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# PXle-5650 Specifications

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# PXIe-5650 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.

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 <sup>[1]</sup>	500 kHz to 1.3 GHz
Resolution	<3 Hz
Accuracy	Refer to the <a href="#">Reference Clock</a> section.

## Frequency Settling Time<sup>[2]</sup>

Settling Time (ppm)	Median (ms)	Maximum (ms)
≤0.01	6.5	13
≤0.1	1.5	6.5 <sup>[3]</sup>

Table 1. Narrow 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

Table 2. Wide Loop Bandwidth

## 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 <sub>pk-pk</sub> into 50 Ω
Coupling	AC
Output impedance	50 Ω

## External Reference Input

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

## Spectral Purity

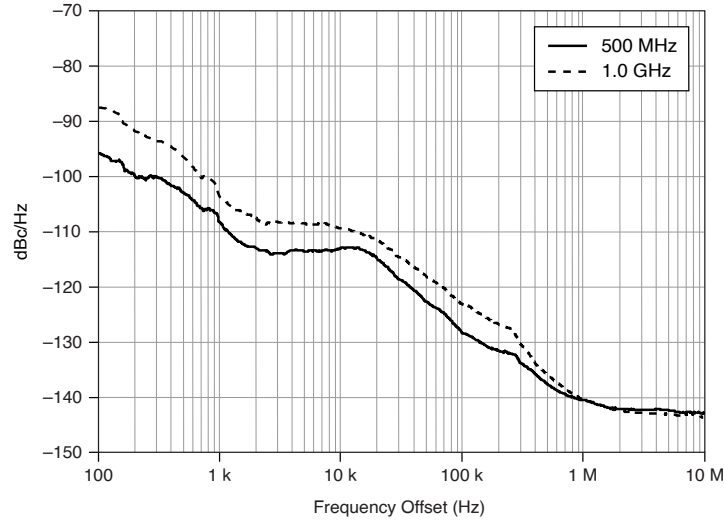
Frequency	Phase Noise (dBc/Hz)
100 MHz	<-125, typical
500 MHz	<-111
1 GHz	<-105

Table 3. Single Sideband (SSB) Phase Noise at 10 kHz Offset<sup>[4]</sup>

Residual FM, 1 GHz (300 Hz to 3 kHz, RMS)	<0.8 Hz RMS, typical
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Jitter <sup>[5]</sup> (seconds, RMS), 622 MHz with 1 kHz to 5 MHz jitter bandwidth	<200 fs, typical
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Figure 1. Measured Phase Noise at 500 MHz and 1 GHz (0 dBm Output Power)



## Harmonics

500 kHz to 1.3 GHz (0 dBm to -40 dBm output power)	-24 dBc
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Figure 2. Typical Spectrum at 1.3 GHz

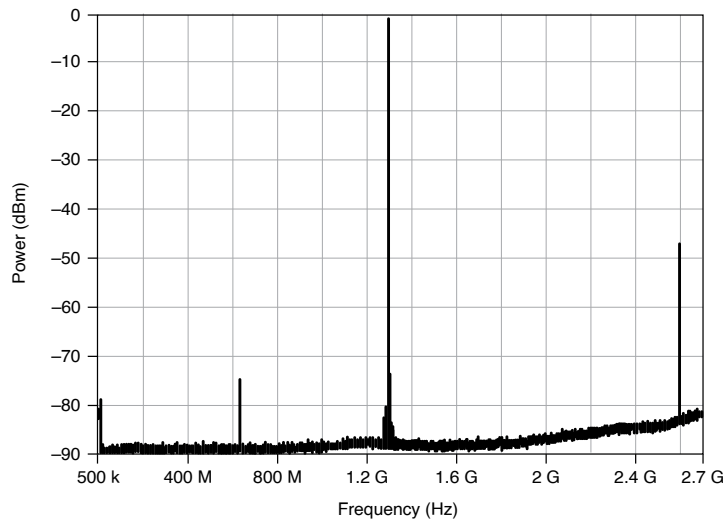
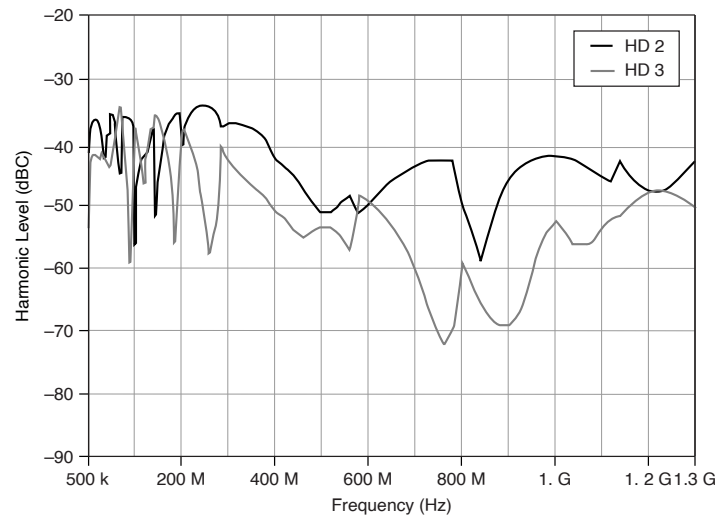


