## THE BIG DEAL

- Cost effective millimeter wave signal source
- High output power @ 30 GHz, +22 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-30GHP-RC is a wide-band signal generator offering CW and pulsed outputs from 10 MHz to 30 GHz. With +25 dBm typical output power up to 25 GHz and +22 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-30GHP-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. |

Rev. B
ECO-019617
EDR-11904/1
SSG-30GHP-RC
MCIL
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**Mini-Circuits**

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## ELECTRICAL SPECIFICATIONS AT +25°C

| Parameter | Condition (GHz) | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Output Frequency | - | 0.01 | | 30 | GHz |
| Frequency Resolution [1] | 0.01 - 15 | - | 0.1 | - | Hz |
| | 15 - 30 | - | 0.2 | - | |
| Frequency Accuracy | Using Internal Reference | - | ±1 | - | ppm |
| Settling Time [2, 4] | Hop Mode [3] | - | 0.2 | 0.3 | ms |
| | Frequency Sweep [3] | - | 0.6 | 0.8 | |
| | PC Control (External) | - | 1.2 | 5.0 | |
| Dwell Time (nominal) [4, 5] | - | 0.01 | - | 10,000 | ms |
| Return Loss | 0.01 - 15 | - | 18.0 | - | dB |
| | 15 - 27 | - | 16.5 | - | |
| | 27 - 30 | - | 11.0 | - | |
| Output Power Max [6] | 0.01 - 12 | +25 | +27 | - | dBm |
| | 12 - 25 | +22 | +25 | - | |
| | 25 - 30 | +19 | +22 | - | |
| Output Power Min [6] | 0.01 - 30 | - | -38 | -30 | dBm |
| Output Power Accuracy [6] | 0.01 - 30 | - | ±1.00 | - | dB |
| Power Resolution (nominal) [7] | 0.01 - 15 | - | 0.5 | - | dB |
| RF Off Output Level | 0.01 - 30 | - | -90 | - | dBm |
| Harmonics [8] | 0.01 - 2 | - | -9 | - | dBc |
| | 2 - 8 | - | -20 | - | |
| | 8 - 15 | - | -30 | - | |
| | 15 - 30 | - | -35 | - | |
| Sub-Harmonics [8, 9] | 15 - 30 | - | -40 | - | dBc |
| 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. Default is minimum Dwell Time.
6. After 15 minutes warm-up time.
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.

# Signal Generator

**SSG-30GHP-RC**

50Ω    0.01 to 30 GHz    -38 dBm to +27 dBm    2.92 mm female

## TYPICAL PHASE NOISE (SSB) AT +25°C

| Carrier Frequency (GHz) | Frequency Offset (dBc / Hz) | | | | |
|---|---|---|---|---|---|
| | 0.1 kHz | 1 kHz | 10 kHz | 100 kHz | 1000 kHz |
| 0.05 | -115 | -128 | -130 | -129 | -130 |
| 0.20 | -104 | -123 | -127 | -128 | -130 |
| 0.40 | -97 | -118 | -125 | -124 | -130 |
| 0.80 | -93 | -112 | -120 | -118 | -128 |
| 1.60 | -85 | -106 | -113 | -113 | -127 |
| 3.20 | -82 | -101 | -109 | -107 | -125 |
| 6.40 | -76 | -95 | -103 | -101 | -120 |
| 12.80 | -69 | -89 | -96 | -95 | -117 |
| 15.00 | -66 | -87 | -95 | -94 | -113 |
| 30.00 | -61 | -81 | -89 | -87 | -109 |

## REGULAR PULSE MODULATION SPECIFICATIONS AT +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 [10, 11] | Measured at the 50% of pulse level | 0.5 | - | 10e6 | µs |
| Pulse Period [10] | 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 [12] | Measured between 10% and 90% of pulse level | - | 0.1 / 0.02 | - | µs |
| Pulse Width Accuracy [13] | Measured at 50% of pulse level — Internal Pulse Modulation | - | ±3 | - | % |
| | Measured at 50% of pulse level — 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 | $PWR_{OUT}$ = 0 dBm, $FREQ_{OUT}$ = 10 MHz | - | 58 | - | dB |
| | $PWR_{OUT}$ = +10 dBm, $FREQ_{OUT}$ = 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 AT +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 [10, 11] | | 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 [12] | | Measured between 10% and 90% of pulse level | - | 0.1 / 0.02 | - | µs |
| Pulse Width Accuracy [13] | Measured at 50% of pulse level | Internal Pulse Modulation | - | ±3 | - | % |
| Pulse Power Ratio [14] | $PWR_{OUT}$ = 0 dBm, $FREQ_{OUT}$ = 10 MHz | | - | 58 | - | dB |
| | $PWR_{OUT}$ = +10 dBm, $FREQ_{OUT}$ = 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 guranteed 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 AT +25°C

