



Radio Meet project

Doel

- Het vergelijken van (SDR) ontvangers.

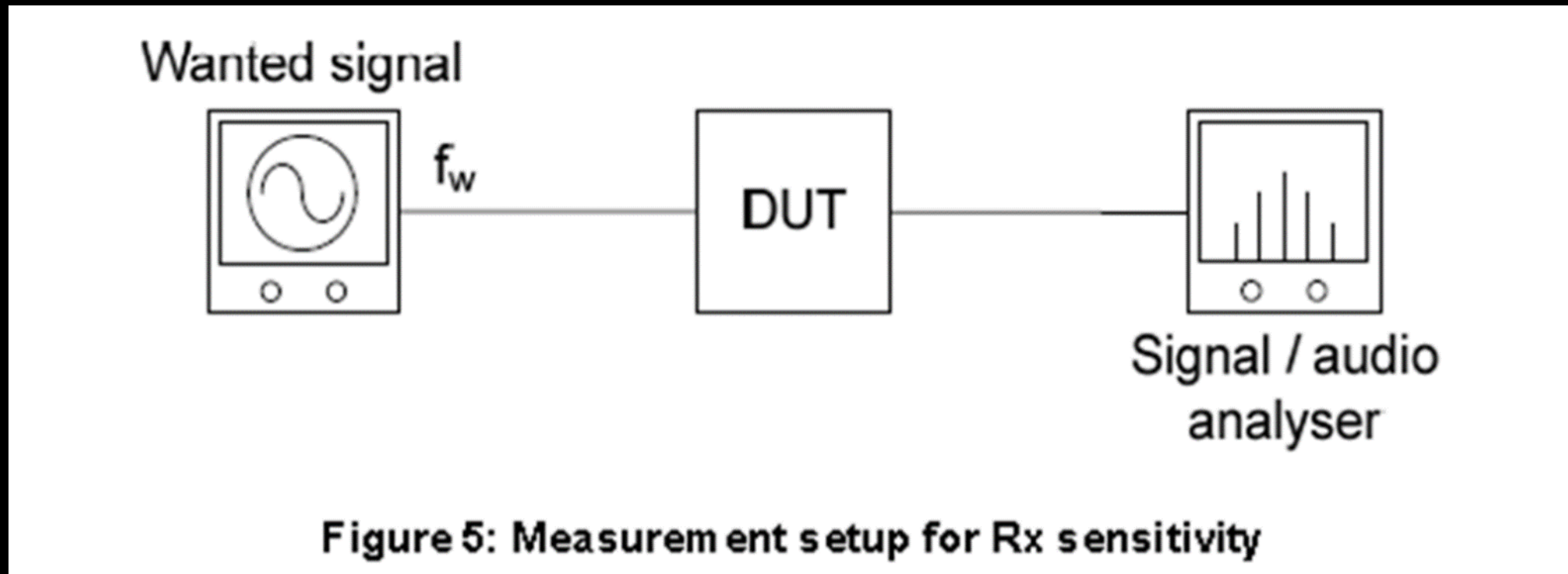


Ontvanger eigenschappen

- Wat bepaald de kwaliteit het meeste?
- Het meten van Selectiviteit bij ontvangers:
het vermogen van een ontvanger om twee elektromagnetische golven van weinig verschillende frequentie van elkaar te scheiden.
- Dynamisch bereik ontvanger:
Het dynamisch bereik heeft ook betrekking op de ontvanger en bepaalt het verschil tussen het zwakste signaal dat hij kan ontvangen en het sterkste signaal dat binnenkomt.

Eerst bepalen gevoeligheid

- Een gemoduleerd signaal aanbieden totdat we een SINAD hebben van 20 dB op de gewenste frequentie.



Wat is SINAD?

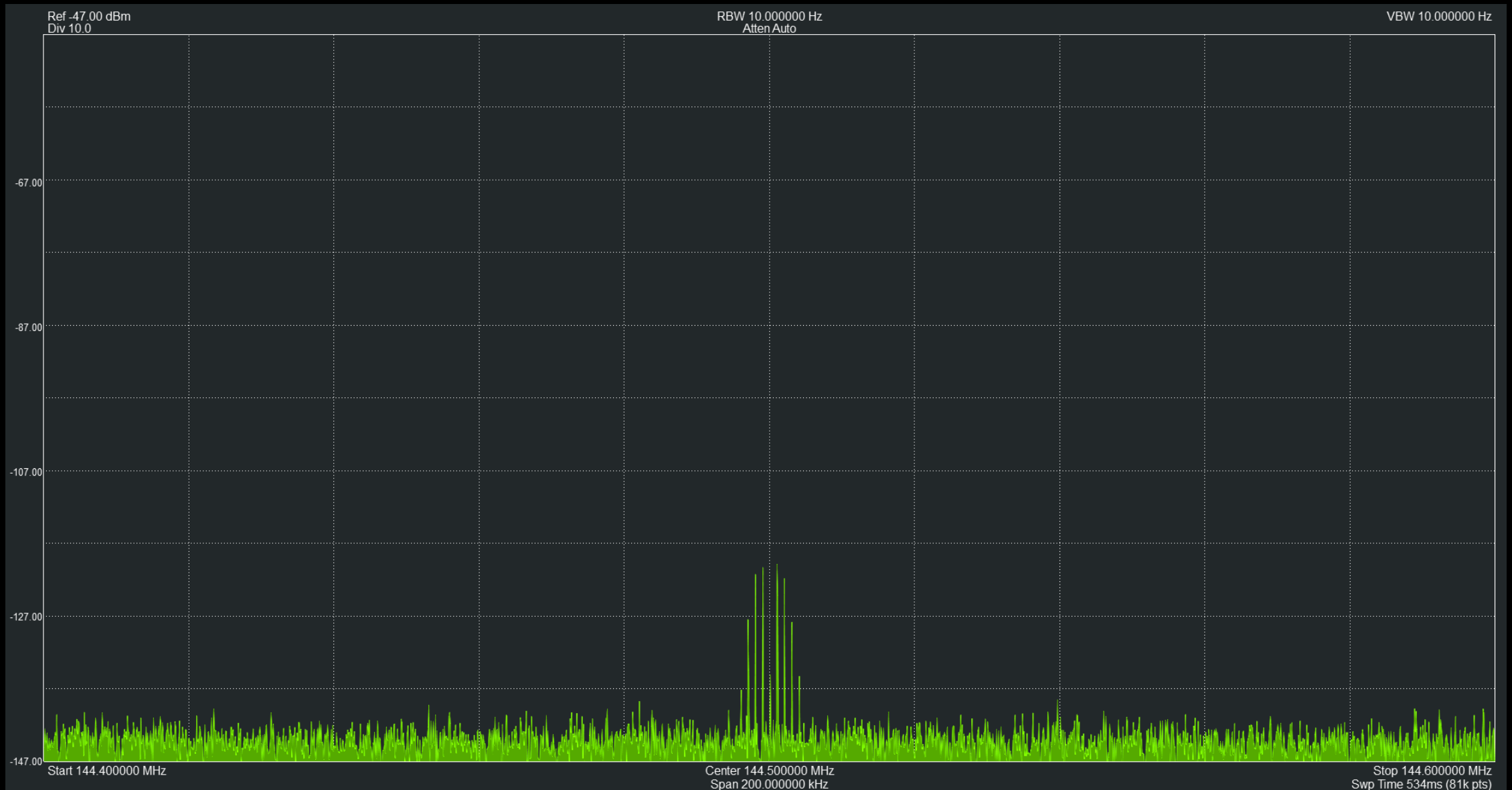
SINAD staat voor Signal to Noise And Distortion en betekent vrij vertaald 'verhouding van signaal tot ruis en vervorming'. De SINAD-waarde geeft de prestatie aan van de audiokwaliteit.

12 dB = Net hoorbaar

14 dB = Gestoord

20 dB = Goed te horen

Voorbeeld: 144.500 MHz, 20 dB SINAD bij 2.5 kHz
zwaai met 1 kHz gemoduleerd signaal



Meetmethode voor Selectivity

- Genereer signaal die 20 dB SINAD geeft op target frequentie (1 kHz AF).
- Genereer tweede signaal met frequentie offset en modulatie van 400 Hz en regel amplitude zodat de SINAD afneemt op het originele signaal tot 14 dB.

