



Jammer overview – frequency bands and modulations

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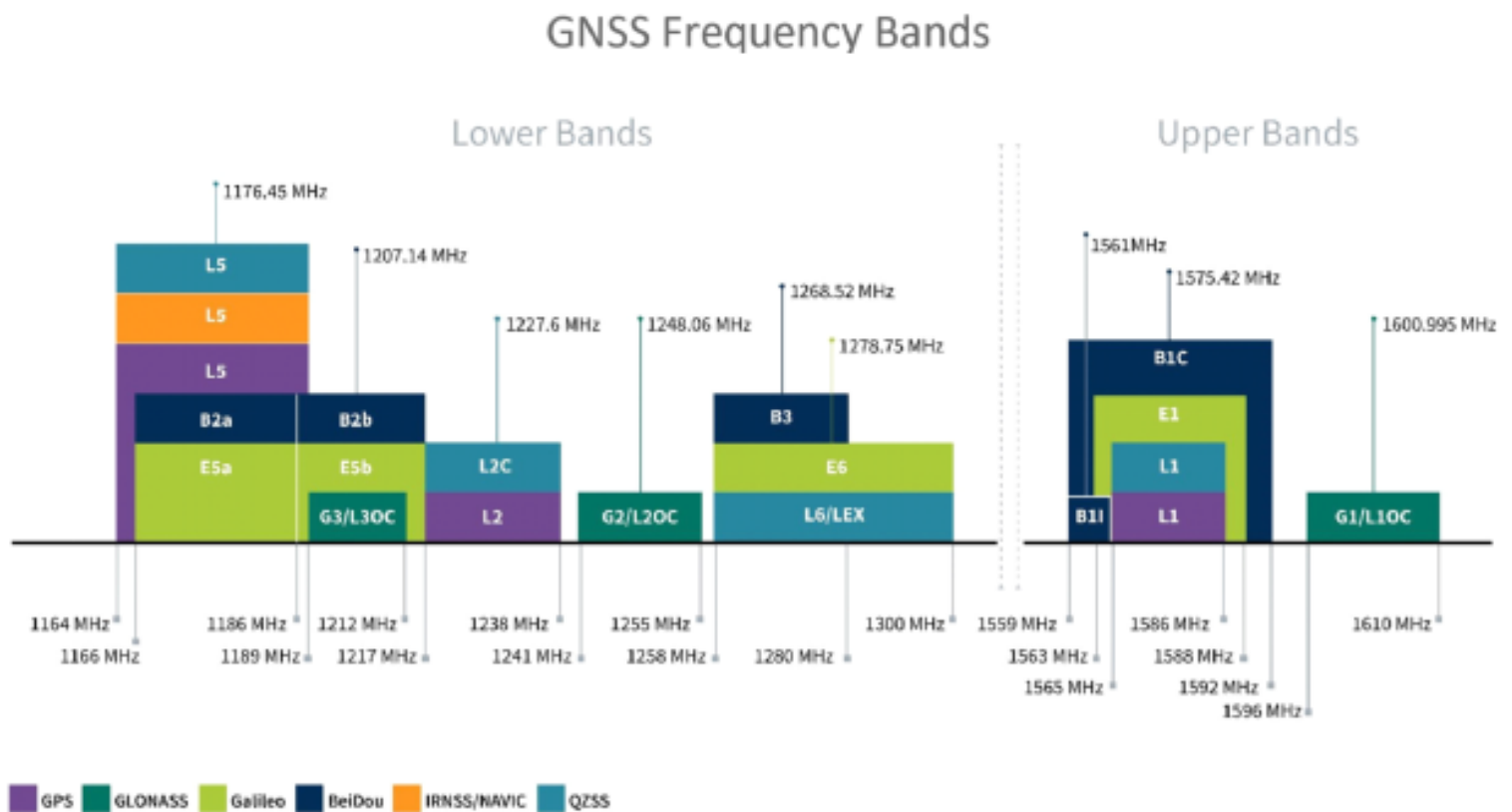
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Introduction

This document contains information and measurements on all the small, handheld (mobile) jammers used during **Jammertest 2022** (Andøya, 19.-23.09.22). The idea is to give an overview of which frequencies the different jammers are affecting, and give some other information, when available, such as modulation.

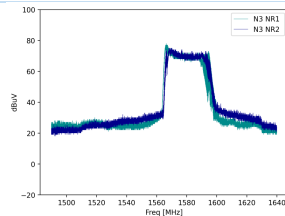
These jammers are a mix of jammers confiscated by Nkom and the Police, as well as being jammers commercially available from the Internet.

The figure below — giving an overview of the different GNSS frequency bands, with their normal designations ('L1', 'E1', 'E5a', etc.) indicated — is included for convenience and for a common reference.

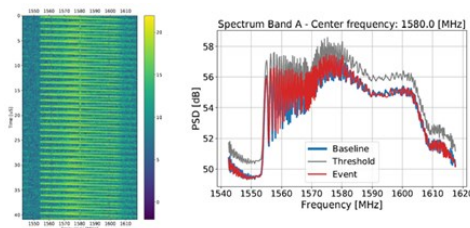


Measurement set-up

All descriptions of the jammers include a picture of the jammer and measurements done at different times.

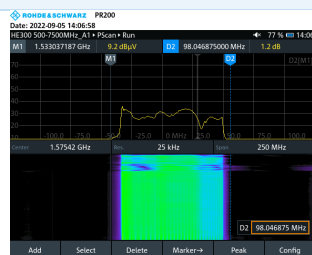


Measurements of this type are done with a Rohde & Schwarz PR100 (or another R&S instrument if indicated).



Measurements of this type are done with Sintef's [ARFIDAAS](#) system with only relevant antennas connected to the measuring unit.

It should be noted that the time labels on the waterfall plots are off by a factor of 10 — instead of approximately 40 μ s, they cover a span of 400 μ s.

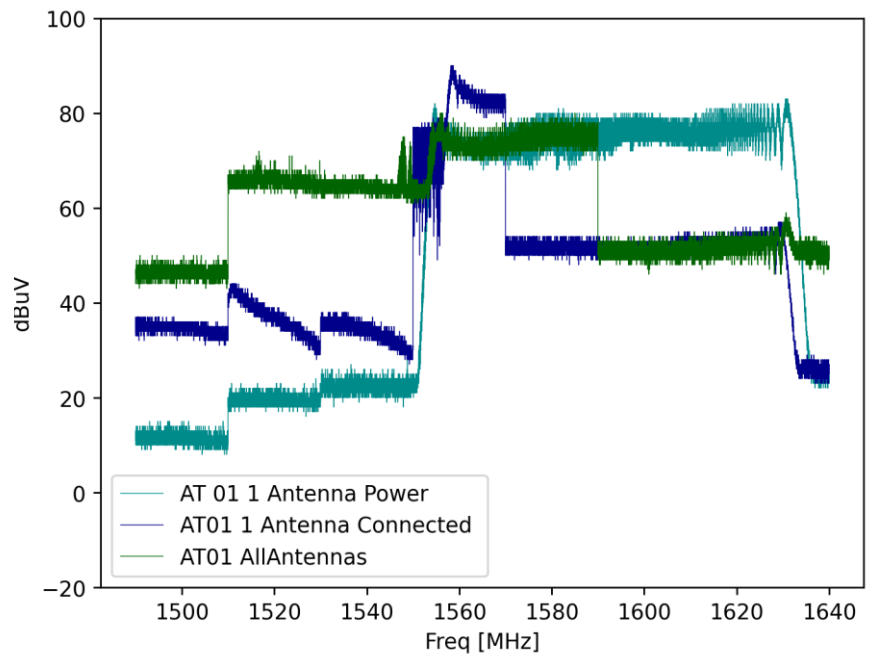


Measurements of this type are done with a Rohde & Schwarz PR200 with only relevant antennas activated during the testing.

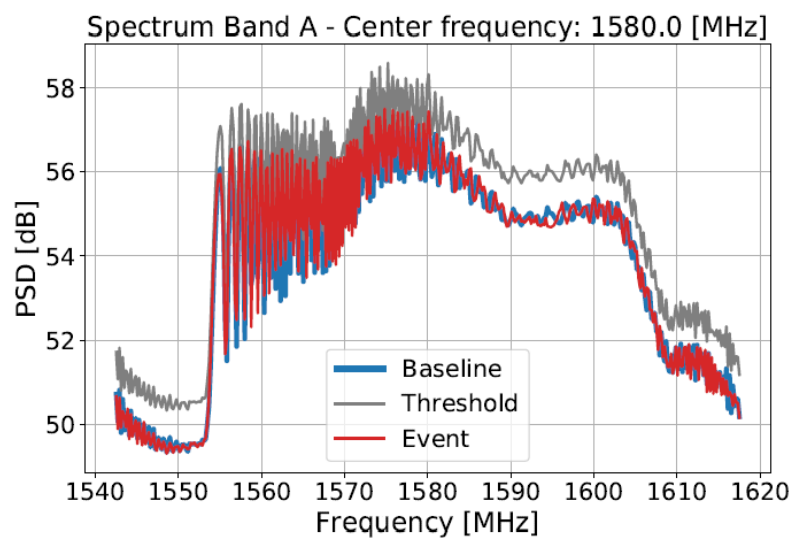
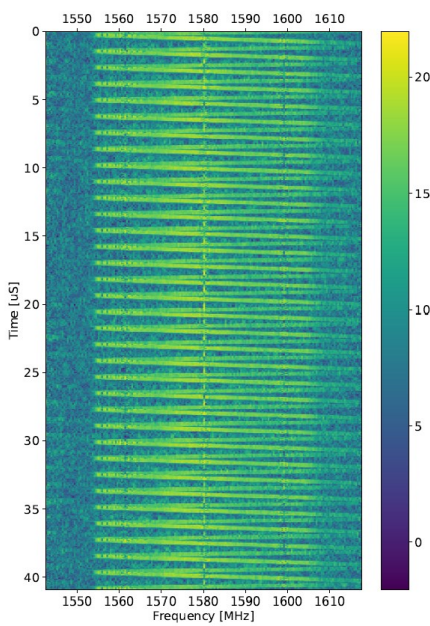
An important note from jammer testing is that regardless of whether the jammer measurements were done with a cable or not, the signal leakage (thought to be from the body of the jammer or the unterminated antenna ports) was easily detected.

Finally, this overview is not supposed to give an indication of power levels, only frequency relate information.

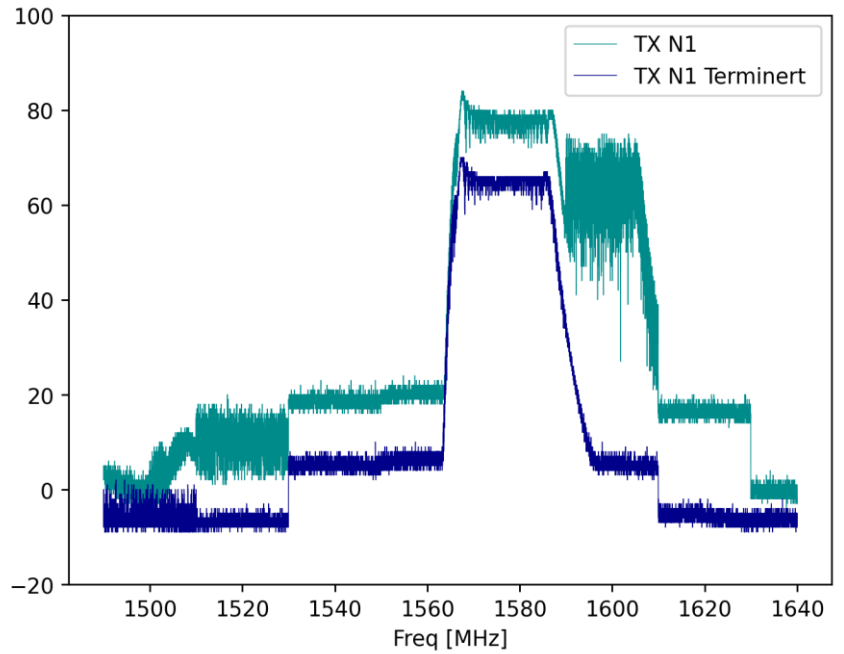
Jammer 1 – «AT01 N8»



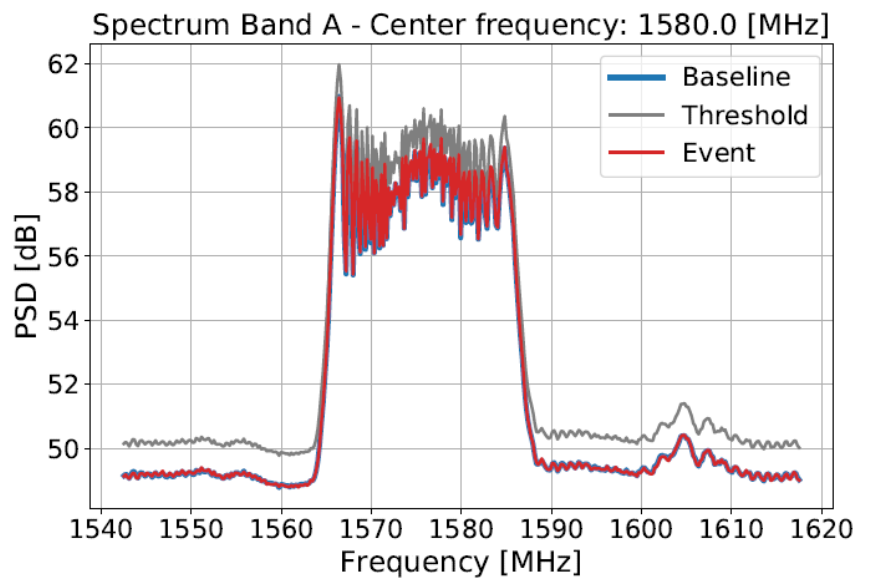
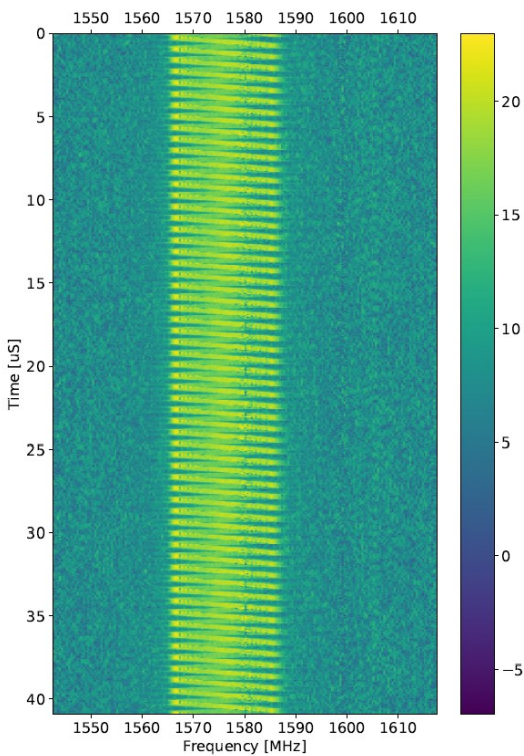
Tested with all but one antenna attached (*'1 Antenna Connected'*), all antennas attached but only one activated (*'1 Antenna Power'*) and all antennas attached and activated (*'AllAntennas'*).



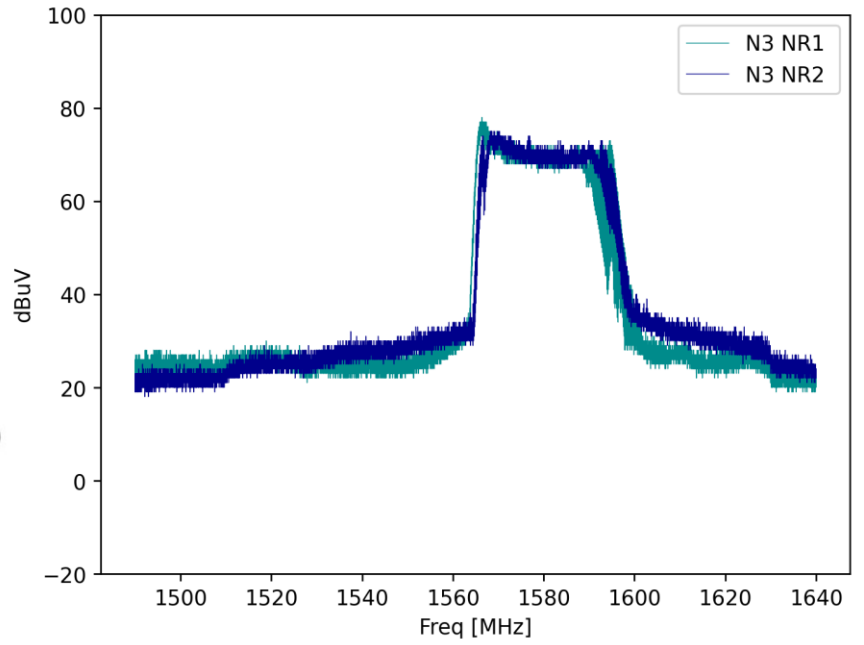
Jammer 2 – «TX-N1»



Measured normally ('TX N1') and with cable ('TX N1 Terminert').