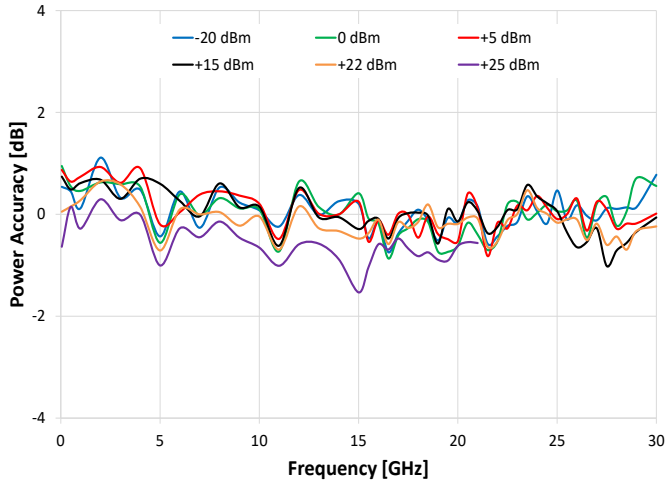| Parameter | Condition | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Aging | Using Internal Reference | | - | 2 | - | ppm/yr |
| Reference In | Frequency | - | - | 10 | - | MHz |
| | Power | - | -3.5 | - | +7.5 | dBm |
| | Phase Noise | 10kHz Offset | - | -145 | - | dBc/Hz |
| Reference Out | Frequency | - | - | 10 | - | MHz |
| | Frequency Accuracy | Using Internal Reference | - | ±1 | - | ppm |
| | Power | - | - | ±5.5 | - | dBm |
| Trigger Out [14] | 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 | $V_{DC}$ |
| Supply Voltage (upper) | - | | 11.4 | 12 | 12.6 | |
| Supply Current, 6V (lower) [15] | - | | - | 1250 | 1850 | mA |
| Supply Current, 12V (upper) | - | | - | 650 | 800 | |
| USB Current [16] | - | | - | 0 | - | |

15. Trigger Out voltage specified with impedance load of 10 kΩ minimum.
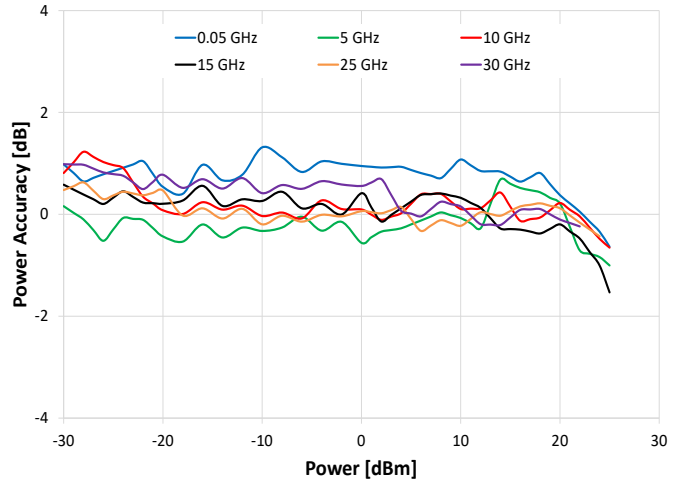16. All power is drawn from power adaptor, USB is used for control only.
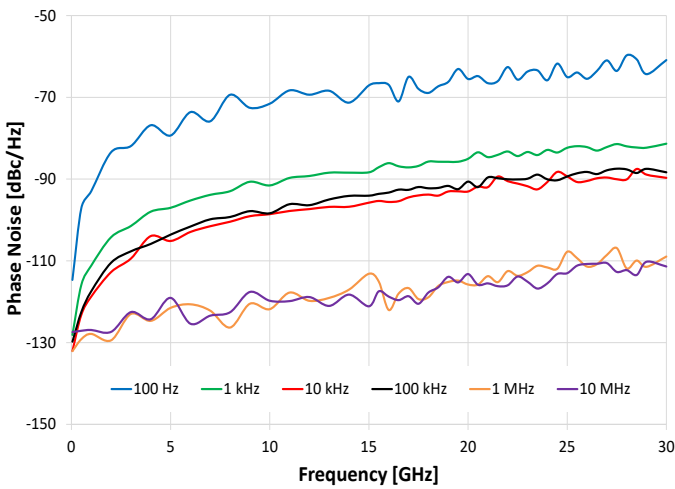
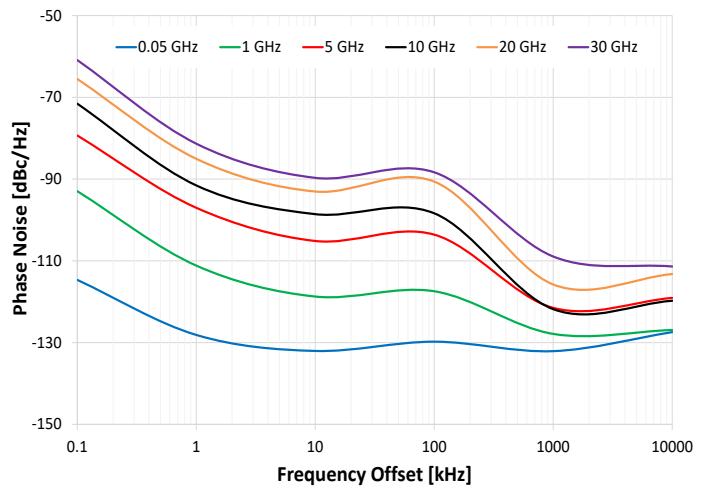## TYPICAL PERFORMANCE GRAPHS

