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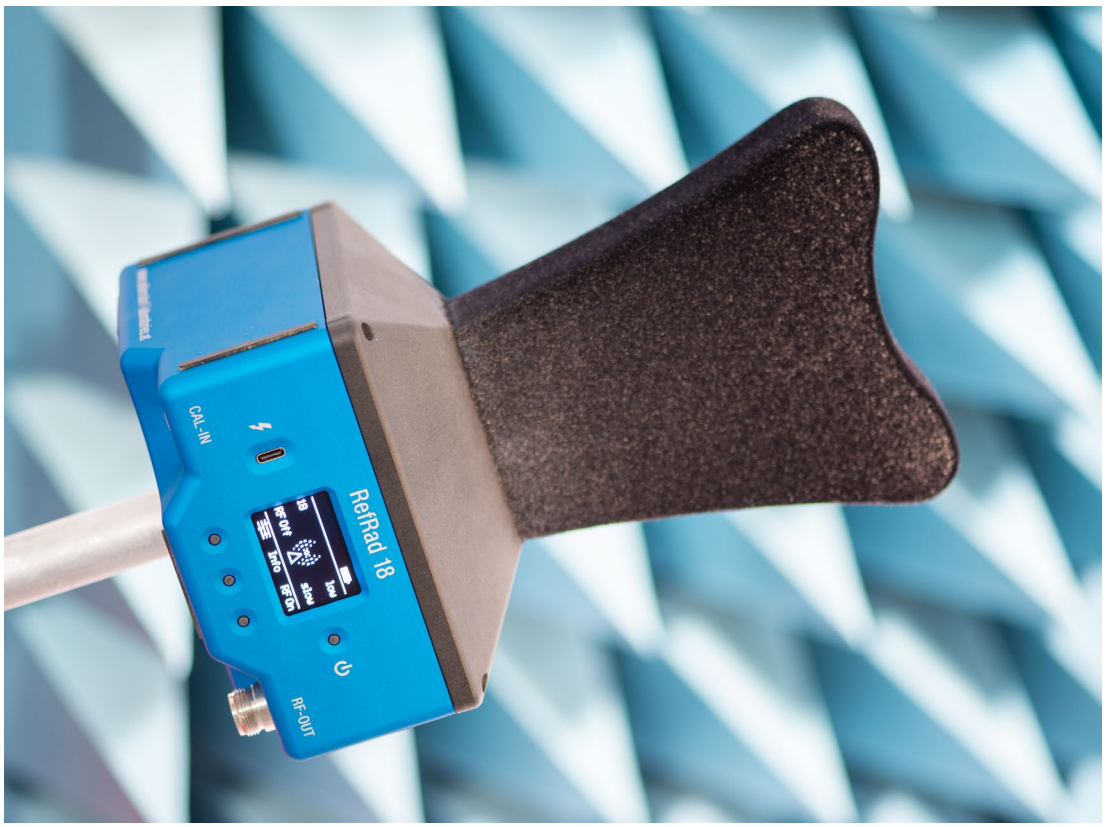
Operating Principle
How to measure with the new **RefRad18** Reference Radiator



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Edition 1.0
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1 Classical Comb Generators

Classical comb generators such as the RefRad X generate narrow pulses at a certain pulse repetition frequency, e.g. a pulse repetition frequency of 5 MHz means one pulse every 200 ns, see Figure 1. If this output is measured with a spectrum analyzer, spectral lines at multiples of 5 MHz are observed, see Figure 2.

Figure 1: Oscilloscope plot, RefRad X, 5 MHz

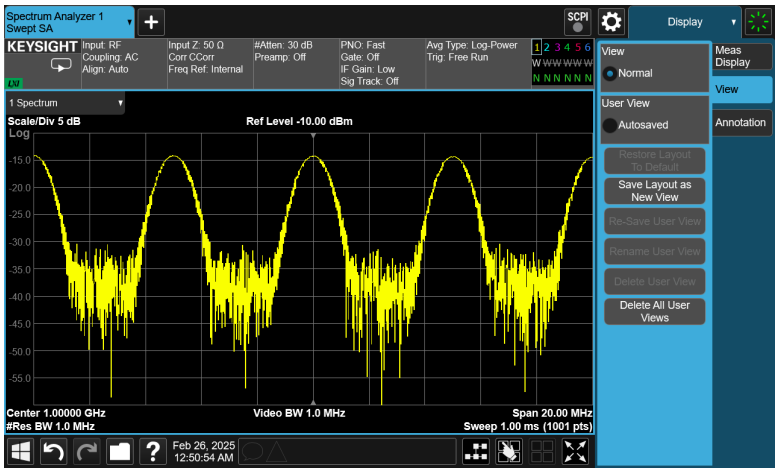

Figure 2: Spectrum analyzer plot, RefRad X

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2 RefRad 18 Principle

2.1 Principle of Signal Generation

The next generation RefRad 18 uses a different principle. The required frequencies are generated sequentially instead of simultaneously. The first frequency is valid for a certain time T, then the next frequency is generated for the same time, and so on. After the last frequency, the cycle starts with the first frequency again. The cycle time T_C is therefore calculated by multiplying the number of frequencies N by the time T.

