S-Series

SGD Fast, Low Noise, Digital Signal Generator

AEROFLEX
A passion for performance.

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

Features

- Wide band cover:
    - SGD-3 - 100 kHz to 3 GHz
    - SGD-6 - 100 kHz to 6 GHz
- +13 dBm output (+20 dBm option)
- 3GPP ACLR -70 dBc
- IQ modulator with 300 MHz RF bandwidth, 200 MHz with internal AWG
- Up to 250 MS/s dual channel arbitrary waveform generator with memory options up to 4 GBytes
- Embedded IQCreator® waveform creation and generic modulation tool
- Low SSB phase noise: −135 dBc/Hz at 1 GHz 20 kHz offset
- Noise floor >10 MHz offset, <-150 dBc/Hz at 1 GHz
- Fast frequency settling time: 100 µs
- List mode
- Internal pulse modulator/generator (option)
- Comprehensive frequency and amplitude sweep capabilities
- Phase coherent LO
- Half-rack width, 4U high with 8.5 inch touch-screen user-interface
- Synchronization and interaction with S-Series modules and instruments
- "Aerolock™ interlocking mechanism for multiple instrument applications
- LAN and GPIB remote control
- Low cost of ownership through modular design
- Carrier phase control

The SGD employs a large touch-screen user-interface to provide a digital signal generator 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 wide bandwidth IQ modulator exhibits excellent dynamic range enabling the most demanding amplifier and receiver selectivity measurements to be performed. 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 SGD excels in all respects. With a comprehensive range of features and options, the SGD meets the needs for a general-purpose signal generator while offering the high performance required of demanding, critical receiver measurements or rapid manufacturing.

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.
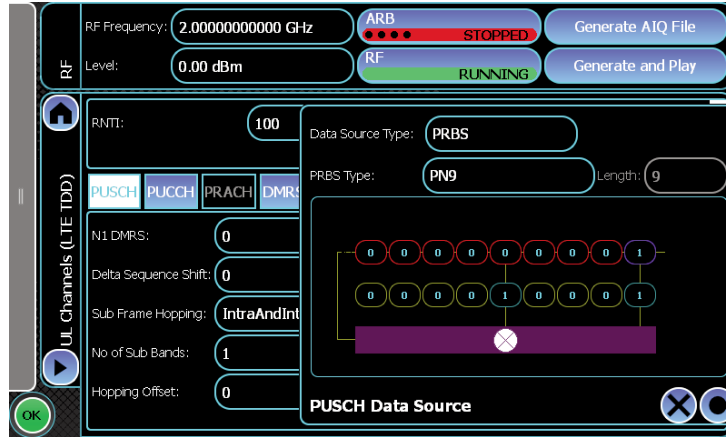
Using the touch-screen to define PUSCH data source in LTE FDD uplink signal

Vector Modulation

High quality wide bandwidth vector modulation is available with a maximum vector modulation bandwidth of 300 MHz at the RF output. With the internal dual channel arbitrary waveform generator fitted, an internal user initiated IQ calibration routine ensures carrier suppression of 55 dB and image suppression of 50 dB. In addition to this, a factory IQ filter coefficient calibration ensures that image rejection is maintained up to 80 MHz offset, ensuring 802.11ac 160 MHz EVM of <1.0% is achieved. The high dynamic range of the IQ modulators provides for an ACLR of -70 dBc on WCDMA signals.

Arbitrary Waveform Generator (AWG)

With sample rates up to 250 MHz per channel, high quality digital modulation is provided with I and Q bandwidths of up to ±100 MHz, ideal for testing multi-channel power amplifiers and support for all forthcoming wideband wireless systems. The AWG has up to 4 GBytes (1 Gsample) sample memory, each 32-bit sample word consisting of 14-bit I, 14-bit Q, and up to 8 markers. The AWG memory can be used to store multiple waveforms up to the limit of the sample memory. Once loaded in the AWG, switching between waveforms is near instantaneous.

The hard disk drive has up to 60 GB available to store AWG waveforms.

Embedded Waveform Creation Tool, IQCreator® (included with AWG option)

IQCreator® is a software utility that enables a user to set up a modulation scheme and then create an AWG file using modulation templates. The resulting file is downloaded into the AWG. All SGDs have generic modulation creation enabled which includes FM (RDS), FSK, MSK, PSK and up to 1024 QAM. Options to enable various wireless technologies are available including LTE FDD and TDD, and 802.11ac 160 MHz VHT.