### Power Accuracy vs. Output Frequency



Legend: -20 dBm, 0 dBm, +5 dBm, +15 dBm, +22 dBm, +25 dBm

### Power Accuracy vs. Output Power



Legend: 0.05 GHz, 5 GHz, 10 GHz, 15 GHz, 25 GHz, 30 GHz

### Phase Noise vs. Output Freq. at Frequency Offsets



Legend: 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz, 10 MHz

### Phase Noise vs. Offset Freq. at Frequency Output



Legend: 0.05 GHz, 1 GHz, 5 GHz, 10 GHz, 20 GHz, 30 GHz

### Spurious vs. Output Frequency @ PWR= +14 dBm



Legend: 0°C, 25°C, 50°C
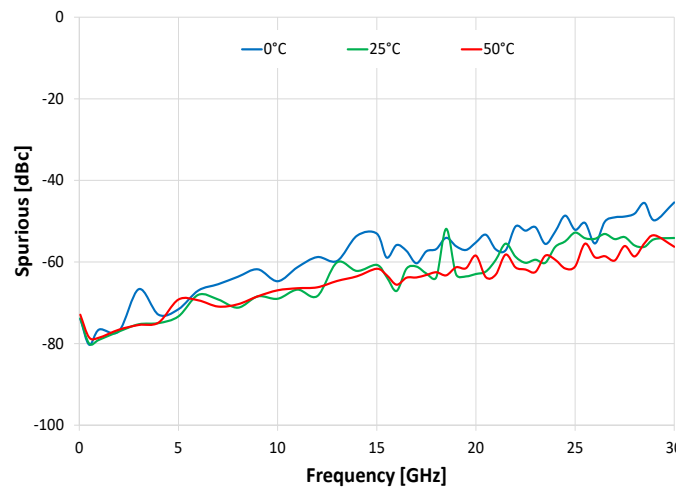
## TYPICAL PERFORMANCE GRAPHS (CONTINUED)

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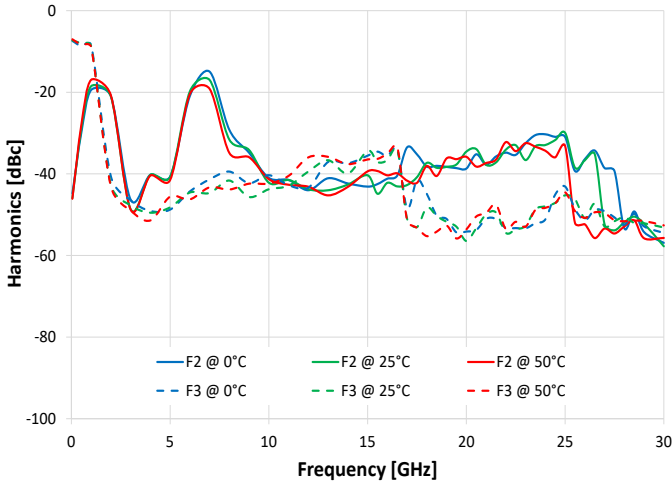


