



## USB & ETHERNET

# Signal Generator

## SSG-30G-RC



50Ω    0.01 to 30 GHz    -47 dBm to +23 dBm    2.92 mm female

### THE BIG DEAL

- Cost effective millimeter wave signal source
- High output power @ 30 GHz, +17 dBm
- Pulse modulation with 0.5 μs pulse width
- USB and Ethernet control

### APPLICATIONS

- 5G FR2 bands n257, n258 & n261
- High power burn-in / life testing
- K & Ku band radar
- Wideband LO source
- Microwave & millimeter wave radio testing



Generic photo used for illustration purposes only.

### PRODUCT OVERVIEW

Mini-Circuits' SSG-30G-RC is a wide-band signal generator offering CW and pulsed outputs from 10 MHz to 30 GHz. With +19 dBm typical output power up to 27 GHz and +17 dBm typical up to 30 GHz, the SSG is an ideal signal source for characterization of millimeter wave components and systems at high power. Configure CW / single-tone outputs at any supported frequency and power level; flexible pulse sequences with pulse widths down to 0.5 μs; or automated frequency / power sweep & hop sequences.

SSG-30G-RC uses a unique modular construction to provide a high power, millimetre wave signal source at an affordable price point for every lab and production test setup. The unit is supplied ready-assembled assembled, with a semi-rigid cable integrating the modules and a precision 2.92 mm output connector on the front panel. Simply connect the serial interface cable on the rear, USB or Ethernet for control and then the power supplies to get started.

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.

### KEY FEATURES

Feature	Advantages
High output power	Reliable high power signal source for millimeter wave systems, reducing the need for external amplification and gain control.
Flexible pulse modulation	Configure pulse sequences with varying frequency, power, pulse width and pulse repetition interval (PRI).
Sweep & hop sequences	Configure custom CW output frequency and power sequences to run unaided for high speed, automated test applications.
USB & Ethernet control	USB HID and Ethernet (HTTP / Telnet / SSH) interfaces provide easy compatibility with a wide range of software setups and programming environments.

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### ELECTRICAL SPECIFICATIONS, +25°C

Parameter	Condition (GHz)		Min.	Typ.	Max.	Unit
Output Frequency	-		0.01		30	GHz
Frequency Resolution <sup>1</sup>	0.01 - 15		-	0.1	-	Hz
	15 - 30		-	0.2	-	
Frequency Accuracy	Using Internal Reference		-	±1	-	ppm
Settling Time <sup>2,4</sup>	Hop Mode <sup>3</sup>		-	0.2	0.3	ms
	Frequency Sweep <sup>3</sup>		-	0.6	0.8	
	PC Control (External)		-	1.2	5.0	
Dwell Time (nominal) <sup>4,5</sup>	-		0.01	-	10,000	ms
Return Loss	0.01 - 15		-	16.5	-	dB
	15 - 21.2		-	16.5	-	
	21.2 - 30		-	14.0	-	
Output Power Max <sup>6</sup>	0.01 - 21		+20	+23	-	dBm
	21 - 27		+17	+19	-	
	27 - 30		+14	+17	-	
Output Power Min <sup>6</sup>	0.01 - 30		-	-47	-45	dBm
Output Power Accuracy <sup>6</sup>	0.01 - 30		-	±1.00	-	dB
Power Resolution (nominal) <sup>7</sup>	0.01 - 30		-	0.5	-	dB
RF Off Output Level	0.01 - 15		-	-70	-	dBm
	15 - 30		-	-80	-	
Harmonics <sup>8</sup>	0.01 - 2	-45 to +20 dBm	-	-9	-	dBc
	2 - 8		-	-20	-	
	8 - 15		-	-30	-	
	15 - 30	-45 to -25 dBm	-	-30	-	
Sub-Harmonics <sup>8,9</sup>	15 - 30	-25 to Max Power	-	-60	-	dBc
		-45 to -25 dBm	-	-10	-	
Non-Harmonic Spurious	-		-	-60	-	dBc

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 (high-speed mode). 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. 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.



## TYPICAL PHASE NOISE (SSB), +25°C

Carrier Frequency (GHz)	Frequency Offset (dBc / Hz)				
	0.1 kHz	1 kHz	10 kHz	100 kHz	1000 kHz
0.05	-116	-130	-140	-143	-157
0.20	-106	-122	-131	-131	-155
0.40	-97	-116	-124	-125	-150
0.80	-91	-109	-118	-118	-144
1.60	-83	-103	-112	-112	-138
3.20	-81	-97	-106	-106	-129
6.40	-73	-92	-100	-100	-123
12.80	-67	-90	-95	-94	-118
15.00	-66	-89	-92	-92	-116
30.00	-60	-83	-86	-86	-110

## REGULAR PULSE MODULATION SPECIFICATIONS, +25°C

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

Parameter	Condition		Min.	Typ.	Max.	Unit
Pulse Width Resolution	Nominal value		0.05	-	-	μs
Pulse Width <sup>10, 11</sup>	Measured at the 50% of pulse level		0.5	-	10e6	μs
Pulse Period <sup>10</sup>	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 <sup>12</sup>	Measured between 10% and 90% of pulse level		-	0.1 / 0.02	-	μs
Pulse Width Accuracy <sup>13</sup>	Measured at 50% of pulse level	Internal Pulse Modulation	-	±3	-	%
		External Pulse Modulation	-	±3	-	
External Pulse Modulation Input Threshold	External Pulse Modulation		-	-	3	V
Trigger Response Delay	Trigger edge to 50% of pulse level		-	1	-	μs
Pulse Power Ratio	PWR <sub>OUT</sub> = 0 dBm, FREQ <sub>OUT</sub> = 10 MHz		-	58	-	dB
	PWR <sub>OUT</sub> = +10 dBm, FREQ <sub>OUT</sub> = 30 GHz		-	50	-	

