

# S-Series

## SGA Fast, Low Noise Signal Generator

**AEROFLEX**  
A passion for performance.



Compact, easy to use, high performance signal generator for R&D, manufacturing and the field

- Wide band cover:
  - SGA-3 - 100 kHz to 3 GHz
  - SGA-6 - 100 kHz to 6 GHz
- +13 dBm output (+20 dBm option)
- Low SSB phase noise:  $-135$  dBc/Hz at 1 GHz, at 20 kHz offset
- Fast frequency settling time: 100  $\mu$ s
- Synthesizer input/output for phase locking multiple signal generators
- Wide bandwidth AM, FM,  $\emptyset$ M with comprehensive and fully flexible modulation modes (option)
- Four internal 10 MHz modulation oscillators
- Internal pulse modulator/generator (option)
- Comprehensive frequency and amplitude sweep capabilities
- Half-rack width, 4U high with 8.5 inch touch screen user-interface
- Synchronization and interaction with a selection of S-Series "plug & play" modules and/or a quantity of SGA
- Aerolock™ interlocking mechanism for multiple instrument applications
- USB, LAN and GPIB remote control – LXI Class C compliant
- Low cost of ownership through modular design

The SGA employs a large touch screen user-interface to provide a signal generator with unparalleled ease-of-use. With such a small form-factor, the SGA is equally at home in the field as it is in the laboratory or a production line. The use of Aeroflex's Fast Low Noise Synthesis (FLNS) technology, added to the experience gained through decades of developing leading-edge signal source products, ensures that signal purity and integrity have not been sacrificed in the quest for speed; the SGA excels in all respects. With a comprehensive range of features and options, the SGA meets the needs for a general-purpose signal generator while offering the high performance required of demanding, critical receiver measurements or rapid manufacturing.

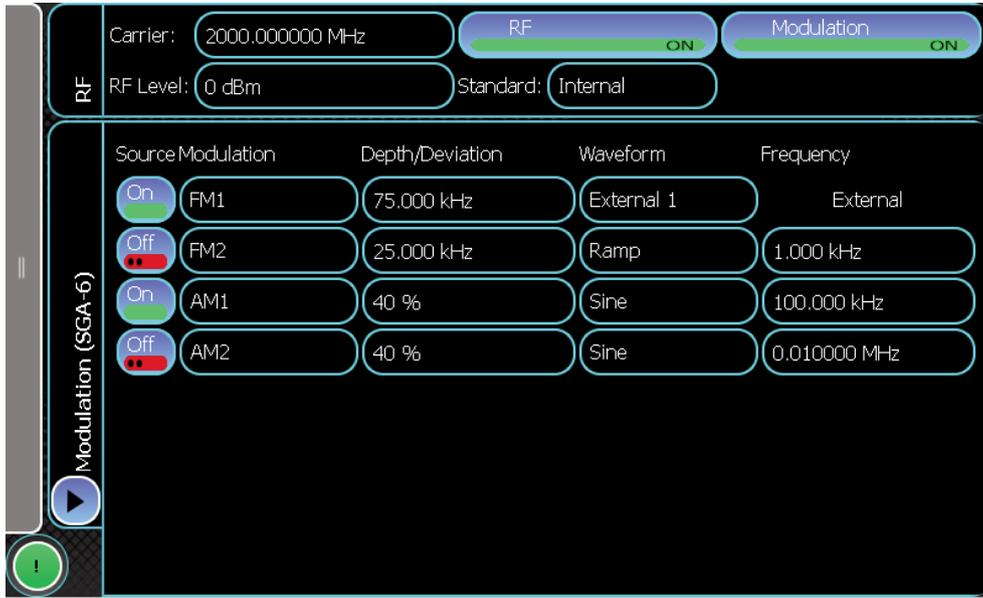
For the very latest specifications visit [www.aeroflex.com](http://www.aeroflex.com)

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## Display and User-Interface

A large 8.5 inch touch-screen LCD enables all relevant set-up information to be displayed on one screen, and without the need to select configurations from lower level menu structures. It is quick to learn, easy to use, clear, with large characters and a wide viewing angle. Touch targets are sufficiently large to ensure usability even when wearing gloves.

