

## Microwave EMC-Source SG-CG2, 1...40 GHz

### Features

- Comb generator with 1 GHz fundamental frequency
- Usable harmonics up to 40+ GHz and beyond
- Internal wideband antenna for increases ruggedness – no external precision microwave connectors necessary
- Internal 9 V battery holder or external DC supply possible
- Compact and rugged case, ideal for portable and field use

### Possible Applications

- Rapid test of wideband receivers
- Rapid test of measurement equipment
- Microwave RX intermodulation tests
- EMC Shielding tests
- Antenna measurements
- Interference emission location & direction finding training



## Specifications

Parameter	Min	Typ	Max	Unit	Remarks
Supply Voltage	7	9	24	Volt	
Current consumption		250	300	mA	Measured with 9V supply, decreases with increased power supply voltage
Fundamental frequency		1		GHz	Crystal referenced
Frequency tolerance, initial error		+/-25		ppm	
Frequency tolerance, temperature drift		+/-25		ppm	-20°C ... +60°C (-4...140°F)
Ambient temperature	-20		+60	°C	Continuous usage up to 45°C (114°F) possible
Antenna Gain		0	1.5	dBi	Integrated wideband microwave antenna
Output frequency range	1		40	GHz	Higher harmonics present, but performance is not guaranteed

Dimensions: 80 x 80 x 230 mm<sup>3</sup>

Weight (excl. battery): 650 g

## User instructions

### Principle of operation

The wideband comb generators of the SG-CG2 were developed for quick microwave receiving equipment test under various conditions. Quick and simple usage was one of the primary design goals.

The SG-CG2 transmitters generate a crystal referenced fundamental frequency of 1.00 GHz and generate harmonics on whole-number multiples of the fundamental, up to 40 GHz and beyond, via non-linear elements. The generated frequency comb is then radiated by an internal wideband microwave antenna with an antenna gain of 0 dBi.

A typical comb power output spectrum, measured at the antenna input, is presented in figure 1.

