Millimeter wave | USB & Ethernet

Wideband Signal Generator

SSG-30G-RC

50Ω -47 dBm to +23 dBm, 10 MHz to 30 GHz

The Big Deal

- Millimeter wave signal source
- High output power @ 30 GHz
- Pulse modulation with 0.5 µs pulse width
- **USB** *and* **Ethernet** control

Case Style: SL3225 & SL2686

SSG-30G-RC Contents

Model No.	Description	Qty.
SSG-15G-RC	Wideband signal generator (10 MHz to 15 GHz)	1
FX-30G-RC	Frequency Extender module (10 MHz to 30 GHz)	1
141-5SM+	RF interconnect cable	1
CBL-0.5FT-MMD+	Serial control interconnect cable	1
MUSB-CBL-7FR+	6.6 ft. USB cable with ferrite	1
CBL-5FT-BMSMB+	BNC(M) to SMB(F) Trigger cable	2
AC/DC-6-3W	AC/DC 6V adapter	1
AC/DC-12-3W	AC/DC 12V adapter	1
CBL-3W-XX	AC power cord *(see Ordering Information)*	2

Typical Applications

- 5G FR2 bands n257, n258 & n261
- K & Ku band radar
- Wideband LO source
- Microwave & millimeter wave radio testing

RoHS Compliant

See our web site for RoHS Compliance methodologies and qualifications

Product Overview

Mini-Circuits' SSG-30G-RC is a wide-band signal generator offering CW and pulsed outputs from 10 MHz to 30 GHz. It is constructed using a cost effective, modular design for maximum flexibility, with a precision 2.92 mm connector for the RF output. You can choose to purchase the complete system as one item, or purchase the FX-30G-RC frequency extender module separately to upgrade your existing SSG-15G-RC signal generator (10 MHz to 15 GHz) for operation up to 30 GHz.

SSG-30G-RC ships with all required accessories and can be set up in moments, just connect the RF and serial control cables between the signal source and frequency extender modules, plug in the power supply and turn on. The system is controlled via Ethernet or USB using Mini-Circuits' powerful signal generator GUI for Windows, or the comprehensive API. SSH, HTTP & Telnet protocols are supported via Ethernet, with programming support for most common languages. The software makes it simple to create a CW output at any supported frequency and power level; configure flexible pulse modulation options, with pulse widths down to 0.5 µs pulse width; or configure automated frequency / power sweep & hop sequences.

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-30G-RC can produce pulse modulated RF signals using an internal or external modulating pulse.
Multiple sweep options	The SSG-30G-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 .

Rev. OR
ECO-012432
EDR-11852
SSG-30G-RC
MCIL
220323

Electrical Specifications[1] at +25°C

Parameter		Test Conditions		Min.	Typ.	Max.	Units
Output Frequency		–		10	–	30,000	MHz
Frequency Resolution [2]		10 - 15,000 MHz		–	0.1	–	Hz
		15,000 - 30,000 MHz		–	0.2	–	
Frequency accuracy		Using Internal Reference		–	±1	–	ppm
Settling time [3,5]	Hop Mode [4]	–		–	0.2	0.3	ms
	Freq. Sweep [4]	–		–	0.6	0.8	
	PC (External) Control	–		–	1.2	5	
Dwell time (nominal) [5,6]		–		0.01	–	10,000	ms
VSWR		10 - 15,000 MHz		–	1.35	–	:1
		15,000 - 21,200 MHz		–	1.35	–	
		21,200 - 30,000 MHz		–	1.50	–	
Output power Max [7]		10 - 21,000 MHz		+20	+23	–	dBm
		21,000 - 27,000 MHz		+17	+19	–	
		27,000 - 30,000 MHz		+14	+17	–	
Output power Min [7]		10 - 30,000 MHz		–	-47	-45	dBm
Power resolution (nominal) [8]		10 - 15,000 MHz		–	0.1	–	dB
		15,000 - 30,000 MHz		–	0.5	–	
Dynamic range		–		–	67	–	dB
Output power accuracy [7]		10 - 15,000 MHz	PWR_{out}: -45 to +20 dBm	–	±1.00	–	dB
		15,000 - 21,000 MHz	PWR_{out}: -45 to +20 dBm	–	±1.00	–	
		21,000 - 27,000 MHz	PWR_{out}: -45 to +17 dBm	–	±1.00	–	
		27,000 - 30,000 MHz	PWR_{out}: -45 to +14 dBm	–	±1.00	–	
RF output level		@RF OFF	10 - 15,000 MHz	–	-70	–	dBm
			15,000 - 30,000 MHz	–	-80	–	
Harmonics [7]		10 - 2,000 MHz	-45 to +20 dBm	–	-9	–	dBc
		2,000 - 8,000 MHz		–	-20	–	
		8,000 - 15,000 MHz		–	-30	–	
		15,000 - 30,000 MHz	-45 to -25 dBm [9]	–	-30	–	
			-25 to Max power	–	-60	–	
Sub-Harmonics [7,10]		15,000 - 24,000 MHz	-45 to -25 dBm [9]	–	-10	–	dBc
			-25 to Max power	–	-45	–	
Non-Harmonic Spurious		–		–	-60	–	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 [10]	500 µs typ (full transmit/receive cycle)					

