1kW LDMOSFET power amplifier for short wave

Spectrum of the 1-transistor version

For the design of the output low pass filter it is necessary to know the data of the output stage. Therefore the 2nd and 3rd harmonics were measured on all bands.

This list shows the attenuation of the first two harmonics as they come out of the raw, unfiltered, PA. Harmonics above the 3rd harmonic are no longer important, since the filter will already be very effective there and will attenuate them sufficiently in any case.

With a push-pull PA, the double frequency (2nd harmonic) is usually relatively low. On the other hand, the triple frequency is very high. The legal regulations require that harmonics (0 to 30 MHz) must be at least 40dB smaller than the fundamental. In USA this would be changed recently to 43dB. I will therefore use 43dB and additionally some reserve for planning the filter and calculate with at least 45dB attenuation. The unit dBc means: dB referred to the fundamental.

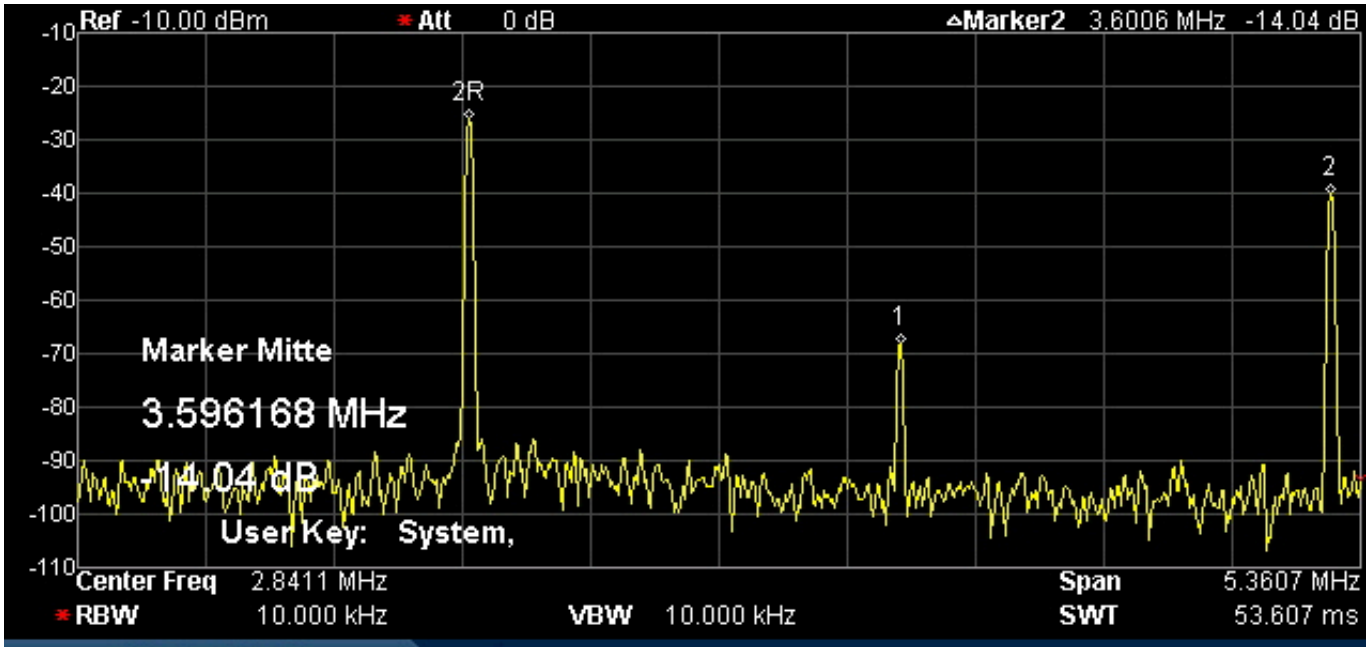
Band	2nd Harmonic [dBc]	3rd Harmonic [dBc]
1.8 MHz	-42	-14
3.5 MHz	-39	-13
5.3 MHz	-33	-4
7.0 MHz	-30	-4
10.0 MHz	-29	-8
14.0 MHz	-32	-16
18 MHz	-39	-17
21 MHz	-43	-17
25 MHz	-43	-19
28 MHz	-43	-21

To have the lowest possible passband attenuation for the fundamental, the filter should not be too close to the frequency limit. The already good attenuation of the 2nd harmonic helps here. At the worst band on 30m there is still 16 dB missing to get to 45 dB attenuation.

