Signal Hound®

VSG60A

Vector Signal Generator

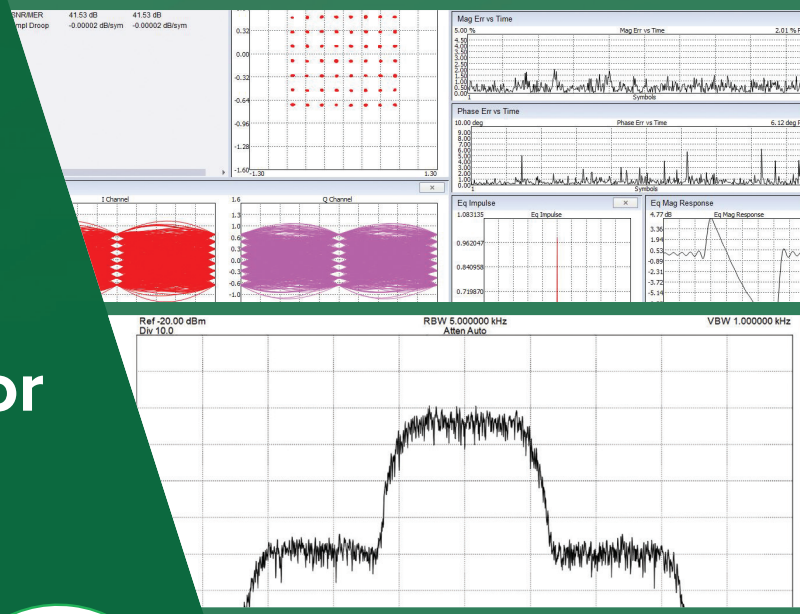50 MHz to 6.0 GHz

40 MHz Streaming Modulation Bandwidth

AVAILABLE FOR
$2,445
US RETAIL

VSG60A 50 MHz to 6 GHz
Vector Signal Generator

Signal Hound®
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MADE IN USA

Unrivaled Value
High Performance

signalhound.com

VSG60A

Vector Signal Generator

50 MHz to 6.0 GHz

40 MHz Streaming Modulation Bandwidth

Now you can afford to create the signals you need

The Signal Hound VSG60A Vector Signal Generator offers the performance and agility of a serious vector signal generator at a fraction of the cost. Now you can afford to test your designs with a golden reference in R&D and dramatically reduce your cost of creating signals in manufacturing.

The VSG60A hardware features an agile, low phase noise LO synthesizer, digital baseband oversampling with reconstruction filter, harmonic filters across the full frequency range, and a trigger output, timed to match the RF output, for integrating the VSG60A into automated test environments.

Commands to change frequency and amplitude are embedded in the same data stream from the PC as the I/Q data, giving the user precise timing across frequency and amplitude changes. A low phase noise, agile local oscillator with a 200 µs switch time enables fast frequency hopping.

A dual 14-bit DAC runs at 2x or 3x the I/Q symbol rate using digital oversampling to provide a flat, clean baseband. Continuously streaming up to 40 MHz of bandwidth at up to 51.2 MSPS from a PC or laptop virtually eliminates I/Q pattern buffer size restrictions.

- **RF Frequency Range: 50 MHz to 6 GHz**
  - **May be used down to 30 MHz**
- **Amplitude range: -55 dBm to +7 dBm**
  - **May be used from -85 dBm to +10 dBm with reduced performance**
- **40 MHz of real-time streaming bandwidth**
- **Typical EVM: 0.3% (1 GHz carrier, 1 MSPS QAM16, alpha 0.35, raised cosine)**
- **Easily generate a number of standard analog and digital waveforms with the provided software or output your own custom arbitrary waveforms**
- **Stream waveforms of virtually any size from your PC or laptop**
- **Agile, low phase noise LO with 200 µs frequency hops**
- **1000+ simultaneous tones, 100 nanosecond pulses**
- **Arbitrary I/Q sample rates from 12.5 kSPS to 51.2 MSPS. Includes 30.72 MSPS for LTE**
- **Amplitude, mixer balance, and DC offset corrected over frequency and temperature**
- **Digital oversampling, baseband filtering, and harmonic filtering across full operating range**
- **Powerful software and API included**
- **Trigger output is available to synchronize the VSG60A with other test equipment**
- **External 10 MHz input may be used for zero ppm frequency error**
- **USB-powered**
- **Under 9 inches long, and under 1 lb**

Measurements,
Capabilities and Features

Create the signals you need, simple or complex

Preprogrammed modulation types

As a vector signal generator, the VSG60A can generate virtually any signal that fits within its 40 MHz bandwidth, limited only by the waveform generation software. The VSG60A ships with a powerful suite of software tools for generating both analog and digital modulation, adding impairments for receiver testing, or loading custom waveforms, all at no additional cost.
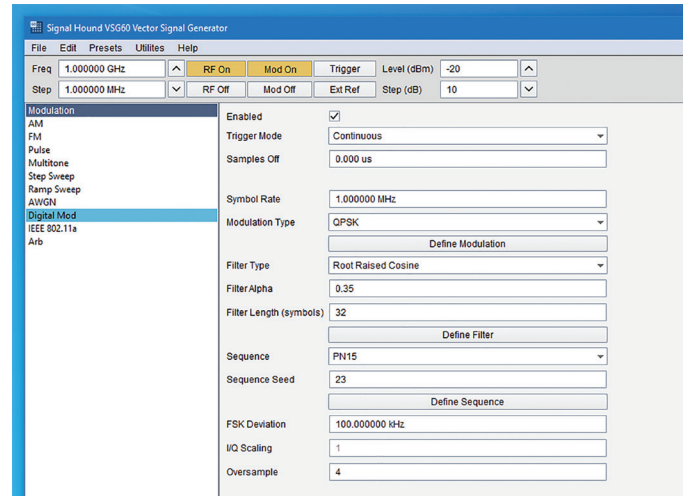
Preprogrammed Modulation Types:

CW AM, FM, Pulse, Multitone, Sweep, AWGN, FSK, GFSK, OOK, ASK, MSK, GMSK, BPSK, DBPSK, QPSK, DQPSK, Pi/4DQPSK, OQPSK, 8-PSK, 16-PSK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM

Easily add custom modulated waveforms

A user-friendly application programming interface (API) is available for communicating with the VSG60A directly from your software application. The VSG60A software includes built-in MATLAB and Python interfaces to easily load custom waveforms.

Use the API to continuously stream I/Q data to the VSG60A at an arbitrary sample rate up to 51.2 MSPS, or use the software to load an arbitrary waveform in text or binary formats. Corrections are automatically applied as the data is streamed to the VSG60A.

The VSG60A offers a wide range of preprogrammed modulation types.
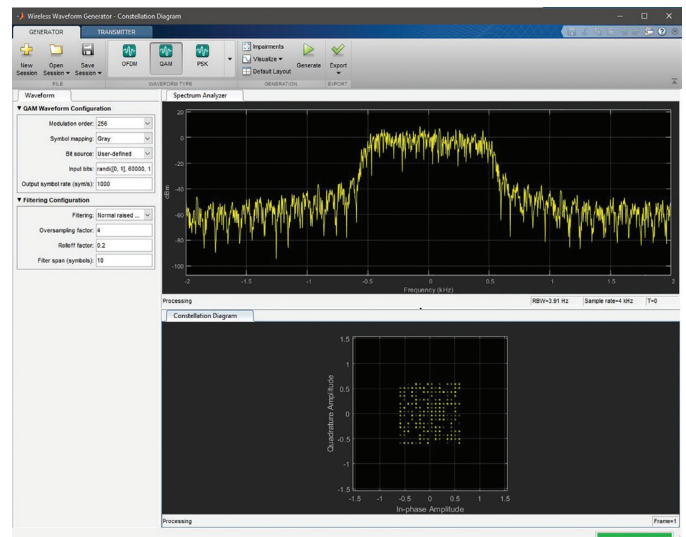
Easily load custom waveforms from your preferred software tools.

Add impairments to evaluate the performance of your design

The VSG60A offers a number of software level digital impairments for your waveforms. You can add impairments to the frequency offset, sample rate, timebase, and I/Q offset. You can add Additive white Gaussian noise (AWGN) with a specific signal to noise ratio. This will allow you to test receiver performance and sensitivity, as well as simulate noise interference.

A custom channel FIR filter can easily be used to model and test complex transmitter/receiver scenarios. Using the impairment channel filter editor, you can model multi-path, model custom group delays, or add precorrections. The filter editor lets you import and export custom length complex FIR filters which can be applied to a number of digitally modulated signals. A filter visualizer displays the impulse and frequency response of your custom filter for quick visual verification.

The capabilities of the VSG60A include a variety of impairment features. In addition, it can stream any generated waveforms that may have more sophisticated impairments. However, unlike VSGs that cost 10 to 20 times more, it cannot generate the filters for you. For example, you cannot have a GPS map position for the receiver and transmitter and have the VSG60A software build a fading model. However, you could import that filter into our software and transmit it.
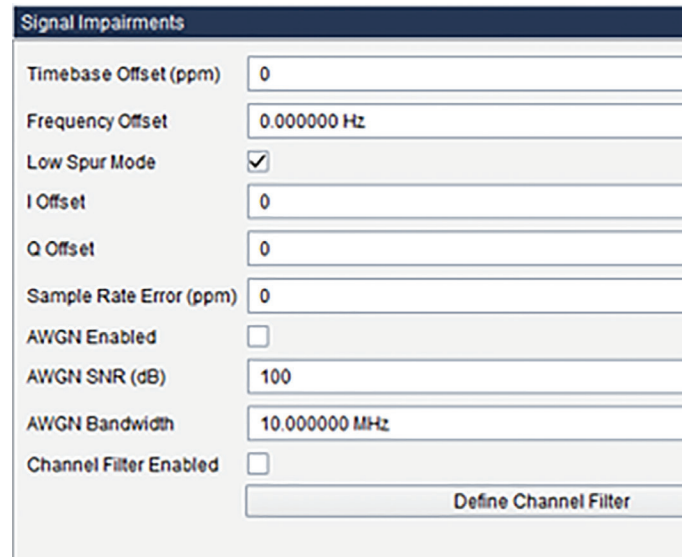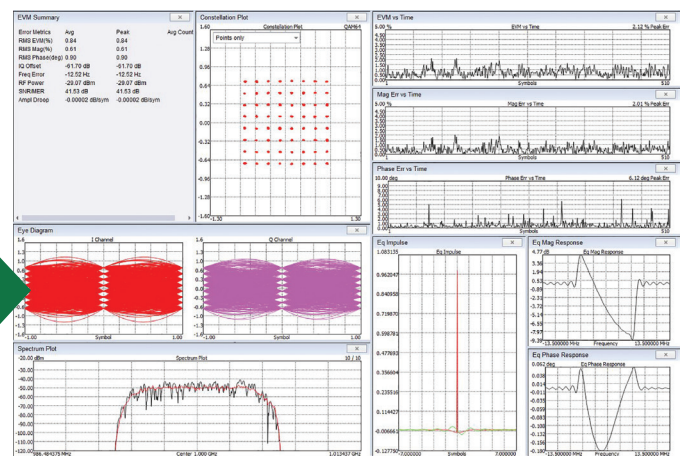