[1] Frequency resolution is tested with 10 MHz external reference.
[2] 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] 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 non-monotonic behavior may be observed.
[8] Harmonic & Sub-Harmonics at low power out above 15 GHz are primarily due to leakage from the Doubler input via low frequency channel.
[9] No sub-harmonics below 15 GHz.
[10] 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
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
16000	-64	-84	-92	-92	-117
20000	-63	-84	-90	-90	-117
25600	-61	-84	-89	-88	-112
30000	-60	-83	-86	-86	-110

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, $FREQ_{OUT}$=30,000 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
	Varying freq. or Power	Measured at the 50% of pulse level	300	–	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, $FREQ_{OUT}$=30,000 MHz	–	50	–	

9 Pulse width must be less than pulse period by at least 0.5 µs.
10 Pulse widths below 0.5 µs can be set, however performance is only guaranteed for 0.5 µs and up.
11 Pulse rise time will increase with pulse interval under 3 µs.
12 Pulse width accuracy is 3% of pulse width, or ±100 ns, 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	@ 10 kHz 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 (SSG-15G-RC)		–	5.6	6	6.4	V_{DC}
Supply Voltage (FX-30G-RC)			11.4	12	12.6	
Supply Current, 6V (SSG-15G-RC)[14]		–	–	1250	1850	mA
Supply Current, 12V (FX-30G-RC)			–	650	800	
USB current [14]		–	–	0	–	

[13] Trigger out voltage specified with impedance load of 10 kΩ 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)

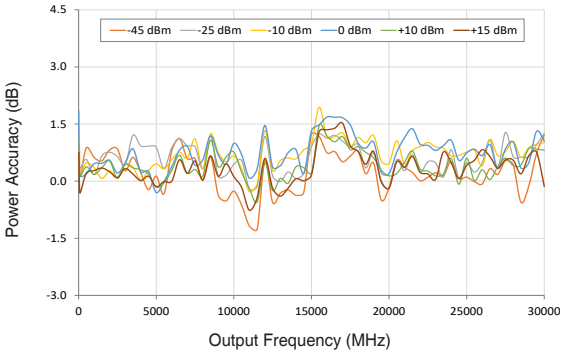
Operating Temperature		0ºC to +50ºC
Storage Temperature		-20ºC to +60ºC
Power in @ Reference In		+10 dBm
Reverse Power(DC) @ Reference Out		8 V_{DC}
Reverse Power(DC) @ RF Out		16 V_{DC}
Reverse Power(RF) @ RF Out	@ 10 - 100 MHz	Derates linearly from +22 dBm at 100 MHz to +13 dBm at 10 MHz
	@ 100 - 15,000 MHz	+22 dBm
	@ 15,000 - 30,000 MHz	+21 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.

