NI PXI-5660 Specifications

RF Vector Signal Analyzer

This document lists specifications for the NI PXI-5660 RF Vector Signal Analyzer.

Minimum or maximum specifications are guaranteed under the following conditions:

- 20 minutes warm-up time at ambient temperature
- Calibration cycle maintained

Typical values 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.

Contents

NATIONAL INSTRUMENTS

Channels

RF 1
IF.....1

Frequency Characteristics

Frequency range .....9 kHz to 2.7 GHz

Real-time bandwidth.....20 MHz

Resolution bandwidth .....fully adjustable
(< 1 Hz to 10 MHz)

Selectivity	
Window	**60 dB : 3 dB Ratio**
Flat Top	2.5 maximum
7-term Blackman-Harris	4.1 maximum

Hardware Tuning Resolution	
Hardware Module	**Resolution**
NI 5620 digitizer	0.015 Hz
NI 5600 downconverter	1 MHz minimum

Downconverter Tuning Speed	
Accuracy	**Settling Time**
1% of step size	10 ms maximum
0.01% of step size	20 ms maximum
0.0001% of step size	30 ms maximum
15 °C to 35 °C.	

Internal Frequency Reference

Frequency .....10 MHz

Temperature stability .....±20 ppb maximum
(referenced to 25 °C)

Aging

Per year ..... ±100 ppb maximum

Per day ..... ±1 ppb after 72 hours

Initial achievable accuracy ..... ±50 ppb maximum

Locking range ..... ±0.5 ppm minimum

Lock time for the NI 5600
(to external reference) ..... 10 sec maximum

Spectral Purity

Noise Sidebands	
Offset Frequency	**Noise Density**
1 kHz	–80 dBc/Hz maximum
10 kHz	–90 dBc/Hz maximum
30 kHz	–95 dBc/Hz maximum
100 kHz	–110 dBc/Hz maximum
1 MHz	–120 dBc/Hz maximum
100 MHz carrier, minimum.	

Residual FM ..... 10 Hz_{pk-pk} in 10 ms maximum

Spurious Responses

Sideband Spurs	
Offset Frequency	**Level**
>10 kHz	–70 dBc maximum
<10 kHz	–55 dBc maximum
–30 dBm input signal; 0 dB attenuation.	

Second-Order Harmonic Distortion (Input IP_2)		
Input Signal	**Distortion**	**Mixer Input IP_2**
10 MHz to 500 MHz	–82 dBc maximum	52 dBm minimum
500 MHz to 1.35 GHz	–80 dBc maximum	50 dBm minimum
mixer level –30 dBm; single –30 dBm input tone.		

Third-Order Intermodulation Distortion (Input IP_3)		
Input Signal	**Distortion**	**Mixer Input IP_3**
10 MHz to 1 GHz	–80 dBc maximum	10 dBm minimum
1 GHz to 2 GHz	–84 dBc maximum	12 dBm minimum
2 GHz to 2.7 GHz	–86 dBc maximum	13 dBm minimum
mixer level –30 dBm; two –30 dBm input tones, ≥200 kHz apart.		

Input-Related Spurs	
Frequency	**Level**
≥5 MHz	–70 dBc maximum
<5 MHz	–60 dBc maximum
–30 dBm input signal; 0 dB attenuation.	

Residual Spurs	
Frequency	**Level**
>12 MHz	–100 dBm maximum
<12 MHz	–70 dBm maximum
input terminated; no input signal; 0 dB attenuation.	

Noise Density	
Frequency	**Averaged Noise Level**
20 MHz to 1 GHz	–135 dBm/Hz maximum (–140 dBm/Hz typical)
1 GHz to 2 GHz	–134 dBm/Hz maximum (–137 dBm/Hz typical)
2 GHz to 2.5 GHz	–130 dBm/Hz maximum (–135 dBm/Hz typical)
2.5 GHz to 2.7 GHz	–129 dBm/Hz maximum (–132 dBm/Hz typical)
input terminated; no input signal; 0 dB attenuation.	

Amplitude Specifications

Input Levels

Amplitude range..... < *Averaged Noise Level* to +30 dBm

Maximum Safe Continuous RF Power	
Attenuation	**Level**
Enabled (10 dB)	+30 dBm
Disabled (0 dB)	+20 dBm

RF input attenuation..... 0 to 50 dB in 10 dB steps

Accuracy

Relative Accuracy[1]	
Frequency	**Accuracy**
<2 GHz	±0.75 dB ±0.5 dB typical
>2 GHz	±1.25 dB ±0.9 dB typical
[1] to 100 MHz 15 °C to 35 °C, with calibration correction.	

Absolute Accuracy	
Frequency	**Accuracy**
<2 GHz	±1 dB ±0.6 dB typical
>2 GHz	±1.5 dB ±1 dB typical
15 °C to 35 °C, with calibration correction.	

