S-Series

SVA Vector Signal Analyzer

AEROFLEX
A passion for performance.

Compact, easy to use, vector analyzer for R&D, manufacturing and the field

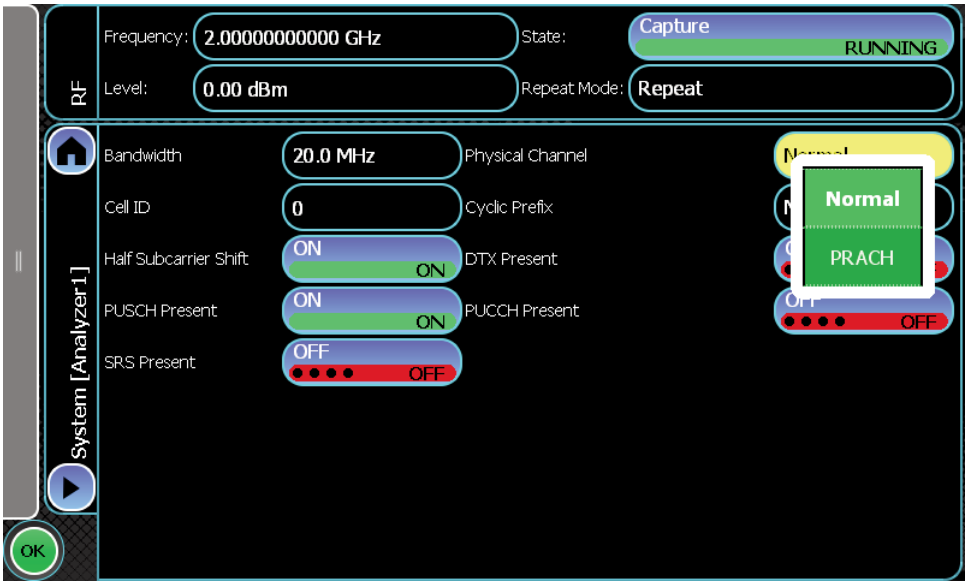
- Wide band cover: SVA-6 - 250 kHz to 6 GHz
  SVA-13 - 250 kHz to 13 GHz
- Input level range to +30 dBm
- Maximum instantaneous bandwidth: 90 MHz
- Digitizer ADC resolution: 13 bits
- Digital downconverter with sample rates up to 250 MS/s
- List mode for fast frequency and level settling time: <250 µs
- Displayed Average Noise Level: typ. -148 dBm/Hz
- Spurious free dynamic range: 75 dB
- Intermodulation free dynamic range: 75 dB
- Up to 512 MByte sample memory
- Real-time streaming output of sample data
- Generic modulation analysis and spectrum analysis as standard
- Measurement suite options for wireless communications test
- Half-rack width, 4U high with 8.5 inch touch screen user-interface
- Synchronization and interaction with SGD signal generator and other S-Series modules
- "Aerolock" interlocking mechanism for multiple instrument applications
- USB, LAN and GPIB remote control
- Low cost of ownership through modular design

The SVA employs a large touch-screen user-interface to provide a vector analyzer with unparalleled ease-of-use. The small form-factor and light weight ensure minimum footprint on the bench or test system and maximum portability. The SVA converts RF signals into digital IF or I&Q sampled data providing vector signal analysis of RF signals with functionality and performance required in the laboratory or the manufacturing test system. With high linearity, low noise and excellent level accuracy, the SVA is ideally suited for the analysis of WLAN, WMAN, WPAN, 2G, 3G, 4G cellular radio signals as well as general purpose analog and digitally modulated signal analysis. A spectrum analyzer mode provides the features and controls you would expect from a conventional spectrum analyzer.

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 intuitive, 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.



Using the touch-screen to set up LTE FDD uplink measurement

Performance Highlights

Level Range: Peak signal powers up +30 dBm can be input directly and with a maximum sensitivity down to typically -148 dBm/Hz, very low level signals are easily discernible from noise, especially useful when measuring transmitter spurious outputs.