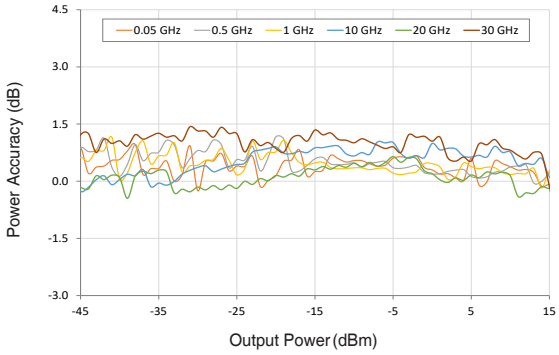
Typical Performance Curves*

*at +25°C unless noted otherwise

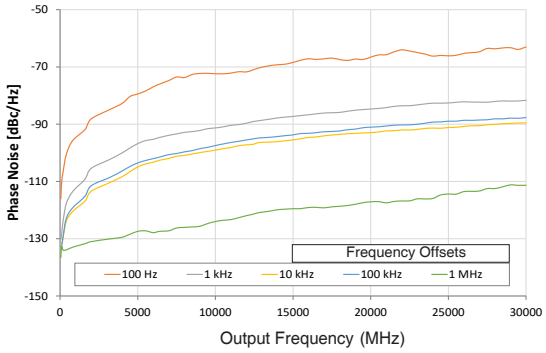
Power Accuracy vs. Output Frequency



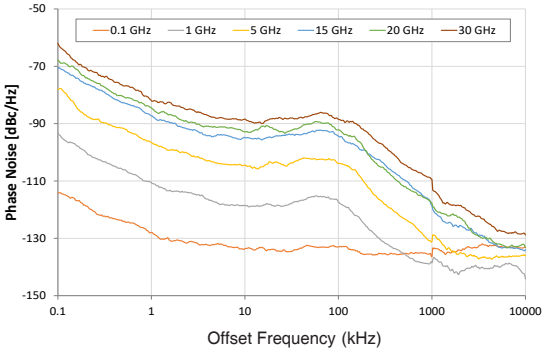
Power Accuracy vs. Output Power



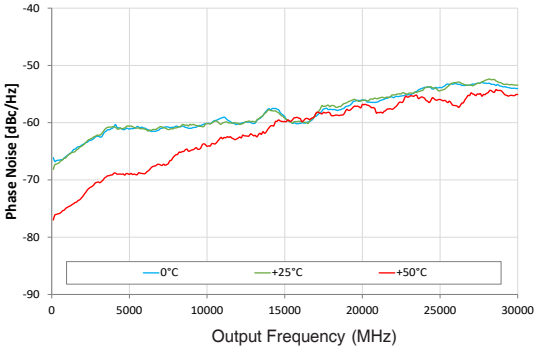
Phase Noise vs. Output Frequency at selected Freq. Offsets



Phase Noise vs. Freq. Offset at selected output frequencies



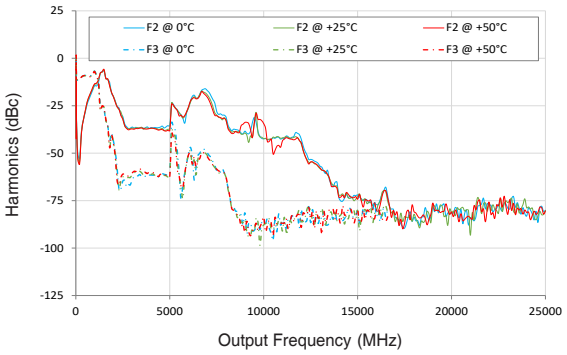
Spurious @ ±1 kHz to 30 MHz offset vs. Output Frequency



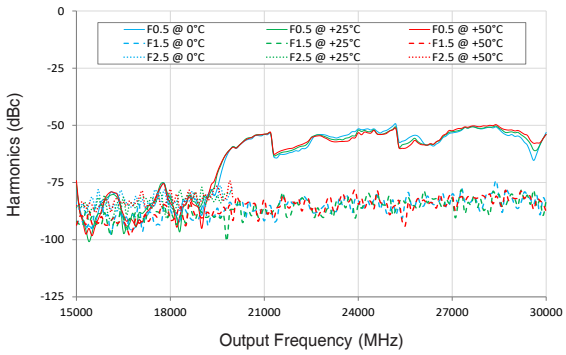
Typical Performance Curves* (continued)

*at +25°C unless noted otherwise

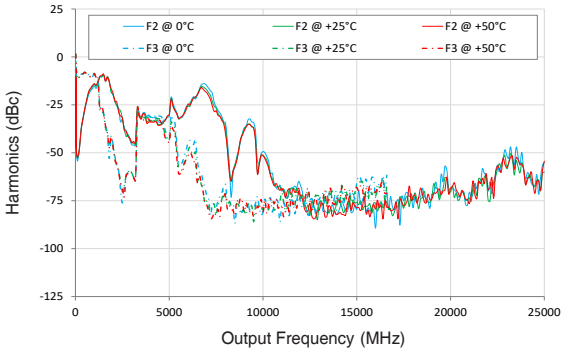
Harmonics vs. Output Frequency @ +10 dBm



