
PXle-5651

Specifications

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PXIe-5651 Specifications

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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.

Specifications are **Warranted** unless otherwise noted.

Conditions

Minimum or maximum warranted specifications are valid under the following conditions unless otherwise noted.

- 30 minutes warm-up time
- Calibration cycle maintained
- Temperature of 0 °C to 55 °C

Typical specifications are valid under the following condition unless otherwise noted.

- Over ambient temperature ranges of 23 °C± 5 °C

Frequency

Range	500 kHz to 3.3 GHz
Resolution	
500 kHz to <1.3 GHz	<3 Hz
1.3 GHz to <3.3 GHz	<6 Hz
Accuracy	Refer to the Reference Clock section.

Frequency Settling Time



Note The frequency settling time specification includes only frequency settling and excludes any residual amplitude settling that may occur as the result of a large frequency change.

Table 1. Narrow Loop Bandwidth

Settling Time (ppm)	Median (ms)	Maximum (ms)
≤0.01	6.5	13
≤0.1	1.5	6.5

Table 2. Wide Loop Bandwidth

Settling Time (ppm)	Median (ms)	Maximum (ms)
0.01	1.0	5.0
0.1	0.3	1.0
1.0	0.2	0.7

Reference Clock

Internal Clock

Initial accuracy	± 3 ppm, maximum
Temperature (15 °C to 35 °C)	± 1 ppm, maximum
Aging	± 5 ppm per year, maximum

Internal Reference Output

Frequency	10 MHz
Amplitude	1 V _{pk-pk} into 50 Ω
Coupling	AC
Output impedance	50 Ω

External Reference Input

Frequency	10 MHz ± 10 ppm
Amplitude	0.2 V _{pk-pk} to 1.5 V _{pk-pk} into 50 Ω
Input impedance	50 Ω
Lock time to external reference	<1 s

Spectral Purity

Table 3. Single Sideband (SSB) Phase Noise at 10 kHz Offset

Frequency	Phase Noise (dBc/Hz)
100 MHz	<-111, typical
500 MHz	<-107
1 GHz	<-105
2 GHz	<-98
3 GHz	<-95
Residual FM (300 Hz to 3 kHz, RMS)	
1 GHz	<0.8 Hz RMS, typical
2.4 GHz	<1.5 Hz RMS, typical
Jitter (seconds, RMS)	
622 MHz with 1 kHz to 5 MHz jitter bandwidth	<200 fs, typical
2.488 GHz with 5 kHz to 15 MHz jitter bandwidth	<50 fs, typical

Figure 1. Measured Phase Noise at 500 MHz and 1 GHz (0 dBm Output Power)

