ENAMS-receiving system

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1. Antenna

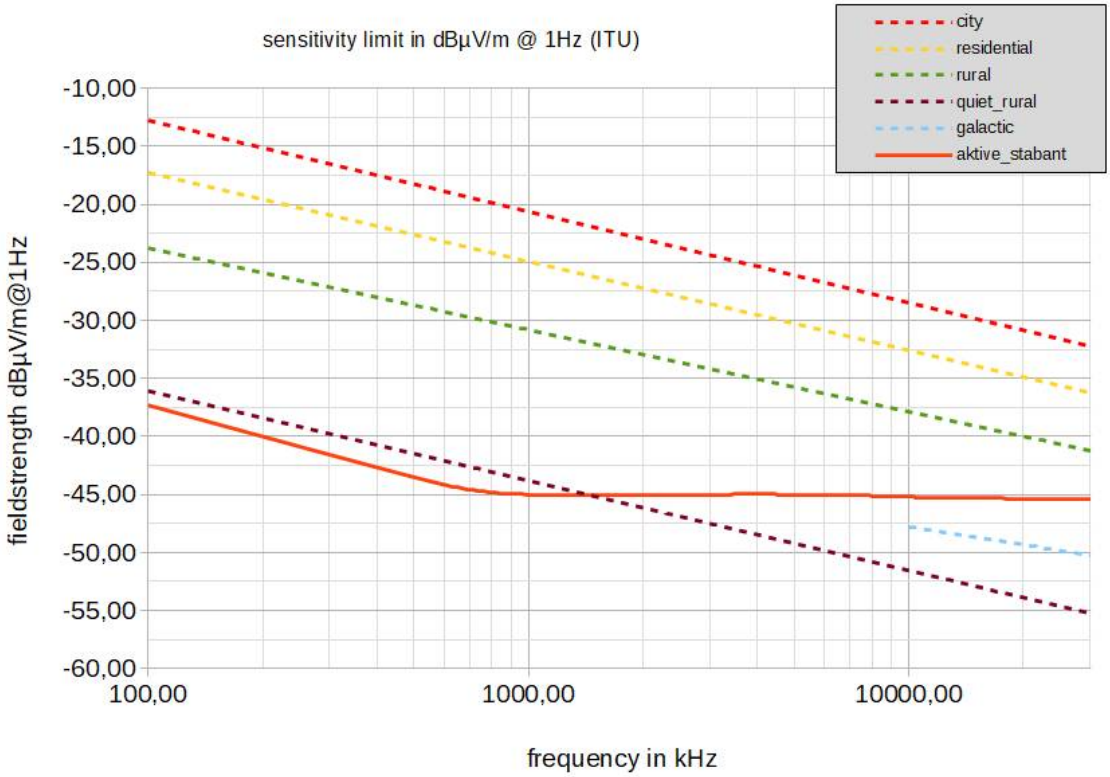
Principle: active e-field sensor, k-factor=1 (variable by changing resistor values), power supply via coaxial cable