**Sub-Harmonics vs. Output Frequency @ -20 dBm**
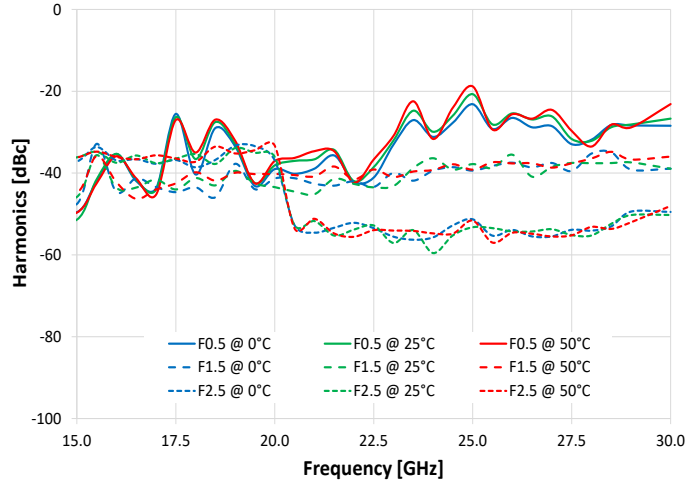


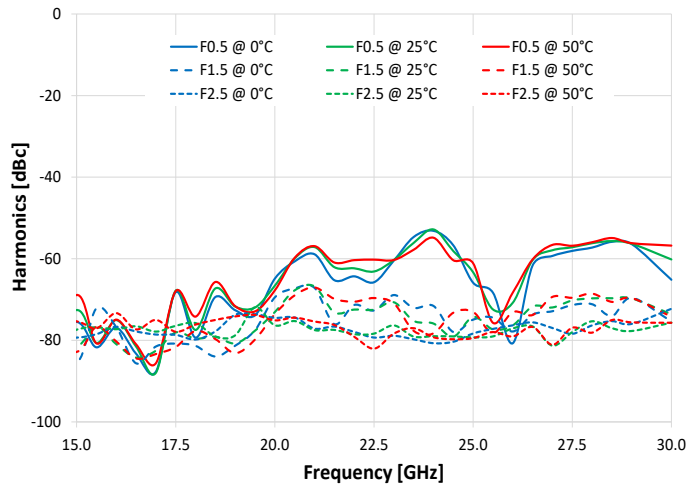**Harmonics vs. Output Frequency @ +10 dBm**
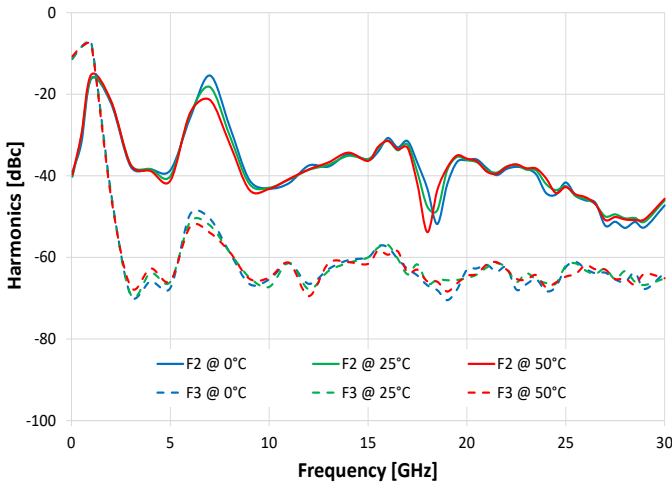


