PCIe-5764 Specifications

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Contents

PCIe-5764 Specifications

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

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.
- **Measured** specifications describe the measured performance of a representative model.

Specifications are **Typical** unless otherwise noted.

Digital I/O

Connector	Molex™ Nano-Pitch I/O™
5.0 V Power	±5%, 50 mA maximum, nominal

Signal	Type	Direction
MGT Tx± <3..0>[1]	Xilinx UltraScale GTH	Output
MGT Rx± <3..0>[1]	Xilinx UltraScale GTH	Input
DIO <7..0>	Single-ended	Bidirectional
5.0 V	DC	Output
GND	Ground	—

Table 1. Digital I/O Signal Characteristics

Digital I/O Single-Ended Channels

Number of channels	8
Signal type	Single-ended
Voltage families	3.3 V, 2.5 V, 1.8 V, 1.5 V, 1.2 V
Input impedance	100 kΩ, nominal
Output impedance	50 Ω, nominal
Direction control	Per channel
Minimum required direction change latency	200 ns
Maximum output toggle rate	60 MHz with 100 µA load, nominal

Voltage Family (V)	V_{IL} (V)	V_{IH} (V)	V_{OL} (100 µA Load) (V)	V_{OH} (100 µA Load) (V)	Maximum DC Drive Strength (mA)
3.3	0.8	2.0	0.2	3.0	24
2.5	0.7	1.6	0.2	2.2	18
1.8	0.62	1.29	0.2	1.5	16
1.5	0.51	1.07	0.2	1.2	12
1.2	0.42	0.87	0.2	0.9	6

Table 2. Digital I/O Single-Ended DC Signal Characteristics[2]

Digital I/O High-Speed Serial MGT[3]

Note MGTs are available on devices with KU040 and KU060 FPGAs only.

Data rate	500 Mb/s to 16.375 Gb/s, nominal
Number of Tx channels	4
Number of Rx channels	4
I/O AC coupling capacitor	100 nF

MGT TX± Channels[4]

Minimum differential output voltage[5]	170 mV pk-pk into 100 Ω, nominal
I/O coupling	AC-coupled, includes 100 nF capacitor

MGT RX± Channels

Differential input voltage range	
≤ 6.6 Gb/s	150 mV pk-pk to 2000 mV pk-pk, nominal
> 6.6 Gb/s	150 mV pk-pk to 1250 mV pk-pk, nominal
Differential input resistance	100 Ω, nominal
I/O coupling	DC-coupled, requires external capacitor

Reconfigurable FPGA

PCIe-5764 modules are available with multiple FPGA options. The following table lists the FPGA specifications for the PCIe-5764 FPGA options.

	KU035	KU040	KU060
LUTs	203,128	242,200	331,680
DSP48 slices (25 × 18 multiplier)	1,700	1,920	2,760
Embedded Block RAM	19.0 Mb	21.1 Mb	38.0 Mb
Default timebase	80 MHz		
Timebase reference sources	Onboard 100 MHz oscillator		
Data transfers	DMA, interrupts, programmed I/O	DMA, interrupts, programmed I/O, multi-gigabit transceivers	
Number of DMA channels	60		

Table 3. Reconfigurable FPGA Options

Note The Reconfigurable FPGA Options table depicts the total number of FPGA resources available on the part. The number of resources available to the user is slightly lower, as some FPGA resources are consumed by board-interfacing IP for PCI Express, device configuration, and various board I/O. For more information, contact NI support.

Note For FPGA designs using the majority of KU040 or KU060 FPGA resources while running at clock rates over 150 MHz, the module may require more power than is available. If the module attempts to draw more than allowed per its specification, the module protects itself and reverts to a default FPGA personality. Refer to the getting started guide for your module or contact NI support for more information.

Onboard DRAM

Memory size	4 GB (2 banks of 2 GB)
DRAM clock rate	1064 MHz
Physical bus width	32 bit

LabVIEW FPGA DRAM clock rate	267 MHz
LabVIEW FPGA DRAM bus width	256 bit per bank
Maximum theoretical data rate	17 GB/s (8.5 GB/s per bank)

Analog Input

Notice The maximum input signal levels are valid only when the module is powered on. To avoid permanent damage to the PCIe-5764, do not apply a signal to the device when the module is powered down.