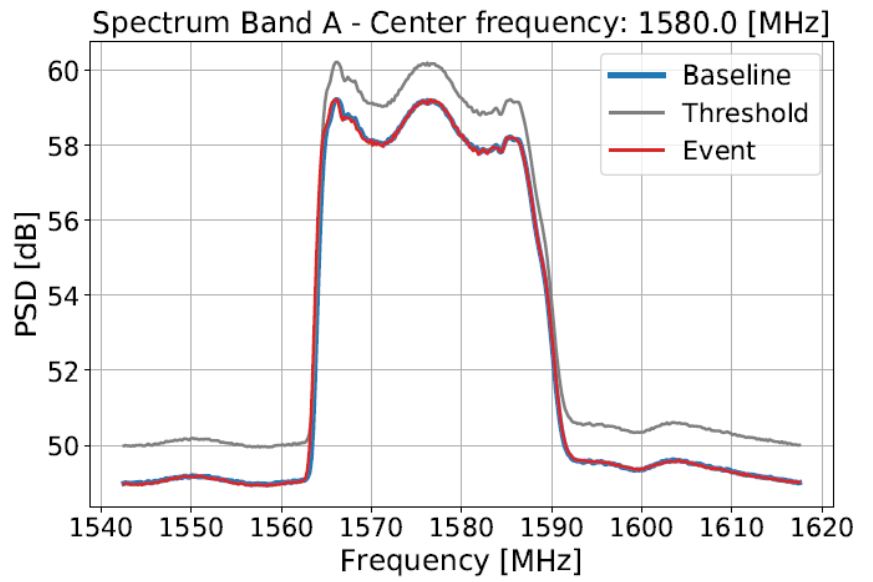
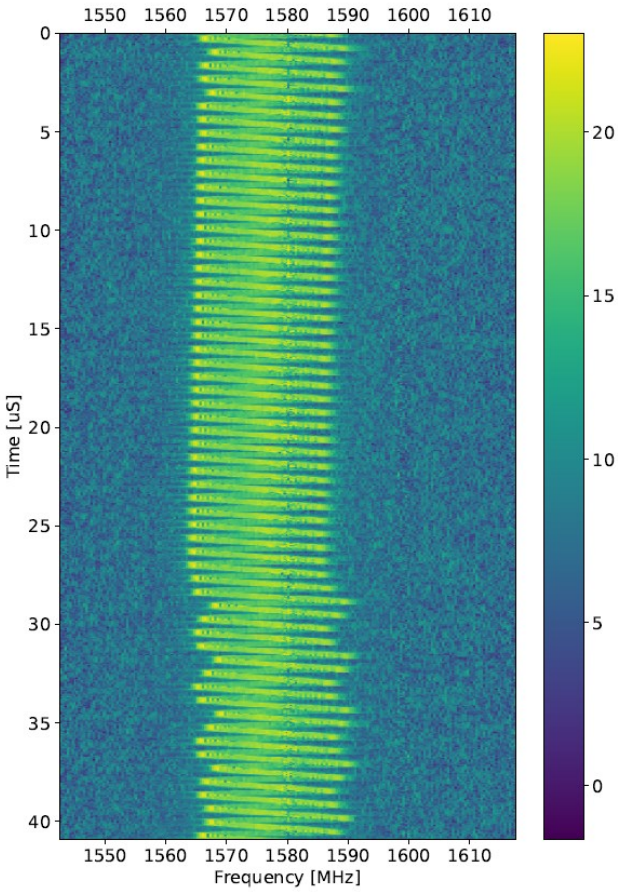
Jammer 3 – «N3»



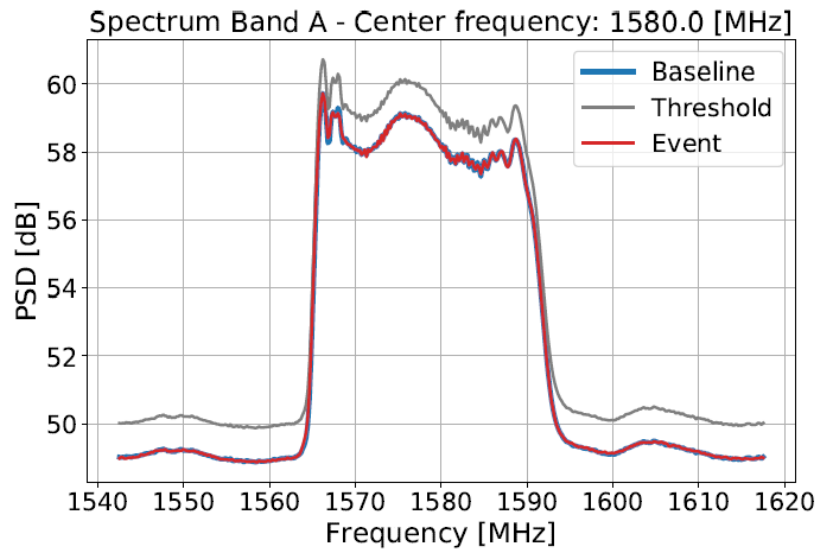
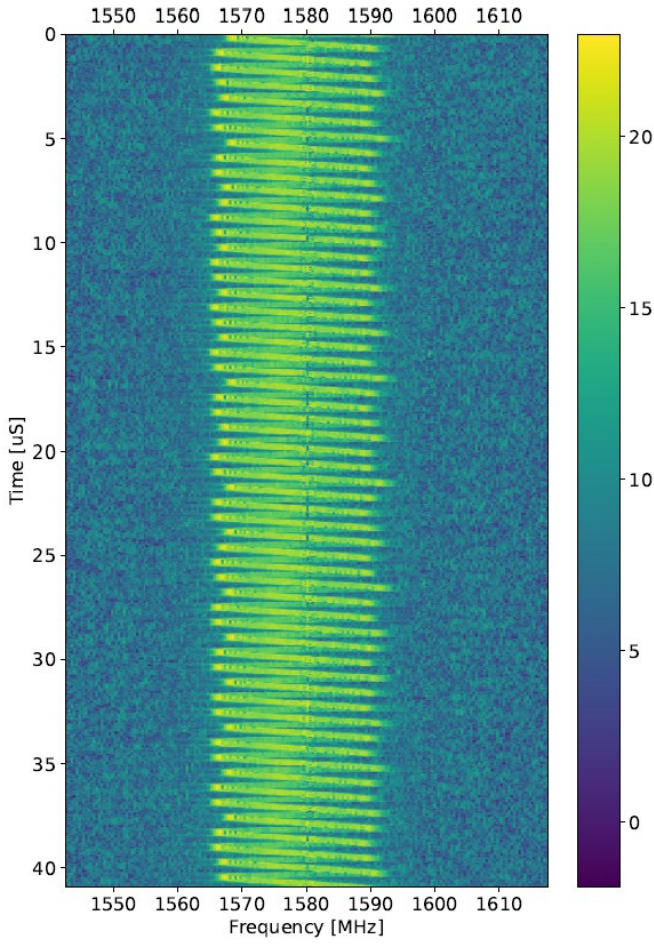
Plot shows the measurements of two of the same type of this jammer, only for the antenna marked 'GPS'.¹

¹ NR1/2 = Number 1/2. This translates to Jammer 3 NR1/2 = Jammer 3.1/2

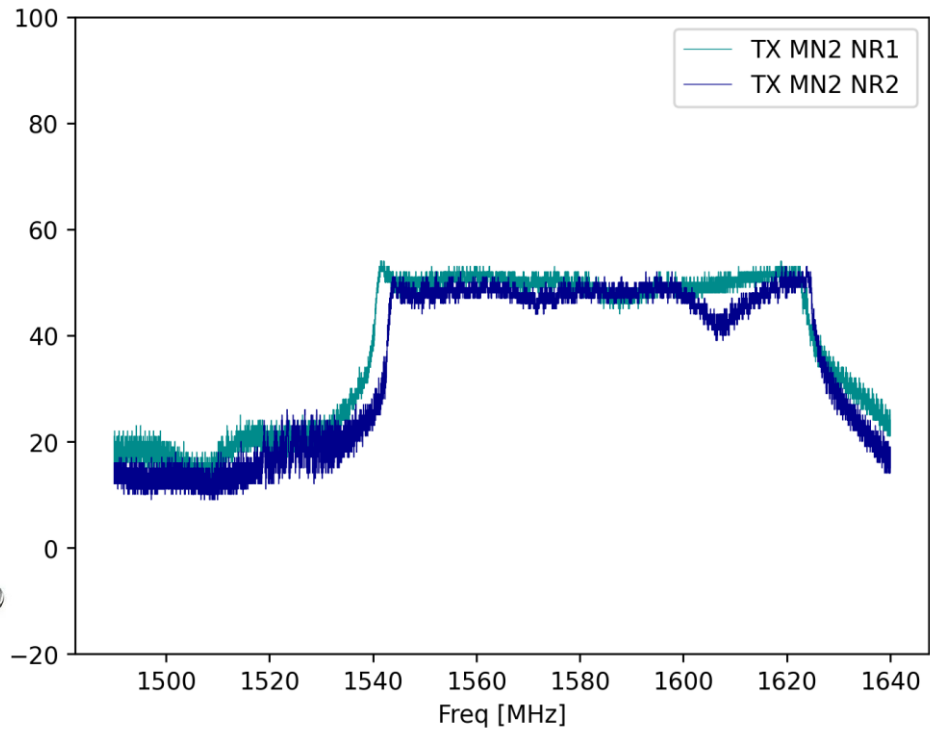
NR1 (Jammer 3.1 – NX)



NR2 (Jammer 3.2 – NX)

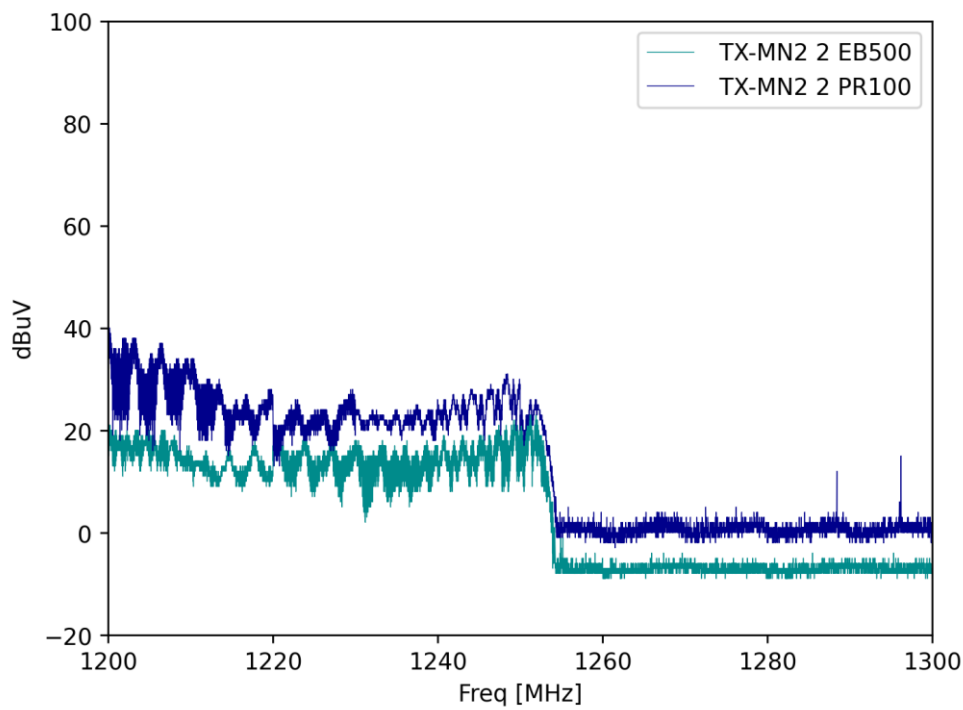


Jammer 4 – «TX-MN2»

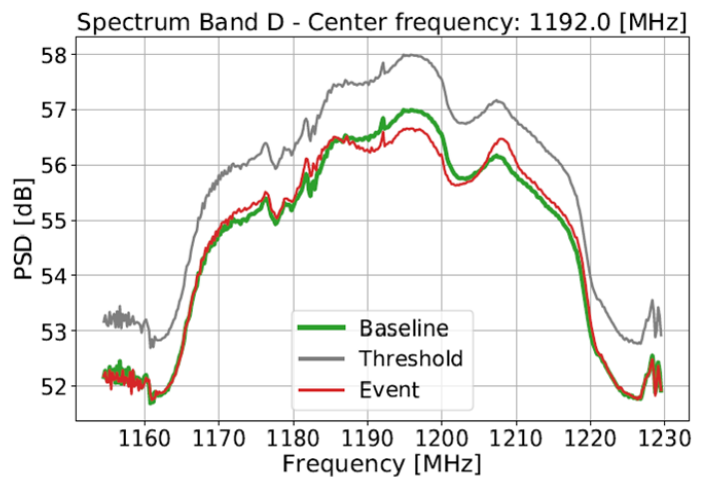
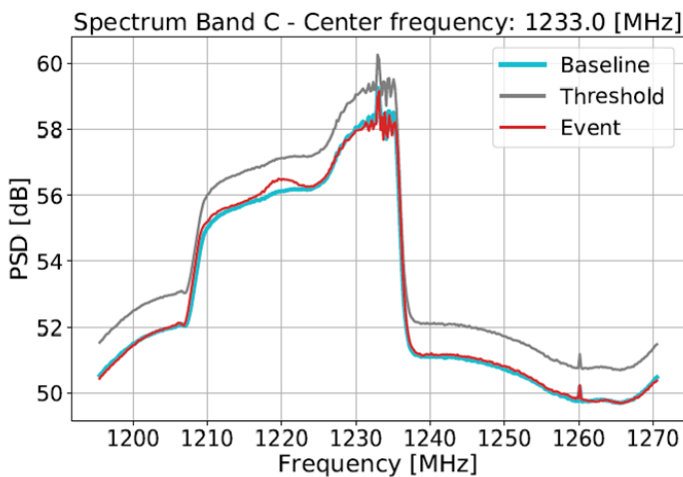
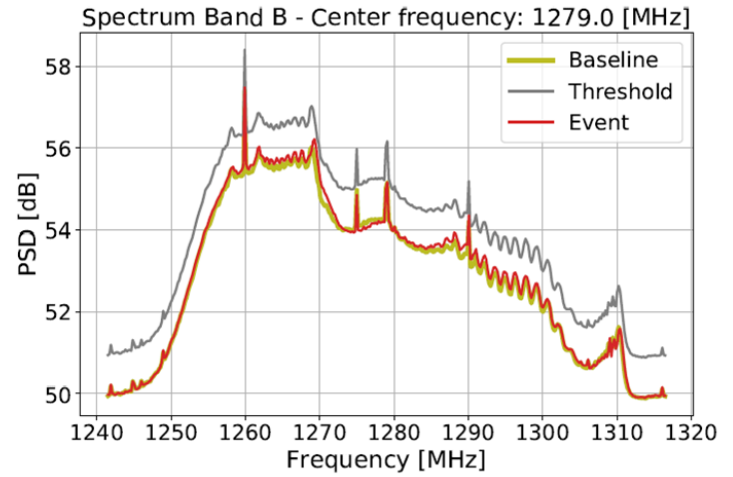
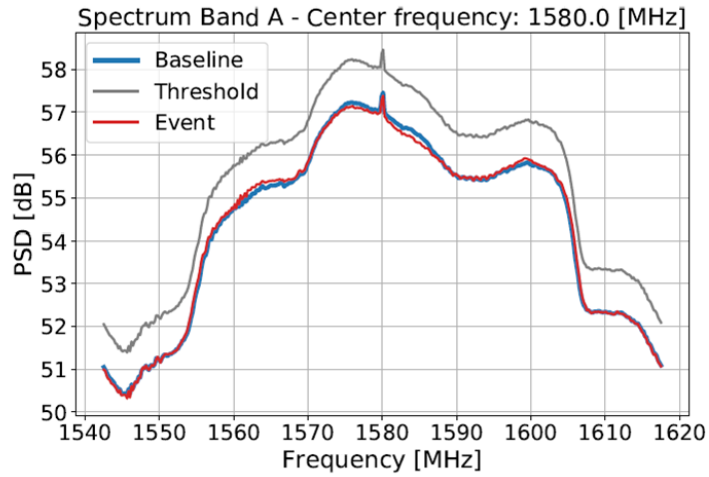


Above: L1-band measurements.