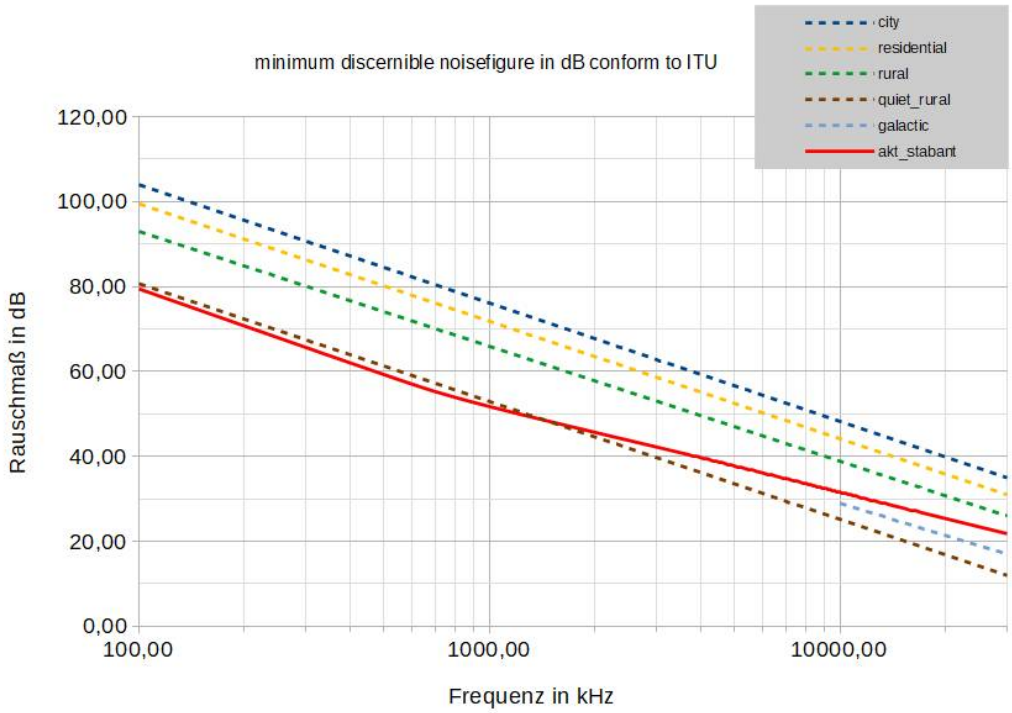
1.1. Measured Values

effective height by mechanical dimensions, 1m radiator, 1m stand, 8 radials	h_N = 1,5 m
electrical gain at 50 Ω load und 9pF antenna substitute	v = -3.5 dB
resulting k-factor	k = 1.0 m^{-1}
k-factor logarithmic	k‘ = 0 dB/m
input capacity	C_i = 8,6 pF
input resistance	R_i = 5 MΩ
output resistance	R_A = 50 Ω
OPIP2	+56 dBm
OPIP3	+43 dBm
1dB-compression (output)	+11 dBm

note: gain and k-factor can be changed by replacing resistors

1.2. Sensitivity Diagrams





2. Receiver

A Red Pitaya 14bit is being used as receiver supplemented by a diplexer network, a lowpass and 2 preamplifiers forming the frontend. For dynamic improvement purposes the 2 available A/D-channels of the red pitaya are used in 2 frequency ranges with different gains. The diplexer cutoff frequency is 8MHz, thus a range up to 8MHz and another 8MHz to 30MHz is implemented. The frontend also contains a 32MHz lowpass of 5th order. The gain of the 2 preamplifiers can be dimensioned independently to optimize dynamic, 10dB (low band) and 20dB (high band) are used momentary. Furthermore the frontend contains a bias-T and a current limiter for the 15V supply of the active antenna.

Attention when measuring the frontend: the antenna input is connected to the $15V_{DC}$ powersupply for the antenna permanently! Use a DC-Block!

2.1 Red Pitaya

Software: HDSDR, input attenuator of RP deactivated (jumper in middle position), external 50Ω load applied (with T-connector)

2.1.1. Intermodulation, f1=11,05MHz, f2=11,1MHz (RP only)

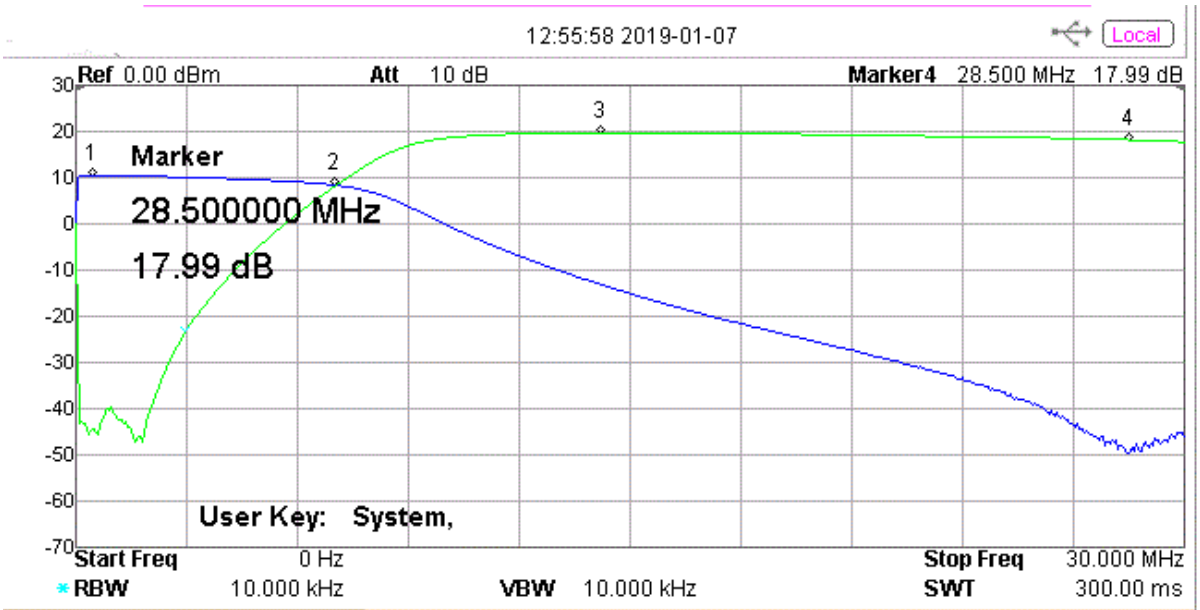
input level	measured	IM	IP3
2 x -30dBm	2 x -42dBm	68dB	+4dBm
2 x -20dBm	2 x -32dBm	72dB	+16dBm
2 x – 10dBm	2 x -22dBm	71dB	+25,5dBm
2 x -3dBm	2 x -15dBm	65dB	+29,5dBm

2.1.2. Noisefigure and Dynamic

The noise figure was measured with the noise generator SUF2 (R&S). A noise level of -133.9dBm/Hz caused a noise increase of 3dB. Thus the resulting noise figure is **F=40.1dB**. For comparison: ELAD FDMS2: F=18.1dB, Perseus: F=23.1/25.5dB with and without preamp. Maximum input level (fullscale A/D converter) is +5dBm.

