

2.7 GHz RF Signal Analyzer

NI PXI-5660

- 9 kHz to 2.7 GHz
- 20 MHz instantaneous bandwidth
- High-stability timebase (10 MHz OCXO)
- ± 20 ppb frequency stability
- ± 50 ppb frequency accuracy
- > 80 dB spurious-free dynamic range
- $+30$ dBm full signal input range
- 14-bit resolution, 64 MS/s digitizer
- 16 or 32 million sample memory

Operating Systems

- Windows XP/2000/NT

Recommended Software

- LabVIEW
- LabWindows™/CVI

Application Software (included)

- Spectral Measurements Toolkit

Driver Software (included)

- NI-TUNER
- NI-SCOPE

Calibration Certificate Included



Overview

The National Instruments PXI-5660 is a modular RF signal analyzer optimized for automated test. It provides fast RF measurements in a compact, 3U PXI package. The NI PXI-5660 features a wide instantaneous bandwidth, highly stable timebase, and vector measurement capabilities that make it ideal for applications such as RF component and commercial electronic test applications. The PXI-5660 is shipped with the National Instruments Spectral Measurements Toolkit, which offers a breadth of spectral analysis functions including in-band power, adjacent-channel power, and power and frequency-peak-search ability. Additionally, it provides vector capabilities, such as 3D spectrograms, I/Q data for modulation analysis, and analog modulation analysis functions.

Hardware

The PXI-5660 hardware consists of a 2.7 GHz downconverter and a high-spectral-purity digitizer.

Analog Input

With the PXI-5660, you can acquire a wide range of signal levels, from $+30$ dBm to less than -130 dBm and achieve up to 50 dB of input attenuation, selectable in 10 dB steps.

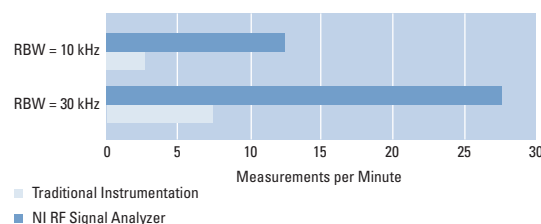
Frequency Characteristics

The PXI-5660 offers outstanding frequency capabilities over its operating range of 9 kHz to 2.7 GHz. It provides a typical noise density of < -140 dBm/Hz and more than 80 dB of intermodulation spurious-free dynamic range. Typical phase noise is < -94 dBc/Hz at a 10 kHz offset.

Superior Measurement Throughput

The most significant advantage of the PXI-5660 over traditional RF instrumentation is measurement throughput. Figure 1 illustrates the difference in throughput between the PXI-5660 and a traditional analyzer. Two comparisons are shown. One graph is a spectral sweep that illustrates the advantages of the wide instantaneous bandwidth of the downconverter. The other graph is an in-band power measurement comparison that shows the throughput advantages of the PXI-5660 as a whole.

Throughput Benchmarks Spectrum Sweep: 5 to 7X Improvement



Performance Benchmarks In-Band Power: 30 to 200X Improvement

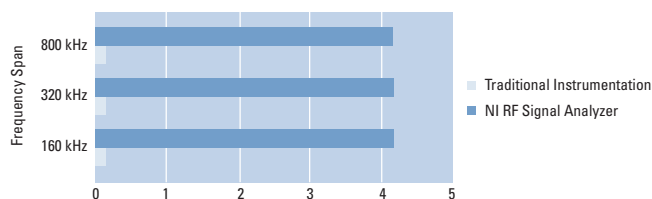


Figure 1. PXI-5660 Performance Benchmarks

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Ultrahigh-Stability Timebase

The PXI-5660 offers an extremely stable timebase with frequency stability of ± 20 ppb and frequency accuracy of ± 50 ppb, making it useful for a range of automation applications.

Accuracy

The noise and distortion characteristics of the PXI-5660 are stable and repeatable over time and a wide range of temperature. For example, with a 1 MHz measurement bandwidth, a -10 dBm signal has a repeatability of less than 0.1 dB, with a resolution bandwidth (RBW) of 1 kHz and number of averages equal to 10. The PXI-5660 uses a software compensation method that reduces amplitude error to less than 0.2 dB over a 20 °C change.