**Sub-Harmonics vs. Output Frequency @ +10 dBm**
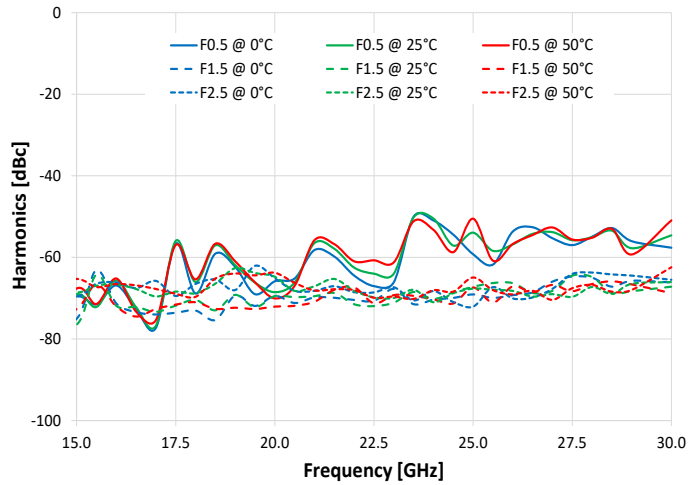


**Harmonics vs. Output Frequency @ +20 dBm**
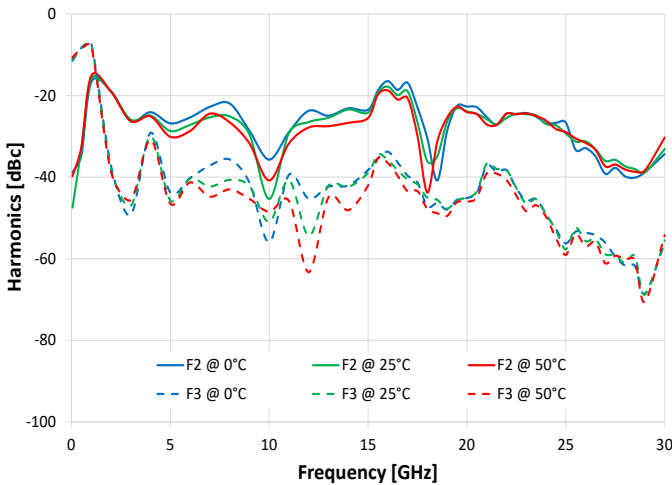


**Sub-Harmonics vs. Output Frequency @ +20 dBm**

## CONTROL INTERFACES

| | | |
|---|---|---|
| **Ethernet Control** | Supported Protocols | TCP / IP, HTTP, Telnet, SSH, DHCP, UDP (limited) |
| | Max Data Rate | 100 Mbps (100 Base-T Full Duplex) |
| **USB Control** | Supported Protocols | HID (Human Interface Device) - High-speed |
| | Min Communication Time [17] | 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 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
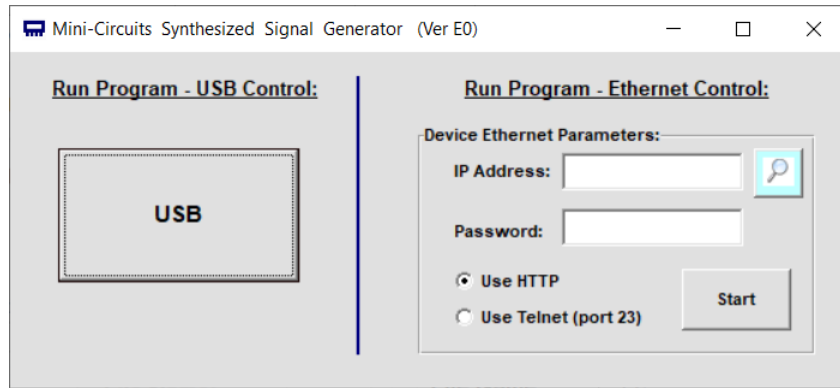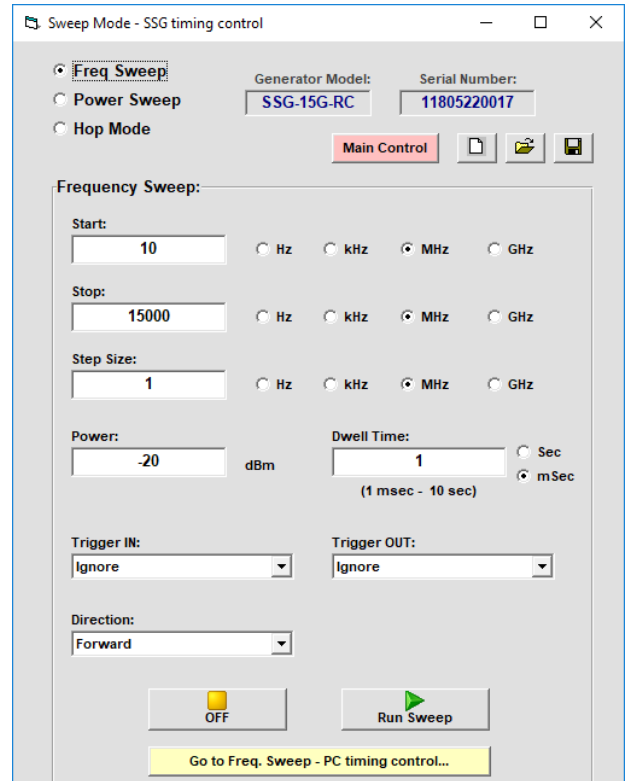


