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DEVICE SPECIFICATIONS

NI PXIe-4463

DSA Analog Output

Français Deutsch 日本語 한국어 简体中文

ni.com/manuals

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 ±5 °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

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D/A converter (DAC) resolution ..... 24 bits

DAC type ..... Delta-sigma

Sample rates (f_s)

Range ..... 100 S/s to 51.2 kS/s

Resolution[1] ..... ≤ 45.5 µS/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.

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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}* ±5 °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} ±5 °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/°C

Offset drift

0 dB attenuation..... ±21 µV/°C

17 dB attenuation..... ±13 µV/°C

37 dB attenuation..... ±10 µV/°C

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Dynamic Characteristics

Passband and Image Rejection

Passband.....DC to 0.454 f_s

Image rejection .....115 dBc min,
0.546 f_s < f_{image} < (520.833 kHz - 0.546 f_s)
75 dBc min, f_{image} > (520.833 kHz - 0.546 f_s)

Filter Delay

Output delay[1] (samples)

0.1 kS/s ≤ f_s ≤ 5.0 kS/s.....64
5.0 kS/s < f_s ≤ 10.0 kS/s.....66
10.0 kS/s < f_s ≤ 14.0 kS/s.....68
14.0 kS/s < f_s ≤ 19.0 kS/s.....70
19.0 kS/s < f_s ≤ 24.0 kS/s.....72
24.0 kS/s < f_s ≤ 29.0 kS/s.....74
29.0 kS/s < f_s ≤ 35.0 kS/s.....76
35.0 kS/s < f_s ≤ 39.0 kS/s.....78
39.0 kS/s < f_s ≤ 44.0 kS/s.....80
44.0 kS/s < f_s ≤ 51.2 kS/s.....83

Flatness

Output Configuration	f_s = 51.2 kS/s	
	Flatness (dB)*, †, Max (Typical)	
	f_{out} = 20 Hz to 20 kHz	f_{out} = 20 Hz to 22.4 kHz
Differential	±0.007 (±0.002)	±0.009 (±0.003)
Pseudodifferential	±0.008 (±0.003)	±0.010 (±0.004)

* Relative to 1 kHz.
† All attenuation settings.

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

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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)

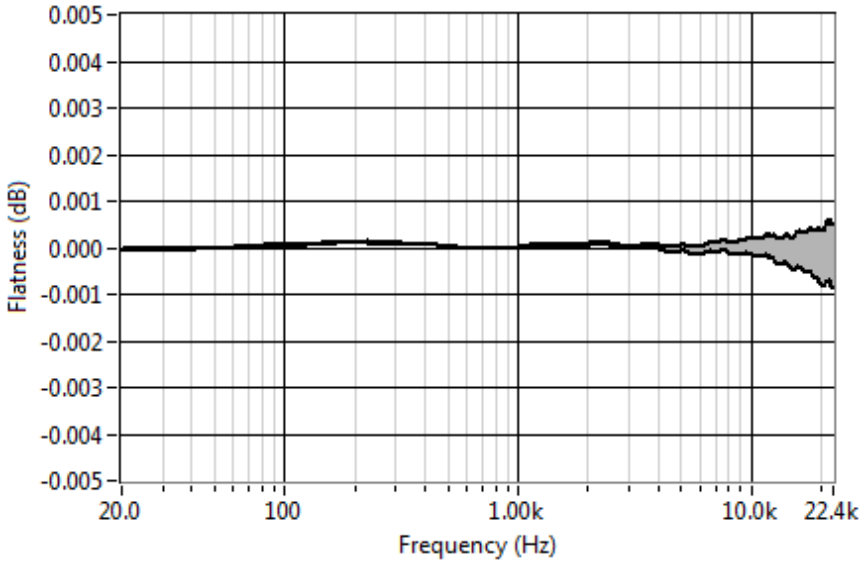
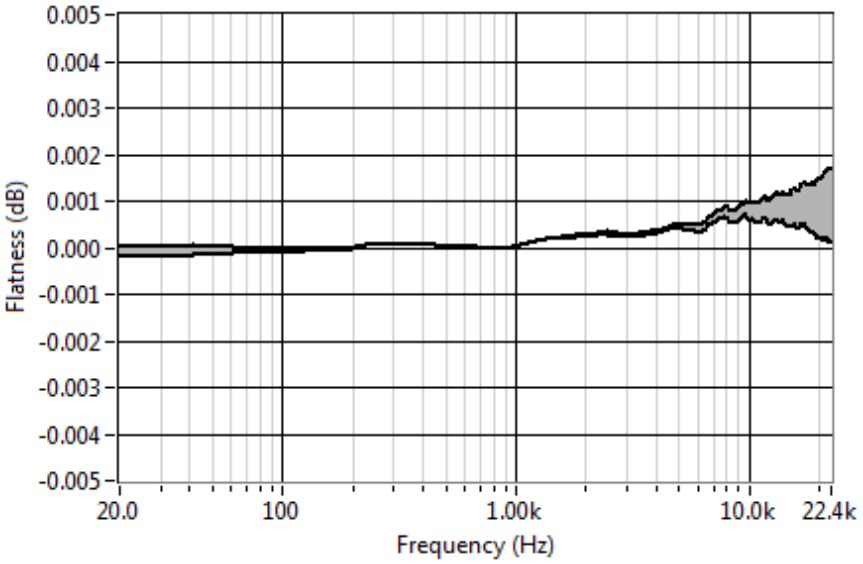


