USB & ETHERNET & DAISY-CHAIN
Signal Generator
SSG-8N12G-RC

50Ω   8 to 12.5 GHz   -55 dBm to +23 dBm   SMA Female

THE BIG DEAL
- Cost effective X-band signal generator
- High output power, +23 dBm
- Excellent harmonics & phase noise
- CW, pulsed, AM, FM & chirp outputs
- Compact design for bench top use
- Power over Ethernet (PoE) enabled
- Daisy-chain for multi-module dynamic control

APPLICATIONS
- Semiconductor high power burn-in & life testing
- Benchtop signal generator
- Automated production test systems
- X-band radar testing
- Quantum computing

Generic photo used for illustration purposes only

PRODUCT OVERVIEW

Mini-Circuits' SSG-8N12G-RC is a wide-band signal generator operating from 8 to 12.5 GHz. With up to +23 dBm typical output power, it is an ideal signal source for characterization of millimeter wave components and systems at high power. Configure CW / single-tone outputs, flexible pulse sequences, AM, FM and Chirp modulations, or automated frequency / power sweep & hop sequences.

SSG-8N12G-RC has been developed in a compact package with powerful software control and automation to provide a cost effective X-band signal generator and LO source for any bench or production test application. This is a high quality, repeatable and reliable signal source with low phase noise and excellent harmonic rejection.

The generator can be controlled via USB or Ethernet (supporting SSH, HTTP & Telnet protocols). Full software support is provided, including our user-friendly GUI application for Windows, flexible API and programming instructions for Windows and Linux environments. The daisy-chain control interface with "dynamic addressing" simplifies control integration and allows multiple units to be combined into a multi-channel signal source with control through a single software interface.

KEY FEATURES

Feature	Advantages
High quality signal source	Outstanding combination of fine frequency and power resolution, low phase noise and excellent harmonic rejection, and low spurious signals in a compact package; suited to a wide range of test applications.
Flexible pulse, AM, FM and Chirp modulation	Configure various analog modulations according to your needs
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.
Dynamic daisy-chain control	Simplify control software and interconnections and develop low-cost, multi-channel signal generator systems by daisy-chaining multiple units with control through a single interface.

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ELECTRICAL SPECIFICATIONS [1], +25°C

Parameter	Condition (GHz)		Min.	Typ.	Max.	Unit
Output Frequency	-		8	–	12.5	GHz
Frequency Resolution [2]	8 - 12.5		–	1	–	Hz
Frequency Accuracy	Using internal reference		–	±1	–	ppm
Return Loss	8 - 12.5		–	-10	–	dB
Output Power Max	8 - 12.5		+20	+23	–	dBm
Output Power Min	8 - 12.5		–	-55	-50	dBm
Power Resolution (nominal)	8 - 12.5		–	0.1	–	dB
Output Power Accuracy	8 - 12.5	-50 to +20 dBm	–	±0.5	±1.0	dB
RF Output Leakage	8 - 12.5	RF off	–	-80	–	dBm
Harmonics	8 - 12.5	-50 to +20 dBm	–	-30	–	dBc
Non-Harmonic Spurious	Offsets 1 MHz to 150 MHz	-50 to +20 dBm	–	-70	-60	dBc
	Offsets 1 kHz to 1 MHz		–	-35	-30	
Boundary Spurs	8 - 12.5		–	-40	–	
Settling Time [3, 4]	Hop mode [5]	8 - 12.5	–	0.12	0.20	ms
	Frequency sweep	8 - 12.5	–	0.15	0.22	
	Power transition (at set frequency)		–	0.015	–	
	PC (external) control		–	2	–	
Dwell Time (nominal) [4, 6]	–		0.01	–	10,000	ms
Phase Offset Range	–		0	–	359	deg
Phase Offset Resolution	–		–	1	–	

1. Specifications are after 15 minutes warm-up time.
2. Frequency Resolution is tested with 10 MHz external reference.
3. Settling Time - transition time between 2 output states. During the transition, RF output is turned off to avoid transient outputs.
4. Generator response time is Dwell Time + Settling Time.
5. For hop sequences pre-loaded into internal memory (high-speed mode).
6. Dwell Time - duration of each signal point in a Sweep or Hop sequence set by user. Default is minimum dwell time.

MODULATION SPECIFICATIONS, [7] +25°C

Parameter	Condition		Min.	Typ.	Max.	Unit
Modulation types	AM, FM, Chirp, Pulse (Rising, Falling and bi-directional)					
Max modulation freq	3 dB point		–	–	5	kHz
FM Max deviation	–		–	50	–	MHz
AM Modulation depth [8]	–		0	–	100	%
Chirp rate	Nominal value		0.0015	–	20	MHz/μs
Pulse Width Resolution	Nominal value		0.05	–	–	μs
Pulse Width [9, 10]	Measured at the 50% of pulse level	Internal Pulse Modulation	5	–	10e6	μs
		External Pulse Modulation	5	–	10e6	
Pulse Period (regular mode)	Measured at the 50% of pulse level	Internal Pulse Modulation	10	–	10e6	μs
		External Pulse Modulation	10	–	10e6	
Pulse interval [11]	Fixed freq. & Power	Measured at the 50% of pulse level	7	–	4e6	μs
	Varying freq. & Power		150	–	4e6	
Pulse Rise / Fall Time [12, 13]	Measured between 10% and 90% of pulse level		–	60 / 30	–	ns
Pulse Width Accuracy [14]	Measured at 50% of pulse level	Internal pulse modulation	–	±10	–	%
		External pulse modulation	–	±10	–	
External pulse modulation input threshold	External pulse modulation		3	–	–	V
Trigger Response Delay	Trigger edge to 50% of pulse level	Internal pulse modulation	–	1	–	μs
		External pulse modulation	–	2	–	
Pulse Power Ratio	PWR$_{OUT}$ = +20 dBm, FREQ$_{OUT}$ = 8 GHz		–	70	–	dB
	PWR$_{OUT}$ = +20 dBm, FREQ$_{OUT}$ = 12.5 GHz		–	70	–	