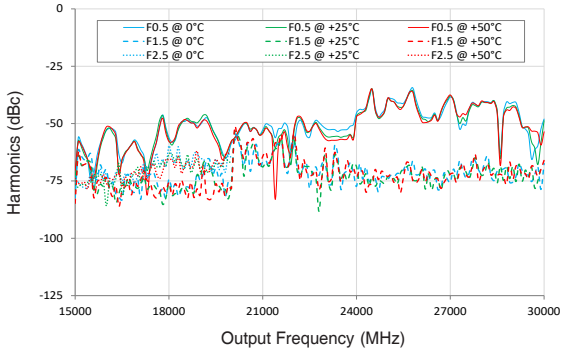
Sub-Harmonics vs. Output Frequency @ +10 dBm



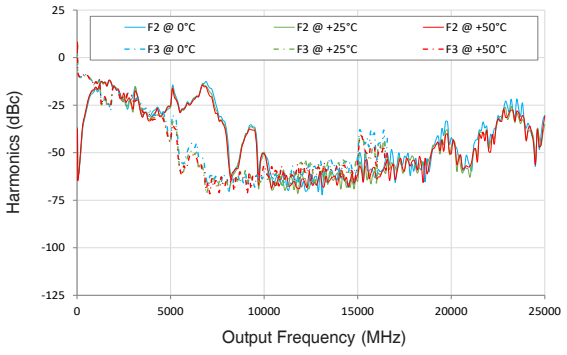
Harmonics vs. Output Frequency @ -20 dBm



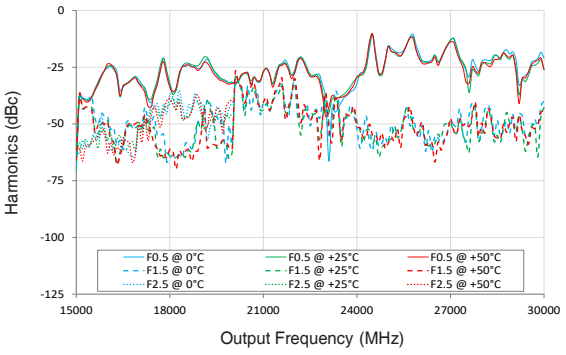
Sub-Harmonics vs. Output Frequency @ -20 dBm



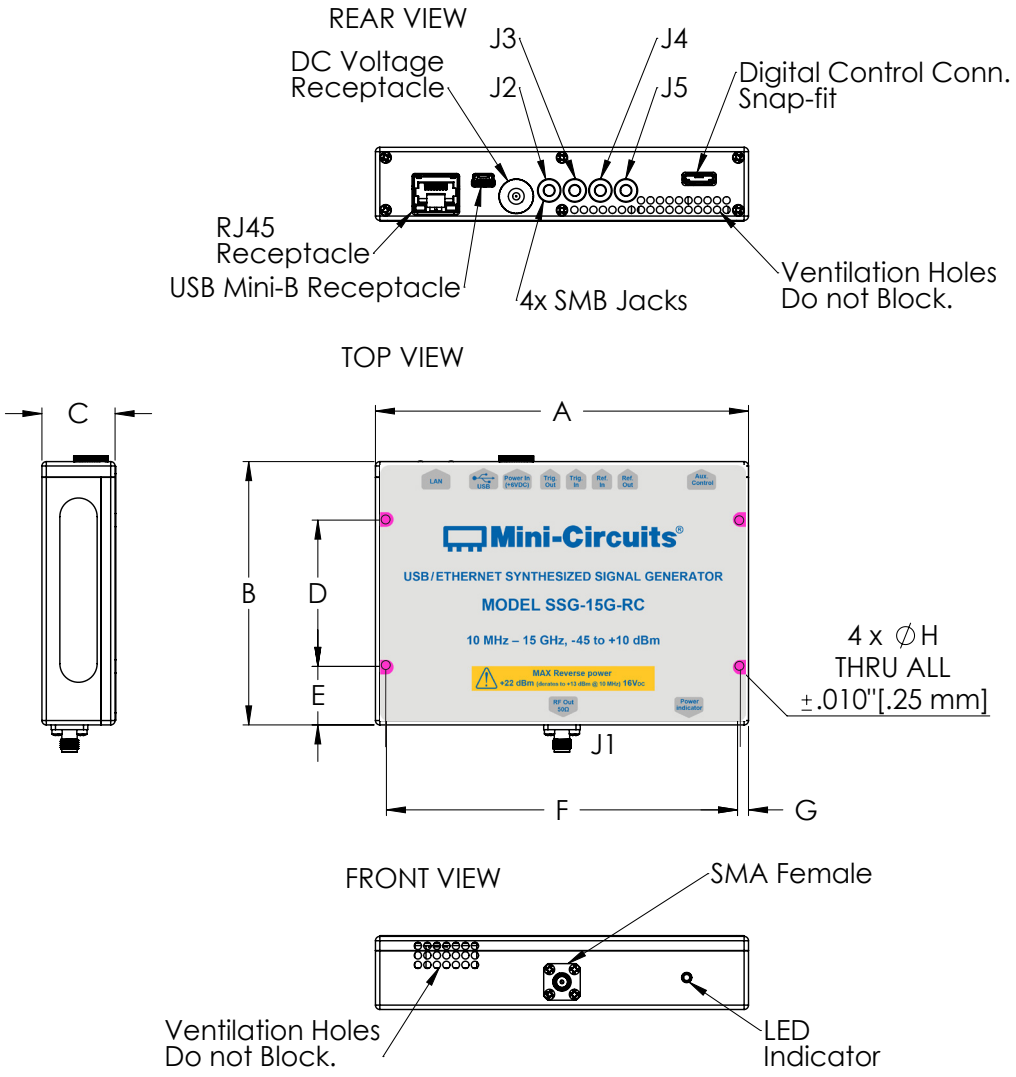
Harmonics vs. Output Frequency @ -45 dBm