At the third harmonic it looks in principle clearly worse. Here at least 40dB additional attenuation are necessary.

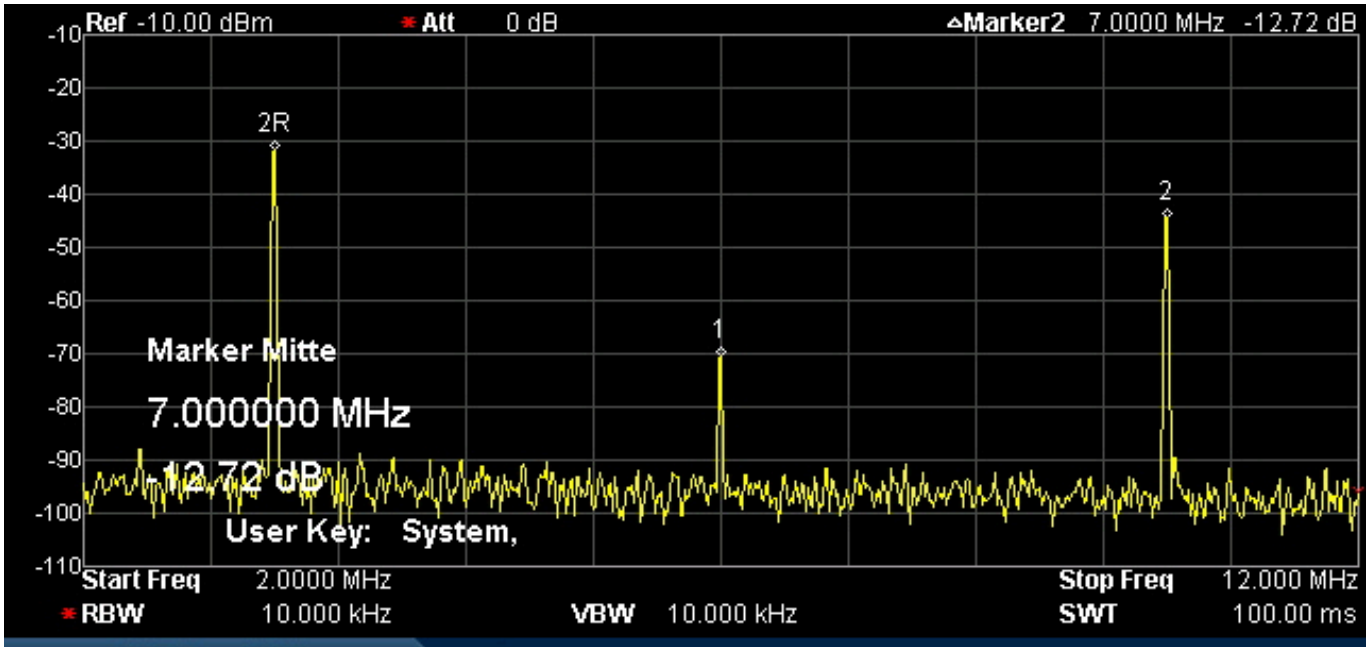
But be careful ! these measured values are only valid if the unfiltered PA is closed with a 50 Ohm dummy load. If the PA is terminated with a filter, these values may change, since the filter input does not have 50 ohms at the frequencies of the harmonics. So these values can only be used as a rough guide for the filter design.

And here are the original pictures:



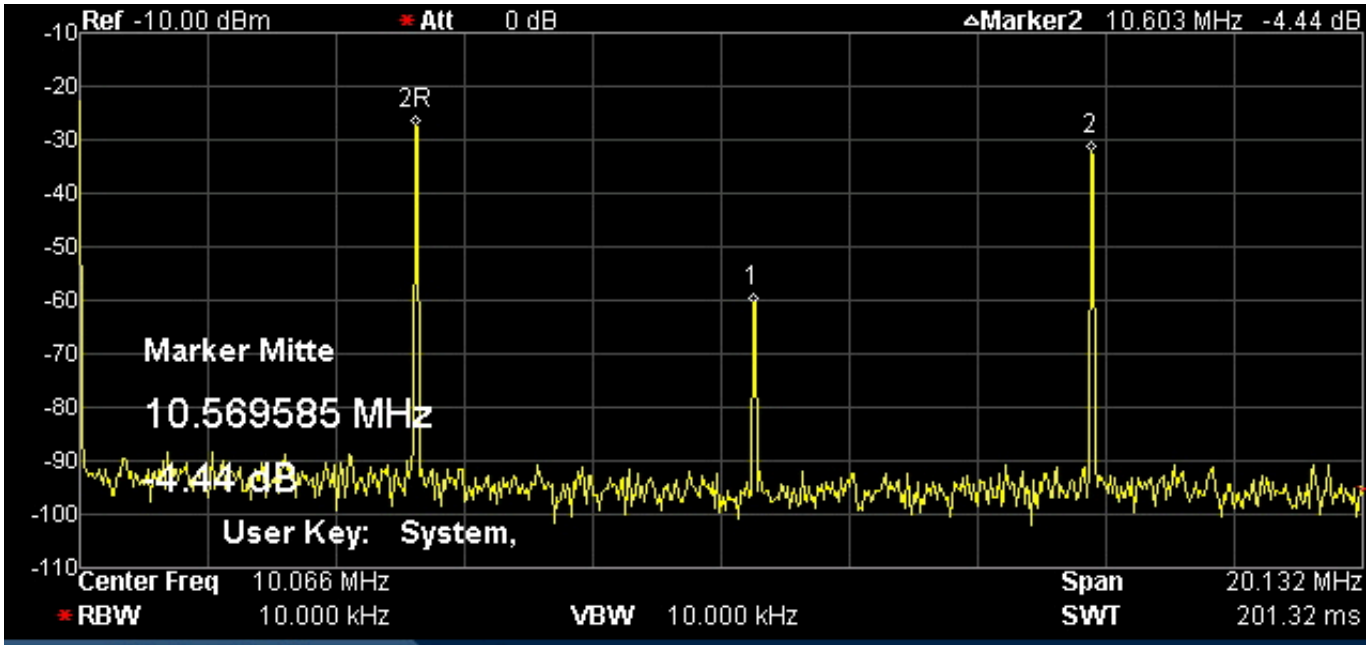
Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	1.795848 MHz	-26.24 dBm
1D	1	Frequenz	1.8047 MHz	-42.15 dB
2R	1	Frequenz	1.795848 MHz	-26.24 dBm
2D	1	Frequenz	3.6006 MHz	-14.04 dB



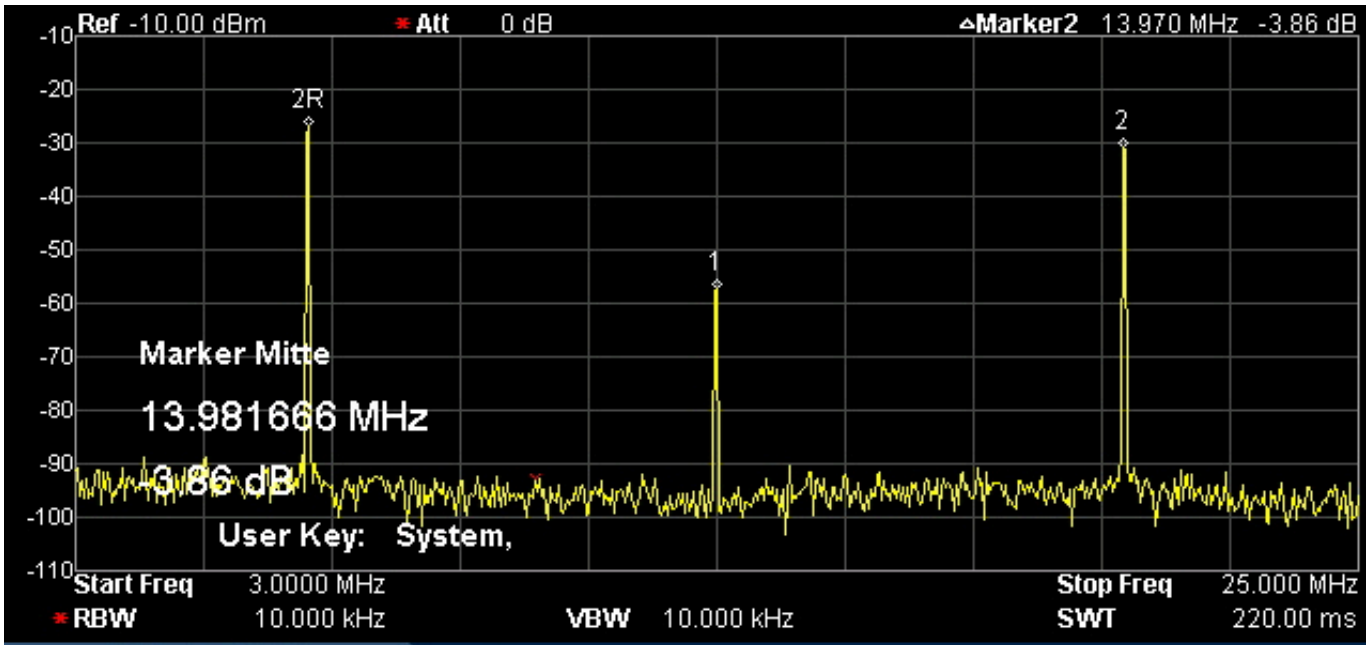
Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	3.500000 MHz	-31.83 dBm
1D	1	Frequenz	3.5000 MHz	-38.88 dB
2R	1	Frequenz	3.500000 MHz	-31.83 dBm
2D	1	Frequenz	7.0000 MHz	-12.72 dB