10. Pulse Width must be less than pulse period by at least 0.5 μs.

11. Pulse Widths below 0.5 μs can be set, however performance is only guaranteed for 0.5 μs and up.

12. Pulse Rise Time will increase with pulse interval under 3 μs.

13. Pulse Width Accuracy is 3% of pulse width, or ±100 ns, whichever is greater.

**DYNAMIC PULSE MODULATION SPECIFICATIONS, +25°C**

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

Parameter	Condition		Min.	Typ.	Max.	Unit
Pulse Width Resolution	Nominal value		0.05	-	-	μs
Pulse Width <sup>10, 11</sup>	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	
Duty Cycle (in Free Run)	Pulse Width divided by Pulse Period		0.0001	-	99.9999	%
Rise / Fall Time <sup>12</sup>	Measured between 10% and 90% of pulse level		-	0.1 / 0.02	-	μs
Pulse Width Accuracy <sup>13</sup>	Measured at 50% of pulse level	Internal Pulse Modulation	-	±3	-	%
Pulse Power Ratio <sup>14</sup>	PWR <sub>OUT</sub> = 0 dBm, FREQ <sub>OUT</sub> = 10 MHz		-	58	-	dB
	PWR <sub>OUT</sub> = +10 dBm, FREQ <sub>OUT</sub> = 30 GHz		-	50	-	

10. Pulse Width must be less than pulse period by at least 0.5 μs.

11. Pulse Widths below 0.5 μs can be set, however performance is only guaranteed for 0.5 μs and up.

12. Pulse Rise Time will increase with pulse interval under 3 μs.

13. Pulse Width Accuracy is 3% of pulse width, or ±100 ns, whichever is greater.

14. Average Power Ratio of the signal in the "on" portion of the pulse to the average power of the signal in the "off" portion of the pulse.

**REFERENCE, TRIGGER & DC POWER, +25°C**

Parameter	Condition		Min.	Typ.	Max.	Unit
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
	Frequency Accuracy	Using Internal Reference	-	±1	-	ppm
	Power	-	-	±5.5	-	dBm
Trigger Out <sup>14</sup>	Low		0	-	0.4	V
	High		3	-	5	
Trigger In	Low		0	-	0.4	
	High		3	-	5	
Supply Voltage (lower)	-		5.6	6	6.4	V <sub>DC</sub>
Supply Voltage (upper)	-		11.4	12	12.6	
Supply Current, 6V (lower) <sup>15</sup>	-		-	1250	1850	mA
Supply Current, 12V (upper)	-		-	650	800	
USB Current <sup>16</sup>	-		-	0	-	

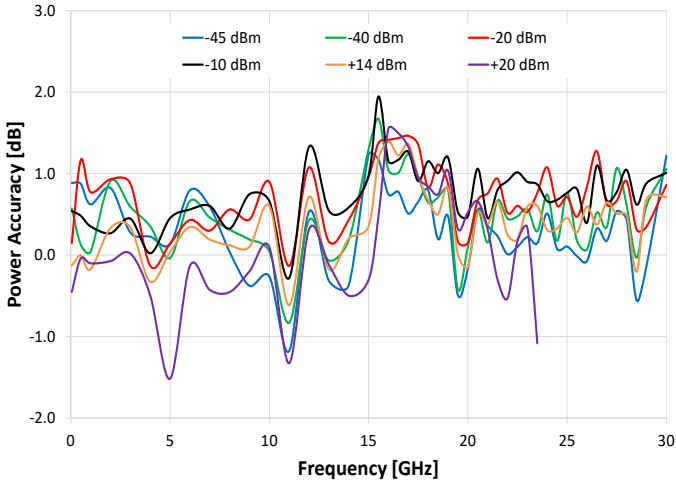
15. Trigger Out voltage specified with impedance load of 10 kΩ minimum.