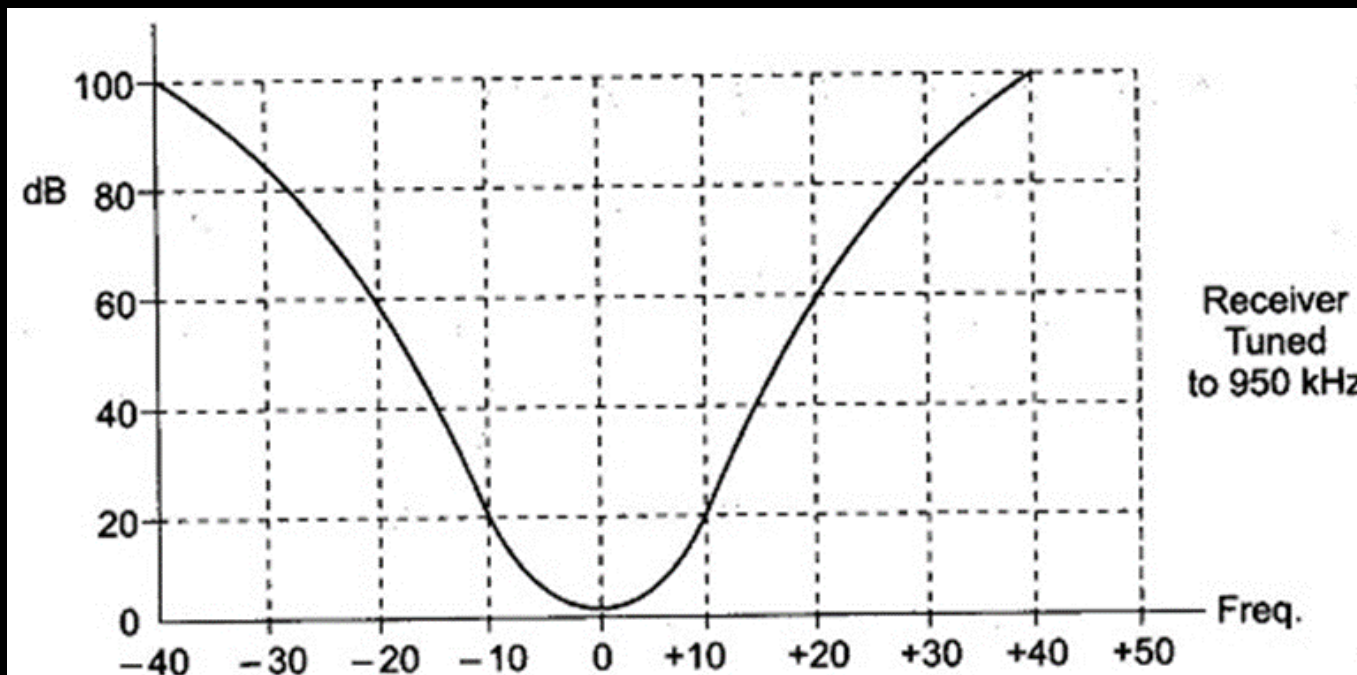
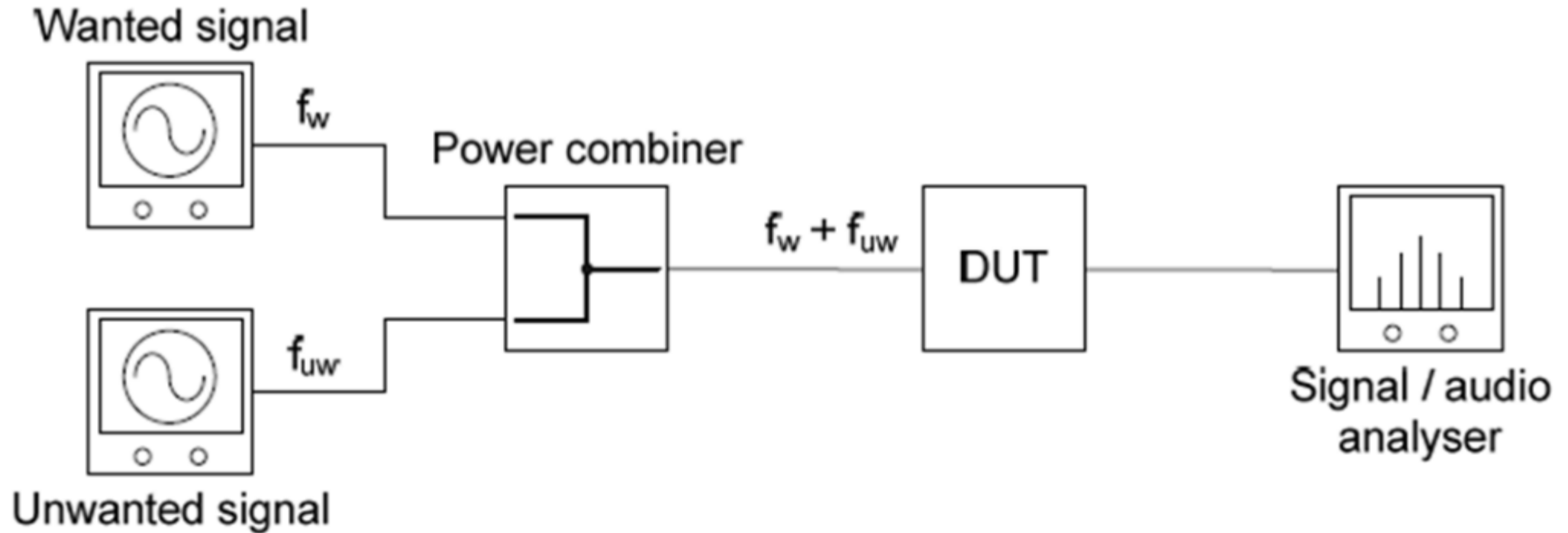
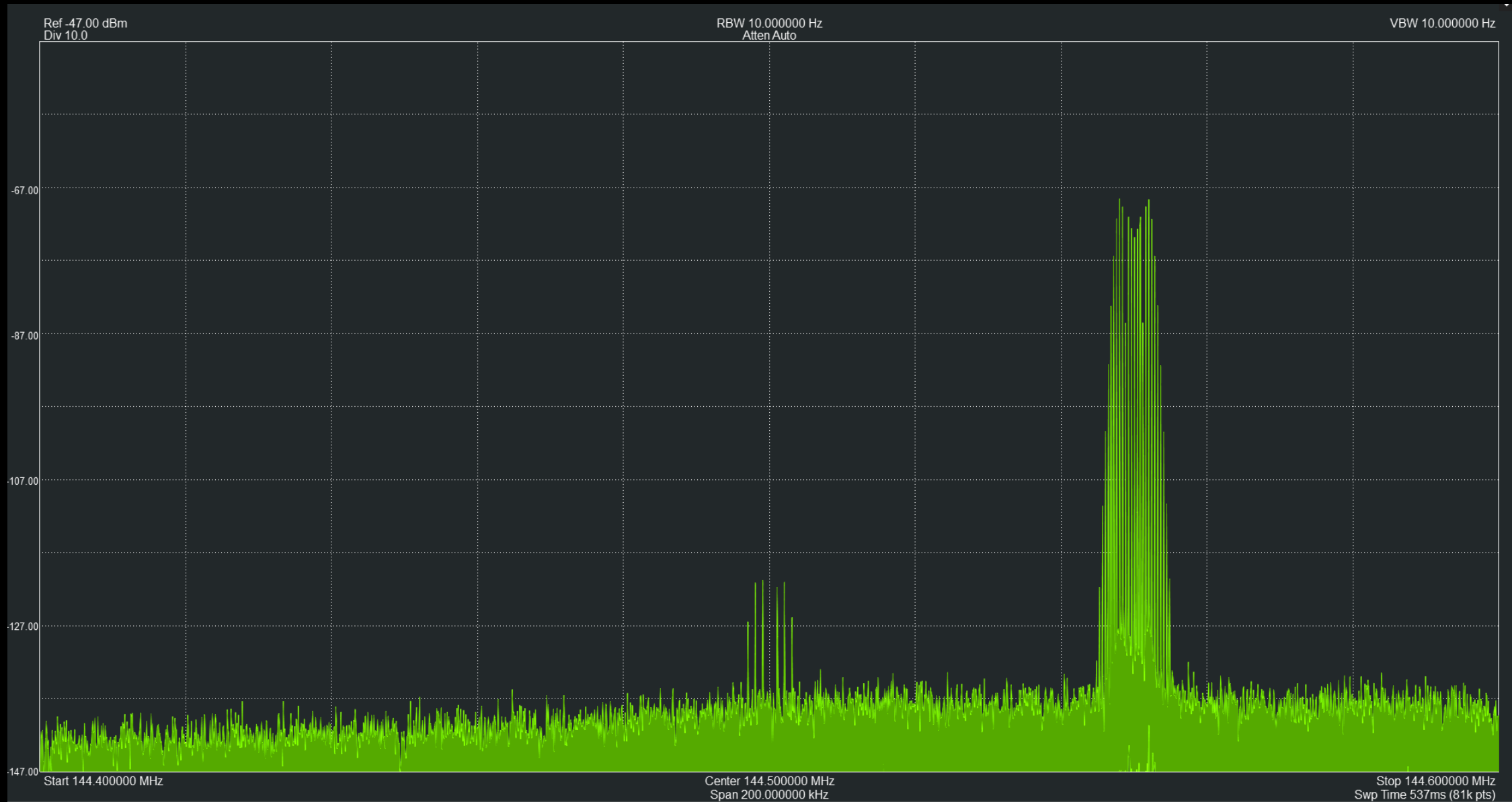


Fig. 16.5 Typical Selectivity Curve

Meet Opstelling



Voorbeeld: 144.500 MHz, 14 dB SINAD bij 2.5 kHz
zwaai met 1 kHz gemoduleerd signal. En een 144.550
MHz signal 400 Hz gemoduleerd.



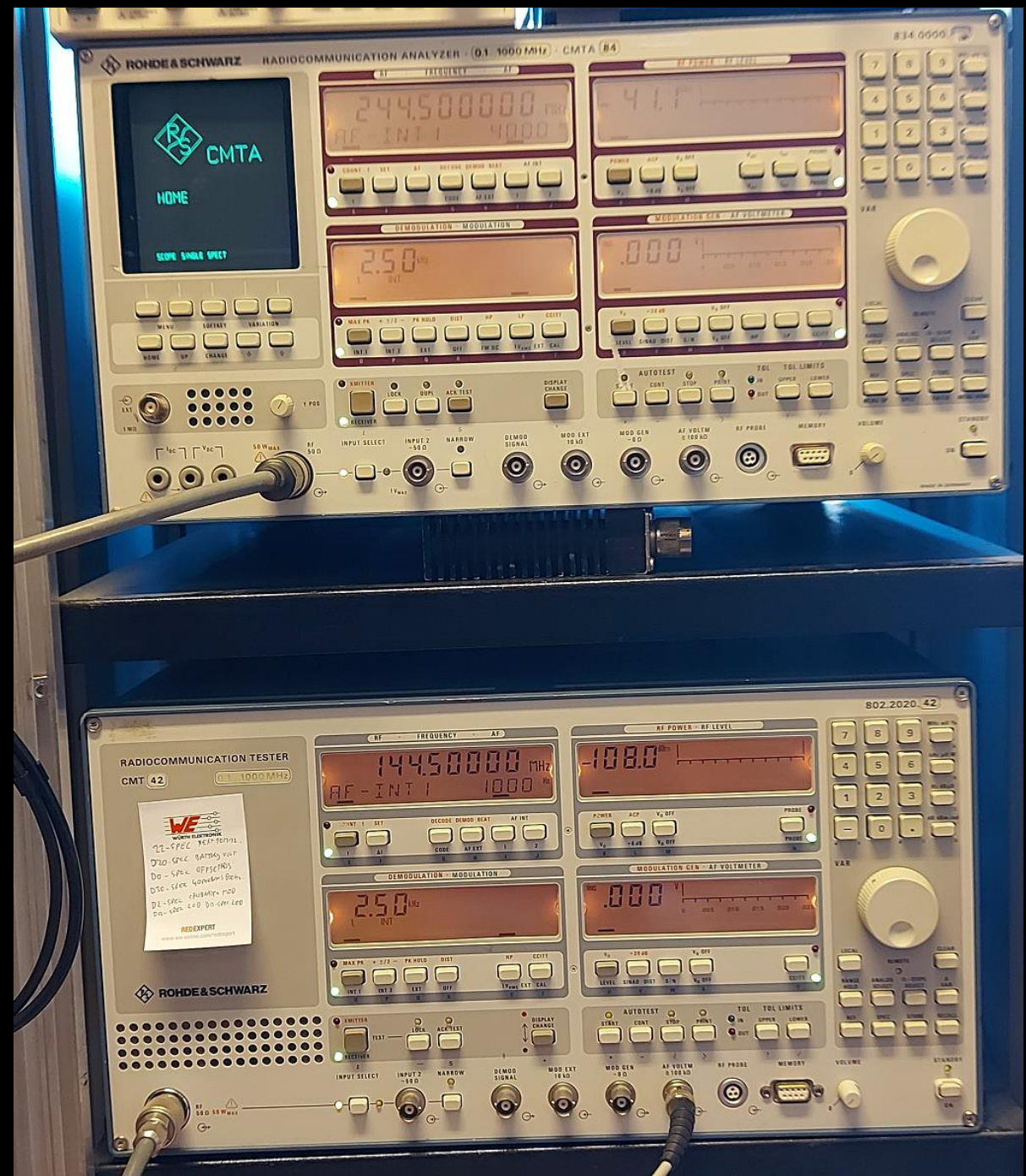
Meetmethode voor Blocking Level

- Genereer signaal die 20 dB SINAD geeft op target frequentie (1 kHz AF).
- Genereer tweede signaal met frequentie offset **ver buiten de ontvangst band** en modulatie van 400 Hz en regel amplitude zodat de SINAD afneemt op het originele signaal tot 14 dB.
- Blocking Level effect kan komen door Intermodulatie verschijnselen en of Analog Converter overload.

