



# SGA SERIES PRODUCT MANUAL



## USB VECTOR SIGNAL GENERATOR

SGA-60  
9 kHz - 6 GHz

# SGA Series Overview.

## **BENCHMARK USB VECTOR SIGNAL GENERATOR**

The SGA series combines laboratory-grade RF performance—spanning middle range phase noise to clean harmonic suppression with an accessible price. It features a high-resolution 16-bit DAC for precision signal synthesis and supports a 100 MHz playback bandwidth alongside 50 MHz real-time streaming. The integrated FPGA-based interpolator allows for granular sample rate adjustments and minimizes CPU overhead, ensuring a seamless, high-efficiency user experience for demanding test environments.

## **EASE OF USE AND COMPACT DESIGN**

The compact form factor facilitates seamless system integration without compromising RF integrity, drastically reducing both deployment complexity and operational overhead. It is ideally positioned for footprint-sensitive and budget-conscious applications where performance cannot be sacrificed.

## **POWERFUL API AND ECOSYSTEM**

The SGA series features a streamlined yet robust API designed for rapid development across diverse software environments. It offers comprehensive support for C/C++, C#, Python, and MATLAB, as well as seamless integration with industry-standard platforms like Qt and LabVIEW. Fully compatible with both Windows and Linux, the API ensures maximum flexibility for cross-platform system architecture.

## **Key Features**

- Frequency: 9 kHz to 6 GHz
- Modulation Bandwidth: 100 MHz playback, 50 MHz real-time
- Memory depth: 128 MB (32 M samples)
- 1 GHz phase noise: -124 dBc/Hz@10 kHz
- Maximum output power: 7 dBm to 14 dBm, 25 dBm (opt.)
- Minimum output power:  $\leq -100$  dBm across full frequency range
- Harmonics:  $\leq -50$  dBc (0 dBm output, typical)
- 16-bit DAC for high-quality baseband waveform
- FPGA-based high-performance interpolator
- Fine sampling rate adjustment supported
- Fine reference frequency adjustment supported
- Built-in GNSS for timing, positioning, and frequency calibration
- USB3.0/2.0 Type-C interface
- Support ARM and X86 processor
- Support Windows and Linux system

# SGA Series Interface Description



GNSS Antenna Port

RF Output



Medium Power Output  
(Option 10)

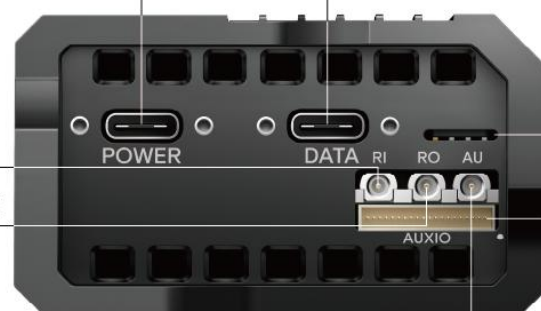
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Power Port

