

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 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.

Contents

| | |
|---------------------------------------------------------|----|
| Input Characteristics | 2 |
| IF/Baseband | 2 |
| Frequency Characteristics | 3 |
| Internal Frequency Reference | 3 |
| Spectral Purity | 4 |
| Spurious Responses | 4 |
| Amplitude Specifications | 6 |
| Input Levels | 6 |
| Accuracy | 6 |
| Linearity | 7 |
| Dynamic Range | 7 |
| Modulation Specifications | 10 |
| Error Vector Magnitude and Modulation Error Ratio | 10 |
| Hardware Front Panels | 12 |
| PXI-5600 RF Downconverter Module | 12 |
| PXI-5620 IF Digitizer Module | 13 |
| Power Requirements | 14 |
| Calibration | 14 |
| Physical Dimensions | 14 |
| Environmental | 15 |
| Safety | 15 |

Input Characteristics

Channels 1 RF
 1 IF

Nominal impedance 50 Ω

Input coupling AC

Maximum DC input voltage ± 25 VDC¹

| Voltage Standing Wave Ratio (VSWR) | | |
|---------------------------------------|--------------------|---------------|
| Attenuation | Frequency | VSWR |
| Enabled (10 dB–50 dB) ² | 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 |

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 PXI-5660. However, high transient currents from low-impedance DC step voltages at input can cause damage.

² Available in 10 dB steps.

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 |
| PXI-5620 digitizer | 0.015 Hz |
| PXI-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 |
| 1 ppm of step size | 30 ms maximum |
| Note: 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 |
| Note: at 100 MHz carrier, minimum | |

Residual FM10 Hz pk-pk in 10 ms maximum

Spurious Responses

| Sideband Spurs | |
|-------------------------------------------------------|-----------------|
| Offset Frequency | Level |
| > 10 kHz | -70 dBc maximum |
| < 10 kHz | -55 dBc maximum |
| Note: -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 |
| Note: mixer level -30 dBm single -30 dBm input tone | | |

| Third-Order Intermodulation Distortion (Input IP₃) | | |
|------------------------------------------------------------------------------|-------------------|-----------------------------------|
| Input Signal | Distortion | Mixer Input IP₃ |
| 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 |
| Note: 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 |
| Note: -30 dBm input signal 0 dB attenuation | |

| Residual Spurs | |
|----------------------------------------------------------------------|------------------|
| Frequency | Level |
| >5 MHz | -100 dBm maximum |
| <5 MHz | -70 dBm maximum |
| Note: input terminated no input signal 0 dB attenuation | |

| Noise Density | |
|----------------------|----------------------------------------------|
| Frequency | Average 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) |

Amplitude Specifications

Input Levels

Amplitude range< -130 dBm to +30 dBm

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

RF input attenuation0 to 50 dB in 10 dB steps

Accuracy

| Relative Accuracy | |
|------------------------------------------------------------------------|-----------------------------|
| Frequency | Accuracy |
| <2 GHz | ±0.75 dB ±0.5 dB typical |
| >2 GHz | ±1.25 dB ±0.9 dB typical |
| Note: 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 |
| Note: 15 °C to 35 °C, with calibration correction | |

Linearity

Group delay variation (15 °C to 35 °C)

20 MHz bandwidth ±15 ns maximum
(30 ns pk-pk)

| 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 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 |
| Note: 1 Hz resolution bandwidth | |

| Maximum Second Harmonic Distortion Dynamic Range | |
|----------------------------------------------------------------------------------------------------------|----------------------|
| Frequency | Distortion DR |
| 10 MHz to 500 MHz | 93 dB minimum |
| 500 MHz to 1.35 GHz | 92 dB minimum |
| Note: $\frac{1}{2}(IP_2 - averageNoiseLevel)$ resolution bandwidth 1 MHz mixer level -30 dB | |

| 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 |
| Note: $2/3(IP_3 - averageNoiseLevel)$ resolution bandwidth 1 MHz mixer level -30 dB | |

