Very Wideband, USB/Ethernet

Synthesized Signal Generator SSG-15G-RC

50Ω -50 dBm to +16 dBm, 10-15000 MHz

Case Style: SL2686

Software Package

The Big Deal

- Wideband generator with 0.1 Hz frequency resolution
- **USB** *and* **Ethernet** control
- Internal & external pulse modulation
- 0.5 µs pulse signals

Typical Applications

- C, X & Ku band radar simulation
- LTE / 5G / WiFi 6E testing
- Dynamic Frequency Selection (DFS) simulation
- High speed wireless ATE

Included Accessories

Model No.	Description	Qty.
AC/DC-6-3W	AC/DC 6V adapter *(see Ordering Information)*	1
CBL-3W-XX	AC power cord *(see Ordering Information)*	1
MUSB-CBL-7FR+	6.6 ft. USB cable with ferrite	1
CBL-5FT-BMSMB+	BNC(M) to SMB(F) Trigger cable	2

& RoHS Compliant

See our web site for RoHS Compliance methodologies and qualifications

Product Overview

Mini-Circuits SSG-15G-RC is a wideband synthesized signal generator operating over a frequency range of 10 MHz to 15 GHz. The signal generator is cased in a compact, rugged metal shielded package (5.1" x 3.6" x 1.0") and equipped with an SMA(F) 50Ω connector at the RF output port and starts immediately when power is applied.

Using the supplied software, the user can easily select one of several different output modes including multiple pulse modulation options, frequency sweep, and power sweep (up, down, or bidirectional).

The SSG-15G-RC can be controlled from almost any Windows or Linux PC, via USB interface, or any computer with a network interface via HTTP, Telnet or SSH. Included with the generator are a 6.6 ft. USB cable, two SMB-BNC cables for trigger and reference, and a 6V power adapter. See page 9 for all accessories and order options available.

Key Features

Feature	Advantages
USB & Ethernet control	USB HID and Ethernet (HTTP / Telnet / SSH) interfaces provide easy compatibility with a wide range of software setups and programming environments.
Pulse modulation options	The SSG-15G-RC can produce pulse modulated RF signals using an internal or external modulating pulse.
Multiple sweep options	The SSG-15G-RC can be set to sweep either power or frequency up, down, or bidirectionally.
Full software support included	Mini-Circuits' full software package, programming and user manual are available for download from https://www.minicircuits.com/softwaredownload/sg.html at no extra cost.

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EDR-11603/1
SSG-15G-RC
RAV
210913

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Electrical Specifications at +25°C

Parameter		Test Conditions		Min.	Typ.	Max.	Units
Output Frequency		–		10	–	15,000	MHz
Frequency Resolution [1]		10 - 15,000 MHz		–	0.1	–	Hz
Frequency accuracy		Using Internal Reference		–	±1	–	ppm
Settling time [2,4]	Hop Mode [3]	–		–	0.2	0.3	ms
	Freq. Sweep [3]	–		–	0.6	0.8	
	PC (External) Control	–		–	1.2	5	
Dwell time (nominal) [4,5]		–		0.01	–	10,000	ms
VSWR		10 - 4,900 MHz		–	1.40	–	:1
		4,900 - 10,000 MHz		–	1.50	–	
		10,000 - 15,000 MHz		–	2.10	–	
Output power Max [6]		10 - 50 MHz		+3	+8	–	dBm
		50 - 15,000 MHz		+10	+16	–	
Output power Min [6]		10 - 4,800 MHz			-50	-45	dBm
		4,800 - 15,000 MHz			-48	-43	
Power resolution (nominal) [7]		10 - 15,000 MHz		–	0.1	–	dB
Dynamic range		–		–	60	–	dB
Output power accuracy [6]		10 - 50 MHz	PWR_{out}: -45 to +3 dBm	–	±0.50	–	dB
		50 - 5000 MHz	PWR_{out}: -45 to -35 dBm	–	±0.60	–	
			PWR_{out}: -35 to -14 dBm	–	±0.75	–	
			PWR_{out}: -14 to +5 dBm	–	±0.55	–	
			PWR_{out}: +5 to +10 dBm	–	±0.90	–	
		5000 - 12000 MHz	PWR_{out}: -45 to -21 dBm	–	±0.70	–	
			PWR_{out}: -21 to +10 dBm	–	±0.80	–	
		12000 - 15000 MHz	PWR_{out}: -45 to -21 dBm	–	±0.70	–	
			PWR_{out}: -21 to +10 dBm	–	±0.95	–	
RF output level		@RF OFF	10 - 7,000 MHz	–	-95	–	dBm
			7,000 - 15000 MHz	–	-75	–	
Harmonics [6]		10 - 2000 MHz	-45 to +10 dBm	–	-9	–	dBc
		2000 - 4900 MHz		–	-25	–	
		4900 - 10000 MHz		–	-20	–	
		10000 - 15000 MHz		–	-30	–	
Non-Harmonic Spurious		–		–	-70	–	dBc
Ethernet Communication	Protocol	TCP / IP, HTTP, Telnet, SSH, DHCP, UDP (limited)					
	Max Data Rate	100 Mbps (100 Base-T Full Duplex)					
USB Communication	Protocol	HID (Human Interface Device) - High Speed					
	Min Communication Time [8]	400 µs typ (full transmit/recieve cycle)					