The VSG60A software offers a number of digital impairments for your waveforms.

Digital modulation impairments

Channel, Additive white Gaussian noise (AWGN), I/Q Offset, Sample rate multiplier, Frequency offset, Timebase multiplier
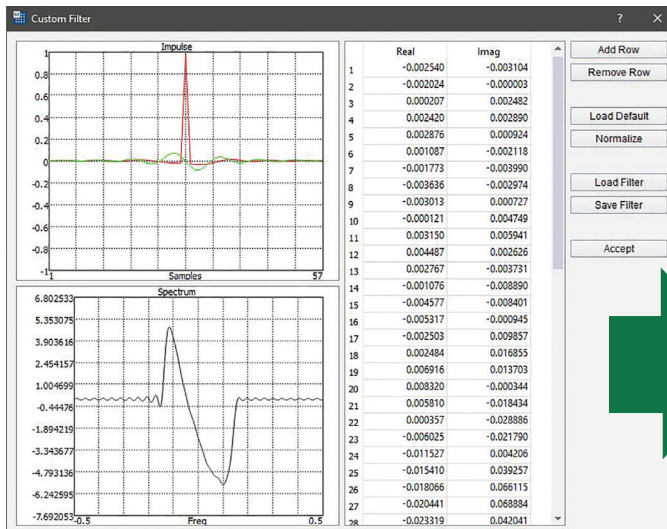
This is an example of custom input impairment, as configured in the custom filter editor of the VSG60A software.


The Spike software has an equalization capability, which will equalize the linear response and mirror the filter set on the VSG transmitter.

Fast switching times for manufacturing

At the API level, the VSG60A can quickly switch between streaming I/Q and changing LO frequency or attenuator settings at precise intervals (200 μs and 10 μs, respectively). This allows the user to build signals that hop across the entire frequency range of the device.

This makes the VSG60A a good choice for generating frequency hopping signals or signals that must cover a wide amplitude range. This is common during the manufacturing test of RF components or subsystems. When the VSG is controlled using the supplied GUI, the switching times are typically 80 ms.

The VSG60A is also perfect for applications such as Bluetooth or military radios, which need to simulate frequency hopping spread spectrum waveforms and protocols.
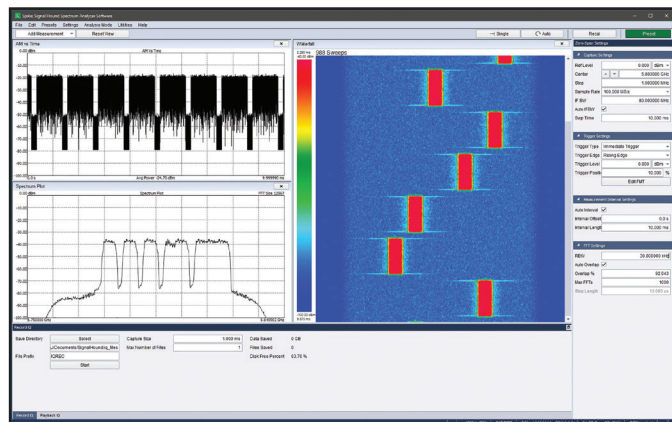
The VSG60A is perfect for frequency hopping applications with the ability to change frequencies in 200 μs.

Accurate frequency resolution

The VSG60A offers two modes for frequency resolution. The default mode is digitally tuned and offers 1 μHz resolution capability. This default setting also includes having the "low spur mode" on. Disabling low spur mode turns off digital tuning and the frequency resolution becomes 1/6 Hz. For example, with low spur mode on and the VSG is outputting 1 GHz, while locked to a 10 MHz time base, the frequency resolution would be ± 1 millihertz.
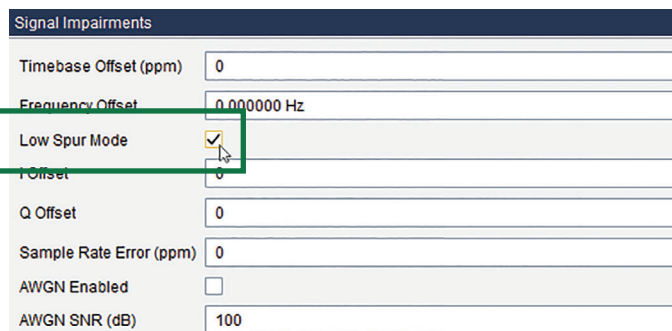
Configurable settings for adjusting frequency resolution

## Achieve near-perfect frequency accuracy with external 10 MHz input

A low-jitter comparator provides low additive phase noise for an external 10 MHz reference input of 0 dBm to +13 dBm. When the external reference is enabled, the internal 10 MHz VCTCXO is disabled and the external reference disciplines the 80 MHz VCXO directly.