16. All power is drawn from power adaptor, USB is used for control only.

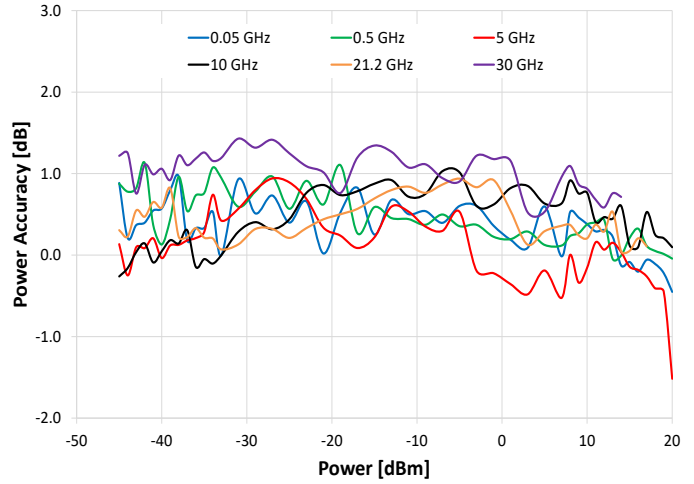


### TYPICAL PERFORMANCE GRAPHS

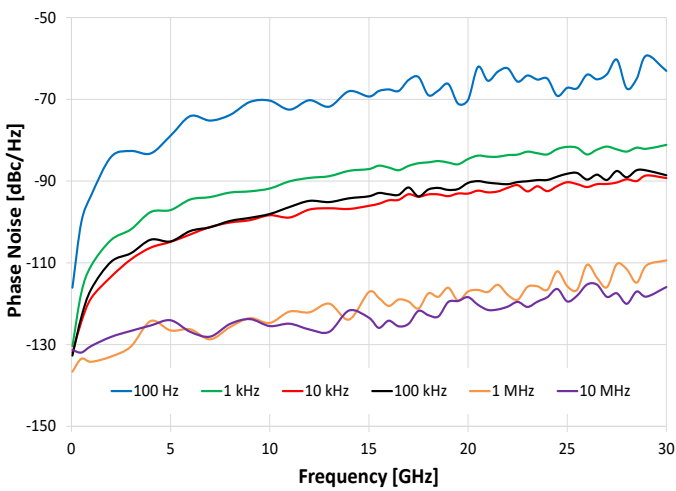
Power Accuracy vs. Output Frequency



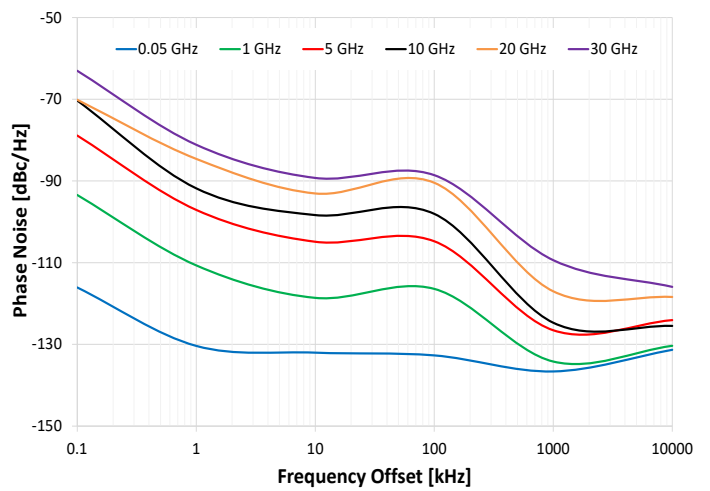
Power Accuracy vs. Output Power



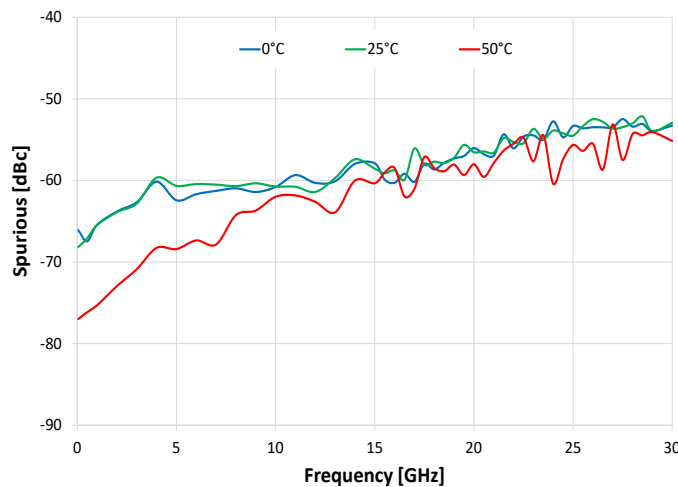
Phase Noise vs. Output Freq. at Frequency Offsets



Phase Noise vs. Offset Freq. at Frequency Output



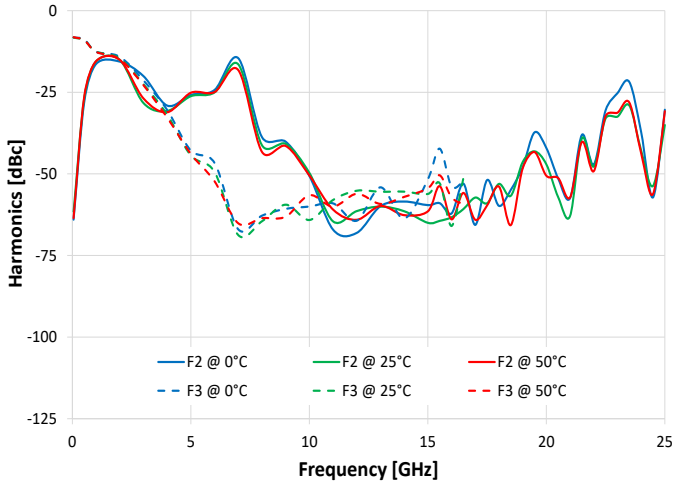
Spurious vs. Output Frequency @ PWR= +5 dBm



