Receiver blocking dynamic range

The blocking dynamic range (also known as "blocking gain compression") of a receiver indicates how well a receiver can process small signals in addition to very large signals. The BDR (blocking dynamic range) of an analogue receiver is reached when an interference signal (f2) becomes so large that a small signal (f1) loses 1 dB of amplitude (S / N) at a distance of 2...20 kHz. The receiver is desensitized by supplying a large signal and loses sensitivity. The blocking dynamic range of a receiver is calculated to

BDR = Blocking Level - MDS

Figure 1 shows the structure of a receiver BDR measurement, which is similar to an IM3 measurement, except that the levels of the two oscillators are now very different. For this measurement, one can also use a suitable "RF two-tone generator".

Setting the generators:
f1 = 7,000MHz, P1 = -107dBm (HP8656B)
f2 = 7,020MHz, P2 = -30 ... + 10dBm (Marconi 2019), f2 must be a low-noise RF signal!

Used receiver: analogue KW receiver (heterodyne receiver)
Receiver setting: SSB or CW, AGC OFF, Attenuation OFF

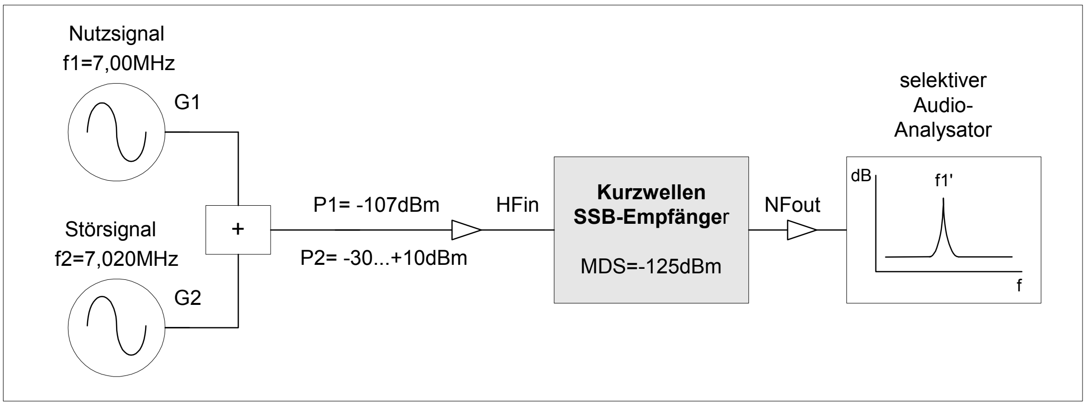

Figure 1: BDR measurement setup for analog and digital receivers

Measuring procedure:

- Adjust receiver to f1, overlay sound NF output to approx. 1kHz, P1 = -107dBm
- Measure the level of the LF signal at the speaker output with the audio analyzer (Fig. 2, left side)
- Increase P2 starting from -30dBm until the audio signal (the wanted signal) decreases by 1dB in amplitude (Fig. 2, right side)

At my analogue receiver, the 1dB compression of the NF signal occurred at P2 = + 4dBm. This results in a "blocking dynamic range" of

BDR = blocking level - MDS = + 4dBm - (-125dBm) = 129dB

As "Audio Analyzer" I use the soundcard of my notebook and the software "Audio-Tester V3.0".