SGD UMTS DL configuration

In the SGD, IQCreator® is supplied embedded and all functions are controllable from the user-interface. Waveforms designed in IQCreator® can include signal impairments and time markers to aid synchronization. Graphical displays of the waveform, FFT, vector, constellation, I and Q phase and amplitude vs. time etc. can be previewed before playing and exported for use in other Windows applications. The "Generate and Play" button provides an instant mechanism for generating and outputting waveforms on the fly.
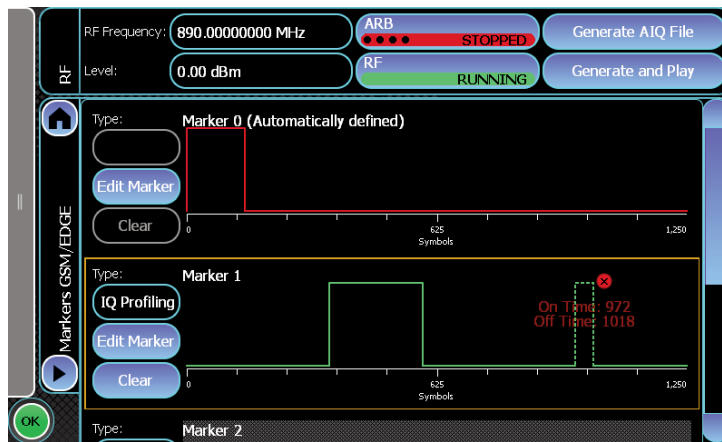
Using the touch-screen to add, move and adjust markers
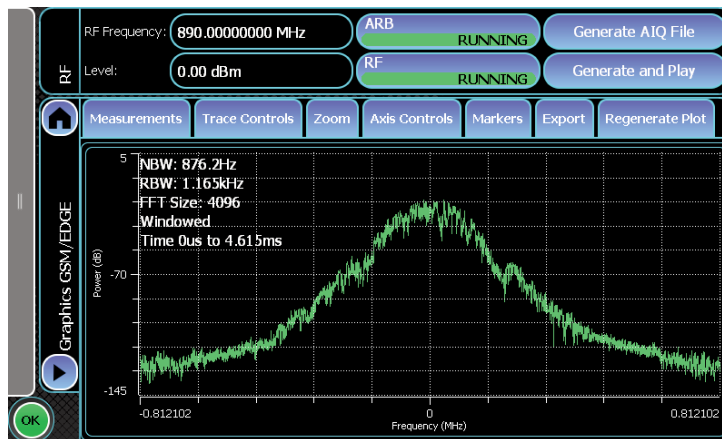
Graphical preview of GSM FFT

IQCreator® includes a utility which allows user-defined waveforms, created using simulation tools such as MATLAB, to be converted and packaged into a form that can be downloaded into the SGD's AWG.

IQCreator® is continually updated to include new modulation capabilities and facilities as standards are updated or new standards released.

IQCreator® is also available as a Windows based software tool in its traditional form for the creation of waveforms remote from the instrument. See separate IQ Creator® brochure for more details at www.aeroflex.com/IQCreator.

Excellent Spectral Purity

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

Low SSB Phase Noise

With SSB phase noise performance of -135 dBc/Hz at 20 kHz offset from a carrier of 1 GHz, the SGD signal generator 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 SGD the capability of measuring receiver signal-to-noise ratios as high as 80 dB.
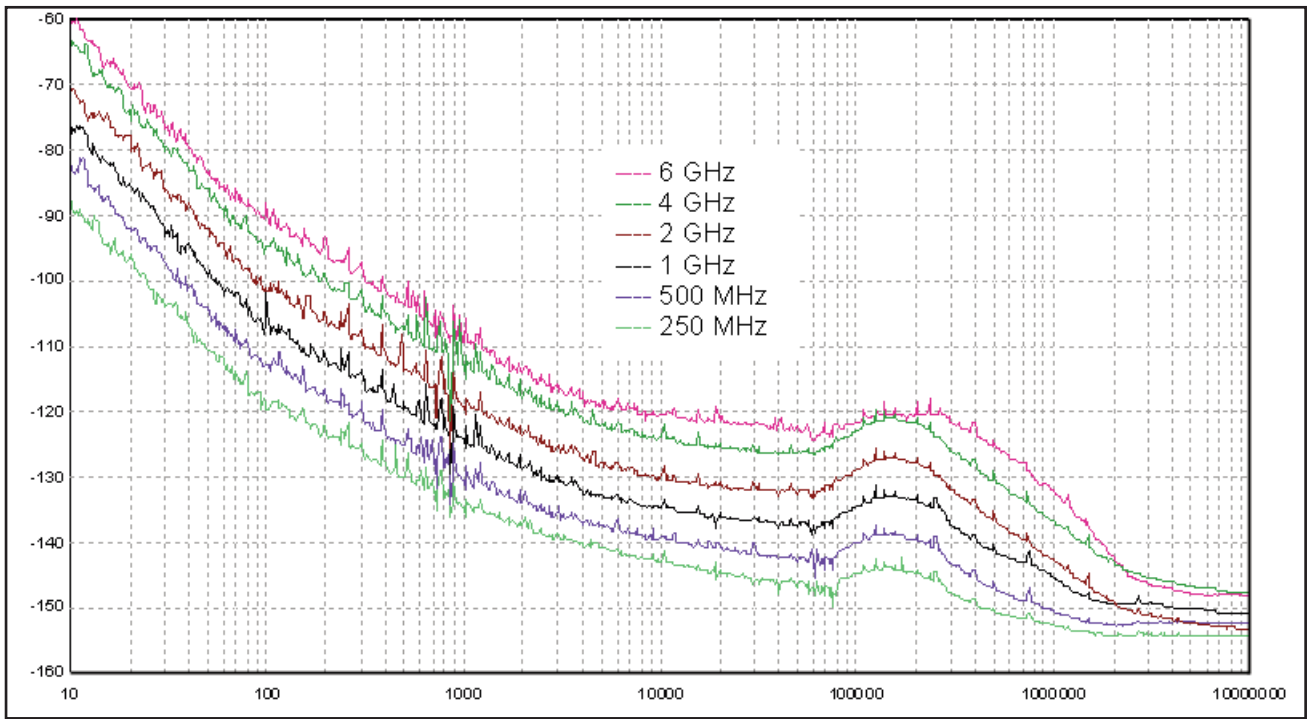
Graph of typical phase noise performance

