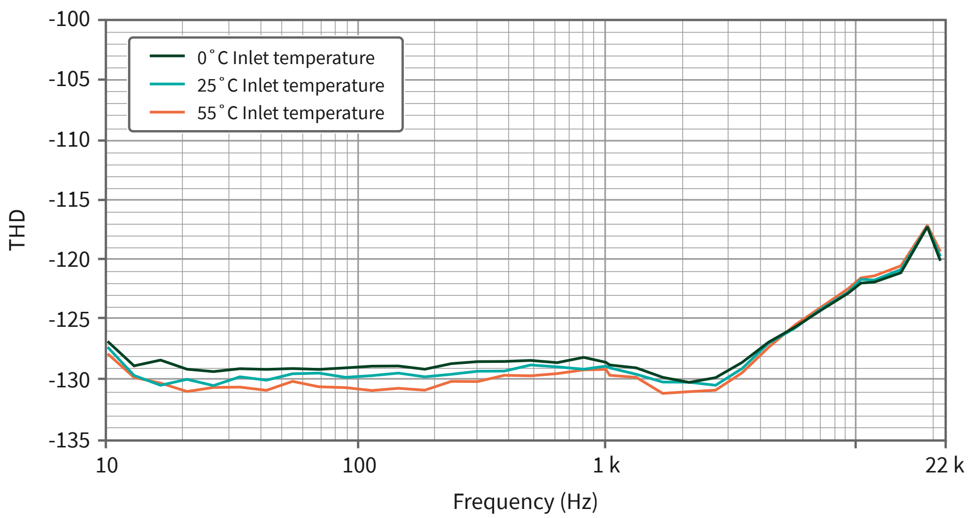


Figure 41. Pure Tone Sine Generator THD vs Frequency and Temperature 2.0 V RMS

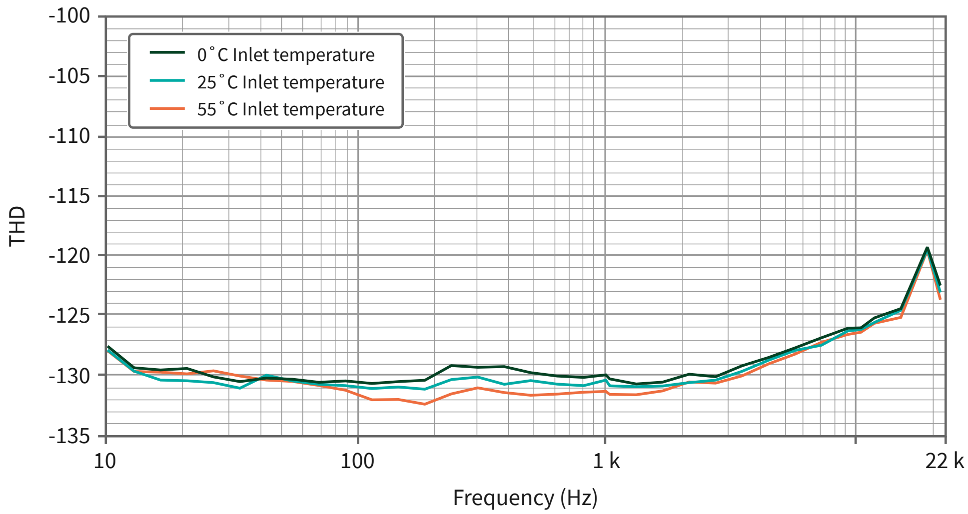
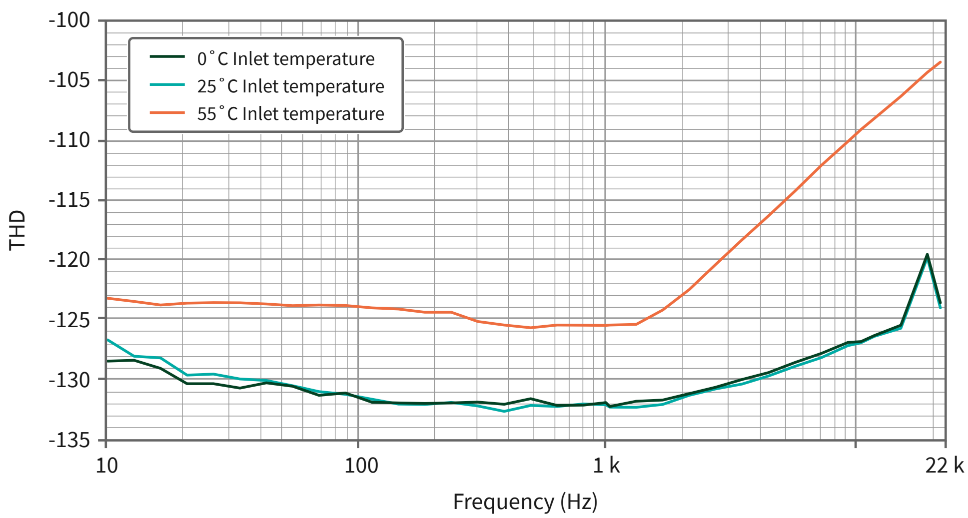