Applications

General-Purpose Test
Spectral analysis
Semiconductor ATE
Ultrasound/radar/lidar
RF component characterization
Military/aerospace
SigInt
Commercial Electronics Test
Cable modem
Mobile phones and pager
Wireless LAN and Bluetooth
Commercial radio
Digital television

Table 1. Applications for the PXI-5660

Acquisition Memory

The PXI-5660 includes up to 64 MB of onboard memory, delivering acquisition of up to 32 million real 16-bit samples or 16 million complex 16-bit samples. The PXI-5660 uses the bus master capability of the NI MITE ASIC to move data to computer memory at much higher speeds – up to 10 times faster – than traditional instrument interfaces. Because this ASIC performs memory management functions usually handled by the host CPU,

you can devote all the computer power of the host CPU to data analysis.

Clock Generation and Triggering

The 10 MHz reference clock on the PXI-5660 can synchronize to any one of three sources – the onboard high-precision OCXO reference clock, an external reference clock, or the PXI backplane. Using the PXI backplane, you can synchronize two or more PXI-5660 signal analyzers with each other and other PXI modules without using cables. You can synchronize the PXI-5660 to an external source using front-panel connectors. It can import and export TTL triggers from the PXI trigger bus, the PXI star trigger line, or the front-panel SMB connector. The PXI trigger bus greatly simplifies synchronizing RF measurements with other PXI modules such as digital multimeters, audio analyzers, and machine vision modules.

Digital Downconversion and Decimation

With the digital downconversion (DDC) functionality of the PXI-5660, you can acquire narrowband signals at much less than the full digitization rate. By downconverting channels of up to 1.25 MHz bandwidth to baseband, the PXI-5660 dramatically reduces the sampling rate necessary to acquire these signals. This feature results in dramatic throughput improvements for narrowband applications. For example, if you want to acquire a signal with a 200 kHz bandwidth

centered at 900 MHz, the rate at which you store samples can be as low as 250 kS/s.

Calibration

National Instruments calibrates the amplitude accuracy of the analog input of the downconverter and digitizer modules. Temperature variations are calibrated and corrected during normal operation, resulting in very high stability and repeatability. The modules are shipped with NIST-traceable and ISO-9002-certified calibration certificates.

Visit ni.com/calibration for more information about calibration services.

Spectral Measurements Toolkit

Zoom FFT
Zoom power spectrum
Averaged power spectrum
Averaged cross spectrum
Averaged frequency response
Amplitude calibration
Power spectral density
Peak frequency
Peak amplitude/power
Spectrum peak search
In-band power
Adjacent channel power
Occupied bandwidth
Demodulate AM
Demodulate FM
Demodulate PM
Downconvert passband

Table 2. Spectral Measurements Toolkit Functions

Software

The National Instruments Spectral Measurements Toolkit (SMT) and NI-RFSA driver software are included with the PXI-5660. SMT plugs directly into NI LabVIEW and LabWindows/CVI software to offer high-level measurement functionality. For a complete list of measurement functions, refer to Table 2. The driver software provides a driver-level interface and integrates with LabVIEW and LabWindows/CVI.

Ordering Information

NI PXI-5660	
32 MB	778284-01
64 MB	778284-02
<i>Includes modules, cables, NI-TUNER, NI-SCOPE, and the NI Spectral Measurements Toolkit.</i>	

BUY NOW!

For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to ni.com/rf.

2.7 GHz RF Signal Analyzer

Specifications

Valid over specified operating environment (0 to 50 °C) unless otherwise stated.

General

Channels..... 1 RF
1 IF

Frequency

Frequency range..... 9 kHz to 2.7 GHz
Instantaneous bandwidth 20 MHz
Resolution bandwidth (RBW)..... Fully adjustable (<1 Hz to 10 MHz)
Internal reference frequency 10 MHz
Temperature stability ± 20 ppb, max¹
Initial achievable accuracy ± 50 ppb, max
Aging ± 100 ppb/year
Locking range $\geq \pm 0.5$ ppm
Lock time to ext frequency reference ... <10 s
Warm-up time (typical) 20 minutes
Selectivity (60 dB : 3 dB)..... <2.5 (Flat Top) <4.1
(7 Term Blackman-Harris)