Figure 2. Flatness (17 dB Attenuation, Differential Configuration)



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

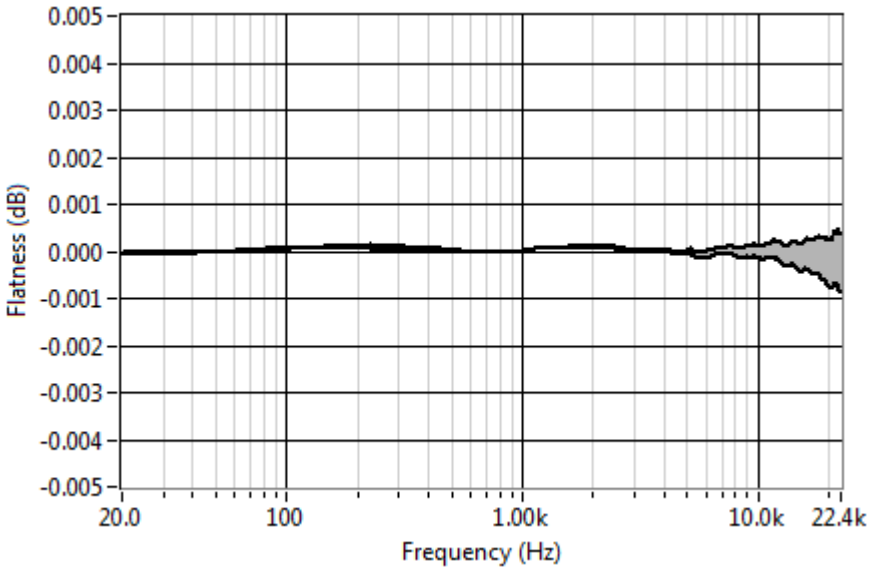
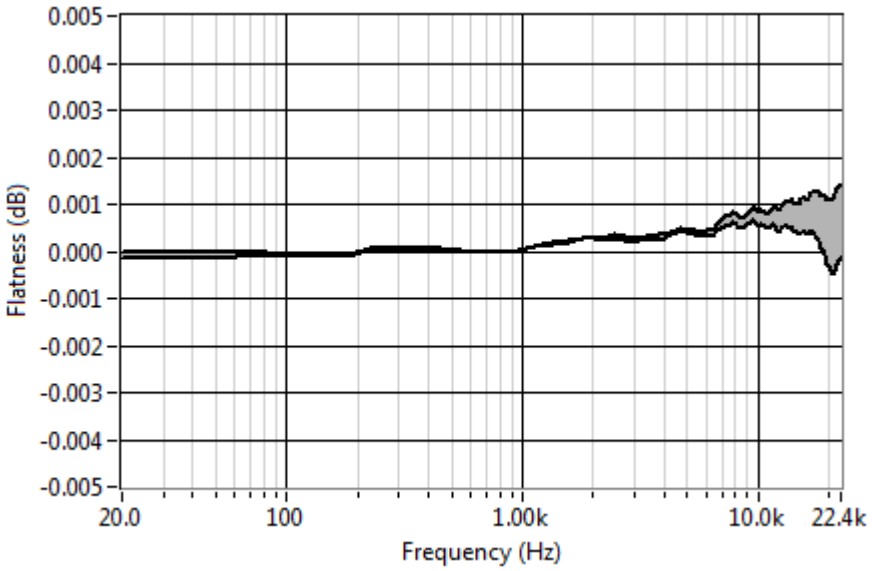