The external 10 MHz reference input of the VSG60A

Low EVM (and ACPR) for golden transmitter

Many wireless protocols call out transmission requirements for performance with a specific signal-to-noise ratio. The VSG60A specifies a typical EVM of 0.3% (1 GHz carrier, 1 MSPS QAM16, alpha 0.35, raised cosine). It typically has a 50 dB signal-to-noise ratio, which allows the VSG to be used for most applications. Within 40 MHz of bandwidth, there's really no modulation that's off the table for the VSG60A. Now you can afford a VSG to simulate your transmitter in a closed-loop environment.
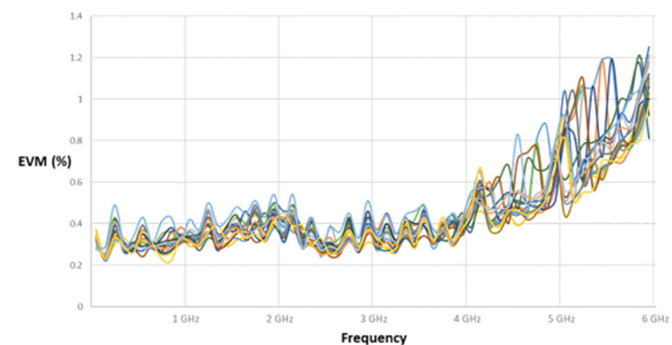

The VSG60A's EVM is specified and tested on each VSG. Shown are EVM test results for 17 VSGs.

Generate clean signals at a fraction of the cost

Accurate phase noise measurements

Generating clean digitally modulated signals has always been expensive. Now the VSG60A offers you the ability to create signals with low phase noise for less than a 1/10 of what you used to pay! When testing receivers, it is important that the signal generator itself have low phase noise so as not to contribute to the device measurement. The VSG60A offers specified performance better than -125 dBc at 10 kHz offset (at 1 GHz CW).
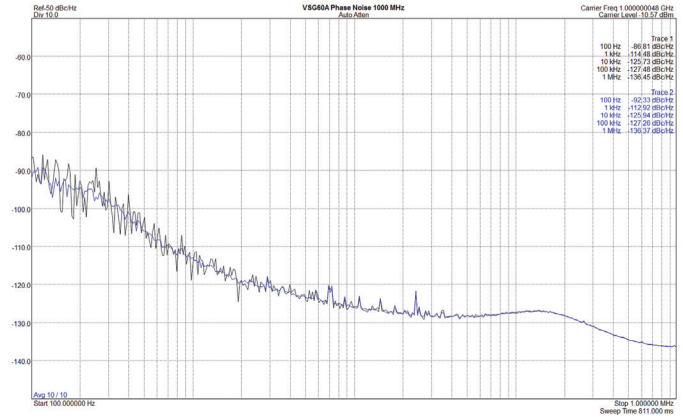
The VSG60A offers surprisingly clean signals at a price you can afford.

Low spur mode via digital tuning

The VSG60A uses a low IF architecture design that enables phase noise performance with a lower cost design, but it does come with a tradeoff of higher image response spurs. To mitigate these spurs, a low spur mode has been added, which is on by default. When low spur mode is enabled, the fractional-N PLL uses a very low denominator to keep the spurs at least 2 MHz away from the carrier and typically below -50 dBc above 3.7 GHz, and below -55 dBc below 3.7 GHz. This gives a coarse LO frequency, which is then digitally tuned to the exact requested frequency.
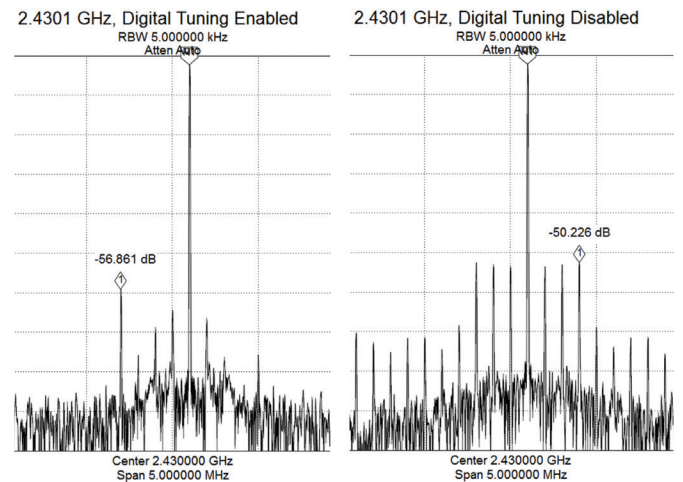

Low spur mode on the VSG60A reduces the image response spurs.

Specify arbitrary sample rates

The VSG60A allows you to specify arbitrary sample rates, which then lets you generate any protocol or wireless signal that's within the 40 MHz bandwidth (WiFi, Bluetooth, LTE, GSM, CDMA, etc.). This allows for easy digital oversampling, with no need to do resampling. This makes arbitrary waveforms generated in other software instantly compatible with our generator, without a need to resample.

