# Vector Signal Generators

*SG390 Series — DC to 2 GHz, 4 GHz and 6 GHz vector signal generators*

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## SG390 Series Vector Signal Generators

- ***DC to 2 GHz, 4 GHz or 6 GHz***
- ***Dual baseband arb generators***
- ***Vector and analog modulation***
- ***I/Q modulation inputs (300 MHz RF BW)***
- ***ASK, FSK, MSK, PSK, QAM, VSB, and custom I/Q***
- ***Presets for GSM, EDGE, W-CDMA, APCO-25, DECT, NADC, PDC, ATSC-DTV & TETRA***
- ***GPIB, RS-232 & Ethernet interfaces***

Introducing the new SG390 Series Vector Signal Generators — high performance, affordable RF sources.

Three new RF Signal Generators, with carrier frequencies from DC to 2.025 GHz, 4.050 GHz and 6.075 GHz, support both analog and vector modulation. The instruments utilize a new RF synthesis technique which provides spur free outputs with low phase noise (–116 dBc/Hz at 1 GHz) and extraordinary frequency resolution (1 µHz at any frequency). Both analog modulation and vector baseband generators are included as standard features.

The instruments use an ovenized SC-cut oscillator as the standard timebase, providing a 100 fold improvement in the stability (and a 100 fold reduction in the in-close phase noise) compared to instruments which use a TCXO timebase.

### A New Frequency Synthesis Technique

The SG390 Series Signal Generators are based on a new frequency synthesis technique called Rational Approximation Frequency Synthesis (RAFS). RAFS uses small integer divisors in a conventional phase-locked loop (PLL) to synthesize a frequency that would be close to the desired frequency (typically within ±100 ppm) using the nominal PLL reference frequency. The PLL reference frequency, which is sourced by a voltage controlled crystal oscillator that is phase locked to a dithered direct digital synthesizer, is adjusted so that the PLL generates the exact frequency. Doing so provides a high phase comparison frequency (typically 25 MHz)


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yielding low phase noise while moving the PLL reference spurs far from the carrier where they can be easily removed. The end result is an agile RF source with low phase noise, essentially infinite frequency resolution, without the spurs of fractional-N synthesis or the cost of a YIG oscillator.

## Analog Modulation

The SG390 Signal Generators offer a wide variety of modulation capabilities. Modes include amplitude modulation (AM), frequency modulation (FM), phase modulation (ΦM), and pulse modulation. There is an internal modulation source as well as an external modulation input. The internal modulation source produces sine, ramp, saw, square, and noise waveforms. An external modulation signal may be applied to the rear-panel modulation input. The internal modulation generator is available as an output on the rear panel.

Unlike traditional analog signal generators, the SG390 Series can sweep continuously from DC to 62.5 MHz. And for frequencies above 62.5 MHz, each sweep range covers more than an octave.

## Vector Modulation

The SG390 series builds upon this performance by adding full support for vector signal modulation on RF carriers between 400 MHz and 6.075 GHz. It features a dual, arbitrary waveform generator operating at 125 MHz for baseband signal generation. The generator has built-in support for the most common vector modulation schemes: ASK, QPSK, DQPSK, π/4 DQPSK, 8PSK, FSK, CPM. QAM (4 to 256), 8VSB, and 16VSB. It also includes built-in support for all the standard pulse shaping filters used in digital communications: raised cosine, root-raised cosine, Gaussian, rectangular, triangular, and more. Lastly, it provides direct support for the controlled injection of additive white Gaussian noise (AWGN) into the signal path.

## Internal baseband generators

Using a novel architecture for I/Q modulation, the SG390 series provides quick, user-friendly waveform generation. The baseband generator supports the playback of pure digital data. It automatically maps digital symbols into a selected I/Q constellation at symbol rates of up to 6 MHz and passes the result through the selected pulse shaping filter to generate a final waveform updated in real time at 125 MHz. This baseband signal is then modulated onto an RF carrier using standard IQ modulation techniques.

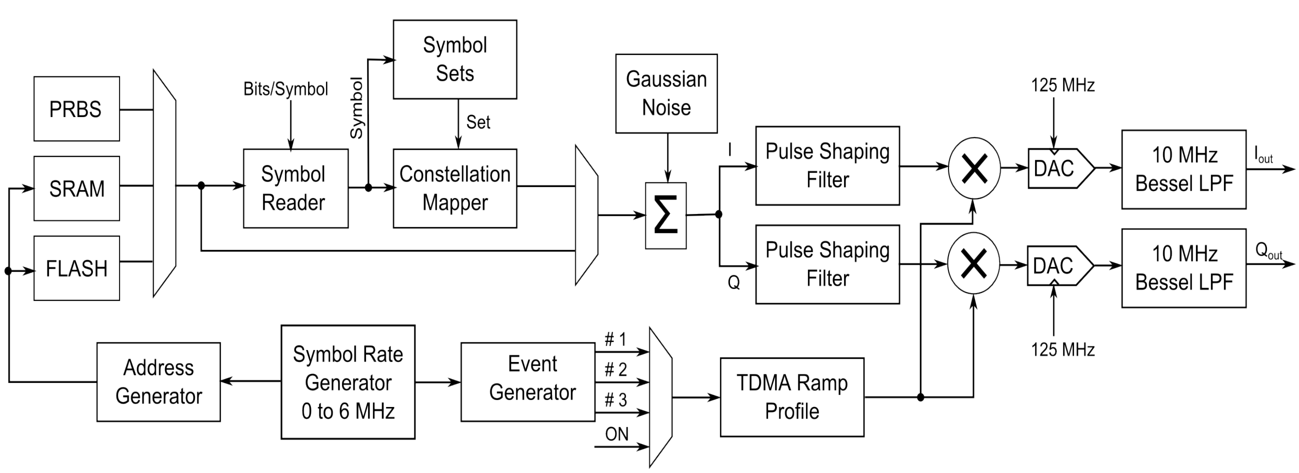
Preset communications protocols (GSM, GSM EDGE, W-CDMA, APCO-25, DECT, NADC, PDC, TETRA, and ATSC DTV) quickly configure the signal generator to the correct modulation type, symbol data rates, TDMA duty cycles and digital waveform filters. The preset protocols also configure the rear-panel TDMA, START of FRAME, and SYMBOL CLOCK digital outputs. The baseband generators can be configured for these protocols without the use of external computers or third party software.