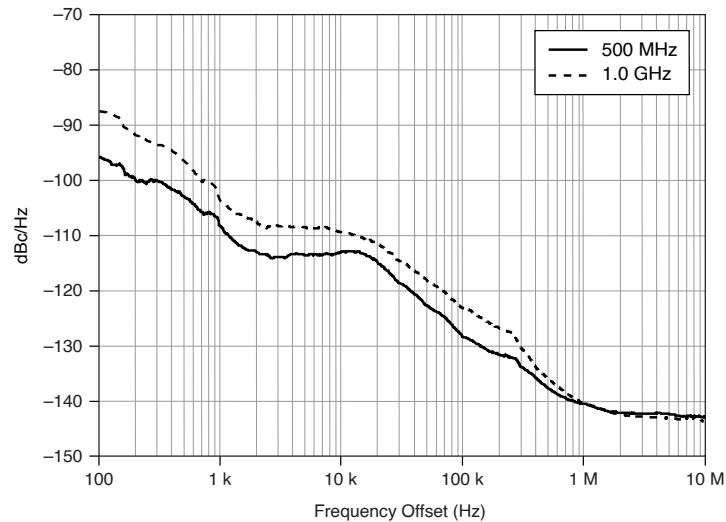


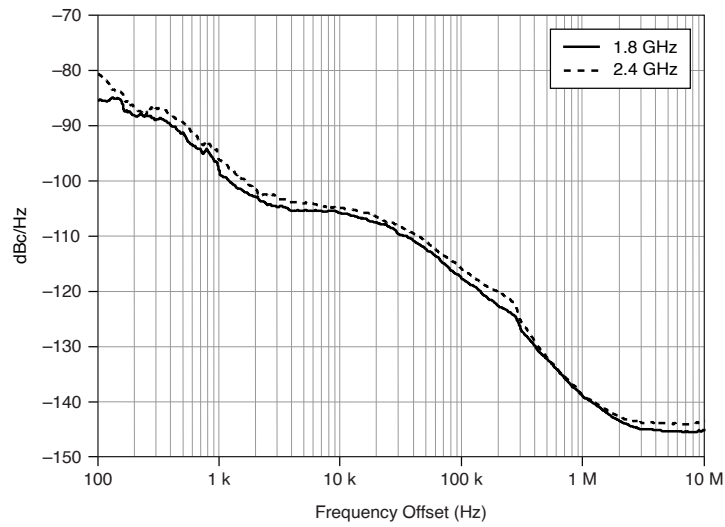
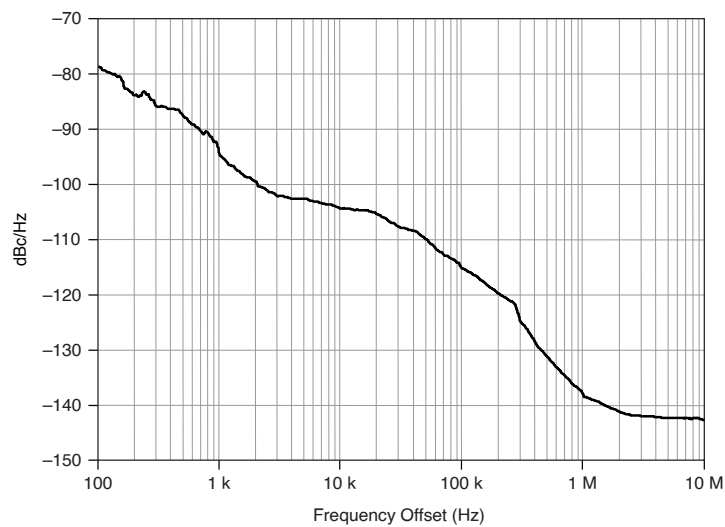
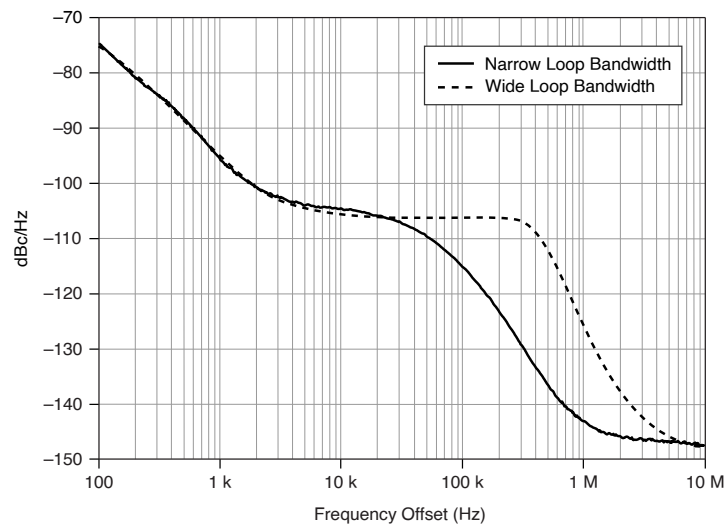
Figure 2. Measured Phase Noise at 1.8 GHz and 2.4 GHz (0 dBm Output Power)**Figure 3. Measured Phase Noise at 3.0 GHz (0 dBm Output Power)**

Figure 4. Measured Phase Noise at 3.0 GHz in Narrow and Wide Loop Bandwidth (0 dBm Output Power)



Harmonics

500 kHz to 3.3 GHz (0 dBm to -40 dBm output power)	-24 dBc
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Figure 5. Typical Spectrum at 2.45 GHz