In order to have an accurate bit error rate test, a waveform has to be built with the correct sample rate or it's not going to work. The VSG60A allows you to specify arbitrary sample rates, which then enables you to do accurate bit error rate testing.
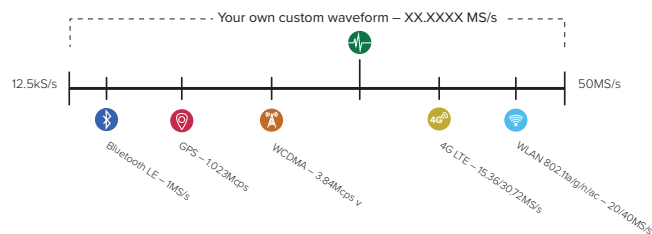
Output your waveform at any sample rate.

Wide output power range

The VSG60A offers an output power range from -85 dBm up to +7 dBm. The upper output power range is limited due to the power for the instrument coming over the USB interface. On the low frequency side the specified performance is -55 dBm, however, it can be digitally supported as low as -85 dBm while maintaining linear power.
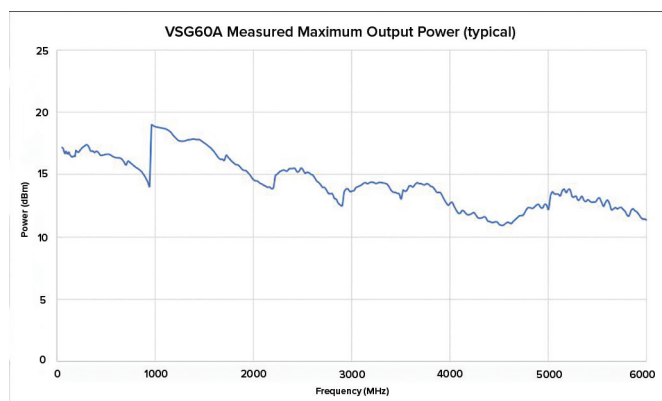
The VSG60A offers an output power range from -85 dBm up to +7 dBm.

USB powered

The VSG60A is powered by USB and does not contain an internal power supply. To keep it USB-powered, it was designed with modulators and amplifiers that strike a balance between linearity and power consumption. Applications requiring high output power and good linearity, especially at high frequencies, may require an external amplifier. An amplifier with a third order intercept 25 dB above the required output power will generally preserve the linearity of the VSG60A.
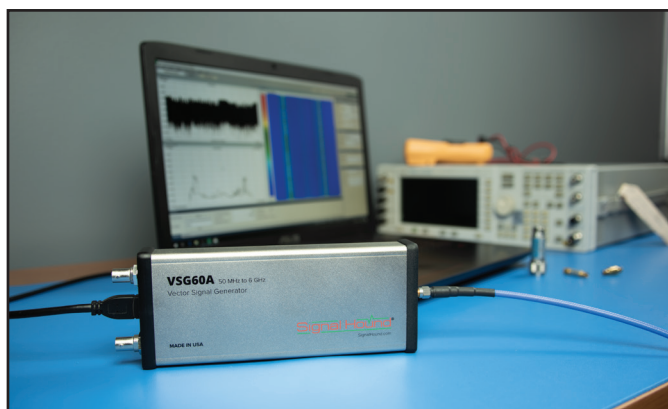
The VSG60A is powered by your PC's USB 3.0 connection.

SWaP+C - Look No Further

Next-generation defense systems are pushing the boundaries of performance even as they continue to reduce size, weight, power, and cost (SWaP+C). Even in the commercial world, providing test engineers with critical test equipment in their drawer or on-the-go provides a competitive advantage. The VSG60A is a natural fit for customers looking for SWaP+C solutions.

	VSG60A
SIZE	3.19" W x 1.19" H x 8.63" D
WEIGHT	0.81 lbs
POWER	6 W

The VSG60A offers excellent SWaP+C parameters.

Signal Corrections across 0° to 60° C

Each VSG60A is tested in our environmental chambers and a correction table is generated across a 0° to 60° C temperature range. These corrections are stored on the VSG and applied automatically. The corrections include:
  * amplitude flatness
  * image balance
 * I/Q offset
  * temperature corrections

Additionally, the user can adjust the internal timebase as needed, and manually adjust the DC offset to null out the LO feedthrough, if the factory adjustment is insufficient for a particular task, such as improving the on/off ratio for pulse modulation.

Each VSG60A is tested and a correction table is generated across a 0° to 60° C temperature range.