Figure 4. Flatness (17 dB Attenuation, Pseudodifferential Configuration)



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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° × f_{out} × *clock skew*. Refer to the *General Specifications* section for the maximum intermodule clock skew.

Phase Linearity[2]

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.

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Idle Channel Noise

Attenuation (dB)	Idle Channel Noise (μV_{rms})*, Max (Typical)	
	f_s = 51.2 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 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 (nV / $\sqrt{Hz}$)*, Typical	
	f_s = 51.2 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.

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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)

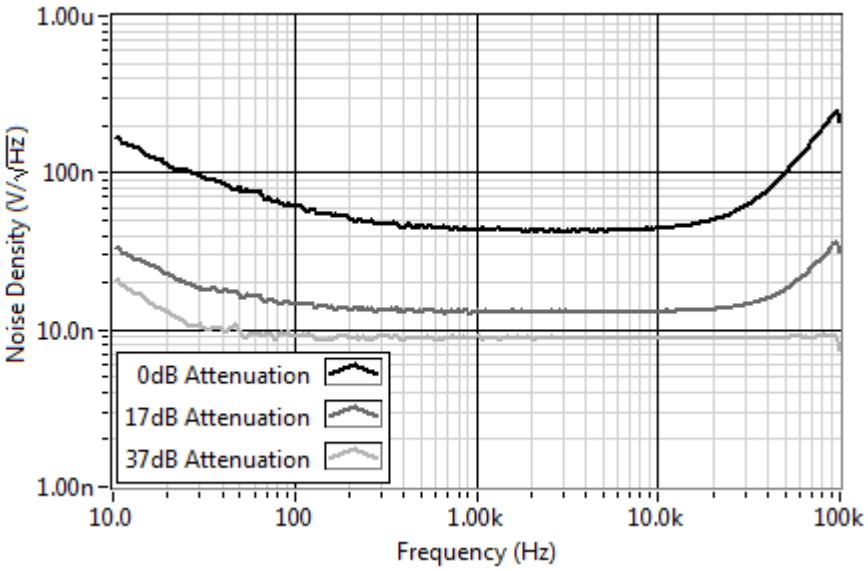
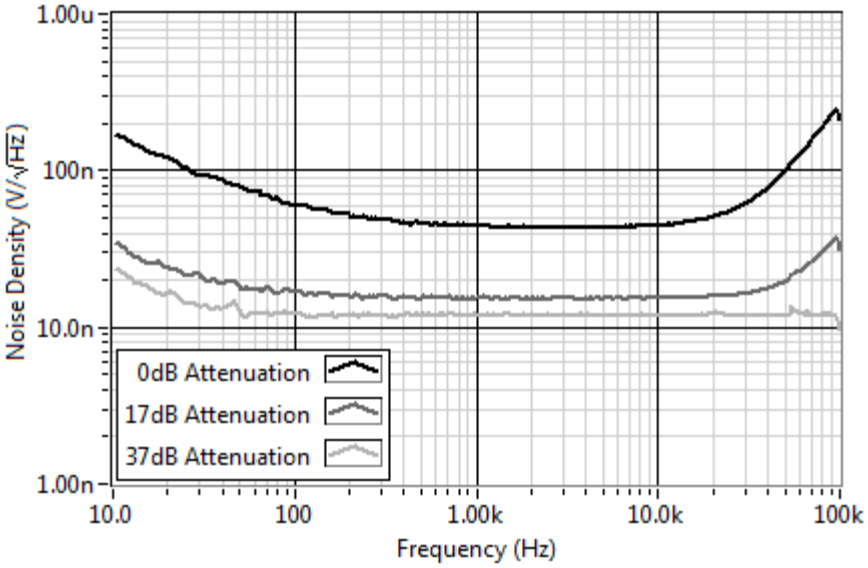