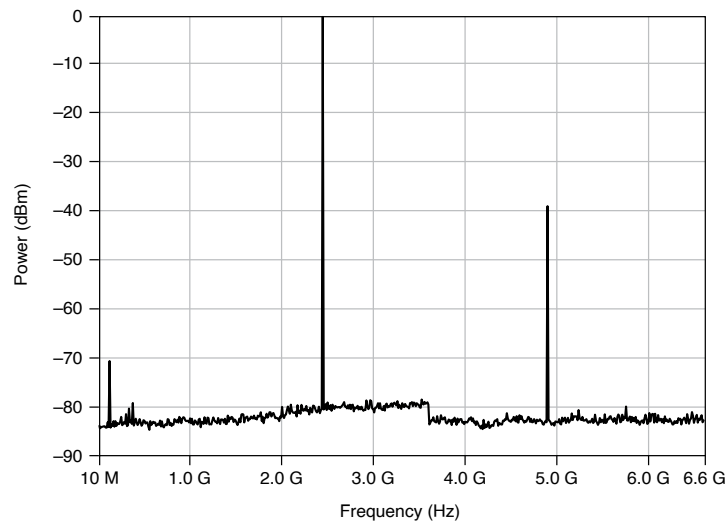
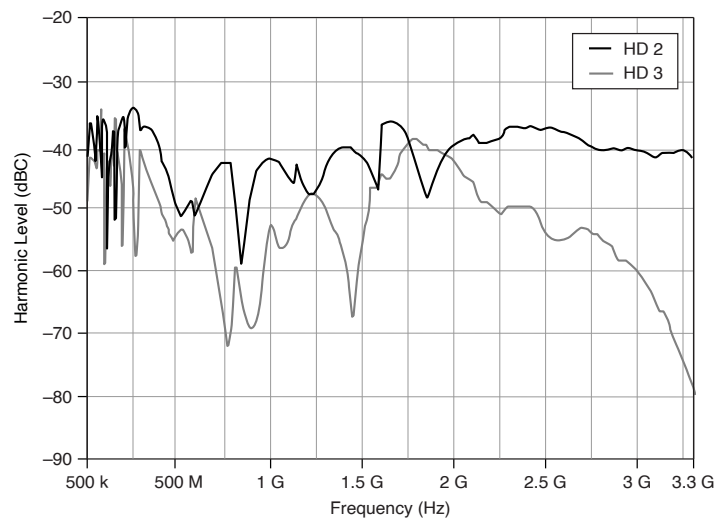


Figure 6. Typical Second Harmonic (HD 2) and Third Harmonic (HD 3) Levels (0 dBm Output Power)



Nonharmonics

Narrow Loop Bandwidth

Table 4. Nonharmonic Products at 0 dBm to -20 dBm Output Power

Frequency	<3 kHz Offset (dBc), Typical	>3 kHz Offset (dBc)	>100 kHz Offset (dBc)
500 kHz to <50 MHz	<-57	<-57	<-57
50 MHz to <3.3 GHz	<-65	<-65	<-70

Wide Loop Bandwidth

Table 5. Nonharmonic Products at 0 dBm to -20 dBm Output Power

Frequency	<3 MHz Offset (dBc), Typical	>3 MHz Offset (dBc), Typical
500 kHz to <50 MHz	<-57	<-57
50 MHz to <3.3 GHz	<-44	<-70
Subharmonic products 500 kHz to 3.3 GHz		Not applicable

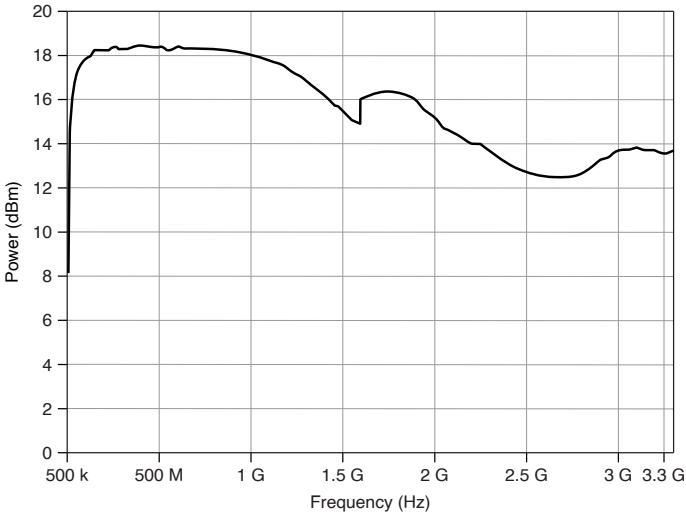
Amplitude

Resolution	<0.1 dB
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Table 6. Amplitude Range

Frequency	Amplitude (dBm)
500 kHz to <10 MHz	-90 to 5
10 MHz to <50 MHz	-90 to 8
50 MHz to <500 MHz	-90 to 10
500 MHz to <1.3 GHz	-90 to 10
1.3 GHz to <1.6 GHz	-90 to 10
1.6 GHz to <2.9 GHz	-80 to 8
2.9 GHz to <3.3 GHz	-70 to 8
Maximum available power	2 dB above maximum specified amplitude, typical
Minimum available power	10 dB below minimum specified amplitude, typical

Figure 1. Measured Maximum Available Power



Power Level Accuracy

Table 7. Power Level Accuracy (15 °C to 35 °C)