A mouse and keyboard may also be connected to allow ease of use when using Windows features.



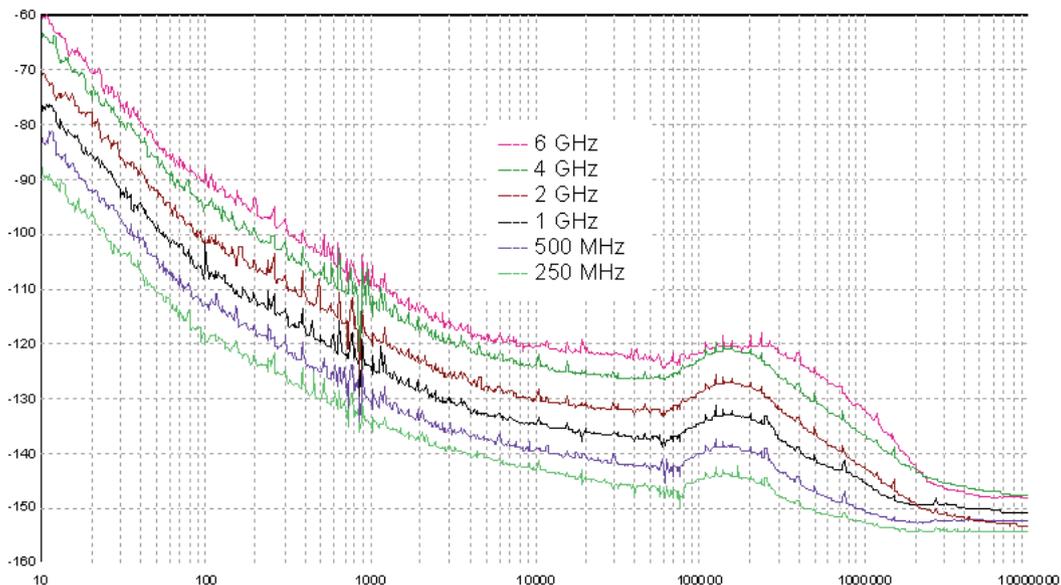
*No knobs or keyboard, just a simple touch screen user interface*

## Excellent Spectral Purity

The excellent noise characteristics and the low level of spurious signals of the SGA enable the instruments to be used with confidence for a wide range of critical measurements for the most demanding measurements on modern receivers, RF systems and A-D converters.

## Low SSB Phase Noise

With a specified SSB phase noise performance of typically -135 dBc/Hz at 20 kHz offset from a carrier of 1 GHz, the SGA is easily able to measure receiver selectivity beyond 80 dB. The low residual FM noise figure or less than 1 Hz RMS at 1 GHz gives the SGA the capability of measuring receiver signal-to-noise ratios as high as 80 dB.



*Graph of typical phase noise performance*

## Fast Frequency and Level Settling Times

These are critical parameters to ensure maximum throughput in production applications. With frequency and level settling times of 1 ms in conventional frequency selection mode, or 100  $\mu$ s in list mode, the SGA is ideally suited for frequency hopping and semiconductor production test applications.

## RF Output

RF output up to +13 dBm can be set to a resolution of 0.01 dB. A high power option is available to extend the maximum calibrated RF level to +20 dBm.