Gebruikte apparatuur



Twee R&S Radiocommunication
analyzers en een
Power power divider



Software in Visual Studio 2019

The image shows a screenshot of Visual Studio 2019 with two dialog boxes open over a code editor. The code editor displays the source code for a class named `FrmSense`, which includes various methods and properties for handling data and user input.

Selectivity Test Dialog

| Desirable Frequency | | Measurement | |
|-----------------------|---------|--------------------|--|
| Frequency [MHz] | 144.500 | Frequency [MHz] | |
| Modulation [kHz] | 3 | Undes. Level [dBm] | |
| Signal Level [dBm] | -100 | SINAD [dB] | |
| Undesirable Frequency | | Measurement Points | |
| Freq. Span [MHz] | 1 | | |
| Freq. Step [kHz] | 10 | | |
| AF Frequency [Hz] | 400 | | |
| Min SINAD [dB] | 14 | | |

Buttons: Start, File Store

Sensitivity Test Dialog

| Input | | Result | |
|------------------|---------|--|--|
| Frequency [MHz] | 144.500 | signal Level [dBm] | |
| Modulation [kHz] | 2.5 | SINAD [dB] | |
| SINAD [dB] | 20 | Result [uV] | |
| AF Freq [Hz] | 1000 | <input checked="" type="checkbox"/> Via Power Splitter | |

Buttons: Start, Scan Modulation, File Store, Copy to Selectivity

Scan Modulation

| | |
|----------------------|---|
| Low Mod. Freq [kHz] | 1 |
| High Mod. Freq [kHz] | 5 |
| Step Mod. Freq [kHz] | 1 |

Buttons: Scan Modulation, File Store

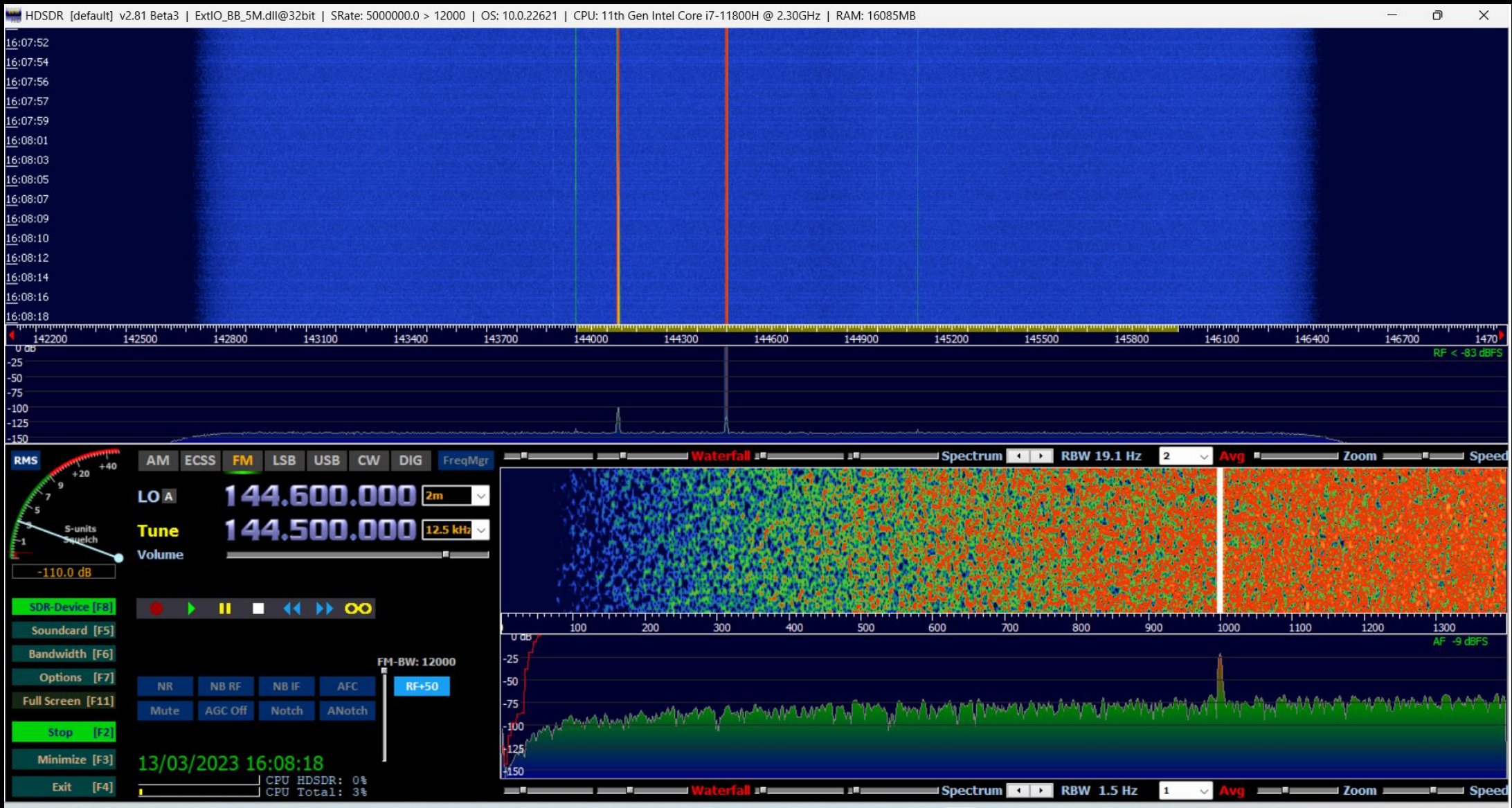
Error List

| Code | Description |
|---------|--|
| IDE0044 | Make field readonly |
| IDE0051 | Private member 'FrmSense.SaveData' is unused |
| IDE1006 | Naming rule violation: These words must begin with upper case characters: ilask |
| IDE1006 | Naming rule violation: These words must begin with upper case characters: ilbna |
| IDE1006 | Naming rule violation: These words must begin with upper case characters: ilccac |
| IDE1006 | Naming rule violation: These words must begin with upper case characters: ilclt |
| IDE1006 | Naming rule violation: These words must begin with upper case characters: ilcmd |
| IDE1006 | Naming rule violation: These words must begin with upper case characters: ilcmda |

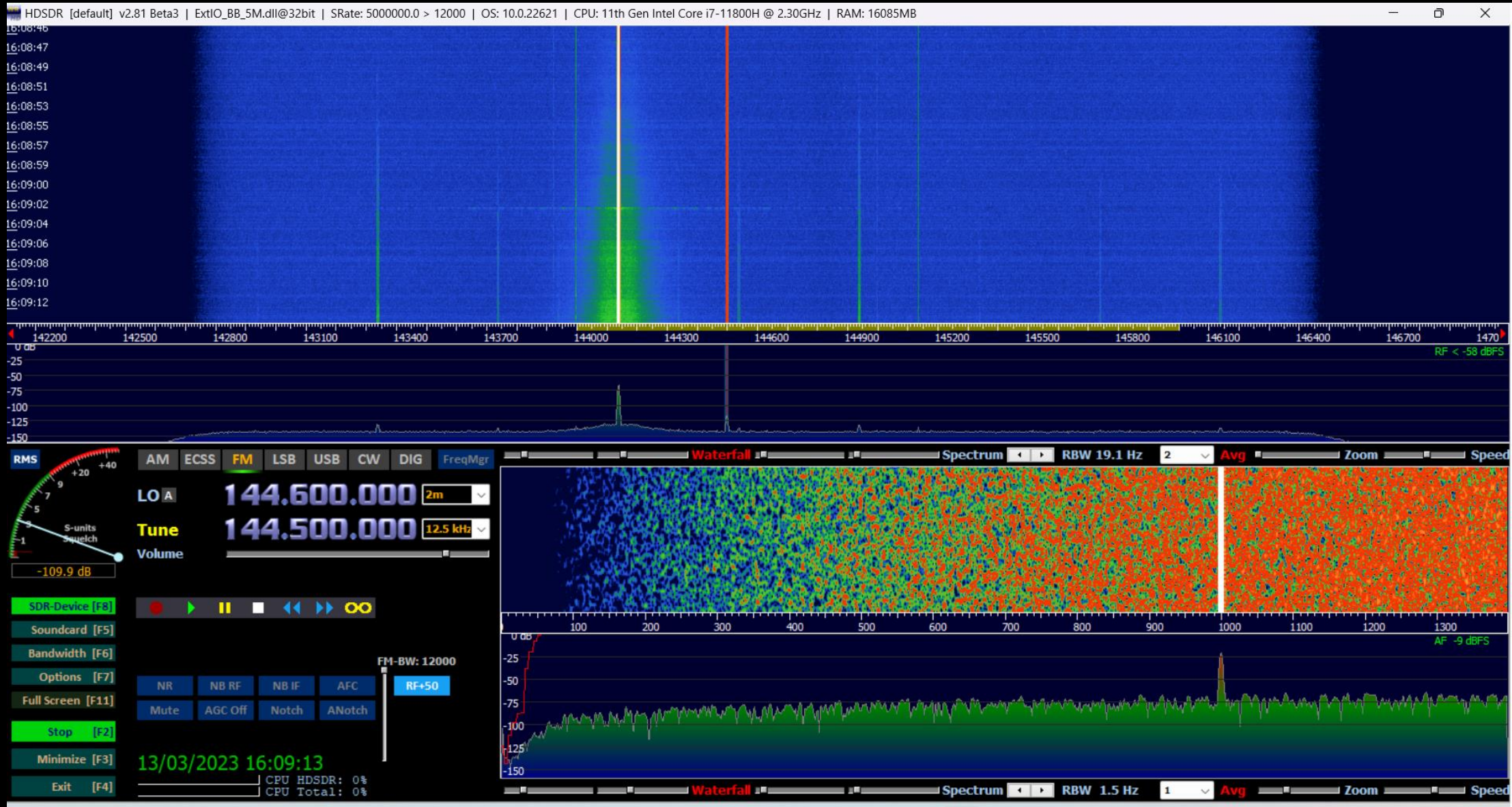
Search Error List

| Project | File | Line | Suppression State |
|---------|-------------|------|-------------------|
| RMS | FrmSense.vb | 2 | Active |
| RMS | FrmSense.vb | 2 | Active |
| RMS | Gpib-32.vb | 314 | Active |
| RMS | Gpib-32.vb | 319 | Active |
| RMS | Gpib-32.vb | 324 | Active |
| RMS | Gpib-32.vb | 329 | Active |
| RMS | Gpib-32.vb | 334 | Active |
| RMS | Gpib-32.vb | 339 | Active |

