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Generator Shoots For Low Phase Noise

This high-performance (but affordable) analog signal generator takes advantage of an innovative synthesis technique to achieve outstanding phase-noise performance to 4 GHz.

Phase noise can be damaging to many systems, degrading receiver performance in electronic-warfare (EW), communications, and various other military systems. But the model SG384 analog signal generator from Stanford Research Systems (www.thinkSRS.com) incorporates a unique approach to frequency synthesis that minimizes phase noise without sacrificing frequency resolution. The high-performance (but affordable) signal generator operates from DC to 4.05 GHz with 1-μHz resolution and phase noise of only -116 dBc/Hz offset 20 kHz from a 1-GHz carrier.

1. The SG384 is a compact analog signal generator with frequency range of DC to 4.05 GHz (and to 8.10 GHz with a frequency-doubler option) and excellent spectral purity.

The SG384 signal generator (**Fig. 1**) features a frequency synthesis approach called Rational Approximation Frequency Synthesis, which is detailed elsewhere in this issue ("Presenting A Novel Synthesis Approach"). It is an analog frequency synthesis approach, which delivers superb spectral purity without sacrificing frequency switching speed, capable of achieving settling time of 8 ms or better. The standard version of the SG384 provides sinewave outputs to 4.05 GHz. A version is also available equipped with an optional frequency doubler to take output signals to 8.10 GHz.

The standard timebase is an oven-controlled crystal oscillator (OCXO) based on a stress-compensated (SC) cut crystal resonator with aging rate of better than ±0.05 ppm/year. As an option, the SG384 can also be outfitted with an oven-controlled Rubidium atomic clock (Option 04) with aging rate of better than ±0.001 ppm/year for improved long-term and temperature stability. A rear-panel connector also allows an external timebase (at 10 MHz and 0.5 to +4 V peak to peak or -2 to +16 dBm) to be used with the SG384.

In terms of performance, the SG384 delivers signals that are extremely stable, judging by its spectral purity specifications. Output signals are available at a combination of connectors: BNC and Type N connectors on the front panel and an SMA connector on the rear panel. The front-panel BNC connector provides signals from DC to 62.5 MHz at amplitudes from 0.001 to 1.00 V root mean square (RMS) into a 50-Ω load. Signals can be adjusted over an offset range of ±1.5 VDC with 5-mV offset resolution and better than 1% amplitude resolution. Harmonics at the BNC connector are better than -40 dBc and spurious levels are better than -75 dBc.

The front-panel Type N connector provides output signals from 950 kHz to 4.05 GHz; with a frequency-doubler option (Option 02), its frequency range can be extended to 8.10 GHz. These signals can be controlled over an amplitude range of -110 to +13 dBm with 0.01-dBm power resolution and ±1-dB power accuracy into a 50-Ω load. The output impedance match is better than a 1.60:1 VSWR.

The Type N connector is reverse protected against 30 V and +25 dBm RF power. The spectral purity of signals at the Type N connector, especially at a test frequency of 1 GHz, includes better than -25 dBc harmonics for an output level of +7 dBm, better than -65 dBc spurious levels for offsets less than 10 kHz from the carrier, and better than -75 dB spurious levels for offsets greater than 10 kHz from the carrier. The single-sideband (SSB) phase noise is typically -80 dBc/Hz offset 10 Hz from the carrier, typically -102 dBc/Hz offset 1 kHz from the carrier, typically -116 dBc/Hz offset 20 kHz from the carrier, and typically -130 dBc/Hz offset 1 MHz from the carrier (**Fig. 2**).

The SG384 boasts residual FM of typically 1 Hz RMS measured for bandwidths of 300 Hz to 3 kHz and residual AM of typically 0.006% RMS measured for bandwidths of 300 Hz to 3 kHz. Front-panel output signals can be adjusted in phase over a maximum phase step of ±360 deg. The phase adjustment resolution is 0.01 deg. for signals from DC to 100 MHz, 0.1 deg. for signals from 100 MHz to 1 GHz, and 1 deg. for signals from 1 to 8.1 GHz.

The SG384 features generous modulation capabilities, generating sine, ramp, saw, square, pulse, and noise waveforms by means of an internal modulation source or by connection to an external source.

It can generate amplitude modulation (AM) at depths from 0 to 100% with 0.1% resolution and better than 100 kHz modulation bandwidths. The AM distortion is 0.1% or better at the BNC connector and 3% or better at the Type N connector.

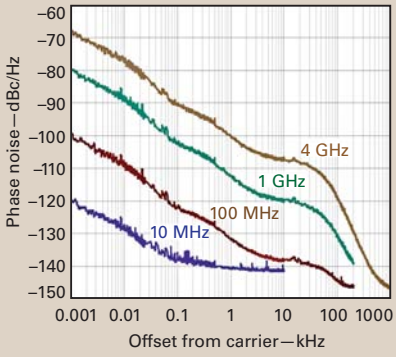
It also supports frequency modulation (FM) at deviations from 10 Hz to 1 MHz with resolution equal to the larger of 1 Hz or 0.1% of the deviation. The FM deviation accuracy is 0.1% or better at the BNC connector (to 62.5 MHz) and

3% or better at the Type N connector (above 62.5 MHz). The SG384's FM distortion is -70 dBc or better with 20-kHz deviation at a 1-GHz carrier.

The signal generator can also provide signals with phase modulation and pulse modulation as well as phase-continuous sweeps. The phase modulation covers a range of 0 to 360 deg. with 0.01-deg. resolution to 100 MHz, 0.1-deg. resolution to 1 GHz, and 1-deg. resolution above 1 GHz. The deviation accuracy is 0.1% or better at the BNC connector and 3% or better at the Type N connector.

The generator also controls pulse modulation across a range of pulse widths from 100 ns to 9999.9999 ms and pulse periods from 1 μs to 10 s with timing resolution of 5 ns.

In addition, the SG384 can perform phase-continuous frequency sweeps, including sweeps from DC to 62.5 MHz, 59.375 to 128.125 MHz, 950 to 2050 MHz, 1900 to 4100 MHz, and, with the doubler option, 3800 to 8200 MHz. The SG384 can even generate white Gaussian noise with effective noise bandwidths from 1 μHz to 50 kHz. With an option (Option 03), the signal generator can deliver in-phase/quadrature (I/Q) modulated signals at a rear-panel SMA connector at carrier frequencies from 0.4 to 4.05 GHz and 3-dB modulation bandwidths to 200 MHz.



2. The SG384 signal generator employs a unique frequency-synthesis technique to achieve low phase noise close to the carrier while also maintaining fine tuning resolution.

The SG384 provides a great deal of flexibility in terms of remote control for automatic-test-equipment (ATE) applications, with interfaces for Ethernet local area network (LAN) connections, GPIB automated instrument setups, and RS-232 hookups. The compact signal generator measures 8.5 x 3.5 x 13 in. and weighs 10 lbs. It consumes less than 90 W from a power supply at 90 to 264 VAC. DE

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