

## Comb Generator SG-CG1

### Features

- ECL compatible output
- Two outputs
- Harmonics from 100MHz to 18GHz
- Internal frequency synthesizer 100-200MHz
- Tuneable step size of 400kHz
- Applicable with internal or external synthesizer/oscillator (30MHz – 4GHz)
- External reference input for synchronization
- PC interface (Serial/USB)
- Minimum output harmonics level (for 200MHz input)  $\geq -55\text{dBm}$  at 10 GHz



### Applications

- Frequency multipliers
- Signal generator
- Spectrum analysis
- EMC source
- Broad band test equipment
- UWB applications
- FMCW radars

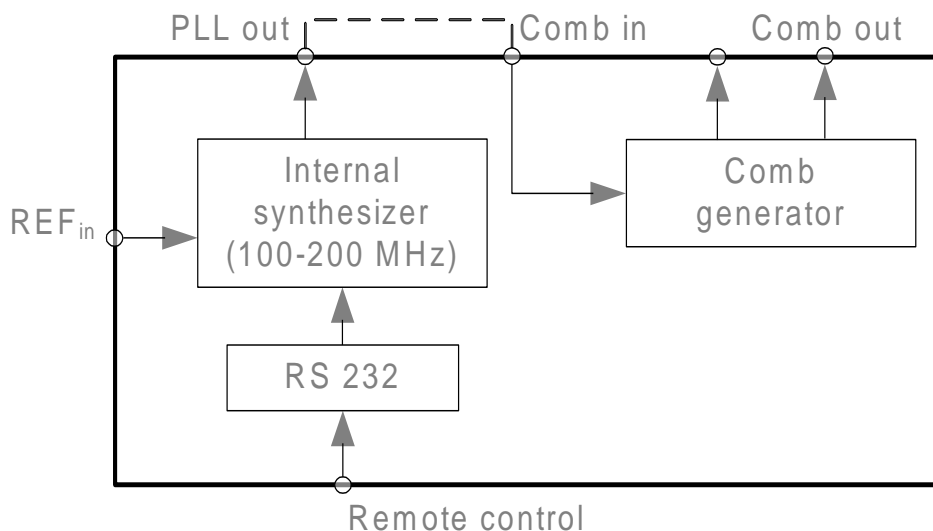


Fig.1: SG-CG1 functional diagram.

## Product description

SG-CG1 is a comb/ pulse generator with a low spurious internal frequency synthesizer. The internal synthesizer sweeps from 100 MHz to 200 MHz with the step size of 400 kHz. The synthesizer output can be connected to the comb generator. With this configuration it is possible to get the comb output with the step resolution of 400 kHz. For synchronization purpose SG-CG1 uses an external 10 MHz reference input signal. The synthesizer has an easy to use serial/USB PC control interface. The USB to serial adaptor is included with the SG-CG1.

For applications where high phase noise performance is required the user has the possibility to use an external very low phase noise synthesizer/ oscillator. The minimum input power requirement of the comb generator is only 0 dBm.

## Specifications

Parameter	Min	Typ	Max	Unit	Remarks
REF <sub>in</sub>	10		10	MHz	Synthesizer reference input
REF <sub>in</sub> power	-5	0	5	dBm	Reference input power
PLL out	100		200	MHz	Internal synthesizer sweep
Comb in	0.03		4.0	GHz	
Comb out	0.03		18	GHz	
Comb input power	0		16	dBm	
Typ. comb output power	-38	-34		dBm	At 4 GHz for 200 MHz input
Typ. comb output power	-55	-50		dBm	At 10 GHz for 200 MHz input

## Electrical specification

Input power supply: 85 – 264 VAC  
 Input frequency: 50 – 60 Hz

## Physical dimensions

Height x width x depth: 85 x 250 x 260 (mm<sup>3</sup>)  
 Weight: 2 kg

## Typical performance

Fig.2 shows the comb generator output driven by the internal synthesizer at 200 MHz. The spectrum shows the combs have nearly the same output power. This is a prominent feature of SG-CG1.