Control of RF input level is provided using reliable, high speed electronic switched attenuation. To optimize downconverter operating conditions, RF attenuation is selectable in 1 dB steps to a maximum of 31 dB. IF attenuation is automatically selected in a 35 dB range with 1 dB resolution in order to optimize the ADC operating point thus optimizing of dynamic range for a wide range of input signal powers and signal characteristics.

Level Accuracy: With a total measurement uncertainty of typically ±0.3 dB below 3 GHz, accurate RF power measurements are made possible. Together with <0.08 dB repeatability error, high production yields can be maintained.

High Dynamic Range: The SVA is designed for difficult transmitter measurements such as burst power in TDD and TDMA systems and spectral emissions on cellular terminals. Measurement of GSM burst power ramps with over 80 dB dynamic range is possible in a single step. ACLR and spectral mask measurements on WCDMA signals can also be made in a single step with a measurement range of typically 68 dB for ACLR.

Wide Bandwidth: -1 dB bandwidth of up to 90 MHz is achieved.

Amplitude and phase correction can be applied to provide amplitude flatness of ±0.1 dB over a 5 MHz bandwidth and ±0.25 dB flatness for bandwidths up to 67 MHz. Phase compensation ensures phase flatness of <±0.03 radians across the entire corrected bandwidth.

Low Phase Noise: At 2 GHz, 20 kHz offset, the typical phase noise is -116 dBc/Hz. Noise floor at 2 GHz is typically -138 dBc/Hz at 10 MHz offset.

Fast Switching: Below 6 GHz, frequency settling can be achieved in typically 250 μs, making the SVA ideal for high productivity RFIC testing.

Flexible ADC: Sample data is available as digital IF samples at the full ADC sample rate or as digitally downconverted, decimated and re-sampled I & Q data samples at a user defined rate. Sample data may be streamed out of the rear panel data interface. Samples rates of up to 62.5 MSa/s can be supported for streaming applications e.g. in radio system emulation type applications or for producing uninterrupted time records for RF events. On board sample memory supports acquisition of up to 256 M x 16 bit samples. The ability to commence processing of captured IQ whilst acquisition is still in progress provides near real time measurement speed.

Data reduction is supported whereby the user can select a subset of acquired data to be passed for processing. This reduces unnecessary data transmission and can help improve measurement speed. This can be especially useful for TDMA type systems such as GSM. It makes it possible to only transfer active burst data for analysis reducing the number of samples to transfer by approximately 80%.

Data acquisition can be edge triggered and the sample length defined by the user or it may be gated in which case the acquisition period is defined by the gate width.

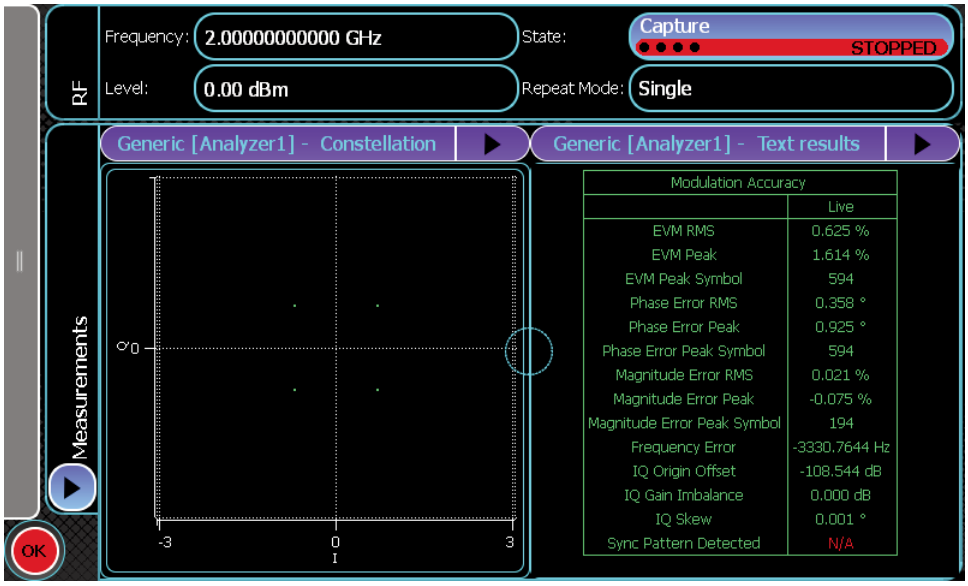
Triggering and Synchronization: The SVA's highly versatile acquisition trigger modes maximize flexibility in synchronized measurement applications. Acquisition can be triggered by software or hardware triggers including the rear panel TTL and digital inputs. Internal IF video and frequency selective IQ level triggering can be derived from the received signal with facilities to prevent false triggering from noisy signals. All trigger modes are supported by a user definable +ve and -ve trigger delay.