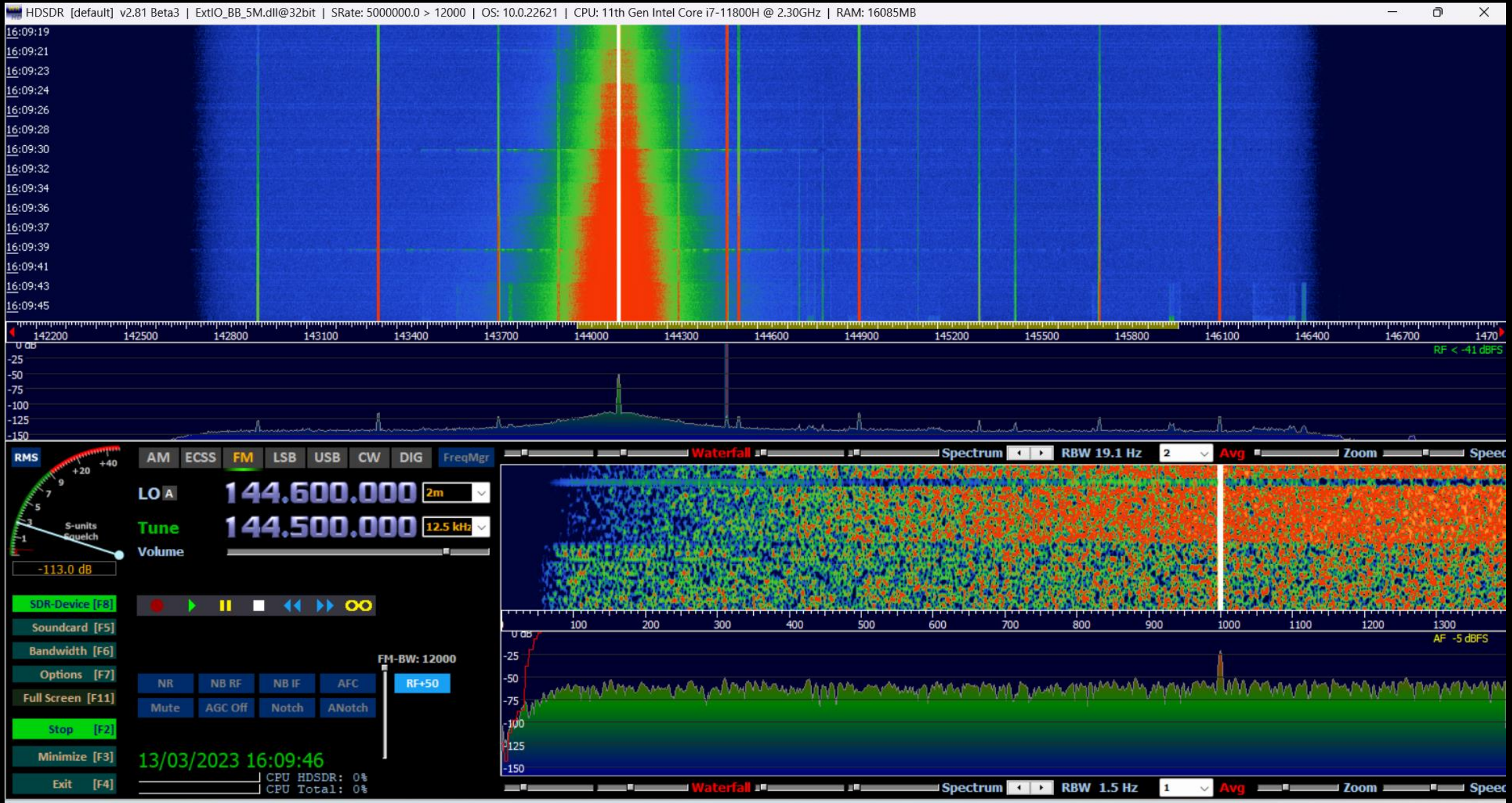
Metingen: Ongewenst geen invloed



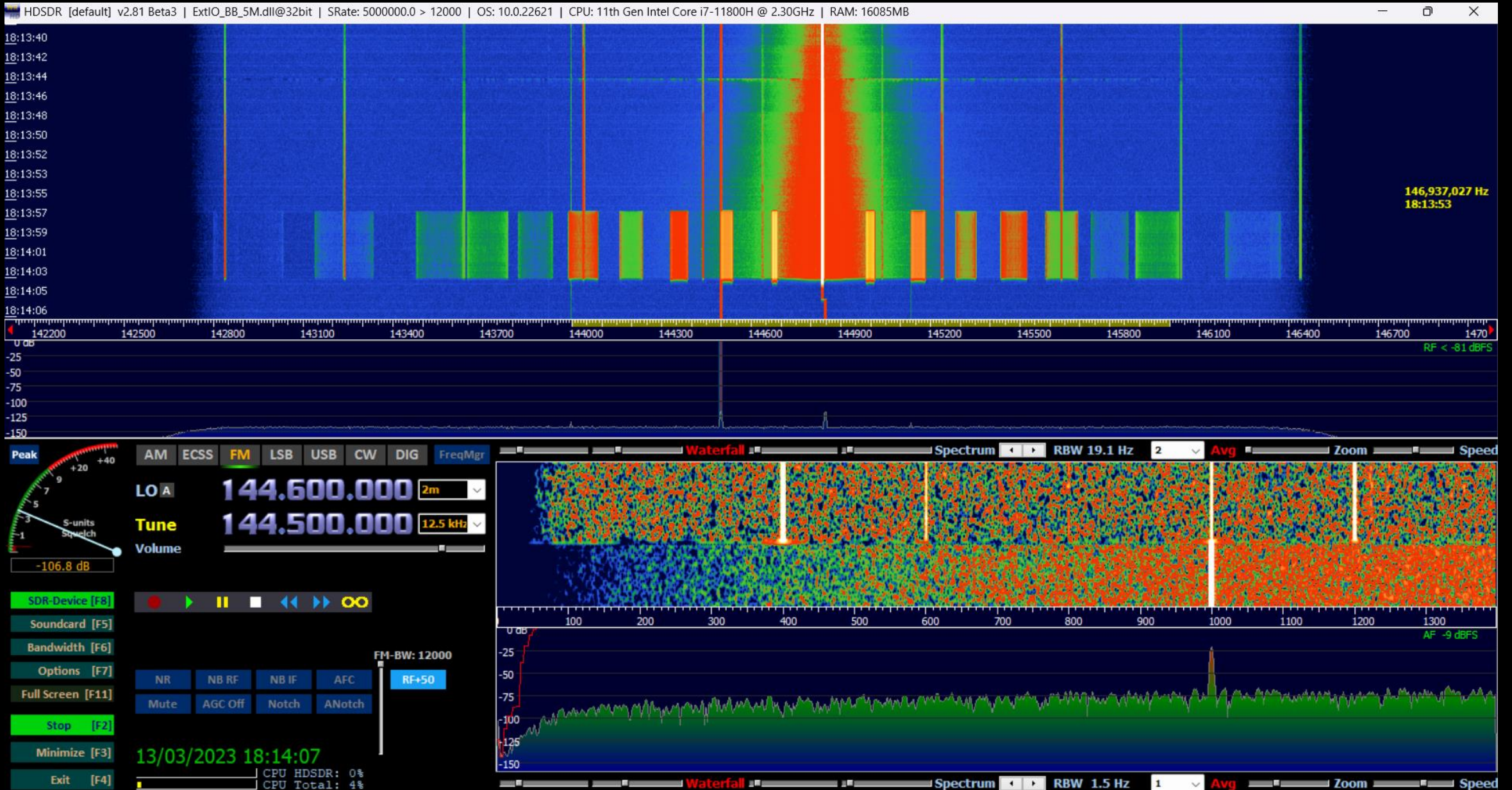
Ongewenst groter: begin intermodulatie



Ongewenst groter: Veel effect



Ongewenst te groot: AD Overload



Resultaat Uniden SDS200E

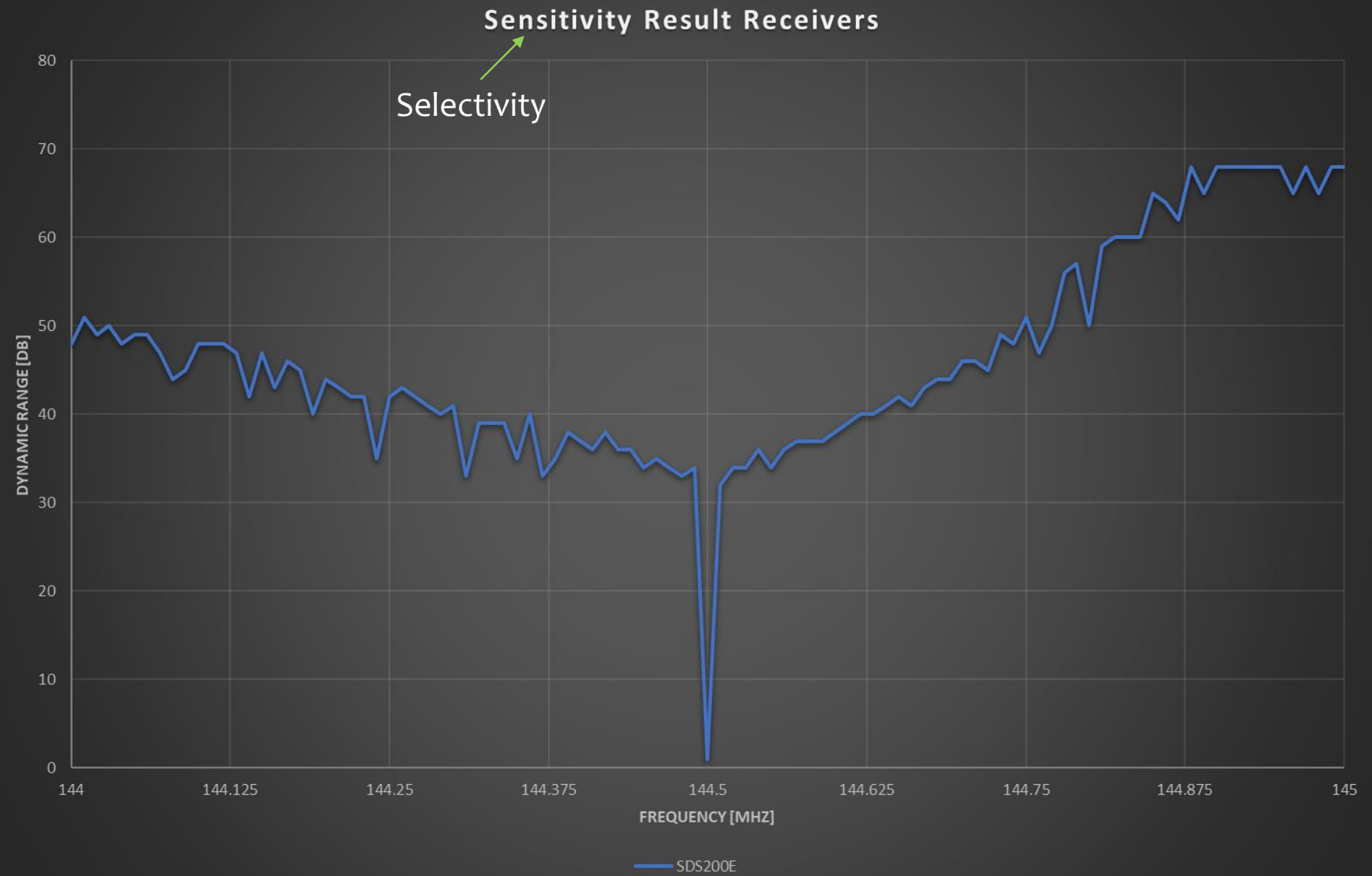
Gevoeligheid: 0.32 μ V @ 20 dB SINAD 144.500 MHz