In the tradition of Aeroflex's excellence in RF signal generation, the ultimate attention has been given to ensure the quality of the RF performance extends beyond the specification. Such attributes are:

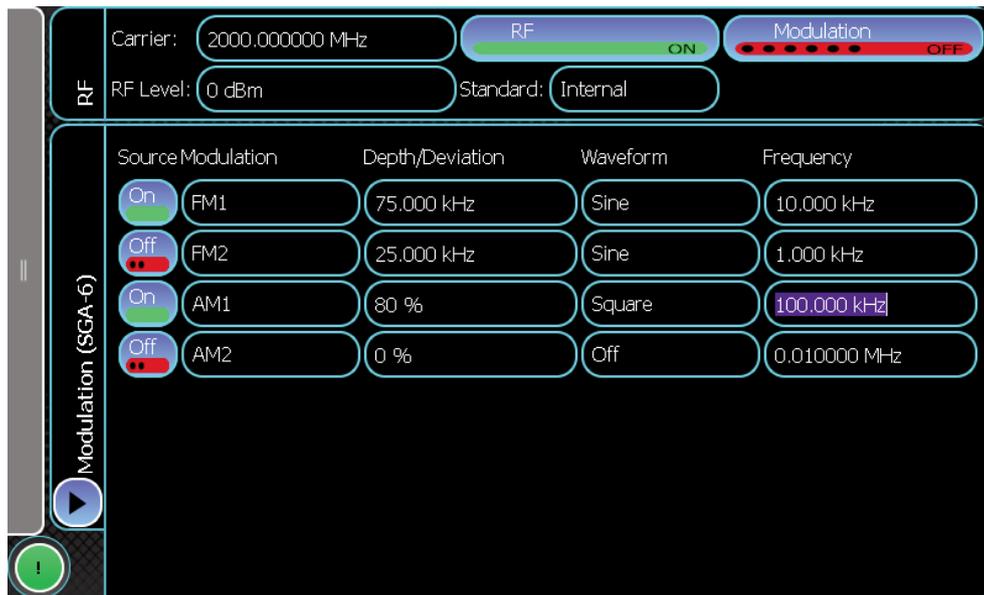
- that no positive RF level transients generated as a result of changing between any frequency or level
- class-leading source VSWR specification helps to ensure that the specified RF level accuracy is more likely to be met when the load match is not ideal
- excellent linearity and monotonicity even over fine RF level steps
- repeatability ensures the same RF level is produced every time

The fastest level switching speed with a long life is achieved by the use of an electronic attenuator ensuring suitability for use in the most demanding production test applications.

For the SGA-3, a reverse power protection (RPP) option provides additional protection for the instrument's RF output if excessive RF or DC power is accidentally applied ensuring a longer instrument life and lower cost of ownership.

## Flexible Modulation Capabilities (Option)

With four internal 10 MHz oscillators and two external modulation inputs, a wide selection of modulation modes is catered for. With four modulation channels it is possible to have single AM, FM or PM (phase modulation) and dual AM and FM (or PM) using any combination of internal and external sources.



*Typical multiple modulation set-up*

Wide AM and FM bandwidths support the testing of broadcast systems by allowing video signals to modulate the carrier with minimal distortion. Wideband FM also supports testing of equipment using frequency shift keying for high speed digital transmission and telemetry.

## Sweep

The comprehensive sweep mode provides a digital sweep of carrier frequency and RF level in discrete steps. It is possible to set the start, stop, number of steps (or step size) and step time, up to a maximum of 65536 steps.

A sweep can be externally triggered via a rear panel BNC connector for Start, Start/Stop and Step, while up to six markers can be used to identify specific events within the sweep.



*Typical frequency sweep set-up*

### List Mode Sweep

With a minimum dwell time of 100 us, list mode provides the ultimate in frequency switching speed. A table of up to 5000 carrier frequency and RF level values may be created. Start address, stop address and dwell time can be controlled and can be externally triggered from a rear panel BNC connector.

