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



RefRad18 Reference Radiator



TABLE OF CONTENTS

1	Classical Comb Generators	3
2	RefRad 18 Principle	4
2.1	Principle of Signal Generation	4
2.2	Measuring with a Spectrum Analyser	5
2.3	Measuring with an EMI Receiver	6

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1 Classical Comb Generators

3

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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

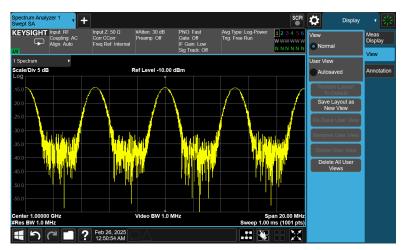


Figure 2: Spectrum analyzer plot, RefRad X



RefRad18 Reference Radiator



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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4



2.2 Measuring with a Spectrum Analyser

5

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 μ s and 4 ms. The reason for this is the settling time of the spectrum analyzer's RBW filter. If a 500 μ s 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.



Frequency	Number of	Т	Tc	Тм
range	frequencies			
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

6

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.

Test Automation											×	00	000	MH
Overview Scan	Table Peal	k Search	Traces / Fin	al Meas	Pe	ak List	Final I	Result	l	LISN Setting	js			
Max Peaksan Start	1.0 GHz		10	Scan S	top	18.0 GH	łz			Adjust	Axis	9	0	100
Range Name 🖉	Ranç	ge 1	Ran	ge 2			Range 3	:	1	Step Mode			∍1Pk	: Clrw
Range Start	1.0 GHz		4.0 GHz			8.0 GHz	2			Linear	·			
Range Stop	4.0 GHz		8.0 GHz			18.0 GH	łz			Scan Type TDomain	Stepped			
Step Size	50.0 MHz		100.0 MHz			200.0 M	1Hz			Filter Type				
Res BW	1.0 MHz		1.0 MHz			1.0 MH:	z			CISPR(6dB)				
Meas Time	75 ms		75 ms			75 ms				Show Range	Bars			
Auto Ranging	On	Off	On	Off		On		Off		On	Off			
RF Attenuation	20 dB		20 dB			20 dB								
Auto Preamp						Off			-					
Preamp	Off		• Off			Off			•	Insert Rang Rang				
RF Input 2		1	1 2		1 2			Insert Range After Range 3						
Start 1.0 GHz Prev Range		•			Range 2 Next Range				Delete Range 3			18.0 Mea	D GH	

Figure 5: EMI receiver, segment definition, RefRad 18



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

Att Input	CISPR) 1 MHz Meas Time 20 dB Notch 1 AC PS	Off 🗕 Step	LIN p Off				Frequenc	/ 18.000	00000 GH
Bargraph									
Max Peak	- 59.14 dBm <mark>-95</mark>		-70	-60		-30	-20	-10	
Scan						 			• 1Pk Clrv
							10 GHz		
10 dBm						_			
					Range			Range 3	

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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7

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