Frequency	>-40 dBm Output Power (dB)	≤-40 dBm Output Power (dB)
500 kHz to <10 MHz	±1.6	±2.2
10 MHz to <3.3 GHz	±0.75	±1.8

Figure 8. Typical Power Accuracy, -40 dBm to 0 dBm, 5 dB Steps

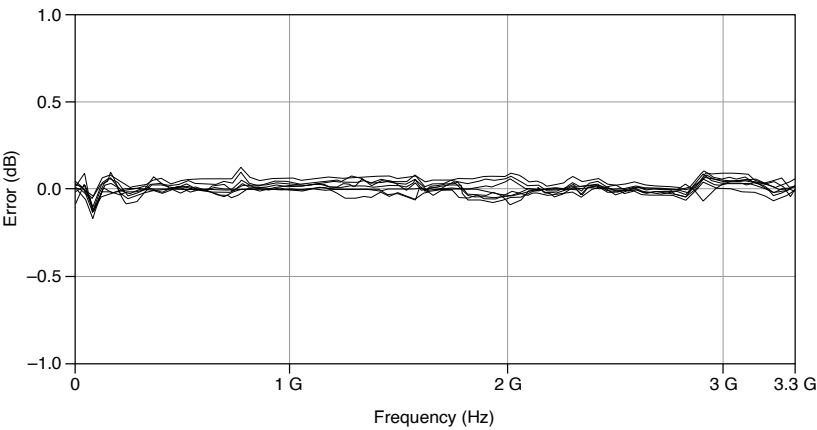
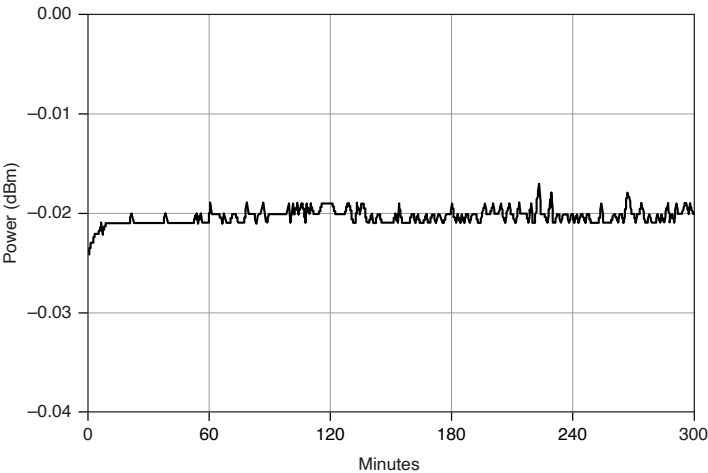


Figure 9. Typical Power (0 dBm) at 2.4 GHz Over Time



Amplitude Settling Time

0.05 dB of final value	<500 ms, typical
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0.25 dB of final value	<10 ms, typical
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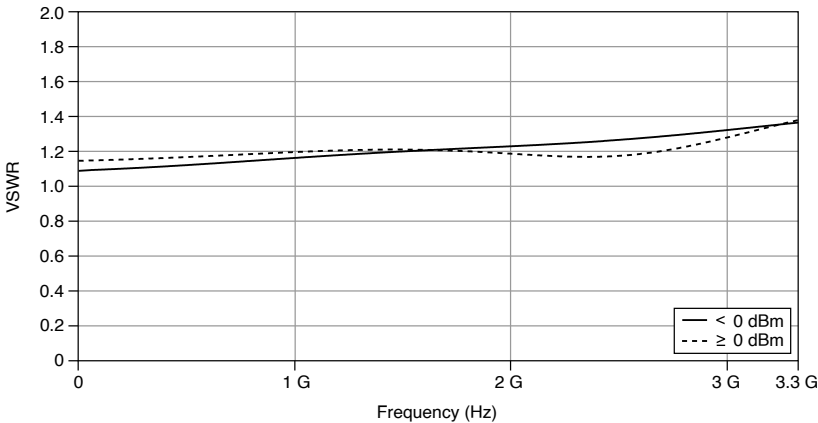
Signal-to-Noise Ratio

≥0 dBm output power	<-140 dBc/Hz, typical
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Voltage Standing Wave Ratio (VSWR)

500 kHz to 3.3 GHz	<1.8:1, typical
Output impedance	50 Ω

Figure 1. Measured VSWR



Reverse Power Handling

RF	0.5 watts, +27 dBm
DC	25 volts

Modulation

Frequency Modulation (FM)