Blocking Level: 16 mV

Dynamic Range: 89 dB



Resultaat Uniden SDS200E



Resultaat HackRF One

Gevoeligheid: 1.0 μ V @ 20 dB SINAD 144.500 MHz

Blocking Level: 35 mV

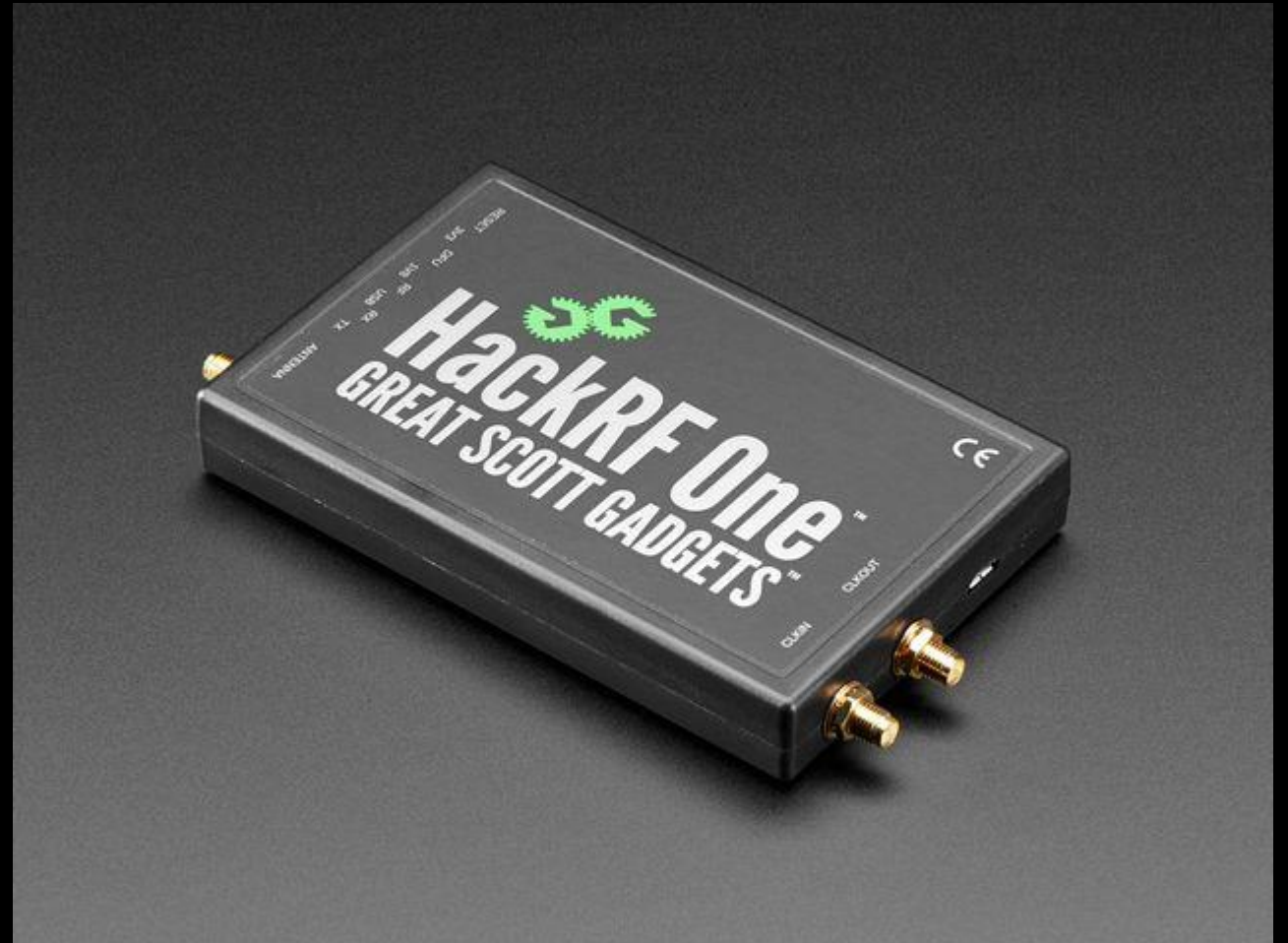
Dynamic Range: 86 dB

Preamp: On

LNA: 24 dB

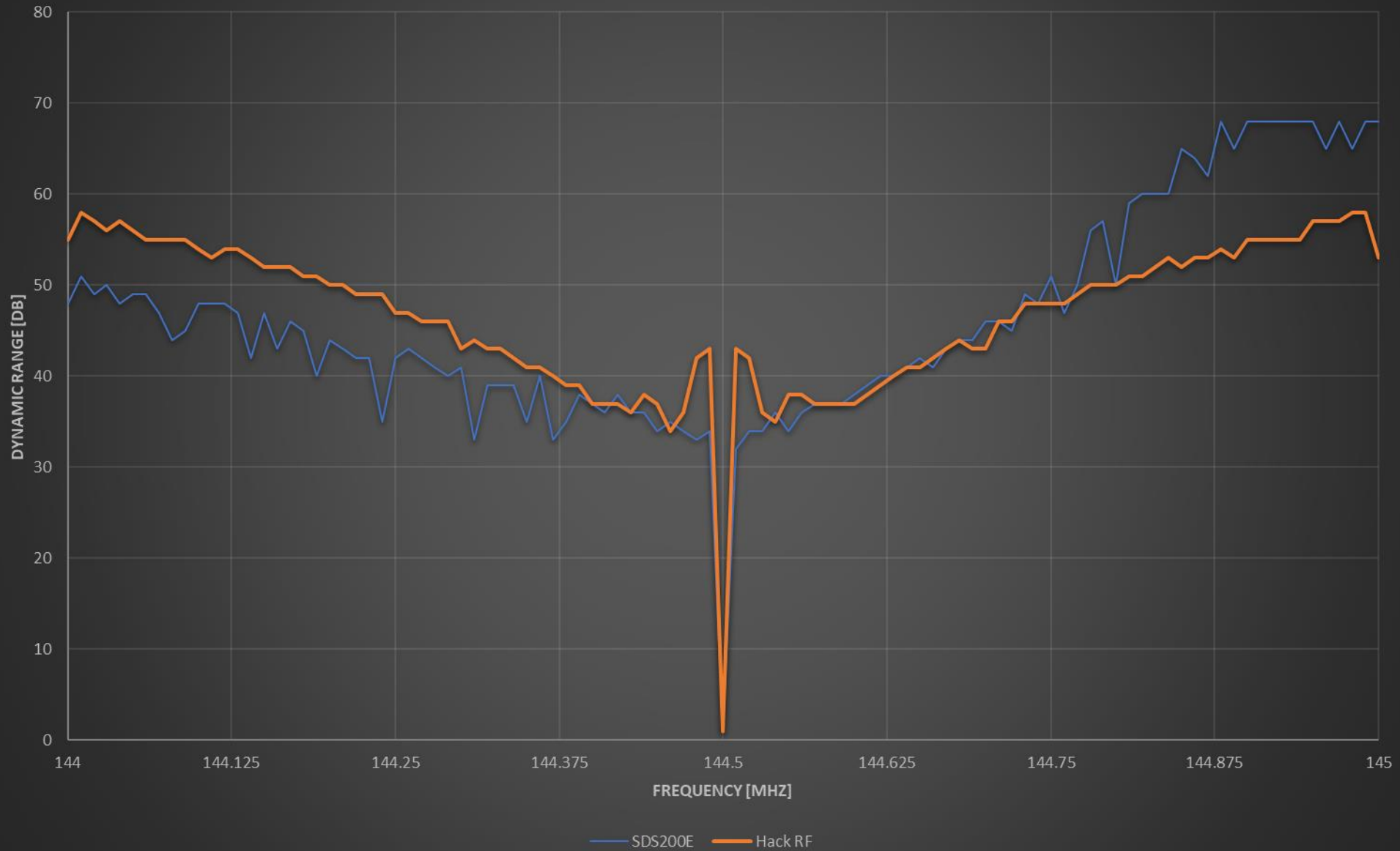
VGA: 32 dB

Software: SDR#



Resultaat HackRF One

Sensitivity Result Receivers



Resultaat Original RTL USB

Gevoeligheid: $0.9 \mu\text{V}$ @ 20 dB SINAD 144.500 MHz

Blocking Level: 102 mV

Dynamic Range: 95 dB?