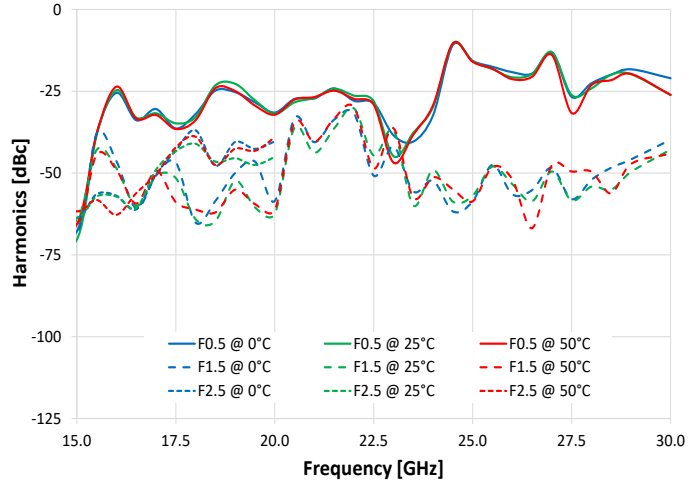


### TYPICAL PERFORMANCE GRAPHS (CONTINUED)

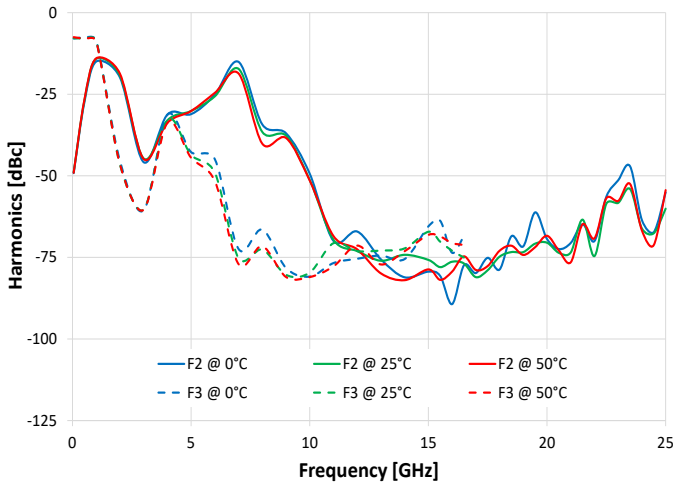
#### Harmonics vs. Output Frequency @ -45 dBm



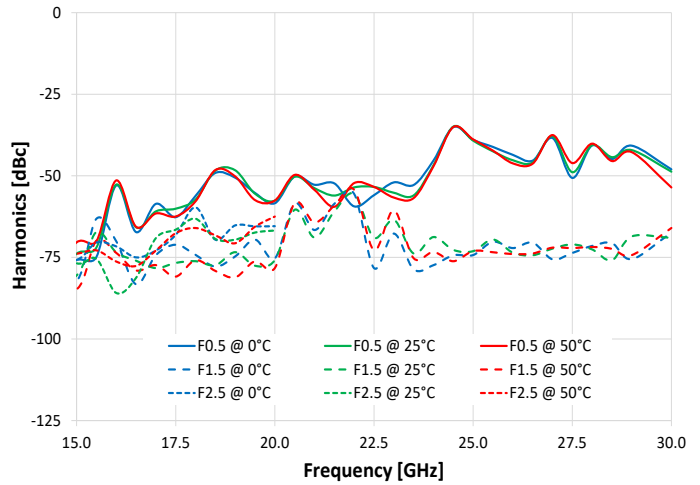
#### Sub-Harmonics vs. Output Frequency @ -45 dBm



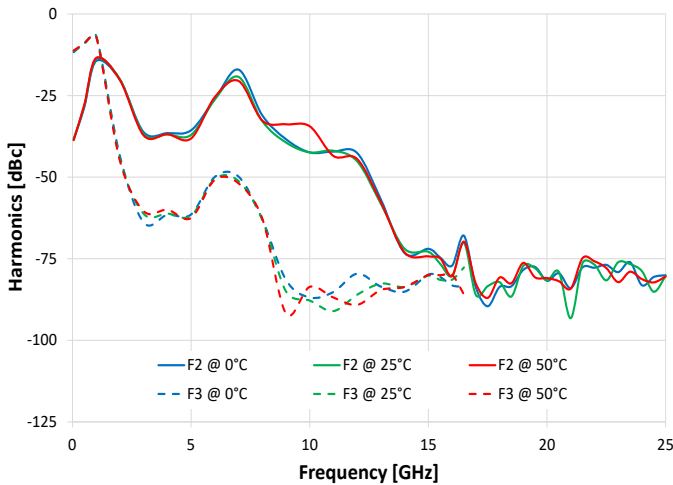
#### Harmonics vs. Output Frequency @ -20 dBm



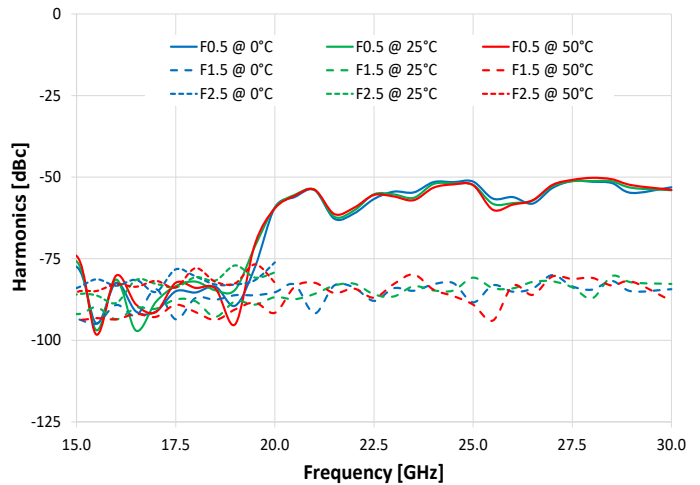
#### Sub-Harmonics vs. Output Frequency @ -20 dBm