Modulation waveform types	Sine, triangle, square
External modulation source	Not supported

Table 8. FM Typical Maximum Deviation

Frequency Range	Typical Maximum Deviation (Sine Wave)
500 kHz to <50 MHz	500 kHz
50 MHz to <100 MHz	125 kHz
100 MHz to <200 MHz	250 kHz
200 MHz to <400 MHz	500 kHz
400 MHz to <800 MHz	1 MHz
800 MHz to <1.6 GHz	2 MHz
1.6 GHz to <3.3 GHz	4 MHz
Modulation waveform frequency	1 Hz to 100 kHz
Characteristic deviation accuracy	<±3.5%
Typical distortion	<0.1%
SINAD	>65 dB

Frequency Shift Keying (FSK)

Modulation waveform types	
PRBS	5-order to 31-order
User-defined	Up to 1,022 bit

Modulation format	2-FSK
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Table 9. FSK Typical Maximum Deviation

Frequency Range	Typical Maximum Deviation
500 kHz to <50 MHz	250 kHz
50 MHz to <100 MHz	31.25 kHz
100 MHz to <200 MHz	62.5 kHz
200 MHz to <400 MHz	125 kHz
400 MHz to <800 MHz	250 kHz
800 MHz to <1.6 GHz	500 kHz
1.6 GHz to <3.3 GHz	1 MHz
FSK characteristic deviation accuracy (100 kHz rate, 10% of maximum deviation)	<±10%
Symbol rate	
PRBS	763 Hz to 100 kHz
User-defined	763 Hz to 100 kHz
Pulse shaping	Not supported

Figure 11. FSK Modulation Eye Diagram, 1.0 GHz Carrier, 100 kHz Symbol Rate, 500 kHz Deviation, Ninth-Order PRBS

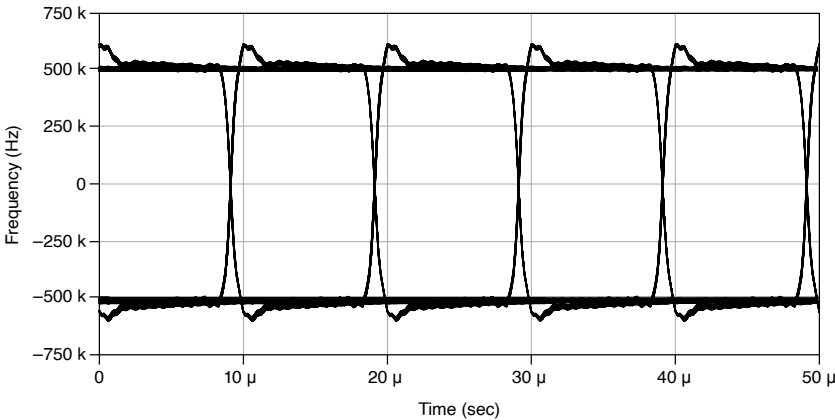
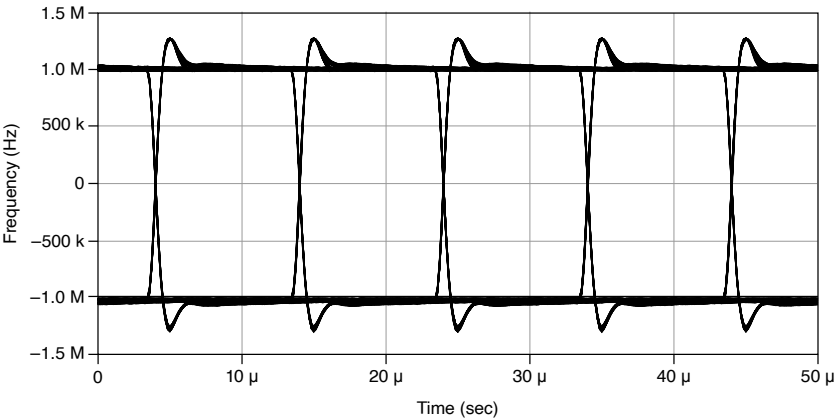


Figure 1. FSK Modulation Eye Diagram, 2.4 GHz Carrier, 100 kHz Symbol Rate, 1.0 MHz Deviation, Ninth-Order PRBS



On-Off Keying (OOK)