Fast Frequency and Level Settling Times

These are critical parameters to ensure maximum throughput in production applications. With frequency settling times of 3 ms in conventional frequency selection mode, or 100 μs in list mode, the SGD is ideally suited for frequency hopping and semiconductor production test applications.

Carrier Phase Control

This controls the phase of the carrier with respect to reference frequency standard and allows multiple SGD to be locked in frequency with controlled phase.

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, particularly 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.

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.

List Mode Sweep

With a minimum dwell time of 100 μs, list mode provides the ultimate in frequency switching speed. A table of up to 1000 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, or internally using an AWG waveform marker.

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 SGD is complemented by the SVA Vector Signal Analyzer 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. 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.

The addition of an SCO Combiner module can create a multisource test system for intermodulation testing or receiver selectivity. With such a system it is possible to couple the settings of one SGD (or SGA) with another, allowing quick and simple control across any frequency or level range where two sources with a defined relationship are required.

"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 only 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.

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.
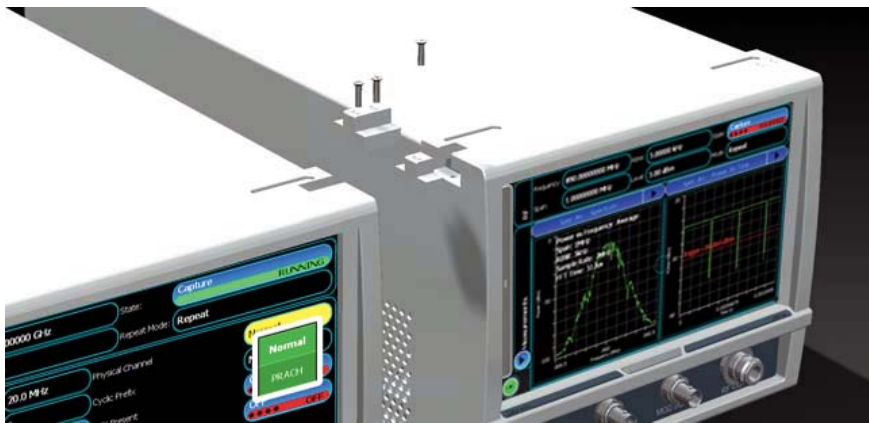
Aerolock™ interlocking mechanism

Two SGDs joined together as one with SCO combiner

Remote Operation

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

Hundreds of full instrument setting stores may be configured. Each store may be independently named allowing quick search of required memory.

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

Low Cost of Ownership

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

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

SPECIFICATION

All specifications apply after a warm-up period of 20 minutes. Parameters with measured performance are not warranted. They have been measured during the product's development to give an indication of expected performance.
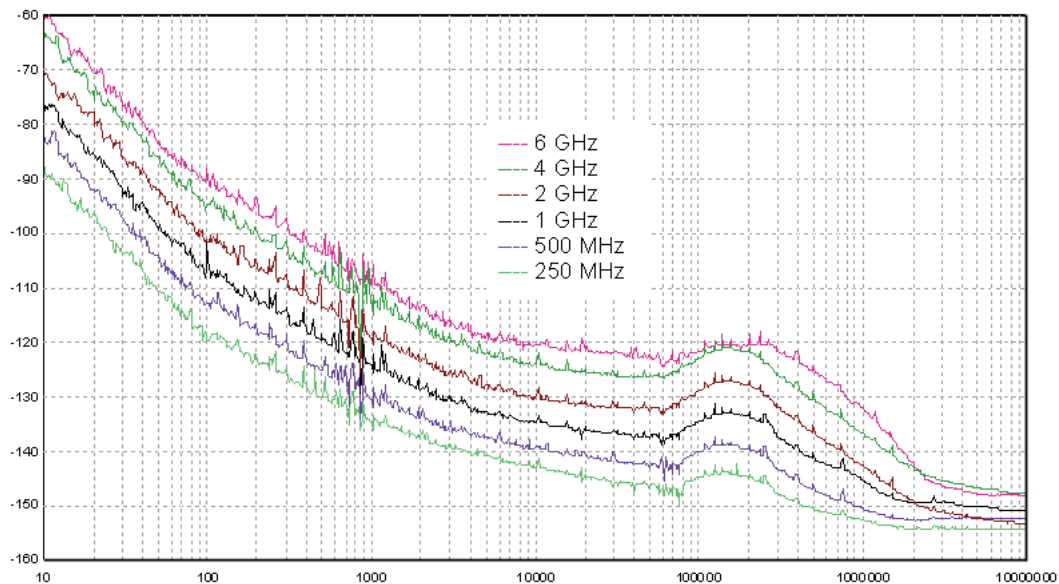
FREQUENCY