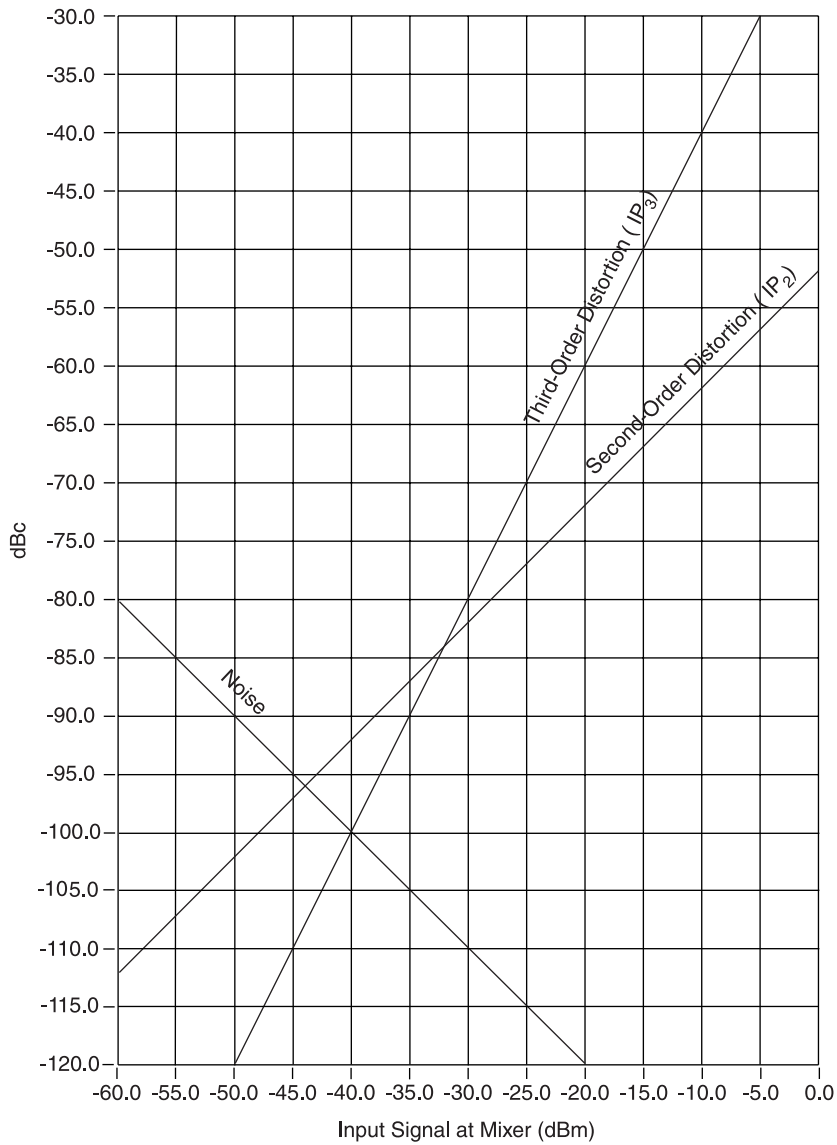


Figure 1. Typical Dynamic Range (1 Hz Resolution Bandwidth)

Modulation Specifications

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

| 800 MHz Carrier Frequency | | | | | |
|-----------------------------------------------------------------------|-------------------|-----------------------------|----------|------------------------------|----------|
| QAM Order | Symbol Rate (kHz) | System Equalization Enabled | | System Equalization Disabled | |
| | | EVM (% rms) | MER (dB) | EVM (% rms) | MER (dB) |
| M = 4 | 270 | N/A | N/A | 1.1 | 39.5 |
| | 1,220 | 1.3 | 37.5 | 1.9 | 35 |
| | 3,840 | 1.6 | 35.5 | 2.3 | 32.5 |
| | 5,360 | 1.9 | 34.5 | 2.5 | 32 |
| | 10,000 | 2.6 | 31.5 | 3.3 | 30 |
| M = 16 | 270 | N/A | N/A | 0.8 | 39.5 |
| | 1,220 | 0.8 | 40.5 | 1.4 | 34.5 |
| | 3,840 | 0.9 | 39.5 | 1.8 | 32.5 |
| | 5,360 | 1 | 39 | 1.9 | 32 |
| | 10,000 | 1.1 | 36.5 | 2.5 | 30 |
| M = 64 | 270 | N/A | N/A | 0.7 | 39.5 |
| | 1,220 | 0.6 | 41.5 | 1.3 | 35 |
| | 3,840 | 0.7 | 40 | 1.6 | 32.5 |
| | 5,360 | 0.8 | 39.5 | 1.7 | 32 |
| | 10,000 | 0.9 | 38 | 2.2 | 30 |
| Note: root raised cosine filter alpha 0.25 2,000 symbols | | | | | |

| 1900 MHz Carrier Frequency | | | | | |
|-----------------------------------------------------------------------|-------------------|-----------------------------|----------|------------------------------|----------|
| QAM Order | Symbol Rate (kHz) | System Equalization Enabled | | System Equalization Disabled | |
| | | EVM (% rms) | MER (dB) | EVM (% rms) | MER (dB) |
| M = 4 | 270 | N/A | N/A | 1.2 | 38.5 |
| | 1,220 | 1.4 | 37 | 1.9 | 34.5 |
| | 3,840 | 1.6 | 35.5 | 2.4 | 32.5 |
| | 5,360 | 2 | 34 | 2.6 | 32 |
| | 10,000 | 2.7 | 31 | 3.2 | 30 |
| M = 16 | 270 | N/A | N/A | 0.9 | 39 |
| | 1,220 | 0.8 | 40 | 1.5 | 34.5 |
| | 3,840 | 0.8 | 40 | 1.8 | 32.5 |
| | 5,360 | 0.9 | 39.5 | 1.9 | 32 |
| | 10,000 | 1 | 38 | 2.4 | 30 |
| M = 64 | 270 | N/A | N/A | 0.9 | 38.5 |
| | 1,220 | 0.7 | 40 | 1.4 | 34.5 |
| | 3,840 | 0.7 | 40 | 1.6 | 32.5 |
| | 5,360 | 0.8 | 39 | 1.7 | 32 |
| | 10,000 | 0.8 | 37.5 | 2.2 | 30 |
| Note: root raised cosine filter alpha 0.25 2,000 symbols | | | | | |