Figure 6. Spectral Noise Density (Pseudodifferential Configuration)



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Spurious Free Dynamic Range (SFDR)

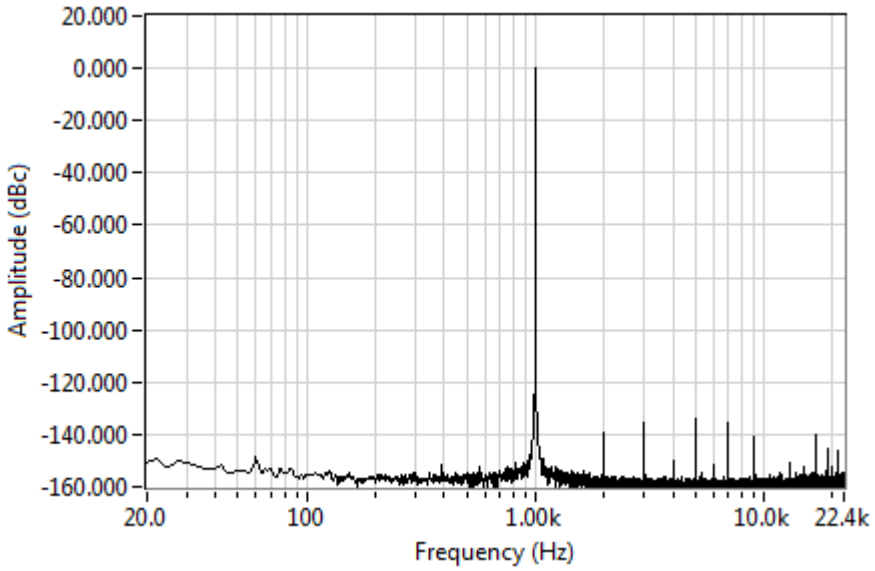
Attenuation (dB)	SFDR (dBc)*, †
	f_s = 51.2 kS/s
0	123
17	121
37	119