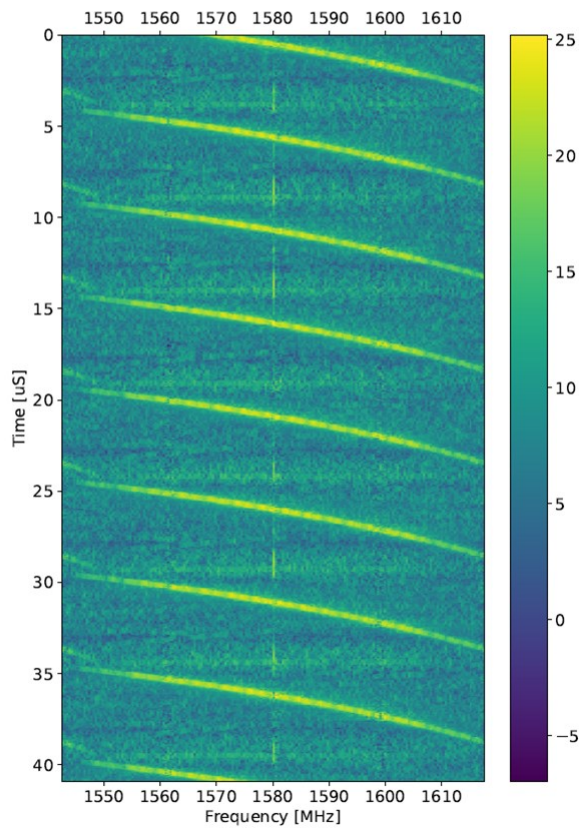
Below: L2-band measurements



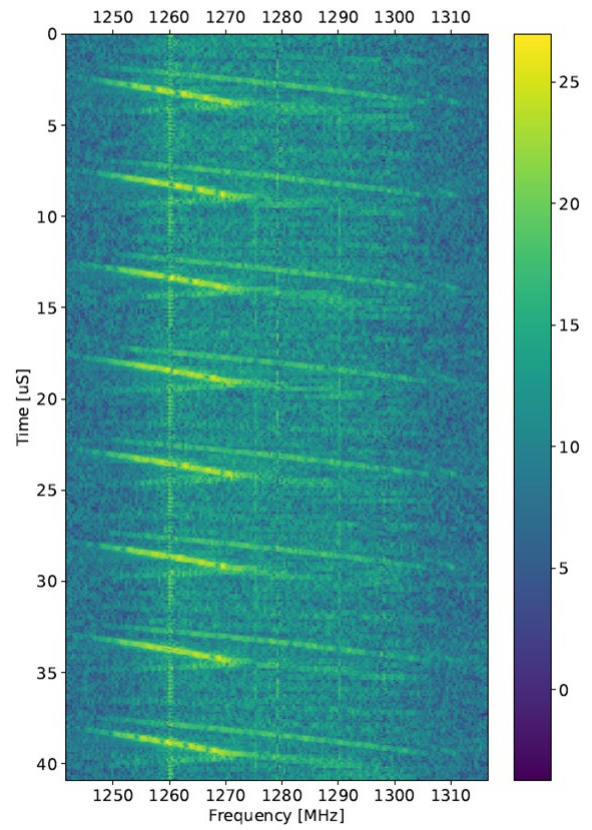
NR1 (Jammer 4.1 – TX-MN2)



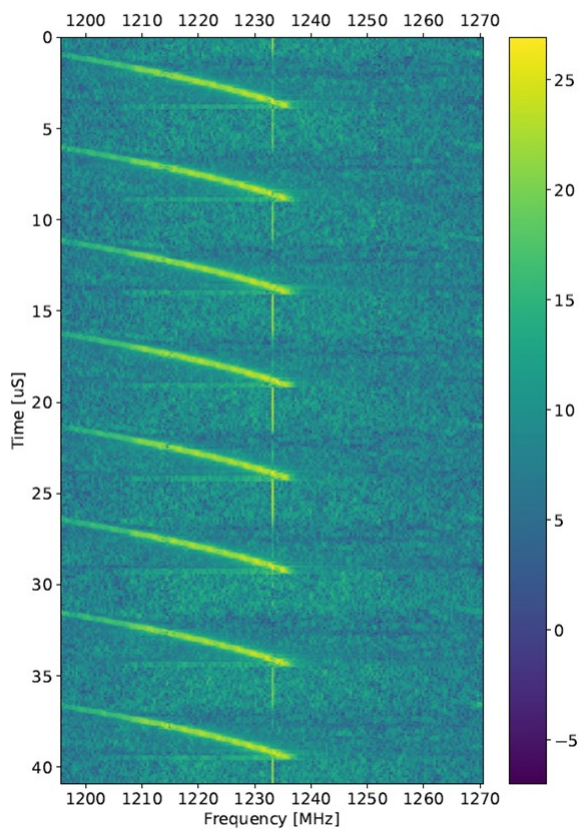
Event000 Channel A



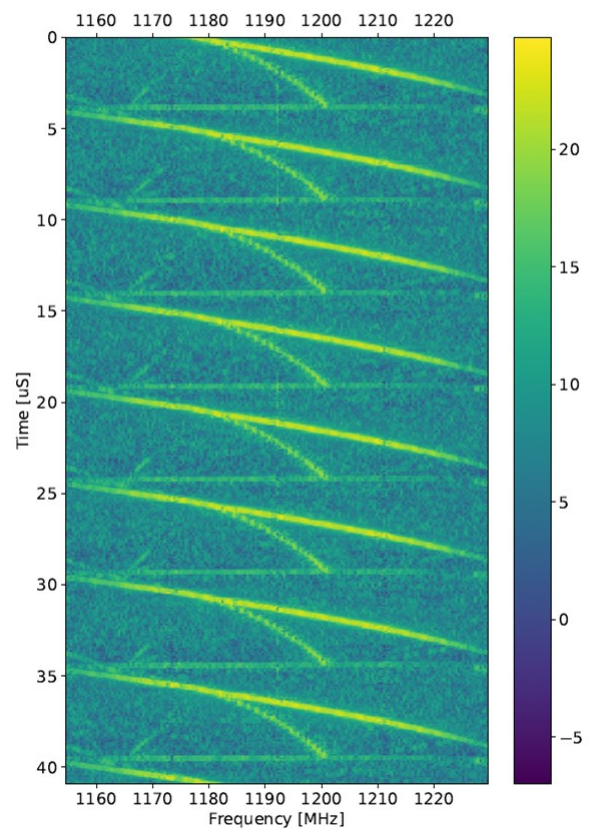
Event000 Channel B



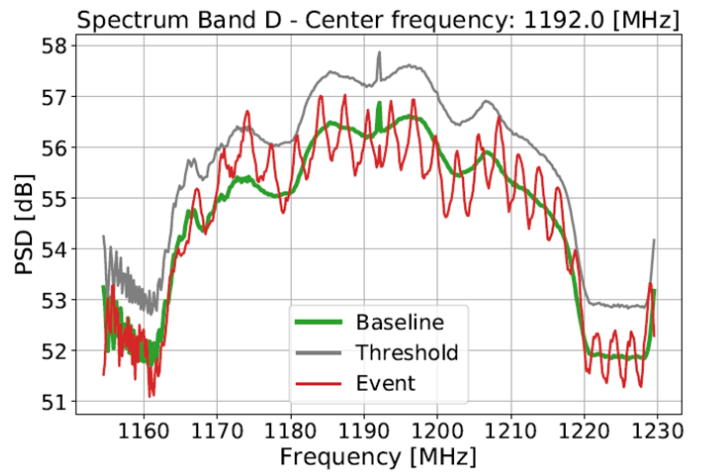
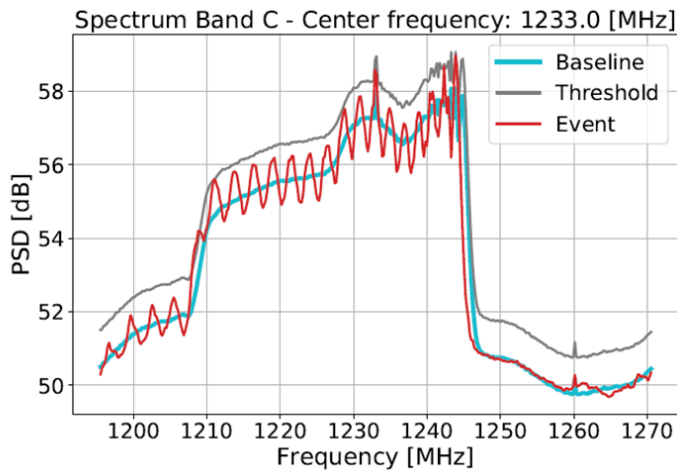
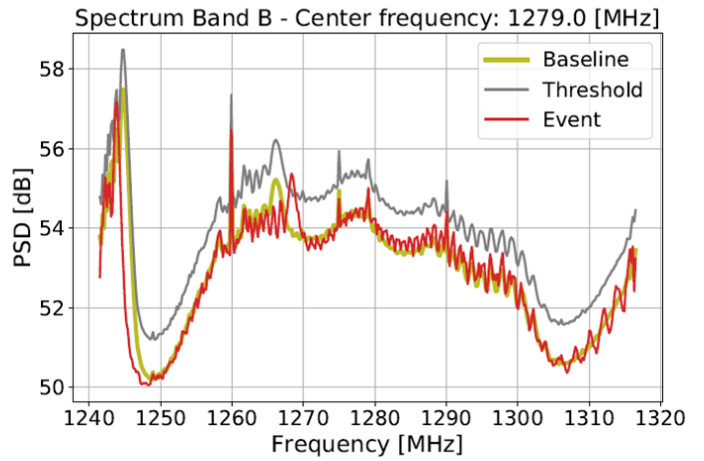
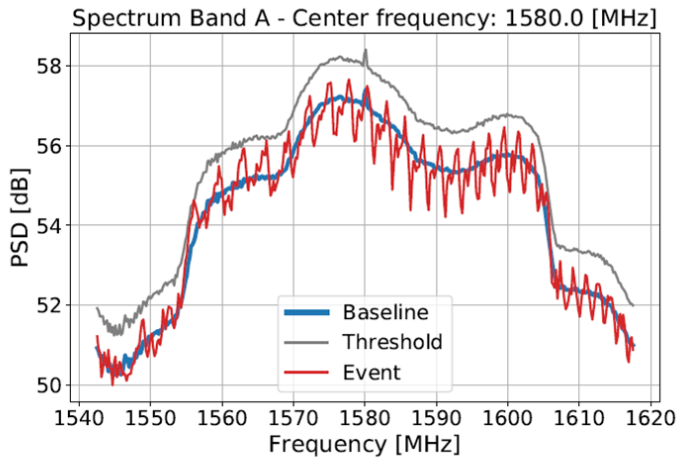
Event000 Channel C



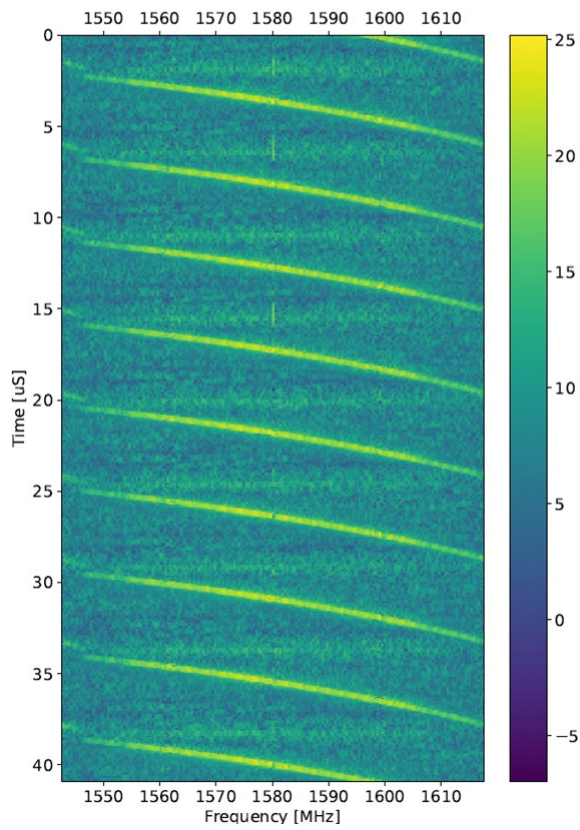
Event000 Channel D



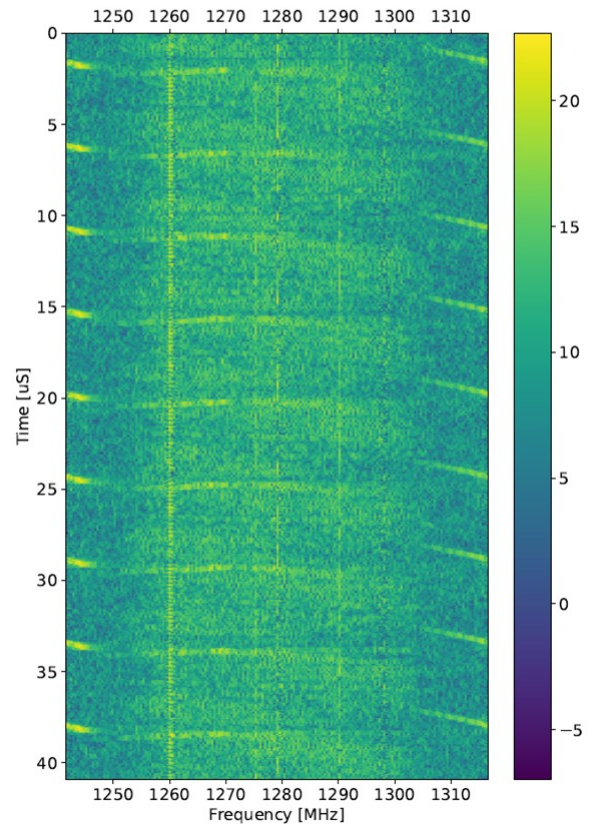
NR2 (Jammer 4.2 – TX-MN2)