[1] Frequency resolution is tested with 10 MHz external reference.
[2] Settling time - transition time between 2 output states. During the transition, RF output is turned off to avoid transient outputs.
[3] For sweep / hop sequences pre-loaded into internal memory (high speed mode).
[4] Generator response time is Dwell time + Settling Time.
[5] Dwell time - duration of each signal point in a Sweep or Hop sequence set by user. Default is minimum dwell time.
[6] The generator is calibrated within typical power range, however performance is guaranteed only within power max/min limits.
[7] At power steps below 0.5 dB increased non-monotonic behavior may be observed.
[8] USB min communication time is based on the polling interval of the USB HID protocol(125 µs polling interval, 1024 bytes per packet), medium CPU load and no other high speed USB devices using the USB bus.

Typical Phase Noise, SSB (dBc/Hz) at +25°C

Carrier Frequency (MHz)	Frequency Offset				
	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
10	-130	-135	-140	-146	-147
50	-116	-130	-140	-143	-157
100	-108	-127	-137	-137	-159
200	-106	-122	-131	-131	-155
400	-97	-116	-124	-125	-150
800	-91	-109	-118	-118	-144
1600	-83	-103	-112	-112	-138
3200	-81	-97	-106	-106	-129
4000	-78	-95	-105	-105	-132
5000	-75	-94	-103	-102	-129
6400	-73	-92	-100	-100	-123
8000	-70	-90	-98	-98	-123
10000	-69	-90	-96	-96	-123
12800	-67	-90	-95	-94	-118
15000	-66	-89	-92	-92	-116

Regular Pulse Modulation Specifications at +25°C

Repetitive RF pulse sequences with fixed freq. and power, supporting internal or external modulation and input / output trigger options.

Parameter	Test Conditions		Min.	Typ.	Max.	Units
Pulse Width resolution	Nominal value		0.05	–	–	µs
Pulse width[9, 12]	Measured at the 50% of pulse level		0.5	–	10e6	µs
Pulse period [9]	Measured at the 50% of pulse level		2	–	10e6	µs
Duty cycle (in Free Run)	Pulse Width divided by Pulse Period		0.0001	–	99.9999	%
Rise / Fall time [11]	Measured between 10% and 90% of pulse level		–	0.1 / 0.02	–	µs
Pulse Width Accuracy [12]	Measured at 50% of pulse level	Internal pulse modulation	–	±3	–	%
		External pulse modulation	–	±3	–	
External pulse mod. input threshold	External pulse modulation		–	–	3.0	V
Trigger response delay	Trigger edge to 50% of pulse level		–	1	–	µs
Pulse Power ratio	@PWR_{OUT}=0dBm, $FREQ_{OUT}$=10 MHz		–	58	–	dB
Pulse Power ratio	@PWR_{OUT}=+10dBm, $FREQ_{OUT}$=15,000 MHz		–	50	–	

Dynamic Pulse Modulation Specifications at +25°C

Flexible RF pulse sequences with varying frequency, power, pulse width and pulse repetition interval (PRI).