7. Regular pulse mode has fixed frequency and power supporting internal and external modulation and input / output trigger options. Dynamic mode allows for flexible RF pulse sequences with varying frequency, power pulse width and pulse repetition interval (PRI).
8. In AM modulation, ensure there is sufficient margin between the carrier power and Generator's Min/Max power spec to allow generating the modulated signal without distortions. For example a modulation depth of 50% translates to power of +1.76 dB to -3.01 dB from the carrier.
9. Pulse Width in normal mode must be less than pulse period by at least 0.5 μs with Internal pulse modulation and by 2 μs in external pulse modulation.
10. Pulse Widths below 0.5 μs can be set, however performance is only guaranteed for the ranges noted in the table.
11. In dynamic mode.
12. Pulse rise time will increase with pulse interval under 3 μs.
13. For signals at same power & frequency.
14. Pulse Width Accuracy is 3% of pulse width, or ±100 ns, whichever is greater.

PHASE NOISE (SSB), +25°C

Frequency Offset (kHz)	Carrier Frequency (GHz)					
	8		10		12.5	
	Typ.	Max	Typ.	Max	Typ.	Max
1	-94.5	-92.5	-92.5	-90.5	-91.0	-88.5
10	-105.5	-103.0	-101.0	-112.5	-101.5	-99.0
100	-113.5	-111.0	-111.0	-108.5	-109.5	-107.0
1,000	-120.5	-117.5	-118.5	-116.0	-111.5	-109.0
10,000	-144.0	-140.0	-145.0	-141.0	-144.0	-141.0
Noise Floor	-150.0	-146.0	-150.0	-146.0	-150.0	-146.0

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	–	+12.5	dBm
	Phase noise	10 kHz Offset	–	-135	–	dBc/Hz
Reference Out	Frequency	–	–	10	–	MHz
	Frequency accuracy	Using internal reference	–	±1	–	ppm
	Power	–	–	+10	–	dBm
	Phase noise	10 kHz Offset	–	-140	–	dBc/Hz
Trigger Out [15]	Low		0	–	0.4	V
	High		3.0	–	5.0	
	Pulse width		–	100	–	µs
Trigger In	Low		0	–	0.4	V
	High		3.0	–	5.0	
	Pulse width		–	1	–	µs
Supply Voltage (V_{DC})	DC Input port [16]		5.7	6.0	6.3	V_{DC}
Supply Current (I_{DC})			–	2.2	2.8	A
Supply Current (I_{DC})	USB port [16]		–	20	–	mA
Supply Voltage (V_{DC})	LAN port [16, 17]		50	53	57	V_{DC}
Supply Current (I_{DC})			–	300	450	mA

15. Trigger out voltage specified with impedance load of 10 kΩ minimum.
16. Model can not be powered via USB. Power must be provided via either 2.1mm DC Input or LAN port (using PoE systems).
17. Compliant with IEEE 802.3at mode A and mode B.

ABSOLUTE MAXIMUM RATINGS

Operating Temperature	0°C to 50°C
Storage Temperature	-20°C to 60°C
Power in @ Reference in	+15 dBm
Reverse Voltage (DC) @ Reference out	8 V_{DC}
Reverse Voltage (DC) @ RF out	15 V_{DC}
Reverse Power (RF) @ RF out	+24 dBm
Voltage input to trigger ports	-0.3V_{DC} to +5.5V_{DC}

Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.
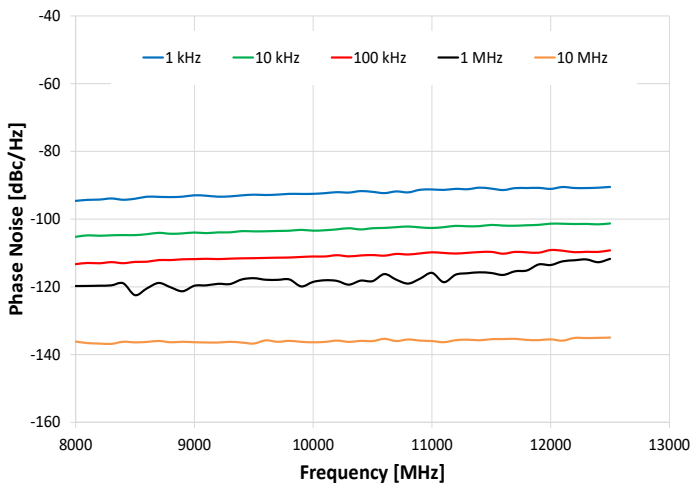
TYPICAL PERFORMANCE GRAPHS
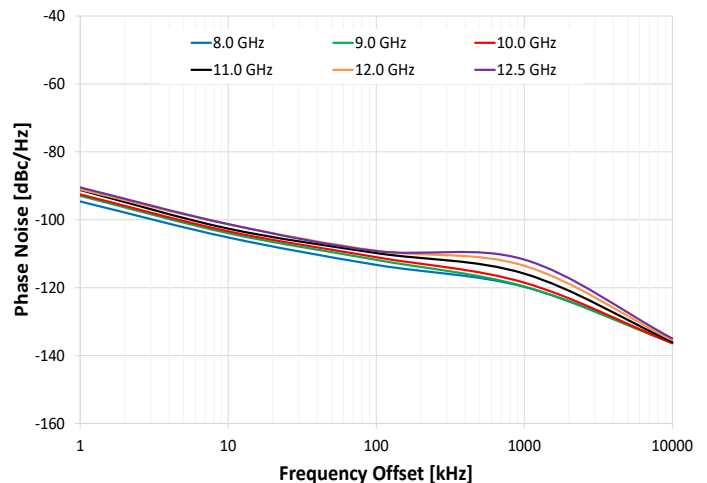
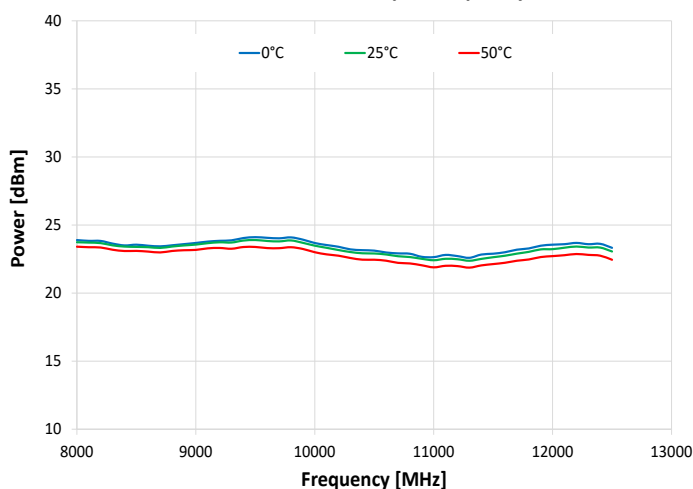**Power Accuracy vs. Output Frequency**
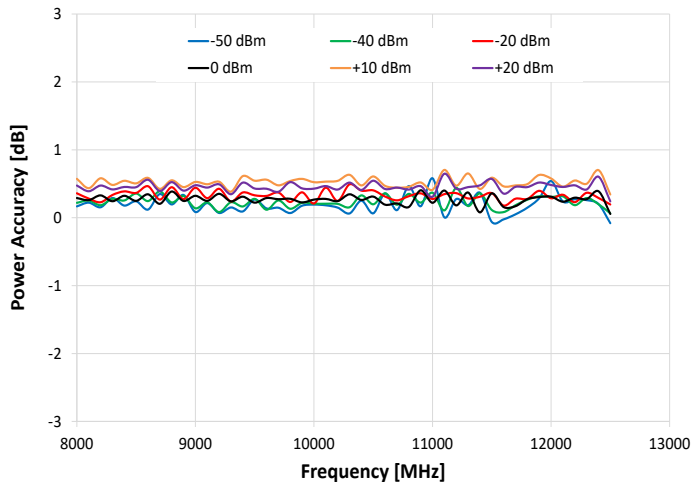
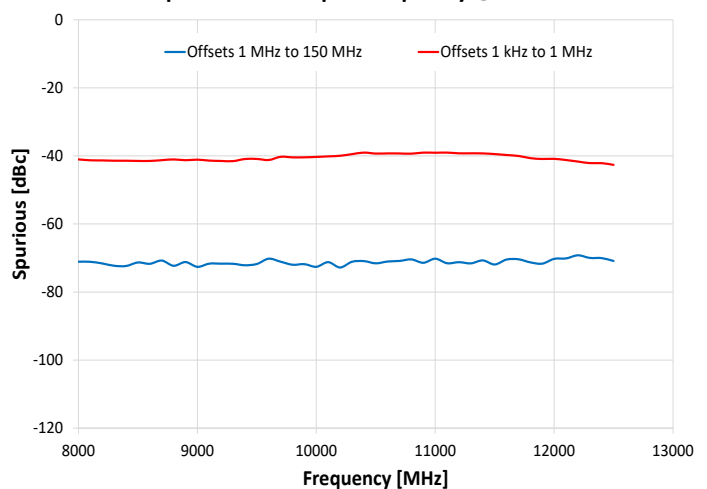**Power Accuracy vs. Output Power**
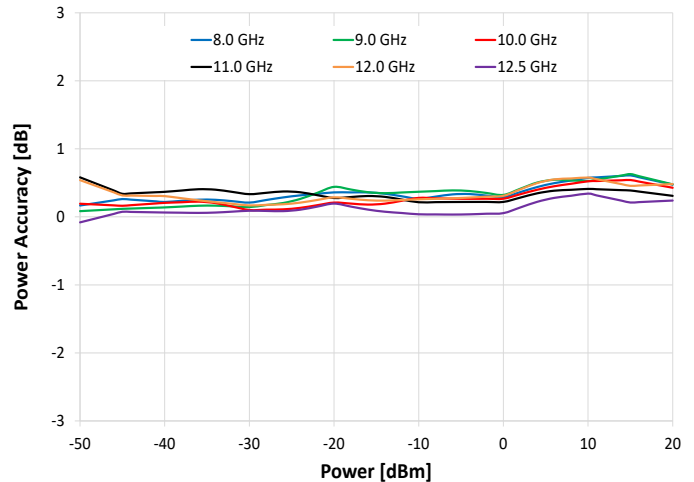
Phase Noise vs. Output Frequency