Range	100 kHz to 3 GHz (SGD-3)
	100 kHz to 6 GHz (SGD-6)
Resolution	0.01 Hz
Accuracy	As frequency reference
Settling Time (CW Mode)	Typical settling time to within 0.1 ppm of final frequency: 3 ms
Settling Time (List Mode)	Typical settling time to within 0.1 ppm of final frequency after trigger pulse in List Mode: <100 µs for frequency changes exceeding 1.6 GHz within the frequency range above 3.2 GHz: >101 µs
Carrier Phase	0 – 359.9 degrees in 0.01 degree steps. Carrier phase controls the phase of the carrier with respect to the reference frequency standard, be it internal or external.

RF LEVEL

Range	-130 to +13 dBm		
	Step attenuator: 0 to 132.5 dB in 0.25 dB steps		
	Note: Performance is not guaranteed below -120 dBm		
Range (option 003)	-130 to +20 dBm		
	-130 to +17 dBm below 50 MHz		
	-130 to +15 dBm below 10 MHz		
	-130 to +13 dBm below 1 MHz		
	Note: Performance is not guaranteed below -120 dBm		
Resolution	0.01 dB		
Accuracy (18°C-28°C)	100 kHz to 50 MHz	<±0.7 dB	
		<±1.0 dB below -110 dBm	
	>50 MHz to ≤3 GHz	<±0.5 dB	
		<±0.6 dB from -90 to -110 dBm	
		<±1.0 dB from -110.01 to -120 dBm	
	>3 GHz	<±0.7 dB	
		<±0.9 dB from -100.01 to -110 dBm	
		<±1.2 dB from -110.01 to -120 dBm	
	Temperature stability 0.01 dB/˚C above 1 MHz, 0.02 dB/˚C below 1 MHz (CW mode)		
	Add 0.2 dB for complex modulated signals		
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		
Monotonicity	Typically better than 0.05 dB (-30 dBm to +13 dBm or to +20 dBm with option 003). Better than 0.2 dB typ. at an RF level between +3.0 and +4.5 dBm and between +9.0 dBm and +10.5 dBm.		
Switching Time (18°C-28°C)	<100 µs to within 0.1 dB of final value after trigger pulse in List Mode. <150 µs when changing carrier frequency		
Output Impedance	50 Ω nominal		
Output VSWR		<+3.5 dBm	<+9.5 dBm
	>1 MHz - 3 GHz	<1.4:1	<1.5:1 typ.
		<+2.5 dBm	<+8.5 dBm
	>3 GHz	<1.6:1	<1.7:1 typ.
Reverse Power Damage Level	+25 dBm, ±16 V DC		
RF Level Offsets	Up to maximum output level range. 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		

SSB Phase Noise (CW Mode)	Carrier freq.	1 kHz	20 kHz	10 MHz
	100 MHz	-130	-140	-150 typ.
	250 MHz	-129	-140	-150 typ.
	500 MHz	-123	-136	-150 typ.
	1 GHz	-117	-130 (-135 typ)	-148 (-152 typ.)
	2 GHz	-111	-124	-148
	4 GHz	-105	-118	-140
	6 GHz	-101	-115	-135
	Phase noise below 100 Hz offset is dependent upon reference phase noise.			
Non-Harmonic Related Spurious (CW Mode)	At offsets >10 kHz:			
	≤1 GHz, better than -80 dBc			
	>1 GHz, better than -76 dBc			
	>2 GHz, better than -70 dBc			
	>5 GHz, better than -68 dBc			
	At carrier frequencies between 3.4 GHz and 4.0 GHz, spurious outputs between 2.3 GHz and 2.7 GHz are specified at better than -62 dBc.			
Sub-harmonics	<1.5 GHz, better than -80 dBc			
	<3 GHz, better than -75 dBc			
	<6 GHz, better than -40 dBc			
Harmonics	1 MHz – 6 GHz ≤-2 dBm, better than -30 dBc			
	≤+8 dBm, better than -30 dBc typ.			
Residual FM (CW Mode)	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 µV 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	RMS Jitter (measured performance)	
	1 GHz	1 Hz – 10 MHz	450 fs	
	155 MHz	100 Hz – 1.5 MHz	58 fs	
	622 MHz	1 kHz – 5 MHz	31 fs	
	2.488 GHz	5 kHz – 15 MHz	25 fs	

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

EXTERNAL VECTOR MODULATION

Carrier Frequency	50 MHz – 6 GHz
Input Impedance	100 Ω differential
Coupling	DC
Input Voltage	±0.707 Vpk on 'I or Q' or ±0.5 Vpk 'I and Q' for calibrated output
I and Q Bandwidth (3 dB) at RF Output	Carrier Frequency Bandwidth ≤30 MHz up to 20 MHz ≤46.875 MHz 20 MHz ≤93.75 MHz 30 MHz ≤187.5 MHz 80 MHz ≤375 MHz 100 MHz >375 MHz 300 MHz