#### Harmonics vs. Output Frequency @ +10 dBm



#### Sub-Harmonics vs. Output Frequency @ +10 dBm





## CONTROL INTERFACES

<b>Ethernet Control</b>	Supported Protocols	TCP / IP, HTTP, Telnet, SSH, DHCP, UDP (limited)
	Max Data Rate	100 Mbps (100 Base-T Full Duplex)
<b>USB Control</b>	Supported Protocols	HID (Human Interface Device) - High-speed
	Min Communication Time <sup>17</sup>	500 μs typ (full transmit/receive cycle)

17. USB Min Communication Time is based on the polling interval of the USB HID protocol (125 μs polling interval, 64 bytes per packet), medium CPU load and no other high-speed USB devices using the USB bus.

## SOFTWARE & DOCUMENTATION

Mini-Circuits' full software and support package including user guide, Windows GUI, API, programming manual and examples can be downloaded free of charge (refer to the last page for the download path).

A comprehensive set of software control options is provided:

- GUI for Windows – Simple software interface for control via Ethernet and USB.
- Programming / automation via Ethernet:
  - Complete set of control commands which can be sent via any supported protocol.
  - Simple to implement in the majority of modern programming environments.
- Programming / automation via USB:
  - DLL files provide a full API for Windows with a set of intuitive functions which can be implemented in any programming environment supporting .Net Framework or ActiveX.
  - Direct USB programming is possible in any other environment (not supporting .Net or ActiveX).

Please contact [testsolutions@minicircuits.com](mailto:testsolutions@minicircuits.com) for support.

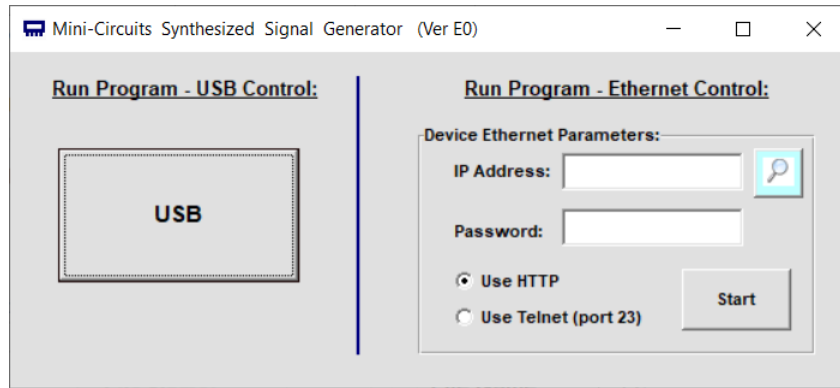
## MINIMUM SYSTEM REQUIREMENTS

<b>GUI</b>	Windows 7 or later
<b>USB API DLL</b>	Windows 7 or later and programming environment with ActiveX or .NET support
<b>USB Direct Programming</b>	Linux, Windows 7 or later
<b>HTTP, Telnet or SSH</b>	Any computer with a network port and Ethernet-TCP/IP (HTTP, Telnet or SSH protocols) support
<b>Hardware</b>	Intel i3 (or equivalent) or later

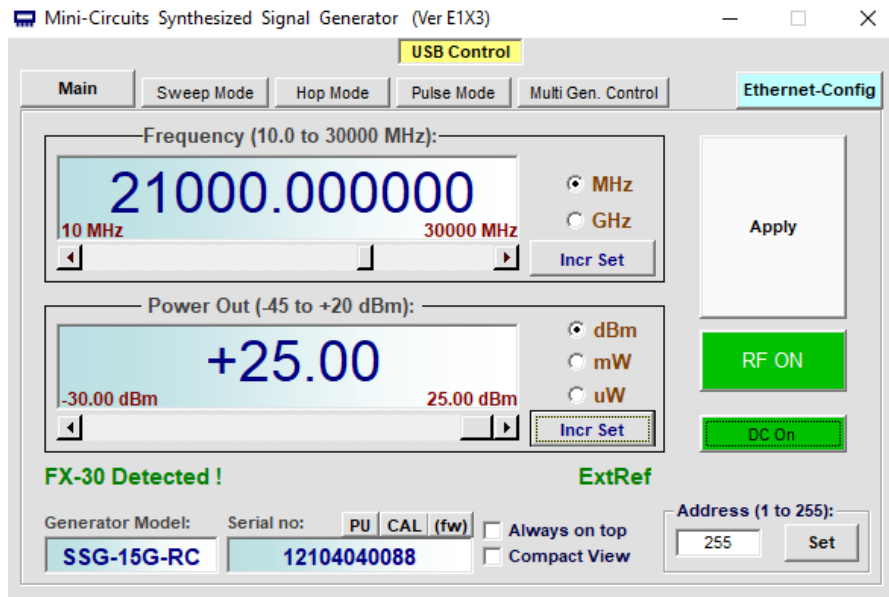


### GRAPHICAL USER INTERFACE (GUI) FOR WINDOWS - KEY FEATURES

- Connect via USB or Ethernet
- Password protected access for safe remote usage over Ethernet



- Configure output power, frequency, pulse modulation
- Program timed signal output sequences (linear sweep and frequency hop)
- Control timed sequences in multiple generators simultaneously
- Track unit operation time since last calibration and setup calibration reminders

