

# NI PXI-5670 Specifications

## 2.7 GHz RF Vector Signal Generator

This document lists specifications for the NI PXI-5670 2.7 GHz RF Vector Signal Generator.

Minimum or maximum specifications are guaranteed under the following conditions:

- 30 minutes warm-up time at ambient temperature
- calibration cycle maintained

Typical values are used to define an average unit measured at ambient temperatures of 15 °C to 35 °C. Maximum and minimum values are specified over temperature ranges of 0 °C to 55 °C unless otherwise noted.

Values that do not list a tolerance are typical numbers unless otherwise specified. Tolerance values represent the maximum variation that will be observed. These numbers are guaranteed over temperature ranges of 0 °C to 55 °C unless otherwise noted.



**Caution – Hot Surface** Allow time to cool before extracting NI 5670 hardware from the PXI chassis to reduce risk of burns. Exercise caution when handling, as recently used NI 5670 hardware modules may exceed safe handling temperatures.

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# Frequency Characteristics

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Frequency range ..... 250 kHz to 2.7 GHz typical

Digital vector modulation bandwidth

3 dB ..... 22 MHz

Tuning resolution (dependent on NI PXI-5421 memory)

8 MB ..... 25 Hz

32 MB ..... 6 Hz

256 MB ..... 0.6 Hz



**Note** The NI PXI-5670 tuning speed and resolution depend on resampling done by the PC. Therefore fine resolution tuning speed is dependent on the speed and memory of the computer. Specifications below are the result of using an NI PXI 8186 Pentium IV controller 2.2 GHz with 512 MB RAM with the Windows XP operating system and NI-RFSG phase continuity disabled.

## Tuning Speed

Sine wave, 50 Hz resolution

Thermal correction disabled .... 35 msec typical

Thermal correction enabled ..... 50 msec maximum

1 MS record, phase continuity off

Digital IF equalization off ..... 340 msec typical

370 msec maximum

Digital IF equalization on ..... 950 msec typical

1.6 sec maximum

## Internal Frequency Reference

Frequency ..... 10 MHz

Temperature stability .....  $\pm 20$  ppb maximum

Aging

Per year .....  $\pm 100$  ppb

Per day .....  $\pm 1$  ppb

Initial achievable accuracy .....  $\pm 50$  ppb

Locking range .....  $\pm 0.5$  ppm minimum

Lock time for the NI 5610

(to external reference) ..... 5 sec maximum

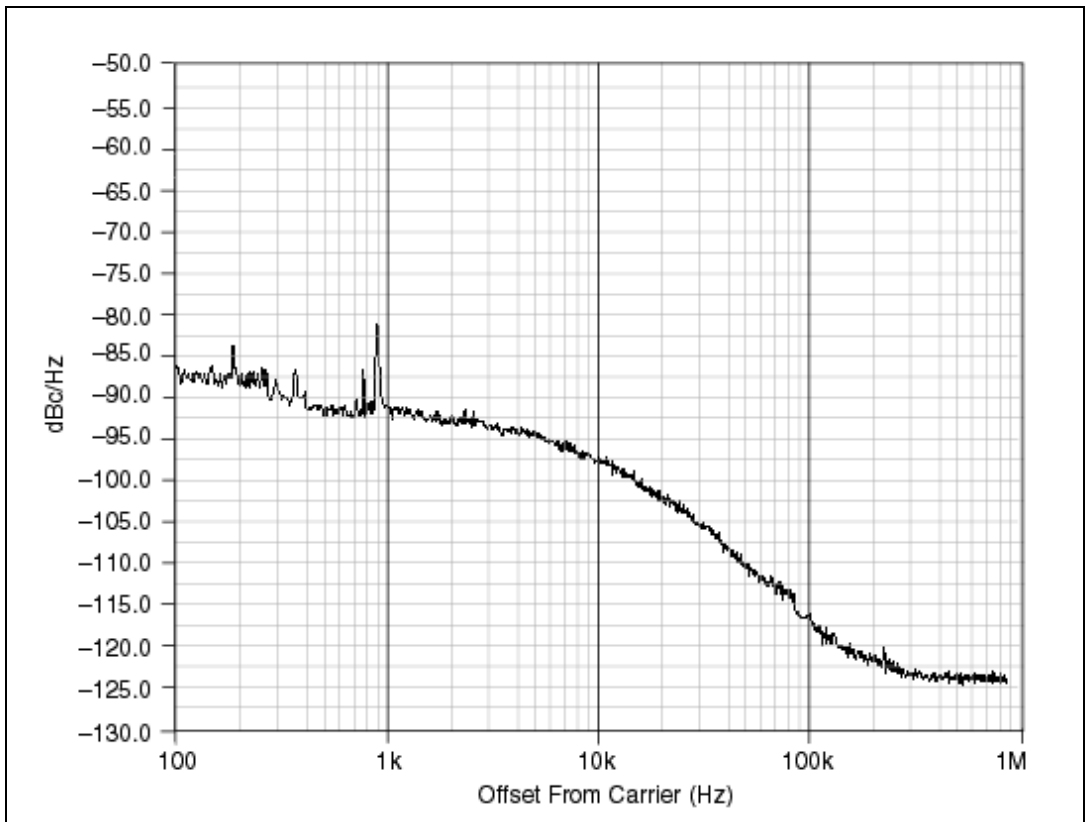
10 MHz reference out .....  $1 \pm 0.1 V_{pk-pk}$  sine wave  
(6.7 dBm into 50  $\Omega$  load,  
fundamental frequency)