Parameter		Test Conditions	Min.	Typ.	Max.	Units
Pulse Width resolution		Nominal value	0.05	–	–	µs
Pulse width [12]		Measured at the 50% of pulse level	0.5	–	4e6	µs
Pulse Interval	Fixed freq. & Power	Measured at the 50% of pulse level	4.5	–	4e6	µs
	Fixed frequency	Measured at the 50% of pulse level	7	–	4e6	µs
	Varying frequency	Measured at the 50% of pulse level	150	–	4e6	µs
Duty cycle		Pulse Width divided by Pulse Period	0.0001	–	99.9999	%
Rise / Fall time [11]		Measured between 10% and 90% of pulse level	–	0.1 / 0.02	–	µs
Pulse Width Accuracy [12]		Measured at 50% of pulse level	–	±3	–	%
Pulse Power ratio		@PWR_{OUT}=0dBm, $FREQ_{OUT}$=10 MHz	–	58	–	dB
Pulse Power ratio		@PWR_{OUT}=+10dBm, $FREQ_{OUT}$=15,000 MHz	–	50	–	

[9] Pulse width must be less than pulse period by at least 0.5µs.
[10] Pulse widths below 0.5µs can be set, however performance is only guranteed for 0.5µs and up.
[11] Pulse rise time will increase with pulse interval under 3µs.
[12] Pulse width accuracy is 3% of pulse width, or ±100ns, whichever is greater.

Electrical Specifications at +25°C (Reference, Trigger & DC power)

Parameter		Test Conditions	Min.	Typ.	Max.	Units
Aging		Using Internal Reference	–	2	–	ppm/yr
Reference In	Frequency	–	–	10	–	MHz
	Power	–	-3.5	–	+7.5	dBm
	Phase Noise	@ 10kHz Offset	–	-145	–	dBc/Hz
Reference Out	Frequency	–	–	10	–	MHz
	Freq. Accuracy	Using Internal Reference	–	±1	–	ppm
	Power	–	–	+5.5	–	dBm
Trigger Out, Low		–	0	–	0.4	V
Trigger Out, High		–	3.0	–	5	
Trigger In, Low [13]		–	0	–	0.4	
Trigger In, High [13]		–	3.0	–	5	
Supply Voltage		–	5.6	6	6.4	V_{DC}
Supply Current [14]		–	–	1250	1850	mA
USB current [14]		–	–	0	–	

[13] Trigger out voltage specified with impedance load of 10kΩ minimum.
[14] All power is drawn from power adaptor, USB is used for control only.

Absolute Maximum Ratings (Exceeding these limits will cause permanent damage)

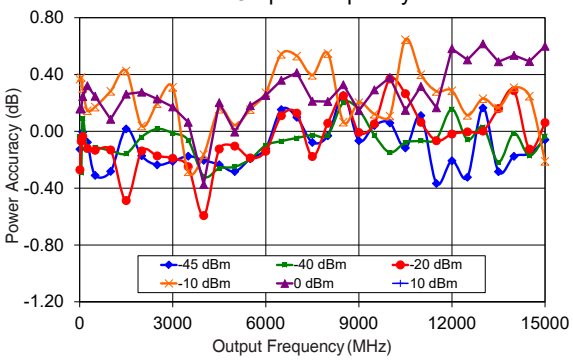
Operating Temperature		0ºC to +50ºC
Storage Temperature		-20ºC to +60ºC
Power in @ Reference In		+10 dBm
Reverse Power(DC) @ Reference Out		8 V_{DC}
Reverse Power(DC) @ RF Out		16 V_{DC}
Reverse Power(RF) @ RF Out	@ 10 - 100 MHz	Derates linearly from +22 dBm at 100 MHz to +13 dBm at 10 MHz
	@ 100 - 15,000 MHz	+22 dBm
Voltage input to Trigger ports		-0.3V_{DC} to +5.5V_{DC}

Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.