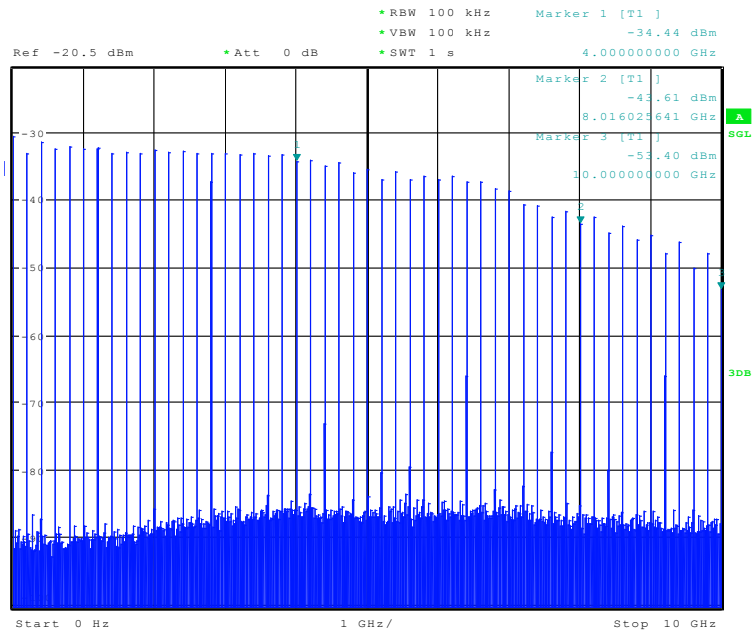


Fig.2: SG-CG1 output spectrum with an internal 200 MHz signal source.

Fig.3 shows the comb generator output driven by the external synthesizer at 200 MHz. One of the key benefits of the SG\_CG is that it can work with an external input signal up to 4 GHz. The output comb reaches up to 18 GHz. This means the user can increase the bandwidth of their signal generators up to 18 GHz. See application circuit Fig.5.

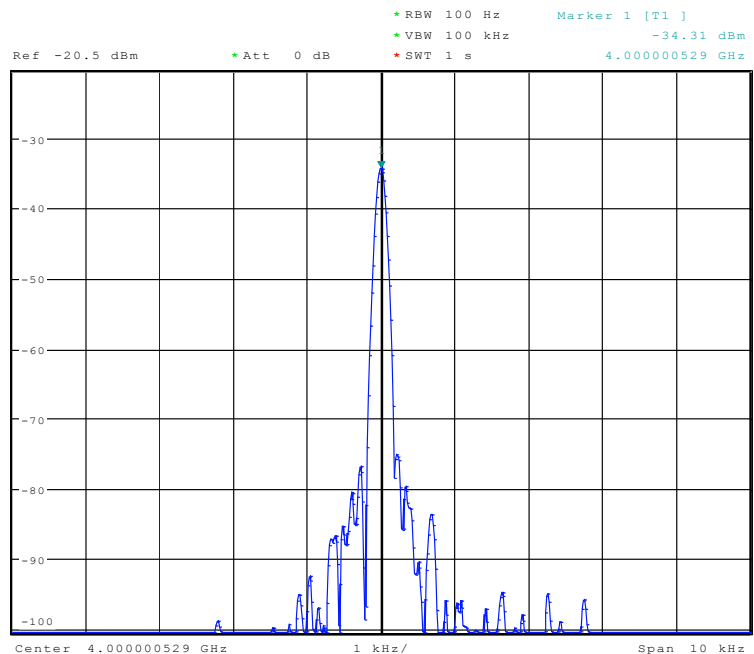


Fig.3: SG-CG1 low noise output spectrum with an external 200 MHz signal source.

Fig.4 shows the phase noise performance with an external signal source. The performance directly depends upon the phase noise of an external signal source.