* 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



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

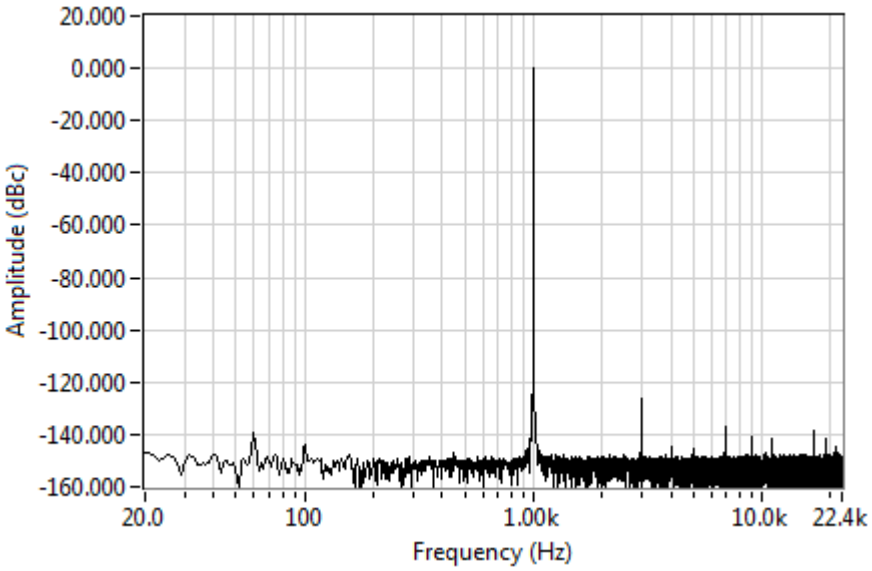
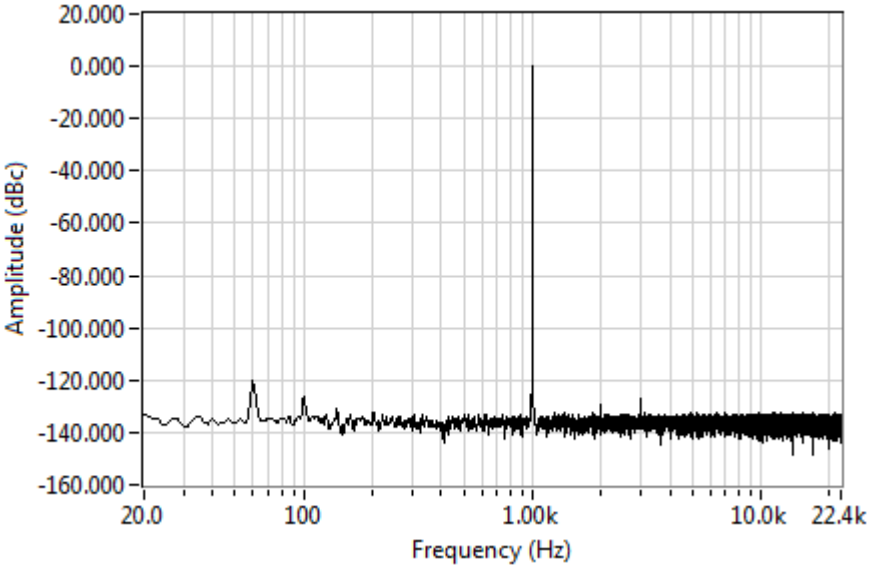


Figure 9. FFT of -1 dBFS, 1 kHz Tone, 37 dB Attenuation



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Total Harmonic Distortion (THD)

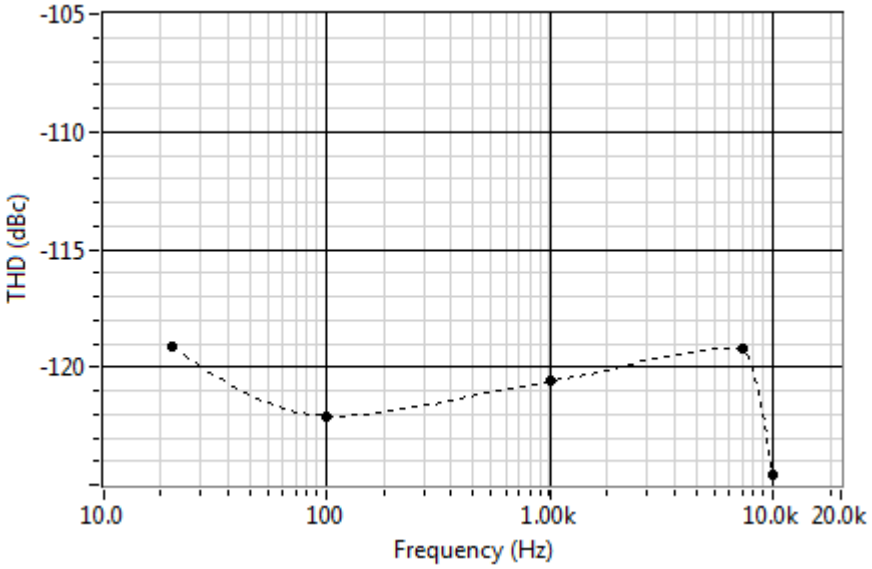
Measurement Bandwidth	THD (dBc)*, †, ‡, 25 °C ±5 °C			
	f_s = 51.2 kS/s			
	f_{out} = 1 kHz	f_{out} = 20 Hz to 20 kHz		
	Load ≥ 60 Ω	Load ≥ 600 Ω	Load ≥ 100 Ω	Load ≥ 60 Ω
20 Hz to 22.4 kHz	-120	-119	-116	-113
20 Hz to 44.8 kHz		-114	-111	-108
20 Hz to 89.6 kHz		-109	-106	-103