A trigger hold off mode is provided to allow control of trigger re-arming. This can be especially useful when acquiring TDD type signals as used in WLAN and WIMAX.

List Mode: This feature enables the digitizer to be pre-loaded with up to 128 combinations of different frequency and level settings. All digitizer internal hardware settings are pre-calculated making re-selection of a new frequency possible in typically 250 μs. This feature is ideally suited for fast mobile phone transmitter alignment applications and is complemented by similar features in the SGD Digital RF Signal Generator in support of the corresponding fast mobile phone receiver alignment. Channelized timer mode allows setting of variable list dwell period (in output samples).

Measurement Personality Highlights

As standard the SVA is supplied with generic demodulation capability for FSK, PSK, QAM and analog (AM/FM) demodulation.



Generic QPSK demodulation- Constellation and text results

Also included as standard is a spectrum analysis function providing frequency and time domain analysis of digitized I & Q data. Analysis can be performed for frequency spans up to 200 MHz. The resolution bandwidth is continuously variable from 1 Hz to 10 MHz using 3 dB or noise equivalent bandwidth windows.

The range of spectrum measurement functions include:

Channel Power and Adjacent Channel Power Measurement: The user defines the channel configuration to be measured (i.e. channel width, channel spacing, center frequency, etc). The measurement then computes the central channel RMS power as an absolute and the adjacent channel powers relative to this from the FFT spectrum. Four adjacent channels are examined (two either side of the central channel). In manual mode up to 99 channels can be specified each with arbitrary channel spacing and channel width.

Occupied Bandwidth is calculated from the FFT spectrum by a function that returns the bandwidth in which a user defined percentage of the total signal power is occupied.

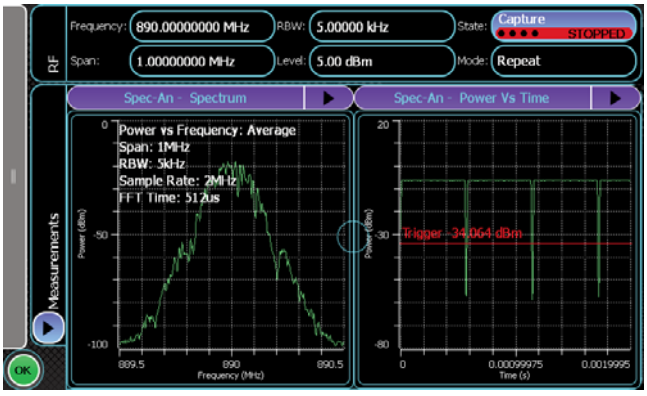
FFT spectrum can be configured as either RMS averaged or peak hold in which case the function will output an averaged result or retain peak values if repeatedly called. The number of averages is user defined.

A marker power function is provided together with a marker peak find and a next peak search function. These enable measurement of discrete signals within the FFT spectrum.