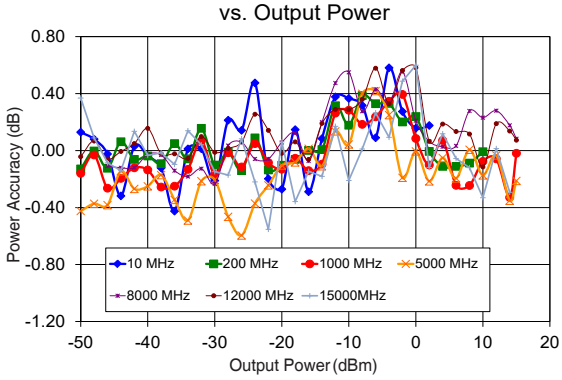
Typical Performance Curves*

*at +25°C unless noted otherwise

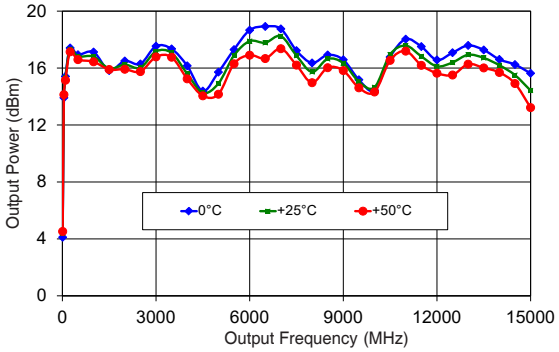
Power Accuracy vs. Output Frequency



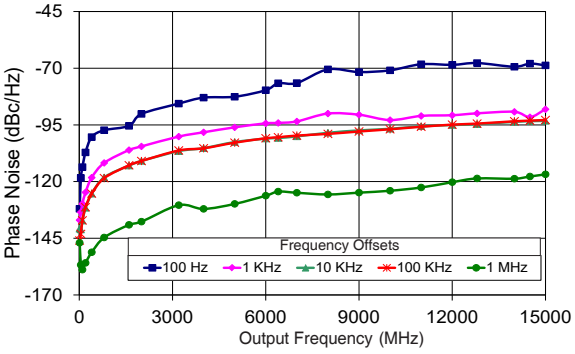
Power Accuracy vs. Output Power



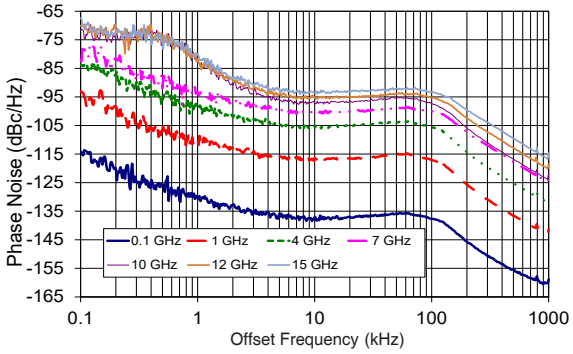
Max Power Output Vs. Output Frequency



Phase Noise vs. Output Frequency at selected Freq. Offsets



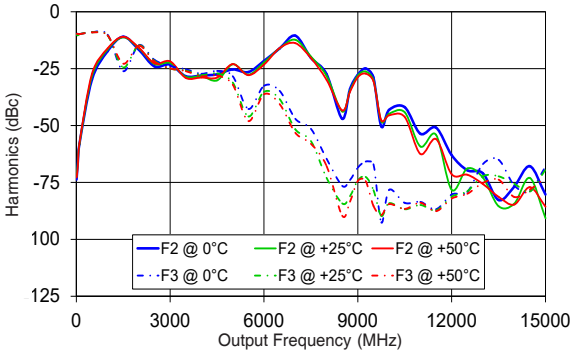
Phase Noise vs. Freq. Offset at selected output frequencies



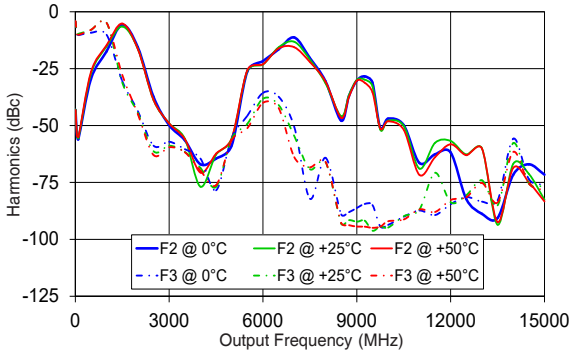
Typical Performance Curves* (continued)