General Characteristics

Number of channels	4, single-ended, simultaneously sampled
Connector type	SMA
Input impedance	50 Ω
Input coupling	AC or DC[6]
Sample rate Internal Sample Clock External Sample Clock	 1 GHz 1 GHz
Analog-to-digital converter (ADC)	ADS54J60, 16-bit resolution

Typical Specifications

Full-scale input range (normal operating conditions)

AC-coupled	2.05 V_{pp} (10.22 dBm) at 10 MHz
DC-coupled	2.00 V_{pp} (10 dBm)

Gain accuracy

AC-coupled	±0.1 dB at 10 MHz
DC-coupled	±0.79% at DC

DC offset

AC-coupled	±22 µV
DC-coupled	±363 µV

Bandwidth (-3 dB)[7]

AC-coupled	0.07 MHz to 1.15 GHz[8]
DC-coupled	DC to 400 MHz

	AC-Coupled			DC-Coupled		
	Input Frequency			Input Frequency		
	10.1 MHz	123.1 MHz	199.1 MHz	10.1 MHz	123.1 MHz	199.1 MHz
SNR[9] (dBFS)	69.8	68.7	67	68.7	67.5	65.8
SINAD[9] (dBFS)	68.7	67.6	66.7	68.1	67.1	65.3
SFDR (dBc)	-80.7	-81.8	-75.6	-76.6	-75.8	-73.4

	AC-Coupled			DC-Coupled		
	Input Frequency			Input Frequency		
	10.1 MHz	123.1 MHz	199.1 MHz	10.1 MHz	123.1 MHz	199.1 MHz
ENOB[10] (Bits)	11.1	10.9	10.8	11.0	10.9	10.6

Table 4. Single Tone Spectral Performance

Note Excludes ADC interleaving spurs.

Module	nV/rt (Hz)	dBm/Hz	dBFS/Hz
AC-coupled	9.7	-147.3	-157.5
DC-coupled	11.9	-145.5	-155.5

Table 5. Noise Spectral Density

Note Noise spectral density is verified using a 50 Ω terminator connected to the input.

Figure 1. AC-Coupled Single Tone Spectrum (10.1 MHz, -1 dBFS, 1 kHz RBW), Measured

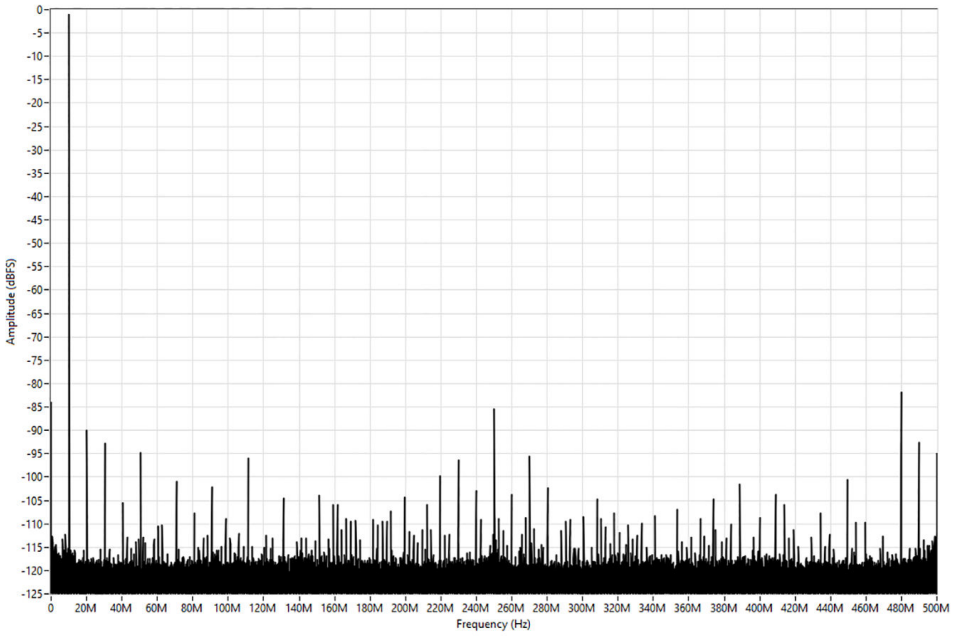


Figure 2. AC-Coupled Single Tone Spectrum (123.1 MHz, -1 dBFS, 1 kHz RBW), Measured