Figure 42. Pure Tone Sine Generator THD vs Frequency and Temperature 6.3 V RMS



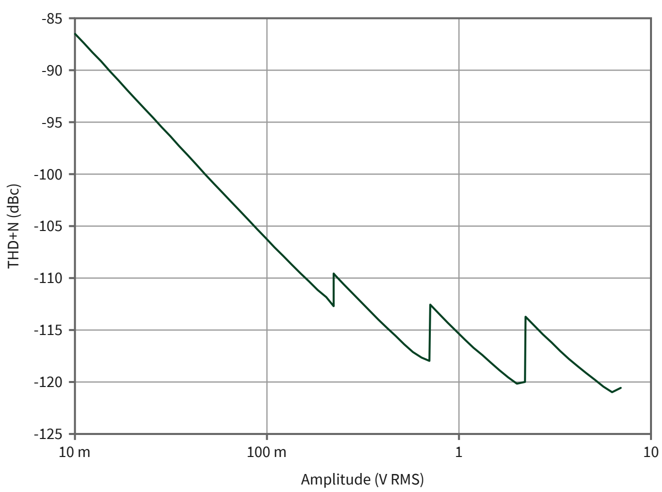
Pure Tone Total Harmonic Distortion (THD) plus Noise

V out	THD+N			
	f_{out} = 1 kHz		f_{out} = 10 Hz to 22 kHz	
	10 Hz to 22.4 kHz Bandwidth	10 Hz to 100 kHz Bandwidth	10 Hz to 22.4 kHz Bandwidth	10 Hz to 100 kHz Bandwidth
10 V peak ≥ V out > 3.16 V peak	-129 dBc + 4.6 µV RMS	-129 dBc + 11 µV RMS	-125 dBc + 4.6 µV RMS	-120 dBc + 11 µV RMS

V out	THD+N			
	f_{out} = 1 kHz		f_{out} = 10 Hz to 22 kHz	
	10 Hz to 22.4 kHz Bandwidth	10 Hz to 100 kHz Bandwidth	10 Hz to 22.4 kHz Bandwidth	10 Hz to 100 kHz Bandwidth
3.16 V peak ≥ V out > 1 V peak	-128 dBc + 1.7 µV RMS	-128 dBc + 4.0 µV RMS	-124 dBc + 1.7 µV RMS	-120 dBc + 4.0 µV RMS
1 V peak ≥ V out > 0.316 V peak	-125 dBc + 0.8 µV RMS	-125 dBc + 2.0 µV RMS	-121 dBc + 0.8 µV RMS	-116 dBc + 2.0 µV RMS
0.316 V peak ≥ V out	-120 dBc + 0.6 µV RMS	-120 dBc + 1.5 µV RMS	-112 dBc + 0.6 µV RMS	-110 dBc + 1.5 µV RMS

Pure Tone THD+N Performance

Figure 43. THD+N of 1 kHz Tone Amplitude Sweep



Transducer Electronic Data Sheet (TEDS) Support

Supports Transducer Electronic Data Sheet (TEDS) according to the IEEE 1451 Standard	Class I, all module inputs

Note For more information about TEDs, go to ni.com/info and enter the Info Code rdteds.