Data Port

Reference Clock Input

Reference Clock Output



Device Status Indicator

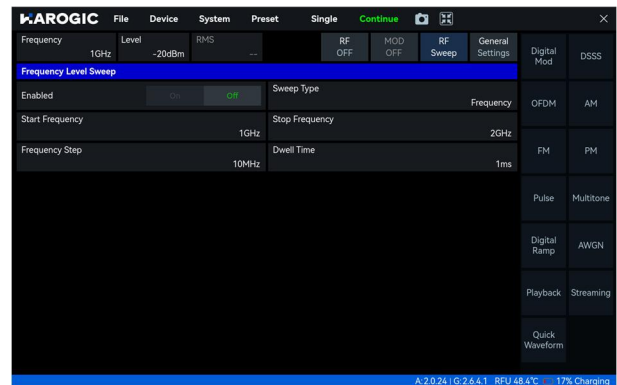
AUXIO

Reserved

# SGStudio Software Overview\*

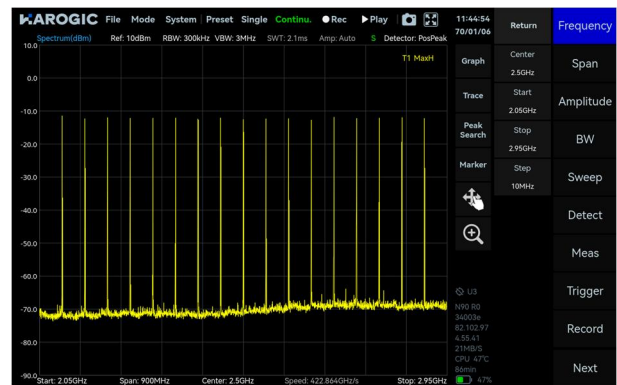
## ■ Clear and User-Friendly Interface

SGStudio features a user-friendly interface designed for ease of operation. The GUI is logically organized into five key functional areas: the Menu bar, RF parameter settings, mode selection, mode parameter settings, and status information.



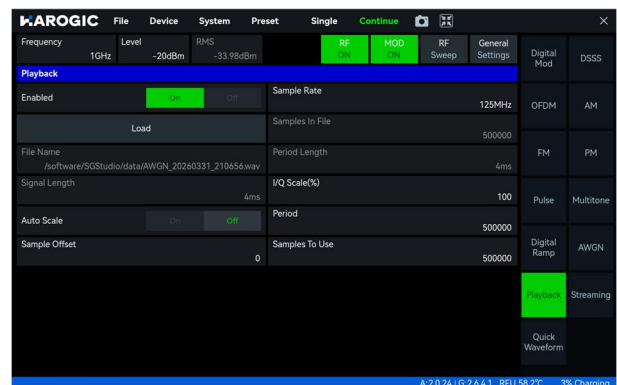
## ■ RF Frequency and Power Sweep Control

SGStudio provides comprehensive RF control, supporting single tone, frequency sweep, and power sweep modes. It simplifies complex characterization tasks, enabling users to perform automated frequency response and compression point testing directly through the GUI—eliminating the need for custom programming.



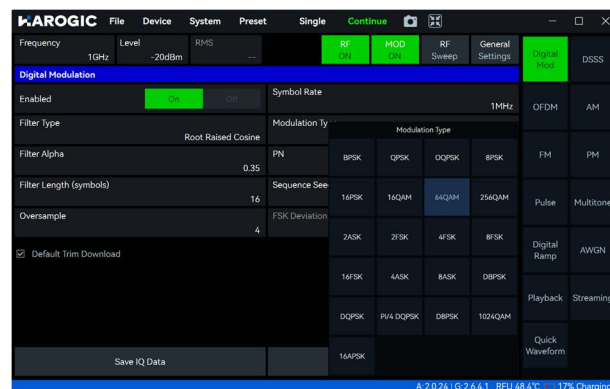
## ■ IQ Streaming and Playback

SGStudio supports continuous real-time waveform streaming from the host for playback, as well as waveform buffering in the device's internal memory for subsequent playback. Buffered playback supports wider signal bandwidth and requires no host intervention during playback, thereby fully freeing host processing resources. In buffered playback mode, the maximum waveform length is limited by the capacity of the device's internal memory.



## Digital Modulation Signal Output

Engineered for versatility, the SGA series supports an extensive library of modulation schemes, ranging from fundamental ASK, FSK, and PSK to high-order 1024QAM. The architecture is specifically optimized for modern wireless standards, with support for DSSS and OFDM to facilitate advanced signal generation for both field testing and R&D verification.



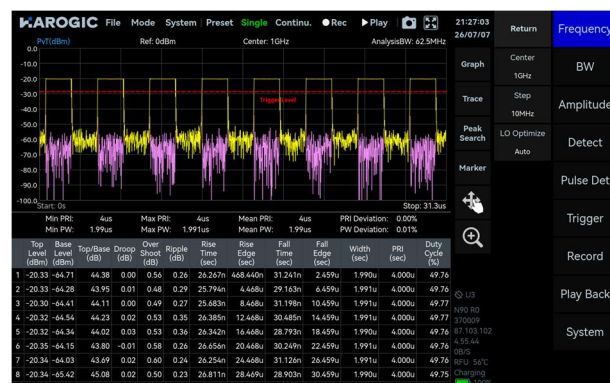
## Basic AM/FM/PM Signal Output

SGStudio supports analog modulation formats, including AM, FM, and PM. Each of the three modulation types supports a variety of modulation signal formats, with configurable parameters including modulation rate, modulation index, frequency deviation, phase deviation, and initial phase, accommodating routine analog modulation signal generation and RF testing requirements.