Gain 42 dB

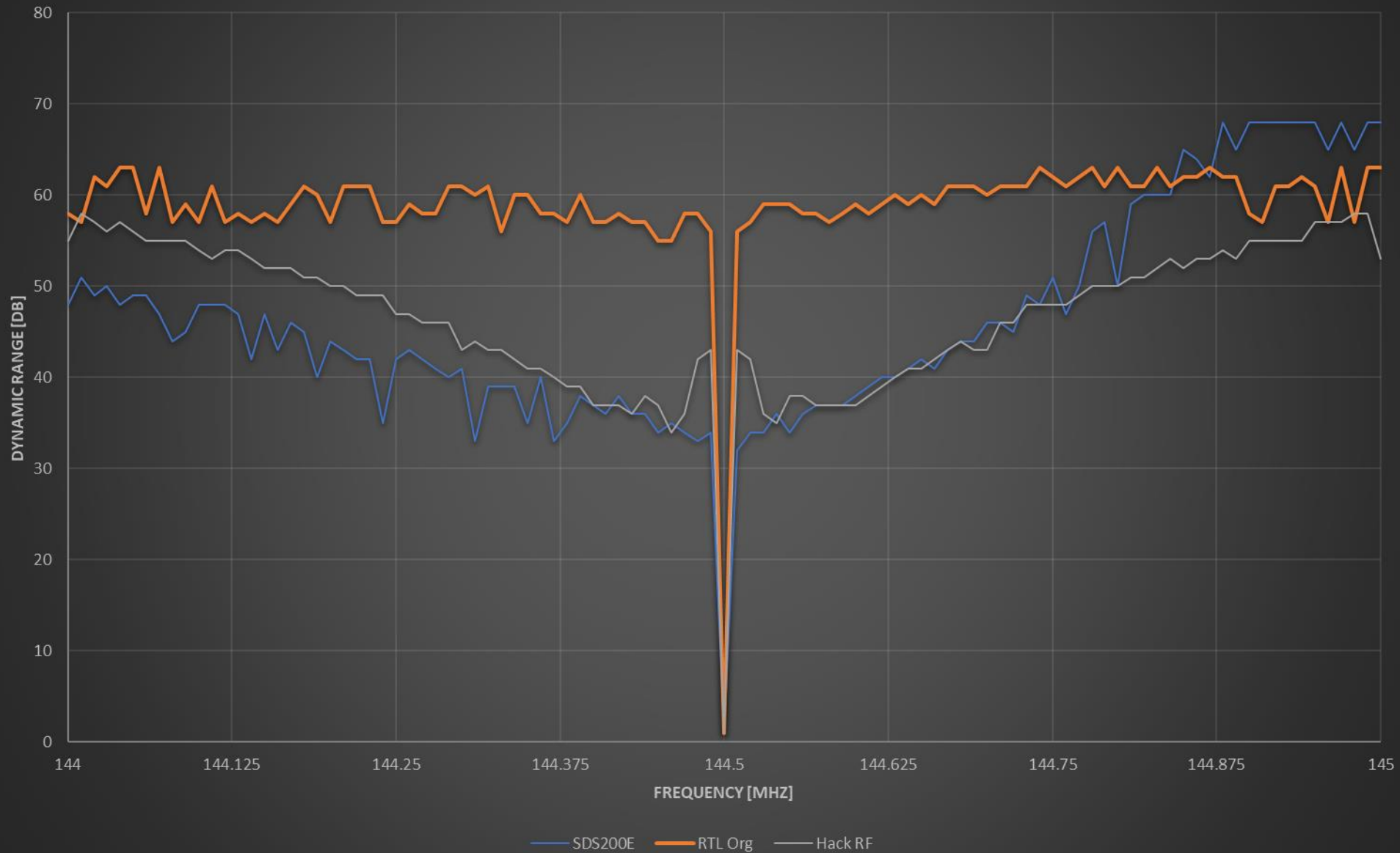
Sample: 2.4 MSPS

Software: SDR#



Resultaat HackRF One

Sensitivity Result Receivers



Resultaat Airspy R2

Gevoeligheid: $0.32 \mu\text{V}$ @ 20 dB SINAD 144.500 MHz

Blocking Level: 10 mV

Dynamic Range: 85 dB

Gain 18 dB

Sample: 2.5 MSPS

Software: SDR#



Resultaat Airspy R2

Gevoeligheid: 0.8 μV (0.32 μV) @ 20 dB SINAD 144.500 MHz

Blocking Level: 22 mV (10 mV)

Dynamic Range: 85 dB

Gain 15 dB (18 dB)

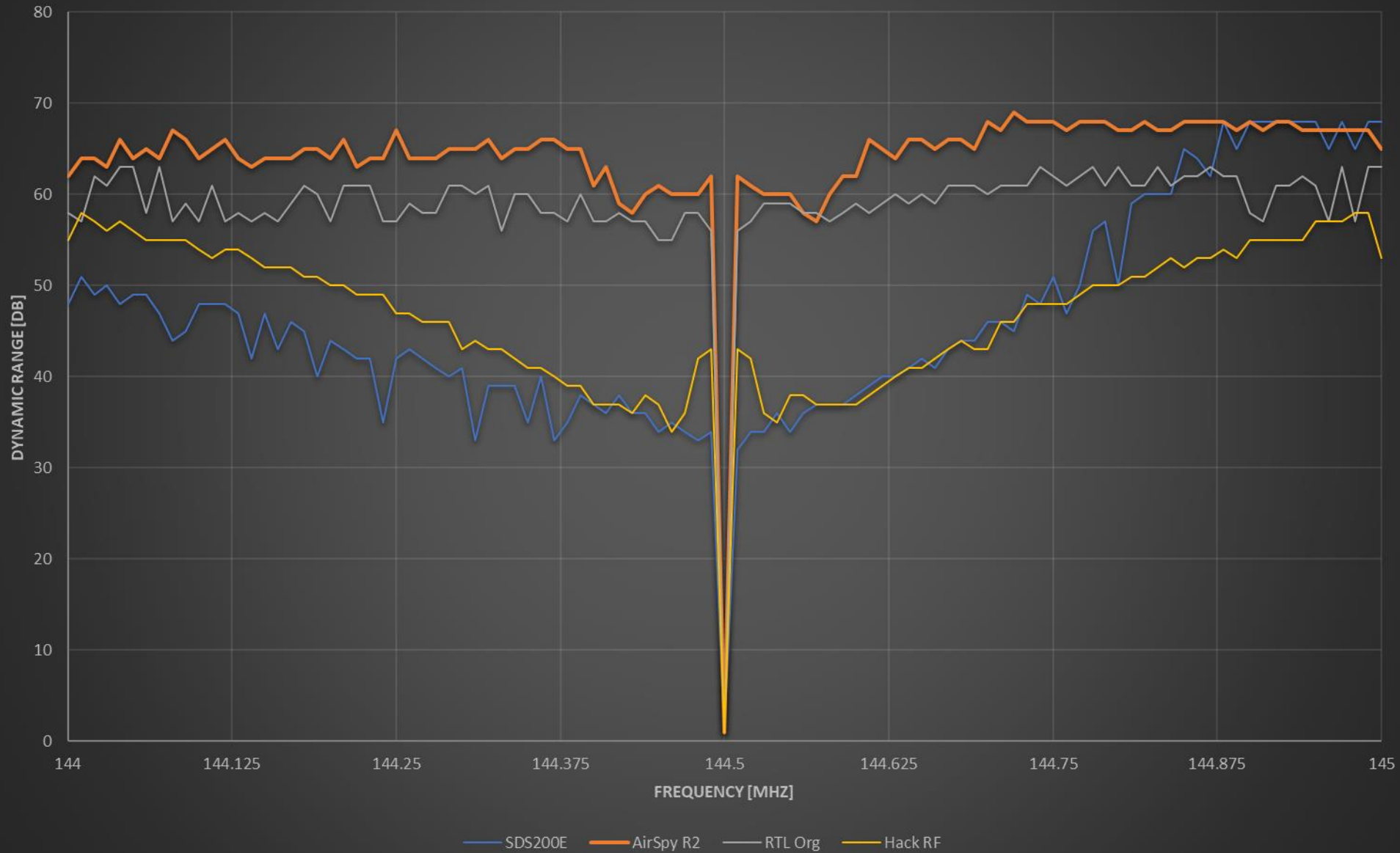
Sample: 2.5 MSPS

Software: SDR#



Resultaat Airspy R2

Sensitivity Result Receivers



Resultaat SDRPlay RSP1A

Gevoeligheid: $0.18 \mu\text{V}$ @ 20 dB SINAD 144.500 MHz

Blocking Level: 8.2 mV

Dynamic Range: 88 dB

Gain 86.9 dB

Sample: 2 MSPS

Software: SDRUNO

NFM 10 kHz Filter



Resultaat SDRPlay RSP1A FM Filter

Gevoeligheid: **0.26 μV** (0.18 μV) @ 20 dB SINAD 144.500 MHz

Blocking Level: **47 mV** (8.2 mV) op FM Signaal @ 100 MHz

Dynamic Range: **100 dB** (88 dB)