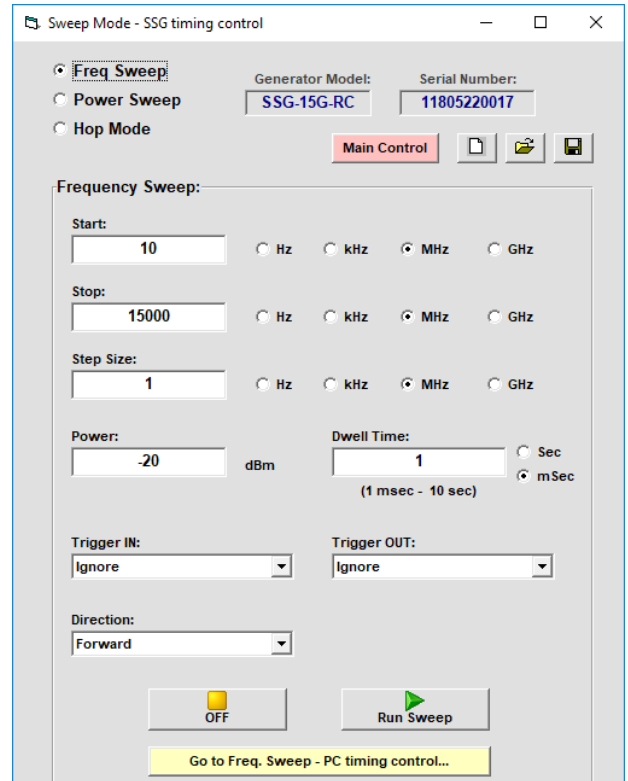






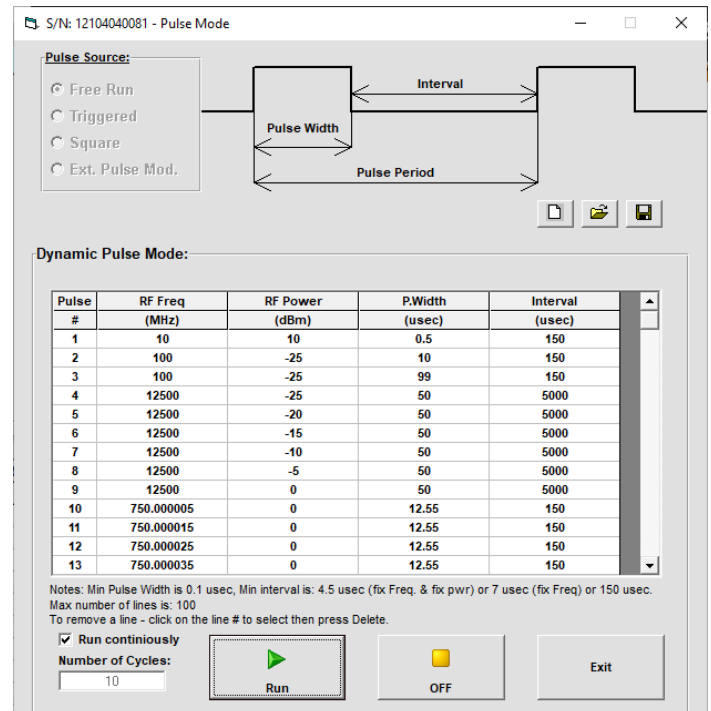
### AUTOMATED SWEEP / HOP SEQUENCES

- 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.