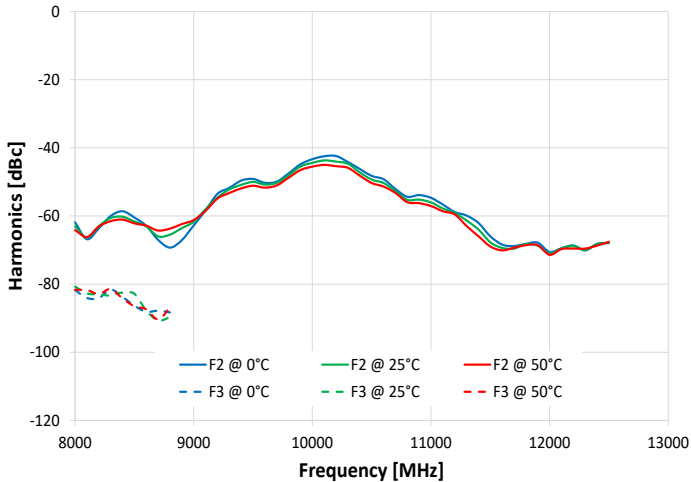**Phase Noise vs. Offset Frequency**

Max Power vs. Output Frequency
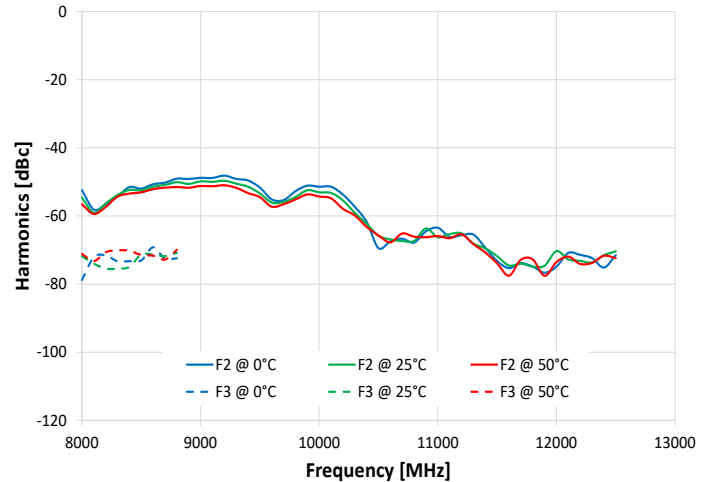

Spurious vs. Output Frequency @ +10 dBm

Signal Generator

SSG-8N12G-RC

50Ω   8 to 12.5 GHz   -55 dBm to +23 dBm   SMA Female

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TYPICAL PERFORMANCE GRAPHS (CONTINUED)

Harmonics vs. Output Frequency @ +20 dBm

Harmonics vs. Output Frequency @ 0 dBm

Harmonics vs. Output Frequency @ -20 dBm
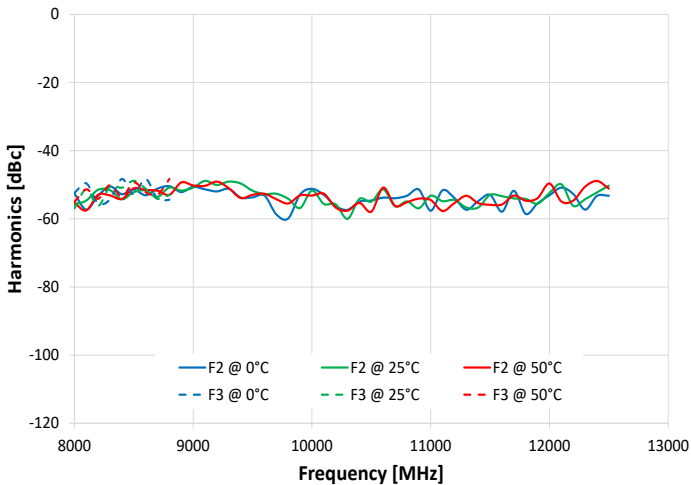
Harmonics vs. Output Frequency @ -40 dBm
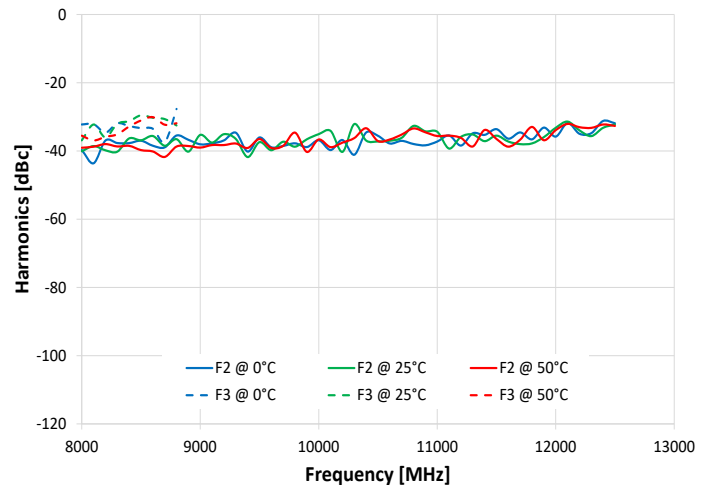
Harmonics vs. Output Frequency @ -50 dBm

Mini-Circuits®
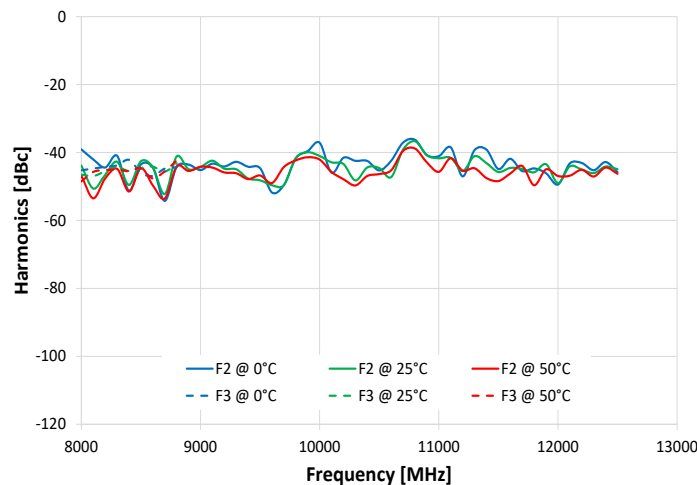
CONTROL INTERFACES

Ethernet Control	Supported Protocols	TCP / IP, HTTP, Telnet, SSH, DHCP, UDP (limited)
	Max Data Rate	1 Gbps (1000 Base-T Full Duplex)
USB Control	Supported Protocols	HID (Human Interface Device) - High-speed
	Min Communication Time [18]	400 μs typ (full transmit/receive cycle)

18. 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 for support.