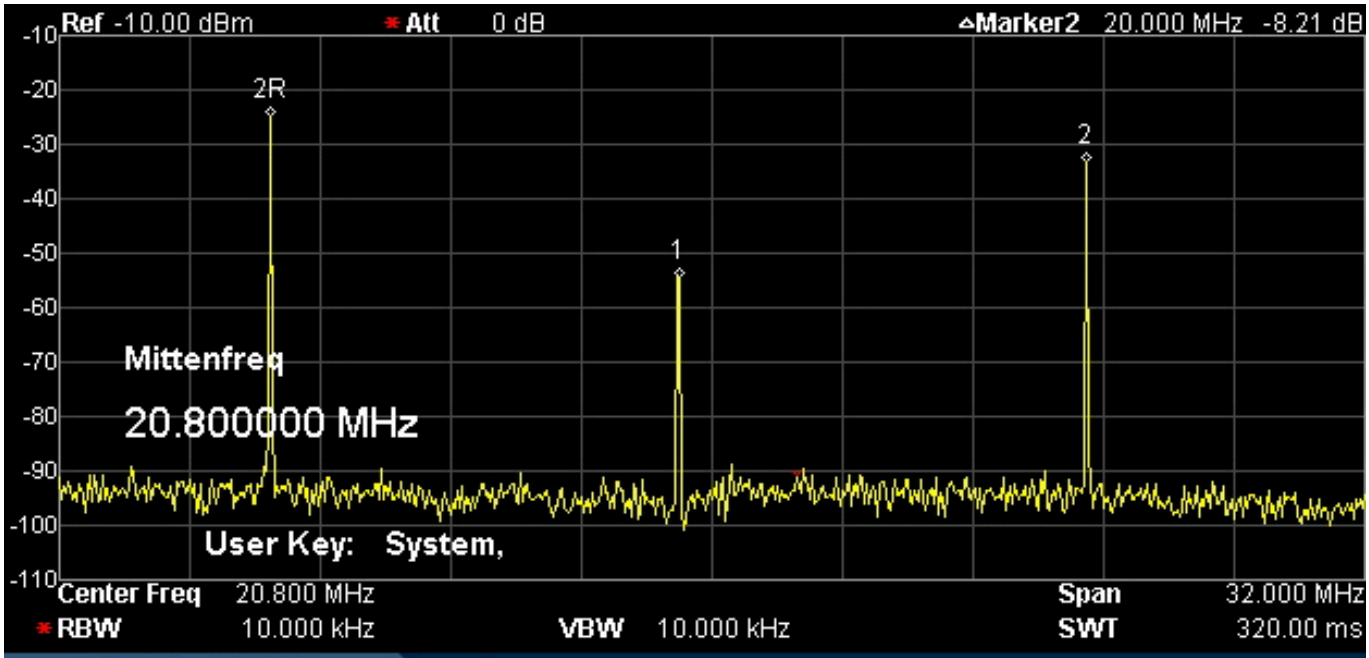
Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	5.268015 MHz	-27.59 dBm
1D	1	Frequenz	5.3015 MHz	-33.09 dB
2R	1	Frequenz	5.268015 MHz	-27.59 dBm
2D	1	Frequenz	10.603 MHz	-4.44 dB