*at +25°C unless noted otherwise

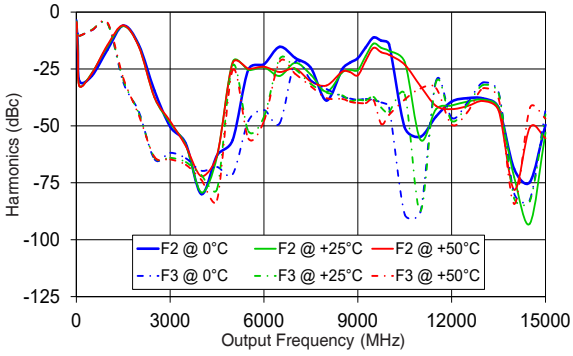
Harmonics Levels
vs. Output Frequency @ PWR=-40dBm



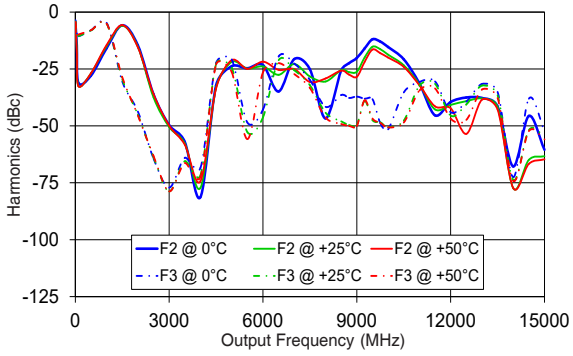
Harmonics Levels
vs. Output Frequency @ PWR=-20dBm



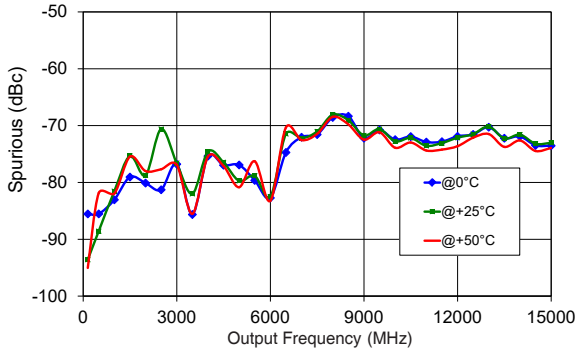
Harmonics Levels
vs. Output Frequency @ PWR=0dBm