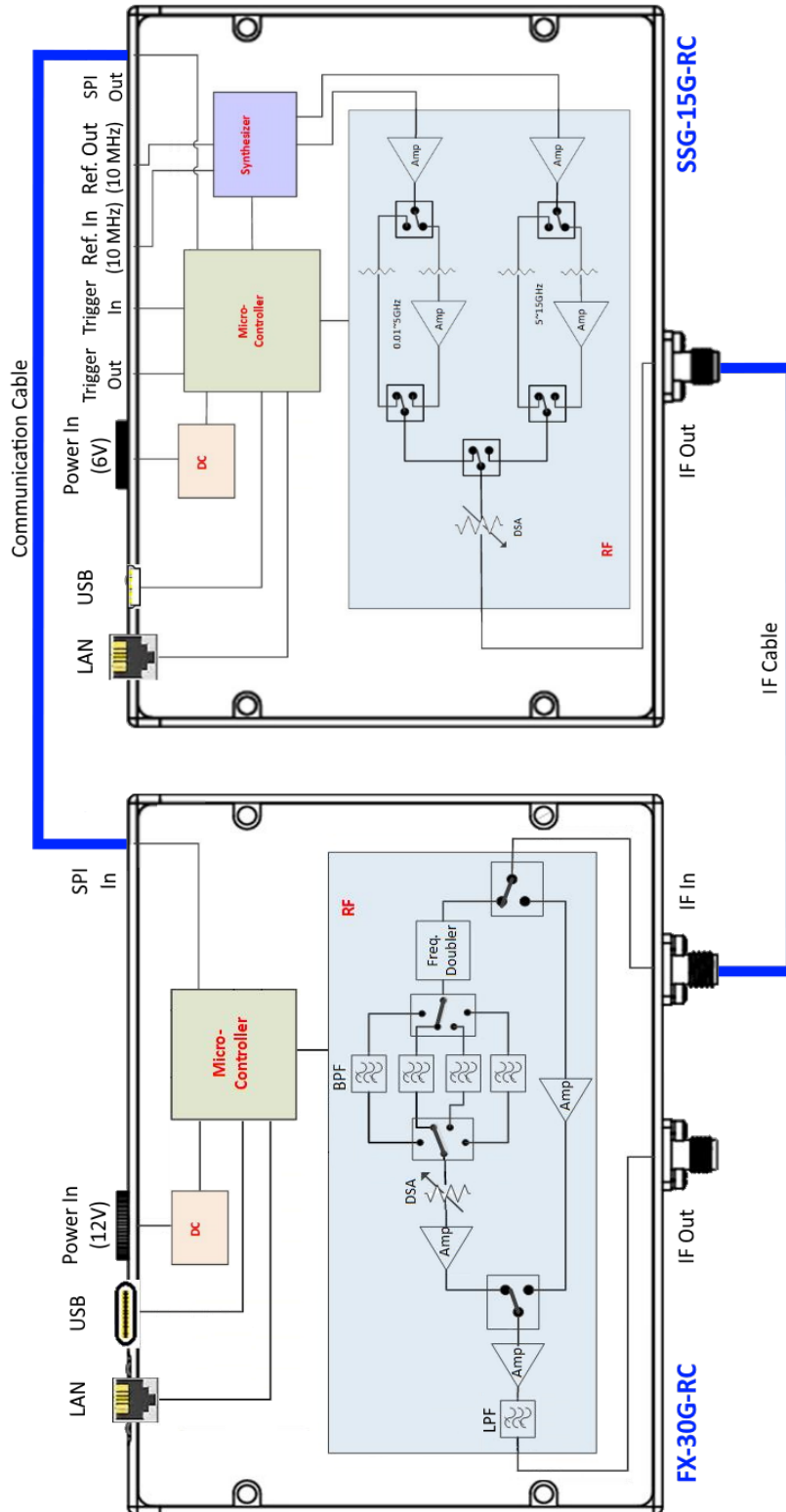
### DYNAMIC PULSE MODULATION

- 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.