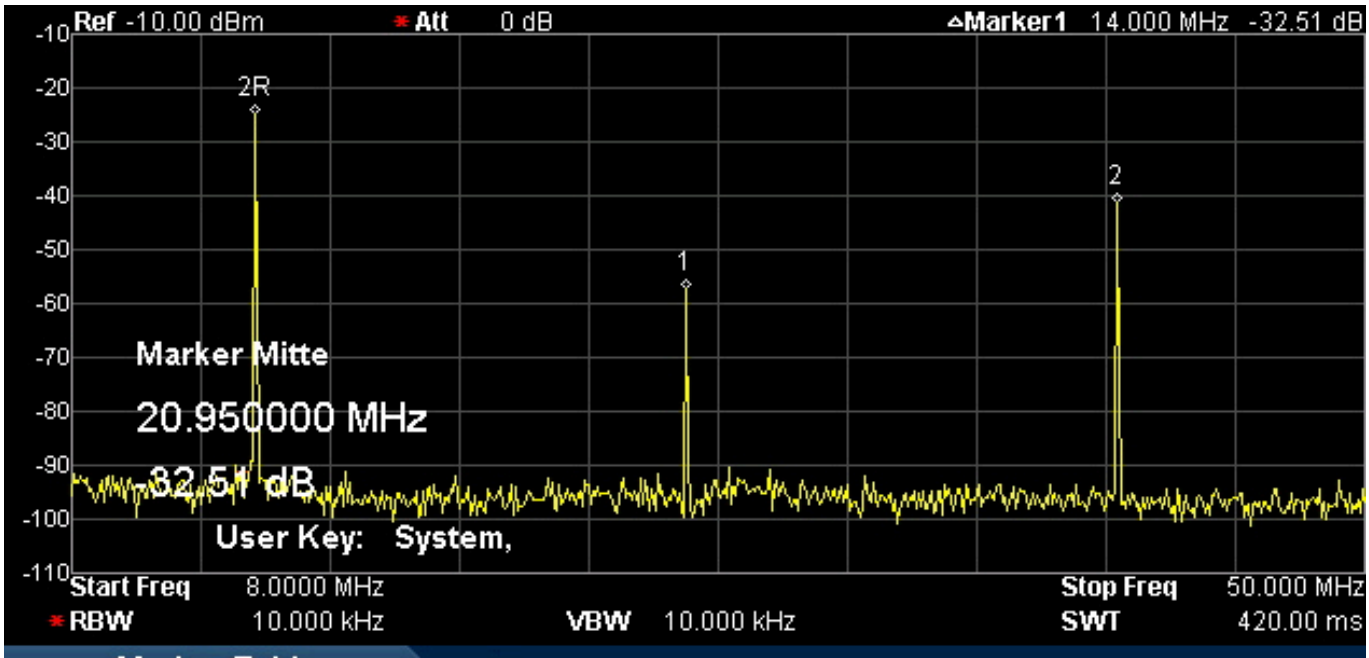
Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	6.996666 MHz	-27.15 dBm
1D	1	Frequenz	7.0033 MHz	-30.20 dB
2R	1	Frequenz	6.996666 MHz	-27.15 dBm
2D	1	Frequenz	13.970 MHz	-3.86 dB