INTERNAL VECTOR MODULATION

The following specifications apply when using one of the internal AWG options (010-012)

I and Q bandwidth (3 dB) at RF Output	Carrier Frequency Bandwidth ≤30 MHz up to 20 MHz ≤46.875 MHz 20 MHz ≤125 MHz 30 MHz ≤187.5 MHz 40 MHz ≤375 MHz 100 MHz >375 MHz 200 MHz
Residual Carrier Leak	-45 dBc typ. After IQ self-cal -55 dBc typ. ≤3.5 GHz, -50 dBc typ >3.5 GHz
IQ Image Suppression	After IQ Self Cal Carrier frequencies >187.5 MHz Tone Frequency 100 kHz -55 dBc typ. 10 MHz -50 dBc typ. 30 MHz -46 dBc typ. 50 MHz -43 dBc typ. 80 MHz -40 dBc typ. Carrier frequencies ≤187.5 MHz, -40 dBc typ Carrier frequencies ≤125 MHz, -43 dBc typ
Third order intermodulation distortion	2 tones at 0 dBm per tone ≤1 GHz <-45 dBc ≤3.5 GHz <-50 dBc >3.5 GHz <-40 dBc

|	
Channels	2 differential channels
Modes	Single ended / differential
DAC Resolution	16 bits
Sample Rate	40 kHz – 250 MHz per channel
Memory	512 MB, 128 Msamples (option 010)
	2 GB, 512 Msamples (option 011)
	4 GB, 1 Gsample (option 012)
Waveform Formats	IQ* 14-bit + 4 markers
AWG Triggering	
AWG File Selection Time	AWG completion On – Seamless
	AWG completion Off – Defined by sample rate
Trigger Sources	Internal; Software AWG marker
	External; TTL
Trigger Modes	Start only; Start & stop; Re-trigger
Start only; Start & stop; Re-trigger	Immediate
Immediate / End of file	+ve, -ve, ANY
Trigger delay	0 to 17 s, resolution 4 ns

Spectral Purity	
Spurious Free Dynamic Range	>70 dB
SSB Phase Noise	<-130 dBc/Hz typ, 20 kHz offset, 100 MHz sine
Floor Noise (no output)	<-140 FS/Hz
Intermodulation Distortion	<-70 dBc