Tuning resolution

Frequency-domain digitizer
(PXI-5620)..... 0.015 Hz
RF downconverter (PXI-5600) 1 MHz, minimum

Tuning speed downconverter

(1% of step size)..... 10 ms, max
(0.01% of step size)..... 20 ms, max
(0.0001% of step size)..... 30 ms, max

Spectral purity (noise sidebands) at 100 MHz, minimum

1 kHz offset..... <-80 dBc/Hz²
10 kHz offset..... <-90 dBc/Hz
30 kHz offset..... <-95 dBc/Hz
100 kHz offset..... <-110 dBc/Hz
1 MHz offset..... <-120 dBc/Hz

Sideband spurs

≥ 10 kHz offset <-70 dBc
<10 kHz offset..... <-55 dBc

Residual FM <10 Hz_{p-p} in 10 ms

¹0 to 50 °C, referenced to 25 °C

²For spans 20 kHz; for spans >20 kHz, the value is <-78 dBc/Hz at 1 Hz offset

Amplitude

Input signal range <-130 to 30 dBm
Maximum safe input
power (continuous) +30 dBm (Atten 10 dB) +20 dBm
(Atten 0 dB)
RF input attenuator 0 to 50 dB (10 dB steps)
Maximum DC input voltage 0 VDC³
Relative accuracy (with respect to 100 MHz, 15 to 35 °C)
 ≤ 2 GHz, calibrated..... ± 0.75 dB, ± 0.5 dB, typical
>2 GHz, calibrated ± 1.25 dB, ± 0.9 dB, typical
Absolute accuracy (15 to 35 °C)
 ≤ 2 GHz, calibrated..... ± 1 dB, ± 0.6 dB, typical
>2 GHz, calibrated ± 1.5 dB, ± 1 dB, typical
Group delay variation..... ± 15 ns, max²

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

³DC levels up to ± 25 VDC at input will not damage the instrument; however, high transient currents from low impedance DC step voltages at input can cause damage.

Spurious Response

2nd-order harmonic distortion (single -30 dBm tone)
9 kHz to 2.7 GHz <-80 dBc (IIP2 > +50 dBm)

3rd-order intermodulation distortion

(two -30 dBm tones, >200 kHz separation)

10 MHz to 1 GHz..... <-80 dBc (IIP3 > +10 dBm)
1 to 2.0 GHz <-84 dBc (IIP3 > +12 dBm)
2.0 to 2.7 GHz <-86 dBc (IIP3 > +12 dBm)

Input-related spurs

Signal level = -30 dBm, 0 dB attenuation

≥ 5 MHz <-70 dBc
<5 MHz..... <-60 dBc

Residual response related spurs

Input terminated, 0 dB input attenuation

≥ 12 MHz <-100 dBm
<12 MHz..... <-70 dBm

Noise density

20 MHz to 1 GHz..... <-135 dBm/Hz
(-140 dBm/Hz, typical)
1 to 2 GHz <-134 dBm/Hz
(-137 dBm/Hz, typical)
2 to 2.5 GHz <-130 dBm/Hz
(-135 dBm/Hz, typical)
2.5 to 2.7 GHz <-129 dBm/Hz
(-132 dBm/Hz, typical)

Inputs/Outputs Downconverter Front Panel

RF input 50 Ω , AC-coupled SMA female
VSWR (input atten = 10 dB)
9 kHz to 2.2 GHz <1.3:1
2.2 to 2.7 GHz <1.5:1
LO emission from RF input..... <-87 dBm, max
IF output 50 Ω , SMA female
Frequency 5 to 25 MHz
Amplitude..... 0 dBm full-scale
External frequency reference input 50 Ω , SMA female
Input power..... -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 output (2 ports)..... 50 Ω , SMA female
Signal Square wave
Amplitude ± 0.5 V (+7 dBm) into 50 Ω
(± 1 V into open circuit)
Accuracy See frequency reference
PXI 10 MHz input/output 50 Ω , SMA female
Input power..... -5 to +15 dBm
Output power 0.5 V (+7 dBm) into 50 Ω