# Spectral Purity

## Phase Noise

<b>Real-time bandwidth &lt; 10 MHz</b>		
<b>Offset Frequency</b>	<b>Carrier Frequency = 1 GHz</b>	<b>Carrier Frequency = 2 GHz</b>
100 Hz	-82 dBc/Hz maximum	-79 dBc/Hz maximum
1 kHz	-87 dBc/Hz maximum	-85 dBc/Hz maximum
10 kHz	-93 dBc/Hz maximum	-92 dBc/Hz maximum
100 kHz	-114 dBc/Hz maximum	-111 dBc/Hz maximum

<b>Real-time bandwidth &gt; 10 MHz</b>		
<b>Offset Frequency</b>	<b>Carrier Frequency = 1 GHz</b>	<b>Carrier Frequency = 2 GHz</b>
100 Hz	-72 dBc/Hz maximum	-70 dBc/Hz maximum
1 kHz	-75 dBc/Hz maximum	-72 dBc/Hz maximum
10 kHz	-100 dBc/Hz maximum	-98 dBc/Hz maximum
100 kHz	-120 dBc/Hz maximum	-119 dBc/Hz maximum



**Figure 1.** Typical Phase Noise at 1 GHz<sup>1</sup>

Residual FM..... 4.5 Hz rms maximum  
(Continuous wave, 300 Hz to 3 kHz integration bandwidth)

## Spurious Responses

Second harmonic (>10 MHz)

0 °C–55 °C ..... ≤ –45 dBc

Output third-order distortion (IMD)

(two –6 dBm tones,

>200 kHz apart) ..... < –86 dBc typical

Residual spurious response

(no input signal,

0 dB attenuation/maximum power level,

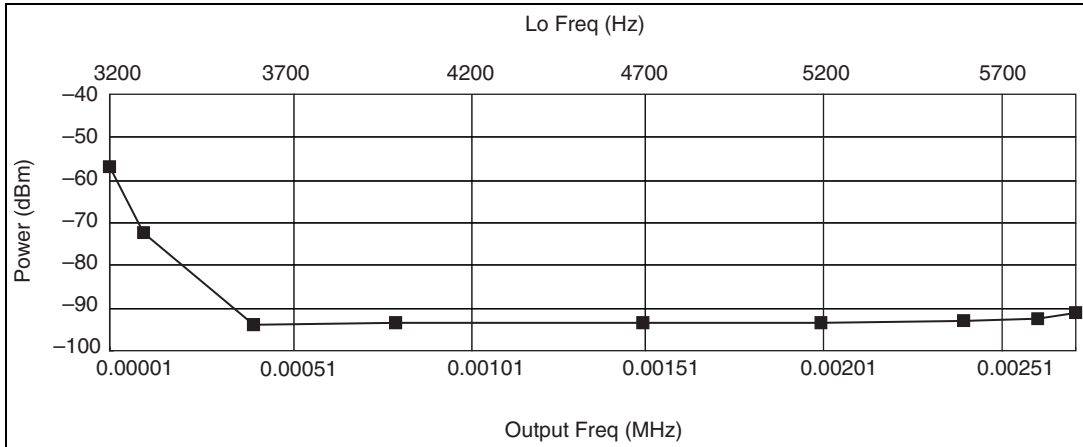
excluding LO feedthrough) ..... < –80 dBc typical