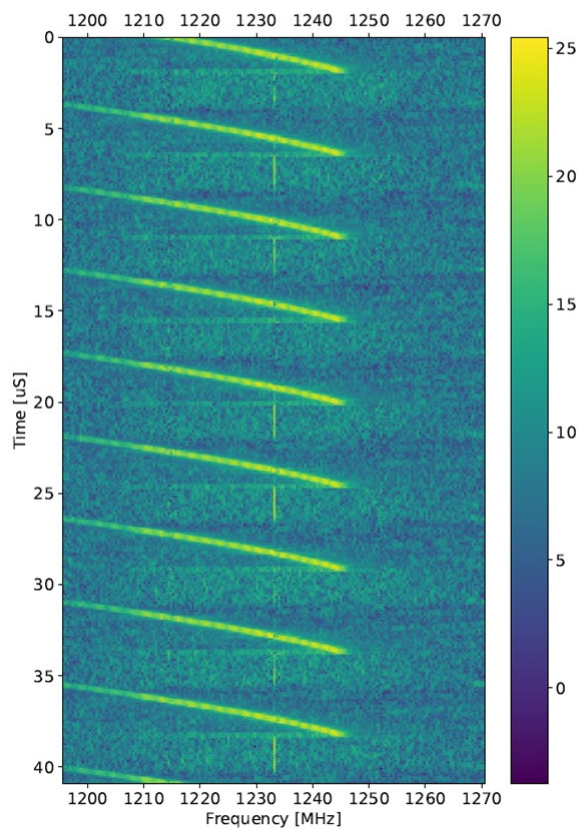
Event000 Channel A



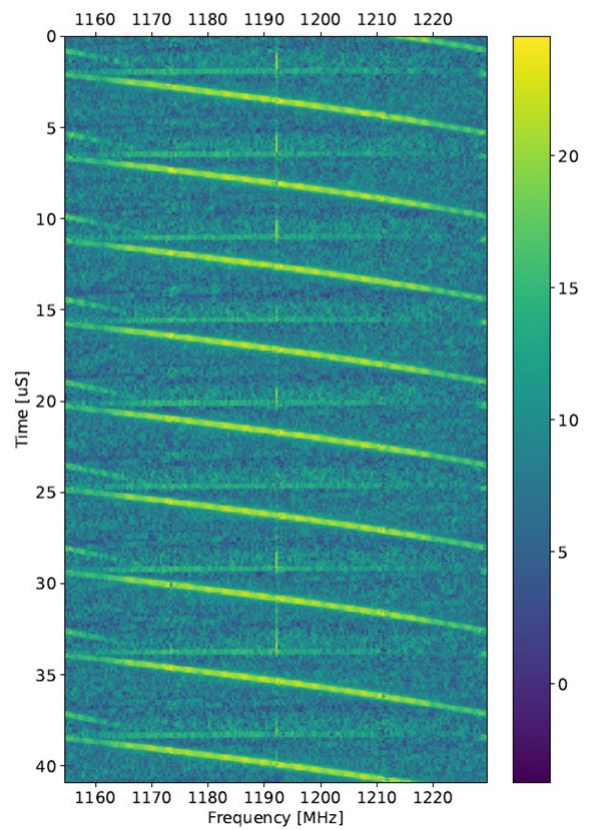
Event000 Channel B



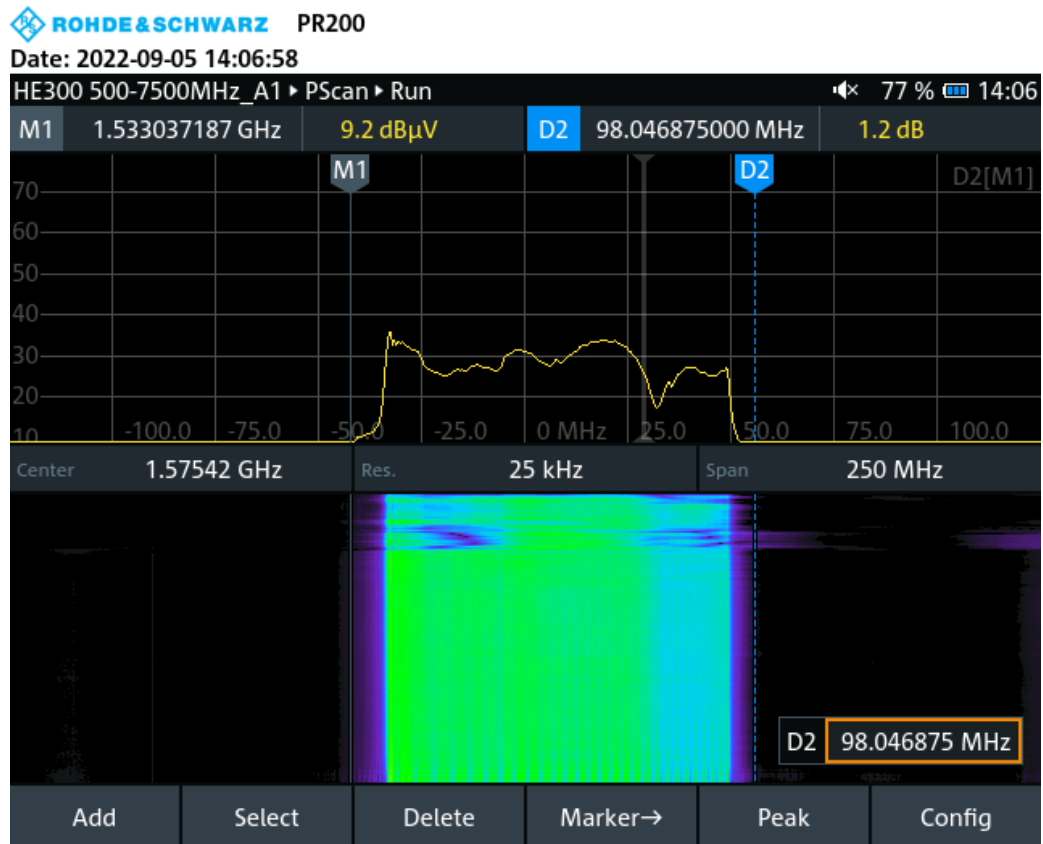
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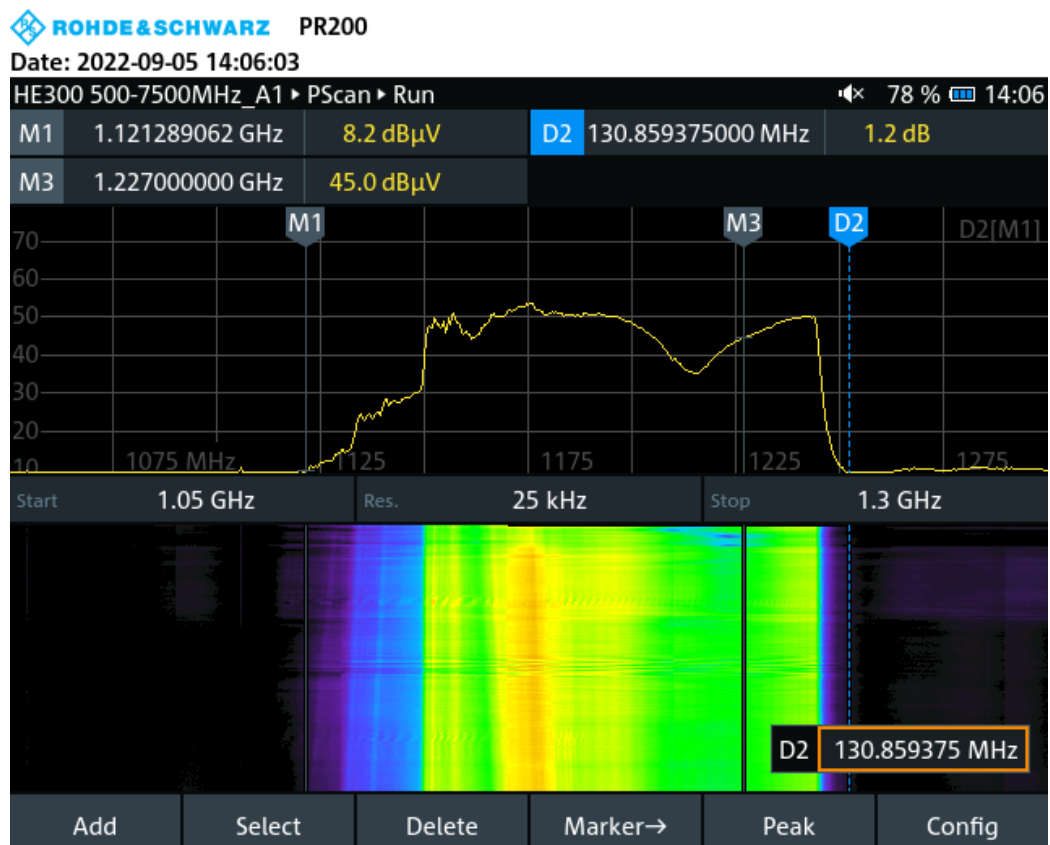
Event000 Channel D



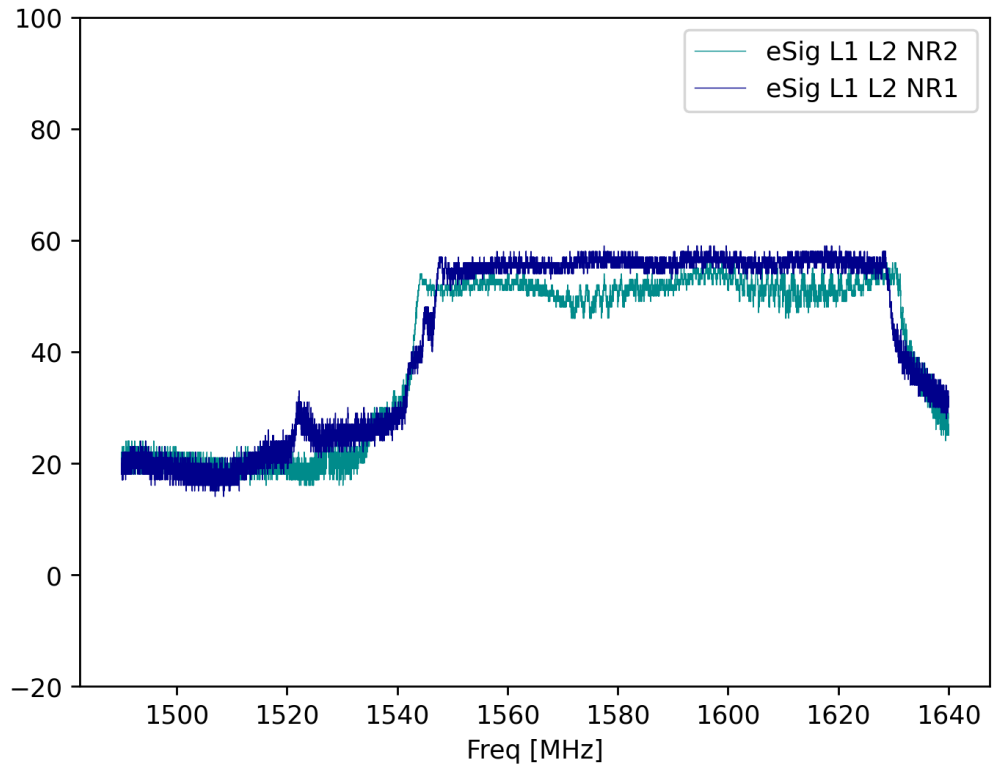
Measurement of L1 emission (this antenna active only):



Measurement of L2 emission (this antenna active only):

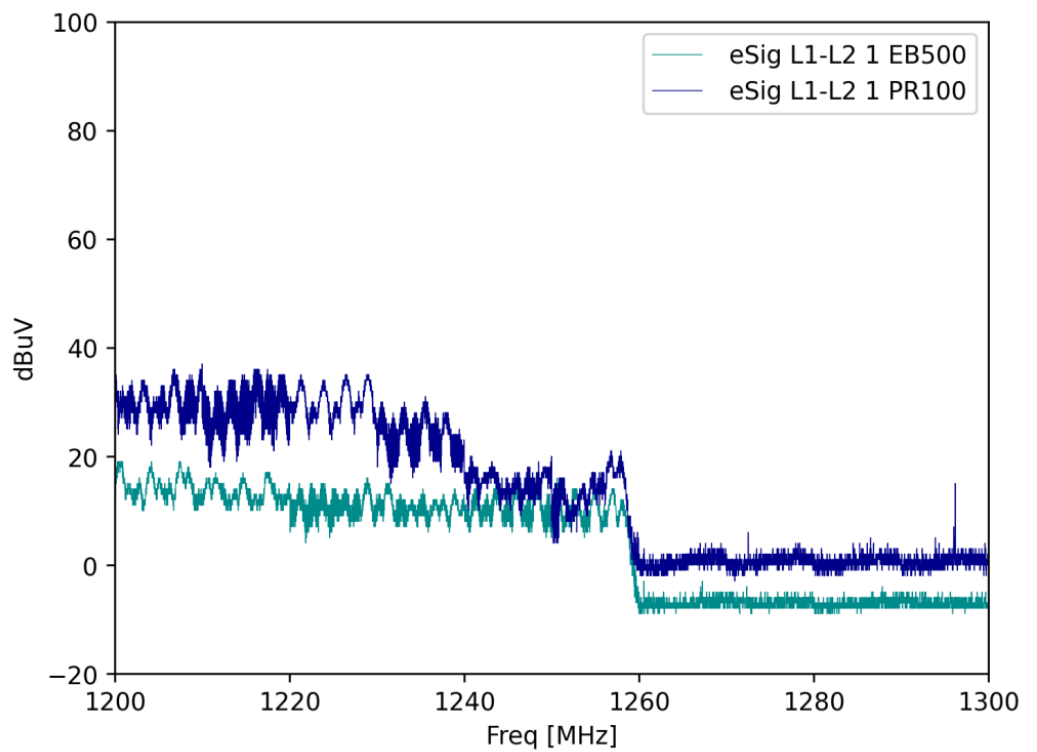


Jammer 5 – «eSig-L1-L2»

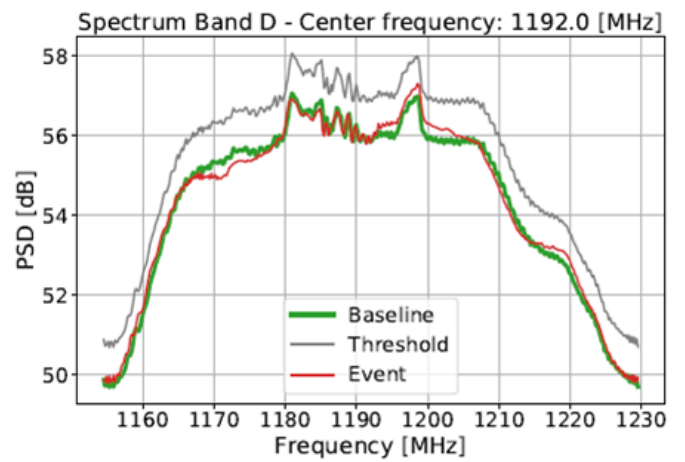
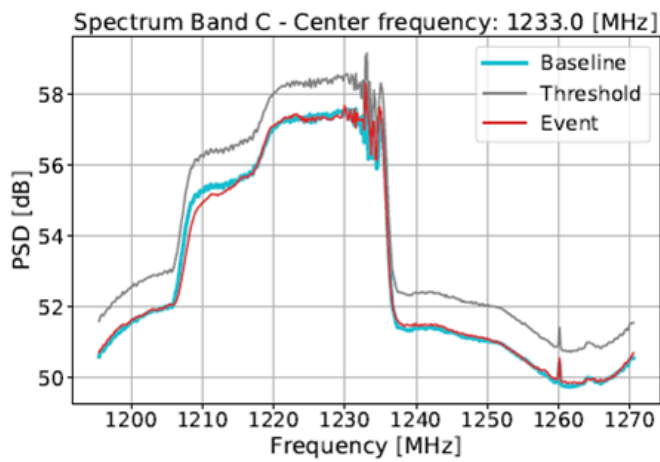
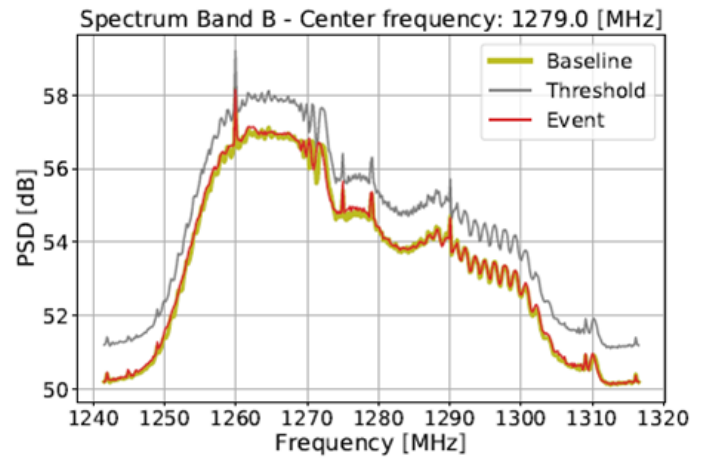
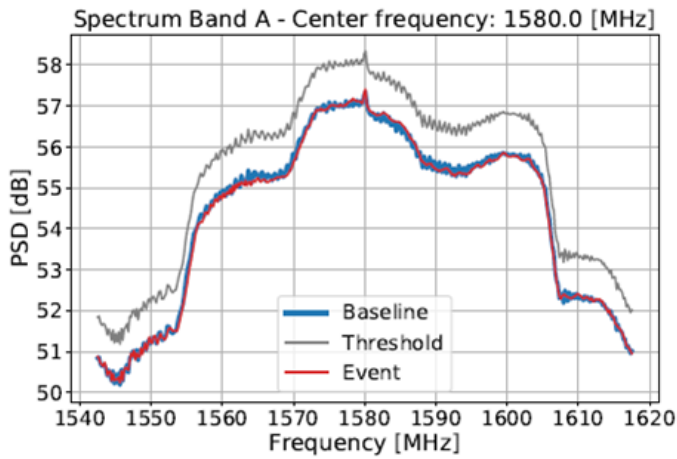


Above: L1-band measurements.