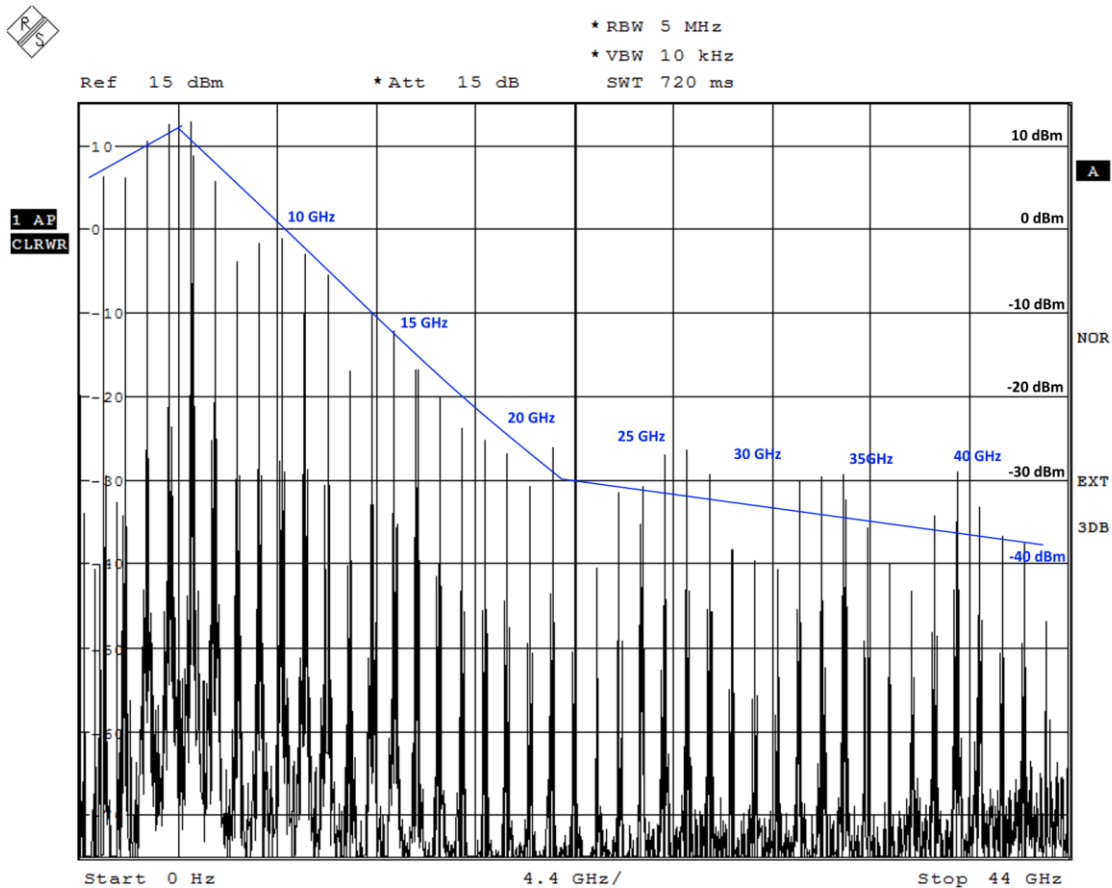


Figure 1: Typical power output spectrum of SG-CG2, measured at the antenna input, frequency range DC - 44 GHz

## Usage

The SG-CG2 comb generators are designed for continuous usage in the ambient temperature range of  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ) up to  $45^{\circ}\text{C}$  ( $113^{\circ}\text{F}$ ). Usage above  $45^{\circ}\text{C}$  ambient temperature is possible, but it is recommended to stick to an intermittent usage duty cycle of 180 seconds maximum on-time, followed by a brief 60 second period of cooling. This extends the permissible temperature range of the device up to  $60^{\circ}\text{C}$  ( $140^{\circ}\text{F}$ ).

The transmitter SG-CG2 is activated by the on/off switch in the lower bottom half of the case (see figure 2). On customer request, this switch can be replaced by a push button. If the SG-CG2 is successfully activated, the status LED besides the switch lights up.

If the status LED does not light up when the switch/button is activated, please check the battery or the external dc supply voltage. Replace the battery when necessary. Please observe the instructions in the power supply section of this document and avoid zinc-carbon dry cells for the 9 V battery option.

The case of the SG-CG2 is classified as IP40 because of the necessary openings for the DC plug and the battery compartment. If you are able to seal these openings via tape or other means, the rest of the case is classified as IP44 and protected against splash water and particle entry.

During operation of the SG-CG2, please handle the device only below the sticker in the lower bottom area of the case (see figure 2). Failure to do so could lead to a severe degradation of output spectrum purity, as reflected portions of the output spectrum could lead to a sub harmonic mixing process of spectral components, spoiling the 1 GHz distance between harmonics. This can also happen if the SG-CG2 is operated near strong active transmitters and substantial energy is coupled into the antenna.