The I/Q waveforms are computed in real time. Symbols are mapped to constellations, digitally filtered, and up-sampled to 125 Msps to drive the I/Q modulator via dual 14-bit DACs. The symbols can be a fixed pattern, PRBS data from an internal source, or come from a downloaded user list of up to 16 Mbits. The constellation mapping can be modified by the user. Digital filters include Nyquist, root Nyquist, Gaussian, rectangular, linear, sinc, and user-defined FIR .

## External I/Q Modulation

The rear-panel BNC I/Q modulation inputs and outputs enable arbitrary vector modulation via an external source. The external signal path supports more than 300 MHz of bandwidth with a full scale range of ±0.5 V and a 50 Ω input impedance.

Baseband Dual Arbitrary Waveform Generator for IQ Modulation

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### Power vs Frequency

All SRS RF signal generators have cascaded stages of amplifiers and digital attenuators to drive the RF output. Five stages can provide up to +25 dB of gain to -130 dB of attenuation in 156 digitally controlled steps. During factory calibration the output power is measured at 32 frequencies per octave for each of the 156 attenuator steps to populate a memory matrix with about 40,000 elements. When set to a particular frequency and power, the instrument interpolates between these matrix elements to determine the best attenuator setting. An analog attenuator is used to provide 0.01 dB resolution between matrix elements and to compensate for residual thermal effects.

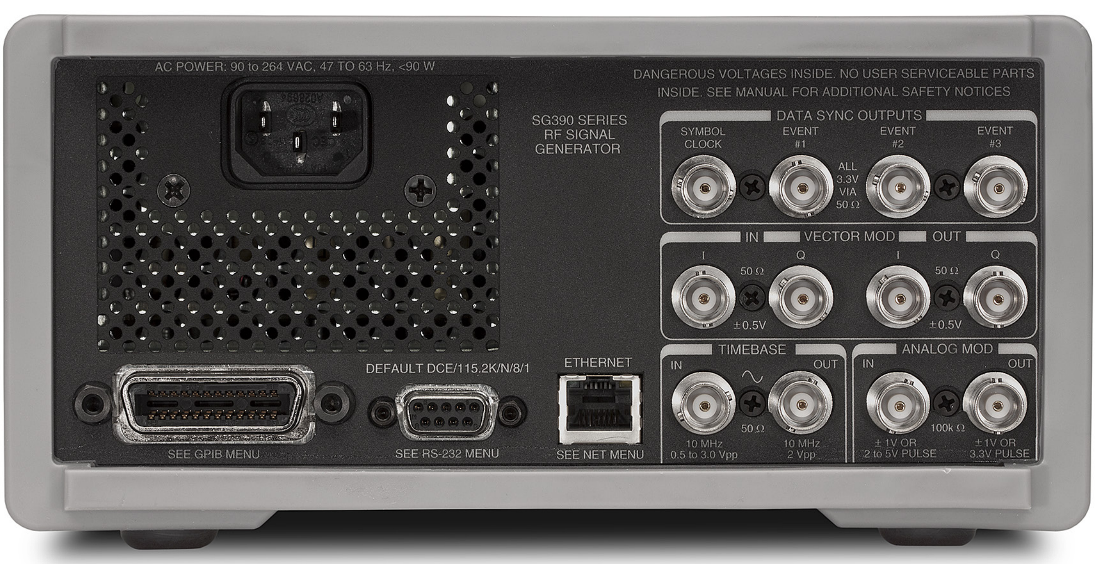
This method eliminates the need for precision attenuators and automatic level controls (ALC) without any sacrifice in performance. Eliminating the ALC also removes its unwanted interactions with amplitude, pulse and I/Q modulation.

### OCXO or Rubidium Timebase

The SG390 Series come with a oven-controlled crystal oscillator (OCXO) timebase. The timebase uses a third-overtone stress-compensated 10 MHz resonator in a thermostatically controlled oven. The timebase provides very low phase noise and very low aging. An optional rubidium oscillator (Opt. 04) may be ordered to substantially reduce frequency aging and improve temperature stability. An external 10 MHz timebase reference may be supplied to the rear-panel timebase input.

### Easy Communication

Remote operation is supported with GPIB, RS-232 and Ethernet interfaces. All instrument functions can be controlled and read over any of the interfaces. Up to nine instrument configurations can be saved in non-volatile memory.