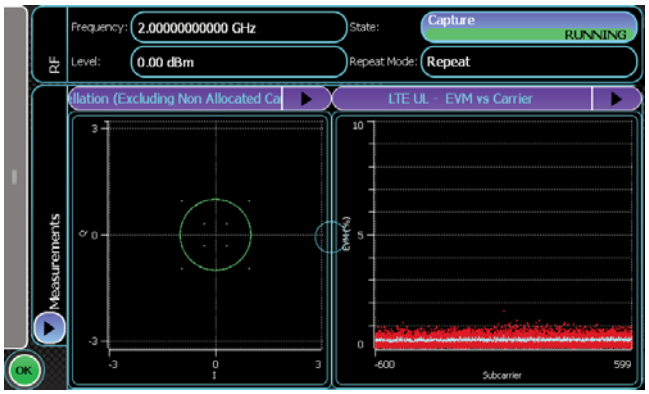
Time domain analysis functions include computation of average power of a range of IQ data samples plus power and frequency versus time. The time window for analysis can be the entire IQ sample array or any user defined subset.

Optional Analysis Libraries

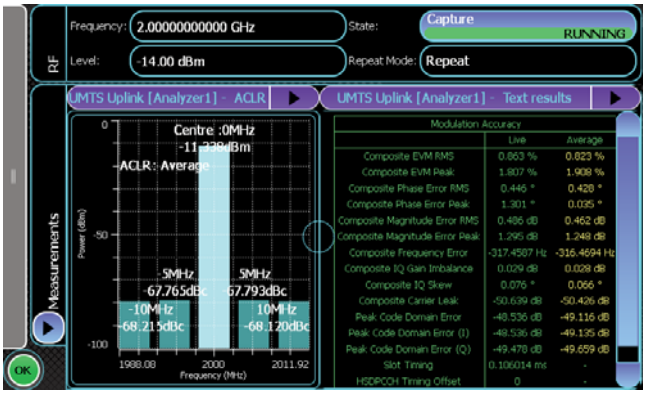
Signal analysis libraries are available for measurement of most 2G, 3G, 4G, WMAN, WPAN, WLAN and LTE transmissions. These provide measurement of power, modulation quality and spectrum parameters in accordance with the relevant standards for mobile terminal testing, ideal for both laboratory and production use.



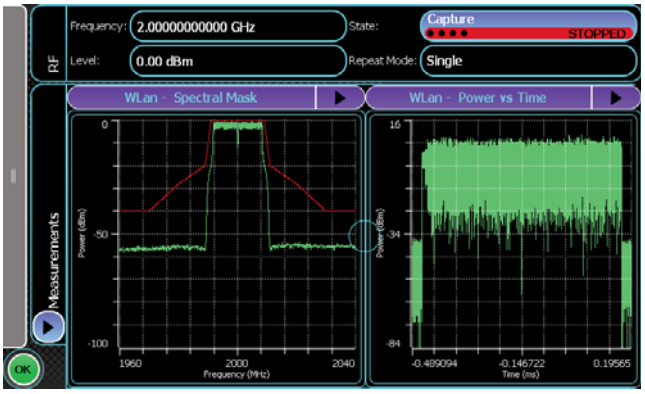
GSM, 8 slots, FFT and Power vs. Time



LTE FDD UL Constellation and EVM vs. Carrier



UMTS UL ACLR and text results



WLAN Spectral Mask and Power vs. Time

A full description and specification for each measurement personality is provided in a separate datasheet.

Modular instrument concept employing Aeroflex's "Aerolock" interlocking mechanism

The SVA is complemented by the SGD Digital RF Signal Generator and the two instruments are designed to work as a pair. The two instruments may be connected physically, using the "Aerolock" interlocking mechanism, and electrically via a USB interface. It is then possible to control the two units as a test system, with the settings of both instruments controlled via a common user-interface. Such a test system may be further enhanced with the addition of one or more of a selection of S-Series modules which mount above or below instruments. "Aerolock" is an ingenious, simple and strong interlocking mechanism allowing S-Series 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 S-Series instruments joined together may be easily carried within the laboratory, the factory or the field without necessitating a 2-person lift.

Aerolock™ interlocking mechanism

An SGD and SVA joined together as one

Remote Operation

The SVA supports remote control via USB, LAN and GPIB interfaces using SCPI format commands where possible. Remote desktop and VNC are also supported allowing off-site remote control.