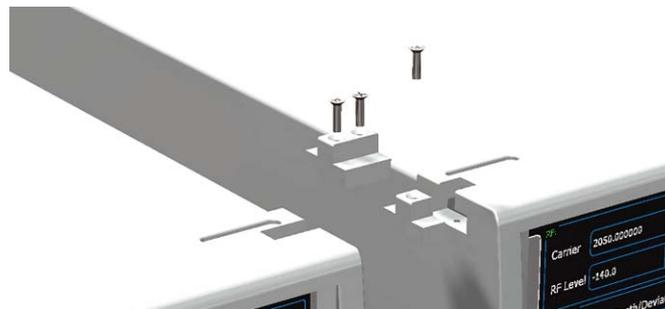
### Pulse Modulation (Option)

An optional pulse modulator with internal pulse generator allows the generation of fast rise time RF signals with on/off ratios that meet the most demanding tests on radar RF and IF stages and EMC/ECCM test applications.

### Modular Instrument Concept Employing Aeroflex's Aerolock™ Interlocking Mechanism

The SGA is designed to work with another SGA and a selection of S-Series modules which mount underneath.

Aerolock™ is an ingenious, simple and strong interlocking mechanism allowing SGA instruments and a full-rack width module, or two half-rack width modules, to be joined as one, creating a bespoke test solution. Weighing-in at less than 8 kg each, two SGAs joined together may be easily carried within the laboratory, the factory or the field without necessitating a 2-person lift.



*Aerolock™ interlocking mechanism*



*Two SGAs joined together as one*

When a module is connected to the SGA via a USB plug & play interface, its presence will be automatically recognised and the features and applications relevant to that module will be available on the SGA.

Many applications will be supported including tests for power amplifiers, receiver selectivity, intermodulation, adjacent channel power and mixer testing, with many more to come in the future. It will be possible to couple the settings of one SGA with another, allowing quick and simple control across any frequency or level range where two sources with a defined relationship are required.

### Remote Operation

The SGA is LXI Class C compliant. USB, LAN and GPIB interfaces are all supported using SCPI format commands where possible. Remote desktop and VNC are also supported allowing off-site remote control.

### Non-Volatile Memory

Up to 500 full instrument setting stores and 500 carrier frequency only stores may be configured. Each store may be independently named allowing quick search of required memory. No settings data is stored in any other memory location within the instrument.

### Removable Hard Disk (Option)

For use in secure areas, the optional removable hard disk allows easy removal of all sensitive instrument settings stores in the event the instrument has to leave the secure area.

### Low Cost of Ownership

The SGA comes with a standard 2-year warranty and recommended 2-year calibration periodicity. Options to extend the warranty to five years are available.

The SGA's modular architecture means that repair can be effected in 30 minutes by replacement using calibrated exchange modules. A quick, "system level" RF adjustment using a USB power sensor restores the instrument's calibration integrity.

The instrument's software may be installed simply from a USB port so that upgrades and bug fixes can be performed with the minimum down-time and maximum convenience. The latest software version will always be available on Aeroflex's web site.

*All specifications apply after a warm-up period of 20 minutes.*

<b>Frequency</b>	
<i>Range</i>	<i>N</i>
100 kHz - <30 MHz	1
30.0 - <46.875 MHz	1/64
46.875 - <93.75 MHz	1/32
93.75 - <187.5 MHz	1/16
187.5 - <375 MHz	1/8
375 - <750 MHz	1/4
750 MHz - <1.5 GHz	1/2
1.5 - <3 GHz	1
3 - 6 GHz	2

<i>Range</i>	100 kHz to 3 GHz (SGA-3) 100 kHz to 6 GHz (SGA-6)
<i>Resolution</i>	$N \times 0.005 \text{ Hz}$
<i>Accuracy</i>	As frequency reference
<i>Settling Time</i> (CW Mode)	Typical settling time to within 0.1 ppm of final frequency 1 ms
<i>Settling Time</i> (List Mode)	Typical settling time to within 0.1 ppm of final frequency after trigger pulse in List Mode.: <100 $\mu\text{s}$ for frequency changes exceeding 1.6 GHz within the frequency range above 3.2 GHz: >101 $\mu\text{s}$
<i>Carrier Phase</i>	0 – 359.9 degrees in 0.1 degree steps Carrier phase controls the phase of the carrier with respect to the reference frequency standard, be it internal or external.