Reduced maintenance costs with field calibration

Signal Hound's Field Calibration Software is available as a free download and may be used to calibrate the VSG60A. This enables an in-house calibration lab to verify the VSG still meets its calibration requirements. Additional equipment, such as a power meter and spectrum analyzer are required to complete the calibration.
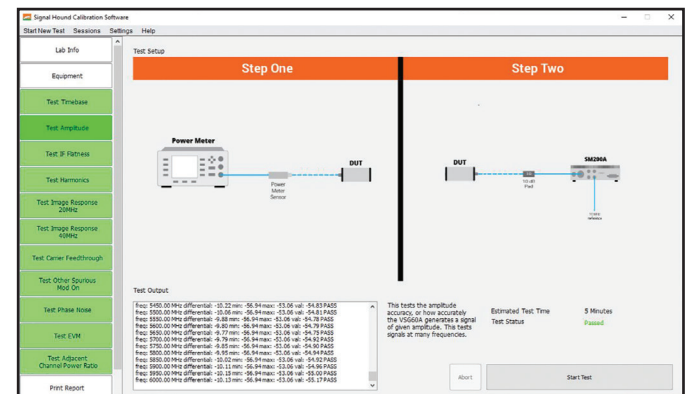
The Signal Hound Field Calibration Software.
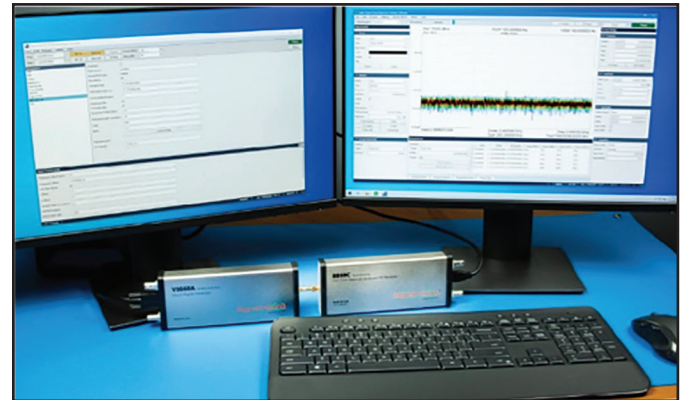
Applications

Receiver testing is now affordable

Unrivaled value and high performance

Test engineers often value having a "golden transmitter" that can simulate different wireless standards to test their designs. Unfortunately, most VSGs fall outside of their budget range. The VSG60A offers an unrivaled value with the performance needed to evaluate most designs. It generates accurate signals that can be used with confidence to challenge your receivers. With the ability to transmit virtually any signal within its 40 MHz of bandwidth, you can be sure that your design will be able to meet the requirements of the wireless community. And at a price that is 1/10th of what you would expect to spend, it's time to add the VSG60A to your RF bench.

The VSG60A vector signal generator paired with our BB60C spectrum analyzer.

Impairments to test your limits

Some wireless protocols require receiver designs to have a one part-per-million bit error rate at a defined signal-to-noise ratio (SNR). With the VSG60A, adding impairments are easy. Add noise to your signal to test BER and verify that you meet the protocol standards.

For example, the Wi-Fi specification states that you should be able to measure the waveform when it has a 33 dB SNR. The VSG60A can be used to transmit these signals so that you can test the threshold or limit that you're testing to.

Waveform with/without SNR impairment pictures shows the result of push button noise impairment.

Easy integration into automated test environments

SCPI automation for R&D and prototype evaluations

The provided waveform generation software can be controlled with SCPI commands. The PC running the software can be interfaced over a network, making the software remotely or locally controllable with 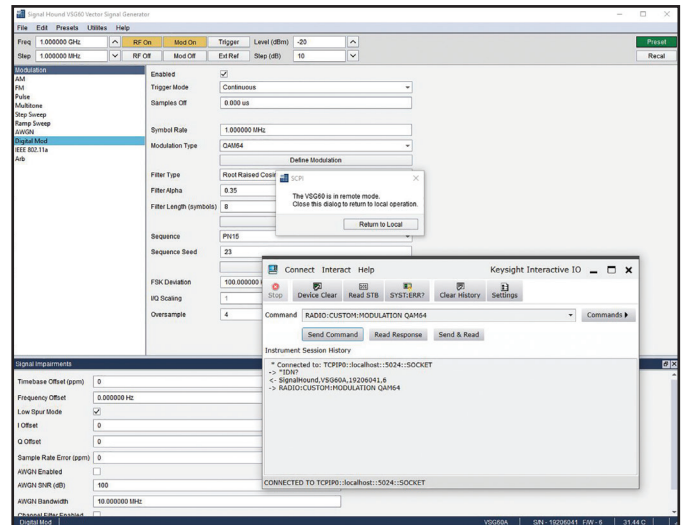SCPI commands. Any programming language that communicates over a TCP/IP socket can send and receive SCPI commands to the VSG.

Use SCPI commands for remote control of the VSG60A

## Use output trigger to drive other equipment

The VSG60A has a trigger output that is a series-terminated 3.3V logic signal, typically meant to drive a high impedance load. The trigger output is synchronized with the RF output. Up to 1000 triggers per second can be output, with a user-selectable pulse width. This enables the VSG60A to be connected to other equipment in an automated testing environment.
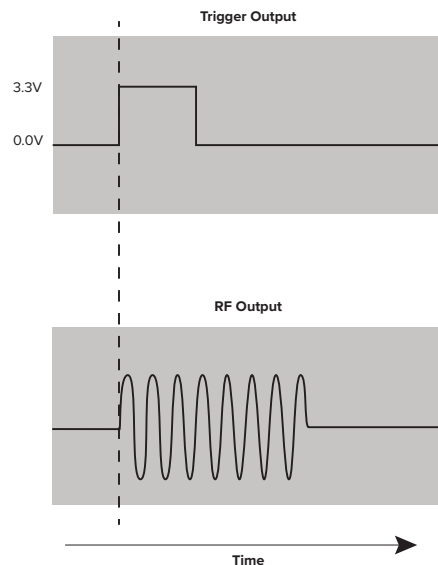
Integrate the VSG60A into an Automate Testing Environment (ATE) with trigger output

