



VSG5000A

Multi-Channel Phase Coherent Vector Signal Generator

The X-COM Systems VSG5000A combines four independent vector signal generators with up to 440 MHz of bandwidth (110 MHz each), 50 minutes of internal waveform storage per channel, and control circuits into a compact 4U rack enclosure. The system makes it easier, more accurate, and less expensive to expose systems to realistic user-defined spectral environments.

The VSG5000A's four channels can be used to simultaneously evaluate the performance of the multiple receivers in smartphones, satellite communications terminals, military battlefield radios, and other communications and electronic warfare systems. It can be used to evaluate MIMO system and subsystem designs, the compatibility of direct-sequence or frequency-hopped spread spectrum systems with other wideband wireless access methods, and evaluate the performance of active phased-array antennas in a complex signal environment.

Each signal generator is independent and can be phase aligned to one or more of the others, varied in phase and frequency, or operated independently all at different center frequencies. This allows virtually any complex RF signal environment to be created with any type or mixed types of waveforms.

The 110-MHz bandwidths of each channel can be combined to produce an instantaneous bandwidth up to 440 MHz, which allows the VSG5000A to create the full bandwidth of many advanced satellite communications transponders or radar systems. The system can also be used with external vector signal generators to produce a signal at any center frequency from kilohertz to millimeter wave.

Multiple waveform files can be seamlessly combined to create sequences of any length and complexity. Segments can include "over the air" RF spectrum captures, pulse type waveforms, any commercial or military communication waveforms, or any other type of waveform.

Control and configuration software supplied with the instrument programs each channel and runs in a Windows 7 environment. A single PC can accommodate any number of VSG5000As via a LAN. The user has control of each carrier's center frequency, amplitude, and phase which can be adjusted relative to any other carrier in 0.25° increments. A Waveform Memory Module (WMM) stores waveform data which are removable from the front panel. Data files in each channel's memory module can be managed via the Gigabit Ethernet interface.

FEATURES

- ▶ Each signal generator independently programmable to play any waveform within an RF bandwidth of 110 MHz at a carrier frequency from 50 MHz to 3 GHz or 6 GHz to 18 GHz.
- ▶ Baseband I&Q outputs available from each channel. To support external VSGs which extend the frequency range from kilohertz to millimeter wave frequencies.
- ▶ 50 minutes of internal waveform storage available per channel at a 110 MHz bandwidth and longer durations at narrower bandwidths.
- ▶ Waveform files can be actual recordings, synthesized using a variety of software tools, or a combination. No limit to number of pulses per second or waveform type including spread spectrum.
- ▶ Triggers can seamlessly switch between different waveform segments.
- ▶ Removable waveform memory modules simplify use of the system in a classified environment.

APPLICATIONS

Electronic Warfare: Play back and recreate complex & dynamic battlefield spectrum.

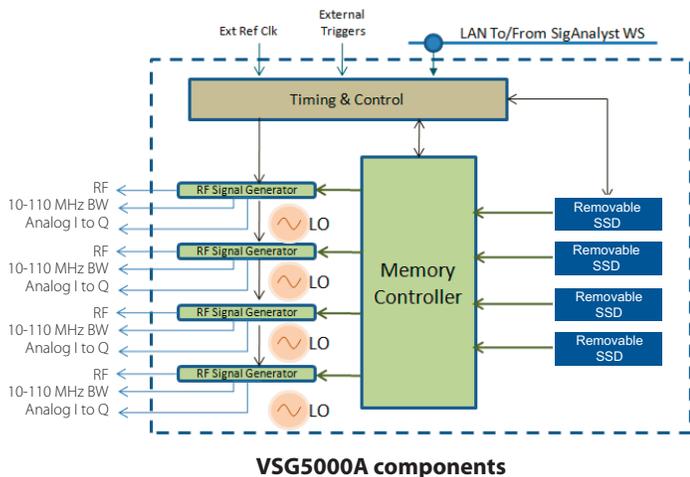
Wireless Communications: Play back waveforms or create new ones for development and testing of satellite and terrestrial voice and data networks, including MIMO systems.

Radar: Generate multiple signals with adjustable phase relationships to test phased antenna arrays.