2.2 Red Pitaya + Frontend (complete receiver)

2.2.1. Frequency Response and Gain of Frontend



Marker Table

Marker	Trace	Type	X Axis	Amp
1D	1	Frequenz	450.000 kHz	10.34 dB
2D	1	Frequenz	7.000000 MHz	8.20 dB
3D	2	Frequenz	14.200000 MHz	19.55 dB
4D	2	Frequenz	28.500000 MHz	17.99 dB

2.2.2. Noise at Output of Frontend with and without Antenna

noiselevel at output, lowband (5MHz) without antenna P_R = -158,6dBm/Hz

noiselevel at output, lowband (5MHz) with antenna P_R = -142,6dBm/Hz

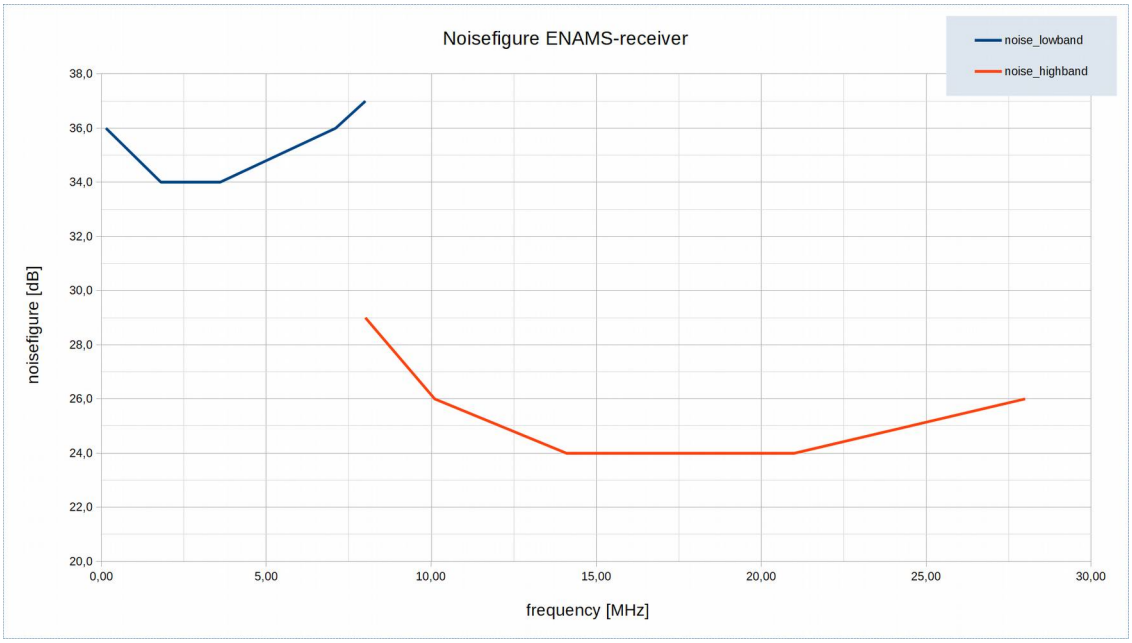
noiselevel at output, highband (14MHz) without antenna P_R = -148,6dBm/Hz

noiselevel at output, highband (14MHz) with antenna P_R = -130,5dBm/Hz

When measuring „with antenna“ the radiator was removed and substituted by an equivalent load (9pF).

2.2.3. Noisefigure with Preamp

noisefigure complete RX:



2.2.4. Input Level Limit (Fullscale) with Preamp

lowband	-2dBm
highband	-13dBm

2.2.5. Intercept Point

lowband (6,0 / 6,5MHz)

IP2 @ 2 x -20dBm	+52dBm (summ) / +56dBm (diff.)
IP3 @ 2 x -20dBm	+20dBm

highband (10,0 / 19,0MHz)

IP2 @ 2 x -20dBm	+37dBm (summ) / +49dBm (diff.)
IP3 @ 2 x -20dBm	+10dBm

2.2.6. Spurious

Frequency [MHz]	level [dBm]
0,110	-115
0,220	-113
2,148	-115
2,258	-116
11,303	-116
13,566	-117
18,088	-116
25,000	-118
29,395	-116