- Configure output power, frequency, pulse modulation
- Program timed signal output sequences (linear sweep and frequency hop)
- Control timed sequences in multiple generators simultaneously
- Track unit operation time since last calibration and setup calibration reminders
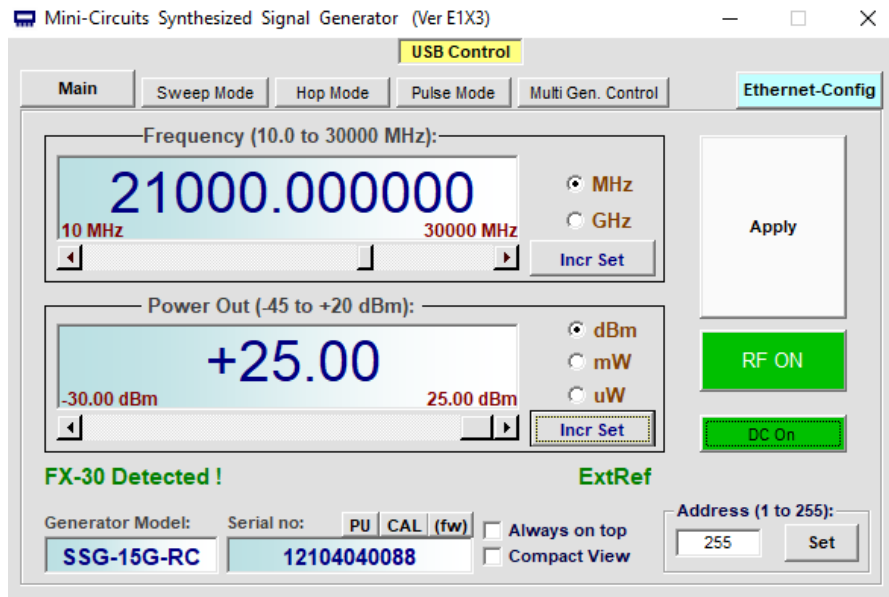
## AUTOMATED SWEEP / HOP SEQUENCES

• 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.
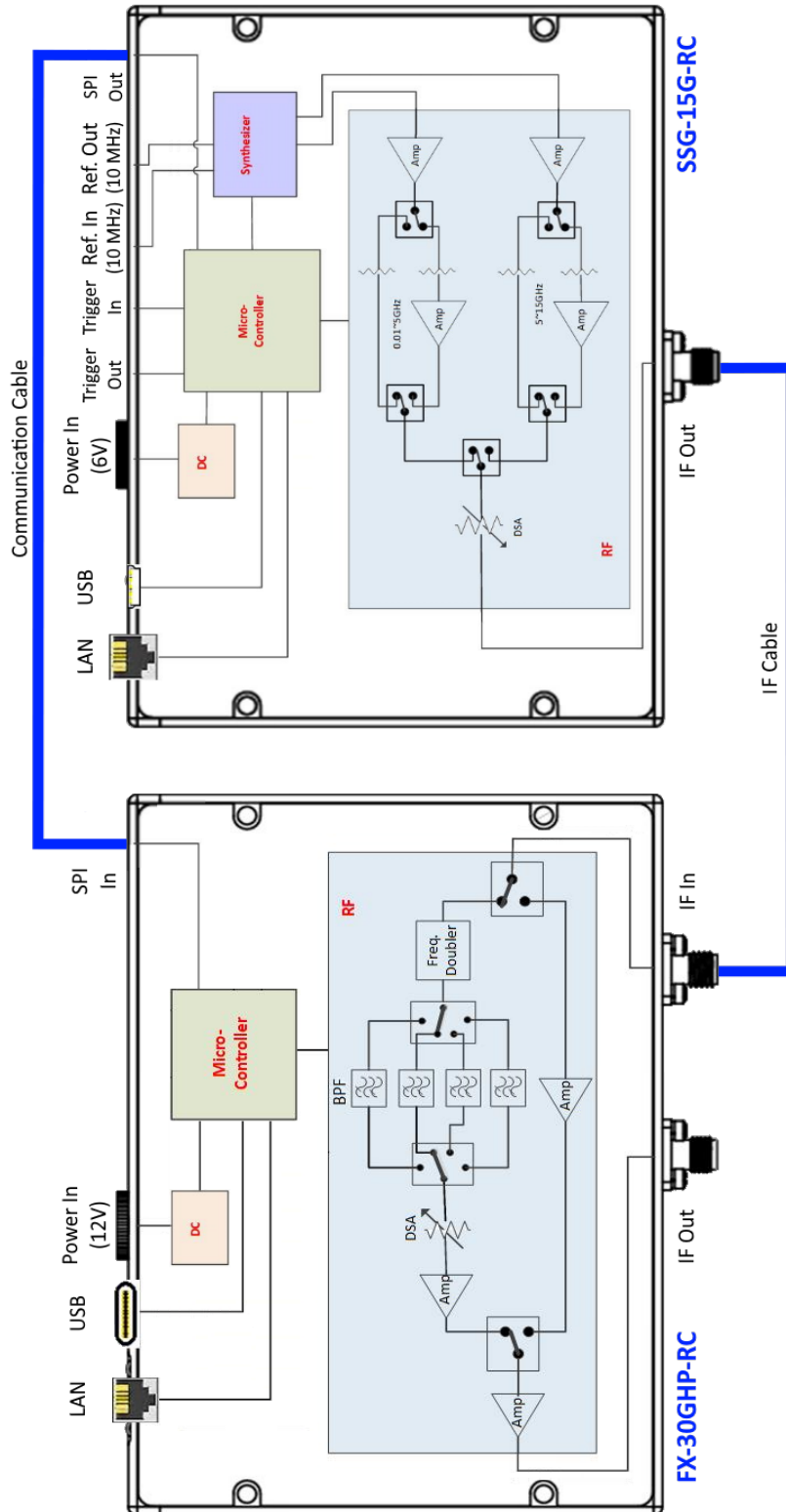