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The VSG5000A has four major subsystems: four RF signal generators, four solid state waveform memory modules, a memory controller, and a timing and control subsystem. The signal generators can act independently or be configured so that their outputs are synchronized in time and phase.



VSG5000A components

RF Signal Generators (RSGs)

The four independent RSGs use a single frequency reference to ensure phase coherency of their outputs, which is essential for evaluating MIMO performance. Each RSG can be tuned to the same or a different center frequency between 50 MHz and 3 GHz or 6 GHz and 18 GHz.

Waveform Memory Modules (WMM)

Each RF channel has a dedicated removable solid-state disk drive. Waveforms are stored in 16 bit I&Q format. At the VSG5000A's full 110 MHz channel bandwidth, a WMM will provide 50 min. of storage for each RSG and for longer periods with narrower bandwidths. The four WMMs can be removed from the VSG5000A and connected to an X-COM workstation for very-high-speed file transfer.

Waveform segments can be any time span and spectral width from 10 MHz to 110 MHz. WMM file management can also be performed via the Ethernet interface on the rear panel of the VSG5000A through the Windows MCVSG control software.

Optional 3.5 hour or 7 hour external data packs are available per channel. These external data packs allow very-high-speed transfer of files to the VSG5000A without physically moving any drives or swapping any cables.

Waveform segments can be entire files or time slices of recorded RF spectrum, files created in MATLAB or other similar programs, or a combination of recorded waveforms that have been manipulated using X-COM's RF Editor software.

Memory Controller Module (MCM)

Waveform data is stored in high dynamic range 16 bit I&Q format. The MCM converts stored digital waveform files to analog I&Q waveforms prior to up-conversion. Each channel can operate at a different sample rate. The MCM controls the execution of waveform playback sequence for each channel.

Any combination of the four channels can simultaneously play a unique (or the same) waveform segment or sequence under MCM control. If multiple channels are playing the same segment or sequence, relative phase delays with 1° resolution can be set. A sequence consists of a series of waveform segments that can be played once or looped with specified time delays between each loop. The MCM works with the timing and control subsystem to manage system storage resources to ensure seamless, zero-delay transitions from waveform segment to waveform segment.



Typical configuration

Timing and Control Subsystem (TCS)

The TCS controls the unit's highly-accurate internal clock source as well as a precision 10-MHz external clock reference if desired to ensure synchronization between the VSG5000A and other equipment in a larger test environment.

The TCS also manages the external trigger input that can be used to initiate the starting or stopping of waveform playback. I&Q channel slew settings/calibration and LO tuning for each channel are controlled by the TCS.

An external timing module is available to allow phase alignment across up to eight VSG5000A units.

X-COM's SigAnalyst Workstation

X-COM's SigAnalyst workstation is configured for optimum performance when controlling a system using VSG5000As. It can be tailored to accommodate multiple datapacks and 16 Tbytes or more of RAID 0 waveform storage. The workstation can directly connect to the waveform memory modules to provide high-speed transfer.

The workstation has a quad-core processor and 24 Gbytes of RAM that support high-speed execution of X-COM's Spectro-X and RF Editor software as well as other development tools such as MATLAB, Agilent Signal Studio or Tektronix RF Express.

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VSG5000A SPECIFICATIONS

RF performance, single output channel

Frequency range	50 MHz to 3 GHz or 6 GHz to 18 GHz	
Resolution (Hz)	1	
Stability, including temperature and aging (+/-ppm)	2	
Maximum RF bandwidth (MHz)	110	
Spectral purity (dBc/Hz)	50 MHz to 3 GHz	6 GHz to 18 GHz
100 Hz	-79	-67
1 kHz	-93	-84
10 kHz	-96	-90
100 kHz	-119	-112
1 MHz	-133	-135
Output power, single tone CW (dBm)	+5 minimum	
Output power attenuation (dB)	0 to 25	
Output power resolution (dB)	0.1	
Output power uncertainty, 6-18 GHz carrier with 10 MHz baseband signal applied, (dB)	±0.75	
In-band ripple (dB)	50 MHz to 3 GHz	6 GHz to 18 GHz
	50-2800 MHz	±0.75
	2800-3000 MHz	±1.25