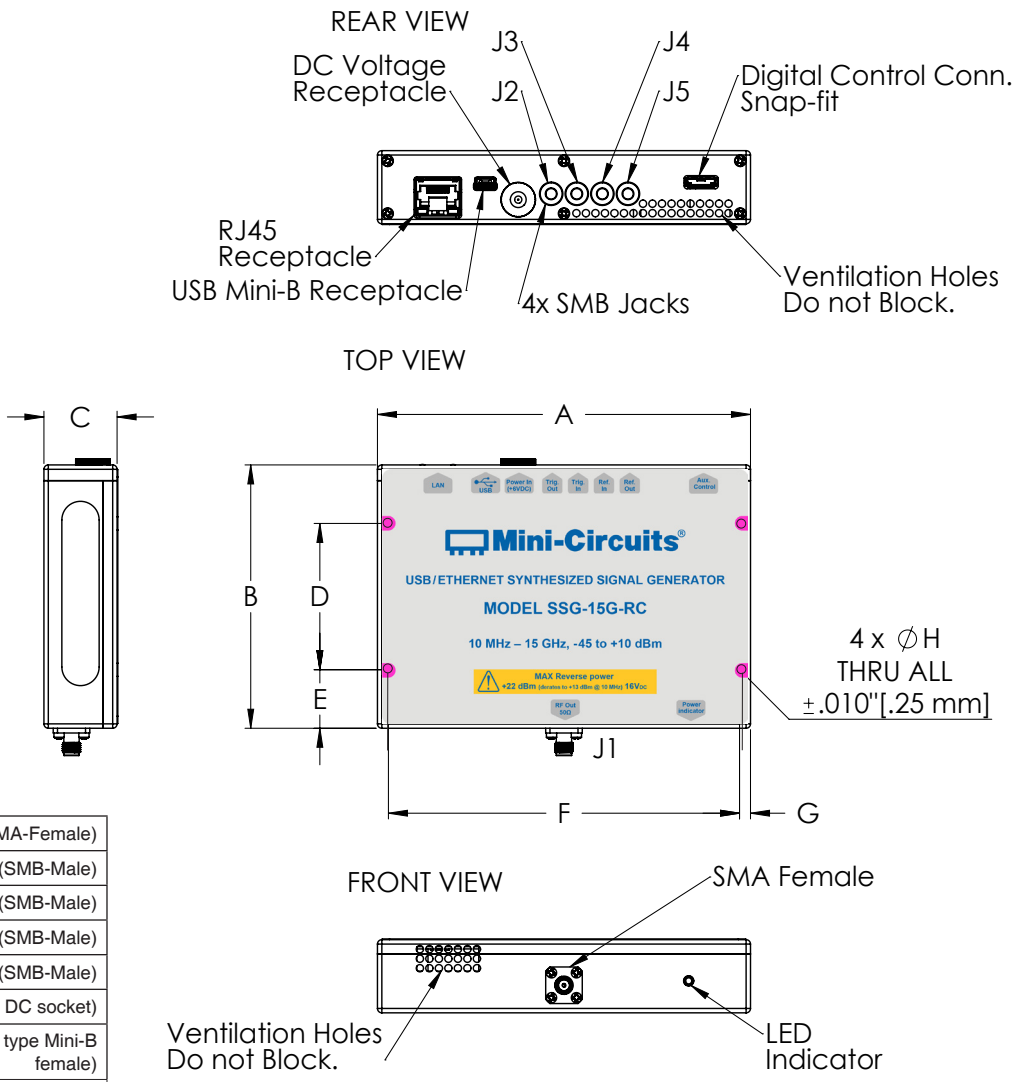
Harmonics Levels
vs. Output Frequency @ PWR=+10dBm



Spurious @ ±100kHz to 50 MHz offset
vs. Output Frequency @ PWR=+5dBm



Outline Drawing SL2686



Connections

RF Output	J1 (SMA-Female)
Ref. In	J4 (SMB-Male)
Ref. Out	J5 (SMB-Male)
Trigger In	J3 (SMB-Male)
Trigger Out	J2 (SMB-Male)
Power In [15]	(2.1 mm DC socket)
USB Port	(USB type Mini-B female)
Network (Ethernet/LAN)	(RJ45 socket)
Aux. Control (future use)	(Snap-fit)

[15] No power On/Off switch. SSG will power on as soon as power is connected, starting at the specified startup condition(factory default 15 GHz, -45 dBm, RF OFF).

Outline Dimensions (inch / mm)

A	B	C	D	E	F	G	H	WT. GRAMS
5.10	**3.60**	**1.00**	**2.000**	**0.800**	**4.800**	**0.150**	**0.125**	600
129.5	91.4	25.4	50.80	20.32	121.92	3.81	3.18	

Software & Documentation Download:

- Mini-Circuits' full software and support package including user guide, Windows GUI, DLL files, programming manual and examples can be downloaded free of charge from **https://www.minicircuits.com/softwaredownload/sg.html**
- Please contact **testsolutions@minicircuits.com** for support