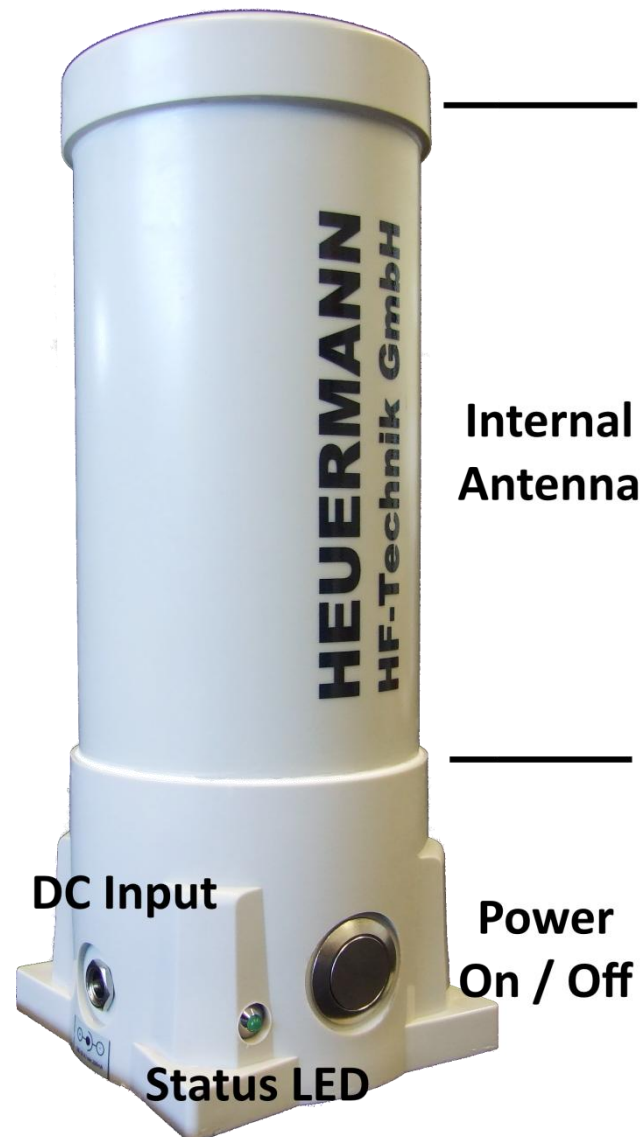


Figure 2: SG-CG2 with markings for antenna area, DC input, status LED and power switch

### Power supply considerations

As a configurable option the SG-CG2 transmitter has an internal 9 V battery holder. Furthermore a 5.5/2.1 mm DC input jack is provided as standard. During normal operation, the input current of the device does not exceed 350 mA.

When using the internal 9 V battery holder, the usage of alkaline chemistry based cells (6LR61 or 1604A) is possible, but we strongly recommend lithium based primary cells (1604LC) for extended usage. We cannot guarantee any operation of the device when using zinc-carbon based cells (PP3, 6F22 or 1604D – often called "heavy duty"). This is primarily caused by their higher internal resistance, which does not permit high current usage. This is also often the case with rechargeable 9 V batteries. For usage in the SG-CG2 generator we strongly recommend „Energizer High Tech 9V“ (6LR61/1604A) or

„Energizer Lithium 9V“ (LA522/1604LC) batteries, which are both designed for high current device usage. Compatible types with high current ability may also be used.

The total expected operation time of the SG-CG2 running on a fresh 9 V alkaline battery is about 1h. When using lithium based 9 V batteries this can be extended to 2.5h, mainly due to higher specific charge and lower internal resistance of the lithium cell chemistry. If you are using unsuitable 9 V batteries the usable operational time of the device can be decreased to about 15 minutes.

Despite the internal battery option there is always the possibility to supply external DC power directly to the SG-CG2 via a standard 5.5/2.1 mm DC input jack. The allowed input voltage range is 7 to 24 V, center positive (see figure 3), with a voltage dependant maximum current load of 350 mA. Please do not use unregulated supplies, unless you have checked that the total output open circuit voltage does not exceed 24 V at any time. Also please refrain from connecting the SG-CG2 directly to a vehicle power outlet, as no transient or reverse voltage protection is provided inside the device! When connecting the SG-CG2 to an external power source of low internal resistance and without internal current limiting capability, such as Li-Ion or lead acid batteries, the addition of an inline fuse is mandatory.

The connection of the DC jack is center positive (see figure 3)!

If the power on rise time of the input voltage is too high, or the internal resistance of the source reaches a certain limit, the SG-CG2 may fail to power on successfully. This is indicated by the status LED staying dim while engaging the power switch. When using an external DC power supply it may sometimes help to fully power the supply first and after steady state has been established, switch the SG-CG2 on to operational state if this problem occurs.

As the power changeover from the DC input jack to the internal battery holder is purely mechanic via the dc plug insertion, it is recommended to fully remove the DC plug out of the jack when using the internal 9 V battery.