*SG394 rear panel*

## Frequency Setting

| | |
|---|---|
| Frequency ranges | *DC to 62.5 MHz (BNC output, all models)* |
| SG392 | 950 kHz to 2.025 GHz (N-type output) |
| SG394 | 950 kHz to 4.05 GHz (N-type output) |
| | 4.05 GHz to 8.1 GHz (w/ Opt. 02) |
| SG396 | 950 kHz to 6.075 GHz (N-type output) |
| | 6.075 GHz to 8.1 GHz (w/ Opt. 02) |
| Frequency resolution | 1 µHz at any frequency |
| Switching speed | <8 ms (to within 1 ppm) |
| Frequency error | $<(10^{-18} + \text{timebase error}) \times f_C$ |
| Frequency stability | $1 \times 10^{-11}$ (1 s Allan variance) |

## Front-Panel BNC Output

| | |
|---|---|
| Frequency range | DC to 62.5 MHz |
| Amplitude | 1.00 Vrms to 0.001 Vrms |
| Offset | ±1.5 VDC |
| Offset resolution | 5 mV |
| Max. excursion | 1.817 V (amplitude + offset) |
| Amplitude resolution | <1 % |
| Amplitude accuracy | ±5 % |
| Harmonics | <–40 dBc |
| Spurious | <–75 dBc |
| Output coupling | DC, 50 Ω ±2 % |
| User load | 50 Ω |
| Reverse protection | ±5 VDC |

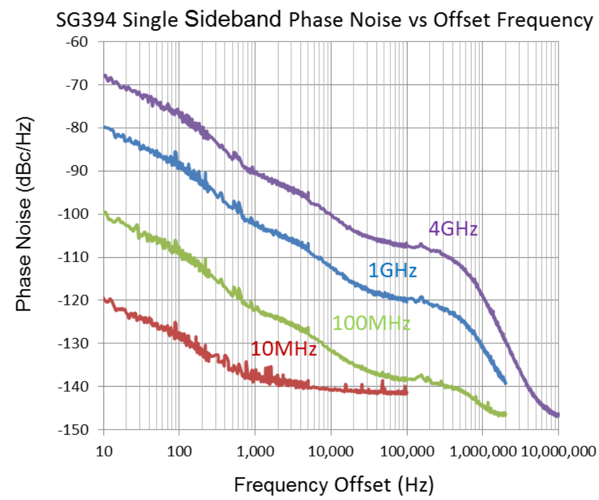
## Front-Panel N-Type Output

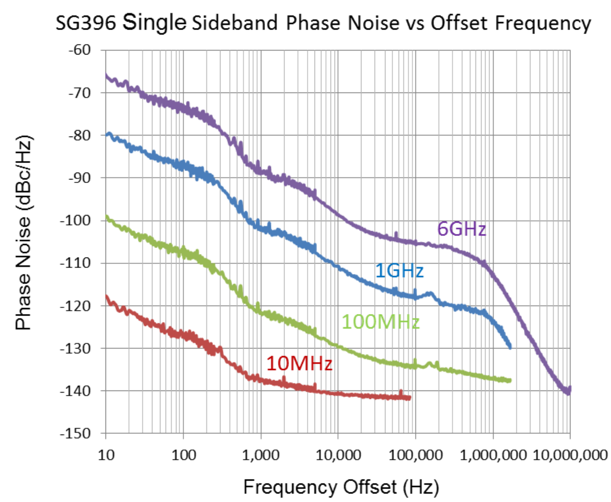
| | |
|---|---|
| Frequency range | |
| SG392 | 950 kHz to 2.025 GHz |
| SG394 | 950 kHz to 4.050 GHz |
| SG396 | 950 kHz to 6.075 GHz |
| Power output | |
| SG392 | +16.5 dBm to –110 dBm |
| SG394 | +16.5 dBm to –110 dBm (<3 GHz) |
| SG396 | +16.5 dBm to –110 dBm (<4 GHz) |
| Voltage output | |
| SG392 | 1.5 Vrms to 0.7 µVrms |
| SG394 | 1.5 Vrms to 0.7 µVrms (<3 GHz) |
| SG396 | 1.5 Vrms to 0.7 µVrms (<4 GHz) |
| Power resolution | 0.01 dBm |
| Power accuracy | ±1 dB |
| Output coupling | AC, 50 Ω |
| User load | 50 Ω |
| VSWR | <1.6 |
| Reverse protection | 30 VDC, +25 dBm RF |

## Spectral Purity of the RF Output Referenced to 1 GHz*

| | |
|---|---|
| Sub harmonics | None |
| Harmonics | <–25 dBc (<+7 dBm, N-type output) |
| Spurious | |
| <10 kHz offset | <–65 dBc |
| >10 kHz offset | <–75 dBc |
| Phase noise (typ.) | |
| 10 Hz offset | –80 dBc/Hz |
| 1 kHz offset | –102 dBc/Hz |
| 20 kHz offset | –116 dBc/Hz (SG392 & SG394) |
| | –114 dBc/Hz (SG396) |
| 1 MHz offset | –130 dBc/Hz (SG392 & SG394) |
| | –124 dBc/Hz (SG396) |
| Residual FM (typ.) | 1 Hz rms (300 Hz to 3 kHz BW) |
| Residual AM (typ.) | 0.006 % rms (300 Hz to 3 kHz BW) |

** Spurs, phase noise and residual FM scale by 6 dB/octave to other carrier frequencies*




## Phase Setting on Front-Panel Outputs

| | |
|---|---|
| Max. phase step | ±360° |
| Phase resolution | 0.01° (DC to 100 MHz) |
| | 0.1° (100 MHz to 1 GHz) |
| | 1.0° (1 GHz to 8.1 GHz) |

## Standard OCXO Timebase

| | |
|---|---|
| Oscillator type | Oven controlled, 3rd OT, SC-cut crystal |
| Stability (0 to 45 °C) | <±0.002 ppm |
| Aging | <±0.05 ppm/year |

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# SG390 Series Specifications (Analog)

## Rubidium Timebase (Opt. 04)

| | |
|---|---|
| Oscillator type | Oven controlled, 3rd OT, SC-cut crystal |
| Physics package | Rubidium vapor frequency discriminator |
| Stability (0 to 45 °C) | <±0.0001 ppm |
| Aging | <±0.001 ppm/year |