Sub-Harmonics vs. Output Frequency @ -45 dBm



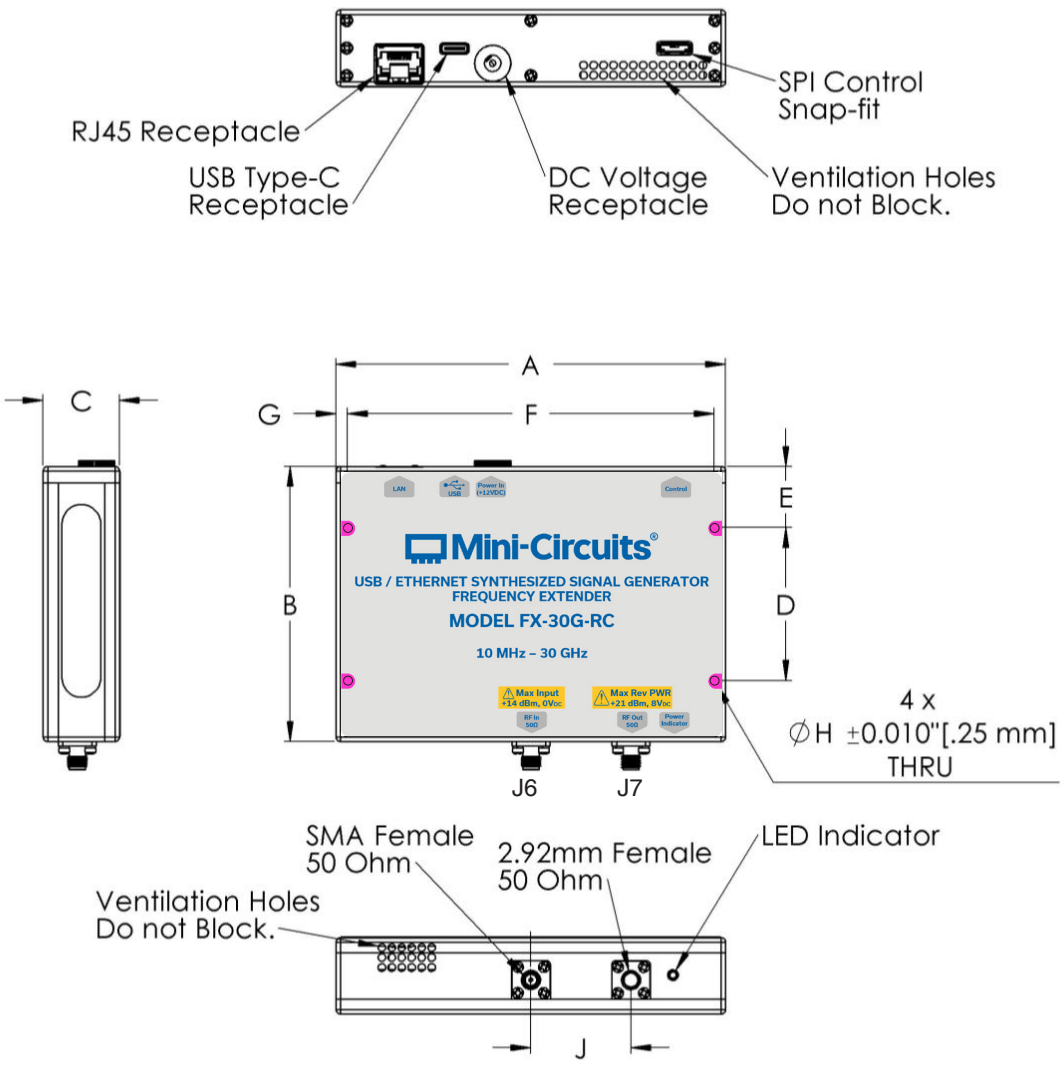
Outline Drawing (SSG-15G-RC / SL2686)