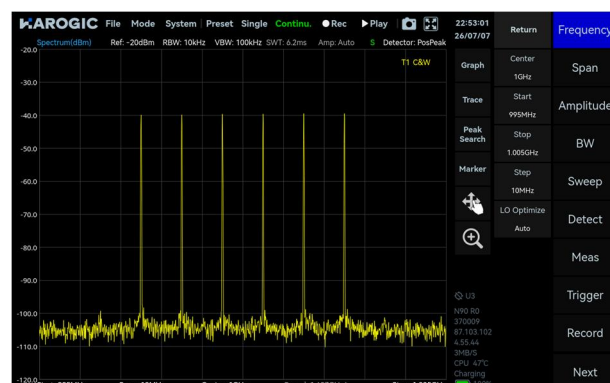
## Basic Pulse Signal Output

SGStudio supports basic pulse signal output with configurable pulse repetition period, duty cycle, and pulse width.



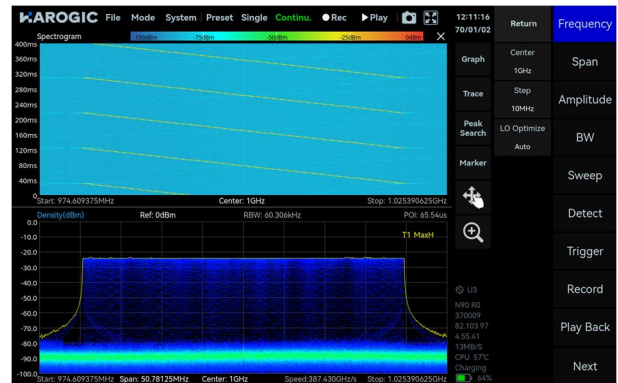
## Multitone Signal Output

The SGA series supports the generation of multi-tone RF signals composed of multiple discrete tones. Users can configure the number of tones, tone spacing, and phase mode. In-band notches can also be configured relative to the RF center frequency, making this function suitable for dynamic range, intermodulation distortion, and frequency-response flatness testing.



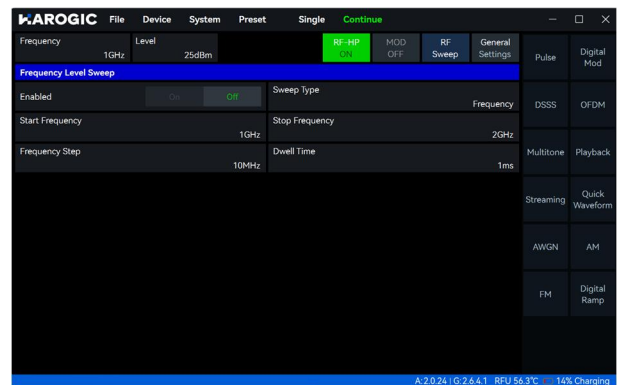
## ■ Digital Ramp Sweep

SGStudio supports linear digital ramp frequency sweeps with configurable sweep span, sweep time, and sweep period. This function is suitable for radar signal simulation, wideband excitation, and frequency-response testing.



## ■ Medium Power Output (opt.10)

The SGA series offers an optional medium-power RF output port, delivering up to 25 dBm of output power over the 10 MHz to 6 GHz frequency range. This option is ideal for applications requiring higher excitation levels, such as device testing and system integration.



\*Some spectrum and waveform illustrations are shown using measurement screens from spectrum analyzer software.