Figure 3. Typical Second Harmonic (HD 2) and Third Harmonic (HD 3) Levels (0 dBm Output Power)



## Nonharmonics

### Narrow Loop Bandwidth

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 1.3 GHz	<-65	<-65	<-70

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

### Wide Loop Bandwidth

Frequency	<3 MHz Offset (dBc), Typical	>3 MHz Offset (dBc), Typical
500 kHz to <50 MHz	<-57	<-57
50 MHz to 1.3 GHz	<-44	<-70

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

Subharmonic products 500 kHz to 1.3 GHz	Not applicable <sup>[6]</sup>
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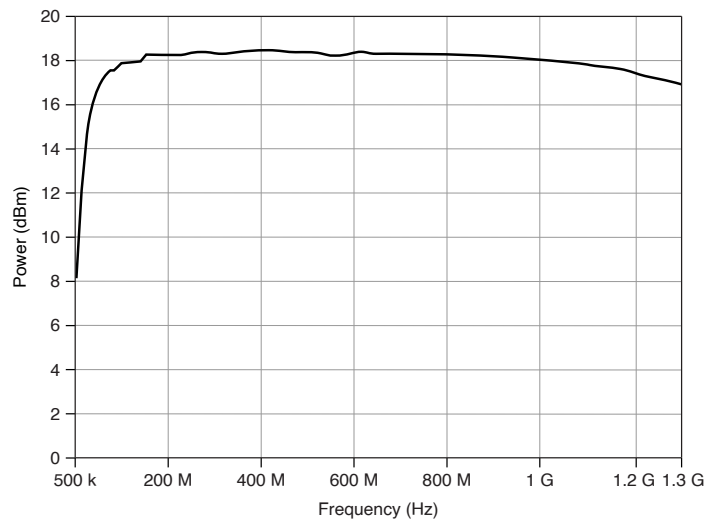
# Amplitude

Resolution	<0.1 dB
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

Table 6. Amplitude Range

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

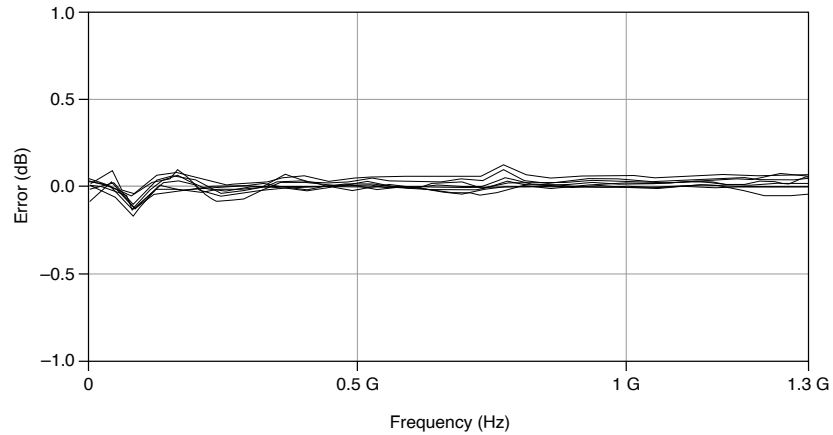
Frequency	>-40 dBm Output Power (dB)	≤-40 dBm Output Power (dB)
500 kHz to <10 MHz	±1.6	±2.2



Frequency	>-40 dBm Output Power (dB)	≤-40 dBm Output Power (dB)
10 MHz to 1.3 GHz	±0.75	±1.8