### BLOCK DIAGRAM

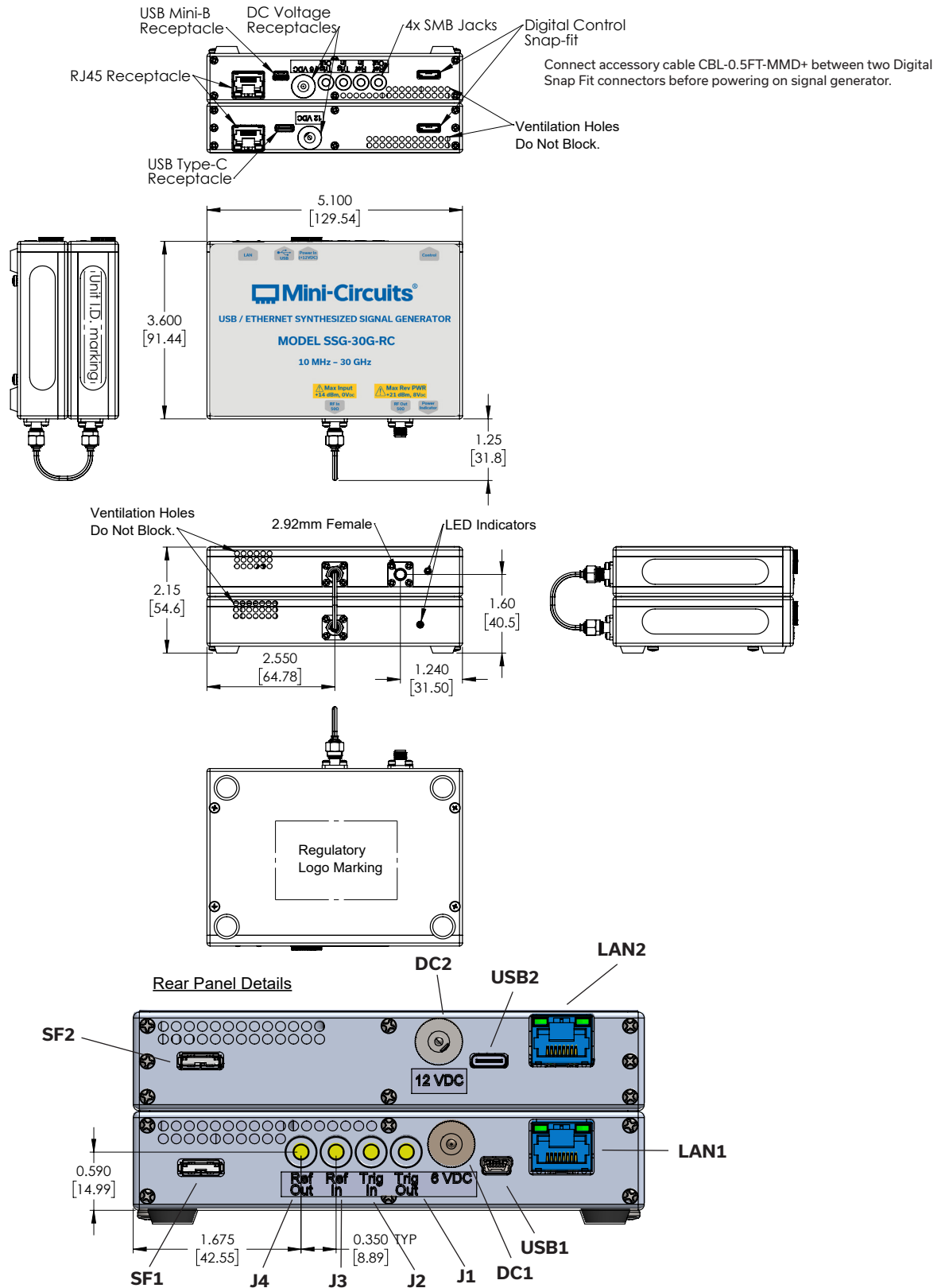


**Notes:**

USB / Ethernet control connection(s) are made to the SSG-15G-RC module. The USB / Ethernet connections on the FX-30G-RC model are not used in this configuration. The appropriate DC power supplies must be connected to both modules.



### CASE STYLE DRAWING (SL3512)



**CONNECTIONS**

Name	Connector Type	Description
J1	SMB Male	Trigger Out
J2	SMB Male	Trigger In
J3	SMB Male	Reference In
J4	SMB Male	Reference Out
DC1	2.1 mm DC Socket	DC Power In (6V) <sup>18</sup>
USB1	USB Type Mini-B Female	USB Port for control of the module
LAN1	RJ45 Socket	Network (Ethernet/LAN)
SF1	Digital Snap Fit	Serial Control Interconnection, connect accessory cable between SF1 & SF2
J5	2.92 mm Female	RF Output
DC2	2.1 mm DC Socket	DC Power In (12V) <sup>18</sup>
USB2	USB Type C	USB Port for factory usage
LAN2	RJ45 Socket	Network for factory usage
SF2	Digital Snap Fit	Serial Control Interconnection, connect accessory cable between SF1 & SF2

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

**ABSOLUTE MAXIMUM RATINGS <sup>19, 20</sup>**

Operating Temperature		0°C to 50°C
Storage Temperature		-20°C to 60°C
Power In @ Reference In		+10 dBm
Reverse Power (DC) @ Reference Out		8 V <sub>DC</sub>
Reverse Power (DC) @ RF Out		16 V <sub>DC</sub>
Reverse Power (RF) @ RF Out <sup>21</sup>	0.01 - 15 GHz	+22 dBm
	15 - 30 GHz	+21 dBm
Voltage Input to Trigger Ports		-0.3V <sub>DC</sub> to +5.5V <sub>DC</sub>

19. Permanent damage may occur if any of these limits are exceeded.

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

21. Model can handle max output power into Open or Short.



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50Ω 0.01 to 30 GHz -47 dBm to +23 dBm 2.92 mm female






DETAILED MODEL INFORMATION IS AVAILABLE ON OUR WEBSITE [CLICK HERE](#)

Performance Data & Graphs	Data Graphs
Case Style	SL3512
Environmental Rating	ENV55
Software, User Guide & Programming Manual	<a href="https://www.minicircuits.com/softwaredownload/sg.html">https://www.minicircuits.com/softwaredownload/sg.html</a>
Regulatory Compliance	<p>Refer to user guide for compliance information</p>  <p><a href="https://www.minicircuits.com/app/AN49-003.pdf">https://www.minicircuits.com/app/AN49-003.pdf</a></p>
Support	<a href="mailto:testsolutions@minicircuits.com">testsolutions@minicircuits.com</a>

## INCLUDED ACCESSORIES

	Qty.	Part No.	Description
	1	AC/DC-6-3W	AC/DC Grounded Power adapter, 0°C to +40°C AC Input: 100-240 V, 50/60 Hz, $I_{Max} = 1.2A$ DC Output $6\pm0.3V$ , $I_{Max} = 3A$
	1	AC/DC-12-3W	AC/DC Grounded Power adapter, 0°C to +40°C AC Input: 100-240 V, 50/60 Hz, $I_{Max} = 1.2A$ DC Output $12\pm0.6V$ , $I_{Max} = 3A$
(Refer to power cord table)	2	CBL-3W-xx	AC power cord (IEC C13 connector to local plug) Select an option from the AC power cord list with each unit.
	1	CBL-0.5FT-MMD+	6.0 in. (15.0 cm) control cable for connecting the SSG to 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
	2	CBL-5FT-BMSMB+	5.0 ft (1.5 m) Trigger cable: BNC (male) to SMB (Female)

## AC POWER CORD OPTIONS <sup>22</sup>

United States	Europe	United Kingdom	Australia and China	Israel
				
CBL-3W-US	CBL-3W-EU	CBL-3W-UK	CBL-3W-AU	CBL-3W-IL

22. Select one option from the list with each unit. Please contact [testsolutions@minicircuits.com](mailto:testsolutions@minicircuits.com) if your region is not listed.





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### OPTIONAL ACCESSORIES

Part No.	Description
MUSB-CBL-3FR+	3.3 ft (1.0 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+	5.0 ft (1.5 m) network cable: RJ45 (Male) to RJ45 (Male) Cat 5E cable
CBL-5FT-BMSMB+ (spare)	5.0 ft (1.5 m) Trigger & Reference cable: BNC (male) to SMB (Female)

### CALIBRATION

Part No.	Description
CALSSG-30G-RC	Calibration Service for SSG-30G-RC <a href="#">CLICK HERE</a>

#### 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 <https://www.minicircuits.com/terms/viewterm.html>