Hardware Front Panels

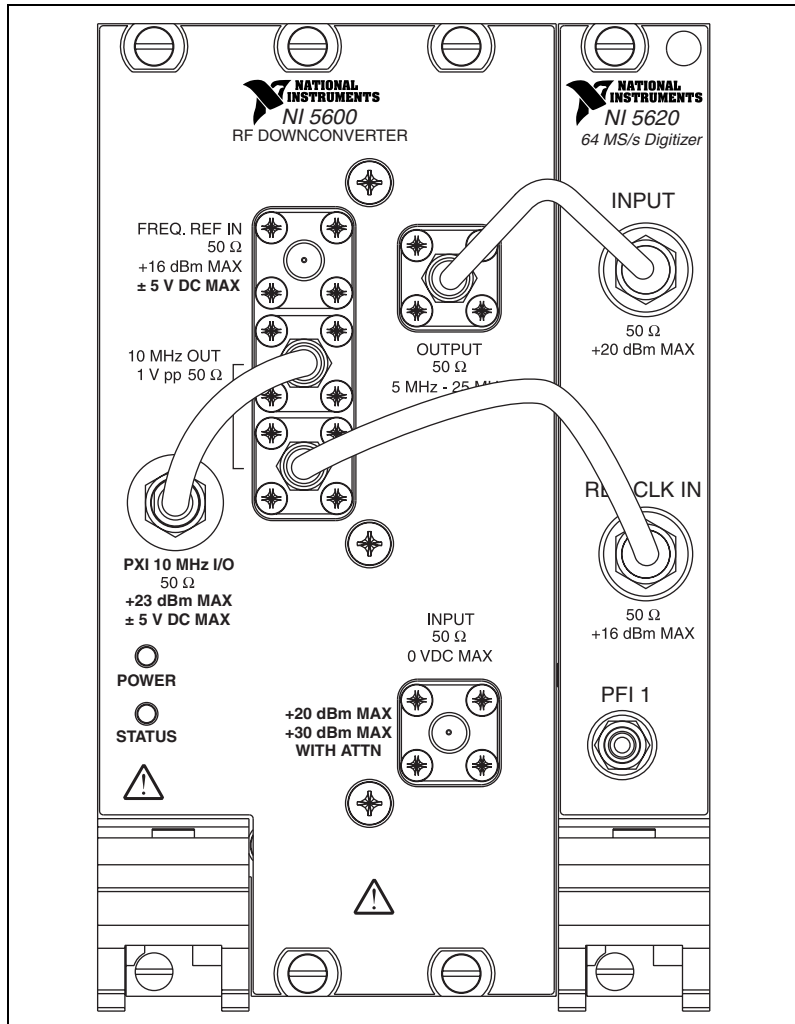


Figure 2. NI PXI-5660 Front Panels

PXI-5600 RF Downconverter Module

INPUT

ConnectorSMA female
 Impedance.....50 Ω
 CouplingAC

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

PXI-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

ConnectorSMA female
Impedance.....50 Ω
Input amplitude.....-5 to +15 dBm
Maximum safe input level.....+16 dBm
Maximum safe DC input voltage \pm 10 V
Input frequency range.....10 MHz \pm 0.5 ppm

PFI 1

ConnectorSMB male
Level.....TTL
Maximum input voltage5.5 V

Power Requirements

| Module | +3.3 VDC | +5 VDC | +12 VDC | -12 VDC |
|--------------------------------|----------|--------|---------|---------|
| PXI-5600 RF downconverter | 920 mA | 2.3 A | 700 mA | 115 mA |
| PXI-5620 IF digitizer | 600 mA | 1.5 A | 450 mA | 35 mA |
| Note: voltages \pm 5% | | | | |

Calibration

Interval.....1 year

Physical Dimensions

PXI-5600 (3 PXI slots)10 cm by 16 cm by 6.1 cm
(3.9 in. by 6.3 in. by 2.4 in.)

PXI-5620 (1 PXI slot).....10 cm by 16 cm by 2.0 cm
(3.9 in. by 6.3 in. by 0.8 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 |
|----------------------|--------------------------------|

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 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

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

ImmunityEN 61326:1997 + A2:2001,
Table 1

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



Note For full 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.