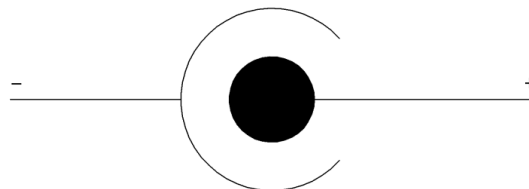
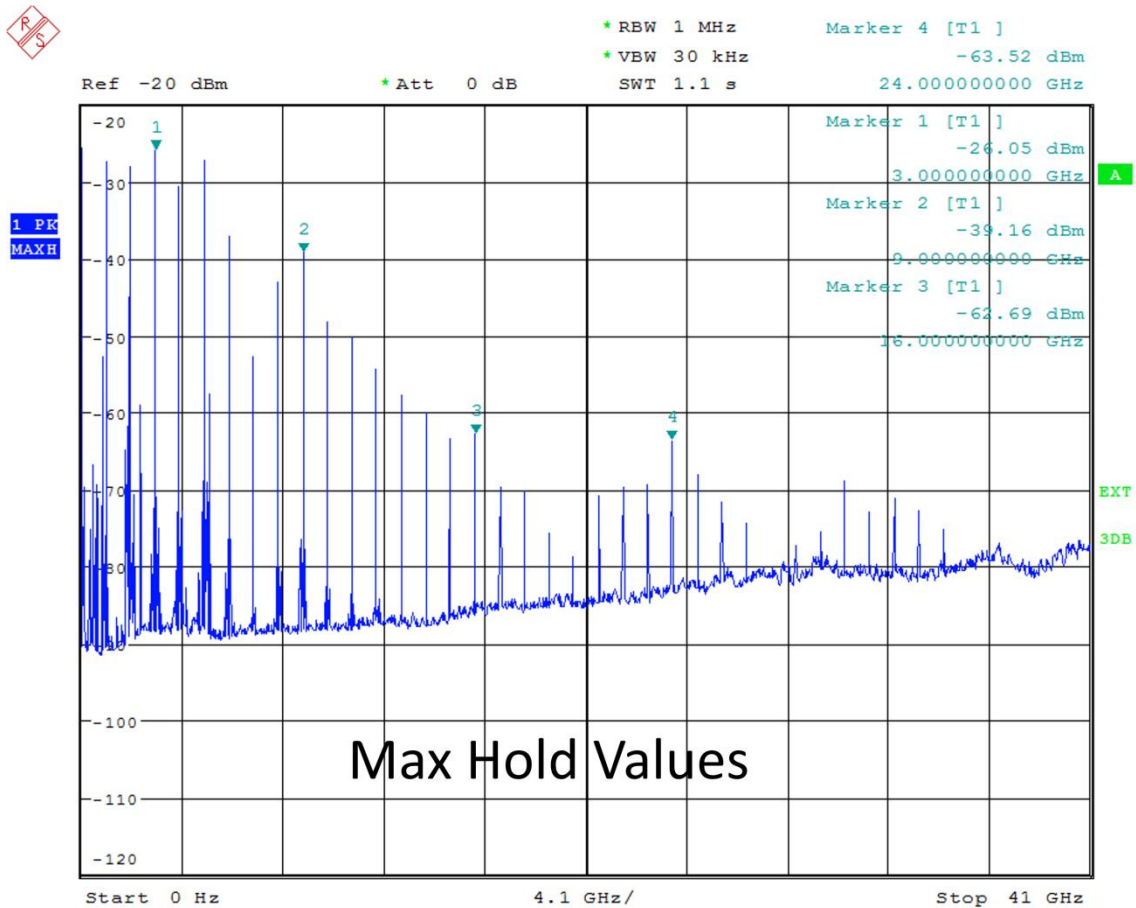