Maximum load capacitance	10,000 pF

Frequency Timebase Characteristics

Accuracy	
Using internal VCXO timebase	
T_{cal} ±5 °C	±27 ppm maximum/warranted
Over full operating temperature range	±100 ppm maximum/warranted
Using external timebase	Equal to accuracy of external timebase

Triggers

Analog trigger	
Purpose	Reference trigger only
Source	Any channel
Level	Full scale, programmable
Mode	Rising-edge or falling-edge with hysteresis, entering or leaving window
Resolution	24 bits
Digital trigger	
Purpose	Start or reference trigger
Source	PFI0, 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, Reference Trigger Out, Sync Pulse Out
Destinations	PFI0, PXI_Trig<0..7>, PXIe_DStarC
Polarity	Software-selectable except for Sync Pulse Out (always active low)

PFI 0 (Front Panel Digital Trigger)

Input	
Logic compatibility	3.3 V or 5 V
Input range	0 V to 5.5 V
V_{IL}	0.95 V maximum/warranted
V_{IH}	2.4 V minimum
Input impedance	10 kΩ
Overvoltage protection	±10 V peak
Output	
Output range	0 V to 3.45 V

V_{OL}	0.33 V maximum/warranted at 5 mA
V_{OH}	2.8 V minimum at 5 mA
Output impedance	50 Ω
Output current	±5 mA maximum/warranted

General Specifications

This section lists general specification information for the PXIe-4468.

Bus Interface

Form factor	x1 PXI Express peripheral module, Specification rev 1.0 compliant
Slot compatibility	x1 and x4 PXI Express or PXI Express hybrid slots
DMA channels	2, analog input; 2, analog output

Timing and Synchronization

Number of timing engines	4
Reference clock source	Onboard clock, backplane PXIe_CLK100
Intermodule ADC, DAC clock skew	
T_{tb} ±5 °C	23 ns maximum/warranted
Over full operating temperature range	30 ns maximum/warranted

Power Requirements

+3.3 V	+3.0 A, maximum, maximum/warranted
+12 V	+2.0 A, maximum, maximum/warranted

Physical

Dimensions (not including connectors)	16 cm x 10 cm (6.3 in. x 3.9 in.) 3U CompactPCI slot
Analog input/output connector	BNC female or Mini-XLR male
Digital trigger connector (PFI 0)	SMB male
Front-panel LEDs	2 (Access, Active), 4 (Active, per channel—<AI 0..1> and <AO 0..1>)
Weight	360 g (12.7 oz)
Measurement Category	I

Caution Do not use the PXIe-4468 for connections to signals or for measurements within Categories II, III, or IV.

Caution The protection provided by the PXIe-4468 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.

Environmental Characteristics

Temperature	
Operating	0 °C to 55 °C
Storage	-40 °C to 71 °C
Humidity	
Operating	10 to 90%, noncondensing
Storage	5% to 95%, noncondensing
Pollution Degree	2
Maximum altitude	2,000 m (at 25 °C ambient temperature)
Shock and Vibration	
Operating vibration	5 Hz to 500 Hz, 0.3 g RMS
Non-operating vibration	5 Hz to 500 Hz, 2.4 g RMS
Operating shock	30 g, half-sine, 11 ms pulse

Calibration

External calibration interval	2 years
Warm-up time	15 minutes