<sup>1</sup> Real-Time Bandwidth <10 MHz.

NI PXI-5421 system clock

Rate.....100 MHz

Harmonic and spurious response.....-105 dBm typical



**Figure 2.** LO leakage at RF OUTPUT, 0 dB Output Power

Output-related spurious response

(nonharmonic) .....-80 dBc maximum

(6,400 MHz – *RF output frequency*) .....-64 dBc typical,  
-58 dBc maximum

**Close-In Spurious Responses (Carrier-Modulated)**

Real-Time Bandwidth	Spurious Response	
	Offset from Carrier	Maximum Power (dBc)
<10 MHz	<100 Hz	<-50
	100 Hz to 10 kHz	<-60
>10 MHz	<400 Hz	<-40
	100 Hz to 2 kHz	<-50

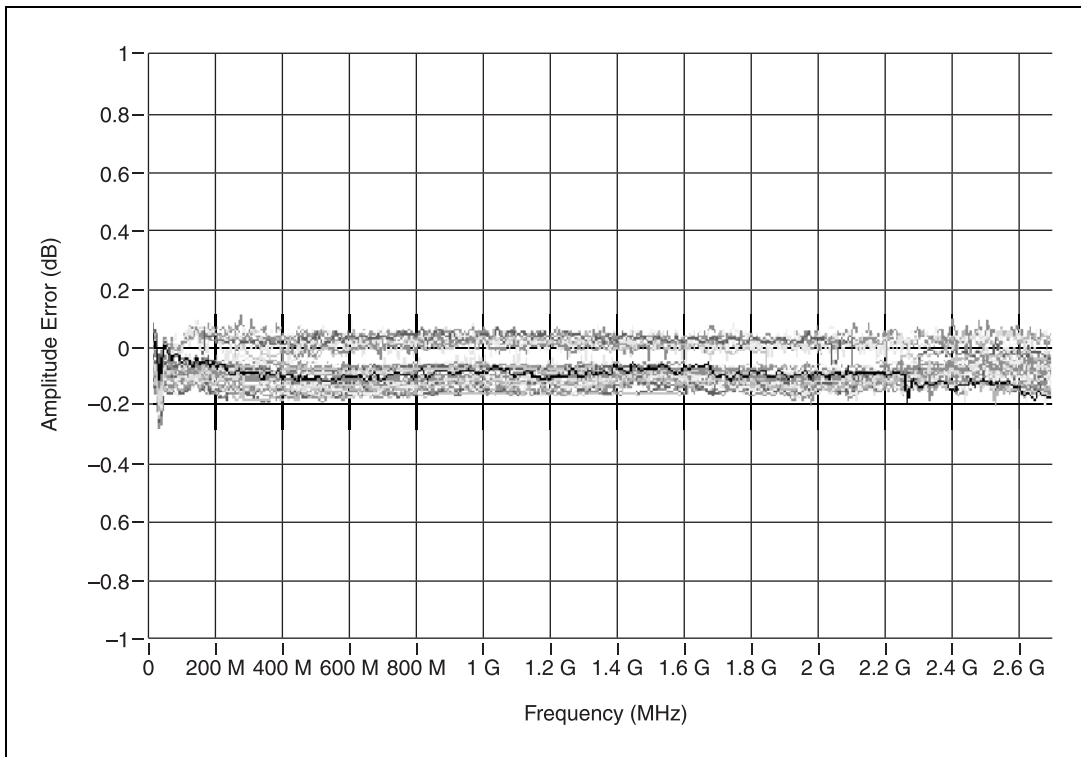
# RF Output Characteristics

## Power Range

Output ..... –145 dBm to +13 dBm minimum  
 Resolution NI 5670 ..... 0.02 dB minimum  
 Resolution NI 5610 ..... 1 dB typical  
 Amplitude settling time NI 5610 .... <0.1 dB within 150 msec  
 maximum  
 <0.01 dB within 300 msec  
 maximum