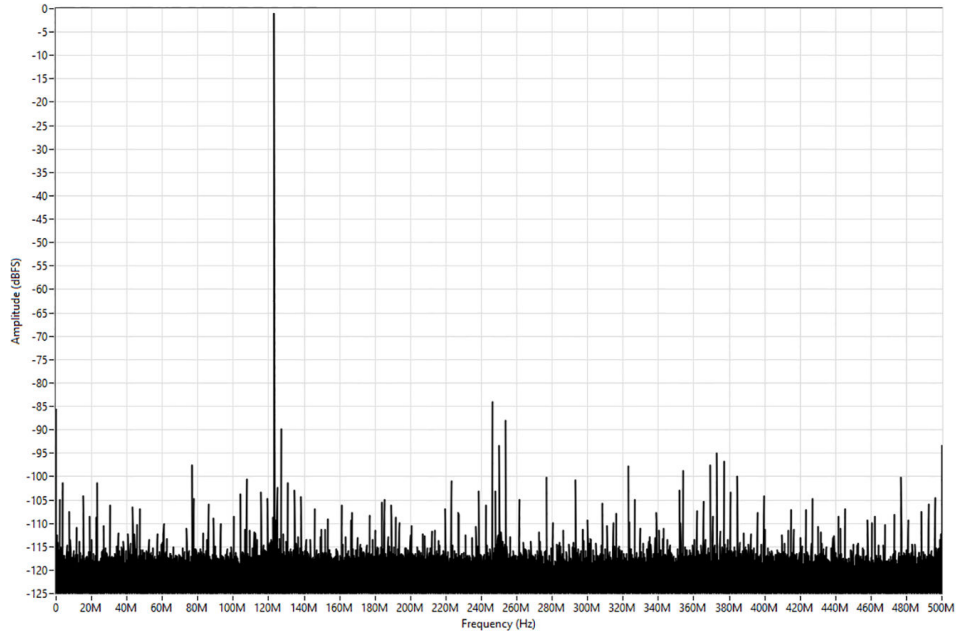


Figure 3. AC-Coupled Single Tone Spectrum (199.1 MHz, -1 dBFS, 1 kHz RBW), Measured

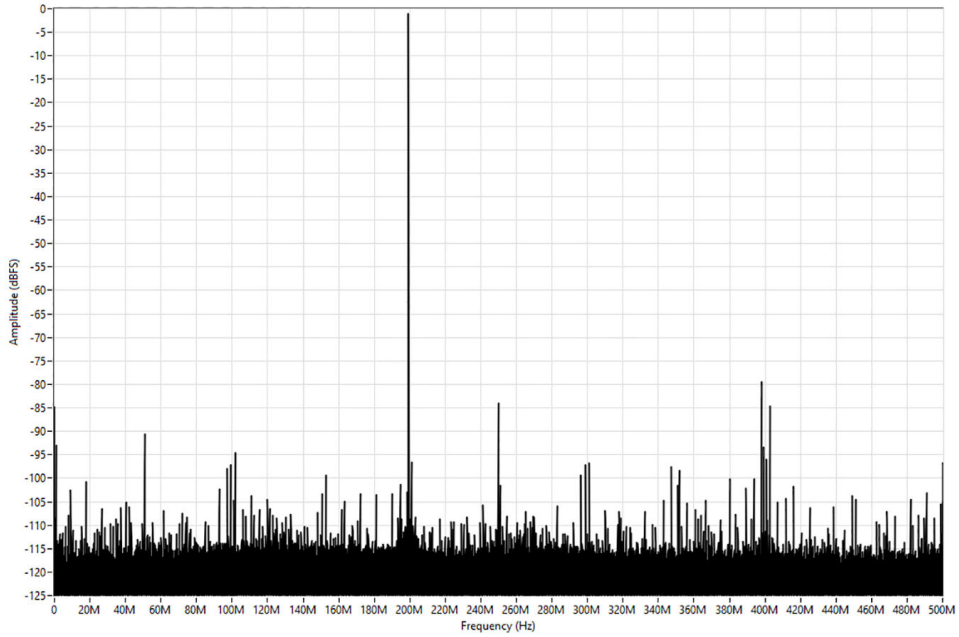


Figure 4. DC-Coupled Single Tone Spectrum (10.1 MHz, -1 dBFS, 1 kHz RBW), Measured