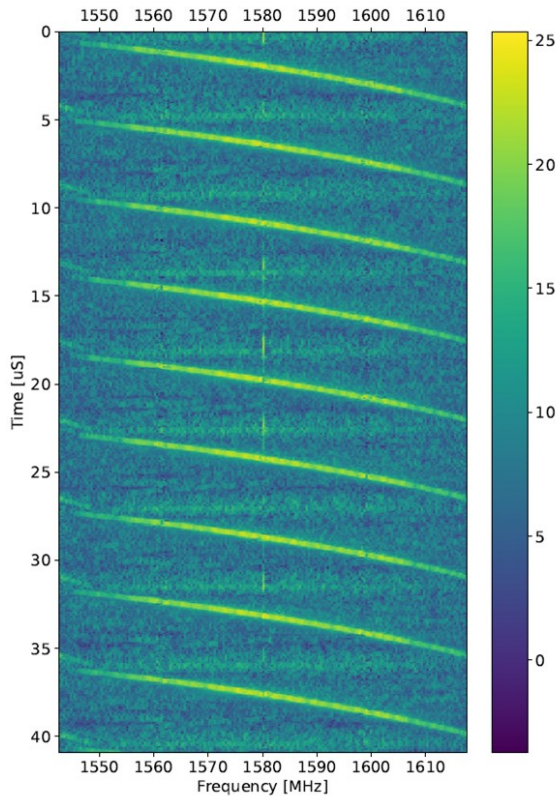
Below: L2-band measurements



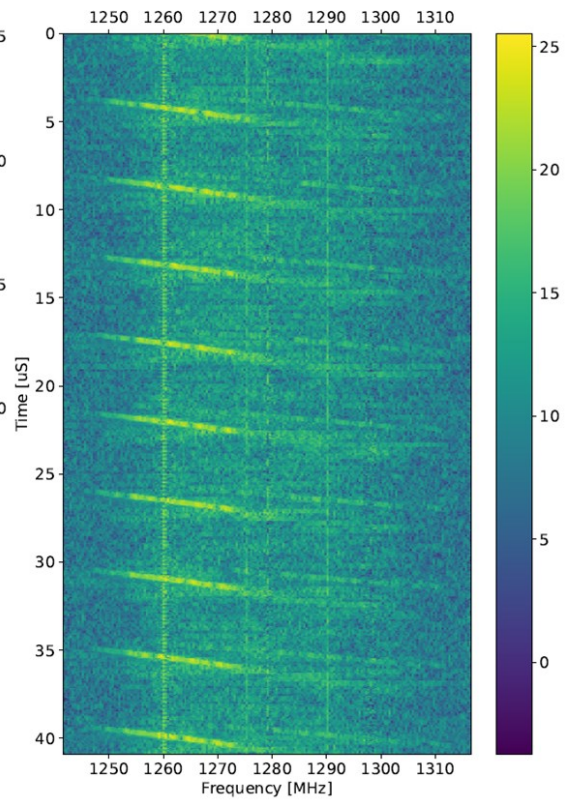
NR1 (Jammer 5.1 – eSig-L1-L2)



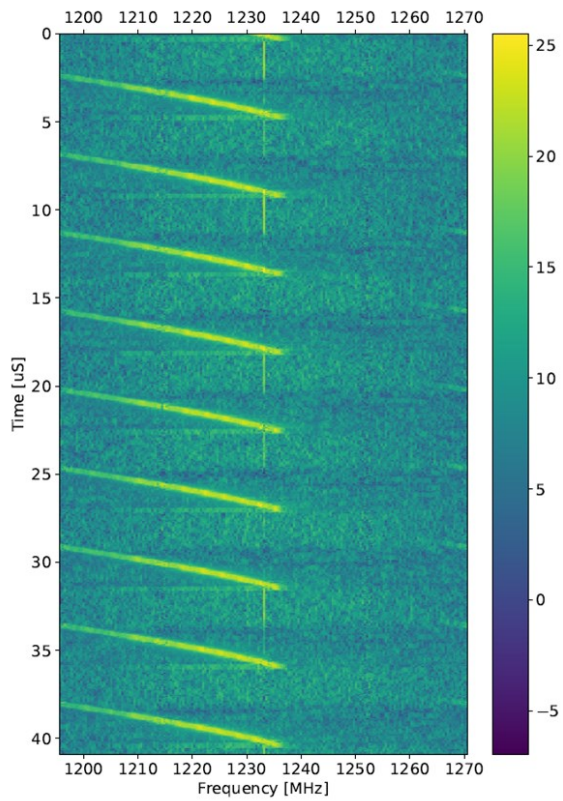
Event000 Channel A



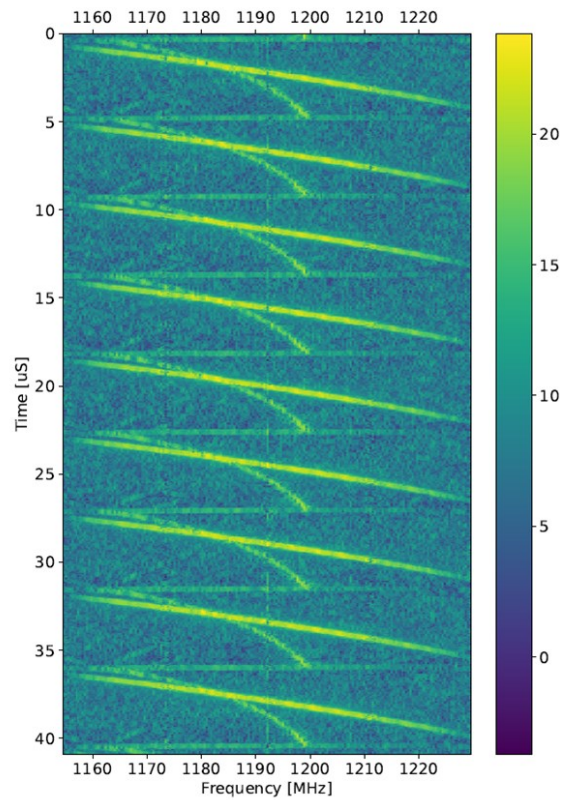
Event000 Channel B



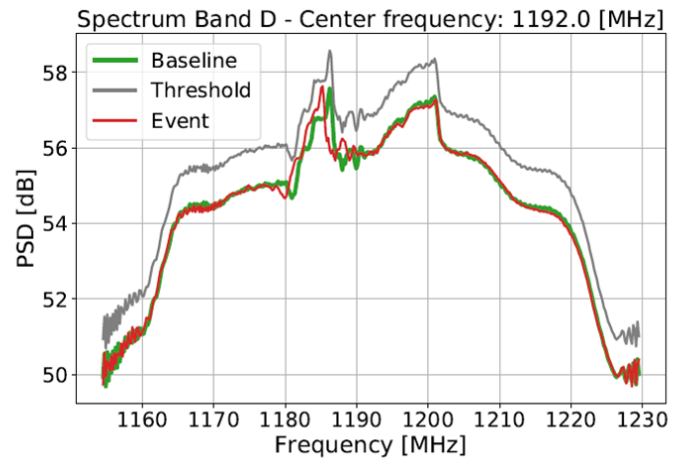
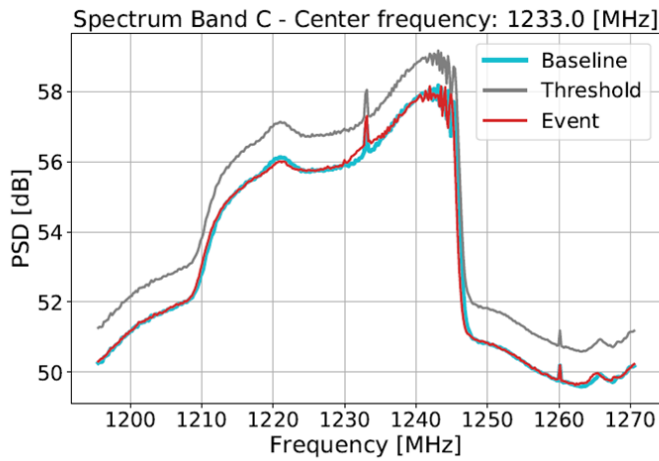
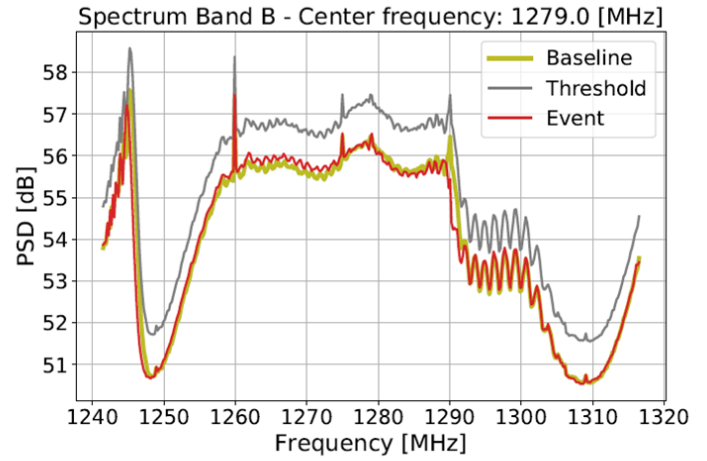
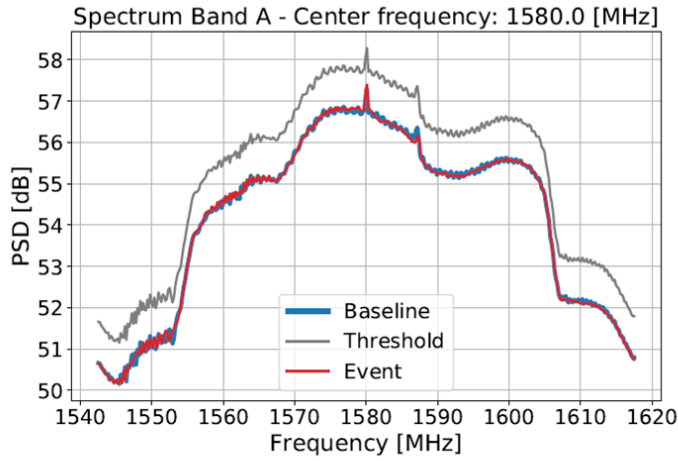
Event000 Channel C



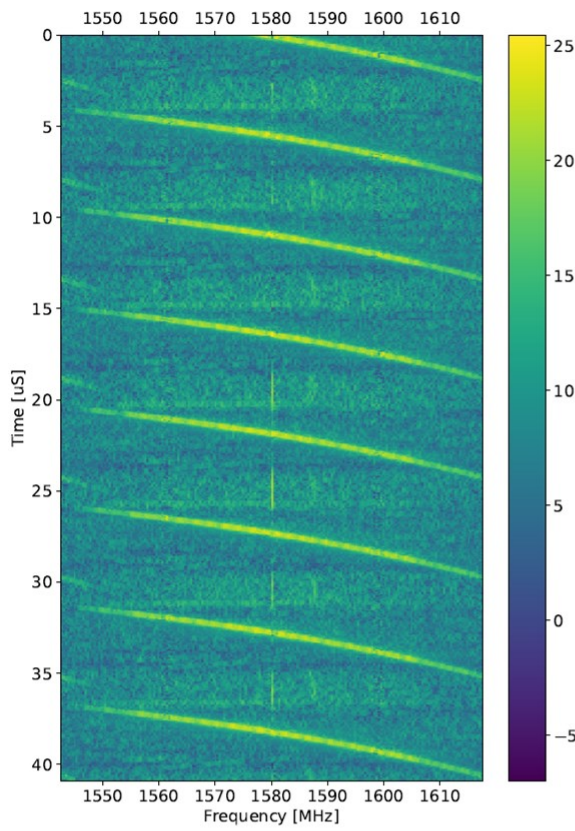
Event000 Channel D



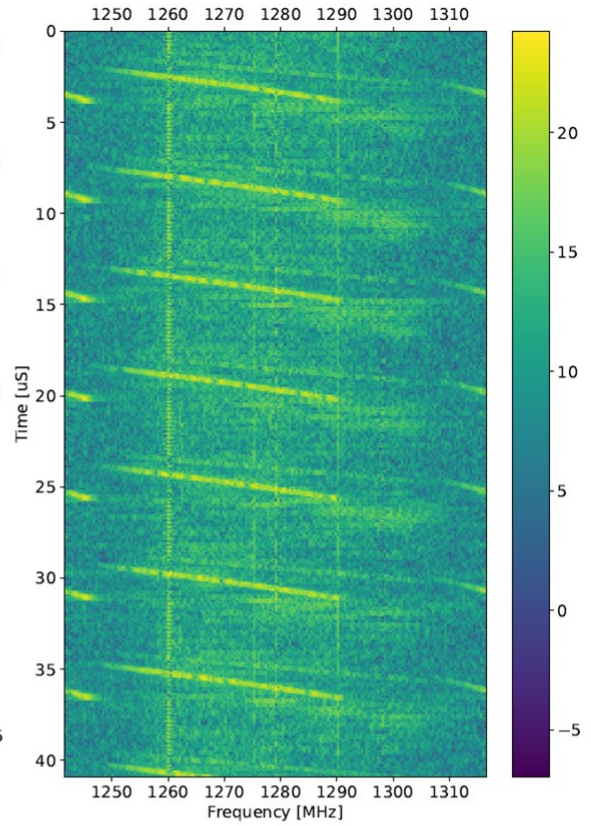
NR2 (Jammer 5.2 – eSig-L1-L2)