## Specifications\*

### FREQUENCY

|                                 |                                                                          |                                    |
|---------------------------------|--------------------------------------------------------------------------|------------------------------------|
| Frequency range                 | 9 kHz to 6 GHz                                                           |                                    |
| Frequency resolution            | Output frequency <500 MHz                                                | 1 Hz                               |
|                                 | 500 MHz ≤ Output frequency ≤ 6 GHz                                       | 0.1 Hz                             |
| LO switching time               | ≤100 us pre-programmed; ≤50 ms software controlled                       |                                    |
| Reference clock                 | Internal or external, manual correction or GNSS calibration is available |                                    |
| Frequency accuracy              | TCXO (std.)                                                              | ≤0.5 ppm, supports GNSS correction |
|                                 | Frequency correction via GNSS                                            | ≤0.05 ppm, when GNSS is locked     |
| Aging and temperature stability | ≤1 ppm/year, ≤1 ppm                                                      |                                    |
| Built-in GNSS 1PPS accuracy     | ± 100 ns                                                                 |                                    |

### SPECTRUM PURITY

| SSB phase noise (dBc/Hz) |                                                                                                        |                                                                       |       |
|--------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-------|
| Carrier frequency        | 1 GHz                                                                                                  | 3 GHz                                                                 | 6 GHz |
| 1 kHz                    | -115                                                                                                   | -105                                                                  | -98   |
| 10 kHz                   | -124                                                                                                   | -114                                                                  | -108  |
| 100 kHz                  | -125                                                                                                   | -116                                                                  | -110  |
| 1 MHz                    | -138                                                                                                   | -128                                                                  | -122  |
| Harmonics<br>CW, 0 dBm   | 100 MHz                                                                                                | ≤-45 dBc                                                              |       |
|                          | 1 GHz                                                                                                  | ≤-50 dBc                                                              |       |
|                          | 3 GHz                                                                                                  | ≤-60 dBc                                                              |       |
|                          | 6 GHz                                                                                                  | ≤-75 dBc                                                              |       |
| Non-harmonic spurious    | 1 MHz steps size and 20 MHz observation bandwidth                                                      |                                                                       |       |
|                          | Spurious levels are ≤-80 dBc for approximately 98% of frequency points<br>Worst-case spurious ≤-55 dBc |                                                                       |       |
| EVM<br>(Typical)         | 1 GHz                                                                                                  | ≤0.3% 1MSPS QAM 16, Alpha = 0.35<br>≤0.5% 10MSPS QAM 64, Alpha = 0.35 |       |
|                          | 6 GHz                                                                                                  | ≤0.5% 1MSPS QAM 16, Alpha = 0.35<br>≤1.0% 10MSPS QAM 64, Alpha = 0.35 |       |

## AMPLITUDE

|                                        | 9kHz                              | 100 MHz | 1 GHz | 3 GHz            | 6 GHz |
|----------------------------------------|-----------------------------------|---------|-------|------------------|-------|
| Max. output power (dBm)                | ≥0                                | ≥7      | ≥14   | ≥14              | ≥7    |
| Min. output power (dBm)                | ≤-100                             | ≤-100   | ≤-100 | ≤-100            | ≤-100 |
| Power accuracy<br>(Guaranteed/Typical) | Output power: ≥-45 dBm            |         |       | ±1.2 dB / 0.7 dB |       |
|                                        | Output power: -80 dBm to -45 dBm  |         |       | ±1.5 dB / 1.2 dB |       |
|                                        | Output power: -100 dBm to -80 dBm |         |       | ±2.0 dB / 1.8 dB |       |
| Power setting step size                | 0.1 dB                            |         |       |                  |       |

## SIGNAL PROCESSING

|                                           |                                                                                                                                                                                  |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Standard function</b>                  | Single tone, multitone, frequency sweep, power sweep,<br>AM, FM, PM, pulse modulation, digital ramp sweep<br>Gaussian white noise, IQ playback, Real-Time IQ playback            |
| <b>Modulation bandwidth</b>               | 100 MHz RAM playback, 50 MHz continuous streaming                                                                                                                                |
| <b>Built-in memory depth</b>              | 128 MB (32 M samples)                                                                                                                                                            |
| <b>IQ sampling rate</b>                   | 195.3125 kHz to 125 MHz, step size ≤10 Hz                                                                                                                                        |
| <b>Basic modulation signal generation</b> | APSK: 16APSK<br>ASK: 2ASK, 4ASK, 8ASK<br>FSK: 2FSK, 4FSK, 8FSK, 16FSK<br>QAM: 16 QAM, 64 QAM, 256 QAM, 1024 QAM<br>PSK: BPSK, QPSK, 8PSK, 16PSK, DBPSK, DQPSK, D8PSK, Pi/4 DQPSK |