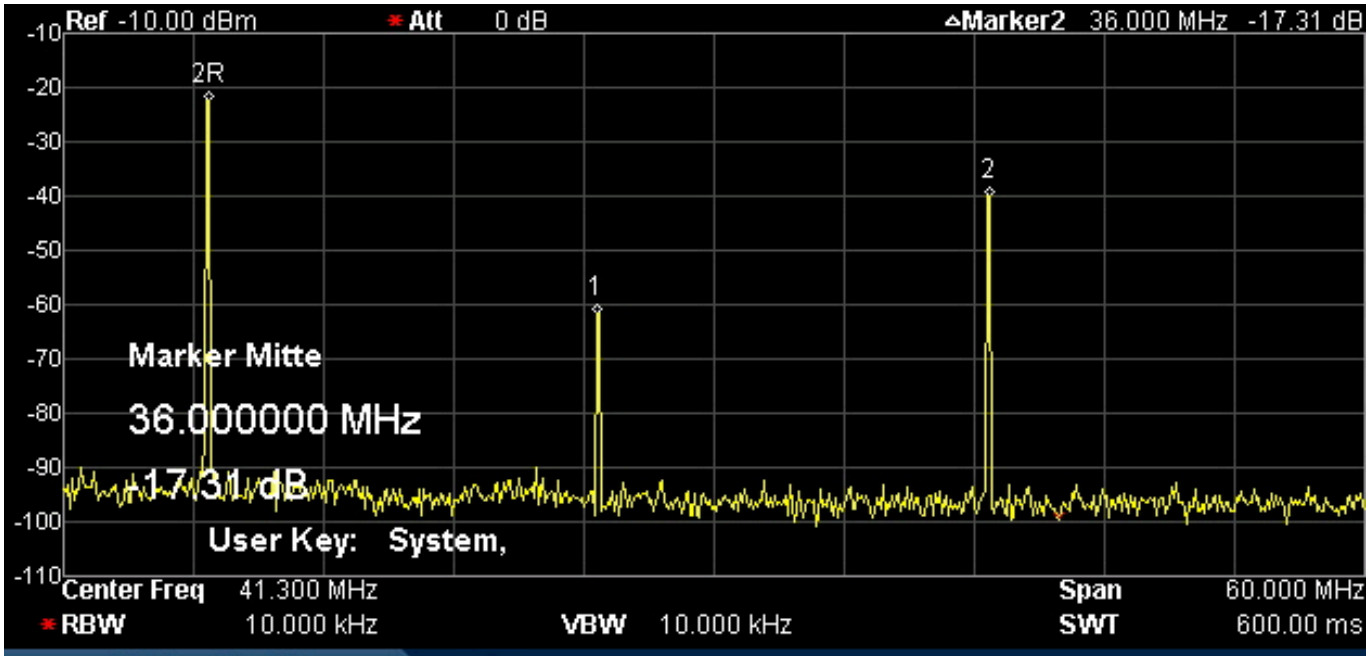
Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	9.973333 MHz	-25.05 dBm
1D	1	Frequenz	10.026 MHz	-29.38 dB
2R	1	Frequenz	9.973333 MHz	-25.05 dBm
2D	1	Frequenz	20.000 MHz	-8.21 dB



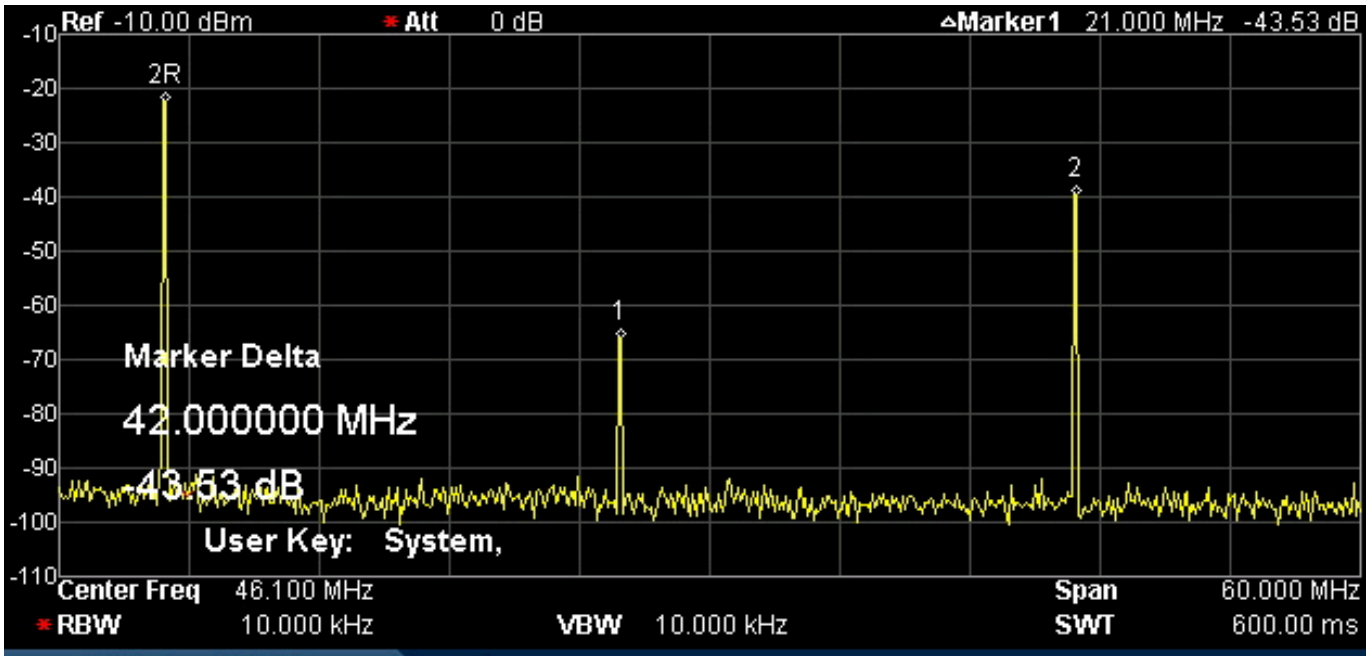
Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	13.950000 MHz	-24.81 dBm
1D	1	Frequenz	14.000 MHz	-32.51 dB
2R	1	Frequenz	13.950000 MHz	-24.81 dBm
2D	1	Frequenz	28.000 MHz	-16.73 dB