* -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



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Figure 11. THD of -1 dBFS Tone, 0 dB Attenuation, Load ≥ 600 Ω, 20 Hz to 44.8 kHz BW

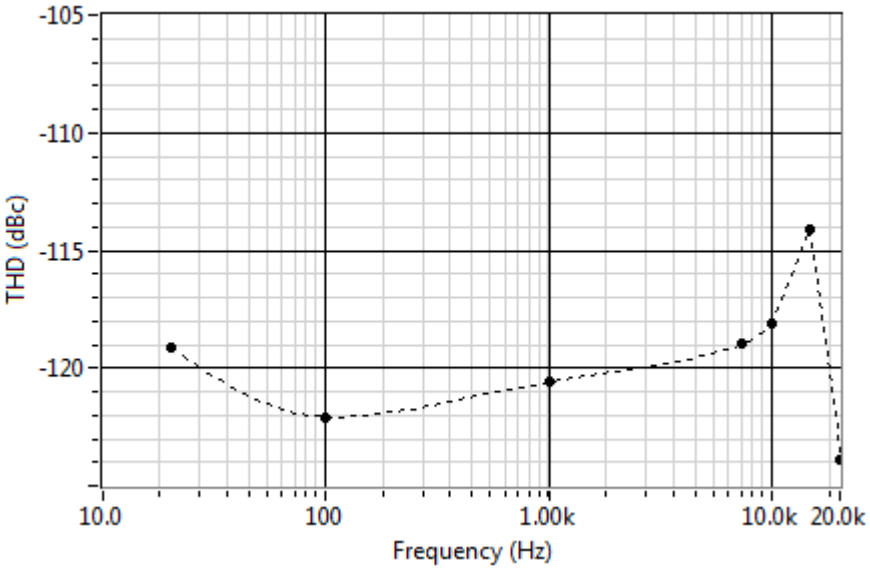
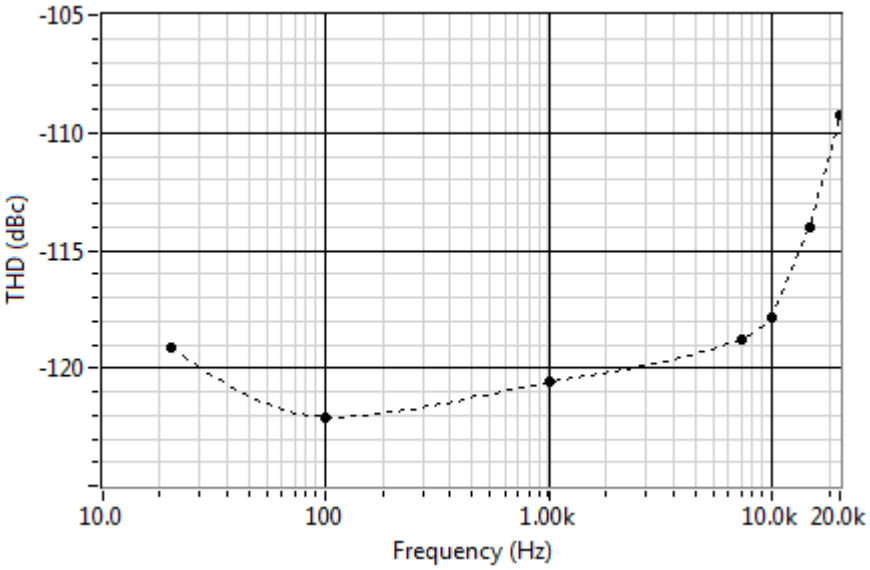
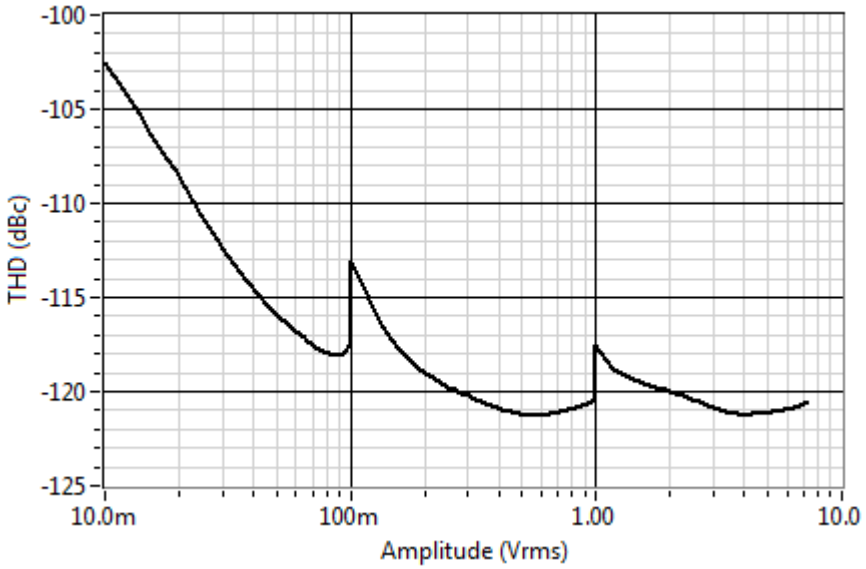