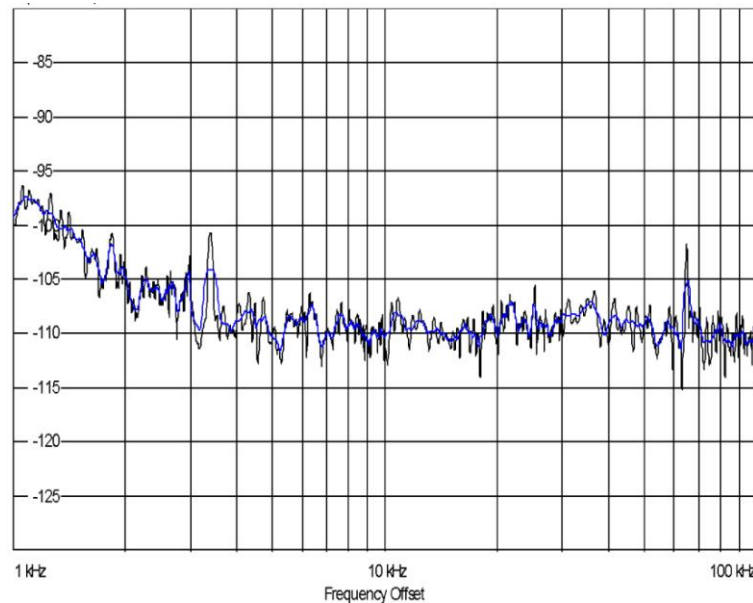


Fig.4: Phase noise response with external 500 MHz signal source. It is measured at 10<sup>th</sup> harmonic i.e. 5.5 GHz

## Application circuits

### Frequency multiplier

Commonly comb generators are limited to a few hundred MHz input frequency. But with the SG-CG1 it is possible to use an external synthesizer input up to 4 GHz. With this opportunity the user can extend the frequency range of their synthesizers. For example if a user has a synthesizer up to 3 GHz the 6<sup>th</sup> harmonic of the SG-CG1 will give 18 GHz output. Since each harmonic is separated by 3 GHz. It is easy to use band pass filter to remove the unwanted frequency components. Fig.5 shows the example setup.

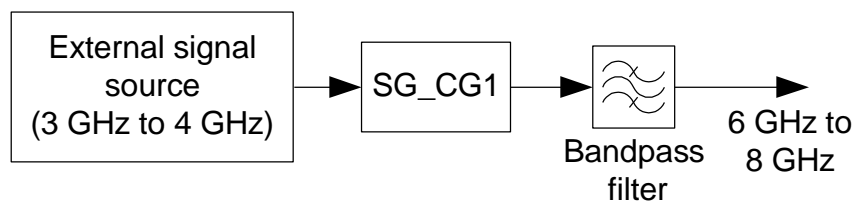


Fig.5: SG-CG1 extends the range of an external frequency source for 6 to 8 GHz.

## Comb Generator

Fig. 6 & 7 show the SG-CG1 typical application setup. It can be used with an external 30 MHz to 4 GHz source or internal 100 MHz to 200 MHz signal source. Power requirements for an external signal source are very easy to meet. The SG-CG1 can be driven from 0 dBm input power. Other commercial comb generators usually require higher input power. Therefore in most cases the user needs an external amplifier to meet the comb generator input power requirements. But in SG-CG1 no external power amplification is required.

The output power of the comb generator depends upon the input frequency. For 100 MHz input the 100<sup>th</sup> harmonic will give a 10 GHz tone and for 200 MHz 50<sup>th</sup> harmonic will give a 10 GHz tone. The power of output harmonics will be 3 dB higher for 200 MHz input compare to 100 MHz input. Therefore the user should select the correct input frequency to get the required output harmonic frequencies and power. The SG-CG1 output harmonics power for 200 MHz input is shown in Fig. 2.

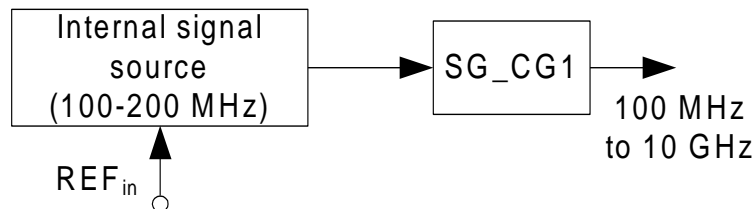


Fig.6: SG-CG1 used with an internal source.

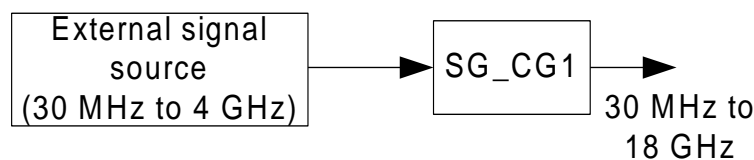


Fig.7: SG-CG1 used with an external source.