## Output Power Level Accuracy

Output Frequency	Output Power Range			
	+7 dBm to –30 dBm	–30 dBm to –80 dBm	–80 dBm to –127 dBm <sup>1</sup>	< –127 dBm (typical) <sup>1</sup>
10 MHz to 2.7 GHz	±0.7 dB	±0.8 dB	±1 dB	±1.5 dB
250 kHz to 10 MHz (typical)	±1.2 dB	±1.3 dB	±1.5 dB	±2 dB
25 °C ±10 °C. Accuracy degrades by <0.03 dB per °C over full temperature range. Accuracy degrades by 0.1 dB per dB above +7 dBm power levels, and by 0.15 dB per dB above +10 dBm power levels. At non-system spur frequencies. Refer to the <i>Spurious Responses</i> section for more information.				



**Figure 3.** Typical Output Power Level Accuracy, -45 dBm to +10 dBm<sup>1</sup>

**Voltage Standing Wave Ratio (VSWR) (output)**

Output Frequency	VSWR
10 MHz to 2.3 GHz	<1.6:1
2.3 GHz to 2.7 GHz	<1.7:1

**Output 1 dB Gain Compression Point (minimum)**

Output Frequency	15 °C to 35 °C	0 °C to 55 °C
Up to 2.0 GHz	17 dBm	16 dBm
2.0 GHz to 2.5 GHz	15.5 dBm	14 dBm
2.5 GHz to 2.7 GHz	14.5 dBm	13 dBm

<sup>1</sup> 1 dB increments, 10 MHz to 2.7 GHz; 5 MHz increments (RF frequency multiple of 5 MHz). Measurement performed using an Anritsu ML2438A power meter with Anritsu MA2473A power sensor at 25 °C ambient. For random RF frequencies, typical sine wave amplitude accuracy is ±0.3 dB.



### Output Noise Density (0 dBm output)

Output Power Level	15 °C to 35 °C	0 °C to 55 °C
0 dBm	-120 dBm/Hz	-115 dBm/Hz
-20 dBm	-140 dBm/Hz	-135 dBm/Hz

### Typical Noise Floor at 2 GHz

Output Power Level (dBm)	Typical Noise Floor (dBm/Hz)
-57	-158
-50	-157
-40	-154
-30	-147
-20	-140
-10	-130
0	-120
10	-110

Vector modulation bandwidth flatness .....  $\pm 0.5$  dB typical<sup>1</sup>

Group delay variation (within the vector modulation bandwidth) .....  $\pm 20$  ns typical

Group delay  
 NI 5421 ..... 750 nsec typical<sup>2</sup>  
 NI 5610 ..... 1,200 nsec typical

Overload protection on RF output  
 Maximum reverse RF power ..... 4 W maximum  
 Maximum DC input .....  $\pm 50$  VDC

<sup>1</sup> Equalization enabled.  $\pm 1.8$  dB maximum with equalization disabled.

<sup>2</sup> For the NI PXI-5421, group delay is the time between receipt of start trigger to commencement of waveform output.

# Local Osc Out 0

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Frequency range .....3.2 GHz to 5.9 GHz

Power .....-22 dBm typical

VSWR.....1.5:1 maximum

## Phase Noise—Local Osc Out 0

Offset Frequency	Carrier Frequency		
	3.2 GHz	4.2 GHz	5.2 GHz
1 kHz	-89 dBc/Hz	-88 dBc/Hz	-85 dBc/Hz
10 kHz	-98 dBc/Hz	-98 dBc/Hz	-95 dBc/Hz
100 kHz	-120 dBc/Hz	-120 dBc/Hz	-120 dBc/Hz