Gain 86.9 dB

Sample: 2 MSPS

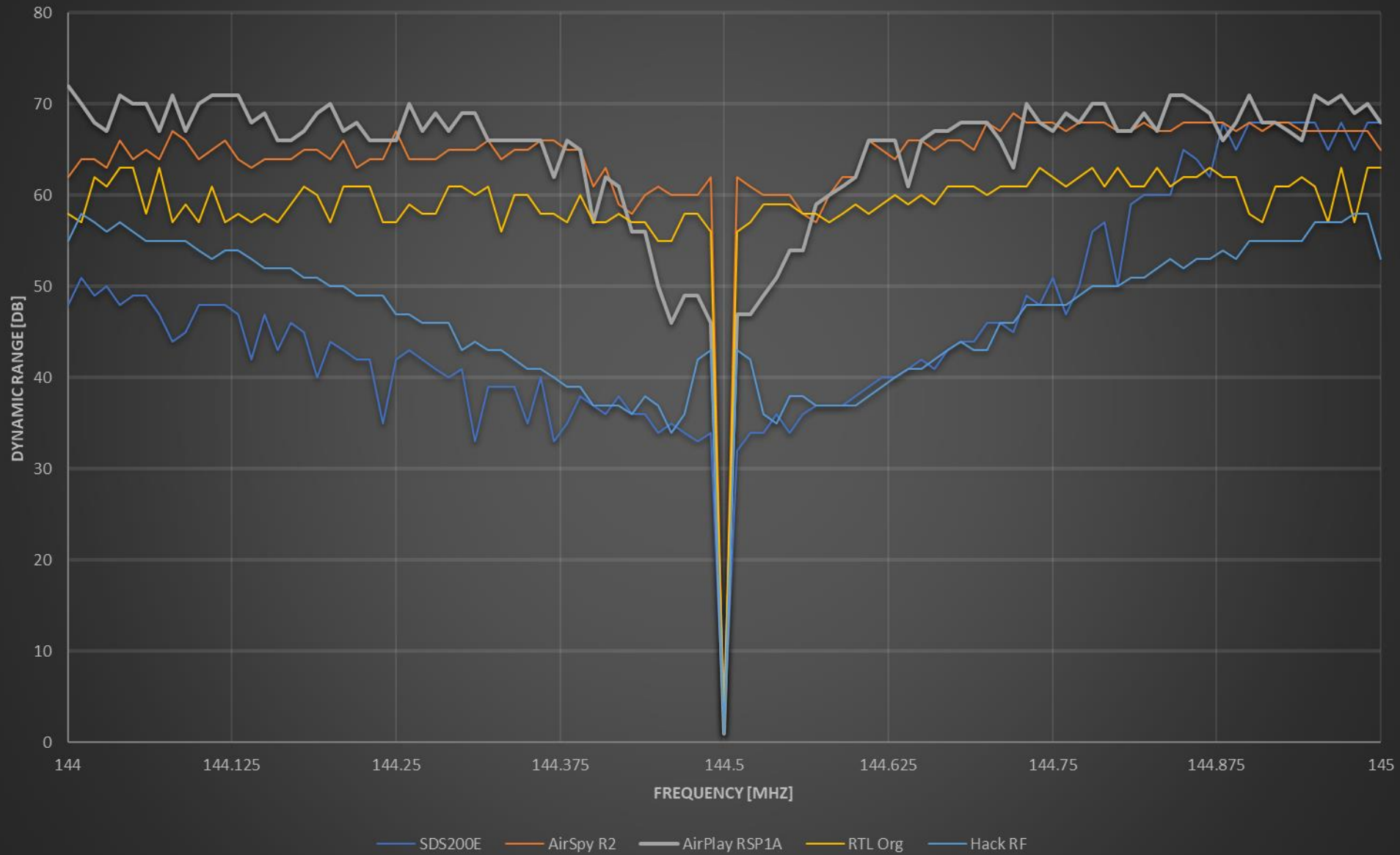
Software: SDRUNO

NFM 10 kHz Filter



Resultaat SDRPlay RSP1A

Sensitivity Result Receivers



Resultaat ICOM IC-R8600

Gevoeligheid: $0.27 \mu\text{V}$ @ 20 dB SINAD 144.500 MHz

Blocking Level: 26 mV

Dynamic Range: 93 dB

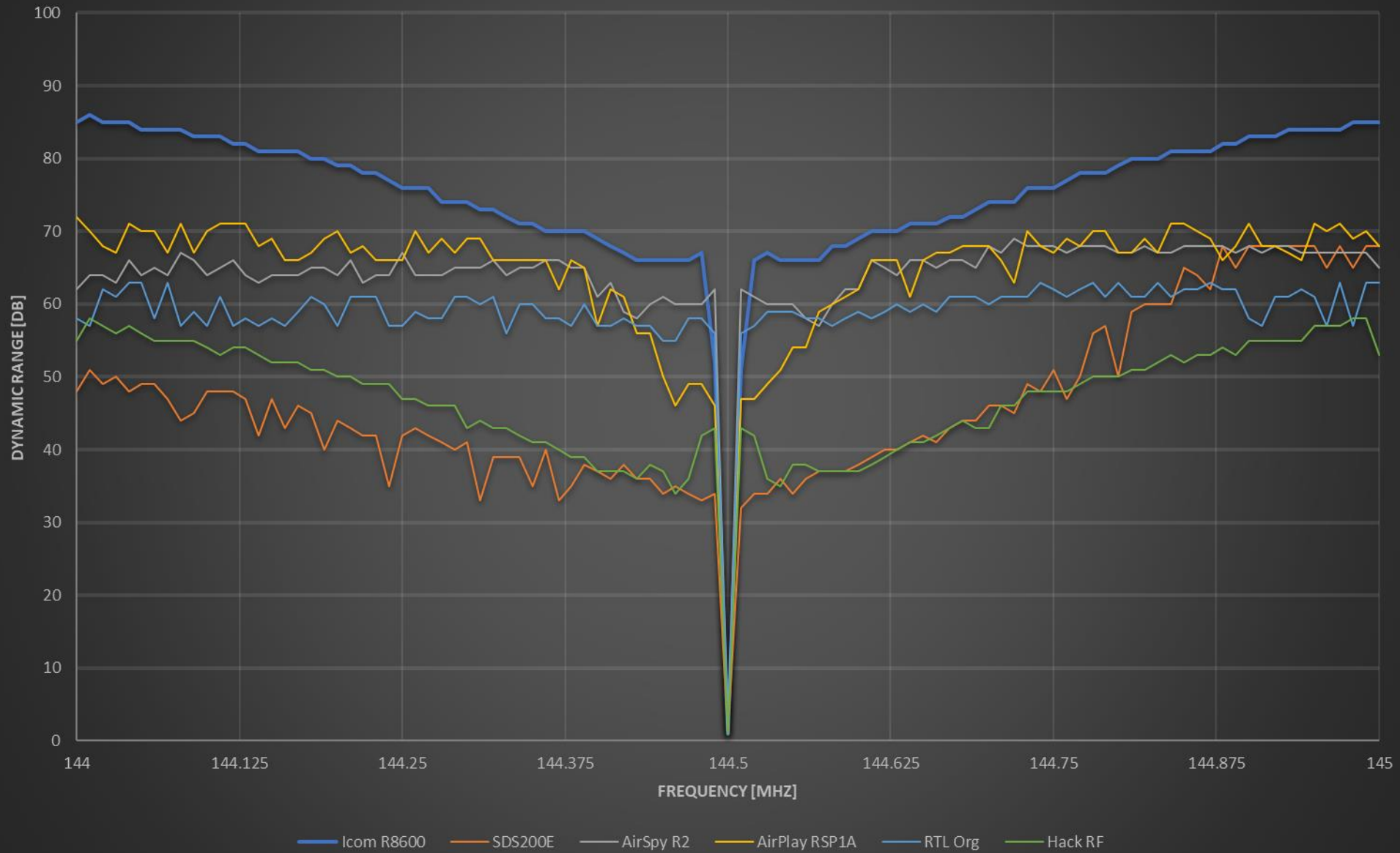
Preamp: On

Filt: 3



Resultaat ICOM IC-R8600

Sensitivity Result Receivers



Resultaat AOR AR5700D

Gevoeligheid: $0.38 \mu\text{V}$ @ 20 dB SINAD 144.500 MHz

Blocking Level: 48 mV

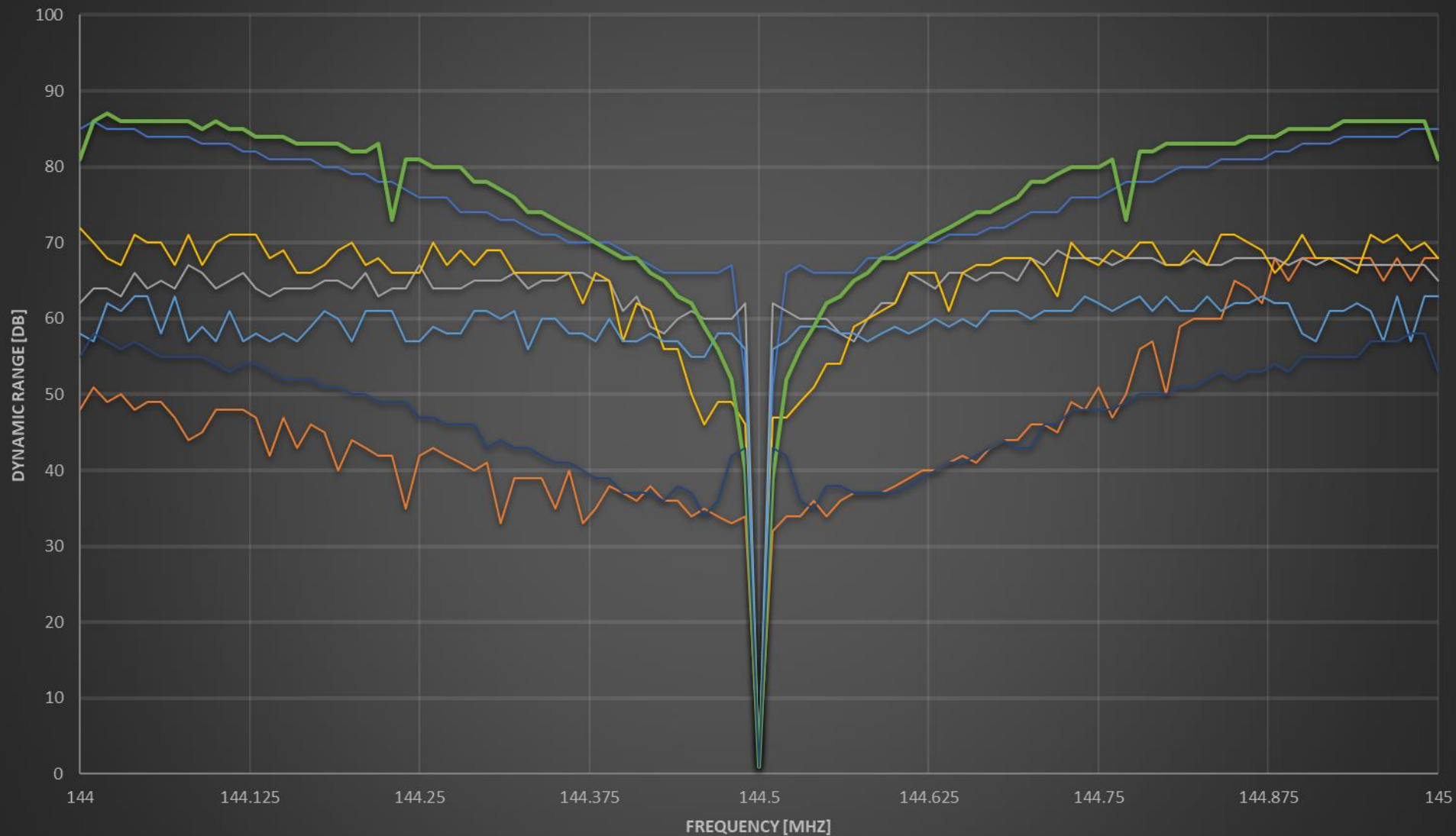