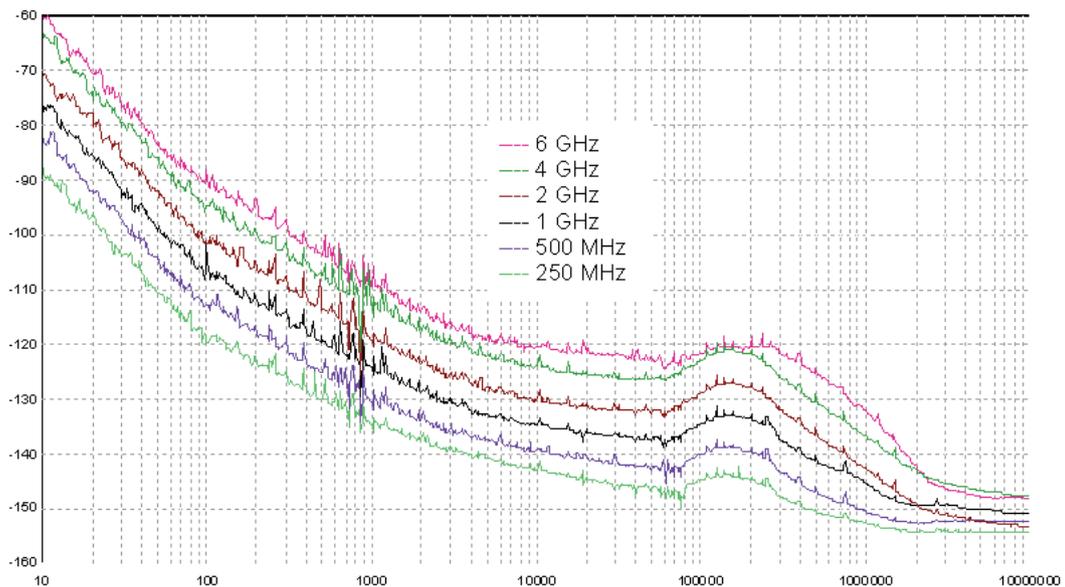
Switching time between...

## RF LEVEL

Range	-130 to +13 dBm -130 to +10 dBm below 1 MHz		
Range (option 003)	-130 to +20 dBm -130 to +16 dBm below 50 MHz -130 to +10 dBm below 1 MHz		
Resolution	+0.01 dB		
Accuracy at 23°C ±5°C	50 kHz - 100 kHz	< ±3 dB	
	100 kHz - 3 GHz	< ±0.5 dB	(typ 0.3 dB)
	>3 GHz	< ±1.0 dB	(typ 0.6 dB)
	Temperature stability +0.01 dB/°C Specification applies above -120 dBm up to 3 GHz and above -100 dBm up to 6 GHz		
Repeatability	Better than ±0.05 dB after warm up following a return from a change of frequency or level valid for at least 2 hours and excluding temperature influence		
Switching Time (within 0.3 dB of final value)	<100 µs to within 0.1 dB of final value (23°C ±5°C) after trigger pulse in List Mode		
Output Impedance	50 Ω nominal		
Output VSWR		< +4 dBm	> +4 dBm
	100 kHz -30 MHz	typ. <1.5:1	typ. <1.5:1
	30 MHz -3 GHz	<1.4:1	<1.5:1
	>3 GHz	<1.5:1	<1.6:1
Reverse Power Damage Level	+25 dBm, ±16 V DC In CW mode, carrier freq. less than 30 MHz or in AM mode, carrier freq. less than 50 MHz: Applied signal of 100 kHz, damage level +12 dBm, rising to +25 dBm for an applied signal of 20 MHz		
Reverse Power Protection SGA-3 only (Option 002)	50 W (from a 50 Ω source) Maximum permissible DC voltage: 50 V		
RF Level Offsets	Up to ±10 dB offset under the following A given RF level offset over a given frequency band A profiled RF level offset between two given frequencies A selection of both of the above		