## UWB Applications

This full electronic comb generator (or pulse generator) with the flat output power over the frequency is a perfect base to generate UWB signals. The fixed frequency can be replaced by a modulated signal. This pulse generator has no dispersion. One pulse is very similar to the pulses of the comb signal (Fig. 8-10).

## Time Domain Signals of the Comb/ Pulse Generator

The Figures 8, 9 & 10 show time domain signals of the SG-CG1.

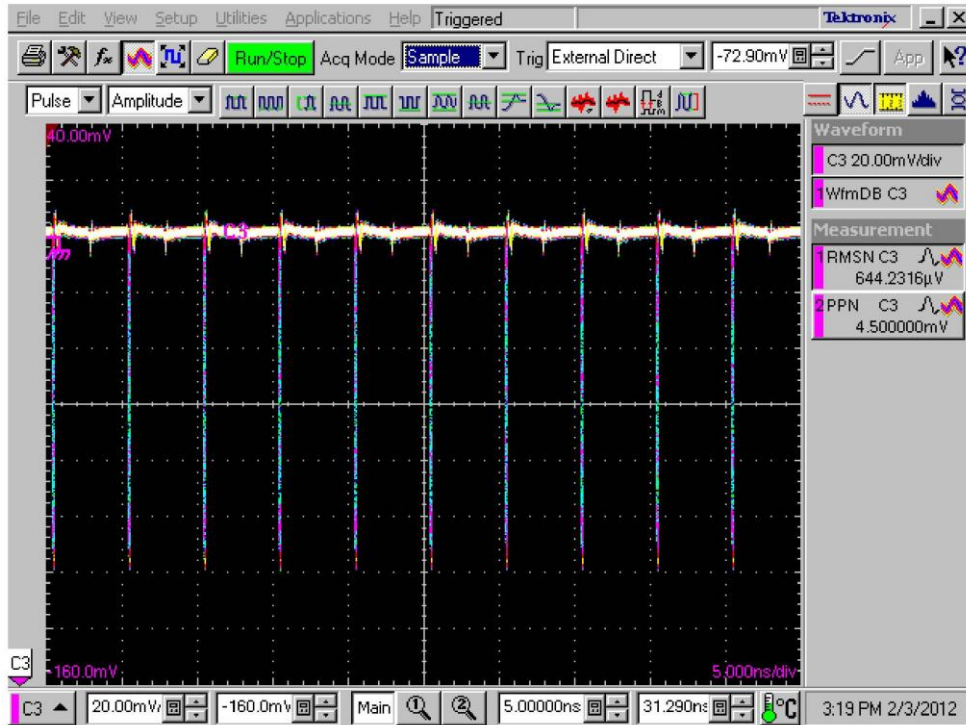


Fig.8: Output of the negative signal SG-CG1 (5ns/div)