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

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



## Amplitude Settling Time

0.05 dB of final value	<500 ms, typical
0.25 dB of final value	<10 ms, typical

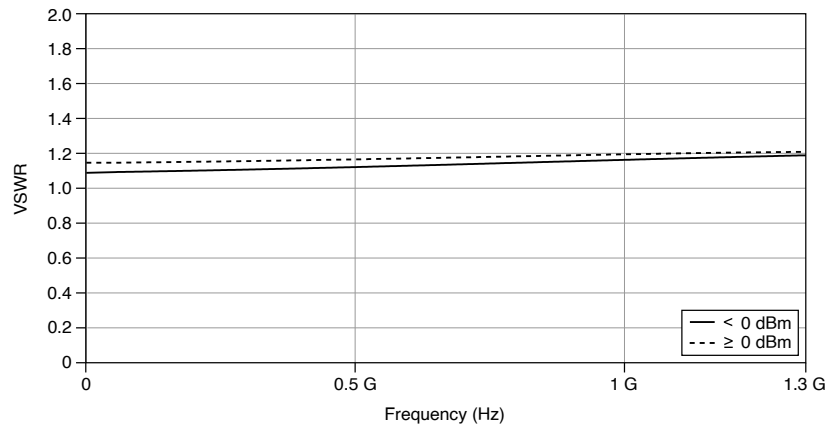
## Signal-to-Noise Ratio

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

500 kHz to 1.3 GHz	<1.8:1, typical
Output impedance	50 Ω

Figure 1. Measured VSWR



## Reverse Power Handling

RF	0.5 watts, +27 dBm <sup>[7]</sup>
DC	25 volts

## Modulation

### Frequency Modulation (FM)

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

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

Frequency Range	Typical Maximum Deviation (Sine Wave)
800 MHz to 1.3 GHz	2 MHz

Table 8. FM Typical Maximum Deviation

Modulation waveform frequency	1 Hz to 100 kHz
Characteristic deviation accuracy <sup>[8]</sup>	<±3.5%
Typical distortion <sup>[8]</sup>	<0.1%
SINAD <sup>[8]</sup>	>65 dB

## Frequency Shift Keying (FSK)

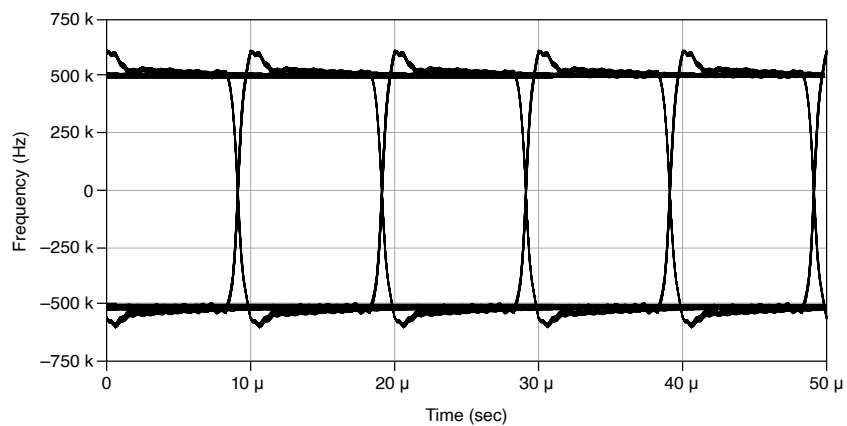
<b>Modulation waveform types</b>	
PRBS	5-order to 31-order
User-defined	Up to 1,022 bit
Modulation format	2-FSK
Frequency Range	Typical Maximum Deviation (kHz)
500 kHz to <50 MHz	250
50 MHz to <100 MHz	31.25
100 MHz to <200 MHz	62.5
200 MHz to <400 MHz	125
400 MHz to <800 MHz	250
800 MHz to 1.3 GHz	500

Table 9. FSK Typical Maximum Deviation

FSK characteristic deviation accuracy (100 kHz rate, 10% of maximum deviation)	<±10%
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<b>Symbol rate</b>	
PRBS	763 Hz to 100 kHz
User-defined	763 Hz to 100 kHz
Pulse shaping	Not supported

Figure 7. FSK Modulation Eye Diagram, 1.0 GHz Carrier, 100 kHz Symbol Rate, 500 kHz Deviation, Ninth-Order PRBS



## On-Off Keying (OOK)

<b>Modulation waveform types</b>	
PRBS	5-order to 31-order
User-defined	Up to 1,024 bit
Frequency Range	Typical Amplitude (dBm)
500 kHz to <10 MHz	-3 to 5
10 MHz to <50 MHz	-3 to 8
50 MHz to 1.3 GHz	-3.5 to 10