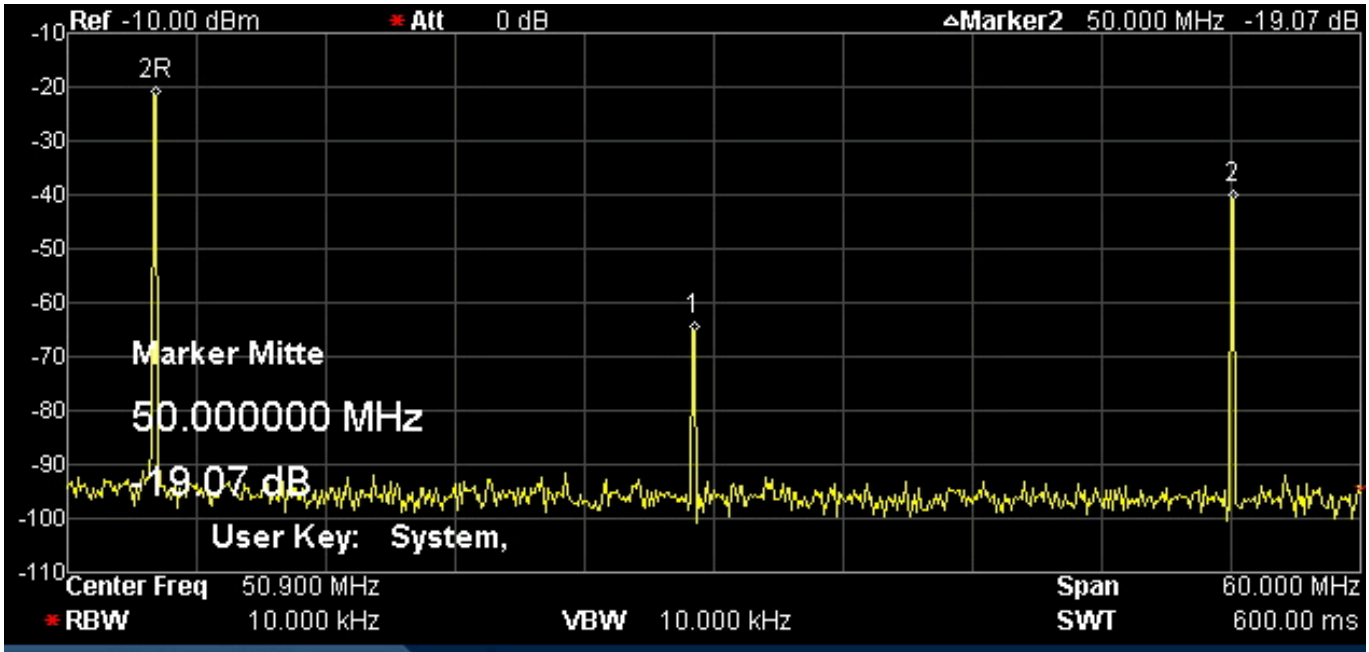
Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	18.000000 MHz	-22.76 dBm
1D	1	Frequenz	17.900 MHz	-38.91 dB
2R	1	Frequenz	18.000000 MHz	-22.76 dBm
2D	1	Frequenz	36.000 MHz	-17.31 dB