# 10 MHz Inputs/Ouputs Front Panel

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Frequency reference input .....50 Ω, SMA female

Input amplitude.....-5 to +16 dBm

Input frequency range.....10 MHz ± 0.5 ppm

10 MHz outputs .....50 Ω, SMA female

Signal.....square wave

Amplitude .....refer to the *Frequency Characteristics* section

Accuracy.....refer to the *Frequency Characteristics* section

# FM Modulation

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Modulation frequency 1 kHz,  
carrier frequency 1 GHz,  
FM deviation 100 kHz,  
filter bandwidth 2 MHz..... <1%

# Digital Modulation

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## QPSK, 16-QAM, 64-QAM

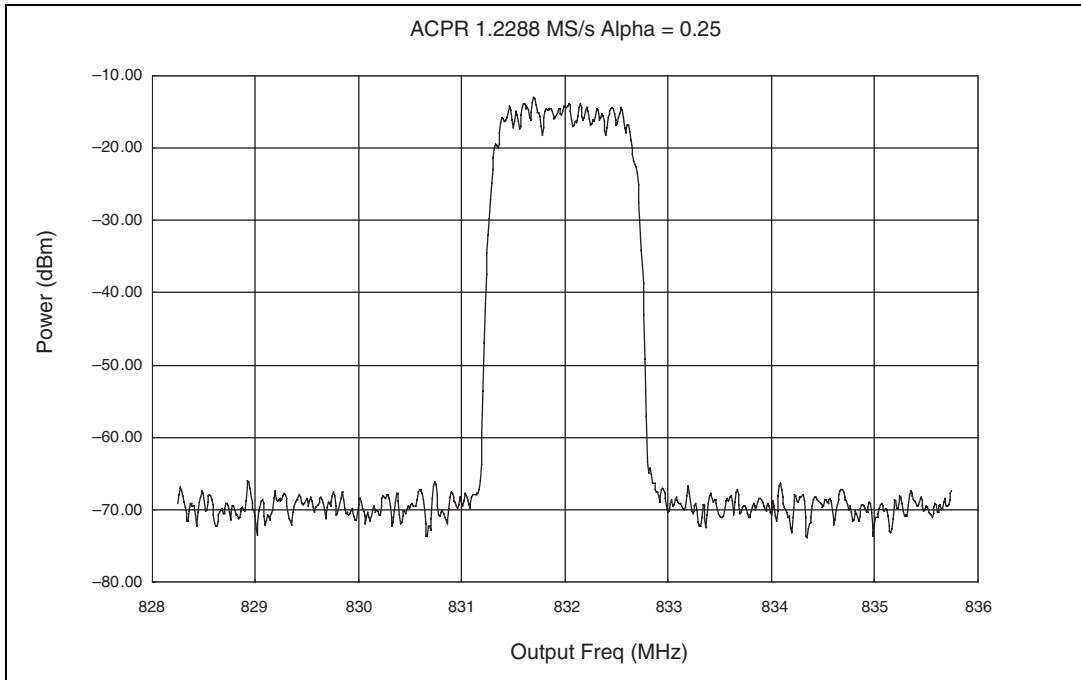
Root Raised Cosine Filter  
alpha = 0.25; carrier frequency = 1 GHz; 2,000 symbol PRBS<sup>1</sup>;  
equalization: on

Symbol Rate	EVM (%)	MER (dB)
200 kS/s	0.7	39
1 MS/s	0.8	38
2.56 MS/s	1.0	36
5.12 MS/s	1.8	35
10 MS/s	2.5	32