Frequency Response of AWG	
Typical 0.5 dB Bandwidth	DC – 100 MHz

ACLR (18°C-28°C)		
3GPP W-CDMA, 1800 MHz to 2200 MHz ≤0 dBm TM1, 64DPCH	adjacent ch.	-68 dBc, -70 dBc typ.
	alternate ch.	-72 dBc typ.
EVM	<1% typ	
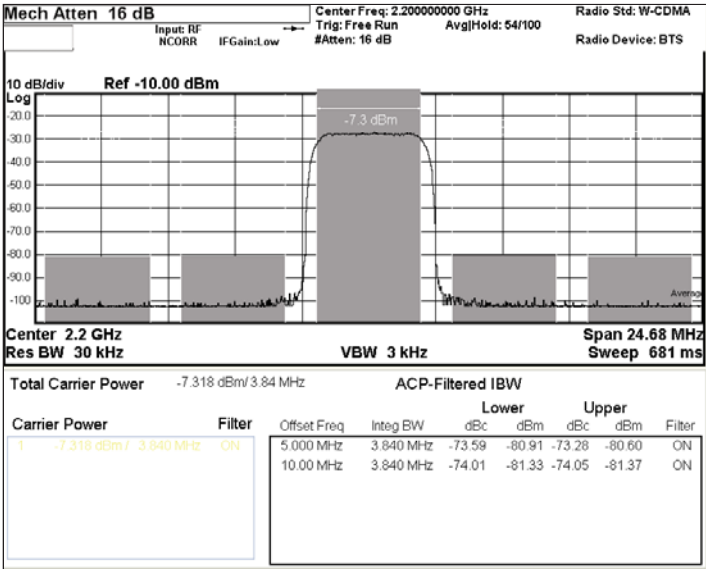
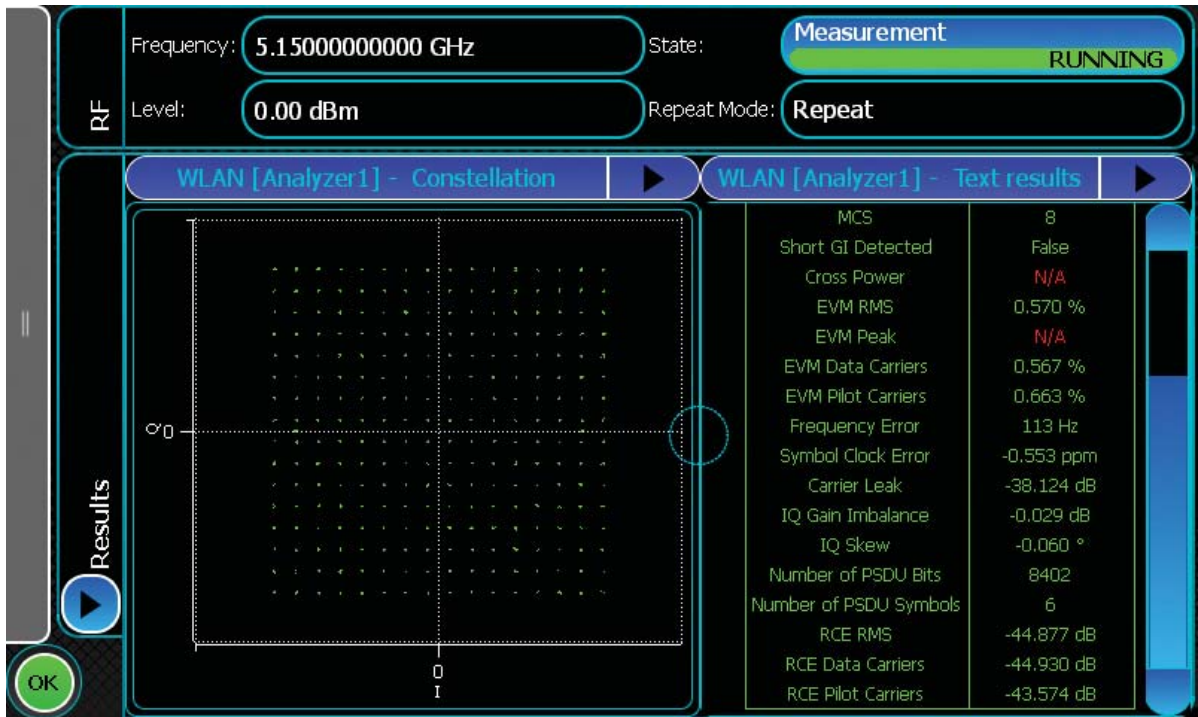Measured performance of ACLR at -6 dBm, TM1, 64 DPCH
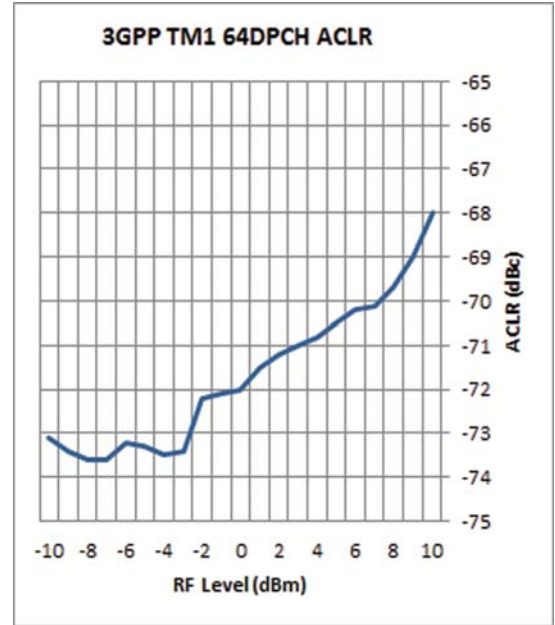
Measured performance of ACLR v. RF Level
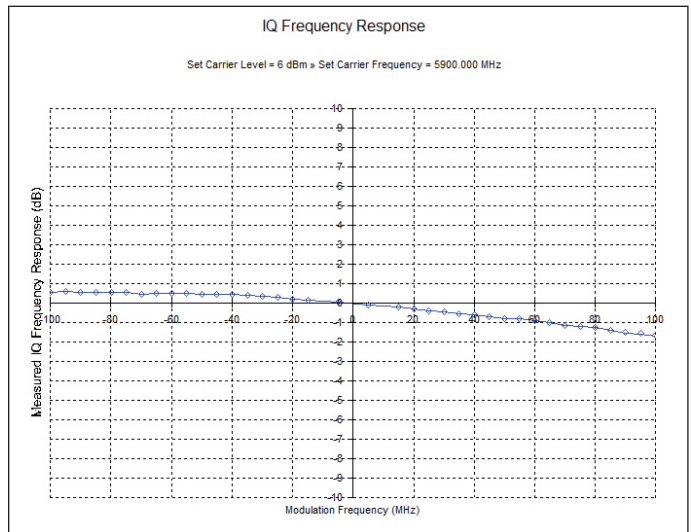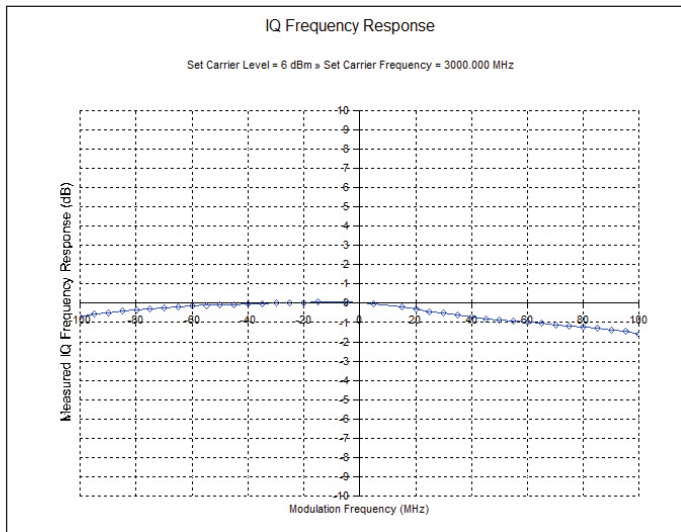
Measured performance of IQ modulation bandwidth using internal AWG at 3000 MHz and 5900 MHz

EVM	Measured
EVM measured for modulation type 802.11ac at 5.15 GHz and 0 dBm	0.57%

Measured performance of 802.11ac 80 MHz VHT MCS8 EVM

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, logarithmic
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.