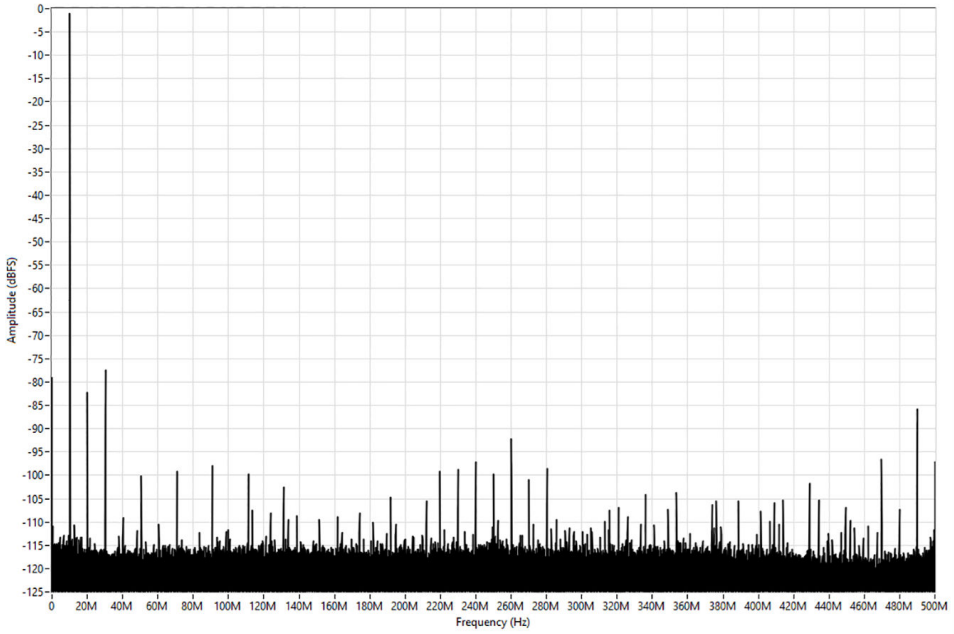


Figure 5. DC-Coupled Single Tone Spectrum (123.1 MHz, -1 dBFS, 1 kHz RBW), Measured

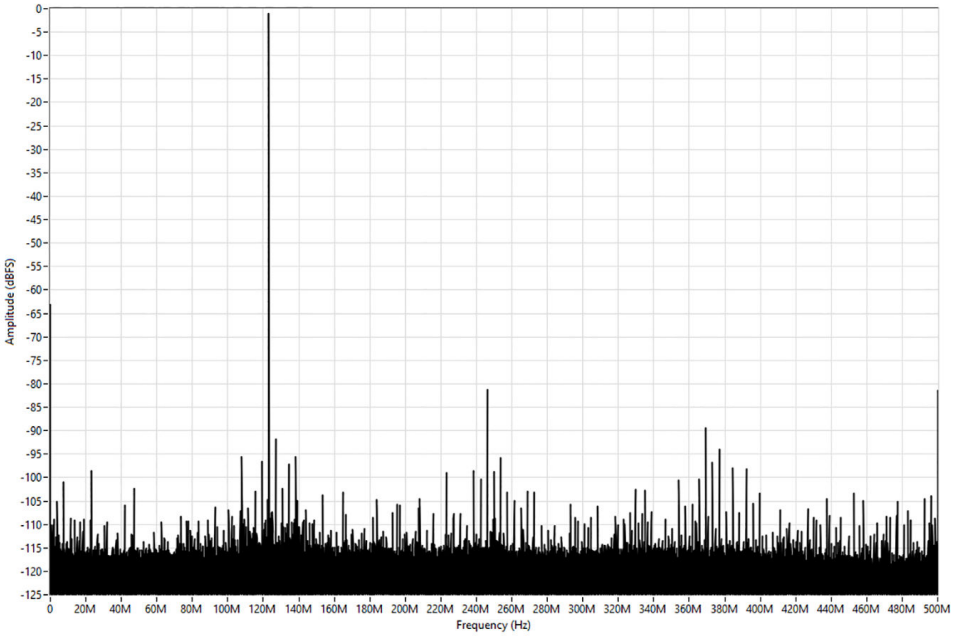
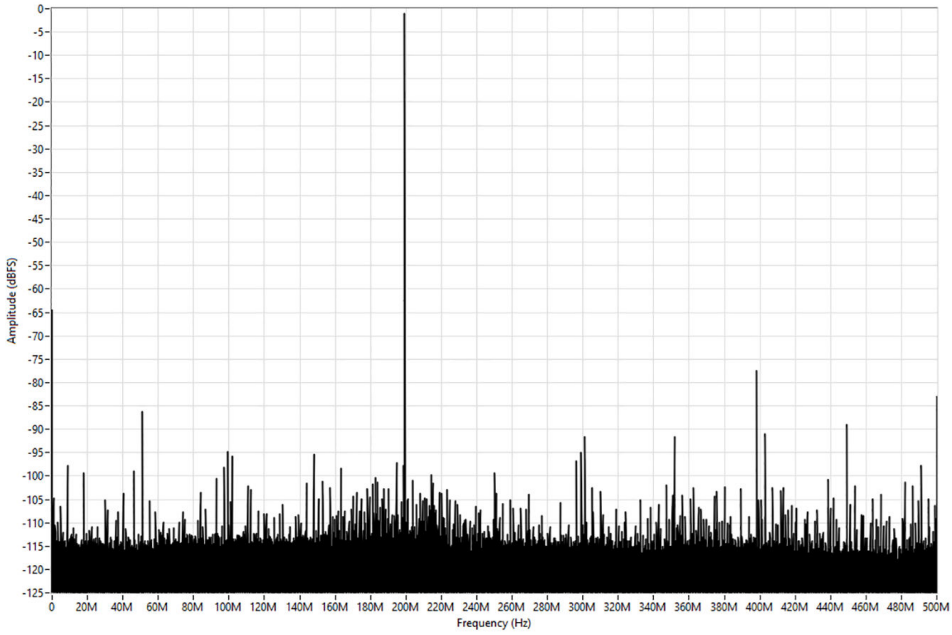