MINIMUM SYSTEM REQUIREMENTS

| GUI	Windows 7 or later
USB API DLL	Windows 7 or later and programming environment with ActiveX or .NET support
USB Direct Programming	Linux, Windows 7 or later
HTTP, Telnet or SSH	Any computer with a network port and Ethernet-TCP/IP (HTTP, Telnet or SSH protocols) support
Hardware	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
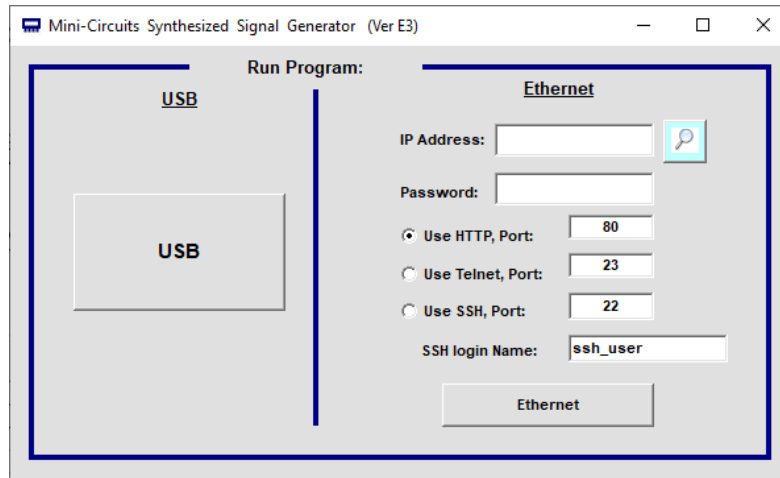
- Configure output power, frequency, pulse modulation
- Program timed signal output sequences (linear sweep and frequency hop)
- Control timed sequences in multiple generators simultaneously
- Track unit operation time since last calibration and setup calibration reminders
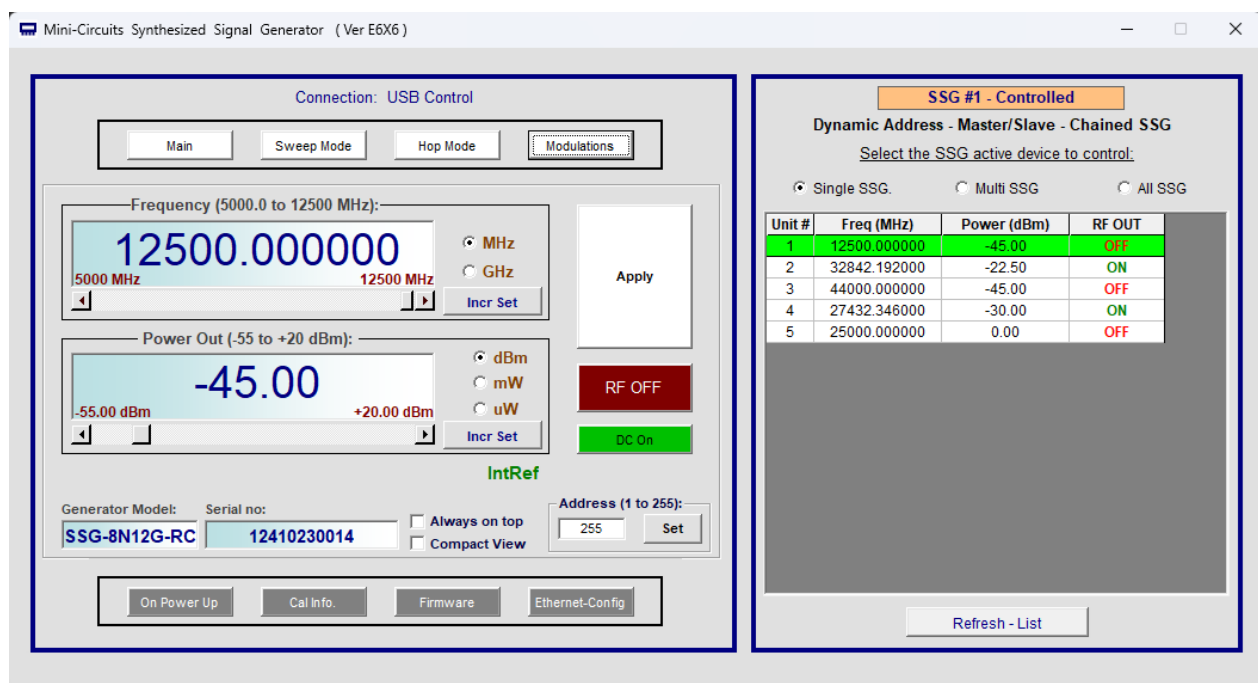
AUTOMATED SWEEP / HOP SEQUENCES

- 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.

MODULATION

- Select AM,FM, Chirp or Pulse modulation
- In the individual screens for each modulation specify the parameters for the modulated signal

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.
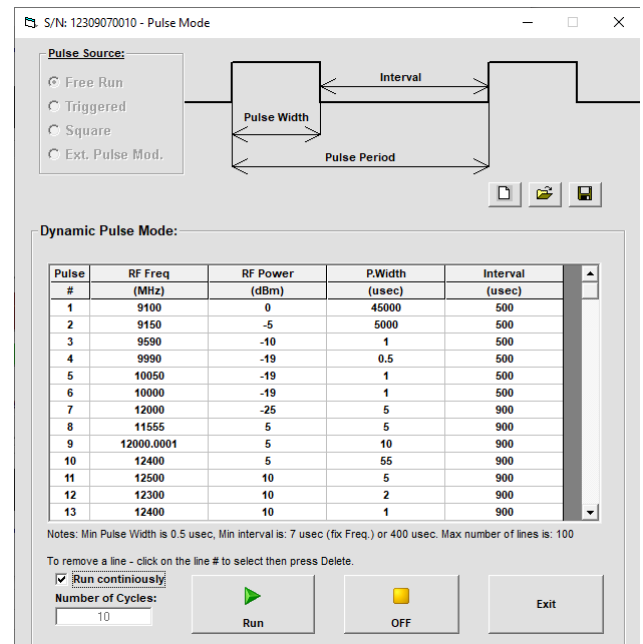