Group Delay Variation (15 °C to 35 °C)

20 MHz bandwidth..... ±15 ns maximum ($30\ ns_{pk\text{-}pk}$)

Linearity

Mixer 1 dB Gain Compression Point	
Frequency	**1 dB Compression Point**
10 MHz to 1 GHz	0 dBm minimum
1 GHz to 2 GHz	2 dBm minimum
2 GHz to 2.7 GHz	4 dBm minimum

Dynamic Range

Compression (1 dB) to Noise Dynamic Range	
Frequency	**Compression-Noise DR**
10 MHz to 1.0 GHz	135 dB minimum
1 GHz to 2 GHz	136 dB minimum
2 GHz to 2.7 GHz	134 dB minimum
resolution bandwidth = 1 Hz.	

Maximum Second Harmonic Distortion Dynamic Range

10 MHz to 1.35 GHz .....92 db minimum[1]

Maximum Intermodulation Distortion (SFDR) Dynamic Range	
Frequency	**Intermodulation DR**
10 MHz to 1 GHz	96 dB minimum
1 GHz to 2 GHz	97 dB minimum
2 GHz to 2.7 GHz	95 dB minimum
$^2/_3$(IP_3 – *Averaged Noise Level*); resolution bandwidth = 1 Hz; mixer level = –30 dBm.	

[1] $^1/_2$(IP_2 – *Averaged Noise Level*); resolution bandwidth = 1 Hz; mixer level = –30 dBm.