Dynamic Range: 97 dB

Filt: NFM 6 kHz



Resultaat AOR AR5700D

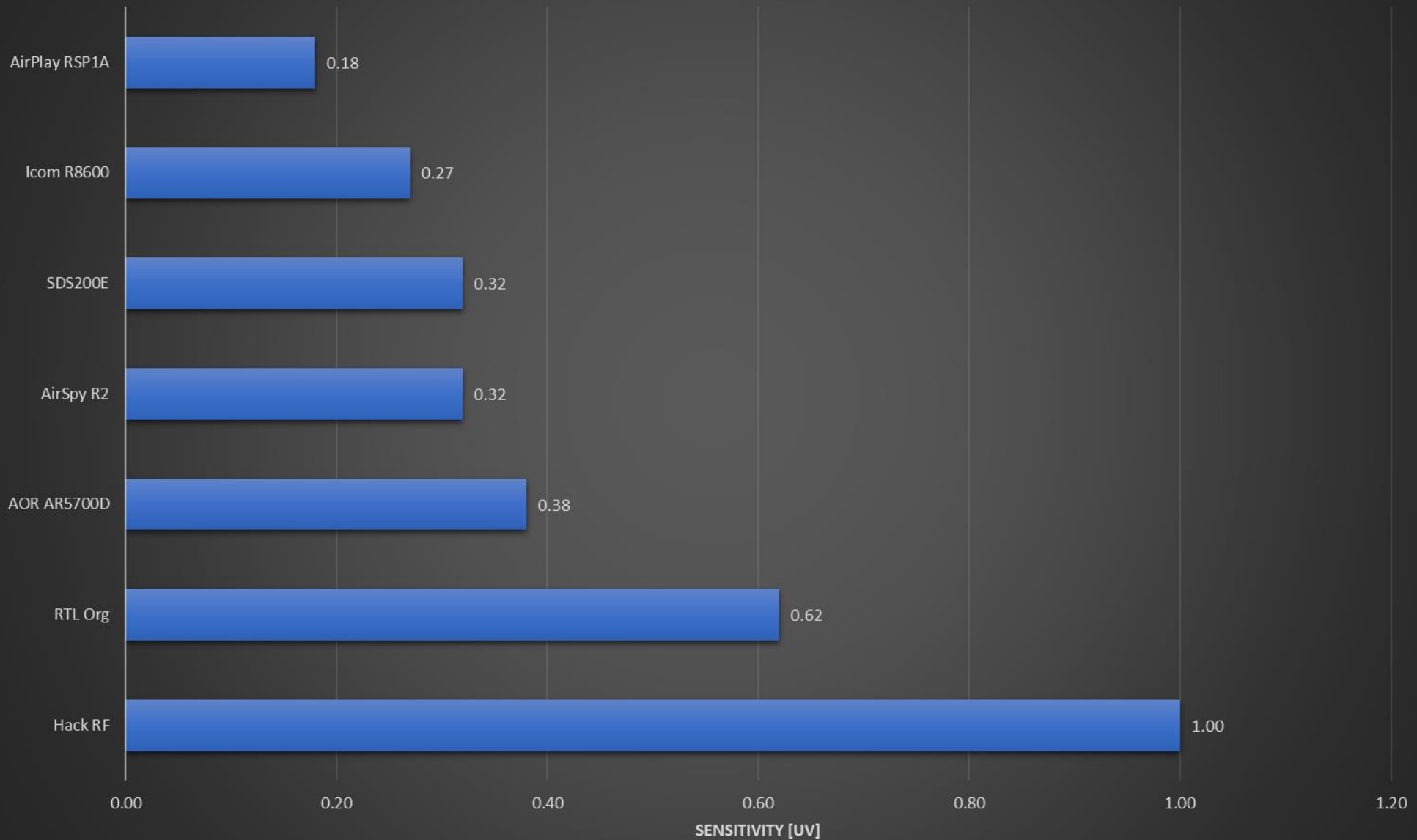
Sensitivity Result Receivers



Icom R8600 SDS200E AirSpy R2 AirPlay RSP1A RTL Org AOR AR5700D Hack RF

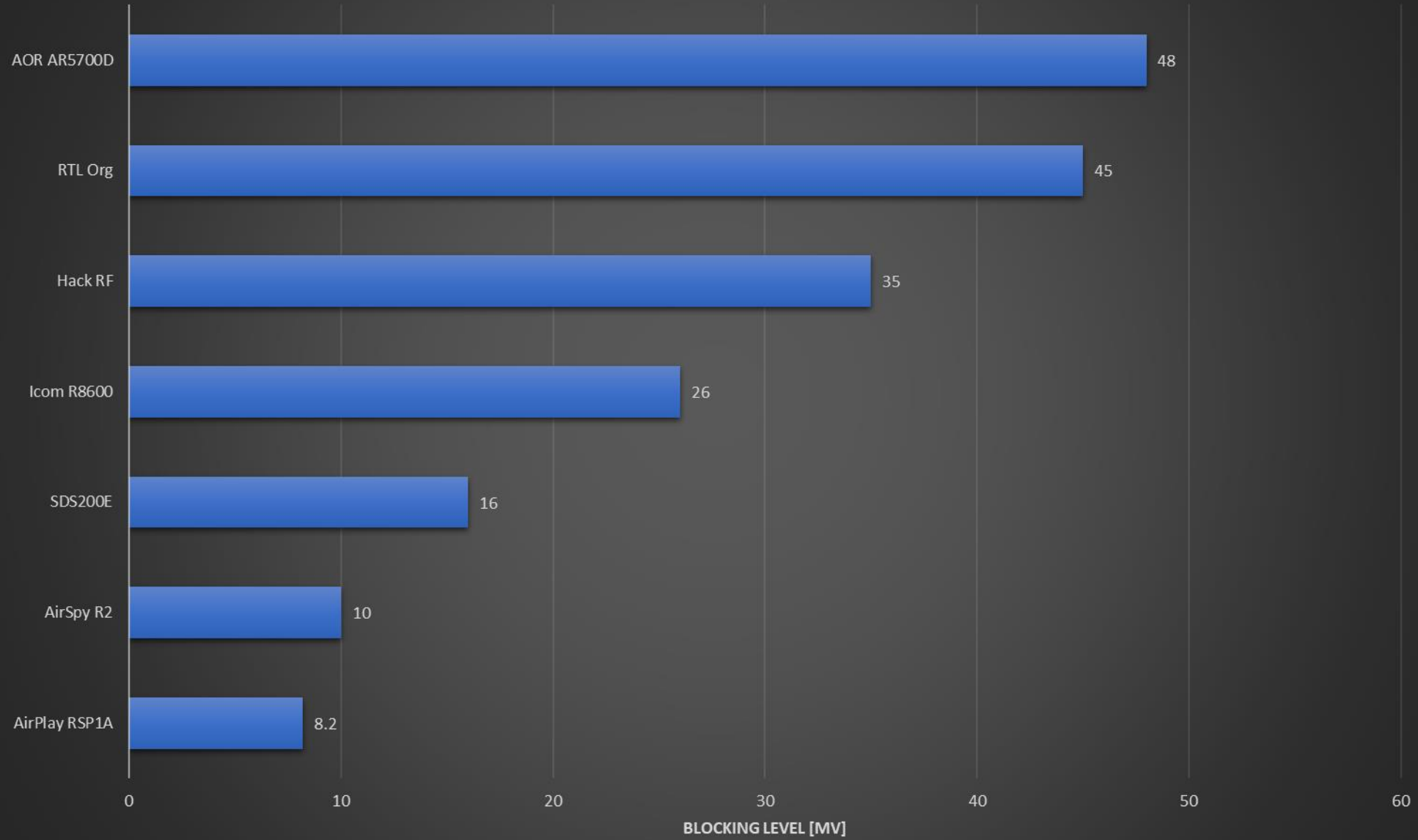
Resultaat Selectivity

Sensitivity for 20 dB SINAD [uV]



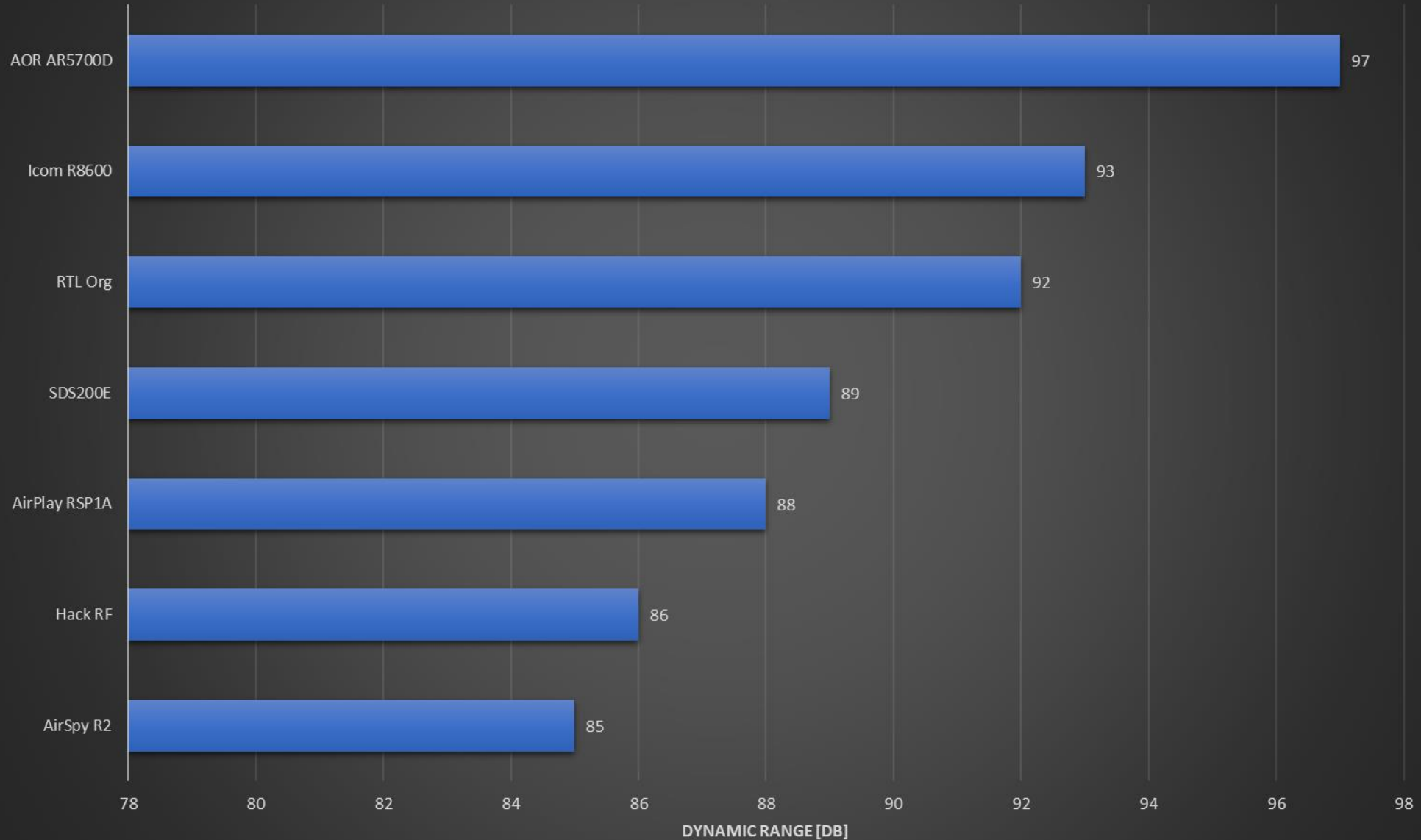
Resultaat Blocking Level

Blocking level



Resultaat Dynamic Range

dynamic range [dB]



Resultaat

Bij de SDR ontvangers gaat het om de instellingen

Dan kan je goede resultaten krijgen

Bedankt voor uw aandacht