## DYNAMIC PULSE MODULATION

• 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.
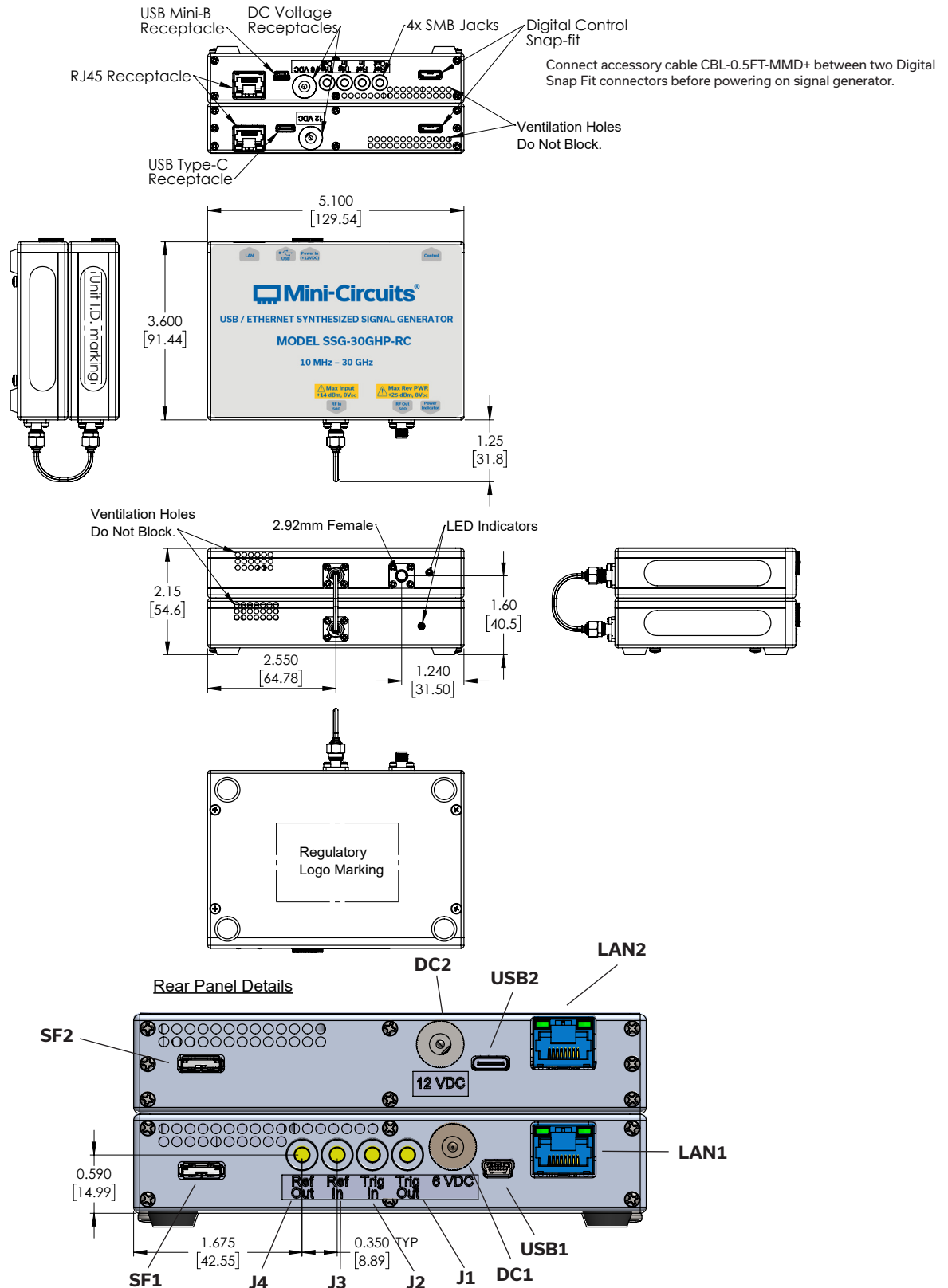• Run continuously or for a preset number of cycles.
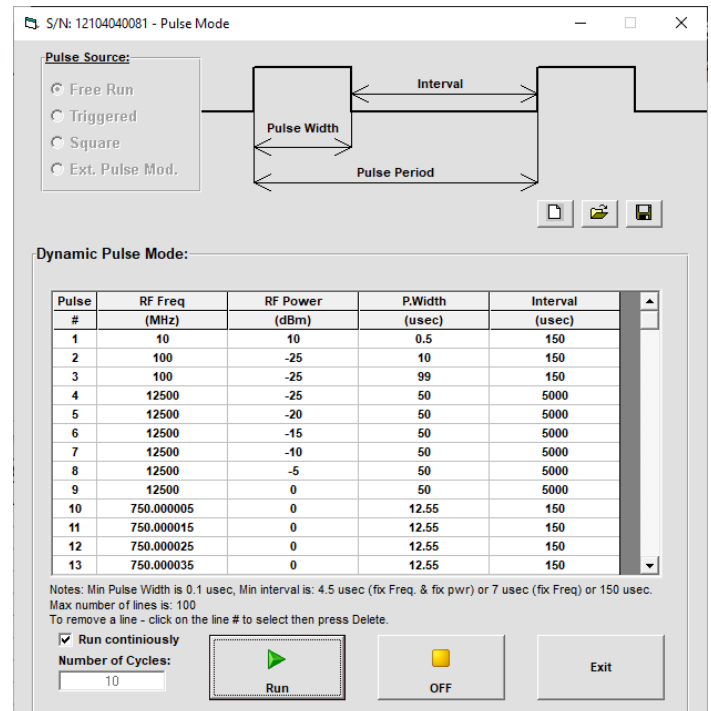
## BLOCK DIAGRAM