Spurious performance

(measured with respect to single tone at -3dBFS)

Spurious Suppression (dBc)	
<10 kHz offset	-50
>10 kHz offset	-60* (See Note 1)
Harmonic suppression (dBc)	-30
Noise floor	-130 dBm/Hz
Image rejection, single tone (dBc)	-50
LO leakage, single tone (dBm)	-55

Baseband analog I/Q output

Maximum bandwidth (MHz)	110
Output power, single-tone CW, digital (dBm)	5
Output attenuation range	Fixed

Phase coherency

Phase offset range (deg)	+/- 180
Phase offset resolution (deg)	0.25

Modulation Signal

Format	I&Q baseband
Resolution (bits)	16
Sample rates (MS/s)	150, 75, 50, 25, 12.5
Source	Solid-state drive arrays

Note 1: -30 dBc for 6 GHz-6.7 GHz, -55 dBc at 4 GHz - F output for 50 MHz to 3 GHz

External trigger

Modes	Single, loop
Source	External
Type	Rising edge
Level (VDC)	5

Reference, storage, and communication

Internal reference oscillator (REF out)	
Frequency (MHz)	10
Stability (ppb)	50
Output level (dBm)	13
Load (ohms)	50
Reference oscillator input (REF In) requirements	
Frequency (MHz)	10
Maximum uncertainty (ppm)	+/-10
Input level (dBm)	-7 to +19
Impedance (ohms)	50
Communications	
LAN Protocol	Ethernet 1000 Base-T TCP-IP

Maximum playback time (min.) (Internal memory modules)

150 MS/s, 110 MHz bandwidth	50
75 MS/s, 60 MHz bandwidth	100
50 MS/s, 40 MHz bandwidth	150
Maximum data rate (Mbytes/s)	600
Minimum PC requirements	Windows 7 (64-b), 512 Mbytes of RAM, 1280 x 720 pixel resolution, 100 Mbytes free disk space, CD-ROM, Ethernet

Mechanical

Housing	Aluminum
Buttons/indicators (front panel)	Power on/off, blue LED ring
Connectors (rear panel)	SMA RF (4) and BNC baseband output (8), BNC female external trigger in, BNC female reference clock in, SMA reference clock out, RJ-45 LAN, DB-9, IEC power jack
Power	120/240 VAC, 84 to 264 VAC, 470 W
Chassis ground terminal	#10-32 x 3/4 in. UNC
Cooling method	Forced air, front panel intake
Warm-up	Specifications apply after 30-min. warm-up period at ambient temperature
Operating/storage temperature, humidity	0 to +45 °C (+32 to +113 °F) non-condensing
Altitude (m)	4,600 above sea level (15,000 ft)
Weight	27 kg (60 lbs)
Dimensions	53 cm (d) x 43 cm (w) x 18 cm (h) 21 in (d) x 17 in (w) x 7 in (h) (4 RU)

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ORDERING INFORMATION

VSG5114A-XX-XX	Four-channel 110 MHz BW vector signal generator.
-RF-XX	RF Band - 50 MHz - 3 GHz tuning range.
-6K-XX	X thru Ku Bands - 6 GHz - 18 GHz tuning range.
-XX-I2	Internal solid state memory module per channel. (50 mins playback at full bandwidth.)
-XX-E	External SAS interface to support external datapacks.
WMM-SDD-2	Extra internal solid state memory module for X-COM VSG5000A.
VSG5000A-DP3	External RAID0 data pack. (3.5 hr playback at full bandwidth.)
VSG5000A-DP7	External RAID0 data pack. (7 hr playback at full bandwidth.)
SA-DAT-AN	SigAnalyst workstation. Quad-core workstation, 24 Gbytes RAM with 16 TByte HDD storage, Spectro-X and RF Editor software packages.
VSG5000A-TIMRF	External timing module 50 MHz - 3 GHz (required for phase aligned applications.)
VSG5000A-TIM6K	External timing module 6 GHz - 18 GHz (required for phase aligned applications.)

EXPORT CONTROL:

This product/technical data is controlled for export under the International Traffic in Arms Regulations (ITAR). A license from the U.S. Department of State is required prior to the export of this product/technical data from the United States.

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