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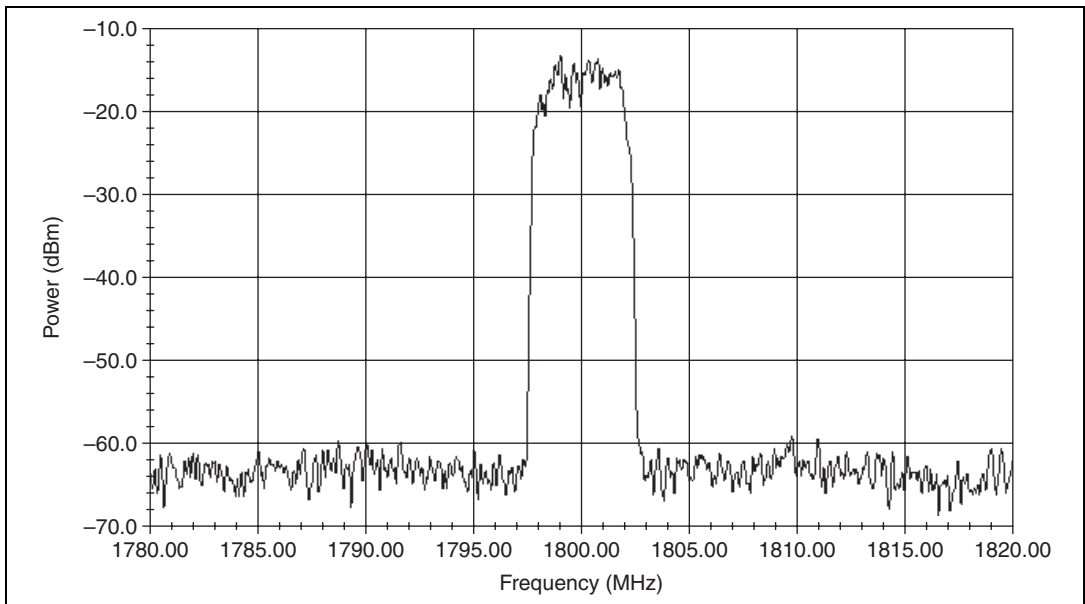
<sup>1</sup> Pseudorandom Bit Stream.

# Typical Digital Modulation Spectrum



**Figure 4.** Power Spectrum for a QPSK Signal of 1.2288 MS/s with Filter Rolloff Factor = 0.25 and Resolution Bandwidth = 100 kHz<sup>1</sup>

<sup>1</sup> NI 5660 RF Signal Analyzer reference level = 0 dBm, NI PXI-5670 output setting = 0 dBm.



**Figure 5.** Power Spectrum for a QPSK Signal of 3.9 MS/s with Filter Rolloff Factor = 0.25 and Resolution Bandwidth = 100 kHz<sup>1</sup>

<sup>1</sup> NI 5660 RF Signal Analyzer reference level = 0 dBm, NI PXI-5670 output setting = 0 dBm.