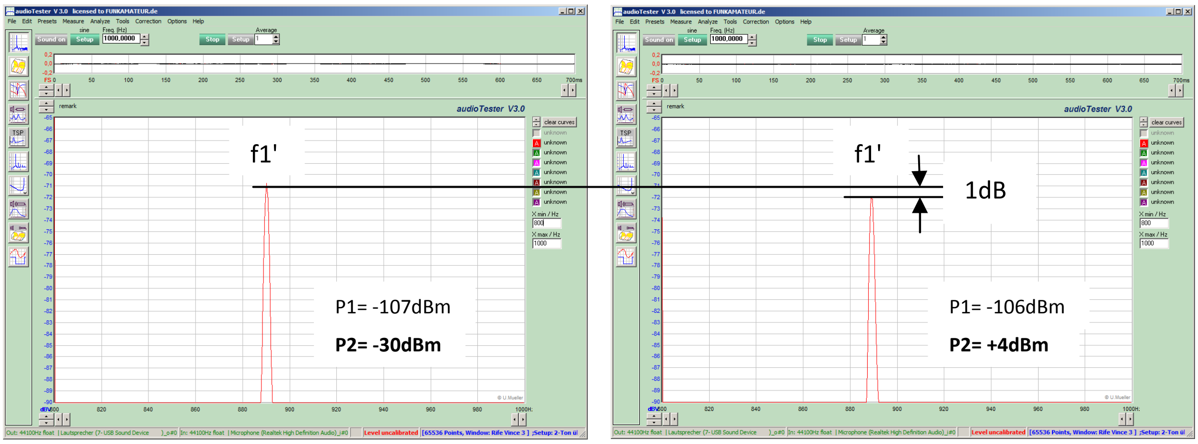

Figure 2: At a signal of P2 = + 4dBm (picture right) the receiver gets in 1dB compression

Note: To measure the level of the AF signal (f1 ') on the speaker output, do not use a broadband AC voltmeter, as this would lead to incorrect results. The reason is due to the sideband noise of the interfering signal, which transmits in the receiving channel with (reciprocal mixing) and increases the cumulative measuring level (S + N) at level increase. In a broadband measurement of the LF signal (here over an SSB bandwidth of 2.4 kHz), the measurement signal would rise despite 1dB compression and not drop, so the correct 1dB compression would not be measurable! Therefore, the LF level must be selective, e.g. using an audio analyzer (see Figure 2).

Blocking dynamic range of digital receivers

Unlike analogue receivers, BDR measurement on digital, direct-sampling SDRs is no longer relevant because large signals do not have a compressing influence on small signals. The ADC in the input of a direct sampling SDR knows neither a "1dB compression" nor a "blocking dynamic range", but a limitation (clipping, saturation).

To show this, I measure the performance of the directly sampling SDR ColibriNANO (Figure 3). Even with an increase of the interference signal up to -15dBm, the small wanted signal of -121dBm at a distance of only 5 kHz remains completely unimpressed. Only when overdriving the SDR, with an input power of <-12dBm, the ADC suddenly abruptly clipping and the reception breaks down. The maximum dynamic range of the ColibriNANO is accordingly

Blocking Dynamic Range = Clipping Level - MDS = -12dBm - (-125dBm) = 113dB

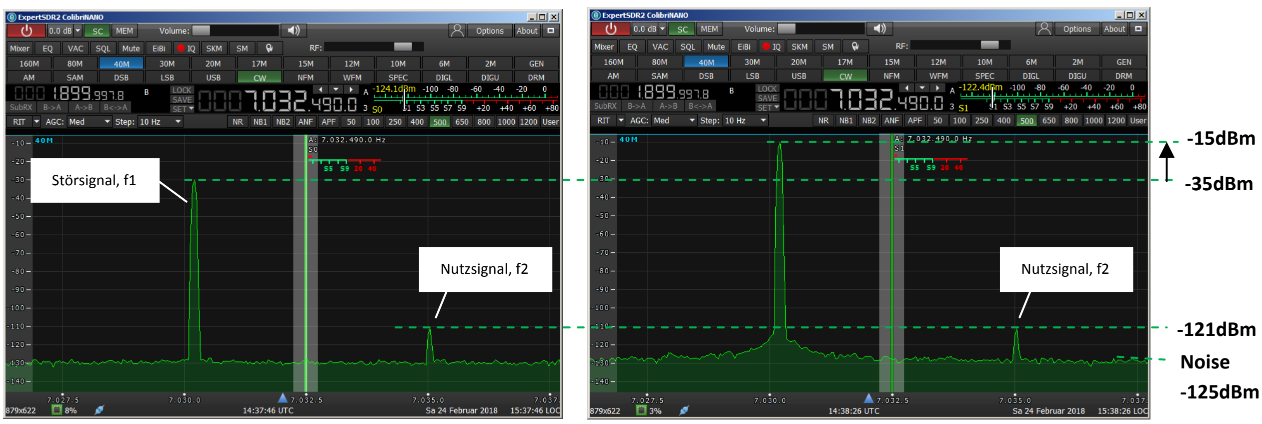

Figure 3: A direct sampling SDR shows no blocking up to its limit

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