Maximize performance with direct device API programming

Signal Hound's open-systems approach provides a highly extensible platform for optimizing your manufacturing's automated test environment. The VSG60A architecture allows for an additional technique to expose the full capabilities of the VSG, such as frequency switching speed and the I/Q streaming interface. In many cases the instrument software can consume computer processor overhead. The added use of the program may have a small impact on overall test times. In cases where fractions of a second are critical, Signal Hound allows its users to bypass the VSG60A software application. This allows for direct device API programming for even faster measurements. The VSG60A can be programmed in C++, LabVIEW, MATLAB, Python, C# or any language that has C bindings. The API now works on Windows and Linux (Ubuntu 18.04) operating systems.
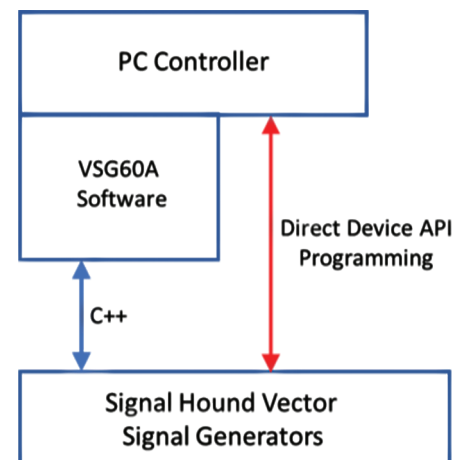
Increase your measurement speed and performance further with direct device API programming.

How We Compare

FEATURE/ SPECIFICATION	SIGNAL HOUND VSG60A VECTOR SIGNAL GENERATOR	TEKTRONIX TSG4106A	KEYSIGHT E4438C (OPT 601)	KEYSIGHT N5182B
Carrier Frequency Range	50 MHz-6 GHz	400 MHz-6 GHz	25 kHz-6 GHz	9 kHz-5 GHz
Output Power	+10 to -55 dBm	+16.5 to -110 dBm	+10 to -136 dBm	+16 to -144 dBm
Arbitrary I/Q BW	40 MHz	N/A	80 MHz	80 MHz
I/Q Date Transfer from PC to VSG	USB 3.0, Real-time Streaming (>200 MB/s)	N/A	GPIB / 10 MB/s LAN	Up to 10 MB/s over USB
Internal Arbitrary Waveform Memory	Uses PC/Laptop Memory	N/A	8 MSa	32 MSa (upgrade to 512 MSa for $6600)
Phase Noise, 1 GHz Carrier, 10 kHz Offset (typical)	-125 dBc/Hz	-110 dBc/Hz	-118 dBc/Hz, 20 kHz offset	-134 dBc/Hz
Harmonics (typical)	-35 dBc	-35 dBc	-35 to -53 dBc	-30 dBc
LO Switch Time	0.2 ms	8 ms	35 ms	5 ms (0.3 ms with option UNZ, $3553 USD)
Amplitude Switch TIme	0.01 ms	Unknown	15 ms	5 ms (0.3 ms with option UNZ, $3553 USD)
Maximum Digital Modulation Symbol Rate	25 MS/s	6 MS/s	50 MS/s	50 MS/s
Dimensions	3.19" W x 1.19" H x 8.63" D	8.5" W x 4.5" H x 13.7" D	16.8" W x 5.25" H x 17" D	16.8" W x 3.5" H x 19.2" D
Weight	0.8 lb.	12 lb.	35 lb.	35 lb.
Power	6 W	< 90 W	< 300 W	< 300 W
Cost	$2,445 USD	$13,600 USD	Used Market Price $10,000 USD	$35,582 USD plus options
Requires External PC	Yes	No	No	No

Technical Specifications

Frequency Range	Specified: 50 MHz to 6 GHz Usable Range: 30 MHz to 6 GHz
Frequency Resolution	Digital Tuning Disabled: 1/6 Hz Digital Tuning Enabled: < 1 μHz
Modulation Bandwidth	40 MHz
Frequency Switch Time	Queued Frequency Step Time: 200 μs (rounded up to next I/Q sample clock) Software-controlled: 80 ms typical
Timesbase	Internal 10 MHz VCTCXO with digital adjustment Stability over temperature: ±0.28 ppm Aging: < 1 ppm/year typical
Amplitude	Range: +7 dBm to -55 dBm, amplitude range goes down to -80 dBm digitally Accuracy: +/- 2 dB (0.5 dB typical) Baseband flatness (20 MHz): ±0.25 dB typical Baseband flatness (40 MHz): ±0.5 dB typical
Error Vector Magnitude (EVM)	0.3% typical (1 GHz carrier, 1 MSPS QAM 16, Alpha = 0.35, raised cosine)
Adjacent Channel Power Ratio (ACPR)	< 3 GHz < -50 dBc (typ. -55 dBc) 3-6 GHz < -40 dBc (typ. -45 dBc) (RRC 0.2, -10 dBm, QPSK 4 MS/s, 5 MHz channel)
Spectral Purity	**Typical Phase Noise (1 GHz)** **Offset** **dBc/Hz** 100 Hz -89 1 kHz -114 10 kHz -125 100 kHz -127 1 MHz -135 **Non-harmonic spurious:** -50 dBc typical for most signals **Harmonics:** -35 dBc typical
I/Q Symbol Clock	Range 12.5 kHz to 51.2 MHz Accuracy +/- 1 ppm + timebase accuracy Switch Time 100 ms typical
Preprogrammed Modulation Types	CW AM, FM, Pulse, Multitone, Sweep, AWGN, FSK, GFSK, OOK, ASK, MSK, GMSK, BPSK, DBPSK, QPSK, DQPSK, Pi/4DQPSK, OQPSK, 8-PSK, 16-PSK, 16-QAM, 64-QAM, 256-QAM, Bluetooth LE, 802.11a/n, arbitrary
Digital Modulation Impairments	Channel, AWGN, I/Q Offset
Custom Modulation	Use the API to continuously stream I/Q data to the VSG60A at an arbitrary sample rate up to 51.2 MSPS, or use the software to load a CSV, binary short integer, or binary floating point I/Q file. Corrections are automatically applied as the data is streamed to the VSG60A.