## Timebase Input

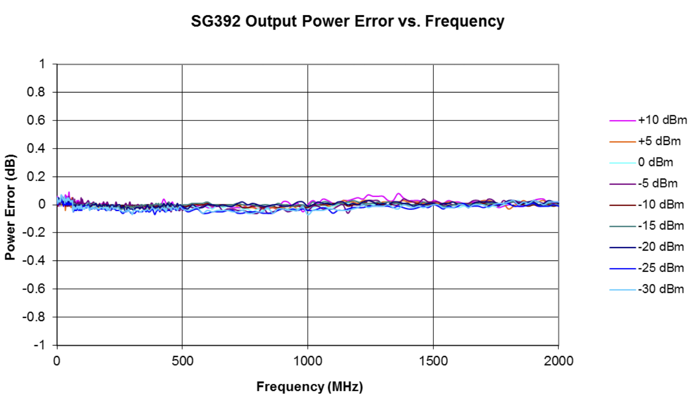
| | |
|---|---|
| Frequency | 10 MHz, ±2 ppm |
| Amplitude | 0.5 to 4 Vpp (–2 dBm to +16 dBm) |
| Input impedance | 50 Ω, AC coupled |

## Timebase Output

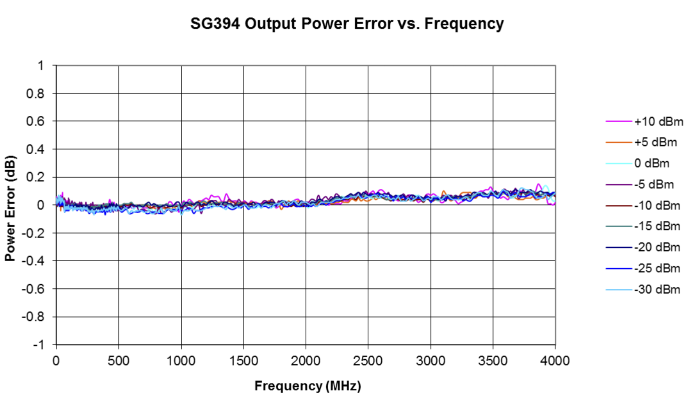
| | |
|---|---|
| Frequency | 10 MHz, sine |
| Source | 50 Ω, DC transformer coupled |
| Amplitude | 1.75 Vpp ±10 % (8.8 dBm ± 1 dBm) |

## Output Power Error

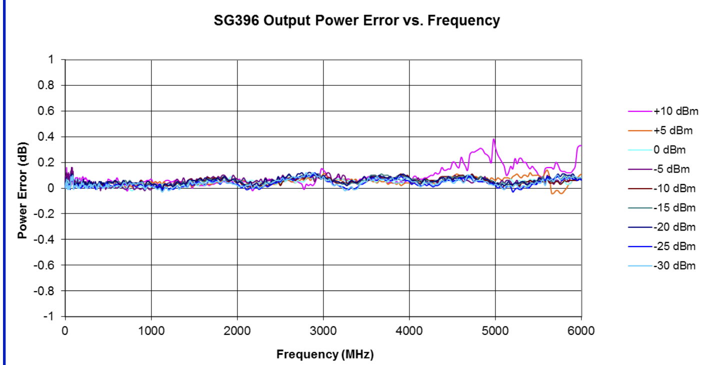
*SG392 power error* (–30 dBm to +10 dBm, DC to 2 GHz)




*SG394 power error* (–30 dBm to +10 dBm, DC to 4 GHz)




*SG396 power error* (–30 dBm to +10 dBm, DC to 6 GHz)




## Internal Modulation Source

| | |
|---|---|
| Waveforms | Sine, ramp, saw, square, pulse, noise |
| Sine THD | –80 dBc (typ. at 20 kHz) |
| Ramp linearity | <0.05 % (1 kHz) |
| Rate | 1 µHz to 500 kHz |
| | ($f_C \leq$ 62.5 MHz (SG392 & SG394)) |
| | ($f_C \leq$ 93.75 MHz (SG396)) |
| | 1 µHz to 50 kHz |
| | ($f_C >$ 62.5 MHz (SG392 & SG394)) |
| | ($f_C >$ 93.75 MHz (SG396)) |
| Rate resolution | 1 µHz |
| Rate error | 1:$2^{31}$ + timebase error |
| Noise function | White Gaussian noise (rms = dev / 5) |
| Noise bandwidth | 1 µHz < ENBW < 50 kHz |
| Pulse generator period | 1 µs to 10 s |
| Pulse generator width | 100 ns to 9999.9999 ms |
| Pulse timing resolution | 5 ns |
| Pulse noise function | PRBS $2^5 – 2^{19}$. Bit period (100 + 5N) ns |

## Modulation Waveform Output

| | |
|---|---|
| Output impedance | 50 Ω (for reverse termination) |
| User load | Unterminated 50 Ω coax |
| AM, FM, ΦM | ±1 V for ± full deviation |
| Pulse/Blank | "Low" = 0 V, "High" = 3.3 VDC |

## External Modulation Input

| | |
|---|---|
| Modes | AM, FM, ΦM, Pulse, Blank |
| Unmodulated level | 0 V input for unmodulated carrier |
| AM, FM, ΦM | ±1 V input for ± full deviation |
| Modulation bandwidth | >100 kHz |
| Modulation distortion | <–60 dB |
| Input impedance | 100 kΩ |
| Input offset | <500 µV |
| Pulse/Blank threshold | +1 VDC |

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## Amplitude Modulation

| | |
|---|---|
| Range | 0 to 100 % (decreases above +7 dBm) |
| Resolution | 0.1 % |
| Modulation source | Internal or external |
| Modulation distortion | |
| BNC output | <1 % ($f_C$ < 62.5 MHz, $f_M$ = 1 kHz) |
| N-type output | <3 % ($f_C$ > 62.5 MHz, $f_M$ = 1 kHz) |
| Modulation bandwidth | >100 kHz |