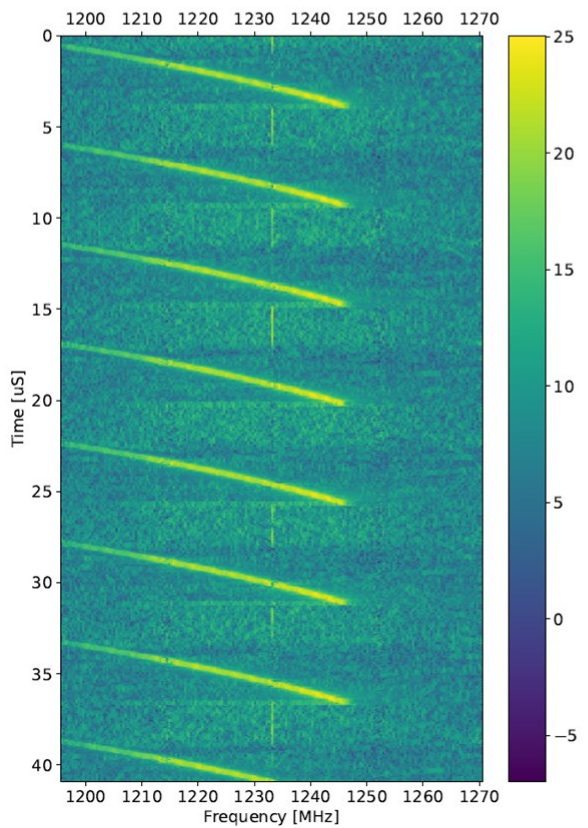
Event000 Channel A



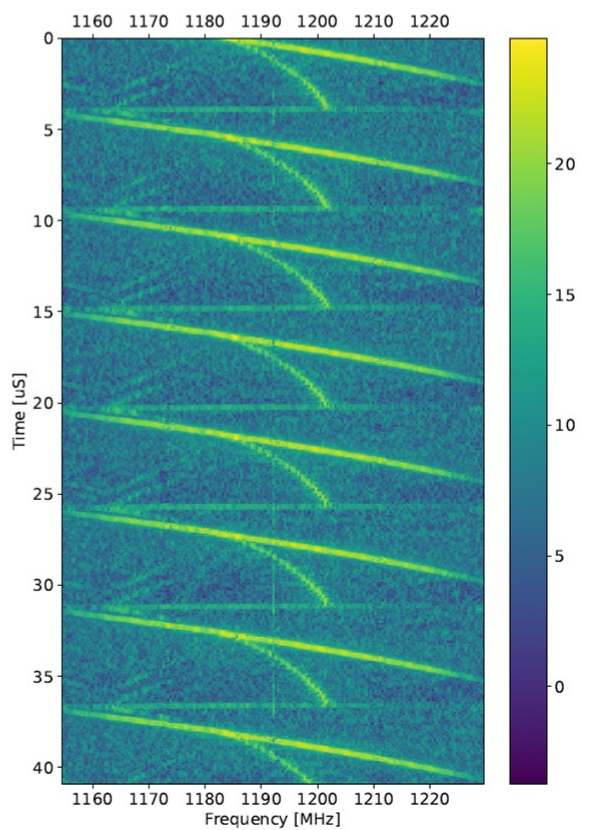
Event000 Channel B



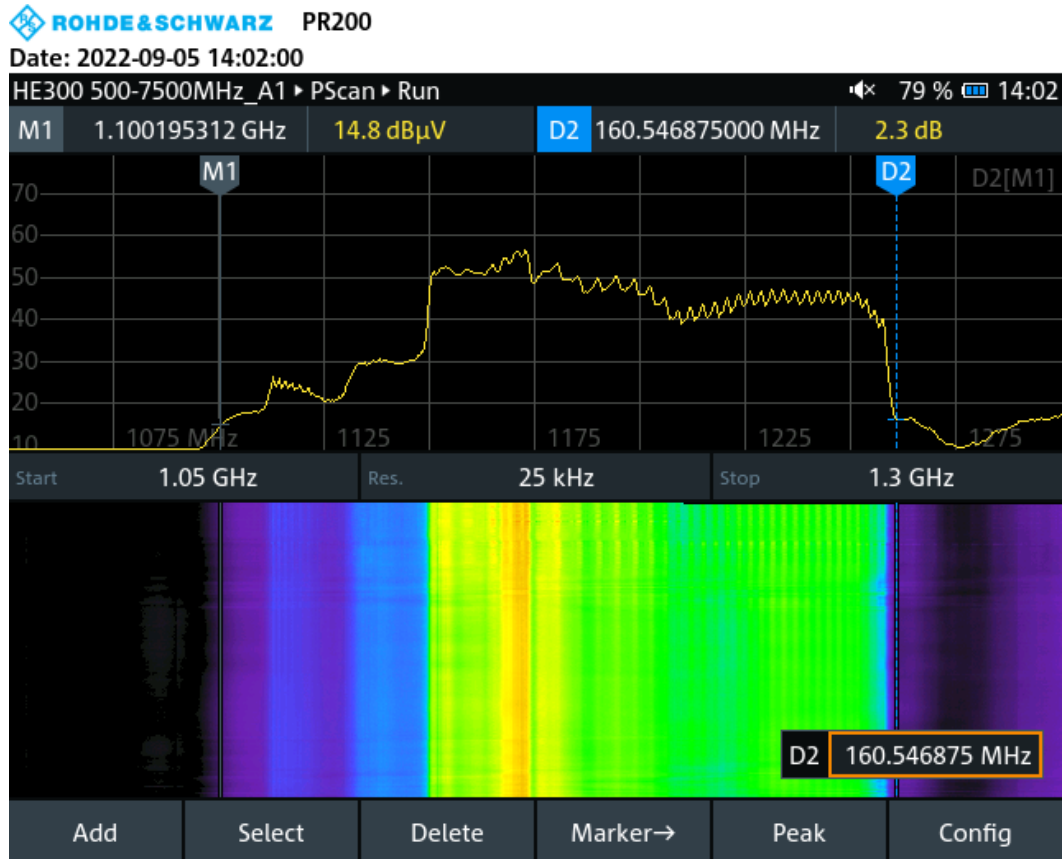
Event000 Channel C



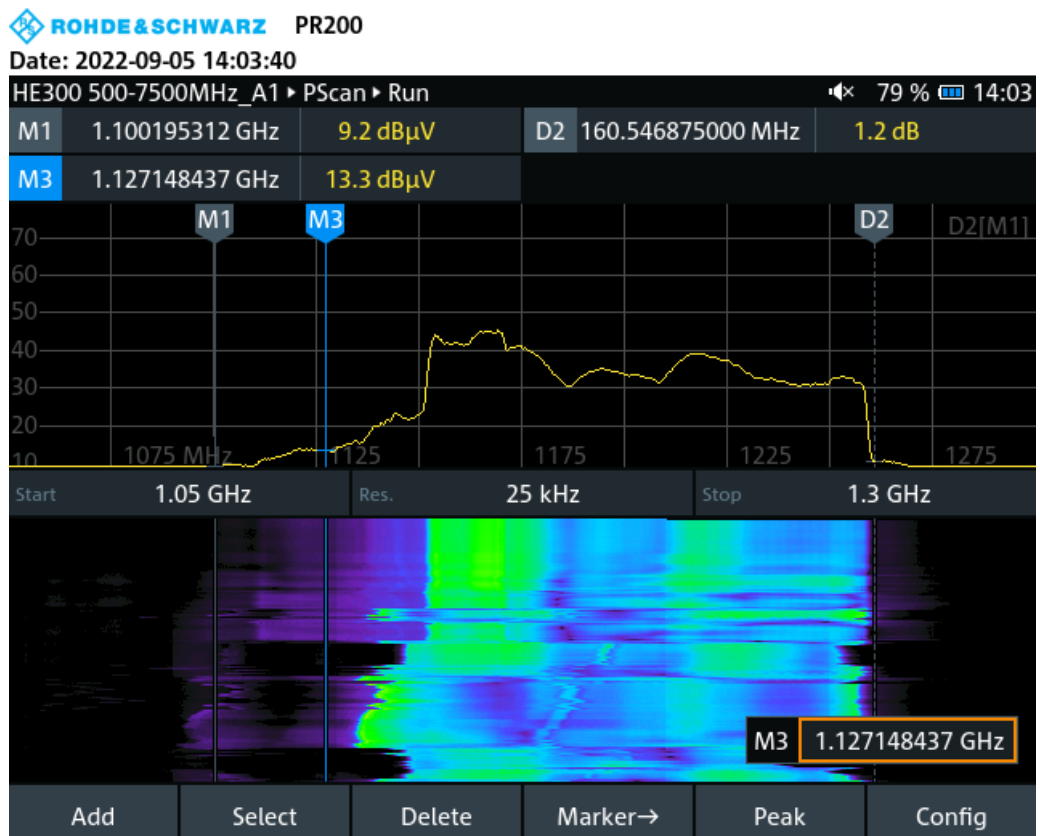
Event000 Channel D



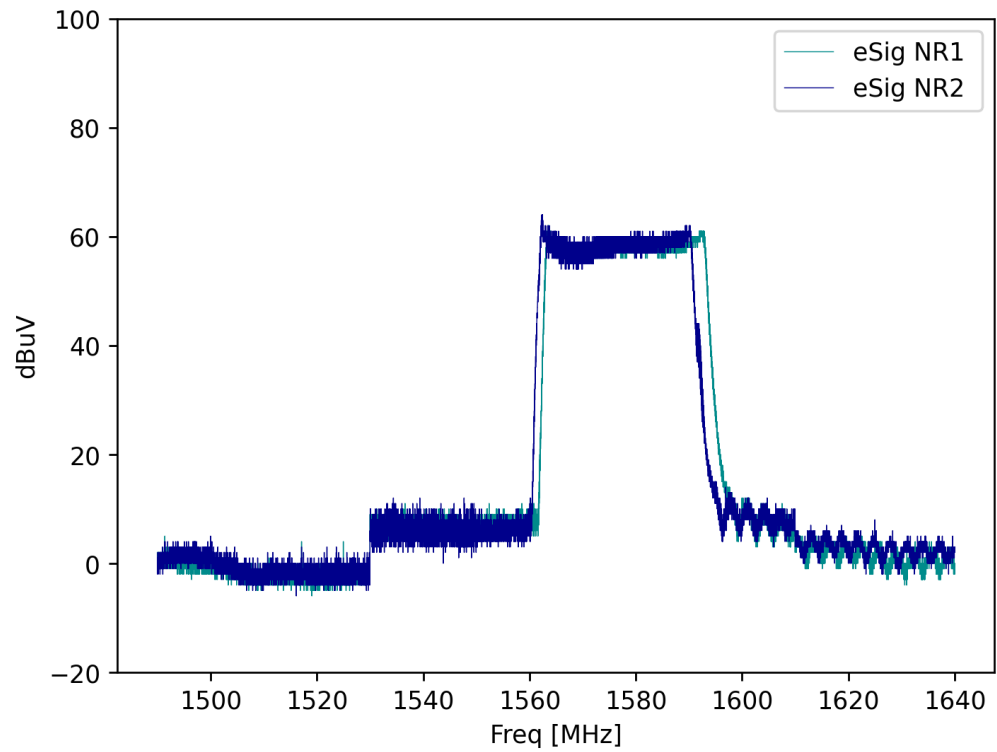
Measurement of L1 emission (this antenna active only):



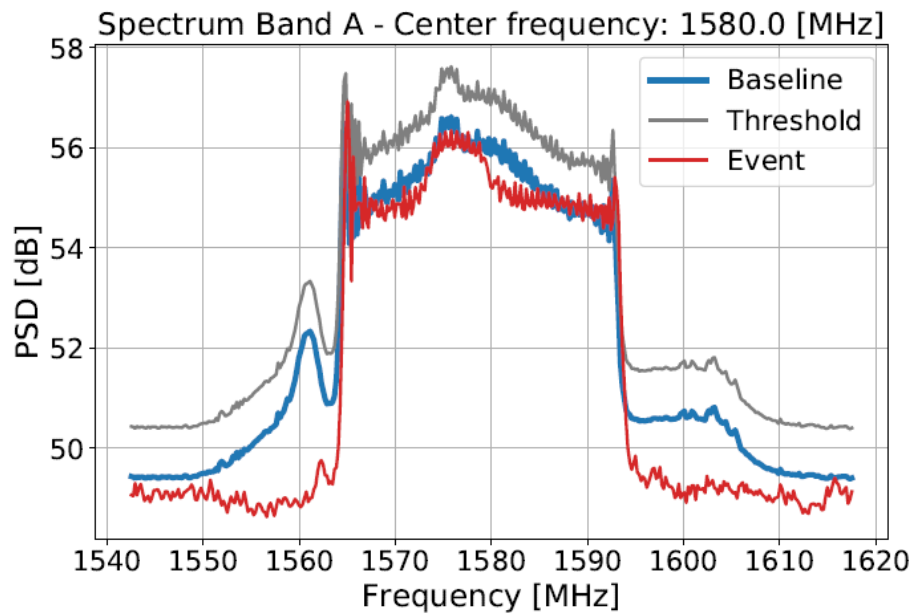
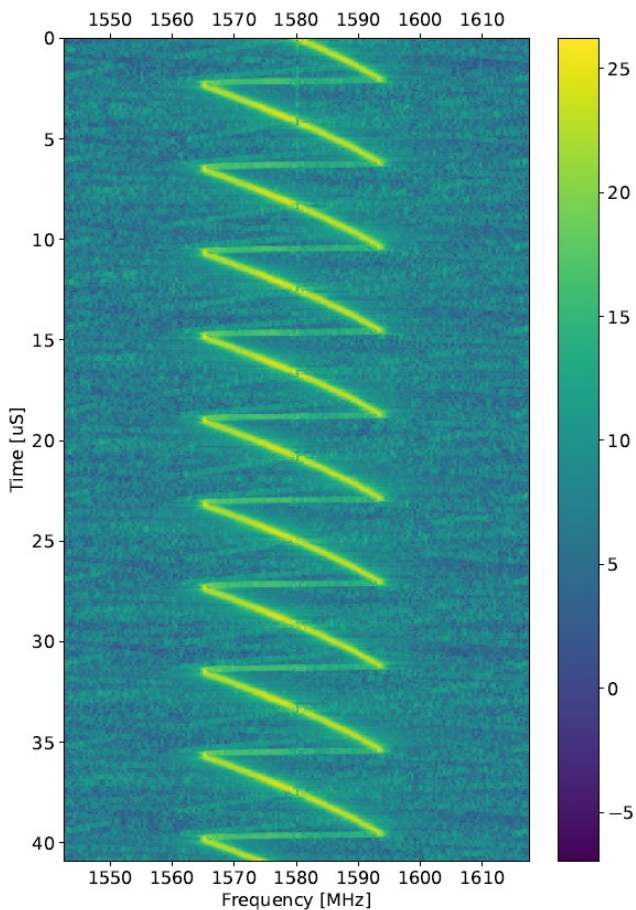
Measurement of L2 emission (this antenna active only):



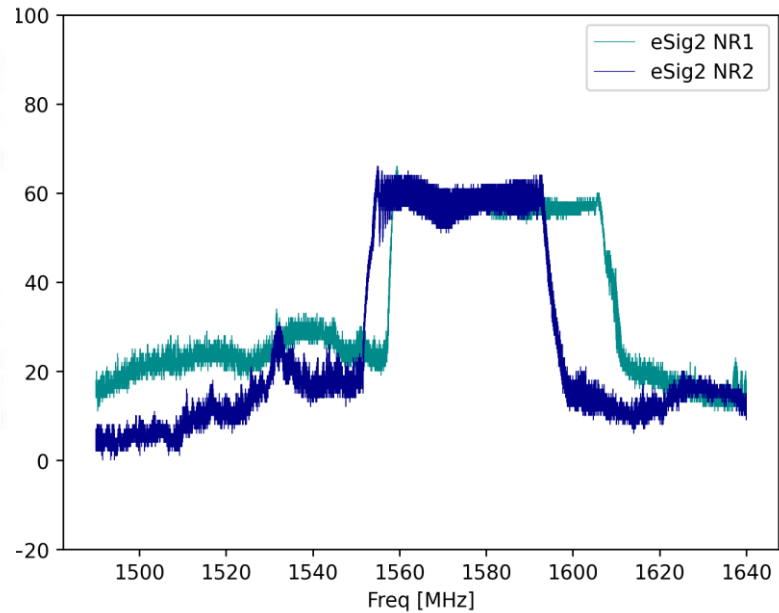
Jammer 6 – «eSig 1»



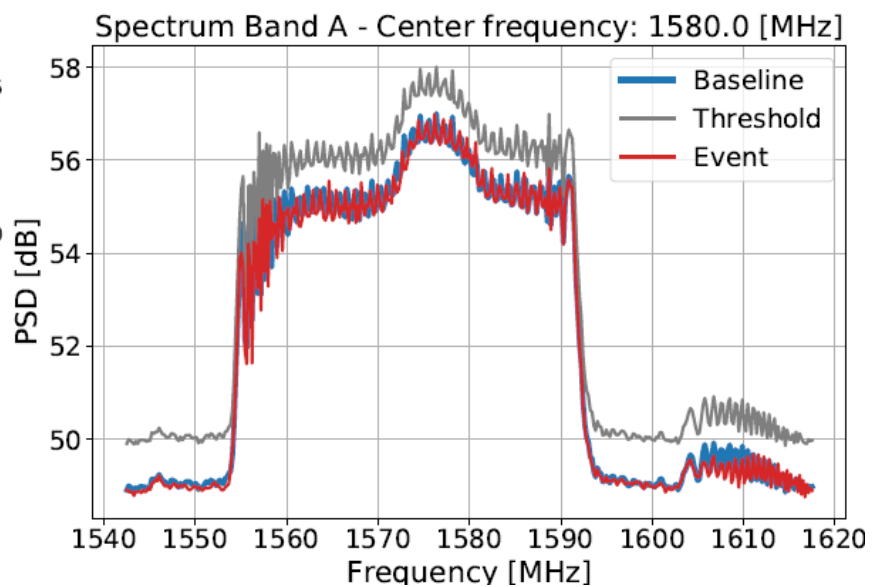
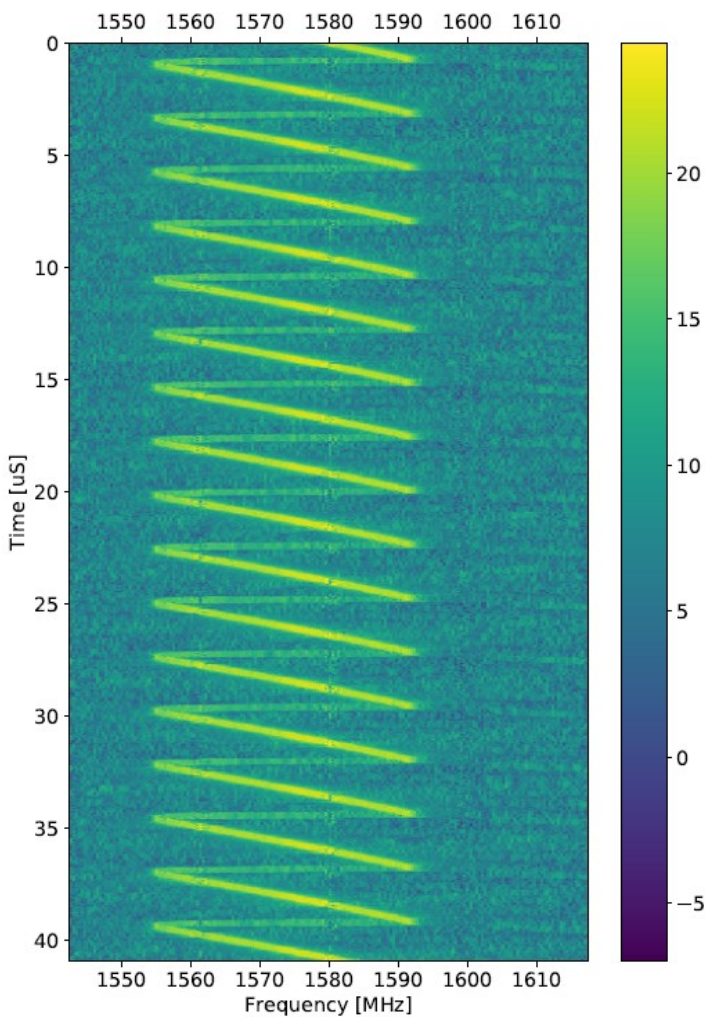
Spectrum and modulation from NR1 or NR2 (both are very similar, also same modulation).