FREQUENCY MODULATION (FM)

- Set carrier power and frequency.
- Set modulating signal frequency.
- Set desired FM deviation.
- Select Sine or triangle wave modulating signal.
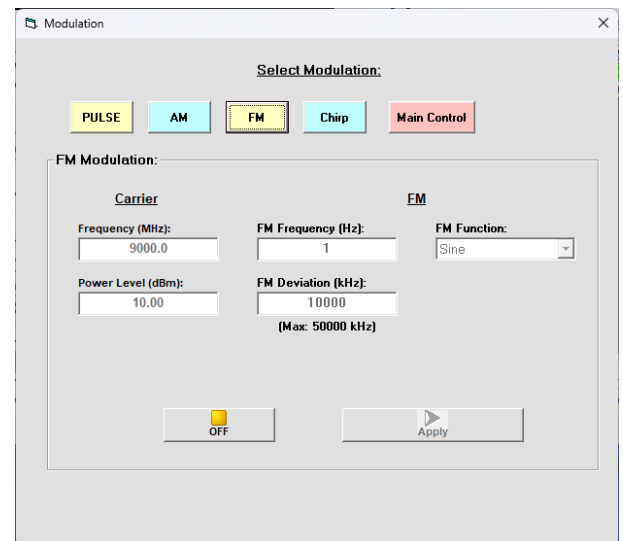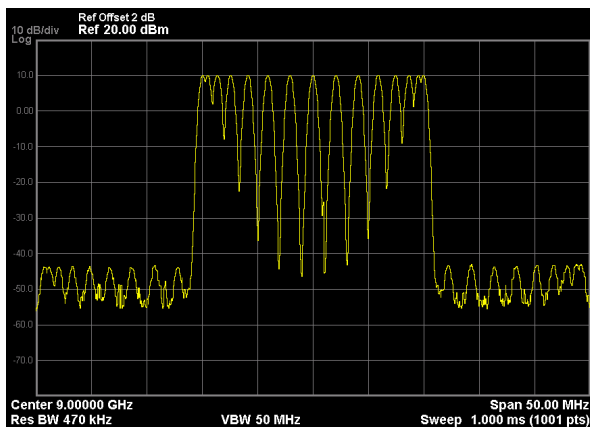
CONNECTING MULTIPLE MODULES (DAISY CHAIN)

The model is designed to connect up to 25 modules in series (daisy chain) using dynamic addressing, meaning there is no need to specifically set the address of the modules. The addresses will be set automatically as part of establishing the communications with the computer. The module connected to the computer's USB port or Ethernet connection will be assigned address 0 (master), the first module connected to it will get address 1 (slave) and subsequent modules incrementing up to address 24 (slave).
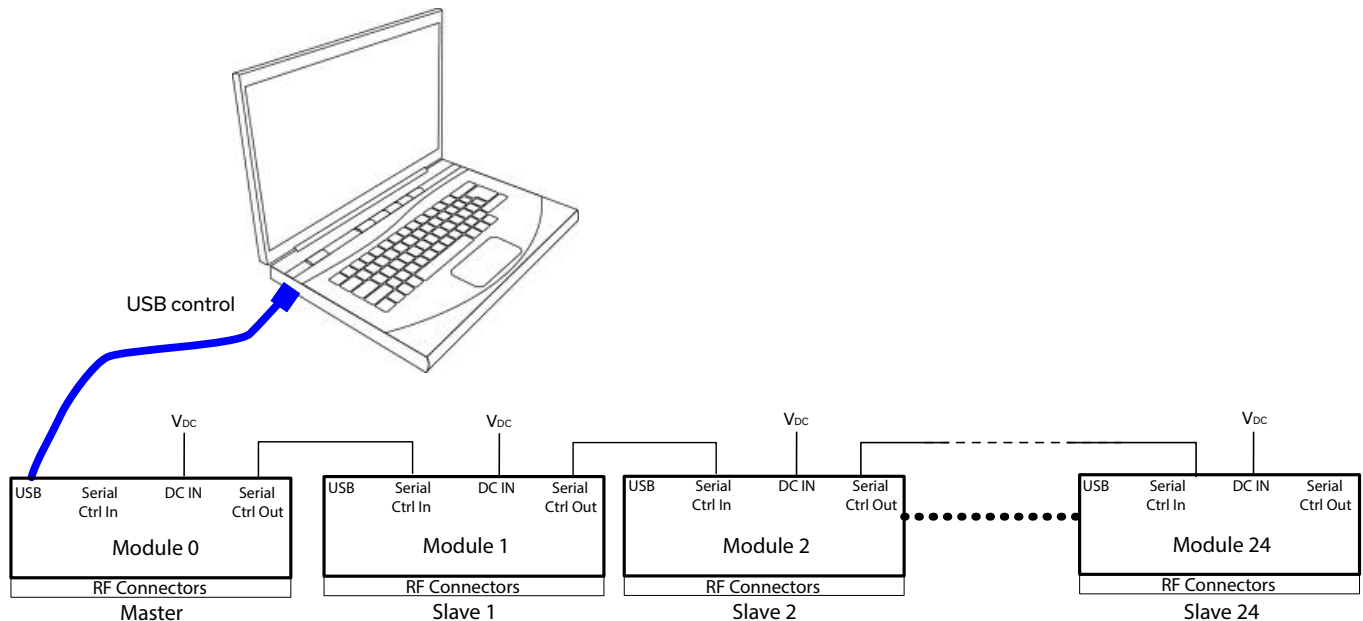

Connections between modules will be made using the serial in/out ports with the module connected to the PC act as a master and all other as slave modules. All control will be through the master module (address 0) which is the only one communicating with the PC or computer network. Serial control out port of each module should be connected to the serial control in port of the next module.

Power must be supplied to each module separately via their individual power supplies.