## Frequency Modulation

| | |
|---|---|
| Frequency deviation | |
| Minimum | 0.1 Hz |
| Maximum (SG392 & SG394) | |
| $f_C \leq$ 62.5 MHz | Smaller of $f_C$ or 64 MHz – $f_C$ |
| 62.5 MHz < $f_C \leq$ 126.5625 MHz | 1 MHz |
| 126.5625 MHz < $f_C \leq$ 253.125 MHz | 2 MHz |
| 253.125 MHz < $f_C \leq$ 506.25 MHz | 4 MHz |
| 506.25 MHz < $f_C \leq$ 1.0125 GHz | 8 MHz |
| 1.0125 GHz < $f_C \leq$ 2.025 GHz | 16 MHz |
| 2.025 GHz < $f_C \leq$ 4.050 GHz (SG394) | 32 MHz |
| Maximum (SG396) | |
| $f_C \leq$ 93.75 MHz | Smaller of $f_C$ or 96 MHz – $f_C$ |
| 93.75 MHz < $f_C \leq$ 189.84375 MHz | 1 MHz |
| 189.8437 MHz < $f_C \leq$ 379.6875 MHz | 2 MHz |
| 379.6875 MHz < $f_C \leq$ 759.375 MHz | 4 MHz |
| 759.375 MHz < $f_C \leq$ 1.51875 GHz | 8 MHz |
| 1.51875 GHz < $f_C \leq$ 3.0375 GHz | 16 MHz |
| 3.0375 GHz < $f_C \leq$ 6.075 GHz | 32 MHz |
| Deviation resolution | 0.1 Hz |
| Deviation accuracy | <0.1 % ($f_C \leq$ 62.5 MHz (SG392 & SG394)) ($f_C \leq$ 93.75 MHz (SG396)) <3 % ($f_C$ > 62.5 MHz (SG392 & SG394)) ($f_C$ > 93.75 MHz (SG396)) |
| Modulation source | Internal or external |
| Modulation distortion | <–60 dB ($f_C$ = 100 MHz, $f_M = f_D$ = 1 kHz) |
| Ext. FM carrier offset | <1:1,000 of deviation |
| Modulation bandwidth | 500 kHz ($f_C \leq$ 62.5 MHz (SG392 & SG394)) ($f_C \leq$ 93.75 MHz (SG396)) 100 kHz ($f_C$ > 62.5 MHz (SG392 & SG394)) ($f_C$ > 93.75 MHz (SG396)) |

## Frequency Sweeps (Phase Continuous)

| | |
|---|---|
| Frequency span | 10 Hz to entire sweep range |
| Sweep ranges | |
| SG392 & SG394 | DC to 64 MHz<br>59.375 MHz to 128.125 MHz<br>118.75 MHz to 256.25 MHz<br>237.5 MHz to 512.5 MHz<br>475 MHz to 1025 MHz<br>950 MHz to 2050 MHz<br>1900 MHz to 4100 MHz (SG394) |
| SG396 | DC to 96 MHz<br>89.0625 MHz to 192.188 MHz<br>178.125 MHz to 384.375 MHz<br>356.25 MHz to 768.75 MHz<br>712.5 MHz to 1537.5 MHz<br>1425 MHz to 3075 MHz<br>2850 MHz to 6150 MHz |
| Deviation resolution | 0.1 Hz |
| Sweep source | Internal or external |
| Sweep distortion | <0.1 Hz + (deviation / 1,000) |
| Sweep offset | <1:1,000 of deviation |
| Sweep function | Triangle, ramp or sine up to 120 Hz |

## Phase Modulation

| | |
|---|---|
| Deviation | 0 to 360º |
| Deviation resolution | 0.01º to 100 MHz, 0.1º to 1 GHz, 1º above 1 GHz |
| Deviation accuracy | <0.1 % ($f_C \leq$ 62.5 MHz (SG392 & SG394)) ($f_C \leq$ 93.75 MHz (SG396)) <3 % ($f_C$ > 62.5 MHz (SG392 & SG394)) ($f_C$ > 93.75 MHz (SG396)) |
| Modulation source | Internal or external |
| Modulation distortion | <–60 dB ($f_C$ = 100 MHz, $f_M$ = 1 kHz, $\Phi_D$ = 50º) |
| Modulation bandwidth | 500 kHz ($f_C$ > 62.5 MHz (SG392 & SG394)) ($f_C$ > 93.75 MHz (SG396)) 100 kHz ($f_C$ > 62.5 MHz (SG392 & SG394)) ($f_C$ > 93.75 MHz (SG396)) |

## Pulse/Blank Modulation

| | |
|---|---|
| Pulse mode | Logic “High” turns RF “on” |
| Blank mode | Logic “High” turns RF “off” |
| On/Off ratio | |
| BNC output | 70 dB |
| Type-N output | 57 dB ($f_C \leq$ 1 GHz)<br>40 dB (1 GHz $\leq f_C$ < 4 GHz)<br>35 dB ($f_C \geq$ 4 GHz) |
| Pulse feed-through | 10 % of carrier for 20 ns at turn on (typ.) |
| Turn on/off delay | 60 ns |
| RF rise/fall time | 20 ns |
| Modulation source | Internal or external pulse |