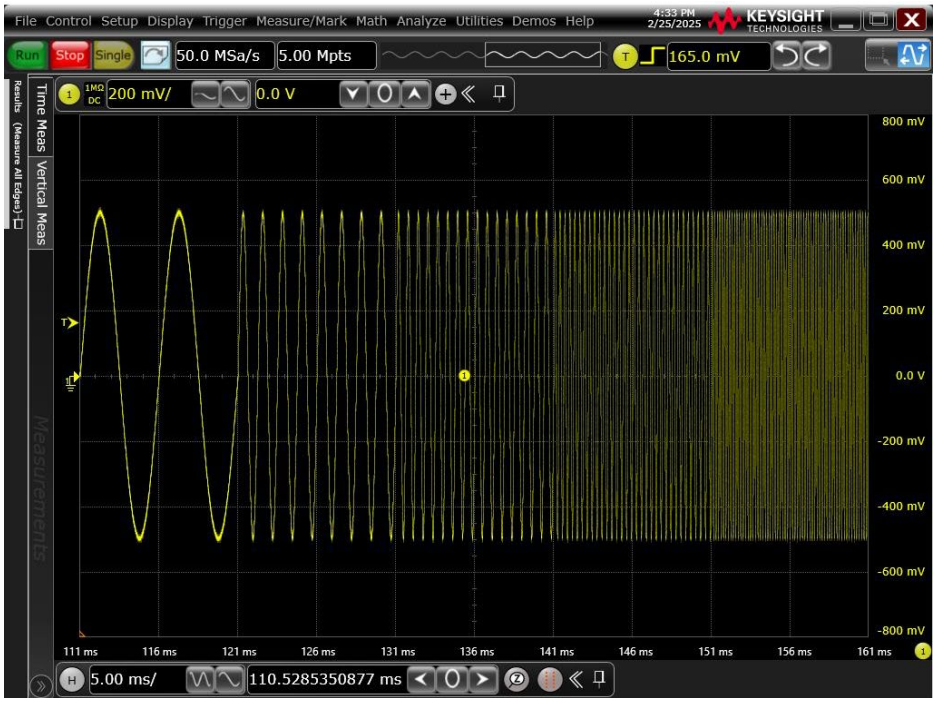

Figure 3: Oscilloscope display, new principle - values for illustration only

Frequency range	Frequency steps
1 - 4 GHz	50 MHz
4 - 8 GHz	100 MHz
8 - 18 GHz	200 MHz

Table 1 Frequency steps of RefRad 18

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2.2 Measuring with a Spectrum Analyser

The spectrum analyzer must be set to the first measurement frequency in zero span with a sweep time equal to the cycle time Tc and a max hold detector. During the time Tc, all frequencies are generated sequentially and when the frequency matches the spectrum analyzer setting, the level is recorded by placing the marker on the peak, see Figure 4.

When the measurement of the first frequency is complete, the spectrum analyzer is set to the next frequency. This is repeated until the last frequency is measured.

The required measurement time T_M is calculated as N times T_C. Example calculations for different settings of the RefRad 18 are given in Table 2