Pulse	Minimum pulse width: 100ns – arbitrary Duty cycle minimum: 0.00001% (100ns pulse with 1 second period) On/Off ratio: > 40dB (typical > 50dB)
Multi-tone Test Pattern	Tone count: 2 to 4001 Tone spacing: 1 Hz to 20 MHz Tone Phase Relationship: parabolic, random, fixed
Inputs/Outputs	Data and Power (1) USB 3.0 port and (1) adjacent USB 2.0 or USB 3.0 port RF output connector: 50 Ω SMA (f) External 10 MHz Input BNC (F), 0 to +13 dBm recommended Trigger Output BNC (F), 3.3V logic level
System Requirements	**Supported operating systems:** • Windows 7 (32/64-bit) • Windows 8 (32/64-bit) • Windows 10 (32/64-bit) • Ubuntu Linux 18.04 (64-bit) **Minimum system requirements:** • Dual core Intel i5/i7 processor, 4th generation or later. • The software will average less than 1GB of memory. • USB 3.0 connectivity.
Operating Temperature	0 to 60 °C
Size and Weight	3.19" W x 1.19" H x 8.63" D, 0.81 lb. (81.03mm x 30.23mm x 219.2mm, 367g)
Power Consumption	Power Requirements: USB-powered, 4.5 – 5.25V, 1200 mA typical.
Connectivity	With the software and device drivers installed, you are ready to connect your device. The supplied USB cable should be connected into your PC first, followed by your device.

VSG60A

Vector Signal Generator

50 MHz to 6.0 GHz

40 MHz Streaming Modulation Bandwidth

Unrivaled Value and High Performance

Price $2,445 USD (Retail)

Calibration certificate and/or extended warranty options available at an additional cost.

Ordering Information

- **Order online: signalhound.com**

- **Most orders ship next day**

- **2-year warranty on all Signal Hound products**

- **30 day money back satisfaction guarantee**

Price includes all software and options — no add-ons needed!

VSG25A

2.5 GHz Vector Signal Generator **$515**

- ■ **-40 dBm to +10 dBm output power**
- ■ **Easily generate analog, digital, and arbitrary waveforms**
- ■ **1000+ simultaneous tones, 6 nanosecond pulses**
- ■ **Built-in support for a number of modulation types**

signalhound.com/products/vsg25a-vector-signal-generator/

SM200B

20 GHz Real-time Spectrum Analyzer **$12,800**

- ■ **100 kHz to 20 GHz frequency range**
- ■ **+20 dBm to -160 dBm measurement range**
- ■ **1 THz sustained sweep speed**
- ■ **160 MHz of instantaneous bandwidth**
- ■ **Phase noise of 132 dBc/Hz, 10 kHz offset, and 1 GHz carrier**

signalhound.com/products/sm200b-20-ghz-real-time-spectrum-analyzer/

SA44B

4.4 GHz Spectrum Analyzer **$1,005**

- ■ **RF Frequency Range: 1 Hz to 4.4 GHz**
- ■ **Wide dynamic range: -151 dBm to +10 dBm**
- ■ **Resolution bandwidths (RBW) pf 0.1 Hz to 250 KHz**

signalhound.com/products/usb-sa44b/

BB60C

6 GHz Real-time Spectrum Analyzer...........**$2,995**

- ■ **Frequency Range: 9 kHz to 6 GHz**
- ■ **Dynamic range: -158 dBm to +10 dBm**
- ■ **Instantaneous bandwidth of 27 MHz**
- ■ **Up to 24 GHz/sec sweep speed (≥10 kHz RBW)**

signalhound.com/products/bb60c/

For additional models, frequencies, options, etc.

Visit: signalhound.com

Online Ordering • All prices retail USD

About Signal Hound

Signal Hound designs and builds powerful, affordable spectrum analyzers and signal generators for engineers and RF professionals around the globe. Whether you're needing EMC precompliance capabilities in a small two-person shop or spectrum monitoring on a national scale, our test equipment is designed with you in mind. Accurate and powerful enough for mission-critical RF analysis, priced at a point accessible to most, and supported by a talented group of engineers committed to what they do – we truly believe that our devices offer unrivaled value in the test equipment industry.

In business since 1996 and selling our own line of Signal Hound test equipment since 2010, we've built the foundation of our company on years of test equipment repair, service, hardware and software development, and manufacturing experience. Signal Hound is a small company with big goals – and an even bigger commitment to providing our customers with an outstanding experience when purchasing and using our products.

Signal Hound®