Non-Volatile Memory

Full instrument stores 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 and captured data in the event the instrument is required to leave the secure area.

Low Cost of Ownership

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

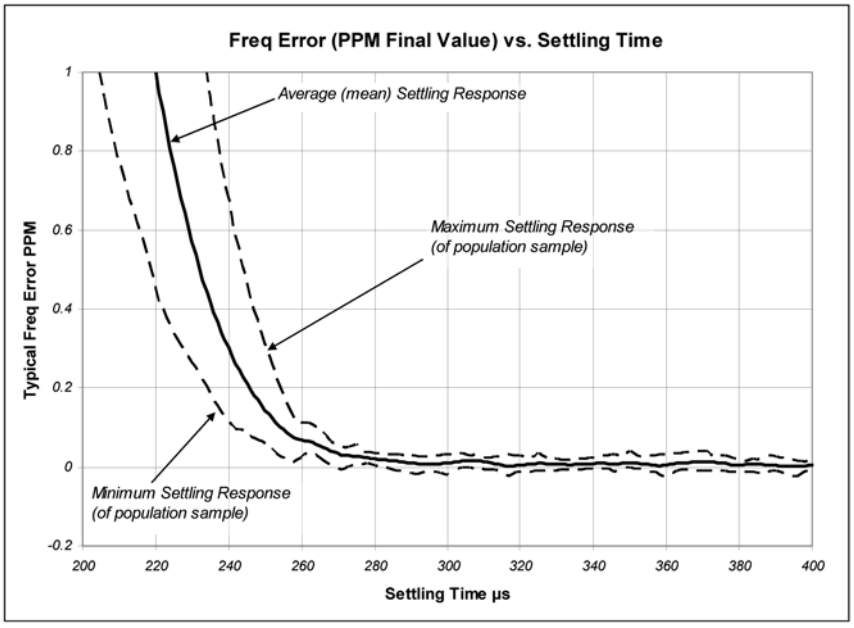
The SVA's modular architecture means that repair can be effected in 30 minutes by replacement using calibrated exchange modules.

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.

Frequency

<table>
<tr><td>Range</td><td>250 kHz to 6 GHz (SVA-6)
250 kHz to 13 GHz (SVA-13)</td></tr>
<tr><td>Resolution</td><td>≤3 GHz, 1 Hz</td></tr>
<tr><td></td><td>≤6 GHz, 2 Hz</td></tr>
<tr><td></td><td>≤9 GHz, 3 Hz</td></tr>
<tr><td></td><td>>9 GHz, 6 Hz</td></tr>
<tr><td>Accuracy</td><td>As frequency reference</td></tr>
<tr><td>Settling Time</td><td>Typical times taken to be settled at final frequency
Up to 3 GHz settled to 0.7 ppm or 1 kHz whichever is the smaller
>3 GHz, ≤6 GHz settled to 2 kHz
>6 GHz, ≤9 GHz settled to 3 kHz
>9 GHz settled to 6 kHz
<table>
<tr><td>Loop bandwidth</td><td><500 MHz</td><td>>500 MHz</td></tr>
<tr><td>Normal</td><td>2 ms</td><td>325 µs</td></tr>
<tr><td>Narrow</td><td colspan="2">10 ms</td></tr>
</table>
</td></tr>
</table>



Typical frequency settling times

Response is a composite of 10 devices at different settling frequencies. Freq error direction has been adjusted where necessary to display a positive response.