## SPECTRAL PURITY

SSB Phase Noise	Carrier freq	1 kHz	20 kHz	10 MHz
	250 kHz -	130	-140	n/a
	99 MHz	-130	-140	-150
	100 MHz	-130	-140	-150
	250 MHz	-129	-140	-150
	500 MHz	-123	-136	-150
	1 GHz	-117	-130	-148 (-135 typ) (-152 typ)
	2 GHz	-111	-124	-148
	4 GHz	-105	-118	-140
	6 GHz	-101	-115	-140
Phase noise below 100 Hz offset is dependent upon reference phase noise				
Non-Harmonic Related Spurious	At offsets >10 kHz: Below 1.5 GHz, better than -82 dBc Below 3 GHz, better than -76 dBc Below 6 GHz, better than -70 dBc			
Sub-harmonics	-80 dBc, -40 dBc >3 GHz			
Harmonics	Above 30 MHz, better than -30 dBc Below 30 MHz, better than -25 dBc			
Residual FM	Less than 1 Hz RMS deviation in a 300 Hz to 3.4 kHz unweighted bandwidth at 1 GHz			
RF Leakage	Less than 0.5 $\mu$ V at the carrier frequency into a single turn 25 mm loop 25 mm or more from the case			
RMS Jitter	Carrier freq.	RMS Jitter Bandwidth		
	1 GHz	1 Hz-10 MHz	450 fs typ.	
	155 MHz	100 Hz-1.5 MHz	58 fs typ.	
	622 MHz	1 kHz-5 MHz	31 fs typ.	
	2.488 GHz	5 kHz-15 MHz	25 fs typ.	



Typical phase noise performance at 250 MHz, 500 MHz, 1 GHz, 2 GHz, 4 GHz and 6 GHz

## MODULATION

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### Modes

AM, FM, phase modulation – (Option 001)

Pulse modulation – (Option 004)

	AM1	AM2	FM1	FM2	PM1	PM2	Pulse
AM1		✓	✓	✓	✓	✓	✓
AM2	✓		✓	✓	✓	✓	✓
FM1	✓	✓		✓	✗	✗	✓
FM2	✓	✓	✓		✗	✗	✓
PM1	✓	✓	✗	✗		✓	✓
PM2	✓	✓	✗	✗	✓		✓
Pulse	✓	✓	✓	✓	✓	✓	

Allowable combinations:

Up to two simultaneous AM and or

Up to two simultaneous FM or ØM

A maximum of four modulation channels are available using any combination of four internal modulation oscillators and two external sources

All the above available with pulse modulation

Range	N
100 kHz - <30 MHz	1
30.0 - <46.875 MHz	1/64
46.875 - <93.75 MHz	1/32
93.75 - <187.5 MHz	1/16
187.5 - <375 MHz	1/8
375 - <750 MHz	¼
750 MHz - <1.5 GHz	½
1.5 - <3 GHz	1
3 - 6 GHz	2

### FREQUENCY MODULATION – (OPTION 001)

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Deviation	N x 10 MHz
Resolution	1 Hz
Accuracy	±3 % of set deviation (1 kHz mod rate)
Total Harmonic Distortion	<0.15% (at 1 kHz mod rate and 2% max deviation) <0.5% (at 1 kHz mod rate and 20% max deviation)
Frequency response (3 dB)	DC to 10 MHz

## PHASE MODULATION – (OPTION 001)

Deviation	$N \times 100 \text{ rad}$
Resolution	0.01 rad
Accuracy	$\pm 3\%$ of set deviation (1 kHz mod rate)
Total Harmonic Distortion	<0.1% (at 1 kHz mod rate and 1 rad deviation) <0.5% (at 1 kHz mod rate and 10 rad deviation)
Frequency response (1 dB)	100 Hz – 10 kHz