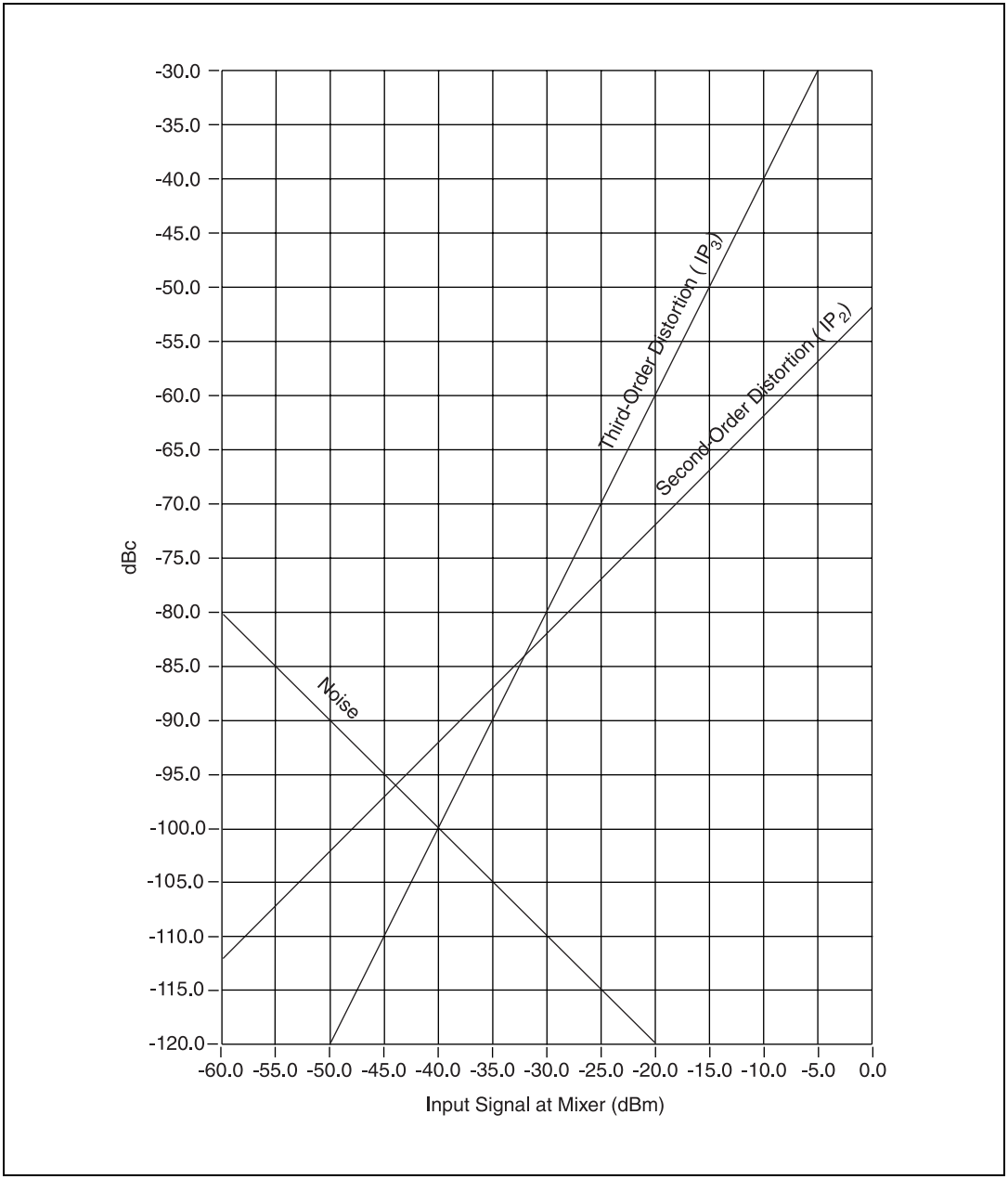

Figure 1. Typical Dynamic Range (1 Hz Resolution Bandwidth)

Modulation Specifications

Error Vector Magnitude (EVM) and Modulation Error Ratio (MER) (Typical)

800 MHz Carrier Frequency					
QAM Order	Symbol Rate (kHz)	System Equalization Enabled[1]		System Equalization Disabled	
		EVM (% rms)	MER (dB)	EVM (% rms)	MER (dB)
M = 4	270	N/A	N/A	1.1	39
	1,220	1.0	40	1.9	35
	3,840	1.4	37	2.3	32
	5,360	1.6	36	2.5	32
M = 16	270	N/A	N/A	0.8	39
	1,220	1.0	40	1.4	34
	3,840	0.9	39	1.8	32
	5,360	1.1	39	1.9	32
M = 64	270	N/A	N/A	0.7	39
	1,220	0.6	41	1.3	35
	3,840	0.7	40	1.6	32
	5,360	0.8	39	1.7	32

Root Raised Cosine Filter; alpha = 0.25; 2000 symbols.

[1] System equalization applied using NI Modulation Toolkit software version 3.0, which removes linear distortion effects from modulation quality measurements. This includes linear distortions from the signal source, the channel, and the receiver.

1900 MHz Carrier Frequency					
QAM Order	Symbol Rate (kHz)	System Equalization Enabled[1]		System Equalization Disabled	
		EVM (% rms)	MER (dB)	EVM (% rms)	MER (dB)
M = 4	270	N/A	N/A	1.2	38
	1,220	1.0	40	1.9	34
	3,840	1.4	37	2.4	32
	5,360	1.6	36	2.6	32
M = 16	270	N/A	N/A	0.9	39
	1,220	0.8	40	1.5	34
	3,840	0.8	40	1.8	32
	5,360	0.9	39	1.9	32
	10,000	1.0	38	2.4	30
M = 64	270	N/A	N/A	0.9	38
	1,220	0.7	40	1.4	34
	3,840	0.7	40	1.6	32
	5,360	0.8	39	1.7	32
	10,000	0.8	37	2.2	30

Root Raised Cosine Filter; alpha = 0.25; 2000 symbols.

[1] System equalization applied using NI Modulation Toolkit software version 3.0, which removes linear distortion effects from modulation quality measurements. This includes linear distortions from the signal source, the channel, and the receiver.

Input Characteristics

Nominal impedance .....50 Ω

Input coupling.....AC

Maximum DC input voltage .....±25 VDC[1]

Voltage Standing Wave Ratio (VSWR)

Attenuation	Frequency	VSWR
Enabled (10 dB–50 dB)[1]	9 kHz to 2.2 GHz	1.3:1 maximum
	2.2 GHz to 2.7 GHz	1.5:1 maximum
Disabled (0 dB)	9 kHz to 2.2 GHz	1.6:1 maximum
	2.2 GHz to 2.7 GHz	2.5:1 maximum
[1] available in 10 dB steps.		

LO emission from RF input.....< –87 dBm maximum

IF/Baseband

Resolution.....14 bits

IF input level.....0 dBm nominal
+10 dBm full scale

IF frequency range.....5 MHz to 25 MHz

Sample rate .....64 MS/s
integer divisions to 1 kS/s

Onboard memory .....16 MS
32 MS optional

Note Refer to the *NI PXI-5620 Specifications* document for additional IF/baseband specifications.

[1] DC levels up to ±25 VDC at input will not damage the NI 5660. However, high transient currents from low-impedance DC step voltages at input can cause damage.