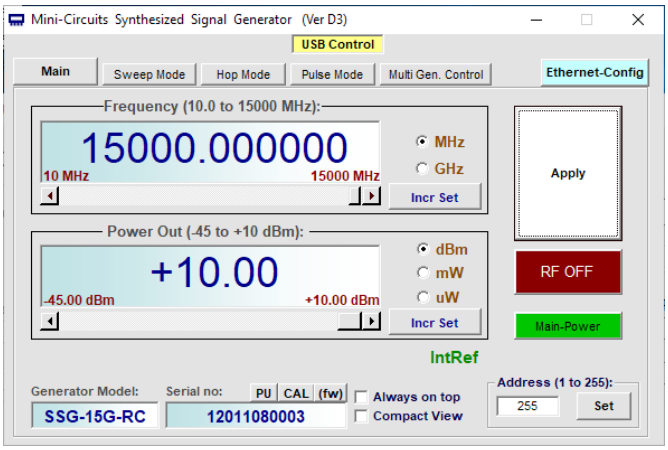
Minimum System Requirements

Parameter	Requirements	
Interface	USB HID or HTTP Get/Post or Telnet protocols or SSH protocols	
System requirements	GUI	Windows 32 & 64 bit systems from Windows 98 up to Windows 10
	USB API (ActiveX & .Net)	Windows 32 & 64 bit systems with ActiveX or .Net support from Windows 98 up to Windows 10
	USB direct programming support	Linux, Windows systems from Windows 98 up to Windows 10
	HTTP, Telnet or SSH	Any computer with a network port and Ethernet-TCP/IP (HTTP, Telnet or SSH protocols) support
Hardware	Pentium® II or higher, RAM 256 MB	

Graphical User Interface (GUI) for Windows

Key Features:

- Set signal power and Frequency
- Set timed sequence of signals (Sweep & random sequence)
- Set timed sequences in multiple generators simultanously
- Set trigger mode.
- Report if using internal or external reference
- Configure pulse modulation
- USB and Ethernet control
- Set condition at power up
- Track unit operation time since calibration
- Set and recieve calibration reminders
- Configure Ethernet settings
- Update firmware



Application Programming Interface (API)

Windows Support:

- API DLL files exposing the full switch functionality See programming manual for details
  - ActiveX COM DLL file for creation of 32-bit programs
  - .Net library DLL file for creation of 32 / 64-bit programs
- Supported by most common programming environments (refer to application note **AN-49-001** for summary of tested environments)

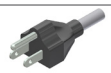
Linux Support:

- Full switch control in a Linux environment is achieved by way of USB interrupt commands.

Ordering, Pricing & Availability Information see our web site

Model	Description
SSG-15G-RC	USB/Ethernet Synthesized Signal Generator

Included Accessories	Part No.	Description	Qty.
	AC/DC-6-3W	AC/DC Grounded Power adapter. 0°C to +40°C AC Input: 100-240V, 50/60 Hz, I_{Max}=1.2A DC Output 6±0.3 V , I_{Max}=3A	1
	CBL-3W-XX	AC Power Cord (*Select one power cord from below with each Signal Generator)*	1
	MUSB-CBL-7FR+	6.6 ft (2.0 m) USB Cable: USB type A(Male) to USB type Mini-B(Male) with ferrite	1
	CBL-5FT-BMSMB+	5 ft (1.5 m) Trigger cable: BNC(male) to SMB(Female)	2

AC Power Cords[16]	Part No.	Description
	CBL-3W-US	Power Cord for United States
	CBL-3W-EU	Power Cord for Europe
	CBL-3W-UK	Power Cord for United Kingdom
	CBL-3W-AU	Power Cord for Australia and China
	CBL-3W-IL	Power Cord for Israel

[16] Power cords for other countries are also available, if you need a power cord for a country not listed in the table please contact **testsolutions@minicircuits.com**.

Optional Accessories	Description
MUSB-CBL-3FR+	2.6 ft (0.8 m) USB Cable: USB type A(Male) to USB type Mini-B(Male) with ferrite
MUSB-CBL-7FR+ (spare)	6.6 ft (2.0 m) USB Cable: USB type A(Male) to USB type Mini-B(Male) with ferrite
CBL-RJ45-MM-5+	5 ft. network cable: RJ45(Male) to RJ45(Male) Cat 5E cable.
CBL-5FT-BMSMB+ (spare)	5 ft (1.5 m) Trigger&Reference cable: BNC(male) to SMB(Female)

Calibration	Description	
CALSSG-15G-RC	Calibration Service	Click Here

Additional Notes

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.

B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.

C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

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