Modulation waveform types	
PRBS	5-order to 31-order
User-defined	Up to 1,024 bit

Table 10. OOK Typical Amplitude

Frequency Range	Typical Amplitude (dBm)
500 kHz to <10 MHz	-3 to 5
10 MHz to <50 MHz	-3 to 8
50 MHz to <1.6 GHz	-3.5 to 10
1.6 GHz to <3.3 GHz	-2.5 to 8

Symbol rate	
PRBS	153 Hz to 100 kHz
User-defined	153 Hz to 100 kHz
Pulse shaping	Not supported

Figure 13. OOK Diagram, 1.0 GHz Carrier, 100 kHz Symbol Rate, Ninth-Order PRBS

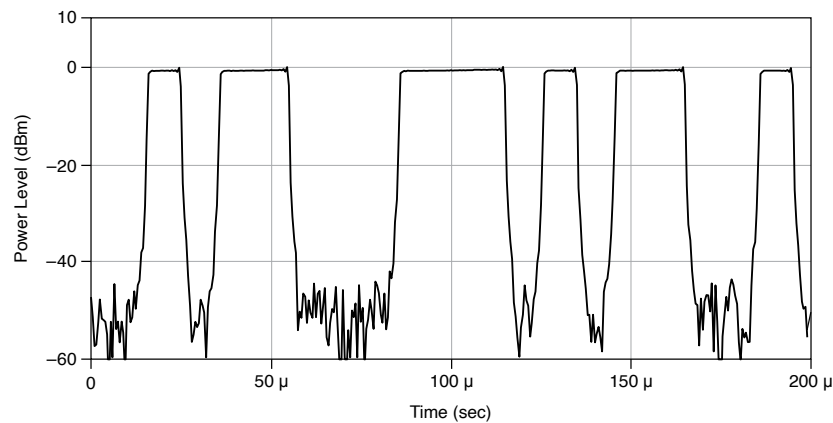
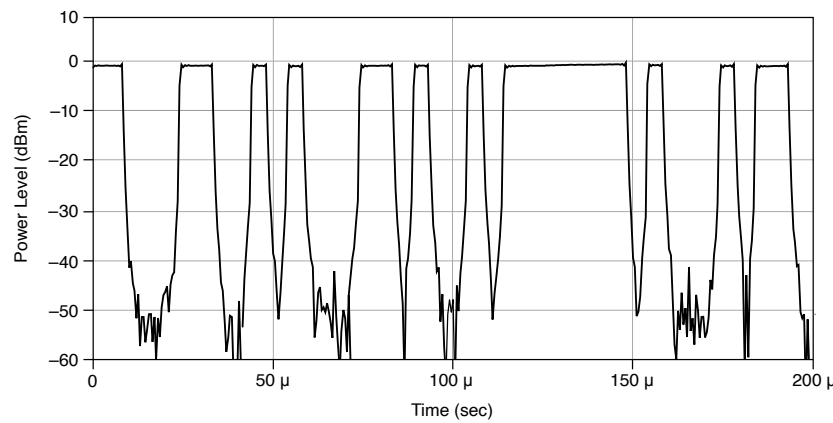


Figure 14. OOK Diagram, 1.0 GHz Carrier, 200 kHz Symbol Rate, Ninth-Order PRBS



DC Power Requirements

Table 11. DC Power Requirements

Voltage (V _{DC})	Maximum Current (A)	Typical Current (A)
+3.3	1.00	0.90
+12	1.00	0.80

Calibration

Interval	1 year
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Physical Dimensions

PXIe-5651 module	3U, one slot, PXI Express module 2.0 cm × 13.0 cm × 21.6 cm (0.8 in. × 5.1 in. × 8.5 in.)
Weight	415 g (14.6 oz)

Environment

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

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 55 °C
Relative humidity range	10% to 90%, noncondensing

Storage Environment

Ambient temperature range	-40 °C to 70 °C (Tested in accordance with IEC 60062-2-1 and IEC 60068-2-2.)
Relative humidity range	5% to 95%, noncondensing

Shock and Vibration

Nonoperational 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 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.)

Compliance and Certifications

Safety Compliance Standards

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1



Note For safety certifications, refer to the product label or the [Product Certifications and Declarations](#) section.

Electromagnetic Compatibility

This product 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, certifications, and additional information, refer to the [Product Certifications and Declarations](#) section.

Product Certifications and Declarations


Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

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 **Engineering a Healthy Planet** 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.

EU and UK Customers

-  **Waste Electrical and Electronic Equipment (WEEE)**—At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit ni.com/environment/weee.

电子信息产品污染控制管理办法（中国 RoHS）

-  **中国 RoHS**— NI 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 NI 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.)