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	

Outline Drawing (FX-30G-RC / SL3225)



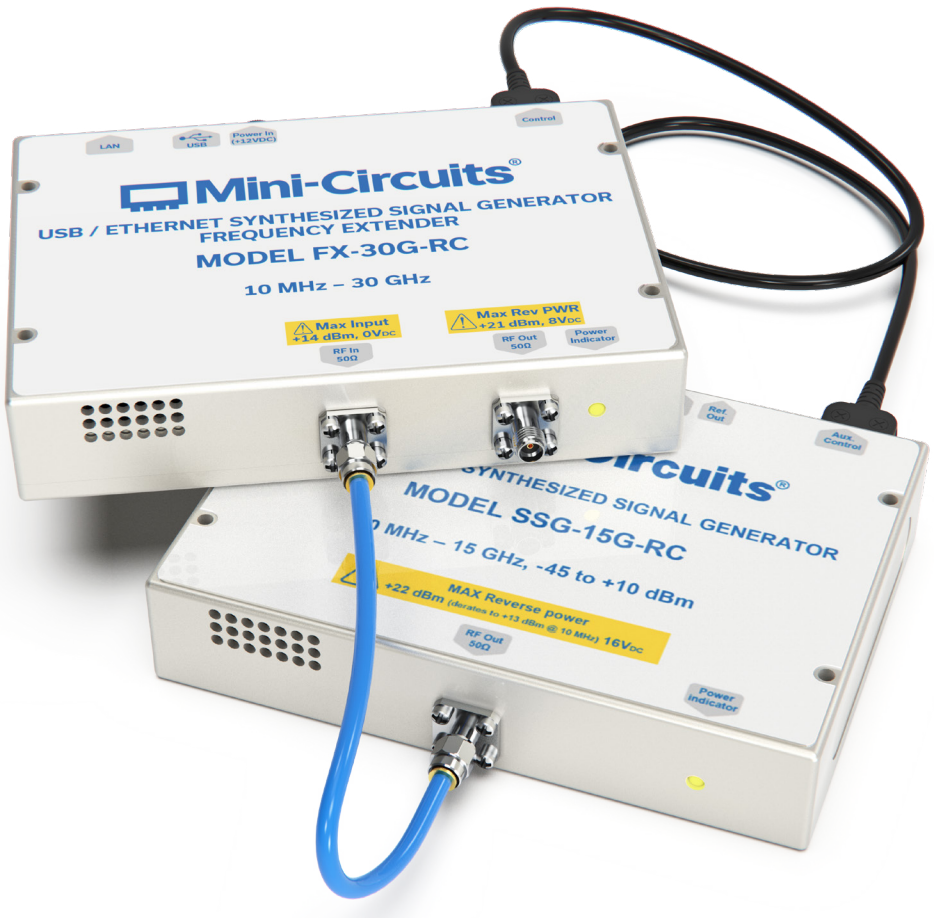
Outline Dimensions (inch / mm)

A	B	C	D	E	F	G	H	J	WT. GRAMS
5.10	**3.60**	**1.00**	**2.000**	**0.800**	**4.800**	**0.150**	**0.125**	**1.310**	600
129.5	91.4	25.4	50.80	20.32	121.92	3.81	3.18	33.27	