Level

Maximum Input Power	*+30 dBm with 10 dB input attenuation*	
RF Input Attenuator	*0 to 31 dB in 1 dB steps*	
IF Attenuator	*0 to 35 dB in 1 dB steps*	
Accuracy at 23C ±5C	*<500 MHz*	*<±1.0 dB (typ ±0.5 dB)*
	≥500 MHz, ≤3 GHz	*<±0.7 dB (typ ±0.3 dB)*
	>3 GHz, ≤6 GHz	*<±1.0 dB*
	>6 GHz	*<±2.0 dB*
	Temperature stability	*±0.02 dB/°C, ≤6 GHz*
		±0.06 dB/°C, > 6 GHz
Repeatability	*≤6 GHz, better than ±0.08 dB* *>6 GHz, better than ±0.15 dB* *after warm up following a return from a change of frequency or level valid for at least 2 hours and excluding temperature influence*	
Settling Time *(List Mode)*	*≤3 GHz*	*<±0.3 dB, 250 µs*
	>3 GHz, ≤6 GHz	*<±0.5 dB, 250 µs*
	>6 GHz	*<±0.5 dB, 750 µs*
Input Impedance	*50 Ω nominal*	
Input VSWR *(Return Loss)*	*≤6 GHz*	*<1.4:1 (16 dB)*
	>6 GHz, ≤10.5 GHz	*<1.5:1 (14 dB)*
	>10.5 GHz	*<1.95:1 (10 dB)*

List Mode

Channel Parameters	*Frequency* *Level (defined as input level or as RF and IF attenuator settings)* *Dwell period (in output samples)*
List Addresses	*128 (numbered 0 to 127)*
Settling Time	*See frequency data*
Address Sources	*Manual (software commanded)* *External (hardware triggered)* *Internal (counter timer)*
External Mode Trigger Sources	*Digital input, TTL+ve, TTL-ve*
Counter Mode (internal)	*Time mode (common to all channels): dwell time 250 µs to 10 s with resolution of 0.1 µs* *Sample mode (channelized): up to 232 output samples*

Spectral Purity

SSB Phase Noise (typical dBc/Hz ambient room temperature):

Fc	*2 GHz*		*5 GHz*	*12 GHz*
	Loop Bandwidth			
Offset	*Narrow*	*Wide*	*Narrow*	
100 Hz	*-55*	*-85*		
1 kHz	*-85*	*-103*		
10 kHz	*-114*	*-103*		
20 kHz	*-116*	*-110*	*-108*	*-100*
100 kHz	*-133*	*-130*		
1 MHz	*-136*	*-136*		
10 MHz	*-138*	*-138*		

Linearity and Noise

<table>
<tr><td>Third Order Intermodulation</td><td>≥30 MHz, <6 GHz -75 dBc typ.
(2 CW tones at up to 0 dBm per tone, 500 to 5000 kHz spacing, manual mode)</td></tr>
<tr><td>Adjacent Channel Leakage Ratio
(in any 3GPP band below 3 GHz)</td><td>Better than 60 dB (3GPP downlink test model 1)
Better than 65 dB typ, (3GPP uplink)</td></tr>
<tr><td>Spurious
(excluding IF image frequencies and harmonic responses)</td><td>-70 dBc typ.
(within the analysis bandwidth at the digitizer reference level)</td></tr>
<tr><td>Harmonic Distortion</td><td>
<table>
<tr><th>Incident Power</th><th>Incident Frequency</th><th>2nd Harmonic (dBc typ.)</th></tr>
<tr><td>0dBm</td><td>850 MHz
1900 MHz
2500 MHz
5000 MHz
6500 MHz</td><td>-78
-88
-65
-72
-70</td></tr>
<tr><td>-5dBm</td><td>850 MHz
1900 MHz
2500 MHz
5000 MHz
6500 MHz</td><td>-83
-95
-72
-76
-75</td></tr>
<tr><td>-10dBm</td><td>850 MHz
1900 MHz
2500 MHz
5000 MHz
6500 MHz</td><td>-90
-100
-79
-82
-78</td></tr>
</table>
</td></tr>
<tr><td>Residual Responses
(No signal input, RF input terminated in 50 Ω, minimum RF and IF attenuation)</td><td>≤6 GHz, better than -95 dBm, (typ. -100)
>6 GHz, better than -95 dBm typ.</td></tr>
<tr><td>Noise Spectral Density
(No signal input, RF input terminated in 50 Ω, minimum RF and IF attenuation)</td><td><500 MHz <-135 dBm/Hz (typ -148)
≥500 MHz, ≤5.8125 GHz <-140 dBm/Hz (typ -147)
>5.8125 GHz <-137 dBm/Hz (typ -147)</td></tr>
</table>