The serial master/slave bus allows connecting modules of different types to the same daisy chain as long as all support Mini-Circuits Dynamic addressing setup. To add a new module to the setup, simply connect the module and refresh the address listing, no need to reset any of the existing modules or assign addresses manually.
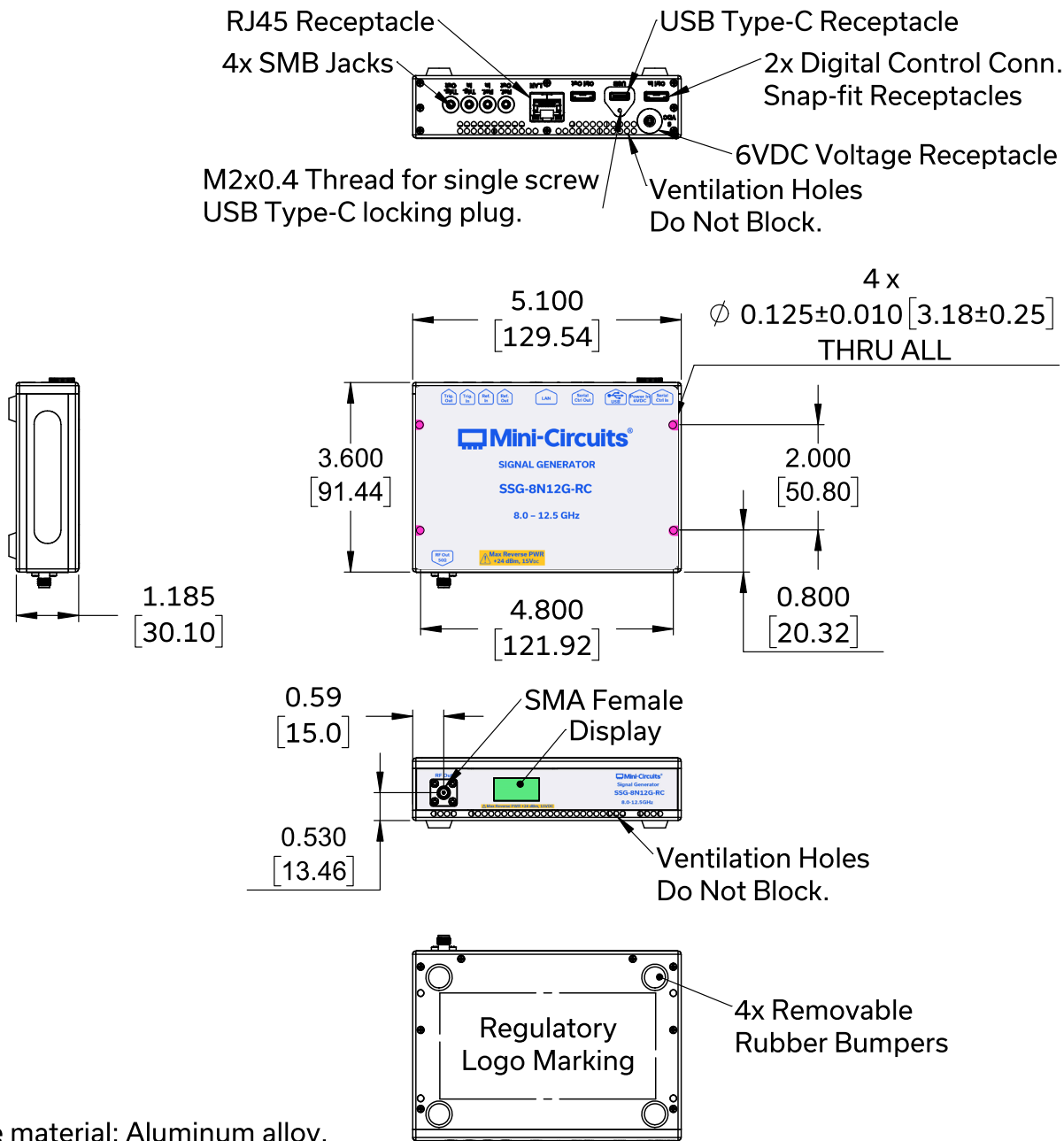
BLOCK DIAGRAM
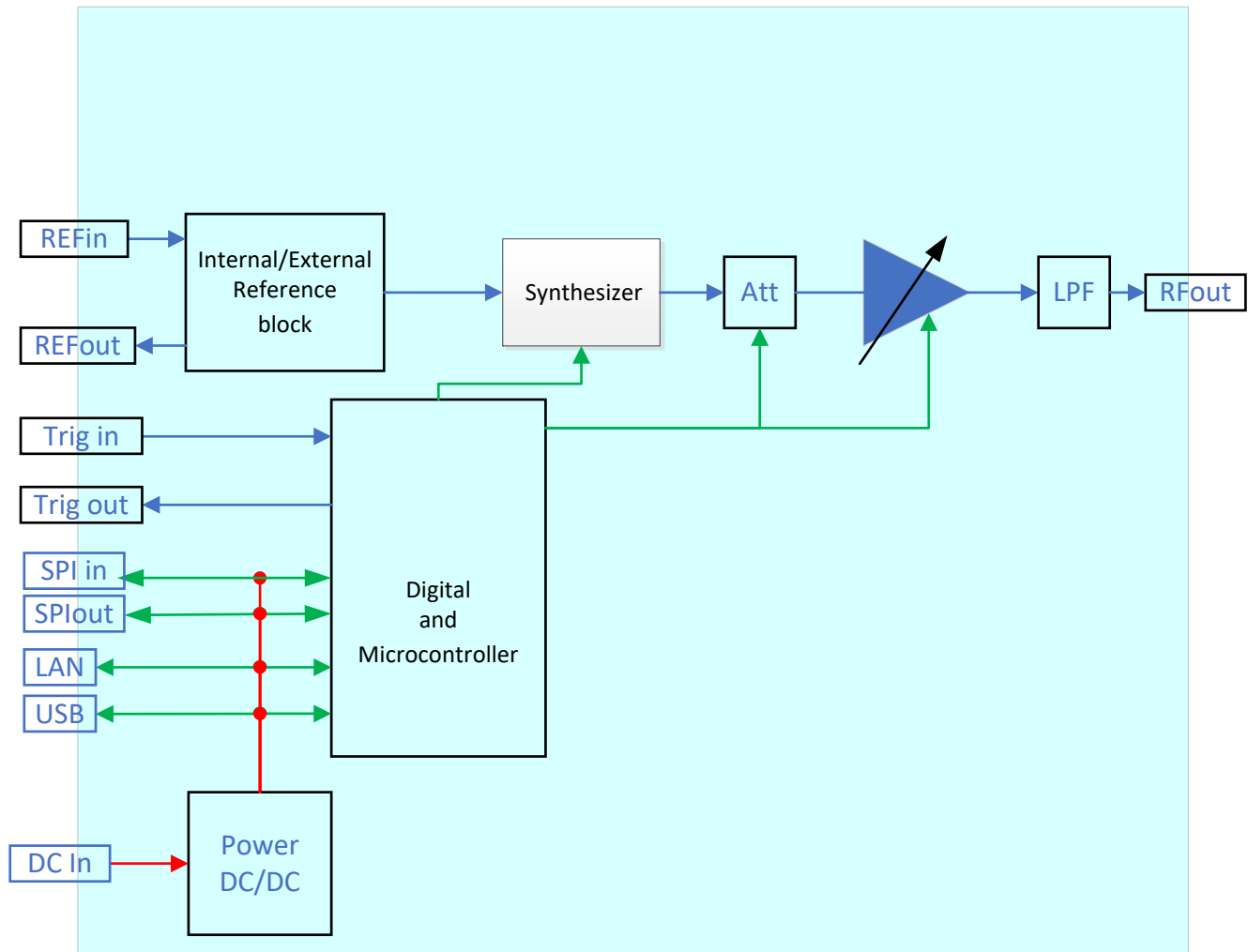
CONNECTIONS