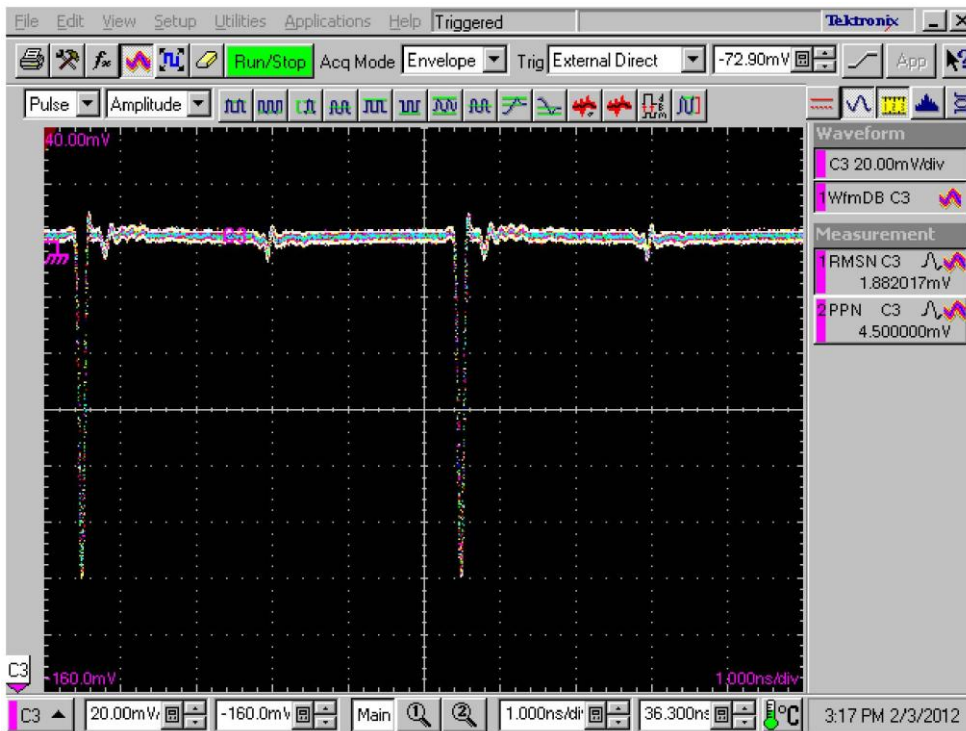


Fig.9: Output of the negative signal SG-CG1 (1ns/div)

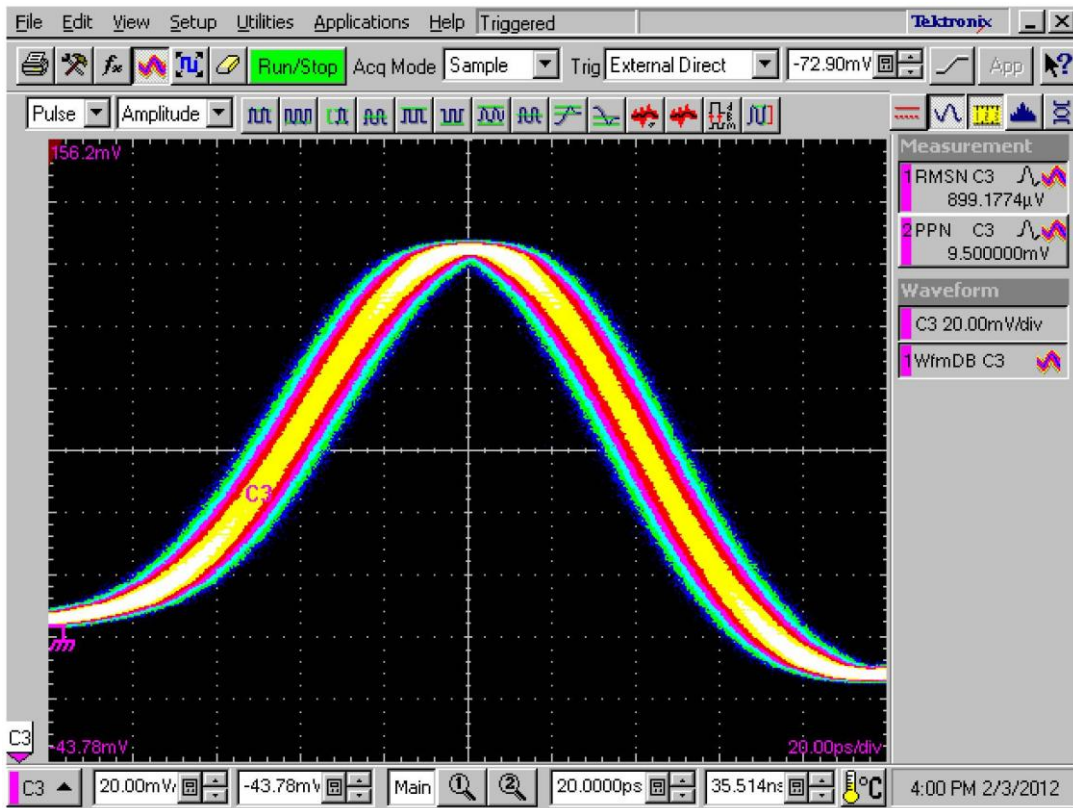


Fig.10: Output of the negative signal SG-CG1 (20ps/div) including the jitter of the signal





## Ordering number

Model: SG-CG1

## Contact information

Heuermann HF-Technik GmbH  
Auf dem Anger 29, D-52076 Aachen; Germany  
Mail: [info@hhft.de](mailto:info@hhft.de) ; Internet: <http://www.hhft.de/>  
Tel.: +49 2408/9379019 Fax: +49 2408/9379952