A/D Conversion

Resolution	*13 bits*
ADC Clock	*250 MHz*
Sample Rate Control, IQ Data	*15.3 kSa/s to 250 MSa/a*
Resolution	*0.1 Hz when the sample rate is entered as a real number* *Sample rate can be entered as a fraction made up of integers*
Sample Rate Accuracy	*As per frequency standard*
Amplitude Flatness (correction on)	See table below
Phase Flatness	*< 500 MHz ±0.03 radians pk-pk to 15 MHz* *≤1 GHz ±0.03 radians pk-pk to 36 MHz* *>1 GHz ±0.03 radians pk-pk to 67 MHz*
Data Output	*A sample data block (equal to the data capture length) can be stored to the memory internal to the SVA* *IF data samples have 16 bit resolution* *IQ data samples can be 16 or 32 bit resolution*
Sample Memory	*256 M x 16 bit samples*

Amplitude Flatness (correction on)

Operating Frequency	*IF Bandwidth (MHz)*			
	<±0.1 dB Flatness	*<±0.25 dB Flatness*	*<±0.65 dB Flatness*	*<±1.0 dB typ. Flatness*
All	*5*			
<500 MHz		*15*		*20*
≤1 GHz		*33*		*36*
>1 GHz			*67*	*90*

Triggering

Trigger Mode	*Single, Repeat*
Trigger Type	*Edge, Gated, None (software triggered)*
Hardware Trigger Sources	*Internal IF or IQ, data (with user-defined level threshold) and timer* *External TTL*
Trigger Polarity	*+ve or –ve (Edge trigger)* *Gate high, Gate low (Gated trigger)*
Trigger Functions	
Pre-trigger	*0 to sample length*
Delayed trigger	*0 to +2 GSa*
Trigger Latency	*0 to 1 sample at the output sample rate*
Trigger Hold Off	*Min trigger hold-off: 0 (default)* *Max trigger hold-off: 65536 µs in 1 µs steps*

Spectrum Analyzer Mode

Frequency Span	*Variable between 2 kHz to 200 MHz and zero span*
Resolution	*1 Hz*
RBW	*Variable between 1 Hz to 10 MHz*
Resolution	*1 Hz*
Window Type	*NEBW: Gaussian 3 dB: Gaussian fixed: Blackman Harris 5 term*
Sample Time	*Up to 333 seconds*
Resolution	*1 ns*
Channel Power and Adjacent Channel Power Measurement	*2 upper and 2 lower or user defined up to 99*
Channel filter alpha	*0.0 to 1.0*
Channel spacing	*up to 15 MHz*
Channel width	*up to 25 MHz*
Occupied Bandwidth Percentage Range	*1% to 99.99%*
N Peaks	*Frequency and power output for up to 10 signal peaks sorted in order of descending power*
Average Power	*The RMS average power for all IQ samples*
Markers	*4 markers plus delta marker*
Marker Functions	*Marker power & frequency with peak search, next peak, peak track* *Power and time* *Frequency and time*
Traces	*Live, avg, max. hold* *Spectrum trace, power versus time trace, frequency versus time trace* *Text results summary*

Reference Frequency Oscillator

Type	*OCXO*
Frequency	*10 MHz*
Temperature stability (0 to 50C)	*$< \pm 1 \times 10^{-8}$ typ.*
Ageing rate	*<1 in 10^{9} per day (<0.001 ppm)* *<1 in 10^{7} per year (<0.1 ppm)*

Memory (80 GB Hard Disk)

Up to 500 full instrument setting stores

Each memory store may be given a unique name

Captured IQ data may be saved to the hard disk

Removable Hard Disk – (Option 005)

For use in secure areas, the removable hard disk may be extracted from the rear panel by releasing two screws.

The removable hard disk also contains the instrument's operating software.