Jammer 7 – «eSig 2»

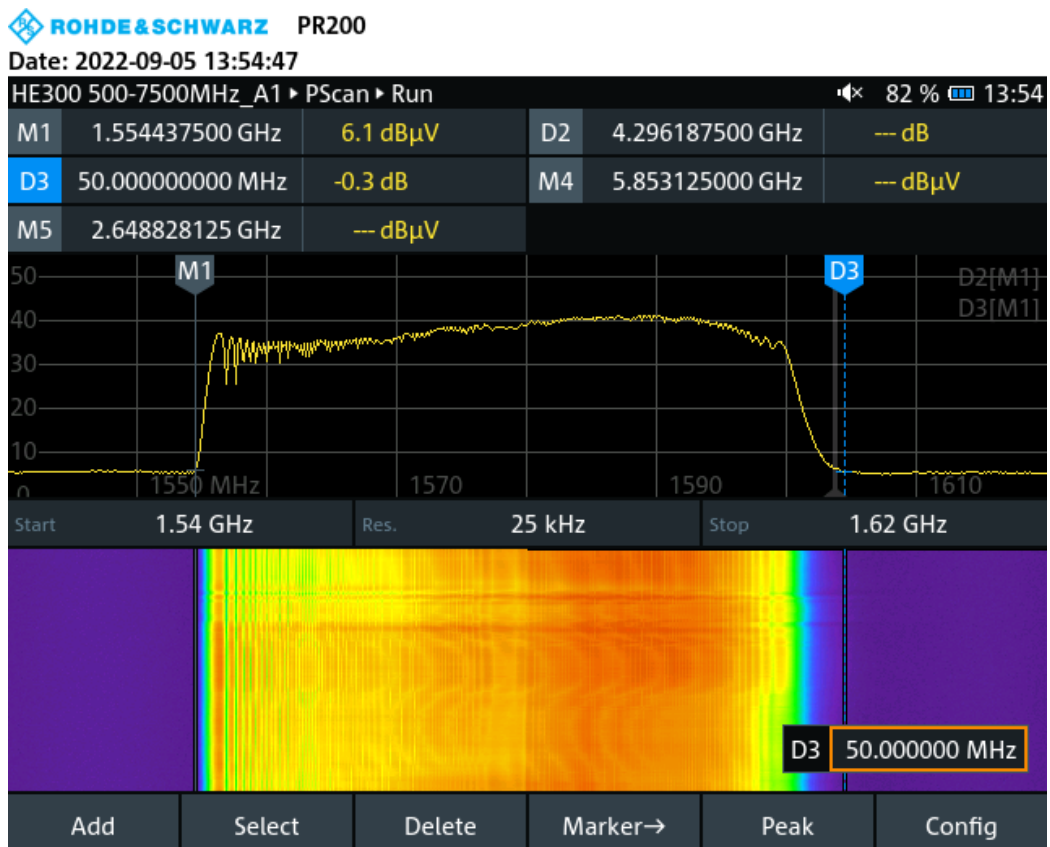
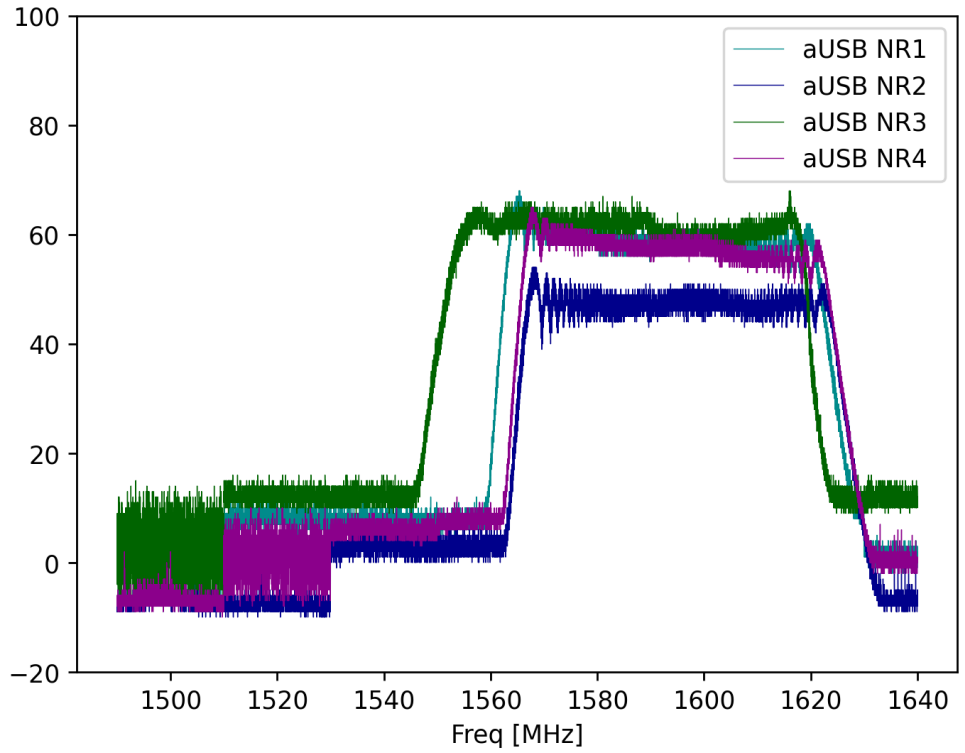


Spectrum and modulation from Jammer 7.2 (NR2) (NR1 is very similar, also same modulation).



Jammer 8 – «aUSB»

Indicates that it jams L1 and L2, but this is not the case. Measurements show it only jams L1.

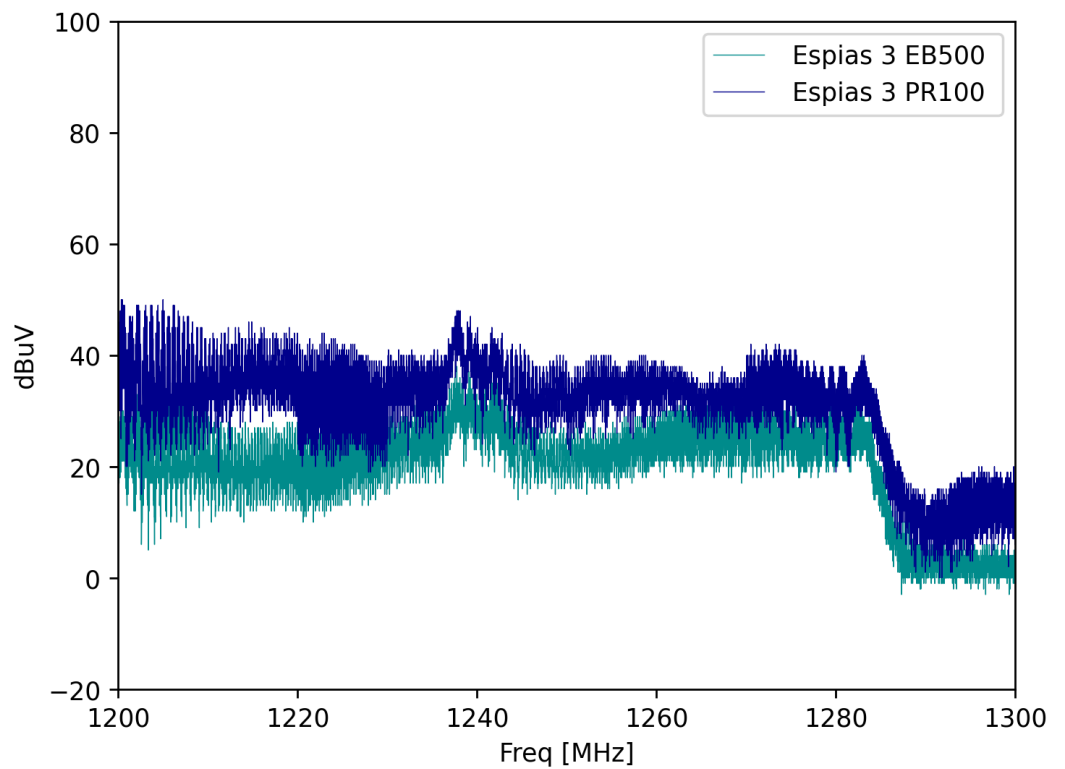


Jammer 9 – «Espias»



All measurements done with one antenna connected and all the other antennas disconnected (but the antenna ports not terminated).

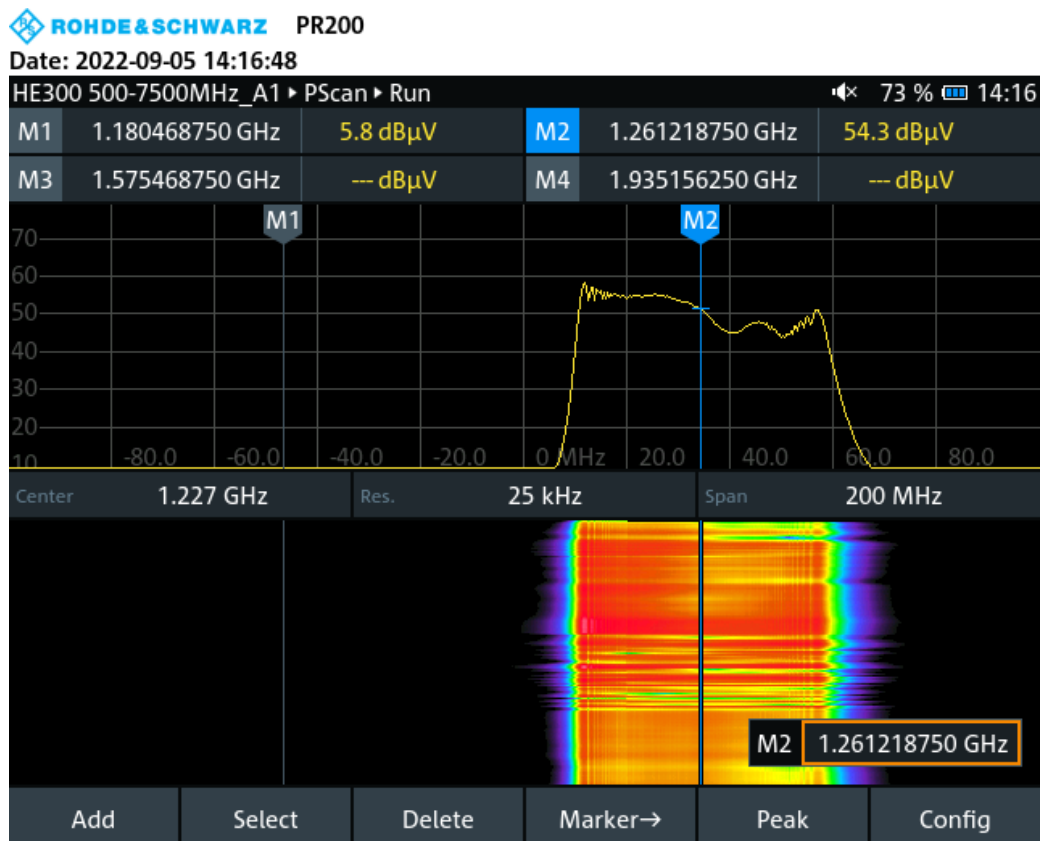
Below: L2-band measurements



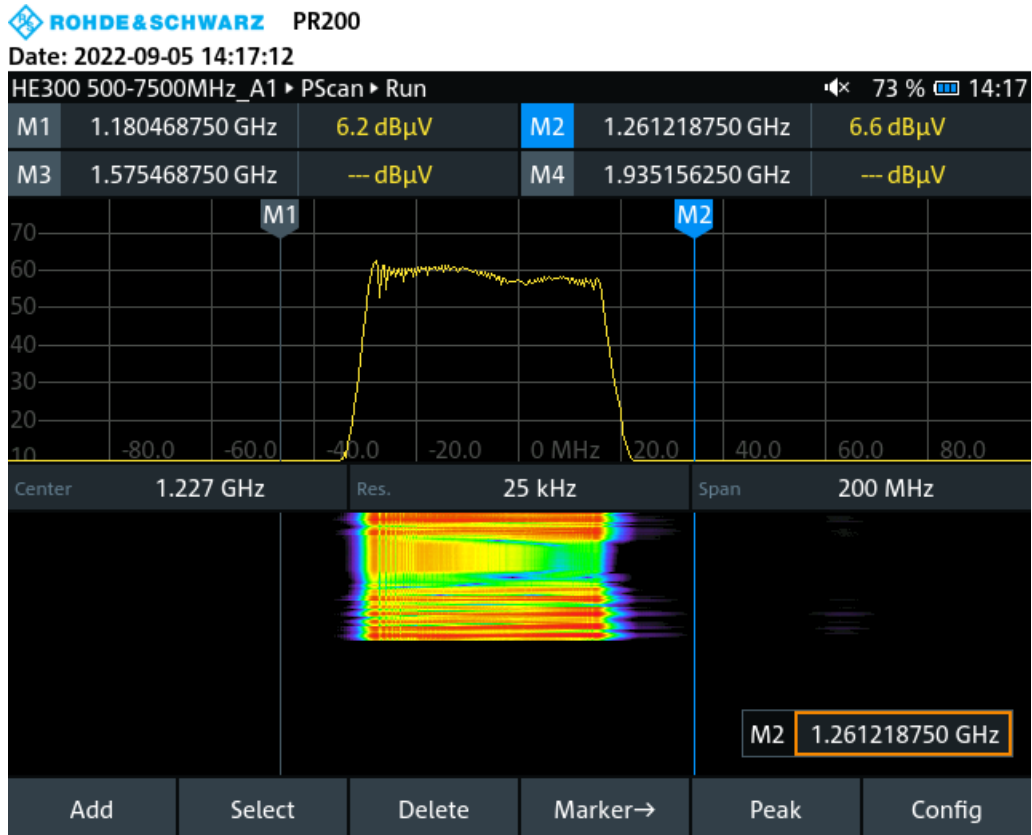
Antenna 1 (approximately 1490-1605 MHz):



Antenna 2 (approximately 1230-1290 MHz):



Antenna 3 (approximately 1195-1250 MHz):