## AMPLITUDE MODULATION –UP TO 2 GHZ – (OPTION 001)

Depth	0 - 99.9%
Resolution	0.1%
Accuracy	+3% of set depth +1%
Total Harmonic Distortion	(1 kHz mod rate, carrier frequency below 3 GHz) <1% for depths <30% <2% for depths <80%
Frequency Response (1 dB)	DC to 10 MHz

## INTERNAL MODULATION GENERATOR

Four internal modulation sources.

Waveforms	Sine, 0 – 10 MHz Triangle, 0 - 1 MHz Square, 0 - 1 MHz +ve and -ve Ramp, 0 - 1 MHz
Resolution	0.01 Hz
Accuracy	As reference frequency oscillator
Total Harmonic Distortion	<0.1%
Frequency Response (1 dB)	DC to 10 MHz

### External modulation

Two external modulation inputs of >100 k $\Omega$  or 600  $\Omega$  (selectable)

Both inputs may be configured as AC or DC coupled

The modulation is calibrated for 1 V RMS or 1 V peak (selectable)

### Sweep Facility

Provides a digital sweep of carrier frequency, RF level and modulation source in discrete steps

Control of start, stop, number of steps and step time

Sweep can be externally triggered from a rear panel BNC connector (TTL) for Start, Start/Stop and Step

Modes	Continuous; single; externally triggered
Carrier Sweep Type	Linear sweep
RF Level Step Size	0.01 dB minimum
Maximum Number of Steps	65536
Marker "event" Output	A TTL pulse will appear on the sweep marker output when specified parameter values have been reached. Up to 6 markers can be set.
Step Time Settings	100 $\mu\text{s}$ to 10 $\mu\text{s}$

### List Mode Sweep Facility

Provides a table of carrier frequency and RF level values.

Start address, stop address and dwell time can be controlled.

Can be externally triggered from a rear panel BNC connector (TTL).

List can run with modulation applied, but can not be changed during playing of list.

Dwell Time Settings	100 us to 10 s
List Size	Up to 5000 entries

### REFERENCE FREQUENCY OSCILLATOR

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Type	OCXO
Frequency	10 MHz
Temperature Stability	As per current OCXO
Ageing Rate	As per current OCXO

### Memory Stores

Up to 500 full instrument setting stores

Up to 500 carrier frequency only stores

Storage medium must be removable from the instrument without removing the external covers

No settings data is stored in any other memory location within the instrument

Each memory store can be given a unique name

#### Removable Hard Disk – (Option 005)

Removable disk which also contains all the user memory stores

### GENERAL DATA

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Remote Control	
Systems	GPiB (IEEE 488) Ethernet (TCP/IP) LXI class C compliant
Command set	SCPI
Interface functions	SH1; AH1; T6; L4; SR1; RL1; PPO; DC1; DT1; CO; E2
Emulation	Aeroflex 2023A Series and 2030/40 Series
Recommended Calibration Cycle	24 months
Weight	<12 kg
Dimensions - H x W x D	4U x 222 mm x 490 mm

Instrument includes side strap handles and front tilt feet.