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

## CASE STYLE DRAWING (SL3512)



USB Mini-B Receptacle

DC Voltage Receptacles

4x SMB Jacks

Digital Control Snap-fit

RJ45 Receptacle

Connect accessory cable CBL-0.5FT-MMD+ between two Digital Snap Fit connectors before powering on signal generator.

Ventilation Holes Do Not Block.

USB Type-C Receptacle

5.100 [129.54]

Unit I.D. marking

**Mini-Circuits®**

USB / ETHERNET SYNTHESIZED SIGNAL GENERATOR

**MODEL SSG-30GHP-RC**

10 MHz – 30 GHz

3.600 [91.44]

⚠ Max Input +14 dBm, 0Vcc

⚠ Max Rev PWR +25 dBm, 8Vcc

RF In 50Ω

RF Out 50Ω

Power Indicator

1.25 [31.8]

Ventilation Holes Do Not Block.

2.92mm Female

LED Indicators

2.15 [54.6]

1.60 [40.5]

2.550 [64.78]

1.240 [31.50]

Regulatory Logo Marking

DC2

USB2

LAN2

Rear Panel Details

SF2

12 VDC

0.590 [14.99]

Ref Out    Ref In    Trig In    Trig Out

8 VDC

LAN1

USB1

DC1

1.675 [42.55]

0.350 TYP [8.89]

SF1    J4    J3    J2    J1    DC1

## 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) [18] |
| 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) [18] |
| 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 [19, 20]

| | | |
|---|---|---|
| **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 $V_{DC}$ |
| **Reverse Power (DC) @ RF Out** | | 16 $V_{DC}$ |
| **Reverse Power (RF) @ RF Out** [21] | 0.01 - 25 GHz | +28 dBm |
| | 25 - 30 GHz | +25 dBm |
| **Voltage Input to Trigger Ports** | | -0.3$V_{DC}$ to +5.5$V_{DC}$ |

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.

# Signal Generator

# SSG-30GHP-RC

50Ω     0.01 to 30 GHz     -38 dBm to +27 dBm     2.92 mm female

## DETAILED MODEL INFORMATION IS AVAILABLE ON OUR WEBSITE

**CLICK HERE**

| | |
|---|---|
| **Performance Data & Graphs** | Data<br>Graphs |
| **Case Style** | SL3512 |
| **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

| | Qty. | Part No. | Description |
|---|---|---|---|
| | 1 | AC/DC-6-3W | AC/DC Grounded Power adapter, 0°C to +40°C<br>AC Input: 100-240 V, 50/60 Hz, $I_{Max}$= 1.2A<br>DC Output 6±0.3 V, $I_{Max}$ = 3A |
| | 1 | AC/DC-12-3W | AC/DC Grounded Power adapter, 0°C to +40°C<br>AC Input: 100-240 V, 50/60 Hz, $I_{Max}$= 1.2A<br>DC Output 12±0.6 V, $I_{Max}$= 3A |
| (Refer to power cord table) | 2 | CBL-3W-xx | AC power cord (IEC C13 connector to local plug)<br>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 [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 |
|---|---|
| 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-30GHP-RC | Calibration Service for SSG-30GHP-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