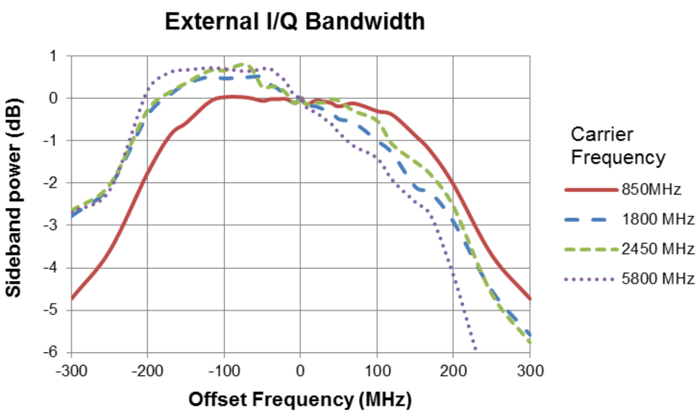
## General

| | |
|---|---|
| Ethernet (LAN) | 10/100 Base-T.TCP/IP & DHCP default |
| GPIB | IEEE488.2 |
| RS-232 | 4800 to 115,200 baud, RTS/CTS flow |
| Line power | <90 W, 90 to 264 VAC, 47 to 63 Hz w/ PFC |
| Dimensions, weight | 8.5" × 3.5" × 13" (WHD) |
| Weight | 10 lbs. |
| Warranty | One year parts and labor on defects in materials and workmanship |

# SG390 Series Specifications (Vector)

## External I/Q Modulation

| | |
|---|---|
| Carrier frequency range | 400 MHz to 2.025 GHz (SG392) |
| | 400 MHz to 4.05 GHz (SG394) |
| | 400 MHz to 6.075 GHz (SG396) |
| I/Q inputs | 50 Ω, ±0.5 V (rear panel) |
| I/Q full scale input | $(I^2 + Q^2)^{1/2} = 0.5$ V |
| Modulation bandwidth | 300 MHz RF bandwidth |
| I or Q input offset | <500 µV |
| Carrier suppression | >40 dBc (>35 dBc above 4 GHz) |




## Dual Baseband Generator (for Vector I/Q Modulation)

| | |
|---|---|
| Channels | 2 (I and Q) |
| DAC data format | Dual 14-bit at 125 MS/s |
| Reconstruction filter | 10 MHz, 3rd order Bessel LPF |
| Arb symbol memory | Up to 16 Mbits |
| Symbol rate | 1 Hz to 6 MHz (1 µHz resolution) |
| Symbol length | 1 to 9 bits (maps to constellation) |
| Symbol mapping | Default or user-defined constellation |
| Symbol source | User-defined symbols, built-in PRBS generator, or settable pattern generator |
| PRBS length | $2^n - 1$ ($5 < n < 32$) (31 to about $4.3 \times 10^9$ symbols) |
| Pattern Generator | 16 bits |
| Digital Filtering | |
| Filter type | Nyquist, Root Nyquist, Gaussian, Rectangular, Linear, Sinc, User FIR |
| Filter length | 24 symbols |
| Noise Impairments | |
| Additive noise | White, Gaussian |
| Level | –70 dBc to –10 dBc (band limited by digital filter) |

## Vector Modulation

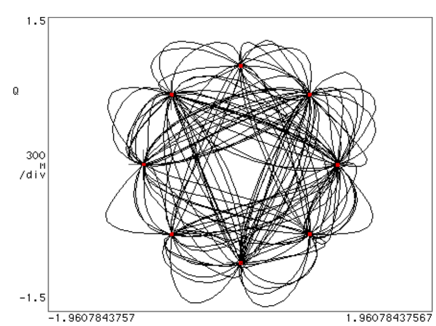
| | |
|---|---|
| Modulation type | PSK, QAM, FSK, CPM, MSK, ASK, VSB |
| PSK derivatives | PSK, BPSK, QPSK, OQPSK, DQPSK, π/4DQPSK, 8 PSK, 16 PSK, 3π/8 8 PSK |
| QAM derivatives | 4, 16, 32, 64, 256 |
| FSK derivatives | 1-bit to 4-bit with deviations from 0 to 6 MHz |
| ASK derivatives | 1-bit to 4-bit |
| CMP derivatives | 1-bit to 4-bit with modulation indices from 0 to 1.0 |
| VSB derivatives | 8 and 16 (at rates to 12 MS/s) |
| Preset modes | GSM, GSM-EDGE, W-CDMA, APCO-25, DECT, NADC, PDC, TETRA, ATSC DTV, and audio clip (analog AM and FM) |

## Rear-Panel Markers

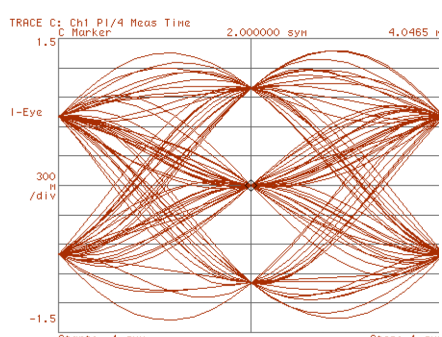
| | |
|---|---|
| Type | Symbol Clock, Data Frame, TDMA, and user-defined |
| Amplitude | 0.5 to 4 Vpp (–2 dBm to +16 dBm) |
| Output impedance | 50 Ω, AC coupled |

## EVM or FSK Errors

| | |
|---|---|
| ***TETRA*** | *(π/4 Diff Quad PSK, 24.3 kS/s, 420 MHz)* |
| EVM (typ.) | 0.76 % (0 dBm) |




*TETRA constellation (420 MHz carrier)*




*TETRA I-EYE diagram (420 MHz carrier)*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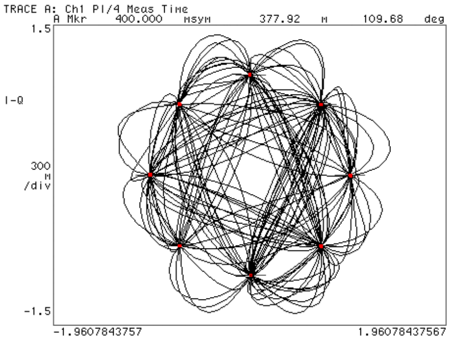
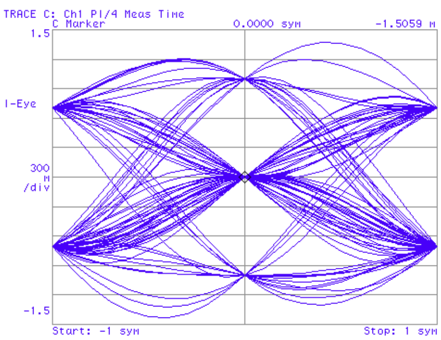
***NADC*** *(π/4 Diff Quad PSK, 24.3 kS/s, 875 MHz)*
EVM (typ.) 0.33 % (0 dBm)