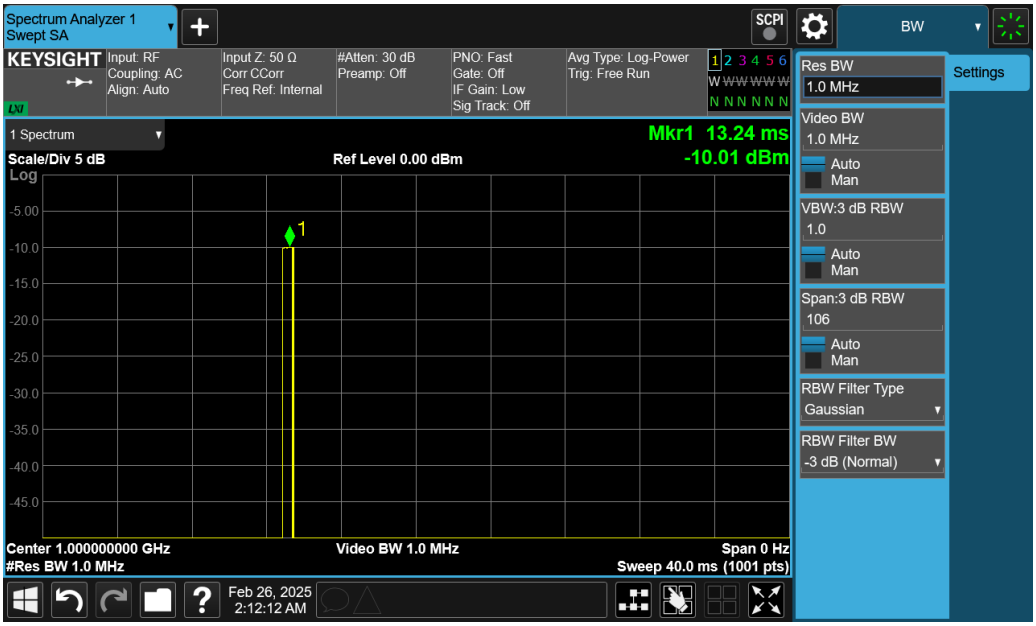

Figure 4: Spectrum analyzer plot, RefRad 18, zero span

The RefRad 18 has two settings for the time T, 500 µs and 4 ms. The reason for this is the settling time of the spectrum analyzer's RBW filter. If a 500 µs pulse is measured with an RBW of less than 4 kHz, the magnitude will be incorrect. With a pulse length of 4 ms, RBWs down to 500 Hz can be used. The small RBW is a great advantage when a high dynamic range is required, e.g. for shielding effectiveness measurements.

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Frequency range	Number of frequencies	T	T_C	T_M
1 - 6 GHz	81	500 µs	40.5 ms	3.3 s
1 - 18 GHz	151	500 µs	75.5 ms	11.4 s
1 - 6 GHz	81	4 ms	324 ms	26.2 s
1 - 18 GHz	151	4 ms	604 ms	91.2 s

Table 2 Measurement time for different RefRad 18 settings

In some applications it is not necessary to measure all the frequencies that are produced by the RefRad 18. For example, in the frequency range 1 - 18 GHz, if results in 1 GHz steps are required, the measurement time is 19 times T_C which is equal to 0.8 s for 500 µs pulses.

2.3 Measuring with an EMI Receiver

An EMI receiver can also be used with the next generation reference generator. In this case the frequency segment list must be set. The measurement time must be set to T_C and the peak detector selected, see Figure 5.

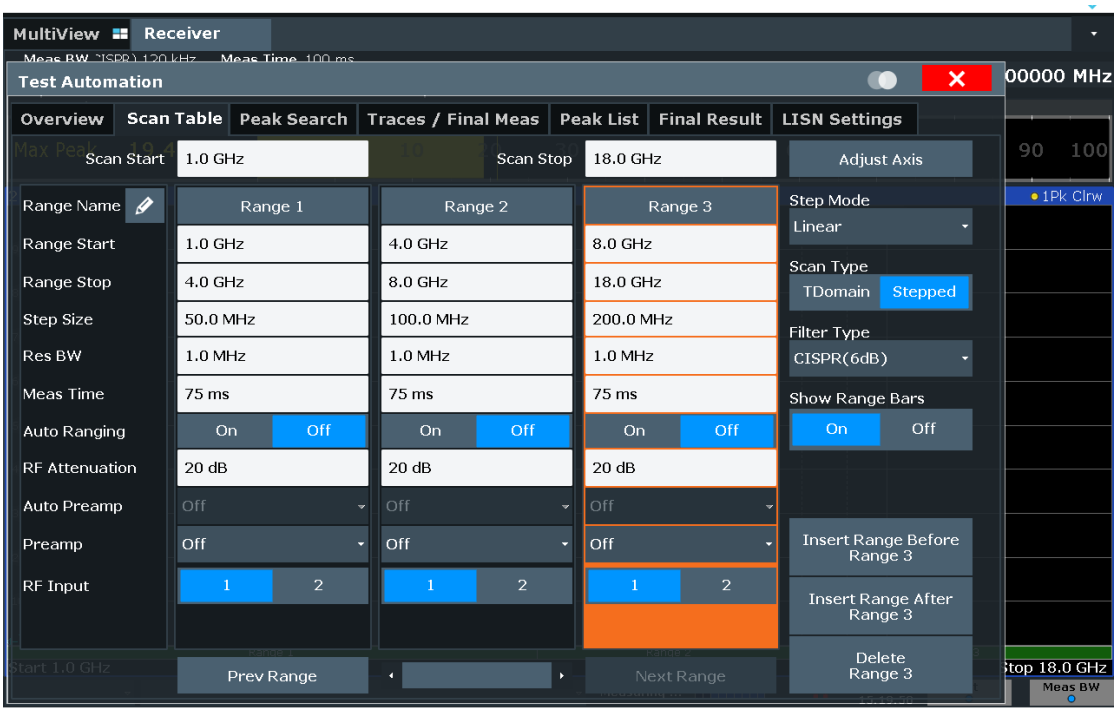

Figure 5: EMI receiver, segment definition, RefRad 18

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When the measurement is complete, the trace (see Figure 6) can be read from the EMI receiver.

Figure 6: EMI receiver, measured trace, RefRad 18

Typical EMC software is capable of performing these measurements and downloading the trace data. Alternatively, Calstan 11 can be used.

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