Figure 12. THD of -1 dBFS Tone, 0 dB Attenuation, Load ≥ 600 Ω, 20 Hz to 89.6 kHz BW



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Figure 13. THD of 1 kHz Tone Amplitude Sweep[1], Load ≥ 60 Ω



Total Harmonic Distortion Plus Noise (THD+N)

Output Configuration	THD+N*, 25 °C ±5 °C		
	f_s = 51.2 kS/s		
	0 dB Attenuation		
	f_{out} = 1 kHz	f_{out} = 20 Hz to 20 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.

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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 ≥ 600 Ω

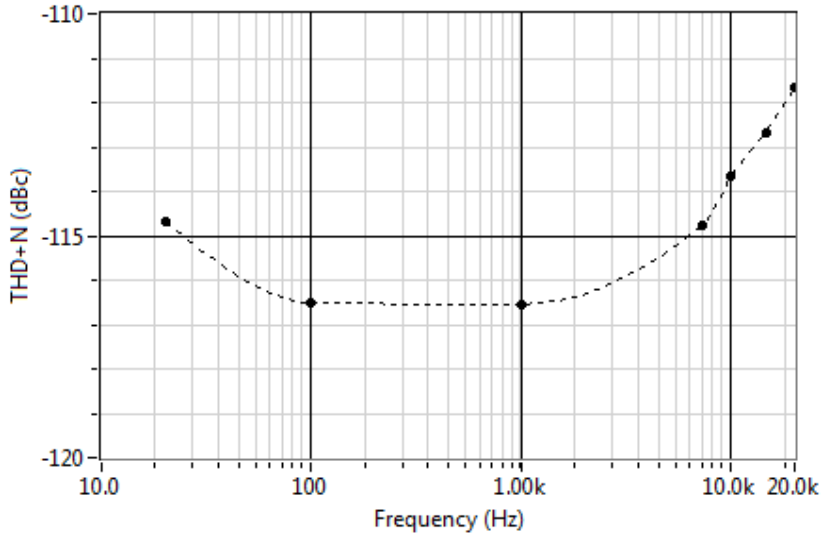
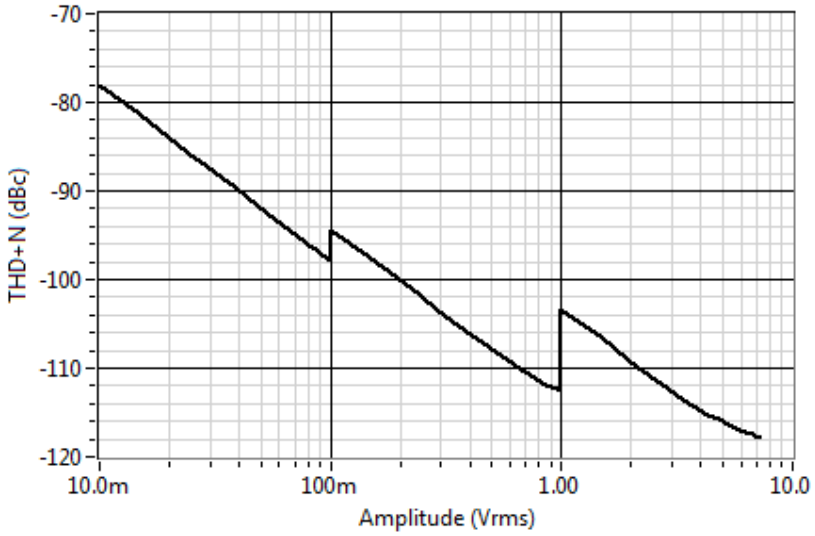