2.7 GHz RF Signal Analyzer

Digitizer Front Panel

IF input (normally connected to PXI-5600 IF output), AC coupled	
Impedance/connector.....	50 Ω , SMA female
Input power.....	0 dBm nominal, +10 dBm full-scale
Maximum safe input level.....	+20 dBm
Maximum DC input voltage.....	± 2 V
VSWR.....	<1.5:1, 5 to 25 MHz
External frequency reference input (normally connected to PXI-5600 10 MHz output)	
Impedance/connector.....	50 Ω , SMA female
Input power.....	-5 to +15 dBm
Maximum safe input level.....	+16 dBm
Maximum DC input voltage.....	± 10 V
Input frequency range	10 MHz ± 0.5 ppm
External trigger (PFI 1)	
Connector.....	SMB male
Level.....	TTL
Maximum input voltage	5.5 V

IF/Baseband

Resolution	14 bits
IF input level.....	0 dBm nominal, +10 dBm full-scale
IF frequency range	5 to 25 MHz
Sample rate.....	64 MS/s and integer divisions down to 1 kS/s
Onboard memory.....	16/32 MS option
Using DDC (complex data).....	8/16 MS option

Power Requirements (Typical)

	+3.3 VDC ($\pm 5\%$)	+5 VDC ($\pm 5\%$)	+12 VDC ($\pm 5\%$)	-12 VDC ($\pm 5\%$)
Downconverter (PXI-5600)	920 mA	2.3 A	700 mA	115 mA
Digitizer (PXI-5620)	600 mA	1.5 A	450 mA	35 mA

Calibration

Interval	1 year
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Physical

PXI-5600	3U, 3-slot, PXI/Compact PCI module 21.6 by 6.0 by 13.0 cm (8.5 by 2.4 by 5.1 in.)
PXI-5620	3U, 1-slot, PXI/Compact PCI module 21.6 by 2.0 by 13.0 cm (8.5 by 0.8 by 5.1 in.)

Environment

Warm-up time	20 minutes
Operating temperature	0 to 50 $^{\circ}\text{C}$
Relative humidity.....	10 to 90%, noncondensing
Storage temperature.....	-20 to +70 $^{\circ}\text{C}$
Relative humidity.....	5 to 95%, noncondensing

Safety and Compliance

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, CSA 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

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

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

Note: For EMC compliance, operate this device according to product documentation.

CE Compliance

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

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

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.

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 not only to the environment but also to NI customers.

For additional environmental information, refer to the NI and the Environment 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.

NI Services and Support



NI has the services and support to meet your needs around the globe and through the application life cycle — from planning and development through deployment and ongoing maintenance. We offer services and service levels to meet customer requirements in research, design, validation, and manufacturing. Visit ni.com/services.

Training and Certification

NI training is the fastest, most certain route to productivity with our products. NI training can shorten your learning curve, save development time, and reduce maintenance costs over the application life cycle. We schedule instructor-led courses in cities worldwide, or we can hold a course at your facility. We also offer a professional certification program that identifies individuals who have high levels of skill and knowledge on using NI products. Visit ni.com/training.

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Our NI Professional Services team is composed of NI applications and systems engineers and a worldwide National Instruments Alliance Partner program of more than 600 independent consultants and

integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.



OEM Support

We offer design-in consulting and product integration assistance if you want to use our products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Local Sales and Technical Support

In offices worldwide, our staff is local to the country, giving you access to engineers who speak your language. NI delivers industry-leading technical support through online knowledge bases, our applications engineers, and access to 14,000 measurement and automation professionals within NI Developer Exchange forums. Find immediate answers to your questions at ni.com/support.

We also offer service programs that provide automatic upgrades to your application development environment and higher levels of technical support. Visit ni.com/ssp.

Hardware Services

NI Factory Installation Services

NI Factory Installation Services (FIS) is the fastest and easiest way to use your PXI or PXI/SCXI combination systems right out of the box. Trained NI technicians install the software and hardware and configure the system to your specifications. NI extends the standard warranty by one year on hardware components (controllers, chassis, modules) purchased with FIS. To use FIS, simply configure your system online with ni.com/pxiadvisor.

Calibration Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit ni.com/calibration.

Repair and Extended Warranty

NI provides complete repair services for our products. Express repair and advance replacement services are also available. We offer extended warranties to help you meet project life-cycle requirements. Visit ni.com/services.



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