Figure 6. DC-Coupled Single Tone Spectrum (199.1 MHz, -1 dBFS, 1 kHz RBW), Measured



Channel-to-channel crosstalk AC-coupled, measured	
1 MHz	-87 dB
100 MHz	-90 dB
250 MHz	-85 dB
400 MHz	-84 dB

Channel-to-channel crosstalk DC-coupled, measured	
1 MHz	-88 dB
100 MHz	-84 dB
250 MHz	-75 dB
400 MHz	-75 dB

Figure 7. AC-Coupled Frequency Response, Measured

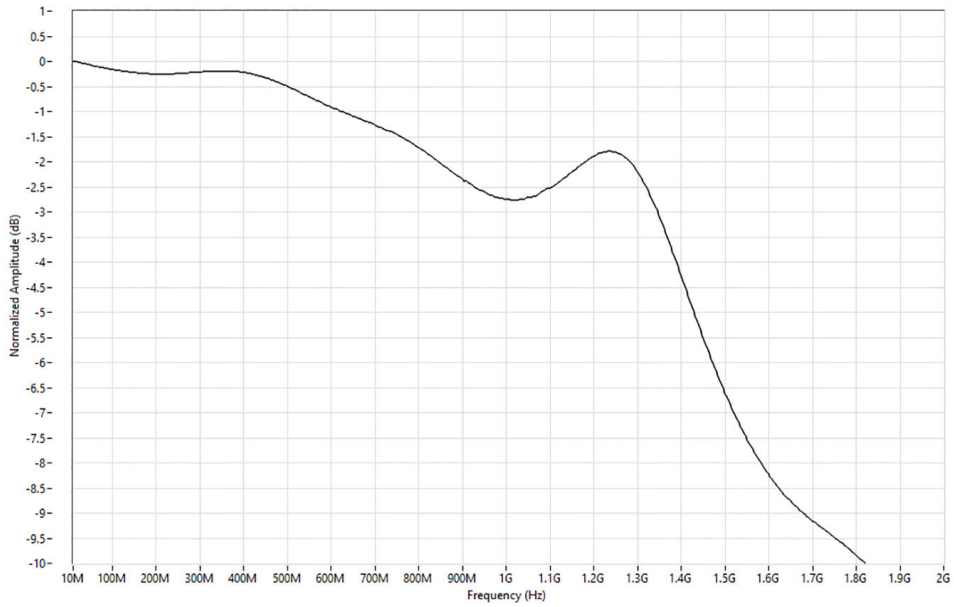


Figure 8. AC-Coupled Passband Flatness for Full Scale Input Supported Frequency Range, Measured