Figure 15. THD+N of 1 kHz Tone Amplitude Sweep, Load ≥ 60 Ω



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Output Configuration	THD+N*, 25 °C ±5 °C			
	f_s = 51.2 kS/s			
	17 dB Attenuation		37 dB Attenuation	
	f_{out} = 1 kHz	f_{out} = 20 Hz to 20 kHz	f_{out} = 1 kHz	f_{out} = 20 Hz to 20 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)*,†	
	2nd Order	2nd and 3rd 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 version[1]

Differential ..... Typically ≤ -100 dBc

Pseudodifferential ..... Typically ≤ -120 dBc

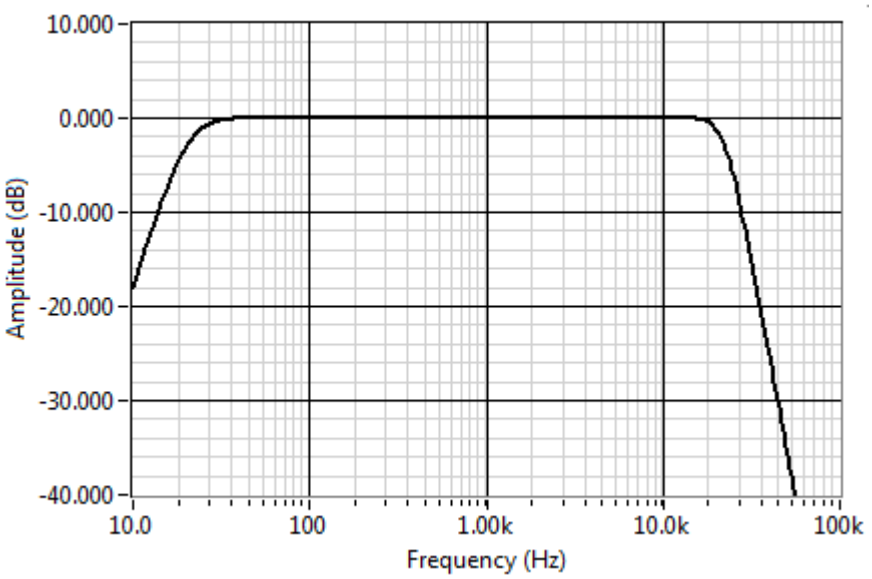
[1] Crosstalk can be reduced by separation and/or shielding between coaxial cables.

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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)



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Onboard Calibration References

Voltage

DC level ..... 5.000 V

Temperature coefficient ..... ±9 ppm/°C max

Time stability ..... ±50 ppm/ $\sqrt{1{,}000\ \text{hr}}$

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)

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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 kΩ
- Input current (0 V ≤ V_{in} ≤ 4.5 V) ..... ≤ 450 µA
- Overvoltage protection ..... ±10 V_{pk} 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 ..... ±5 mA min
- Overvoltage protection ..... ±10 V_{pk} 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

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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.

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[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.

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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 ±5 °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.

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CE Compliance CE

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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