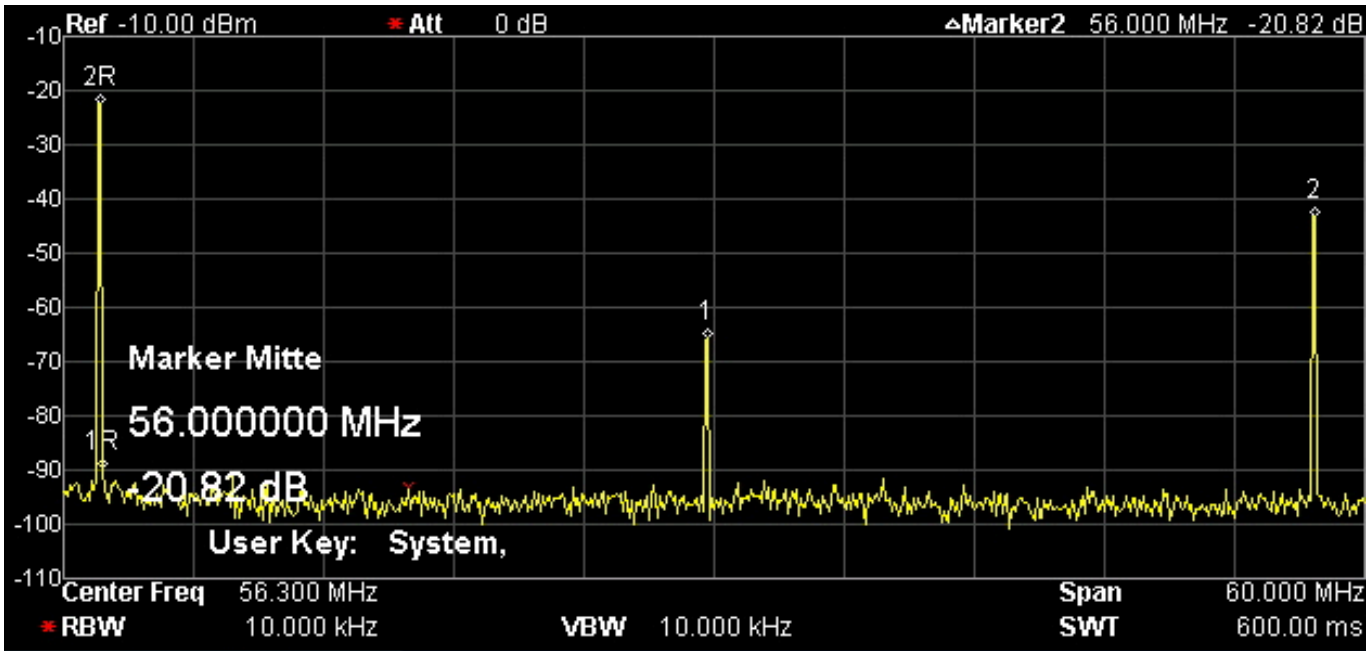
Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	21.000000 MHz	-22.51 dBm
1D	1	Frequenz	21.000 MHz	-43.53 dB
2R	1	Frequenz	21.000000 MHz	-22.51 dBm
2D	1	Frequenz	42.000 MHz	-17.18 dB



Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	25.000000 MHz	-21.87 dBm
1D	1	Frequenz	25.000 MHz	-43.40 dB
2R	1	Frequenz	25.000000 MHz	-21.87 dBm
2D	1	Frequenz	50.000 MHz	-19.07 dB



Marker Table

Marker	Trace	Type	X Axis	Amp
1R	1	Frequenz	28.100000 MHz	-89.81 dBm
1D	1	Frequenz	27.900 MHz	23.84 dB
2R	1	Frequenz	28.000000 MHz	-22.54 dBm
2D	1	Frequenz	56.000 MHz	-20.82 dB