General Data

Remote Control

Systems	*GPIB (IEEE 488)* *Ethernet (TCP/IP)*
Command set	*SCPI*
Interface functions	*SH1; AH1; T6; L4; SR1; RL1; PP0; DC1; DT1; C0; E2*

Recommended Calibration Cycle

24 months

Weight

<8 kg

Dimensions - H x W x D

195 mm (178 mm without feet - 4U) x 222 mm x 490 mm

Instrument includes side strap handle and front tilt feet.

Instrument includes Aerolock™ interlocking mechanism with modules mounted above and below, and to another S-Series instrument on either side.

Front Panel Connectors

RF Input	*50 Ω N-type*
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* *Mouse or keyboard input*

Rear Panel Connectors

RF Input	*50 Ω N-type (option 007)*
TTL Trigger	*BNC – LVTTL logic input thresholds.* *Damage levels: -5 / +10 V*
Digital IO	*IF or IQ 16 bit LVDS data via Aurora interface (Infiniband connector)*
4 x USB 2.0	*Used with a memory stick for transferring memory stores, captured IQ data or other files in or out of the instrument* *Module plug & play connection*
Reference frequency input	*50 Ω BNC accepts 10 MHz at 200 mV to 2 V RMS into 50 Ω or 100 kΩ nominal* *Damage levels: -0.5 / +3 V*
Reference frequency output	*BNC – 10 MHz at 2 V pk-pk nominal square wave into 50 Ω* *Damage levels: -0.5 / +3 V*
GPIB Interface	*As described under Remote Control*
LAN Interface	*As described under Remote Control*

Environmental

Rated range of use	
Temperature	*0 to 50C*
Humidity	*Up to 93% at 40C*
Altitude	*Up to 3050 m*
Conditions of storage and transport	
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*

Power Requirements

AC Supply	*100 – 240 V ~ (Limit 90 - 264 V)* *50 - 60 Hz ~ (Limit 45 - 66 Hz)* *110 VA max.*

User Interface

Screen size	*8.5 inch, 16:9 aspect ratio, colour touch screen*
Keys / switches	*Power on / standby* *Home key*

ORDERING INFORMATION

SVA-6	250 kHz to 6 GHz RF Digitizer and Vector Analyzer
SVA-13	250 kHz to 13 GHz RF Digitizer and Vector Analyzer
Option 005	Removable Storage Disk
Option 007	Rear panel connectors

Spectrum Analysis and Generic Demodulation measurement suites included.

Analysis options:

Option 150	Modulation analysis package- Basic (options 152, 102, 103, 104, 106, 109)
Option 151	Modulation analysis package- Advanced (options 150, 107, 108)
Option 152	3GPP (GSM, EDGE, EGPRS, EGPRS2, WCDMA, HSPA, HSPA+) Measurement suite
Option 102	3GPP2 (CDMA2000, 1xEVDO (0+A)) Measurement suite
Option 103	WLAN (a, b, g, n) Measurement suite
Option 106	Bluetooth V.11 + V.21 + EDR + Version 4 Measurement suite
Option 107	LTE FDD Rel. 8 Measurement suite
Option 108	LTE TDD Rel. 8 Measurement suite
Option 109	TD-SCDMA (3GPP TDD-LCR) Measurement suite

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/xxx	Operating manual (paper format)
46880/xxx	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
23448/030	USB Type A - Type B cable, 1.5 m
46884/xxx	LAN cable, 1.5 m
46884/xxx	LAN crossover cable, 1.5 m
46885/505	Single instrument rack mounting kit (front panel brackets)
46885/506	Double instrument rack mounting kit (front panel brackets)
43139/042	RF double screened connector cable 50 Ω, 1.5 m, BNC (m)
54311/095	RF double screened connector cable 50 Ω, 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 S-Series instruments and modules (see separate datasheets)

SGD-3/6	100 kHz - 3/6 GHz Digital RF Signal Generator
SCO-6	10 MHz - 6 GHz Combiner module
SPA-6	10 MHz - 6 GHz Power Amplifier module

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AEROFLEX
A passion for performance.

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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.

Part No. 46891/463, Issue 2 12/11