List Mode Sweep Facility

Provides a table of carrier frequency, RF level values and AWG files.

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

Can be externally triggered from a rear panel BNC connector (TTL), or internally using AWG file marker.

Dwell time	Up to 10 s
List size	Up to 1000 entries

REFERENCE FREQUENCY OSCILLATOR

Type	OCXO
Frequency	10 MHz
Temperature stability (0 to 40˚C)	$< \pm 1 \times 10^{-8}$ typ.
Ageing rate	<1 in 10^9 per day (<0.001 ppm)
	<1 in 10^7 per year (<0.1 ppm)

PULSE MODULATOR/GENERATOR (OPTION 004)

Pulse Modulator	
On/off ratio	>80 dB
Rise/fall time	<10 ns
Maximum PRF	10 MHz
Video Breakthrough	<100 mV

Internal Pulse Generator	
Modes	Free-run; triggered; single pulse; double pulse; adjustable doublet; external trigger
PRF/pulse period	0.01 Hz-10 MHz/100 ns-100s
Width	10 ns-60 s
Delay	0-60 s
Double-pulse spacing	10 ns-60 s
Resolution (delay/width/period)	10 ns

Effects of Option 004 on RF Level Specification	
Instruments not fitted with option 003 (high power)	Maximum specified RF level reduced to +7 dBm with pulse enabled
	Maximum specified RF level reduced to +10 dBm with pulse disabled
Instruments fitted with option 003	Maximum specified RF level reduced by 6 dB with pulse enabled
	Maximum specified RF level reduced by 3 dB with pulse disabled
RF Level Accuracy	Add 0.2 dB <25 MHz, >7 dBm (units with option 003, high power), add 0.5 dB Temperature stability: ≤3 GHz, additional 0.005 dB/°C >3 GHz, additional 0.01 dB/°C
Output VSWR (all output levels)	Pulse disabled <3 GHz　　　　　<1.6:1 typ. >3 GHz　　　　　<1.8:1 typ. Pulse enabled (on state)　　　　　Pulse enabled (off state) <5 GHz　　　　　<1.7:1 typ.　　　　<2.3:1 typ. 5-6 GHz　　　　　<2.1:1 typ.　　　　<2.3:1 typ.
Carrier harmonics	Unspecified below 50 MHz

All other RF level dependent limits reduced by 3 dB with pulse disabled, and 6 dB with pulse enabled.

GENERAL DATA

Remote Control	
Systems	GPIB (IEEE 488)
	Ethernet (TCP/IP)
GPIB (IEEE 488) Ethernet (TCP/IP) LXI class C compliant	SCPI
Interface functions	SH1; AH1; T6; L4; SR1; RL1; PP0; DC1; DT1; C0; E2

Memory (80 GB Hard Disk)

Up to 500 full instrument setting stores

Each memory store can be given a unique name

Storage medium for all AWG files

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.

Recommended Calibration Cycle

24 months

Weight

8 kg (17.6 lbs) standard

<9 kg (19.8 lbs) with all options fitted

Dimensions - H x W x D

177 mm (4U) x 222 mm x 490 mm, not including feet. (6.97 x 8.74 x 19.29 in.)

Height 195 mm inc. feet. (7.67 in.)

Instrument includes side strap handle and front tilt feet.

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

FRONT PANEL CONNECTOR

RF Output	50 Ω N-type
4 x differential IQ inputs	I+, I-, Q+, Q-, 100 Ω differential BNC Damage levels: ±2 V
2 x USB 2.0	Used with a memory stick for transferring memory stores, AWG waveforms or other files in or out of the instrument Mouse or keyboard input

REAR PANEL CONNECTORS

RF Output	50 Ω N-type (option 007) Note: Rear panel RF output is not available with the standard instrument.
Pulse Modulation Input (Option 004)	50 Ω BNC – TTL and CMOS compatible Damage levels: TBA
4 x USB 2.0	Used with a USB flash drive for transferring memory stores, AWG 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 into Zin >1 kΩ
Event marker (Trig 1, 2, 3) Output	BNC - User selectable markers for frequency or level provide an indication when the specified parameter values have been reached. LVTTL logic output levels. Damage levels: -5 / +10 V
Trigger / Pulse (Trig 1) input	BNC – User selectable for AWG waveform trigger, sweep/list trogger or pulse enable (opt 004) LVTTL logic input thresholds. Damage levels: -5 / +10 V
Reference frequency input	BNC- accepts 10 MHz at 200 mV to 2 V RMS into 50 Ω or 100 kΩ nominal.
Reference frequency output	BNC – 10 MHz at 1.5 V pk-pk 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 50˚C
Humidity	Up to 93% at 40˚C
Altitude	Up to 3050 m
Conditions of Storage and Transport	
Temperature	-40 to +71˚C
Humidity	Up to 95% at 40˚C
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)
	125 VA max.