Connections

Module	Name	Type	Description
SSG-15G-RC	J1	SMA(F)	RF Interconnection Output from SSG-15G-RC to FX-30G-RC
SSG-15G-RC	J4	SMB (M)	Ref. In
SSG-15G-RC	J5	SMB (M)	Ref. Out
SSG-15G-RC	J3	SMB (M)	Trigger In
SSG-15G-RC	J2	SMB (M)	Trigger Out
SSG-15G-RC	DC1	2.1 mm DC socket	DC Power In (6V) - Note: Power adapter marked with green dot [15]
SSG-15G-RC	USB1	USB Type Mini-B	USB Port
SSG-15G-RC	LAN1	RJ45 socket	Network (Ethernet/LAN)
SSG-15G-RC	SF1	Digital snap-fit	Serial Control interconnection
FX-30G-RC	J6	SMA (F)	RF interconnect input
FX-30G-RC	J7	2.92 mm (F)	RF Output
FX-30G-RC	DC2	2.1 mm DC socket	DC Power In (12V) - Note: Power adapter marked with yellow dot [15]
FX-30G-RC	USB2	USB Type Mini-B	USB Port
FX-30G-RC	LAN2	RJ45 socket	Network (Ethernet/LAN)
FX-30G-RC	SF2	Digital snap-fit	Serial Control interconnection

[15] No power On/Off switch. device will power on as soon as power is connected, starting at the specified startup condition in the SSG.



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
	Ethernet	Windows, Linux or Mac computer with a network port and Ethernet TCP/IP support
Hardware	Pentium® II or higher, RAM 256 MB	

Application Programming Interface (API)
Ethernet Support:

- Simple ASCII / SCPI command set for all SSG functions
- Communication via HTTP or Telnet
- Supported by most common programming environments

USB support (Windows)t:

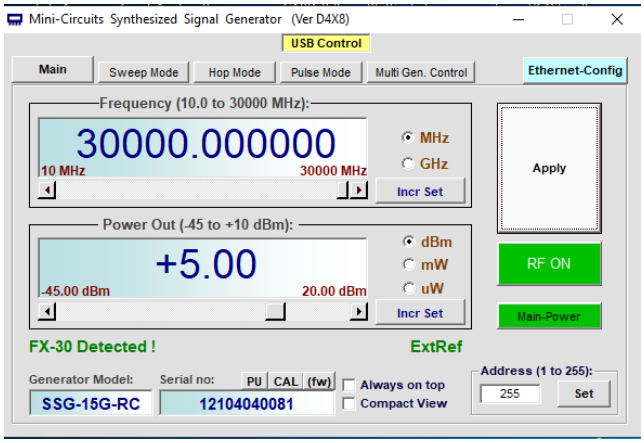
- API DLL files exposing the full switch functionality
  - ActiveX COM DLL file for creation of 32-bit programs
  - .Net library DLL file for creation of 32 / 64-bit programs
  - Supported by most common programming environments (refer to application note **AN-49-001** for summary of tested environments)
  - Simple ASCII / SCPI command set for all SSG functions

Linux Support:

- Direct USB programming using a series of USB interrupt codes.

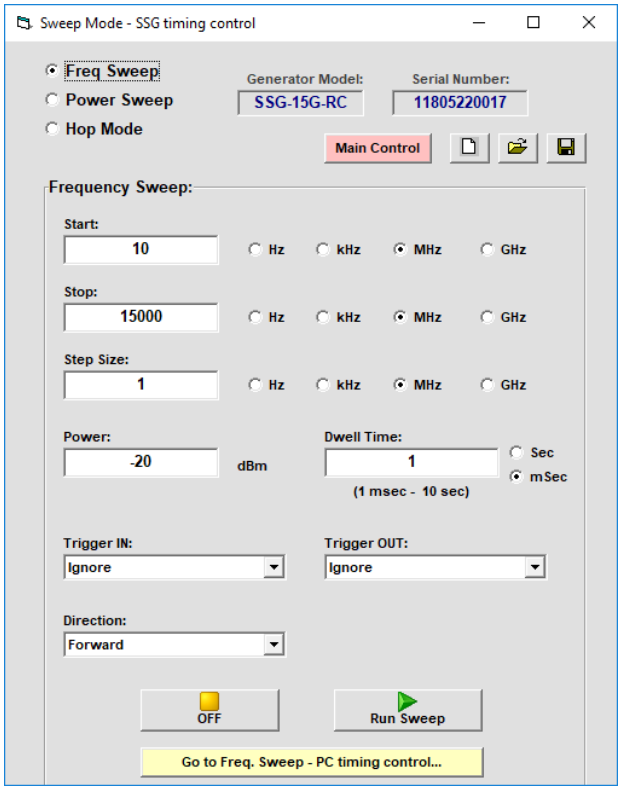
Graphical User Interface (GUI) for Windows
Key Features:

- Set signal power and frequency
- Set timed sequence of signals (sweep & random sequence)
- Set timed sequences in multiple generators simultaneously
- Set trigger mode.
- Configure pulse modulation
- USB and Ethernet control
- Set condition at power up
- Track unit operation time since calibration
- Set and receive calibration reminders
- Configure Ethernet settings
- Update firmware



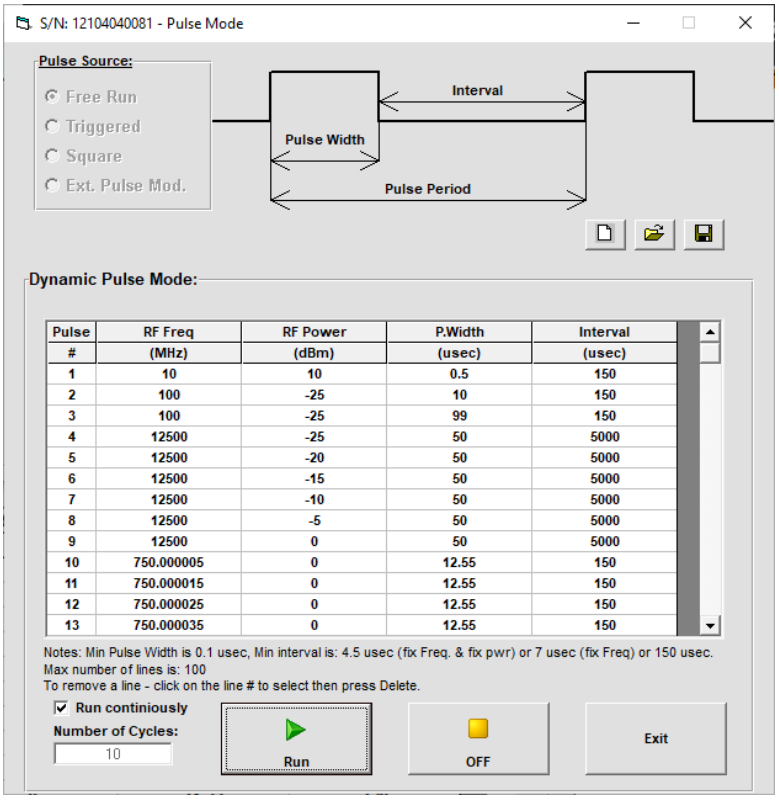
Automated Sweep / Hop Sequences:

- Sweep across a frequency band at a fixed output power.
- Sweep output power levels at a fixed frequency.
- Hop through a list of pre-defined frequency / power settings.
- Set dwell times down to 10 µs in high speed mode.
- Run on demand or in response to external triggers.
- Produce triggers to signal switching points or completing a run.



Dynamic Pulse Modulation:

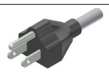
- Configure repetitive pulsed output sequences.
- Define custom pulse lists with a different frequency, power, width & interval at each step.
- Set pulse widths down to 0.5 us.
- Run continuously or for a preset number of cycles.



Ordering, Pricing & Availability Information see our web site

Model	Description
SSG-30G-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
	AC/DC-12-3W	AC/DC Grounded Power adapter. 0°C to +40°C AC Input: 100-240V, 50/60 Hz, I_{Max}=1.2A DC Output 12±0.6 V , I_{Max}=5A	1
	CBL-3W-XX	AC Power Cord (*select the correct region from the AC power cord options below)*	2
	141-5SM+	5in (12.5cm) RF cable for connecting the SSG and FX modules.	1
	CBL-0.5FT-MMD+	6in (15cm) control cable for connecting the SSG and FX modules.	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	
CALFX-30G-RC	Calibration Service for FX-30G-RC	Click Here
CALSSG-15G-RC	Calibration Service for SSG-15G-RC	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/terms/viewterm.html