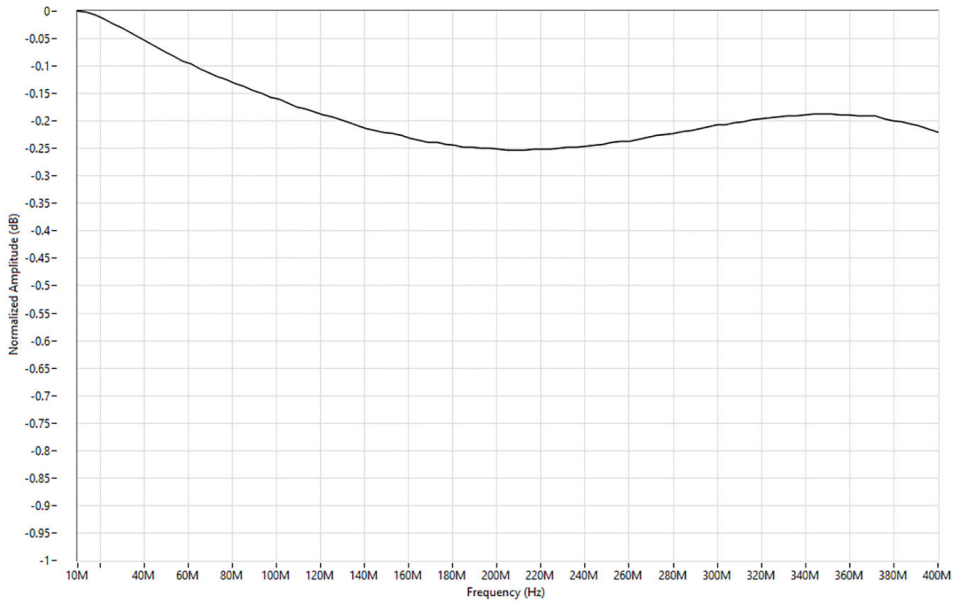


Figure 9. DC-Coupled Frequency Response, Measured

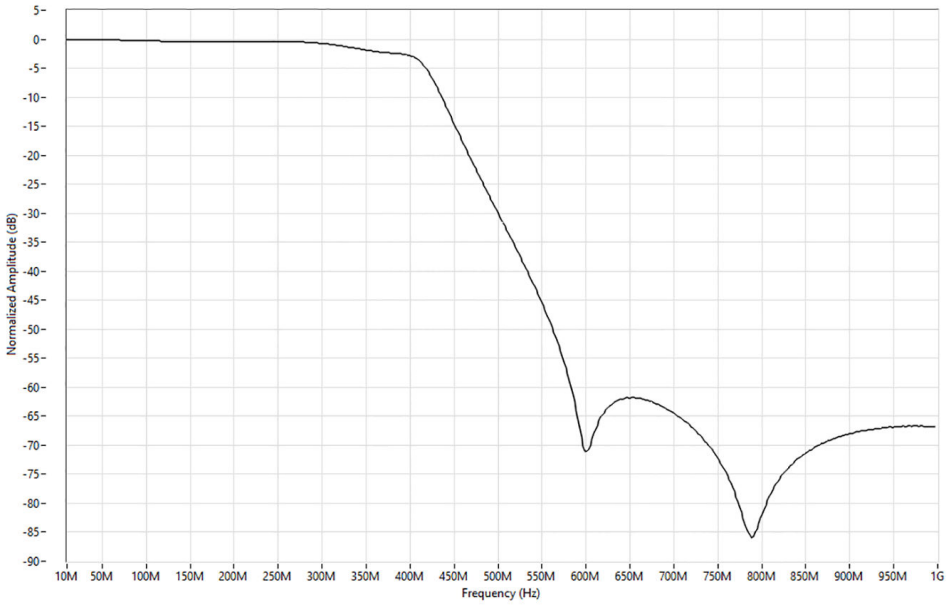


Figure 10. DC-Coupled Frequency Response Zoomed In, Measured

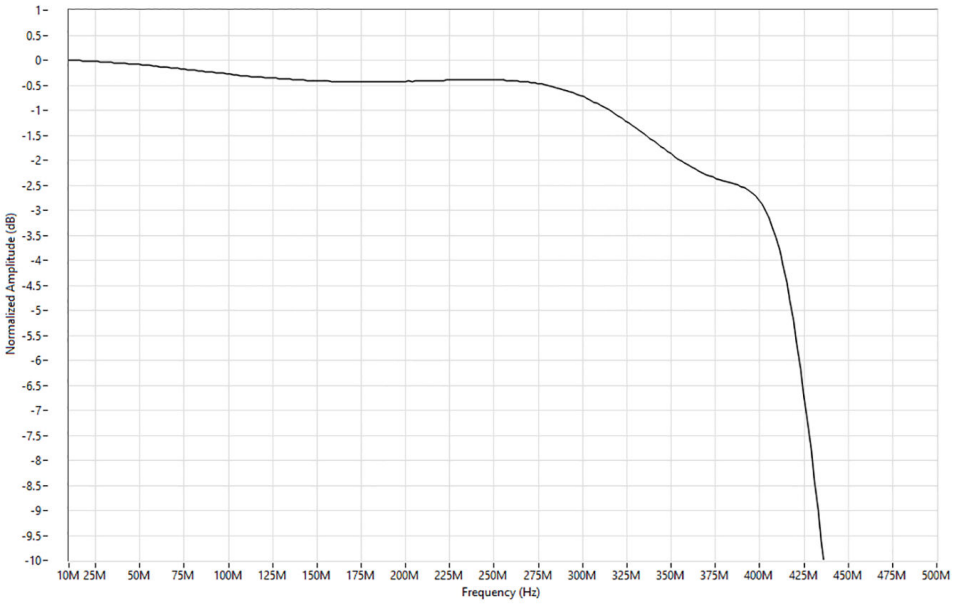
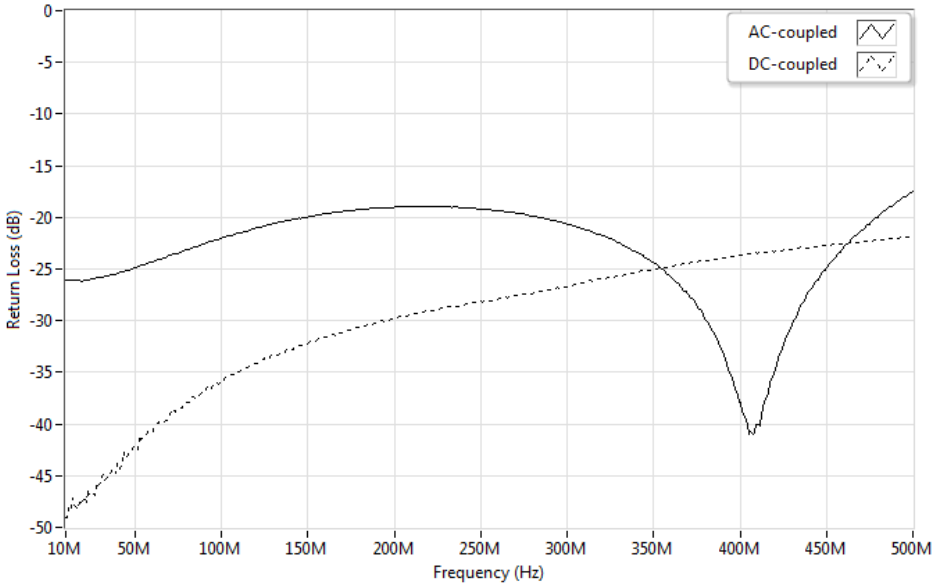