## GENERAL

|                                       |                                                                                  |
|---------------------------------------|----------------------------------------------------------------------------------|
| <b>Input and output</b>               |                                                                                  |
| <b>Power</b>                          | Type-C, PD protocol (12 V/3 A std.)<br>Voltage range 9 to 12 V, Ripple <200 mVpp |
| <b>Data</b>                           | Type-C, USB3.0 (USB2.0 bandwidth limited)<br>Recommend 5 V/1 A power supply      |
| <b>RF output</b>                      | N(F), Output impedance 50 Ω                                                      |
| <b>External reference clock input</b> | MMCX(F), Amplitude ≥1.5 Vpp, Input impedance 200 Ω                               |
| <b>Reference clock output</b>         | MMCX(F), Output impedance 50 Ω, 100 MHz                                          |
| <b>External trigger input</b>         | 3.3 V CMOS, Input high impedance                                                 |
| <b>External trigger output</b>        | 3.3 V CMOS                                                                       |
| <b>GNSS antenna input</b>             | SMA (F)                                                                          |
| <b>Power consumption</b>              | ≤16 W                                                                            |
| <b>Overall/core weight</b>            | ≤360 g/≤120 g                                                                    |

|                                                    |                                                                                |                             |
|----------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------|
| <b>Overall/core dimensions<br/>(L x W x H)</b>     | ≤163 x 66 x 37 mm/≤63 x 60 x 15 mm                                             |                             |
| <b>System requirements</b>                         | Linux                                                                          | aarch64, x64                |
|                                                    | Windows                                                                        | x64                         |
| <b>Operating/storage<br/>temperature (Ambient)</b> | T0 class (std.)                                                                | 0 to 50 °C / -20 to 70 °C   |
|                                                    | T1 class (opt.40)                                                              | -20 to 65 °C / -40 to 85 °C |
|                                                    | T2 class (opt.41), only core                                                   | -40 to 65 °C / -40 to 85 °C |
| <b>Packaging accessories</b>                       | Flash disk * 1, USB 3.0 data cable * 1, USB power cable * 1, Power adapter * 1 |                             |

#### Medium Power Output (opt.10)

|                                                |                                  |                  |
|------------------------------------------------|----------------------------------|------------------|
| <b>Frequency range</b>                         | 10 MHz to 6 GHz                  |                  |
| <b>Max. output power</b>                       | ≥25 dBm (typ.)                   |                  |
| <b>Min. output power</b>                       | ≤-80 dBm (typ.)                  |                  |
| <b>Power accuracy<br/>(Guaranteed/Typical)</b> | Output power: ≥ -20 dBm          | ±1.2 dB / 0.7 dB |
|                                                | Output power: -60 dBm to -20 dBm | ±1.5 dB / 0.7 dB |
|                                                | Output power: -80 dBm to -60 dBm | ±2.5 dB / 1.2 dB |
| <b>Harmonics<br/>(CW, 0 dBm)</b>               | 100 MHz                          | ≤-55 dBc         |
|                                                | 1 GHz                            | ≤-50 dBc         |
|                                                | 3 GHz                            | ≤-42 dBc         |
|                                                | 6 GHz                            | ≤-46 dBc         |

\*Specification applies under the following conditions:

(1) 10 min warm-up after power-on

(2) Ambient temperature: 25 °C (instrument temperature: 50 °C)

(3) With adequate cooling ensuring both ambient and core temperatures remain within the rated range

#### OPTIONS

| <b>Code</b> |                                               |                   |
|-------------|-----------------------------------------------|-------------------|
| 05          | Built-in high precise GNSS                    | built-in hardware |
| 10          | Medium power output                           | built-in hardware |
| 40          | T1 temperature class                          | built-in hardware |
| 41          | T2 temperature class, only available for core | built-in hardware |

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