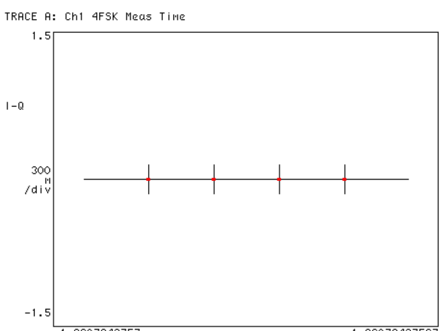



*NADC constellation (875 MHz carrier)*

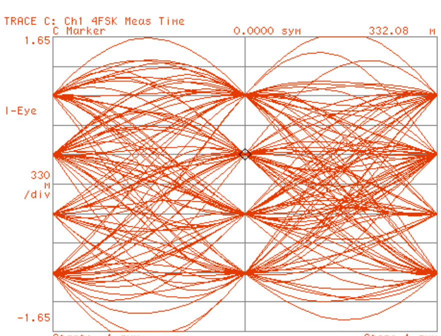



*NADC I-Eye diagram (875 MHz carrier)*

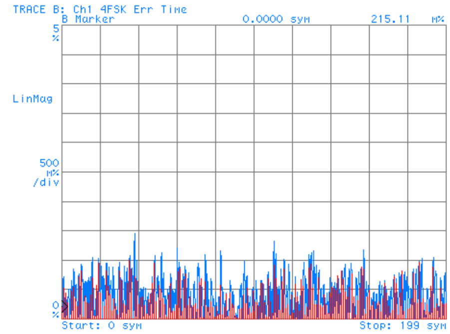
***APCO-25*** *(FSK4-C4FM, 4.8 kS/s, 850 MHz)*
FSK error (typ.) 0.46 % (0 dBm)




*APCO-25 constellation (850 MHz carrier)*

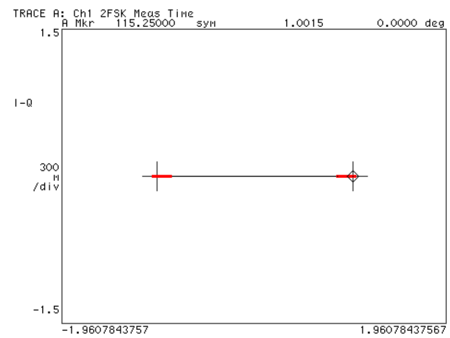



*APCO-25 I-Eye diagram (850 MHz carrier)*

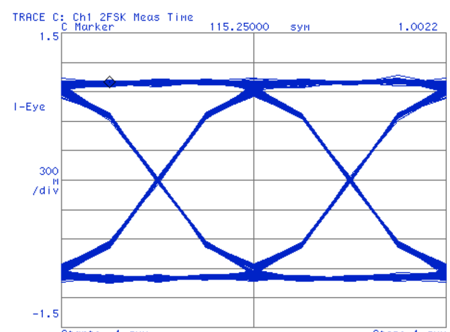



*APCO-25 FSK error for each symbol*

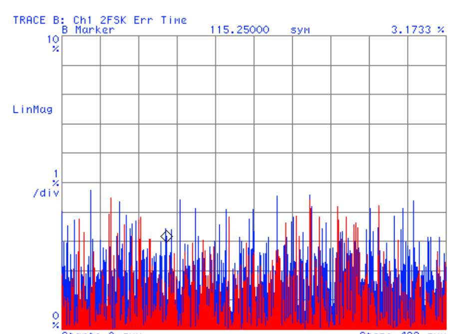
***DECT*** *(FSK2, 1.152 Mbps, 1.925 GHz)*
FSK error (typ.) 1.5 % (0 dBm)




*DECT constellation (1.925 GHz carrier)*




*DECT I-Eye diagram (1.925 GHz carrier)*




*DECT error for each symbol*

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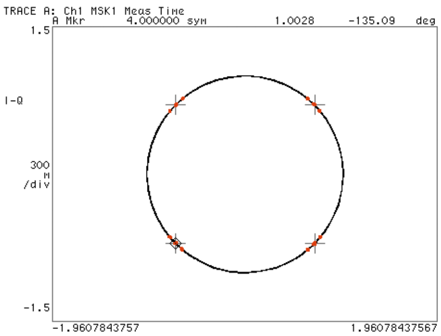
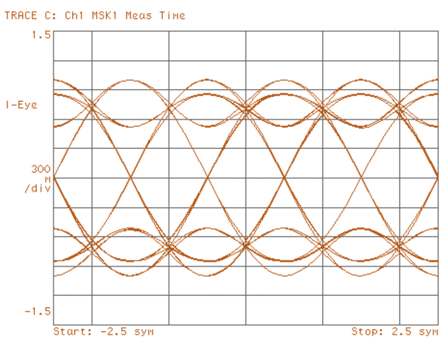
***GSM*** *(GMSK, 270.833 kS/s, 935 MHz)*
EVM (typ.) 0.3 % (0 dBm)
***GSM*** *(GMSK, 270.833 kS/s, 1.932 GHz)*
EVM (typ.) 0.6 % (0 dBm)