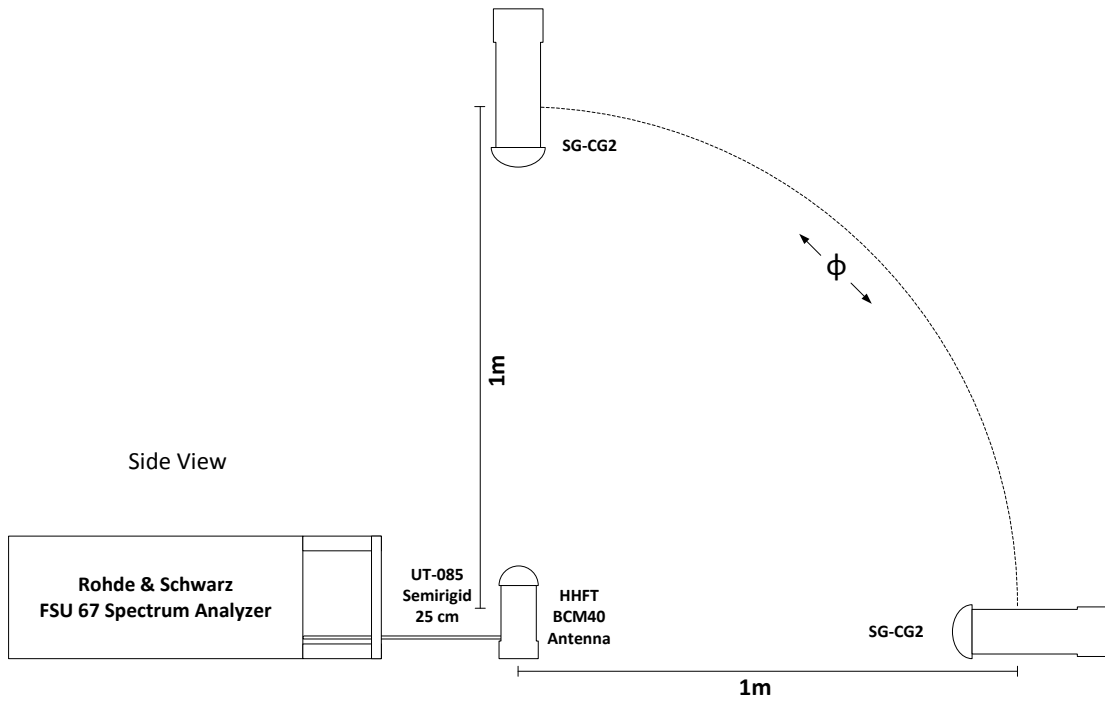