# Physical Characteristics

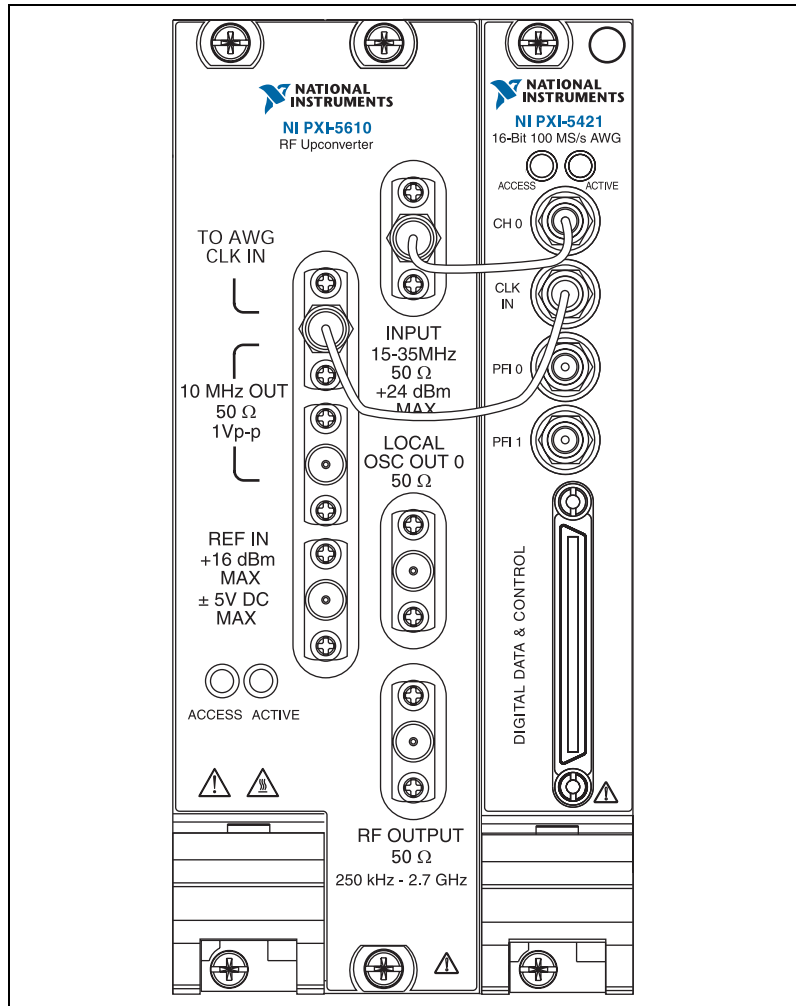


Figure 6. NI PXI-5670 Front Panel

## Front Panel Connectors

### NI 5610 Upconverter Module

- 10 MHz OUT .....SMA
- 10 MHz OUT  
(TO AWG CLK IN) .....SMA
- REF IN .....SMA
- INPUT .....SMA

LOCAL OSC OUT 0..... SMA  
 RF OUTPUT..... SMA  
 NI 5421 AWG Module  
 CH 0..... SMB  
 CLK IN..... SMB  
 PFI 0 ..... SMB  
 PFI 1 ..... SMB  
 Digital Data & Control ..... 68-pin male VHDCI  
 Dimensions (W × H × D)..... 3 cm × 10 cm × 16 cm  
 (0.8 in. × 3.9 in. × 6.3 in.)  
 Weight..... 1,165 g (41.1 oz)

## DC Power

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### NI PXI-5610 Upconverter Module (typical 25 W)

Voltage (V <sub>DC</sub> )	Maximum Current (A)	Typical Current (A)
+3.3	0.5	0.15
+5	3.75	2.6
+12	0.970	0.9
-12	0.075	0.06

### NI PXI-5421 AWG Module (typical 22 W)<sup>1</sup>

Voltage (V <sub>DC</sub> )	Maximum Current (A)	Typical Current (A)
+3.3	2.7	1.9
+5	2.2	2.0
+12	0.5	0.46
-12	0.01	0.01

<sup>1</sup> Refer to the *NI 5421 Specifications* document, located at **Start»Programs»National Instruments»NI-FGEN»Documentation»Specifications**, for complete NI PXI-5421 specifications.

# Environmental

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Specifications in this document are guaranteed under the environmental conditions specified below.

## Operating Environment

Ambient temperature range

NI PXI-5670 ..... 0 to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)

NI PXI-5421 ..... 0 to 45 °C (When installed in NI PXI-101<sub>x</sub> or PXI-1000B chassis.)

Relative humidity range.....10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Altitude (indoor use only).....0 m to 2,000 m (at 25 °C ambient temperature.)

## Storage Environment

Ambient temperature range .....–20 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

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 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-2880F, Class B.)

# Calibration

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Interval ..... 1 year

# Compliance and Certifications

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## Safety

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

- IEC 61010-1, EN 61010-1
- UL 3111-1, UL 61010B-1
- CAN/CSA C22.2 No. 1010.1



**Note** For UL and other safety certifications, refer to the product label, or visit [ni.com/hardref.nsf](http://ni.com/hardref.nsf), search by model number or product line, and click the appropriate link in the Certification column.

## Electromagnetic Compatibility

Emissions ..... EN 55011 Class A at 10 m  
FCC Part 15A above 1 GHz

Immunity ..... EN 61326:1997 + A2:2001,  
Table 1

EMC/EMI ..... CE, C-Tick, and FCC Part 15  
(Class A) Compliant



**Note** For EMC compliance, you *must* operate this device with shielded cabling.

# CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

Low-Voltage Directive (safety).....73/23/EEC

Electromagnetic Compatibility  
Directive (EMC) .....89/336/EEC



**Note** Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit [ni.com/hardref.nsf](http://ni.com/hardref.nsf), search by model number or product line, and click the appropriate link in the Certification column.

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