Figure 11. Input Return Loss, Measured



REF/CLK IN

General Characteristics

Connector type	SMA
Input impedance	50 Ω
Input coupling	AC
Reference input voltage range	0.3 V_{pp} to 4 V_{pp}
Sample Clock input voltage range	0.3 V_{pp} to 4 V_{pp}
Absolute maximum voltage	±12 V DC, 4 V_{pp} AC
Duty cycle	45% to 55%

Onboard reference timebase stability	±0.5 ppm
Sample Clock jitter[11]	
AC-coupled	140 fs RMS
DC-coupled	143 fs RMS

Clock Configuration	External Clock Type	External Clock Frequency	Description
Internal Reference Clock[12]	—	—	The internal Sample Clock locks to an onboard voltage-controlled temperature compensated crystal oscillator (VCTCXO).
Internal Baseboard Reference Clock	—	10 MHz	The internal Sample Clock locks to the 10 MHz Reference Clock provided from the FPGA baseboard.
External Reference Clock (REF/CLK IN)	Reference Clock	10 MHz [13]	The internal Sample Clock locks to an external Reference Clock, which is provided through the REF/CLK IN front panel connector.
External Sample Clock (REF/CLK IN)	Sample Clock	1 GHz	An external Sample Clock can be provided through the REF/CLK IN front panel connector.

Table 6. Clock Configuration Options

Figure 12. AC-Coupled Phase Noise with 385.6 MHz Input Tone, Measured

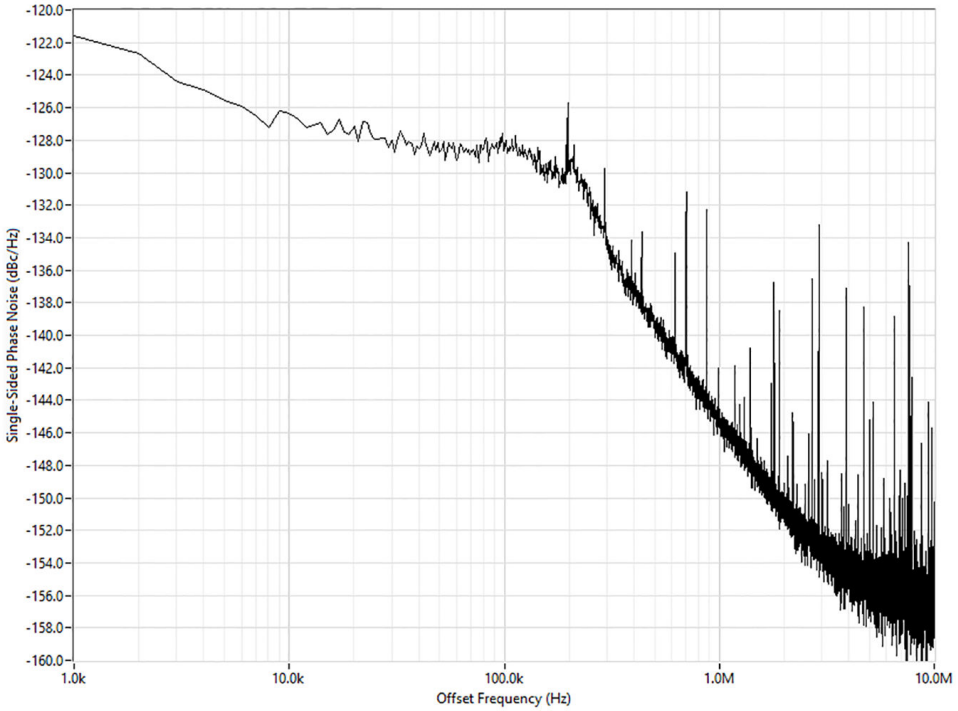
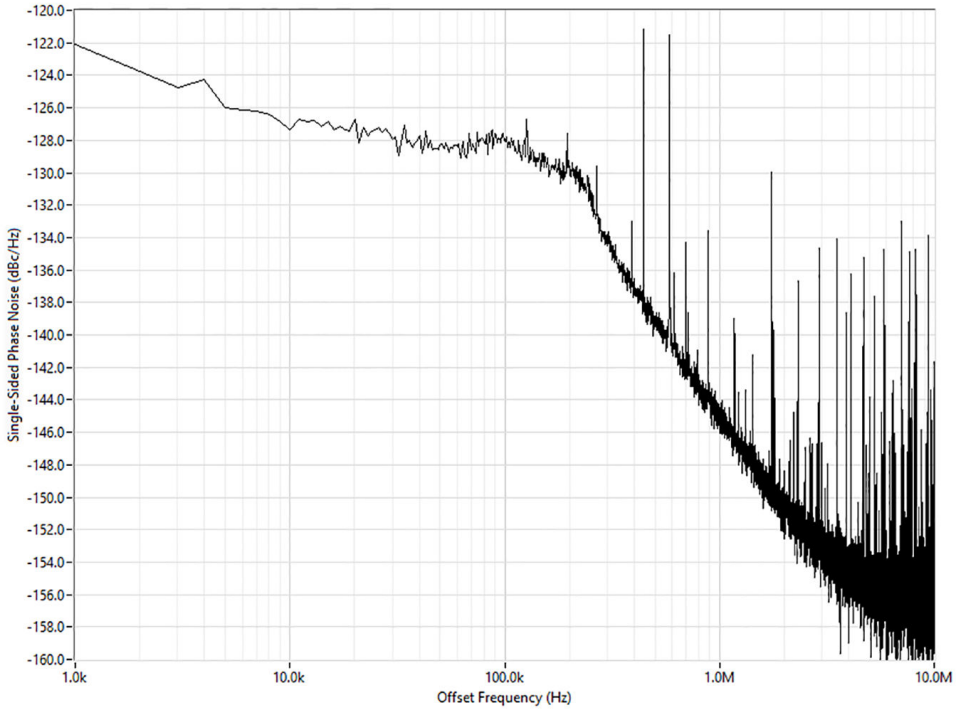