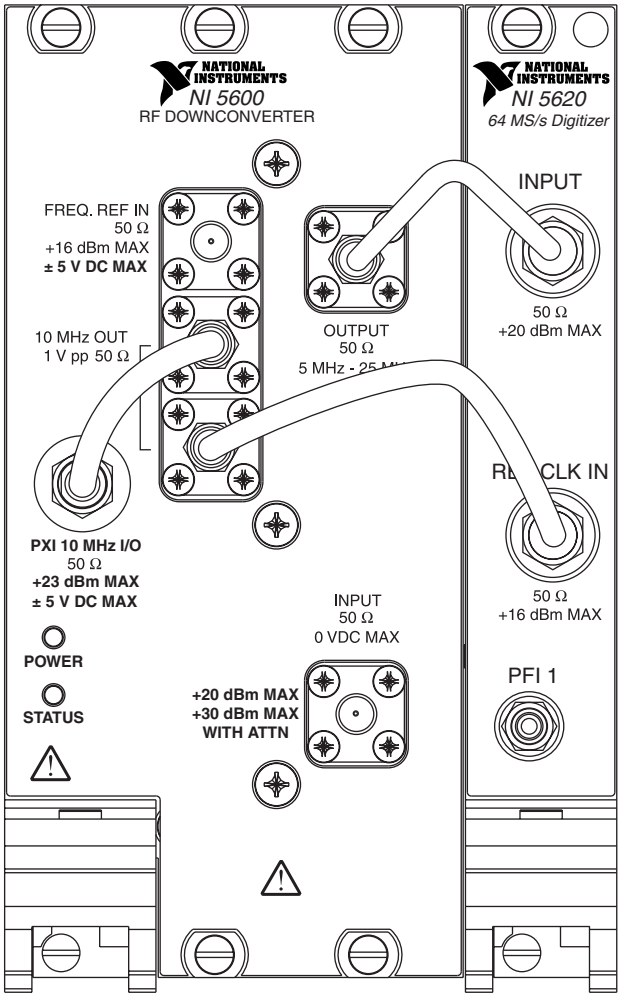

Figure 2. NI 5660 Front Panels

NI 5600 RF Downconverter Module

INPUT

Connector ..... SMA female

Impedance ..... 50 Ω

Coupling ..... AC

OUTPUT

Connector .....SMA female

Impedance.....50 Ω

Frequency .....5 MHz to 25 MHz

Amplitude .....0 dBm full scale

FREQ. REF IN

Connector .....SMA female

Impedance.....50 Ω

Input amplitude.....–5 to +15 dBm

Maximum safe input level .....+16 dBm

Maximum DC input voltage.....±5 V

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

10 MHz OUT (2 ports)

Connector .....SMA female

Impedance.....50 Ω

Signal.....Square wave

Amplitude .....±0.5 V (+7 dBm) into 50 Ω
(±1 V into open circuit)

Accuracy.....Refer to *Internal Frequency Reference*

PXI 10 MHz I/O

Connector .....SMA female

Impedance.....50 Ω

Input amplitude.....–5 to +15 dBm

Output amplitude .....0.5 V (+7 dBm) into 50 Ω

NI 5620 IF Digitizer Module

INPUT

Connector .....SMA female

Impedance.....50 Ω

Input amplitude.....0 dBm nominal
+10 dBm full scale

Maximum safe input level .....+20 dBm

Maximum safe DC input voltage ....±2 V

REF CLK IN

- Connector ..... SMA female
- Impedance ..... 50 Ω
- Input amplitude ..... –5 to +15 dBm
- Maximum safe input level ..... +16 dBm
- Maximum safe DC input voltage .... ±10 V
- Input frequency range ..... 10 MHz ±0.5 ppm

PFI 1

- Connector ..... SMB male
- Level ..... TTL
- Maximum input voltage ..... 5.5 V

Power Requirements

Module	+3.3 VDC	+5 VDC	+12 VDC	–12 VDC
NI 5600 RF downconverter	920 mA	2.3 A	700 mA	115 mA
NI 5620 IF digitizer	600 mA	1.5 A	450 mA	35 mA
voltages ±5%.				

Calibration

Interval ..... 1 year

Physical Dimensions

NI 5600 (3 PXI slots) ..... 3U, Three Slot, PXI/cPCI module
6.0 × 13.0 × 21.6 cm
(2.4 × 5.1 × 8.5 in.)

NI 5620 (1 PXI slot) ..... 3U, One Slot, PXI/cPCI module
2.0 × 13.0 × 21.6 cm
(0.8 × 5.1 × 8.5 in.)

Weight (combined unit) ..... 1,165 g (41.1 oz)

Environmental

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

Operating Environment

Warm-up time.....20 minutes

Ambient temperature range .....0 °C to 50 °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 (indoor use only).....0 m to 2,000 m (at 25 °C ambient temperature)

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.)

Maximum Working Voltage

Input to earth.....0 VDC, Installation Category I

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 61010-1
- CAN/CSA-C22.2 No. 61010-1

Note For UL and other safety certifications, refer to the product label, or visit `ni.com/certification`, 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

CE, C-Tick, and FCC Part 15 (Class A) Compliant

Note For EMC compliance, 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/certification`, search by model number or product line, and click the appropriate link in the Certification column.

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