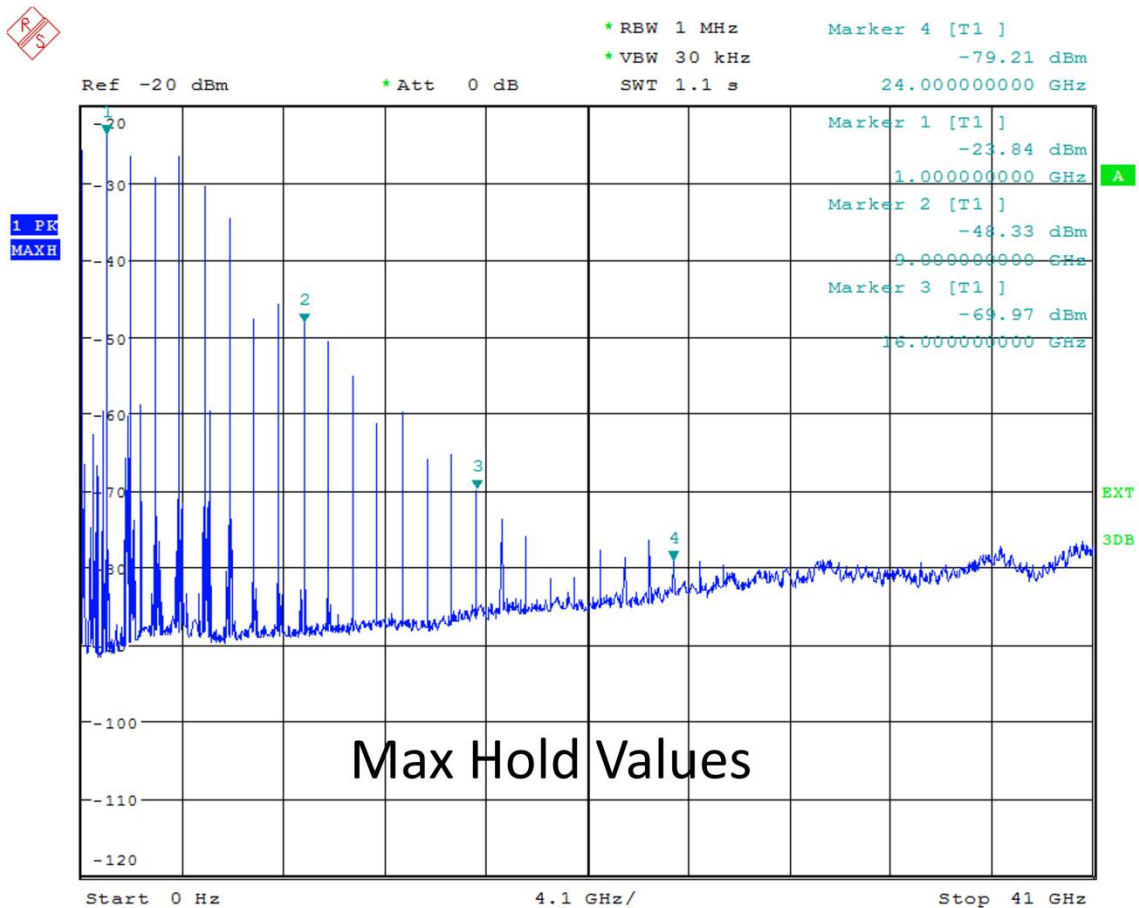
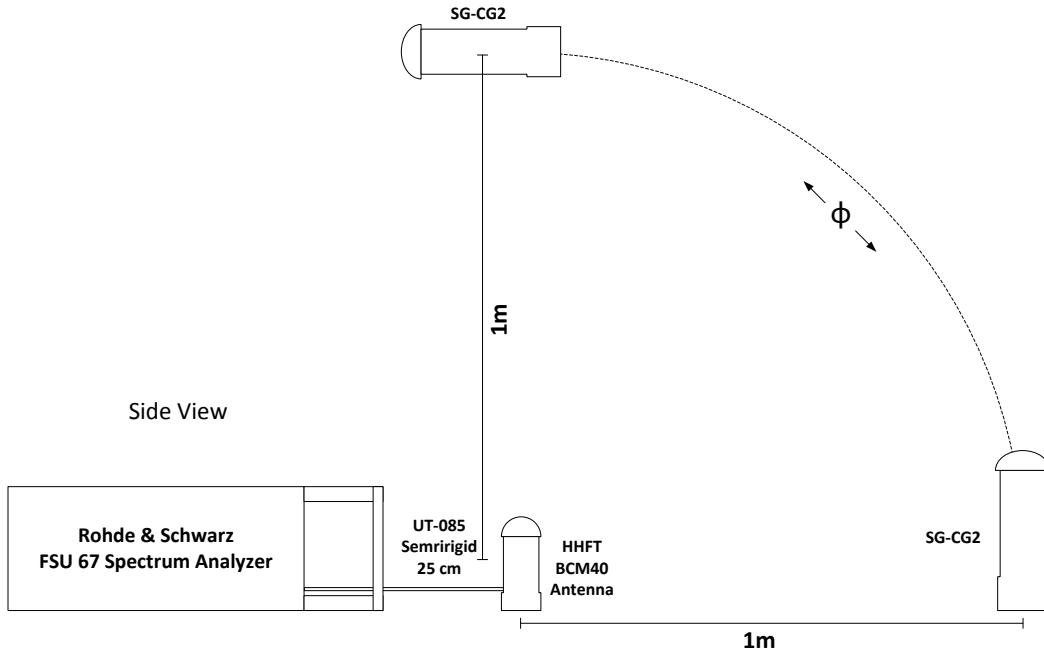