Figure 13. DC-Coupled Phase Noise with 385.6 MHz Input Tone, Measured



Bus Interface

Card edge form factor	PCI Express Gen-3 x8
Slot compatibility	x8 and x16 PCI Express

Maximum Power Requirements

Note Power requirements depend on the contents of the LabVIEW FPGA VI used in your application.

+3.3 V	4.5 A
+12 V	5 A
Maximum total power	75 W

Physical

Dimensions (including I/O bracket, not including connectors)	12.6 cm × 26.3 cm × 4 cm (5.0 in. × 10.4 in. × 1.6 in.)
Weight	990 g (35 oz)
PCI Express mechanical form factor	Standard height, three-quarter length, double slot
Integrated air mover (fan)	Yes
Maximum rear panel exhaust airflow	84 m^3/h (50 CFM) (without any chassis impedance)

Environment

Maximum altitude	2,000 m (800 mbar) (at 25 °C ambient temperature)
Pollution Degree	2

Indoor use only.

Operating Environment

Operating temperature, local[14]	0 °C to 45 °C
Operating humidity	10% to 90% RH, noncondensing

Storage Environment

Ambient temperature range	-20 °C to 70 °C
Relative humidity range	5% to 95% RH, noncondensing

1 Multi-gigabit transceiver (MGT) signals are available on devices with KU040 and KU060 FPGAs only.

2 Voltage levels are guaranteed by design through the digital buffer specifications.

3 For detailed FPGA and High-Speed Serial Link specifications, refer to Xilinx documentation.

4 For detailed FPGA and High-Speed Serial Link specifications, refer to Xilinx documentation.

5 800 mV pk-pk when transmitter output swing is set to the maximum setting.

[6] Only one analog input path type is populated.

[7] Normalized to 10 MHz.

[8] Maximum bandwidth for full scale input signal is 400 MHz. See the ADS54J60 datasheet for details on maximum supported amplitude for frequencies greater than 400 MHz.

[9] Measured with a -1 dBFS signal and corrected to full-scale. 1 kHz resolution bandwidth.

[10] Calculated from SINAD and corrected to full-scale.

[11] Integrated from 1 kHz to 10 MHz. Includes the effects of the converter aperture uncertainty and the clock circuitry jitter. Excludes trigger jitter.

[12] Default clock configuration.

[13] The PLL Reference Clock must be accurate to ±25 ppm.

[14] For PCI Express adapter cards with integrated air movers, NI defines the local operational ambient environment to be at the fan inlet. For cards without integrated air movers, NI defines the local operational ambient environment to be 25 mm (1 in.) upstream of the leading edge of the card.