Instrument includes interlocking mechanism with modules mounted above and below, and to another SGA on either side

## FRONT PANEL CONNECTORS

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## REAR PANEL CONNECTORS

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RF Output	50 $\Omega$ N-type (option 007)
External Modulation Inputs	100 k $\Omega$ / 600 $\Omega$ (option 007) Damage levels: $\pm 5$ V
Pulse Modulation Input	50 $\Omega$ BNC – TTL and CMOS compatible
2 x USB 2.0	Used with a memory stick for transferring memory stores, ARB waveforms or other files in or out of the instrument Module plug & play connection
Sweep out	BNC – Generates 0 – 10 V when the generator is sweeping.
Event Markers	BNC - User selectable markers for frequency or level provide an indication when the specified parameter values have been reached. Output 0 V to +5 V from 600 $\Omega$ Damage levels: -5 V/+10 V
Trigger	BNC – Applying 0 V or a switch closure starts the sweep or steps from point to point on the sweep. Socket is pulled up to +5 V via a 10 k $\Omega$ pull-up resistor Damage levels: -5 V/+10 V
Reference Frequency Input	50 $\Omega$ BNC to accept 1, 5 and 10 MHz at 200 mV to 2 V RMS into 1 k $\Omega$ Damage levels: -0.5 V/+3 V
Reference Frequency Output	BNC – 10 MHz at 2 V pk-pk into 50 $\Omega$ Damage levels: -0.5 V/+6 V
LF Output	5.6 $\Omega$ BNC – The output may be configured to give an output from the internal modulation oscillator or from the internal modulation paths
GPIB Interface	As described under Remote Control
LAN Interface	As described under Remote Control

## ENVIRONMENTAL

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<b>Rated Range of Use</b>	
Temperature	0 to 50C
Humidity	Up to 93% at 40C
Altitude	Up to 3050 m
<b>Conditions of Storage and Transport</b>	
Temperature	-40 to +71C
Humidity	Up to 95% at 40C
Altitude	Up to 4600 m
EMC	EN 61326-1:2006, Emissions Class B, Immunity Table 1 – Performance Criteria B
Safety	EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control and laboratory use-Part 1, General requirements.
Mechanical	MIL-PRF-28800F Class 3
<b>Power Requirements</b>	
AC Supply	100 – 240 V ~ (Limit 90 - 264 V) 50 - 60 Hz ~ (Limit 45 - 66 Hz) VA max. TBA

## USER INTERFACE

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Screen Size	8.5 inch, 16:9 aspect ratio, colour touch screen
Keys/Switches	Power on/standby Home key

## SUPPORTING SOFTWARE

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IVI Drivers	Download from aeroflex.com
Calibration Software	Download from aeroflex.com
Re-alignment Software	In service manual
	Supports Remote Desktop, VNC and Webserver

## **ORDERING INFORMATION/PRODUCT STRUCTURE**

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SGA-3	100 kHz to 3 GHz analog signal generator
SGA-6	100 kHz to 6 GHz analog signal generator
Option 001	AM, FM and phase modulation
Option 002	Reverse power protection (SGA-3 only)
Option 003	High power (+20 dBm)
Option 004	Fast pulse modulation
Option 005	Removable hard disk
Option 007	Rear panel connectors

### **Extended Warranty Options**

Option 203	3 year warranty
Option 204	4 year warranty
Option 205	5 year warranty

### **Supplied Accessories**

AC supply lead  
Getting started manual  
CD-ROM containing operating manual  
CD-ROM containing factory test results

### **Optional Accessories**

47000/068	Operating manual (paper format)
46880/124	Service manual supporting repair to module level (includes semi-automatic adjustment software)
43129/189	1.5 m GPIB lead
46662/836	Soft carry case
46662/835	Hard transit case
TBA	Single instrument rack mounting kit (front panel brackets)
TBA	Double instrument rack mounting kit (front panel brackets)
43139/042	RF double screened connector cable 50 $\Omega$ , 1.5 m, BNC (m)
54311/095	RF double screened connector cable 50 $\Omega$ , 1 m, type N connectors
54311/092	Coaxial adapter N male to BNC female
59999/163	Precision coaxial adapter N male to SMA female

### **Complementary Modules (see separate datasheets)**

SCO-6	10 MHz - 6 GHz Combiner module
SPA-6	10 MHz - 6 GHz Power amplifier module



For the very latest specifications visit [www.aeroflex.com](http://www.aeroflex.com)

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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.