Figure 3: Voltage polarity of the DC jack

### Measured Performance







## Estimated received power as a function of frequency and distance

Gain RX / dBi:		0		Gain TX / dBi:		0		Free-Space Path Loss Model		
f / GHz	$\lambda$ / m	P,TX / dBm	Loss / dB @ 1m	P, RX / dBm @ 1m	Loss / dB @ 10m	P, RX / dBm @ 10m	Loss / dB @ 100m	P, RX / dBm @ 100m		
1	0,3000	5,8	-32,4	-26,6	-52,4	-46,6	-72,4	-66,6		
2	0,1500	5,8	-38,5	-32,7	-58,5	-52,7	-78,5	-72,7		
3	0,1000	10,3	-42,0	-31,7	-62,0	-51,7	-82,0	-71,7		
4	0,0750	11,9	-44,5	-32,6	-64,5	-52,6	-84,5	-72,6		
5	0,0600	12,5	-46,4	-33,9	-66,4	-53,9	-86,4	-73,9		
6	0,0500	6,4	-48,0	-41,7	-68,0	-61,7	-88,0	-81,7		
7	0,0429	-3,8	-49,3	-53,1	-69,3	-73,1	-89,3	-93,1		
8	0,0375	-1,2	-50,5	-51,7	-70,5	-71,7	-90,5	-91,7		
9	0,0333	-0,6	-51,5	-52,1	-71,5	-72,1	-91,5	-92,1		
10	0,0300	-4,5	-52,4	-56,9	-72,4	-76,9	-92,4	-96,9		
11	0,0273	-6,7	-53,3	-60,0	-73,3	-80,0	-93,3	-100,0		
12	0,0250	-10,2	-54,0	-64,2	-74,0	-84,2	-94,0	-104,2		
13	0,0231	-11,5	-54,7	-66,2	-74,7	-86,2	-94,7	-106,2		
14	0,0214	-12,7	-55,4	-68,1	-75,4	-88,1	-95,4	-108,1		
15	0,0200	-15,8	-56,0	-71,8	-76,0	-91,8	-96,0	-111,8		
16	0,0188	-20,6	-56,5	-77,1	-76,5	-97,1	-96,5	-117,1		
17	0,0176	-25,7	-57,1	-82,8	-77,1	-102,8	-97,1	-122,8		
18	0,0167	-24,5	-57,5	-82,0	-77,5	-102,0	-97,5	-122,0		
19	0,0158	-30,3	-58,0	-88,3	-78,0	-108,3	-98,0	-128,3		
20	0,0150	-30,8	-58,5	-89,3	-78,5	-109,3	-98,5	-129,3		
21	0,0143	-24,6	-58,9	-83,5	-78,9	-103,5	-98,9	-123,5		
22	0,0136	-21,3	-59,3	-80,6	-79,3	-100,6	-99,3	-120,6		
23	0,0130	-32,0	-59,7	-91,7	-79,7	-111,7	-99,7	-131,7		
24	0,0125	-34,4	-60,0	-94,4	-80,0	-114,4	-100,0	-134,4		
25	0,0120	-31,3	-60,4	-91,7	-80,4	-111,7	-100,4	-131,7		
26	0,0115	-27,2	-60,7	-87,9	-80,7	-107,9	-100,7	-127,9		
27	0,0111	-25,5	-61,1	-86,6	-81,1	-106,6	-101,1	-126,6		
28	0,0107	-32,4	-61,4	-93,8	-81,4	-113,8	-101,4	-133,8		
29	0,0103	-40,9	-61,7	-102,6	-81,7	-122,6	-101,7	-142,6		
30	0,0100	-41,1	-62,0	-103,1	-82,0	-123,1	-102,0	-143,1		
31	0,0097	-32,0	-62,3	-94,3	-82,3	-114,3	-102,3	-134,3		
32	0,0094	-38,9	-62,5	-101,4	-82,5	-121,4	-102,5	-141,4		
33	0,0091	-28,4	-62,8	-91,2	-82,8	-111,2	-102,8	-131,2		
34	0,0088	-29,2	-63,1	-92,3	-83,1	-112,3	-103,1	-132,3		
35	0,0086	-26,8	-63,3	-90,1	-83,3	-110,1	-103,3	-130,1		
36	0,0083	-30,1	-63,6	-93,7	-83,6	-113,7	-103,6	-133,7		
37	0,0081	-40,1	-63,8	-103,9	-83,8	-123,9	-103,8	-143,9		
38	0,0079	-43,5	-64,0	-107,5	-84,0	-127,5	-104,0	-147,5		
39	0,0077	-39,6	-64,3	-103,9	-84,3	-123,9	-104,3	-143,9		
40	0,0075	-40,2	-64,5	-104,7	-84,5	-124,7	-104,5	-144,7		

## List of available options

**SG-CG2-A** External DC-Supply, 9 V, checked and tested, wide range input  
100 – 240 V, 50 – 60 Hz, Europlug (CEE 7/16)

**SG-CG2-B** Integrated 9V battery holder for primary cells

**SG-CG2-C** Momentary power switch

**SG-CG2-D** 1 GHz reference output (-10 dBm)

**SG-CG2-E** Transport case

**SG-CG2-F** Different comb base frequency (600 – 1400 MHz)