USER INTERFACE

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

Supports Remote Desktop and VNC.

MODULATION FORMATS

Digital Standards

Application	Standard	Specification	Access Method	Modulation Type	Embedded IQCreator
Cellular	LTE	3GPP TS 36.211/212/213	OFDMA/SC-FDMA	BPSK, QPSK, 16 & 64 QAM	Yes
	W-CDMA	3GPP TS 25.211/212/213	CDMA	QPSK, 64 QAM	Yes
	TD-SCDMA	3GPP TS 25.221/222/223	CDMA	GMSK, 8PSK	Yes
	GSM/EDGE	3GPP TS 45.005*	TDMA	QPSK, 8PSK	Yes
	cdma2000	3GPP2 C.S00002-C	CDMA	QPSK	Yes
	1xEV-DO	3GPP2 C.S0024 v4 / 3GPP2 C.S0025-A v2	CDMA	O-QPSK, QPSK	Yes
	cdmaOne	3GPP2 IS-95	CDMA	O-QPSK, QPSK	Yes
WMAN	WiMAX	IEEE 802.16D (2004) / IEEE 802.16E (2005)	OFDM / OFDMA	BPSK, QPSK, 16 QAM, 64 QAM	No
WLAN	WiFi	IEEE 802.11a,b,g,n,ac / IEEE 802.11a-1999 / IEEE 802.11b-1999 / IEEE 802.11g-2003 / IEEE 802.11n-2009 / IEEE P802.11ac/D1.0 / 20, 40, 80, 80+80, 160 MHz	DSSS, OFDM	BPSK, QPSK, 16 QAM, 64 QAM, 256 QAM	Yes
WPAN	Bluetooth®	IEEE 802.15.1-2005**		FSK, QPSK	Yes
	ZigBee®	IEEE 802.15.4-2003		O-QPSK, MPSK	Yes
Cordless	DECT	ETSI EN300 175	TDD	2 & 4FSK, MSK	No
Digital PMR	TETRA	ETSI EN300 392	TDMA	π/4DQPSK	No
Avionics	VDL	mode 2 & 3 mode 4		D8PSK, 2FSK	No
Broadcast	FM Stereo			FM	Yes

* Formerly 3GPP TS 05,05
** Bluetooth Specification 2.1+EDR (Vol 2) +
   Bluetooth low energy RF PHY test specification (RF-PHY.TS/4.0.0)

Generic Modulation

Formats	Selection	Filtering	
PSK	BPSK, π/2BPSK / QPSK, DQPSK, π/4DQPSK, O-QPSK / 8PSK, D8PSK, π/8D8PSK / 16PSK	None / Ideal low pass / Nyquist, Root Nyquist / Gaussian / User	Yes
FSK	2FSK, / 4FSK / MSK		
QAM	(2^N) where N = 4 to 10		
UDSK	User defined PSK/QAM shift keying		No

Modulation formats included with Embedded IQCreator® are indicated in the table above. Other modulation formats are supported using external IQCreator® which generates .aiq files which are transferred to the SGD.

SGD-3	100 kHz to 3 GHz digital RF signal generator
SGD-6	100 kHz to 6 GHz digital RF signal generator
Option 003	High Power (+20 dBm)
Option 004	Fast Pulse Modulation
Option 005	Removable Storage Disk
Option 007	Rear panel connectors

Arbitrary Waveform Generator options (Each AWG option includes IQCreator with PSK, QAM, multi-carrier, tones enabled):

Option 010	AWG with 128 MSamples memory
Option 011	AWG with 512 MSamples memory
Option 012	AWG with 1 GSample memory

IQCreator waveform creation options:

Option 101	Waveform creation package- Basic (options 111 to 115)
Option 102	Waveform creation package- Advanced (options 101, 117 and 118)
Option 111	3GPP (GSM, EDGE, EGPRS, EGPRS2, WCDMA, HSPA, HSPA+)
Option 112	3GPP2 (IS-95, CDMA2000, 1xEVDO (0+A))
Option 113	TD-SCDMA (3GPP TDD-LCR)
Option 114	Bluetooth V.11 + V.21 + EDR + Version 4 and LR-WPAN (802.15.4)
Option 115	WLAN (a, b, g, n)
Option 117	LTE FDD Rel. 8
Option 118	LTE TDD Rel. 8
Option 119	WLAN 802.11ac (requires option 115)

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

47000/132	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
23448/030	USB Type A - Type B 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
TBA	2 x 50 Ω BNC terminations

Complementary S-Series Modules (see separate datasheets)

SVA-6/13	250 kHz to 6/13 GHz Vector Signal Analyzer
SCO-6	10 MHz - 6 GHz Combiner module
SPA-6	10 MHz - 6 GHz Power Amplifier module