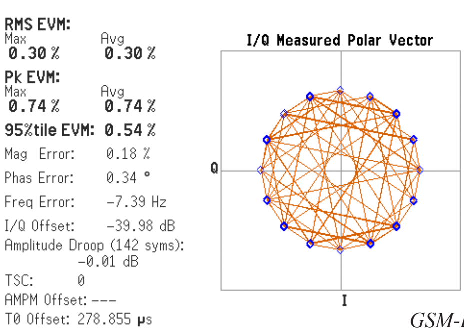



*GSM constellation (9355 MHz carrier)*



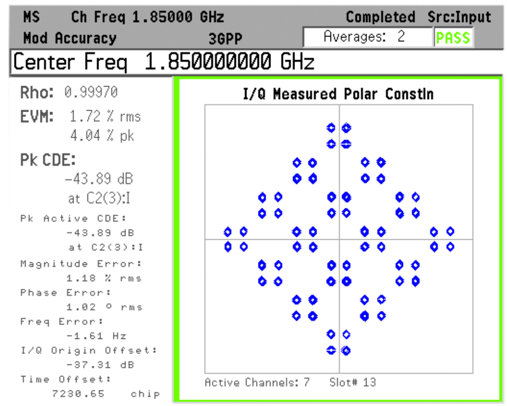

*GSM I-Eye diagram (9355 MHz carrier)*

***GSM-EDGE*** *(3π/8 8PSK, 270.833 kS/s, 935 MHz)*
EVM (typ.) 0.3 % (0 dBm)
***GSM-EDGE*** *(3π/8 8PSK, 270.833 kS/s, 1.932 GHz)*
EVM (typ.) 0.5 % (0 dBm)

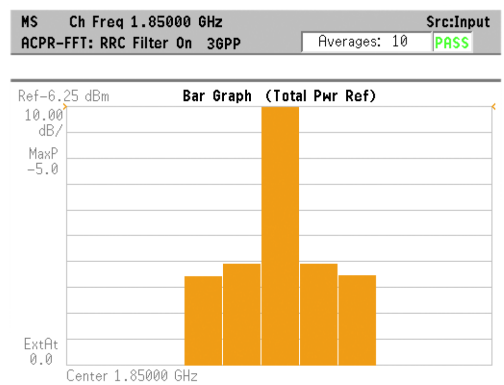



*GSM-EDGE constellation (935 MHz carrier)*

***W-CDMA*** *(QPSK, 3.840 Mcps, 1.850 GHz)*
EVM (typ.) 1.7 % (0 dBm)

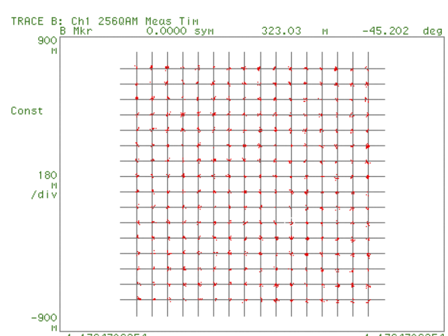



*W-CDMA constellation (1.85 GHz)*

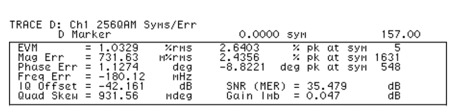



*W-CDMA ACPR*

***QAM256*** *(6 MS/s, 2.450 GHz)*
EVM (typ.) 1.1 % (0 dBm)




*QAM256 constellation (2.45 GHz carrier)*

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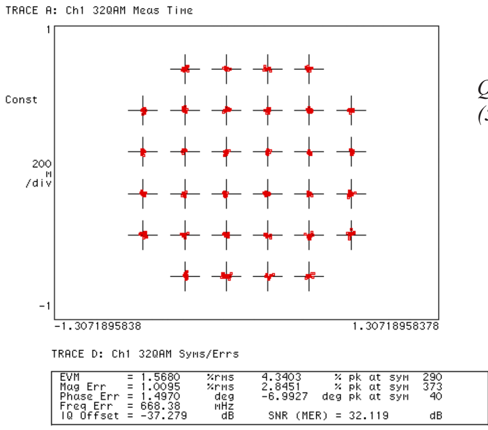
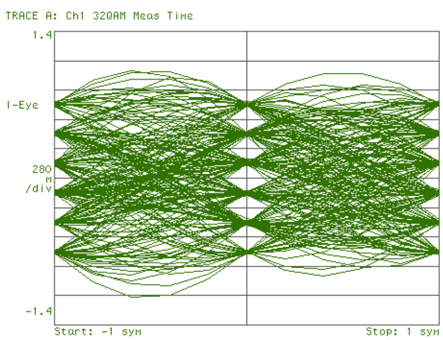
| | | |
|---|---|---|
| ***QAM32*** | | *(6 MS/s, 5.800 GHz)* |
| | EVM (typ.) | 2.5 % (0 dBm) |

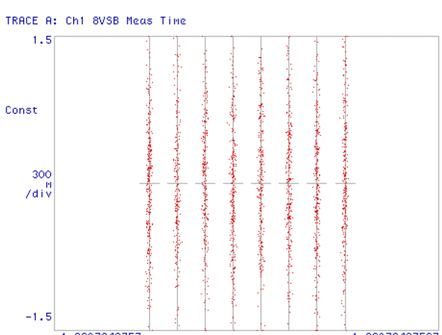



*QAM32 constellation*
*(5.8 GHz carrier)*




*QAM32 I-Eye diagram*
*(5.8 GHz carrier)*

| | | |
|---|---|---|
| ***ATSC-DTV*** | | *(8 VSB, 10.762 MS/s, 695 MHz)* |
| | EVM (typ.) | 2.2 % (0 dBm) |




*ATSC-DTV (8VSB) constellation*
*(695 MHz carrier)*

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