Port Name	Connector Type
RF output	SMA-Female
Reference in	J4 SMB-Male
Reference out	J5 SMB-Male
Trigger in	J3 SMB-Male
Trigger out	J2 SMB-Male
Power in [19]	2.1 mm DC socket
USB port	USB type C female
Network (Ethernet/LAN)	RJ45 socket
Serial Out (Digital Control 1 port)	Digital Snap Fit Connector [20]
Serial In (Digital Control 2 port)	Digital Snap Fit Connector [20]

19. 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 12.5 GHz, -50 dBm, RF Off).
20. Mating connector is Hirose ST40X-10S-CV(30)

OUTLINE DRAWING (SL3643)

RJ45 Receptacle

4x SMB Jacks

USB Type-C Receptacle

2x Digital Control Conn.
Snap-fit Receptacles

6VDC Voltage Receptacle

M2x0.4 Thread for single screw
USB Type-C locking plug.

Ventilation Holes
Do Not Block.

5.100
[129.54]

4 x
∅ 0.125±0.010 [3.18±0.25]
THRU ALL

3.600
[91.44]

2.000
[50.80]

1.185
[30.10]

4.800
[121.92]

0.800
[20.32]

0.59
[15.0]

SMA Female
Display

0.530
[13.46]

Ventilation Holes
Do Not Block.

Regulatory
Logo Marking

4x Removable
Rubber Bumpers

NOTES:
1.   Case material: Aluminum alloy.
2.   Case Finish: Nickel Plate.
3.   Dimensions are in inches [mm]. Tolerances 2 Pl. ±.03 inch; 3 Pl. ±.015 inches.
4.   Weight: 500 grams
5.   Marking may contain other features or characters for internal lot control.

DETAILED MODEL INFORMATION IS AVAILABLE ON OUR WEBSITE   **CLICK HERE**

Performance Data & Graphs	Data Graphs
Case Style	SL3643
Environmental Rating	ENV55
Software, User Guide & Programming Manual	https://www.minicircuits.com/softwaredownload/sg.html
Regulatory Compliance	Refer to user guide for compliance information CE UKCA https://www.minicircuits.com/app/AN49-003.pdf
Support	testsolutions@minicircuits.com

INCLUDED ACCESSORIES [21]

	Part No.	Description	Qty.
	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±0.3 V, I_{Max} = 3A	1
(See images below)	CBL-3W-xx	AC Power Cord (Select one power cord from below with each unit)	1
	USB-CBL-AC-7SC+	6.5 ft (2.0 m) USB Cable: USB type A (Male) to USB type C (Male)	1
	CBL-5FT-BMSMB+	5.0 ft (1.5 m) Trigger cable: BNC (Male) to SMB (Female)	2

21. Additional quantities are available for purchase as optional accessories.

AC POWER CORD OPTIONS [22]

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 if your region is not listed.

OPTIONAL ACCESSORIES

	Part No.	Description
	USB-CBL-AC-7SC+ (spare)	6.5 ft (2.0 m) USB Cable: USB type A (Male) to USB type C (Male)
	CBL-5FT-BMSMB+ (spare)	5.0 ft (1.5 m) Trigger cable: BNC (Male) to SMB (Female)
	CBL-RJ45-MM-5+	5.0 ft (1.5 m) Ethernet cable: RJ45 (Male) to RJ45 (Male) Cat 5E cable
	CBL-5FT-MMD+	5.0 ft (1.5 m) Cable assembly for serial control daisy chain with snap fit connectors
	CBL-1.5FT-MMD+	1.5 ft (0.45 m) Cable assembly for serial control daisy chain with snap fit connectors

CALIBRATION

Part No.	Description	
CALSSG-8N12G-RC	Calibration Service for SSG-8N12G-RC	**CLICK HERE**

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