Table 10. OOK Typical Amplitude

<b>Symbol rate</b>	
PRBS	153 Hz to 100 kHz
User-defined	153 Hz to 100 kHz
Pulse shaping	Not supported

Figure 8. OOK Diagram, 1.0 GHz Carrier, 100 kHz Symbol Rate, Ninth-Order PRBS

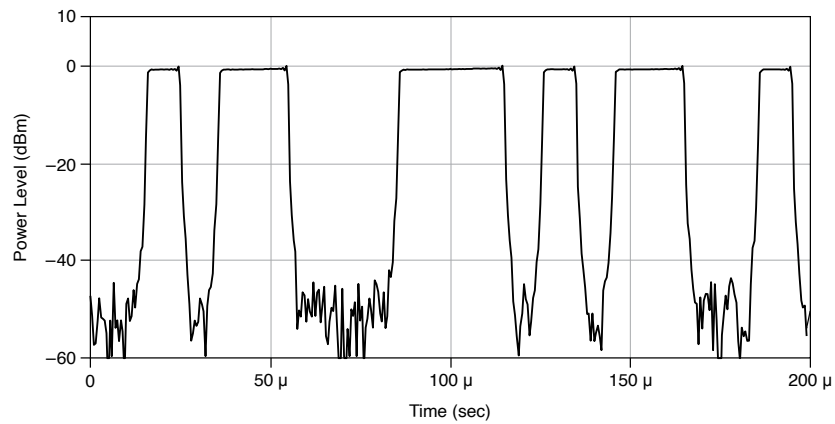
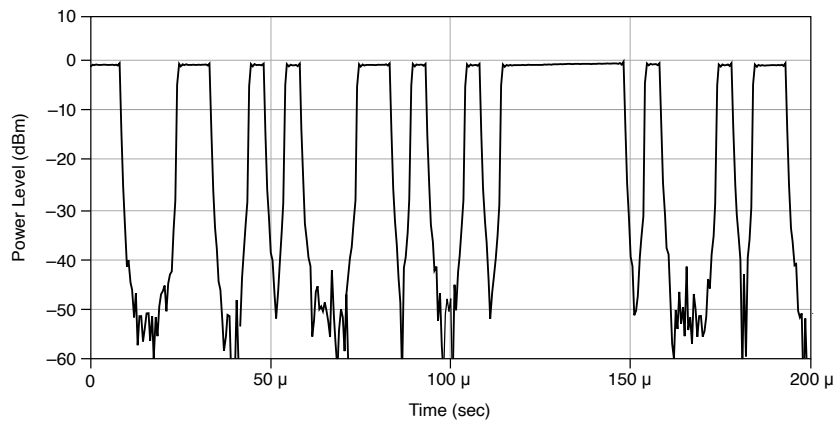


Figure 9. OOK Diagram, 1.0 GHz Carrier, 200 kHz Symbol Rate, Ninth-Order PRBS



## DC Power Requirements

Voltage ( $V_{DC}$ )	Maximum Current (A)	Typical Current (A)
+3.3	1.00	0.90

Voltage (V <sub>DC</sub> )	Maximum Current (A)	Typical Current (A)
+12	1.00	0.80

Table 11. DC Power Requirements

## Calibration

Interval	1 year
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## Physical Dimensions

PXIe-5650 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 40 °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 <sub>rms</sub> (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](https://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](http://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](http://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](http://ni.com/environment/rohs_china)。(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](http://ni.com/environment/rohs_china).)

<sup>1</sup> Tunable down to 100 kHz with amplitude uncalibrated.

<sup>2</sup> 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.

<sup>3</sup> Frequency steps that span the full range of a voltage-controlled oscillator (VCO) require more settling time than steps that remain close together within one VCO or

steps that switch between VCOs. The maximum specification covers this worst-case frequency settling time.

<sup>4</sup> Wide loop bandwidth has very similar phase noise performance at 10 kHz offset, but this noise level extends to approximately 300 kHz offset before it starts rolling down at approximately 20 dB per decade until it reaches the far out noise density.

<sup>5</sup> Measured at 0 dBm output power.

<sup>6</sup> No harmonic multiplication in this band.

<sup>7</sup> If the requested output power is less than -3 dBm, the RF reverse power handling is +15 dBm for signals  $\leq 10$  MHz.

<sup>8</sup> 1 kHz sine wave, 10% of maximum deviation; noise bandwidth of 10 kHz.