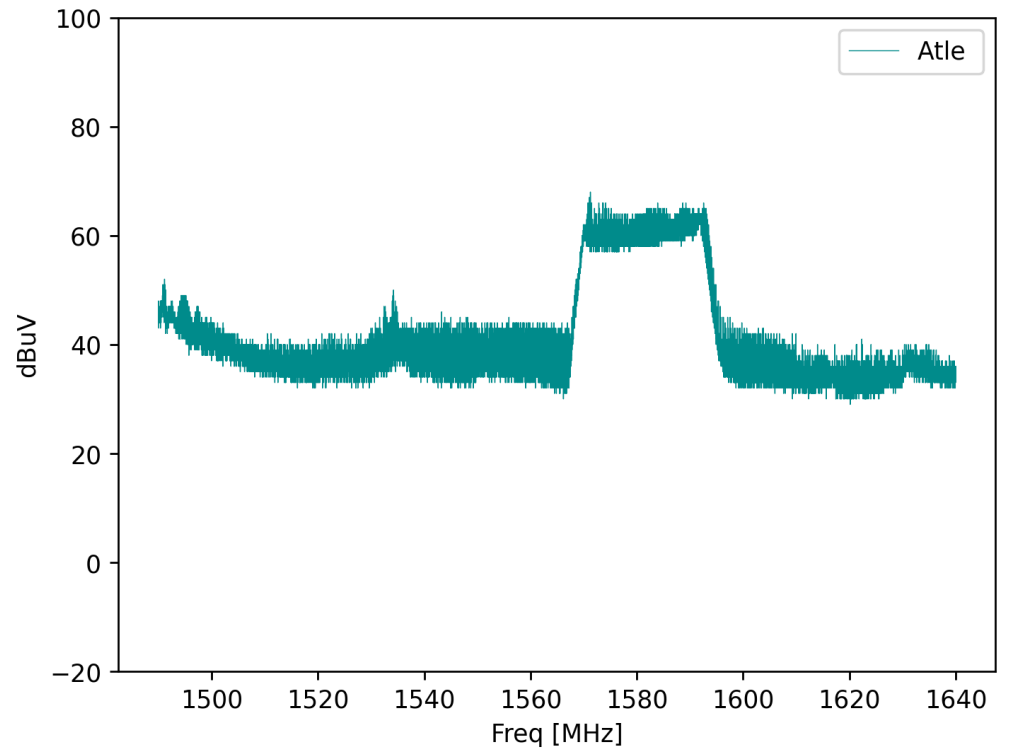


Antenna 4 (approximately 1140-1200 MHz):

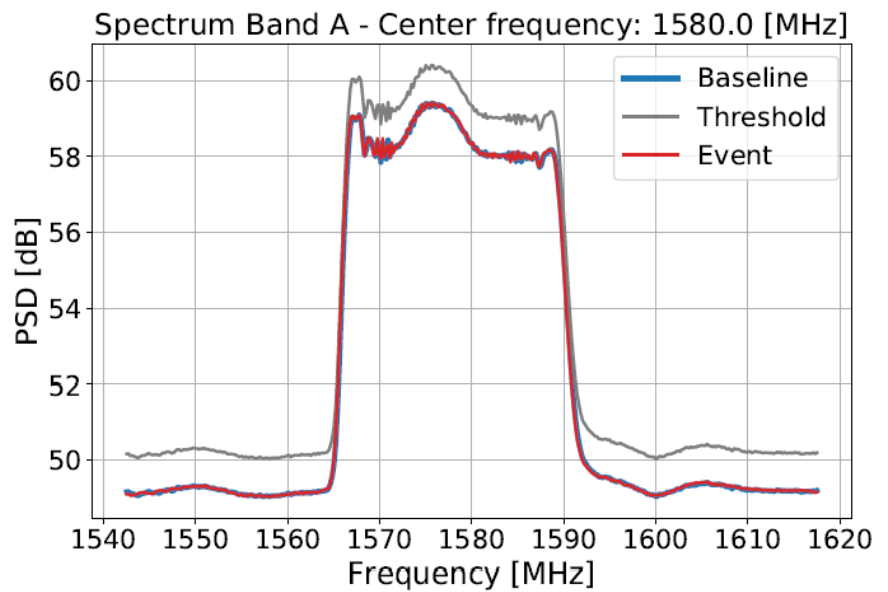
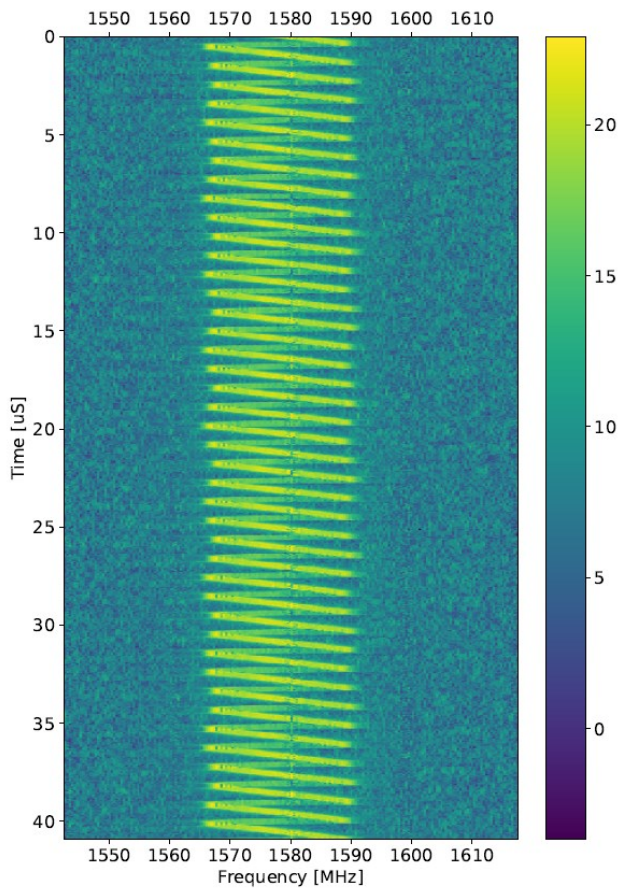
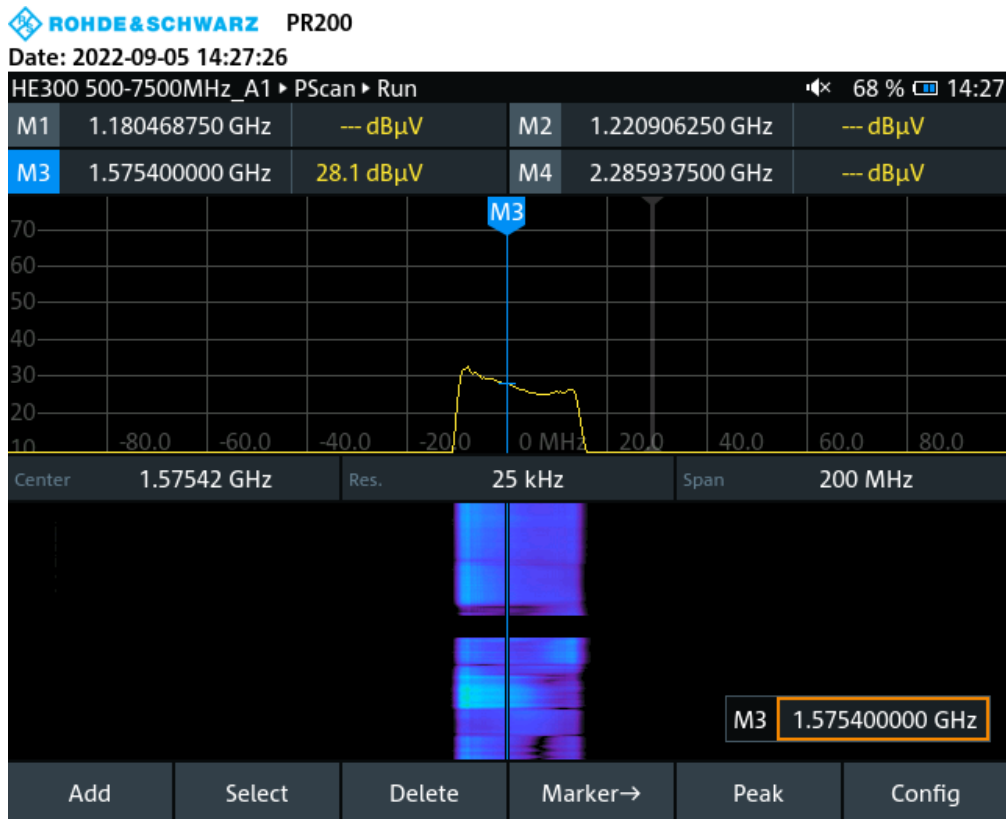


Jammer 10 - «Atle»

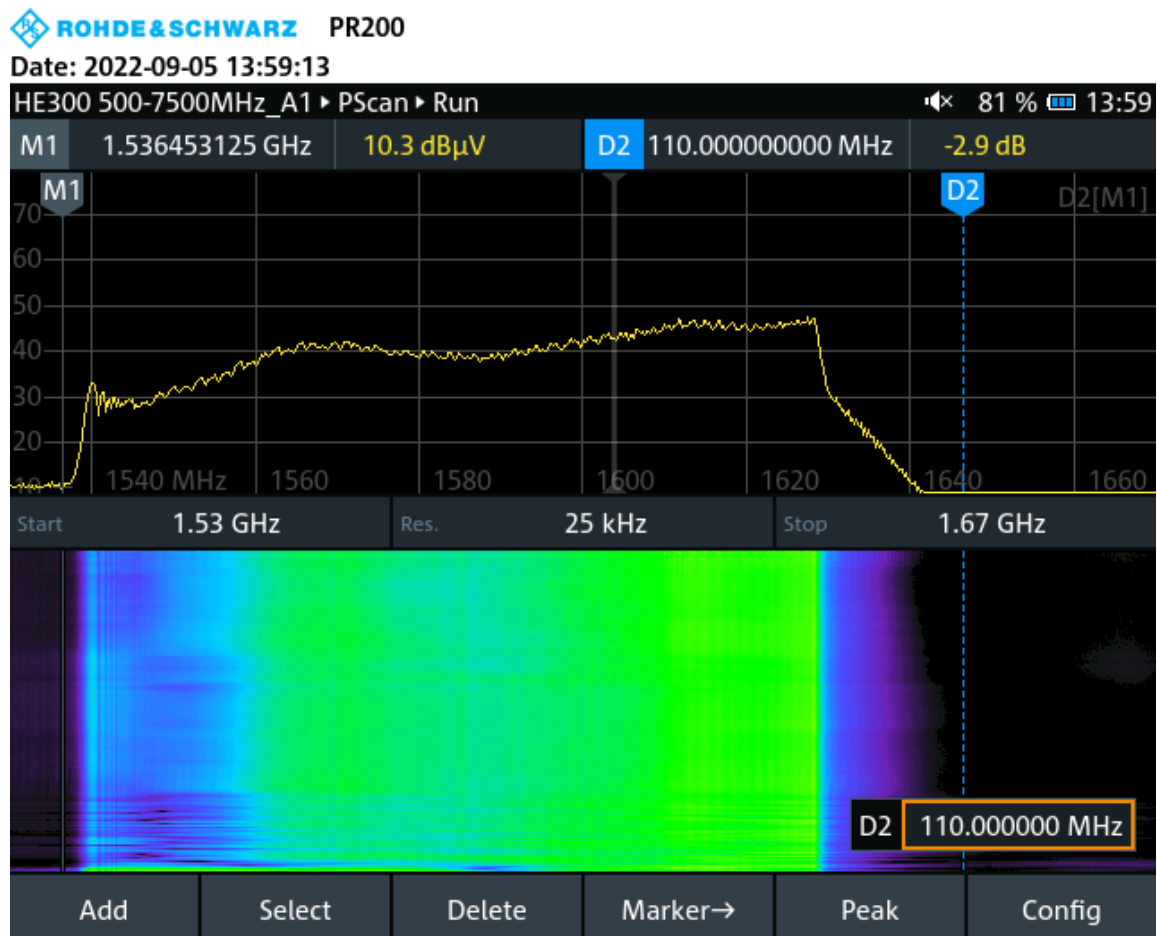
The antenna elector at the side of this jammer is not in synch with the antenna numbers, but inversed, see table below.



Antenna number	Switch number	Main freq. area
1	4	2.8 GHz
2	3	GPS L1
3	2	1.8 GHz
4	1	2.1 GHz



Jammer 11 - «A-1»



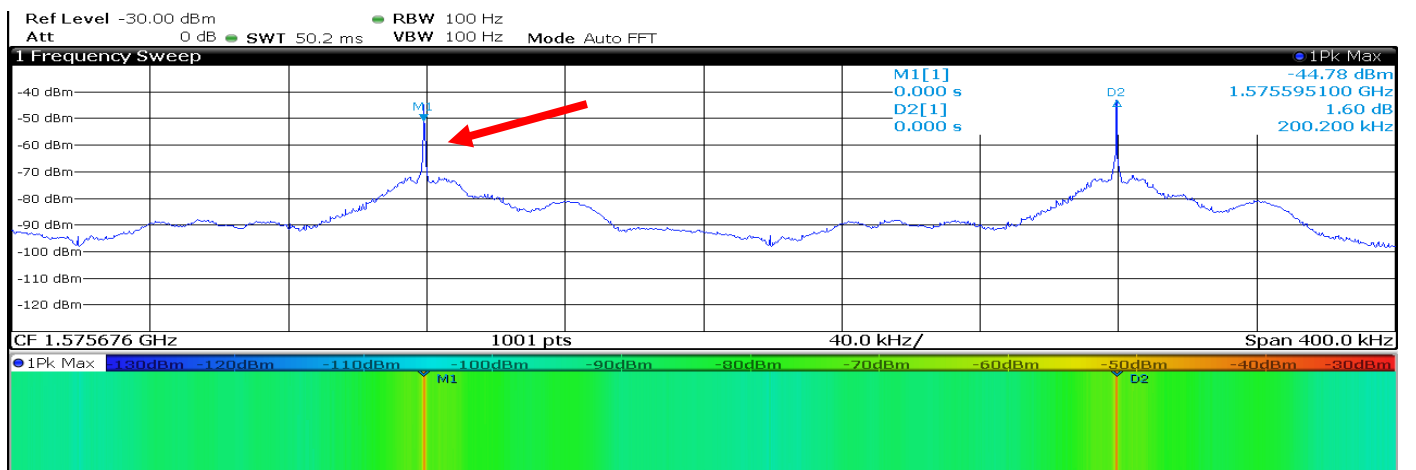
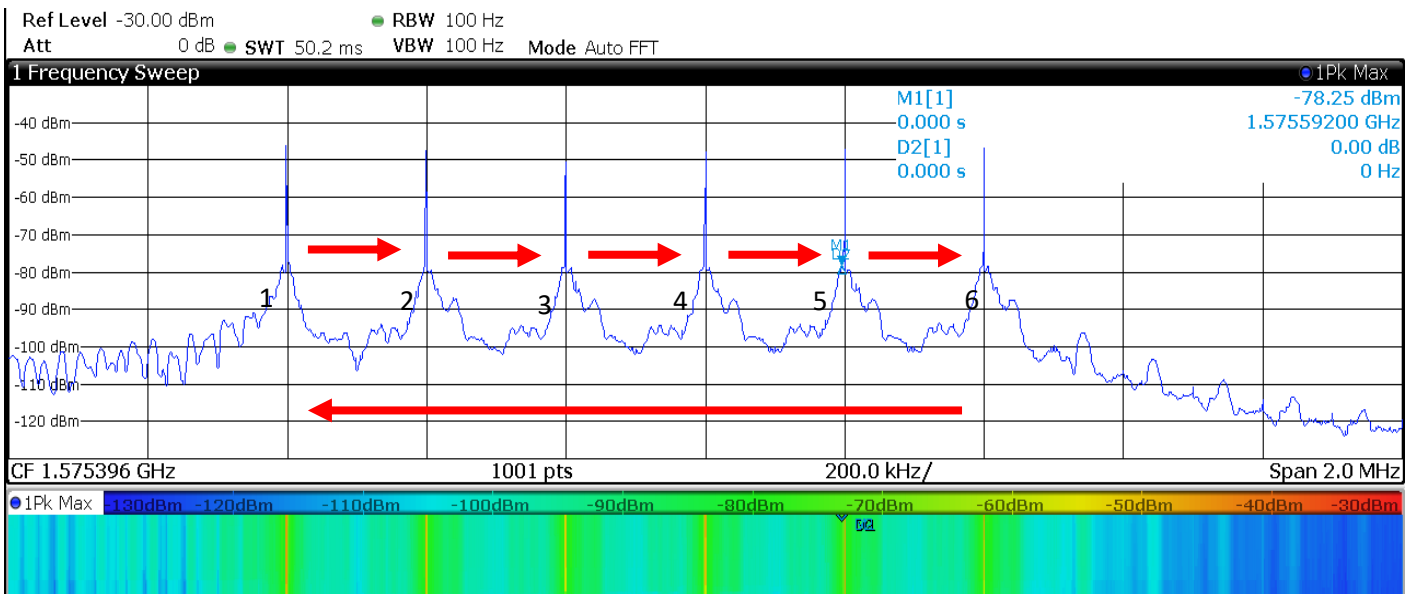
Jammer 12 - «Skipper»



Frequency-hopping jammer.

Signal form:

- Pulsed CW, signal duration of ~9ms~
- Every 50 ms, the CW-frequency is increased with ~200kHz
- After five increments, the CW-frequency is reduced with ~1000kHz (back to start)
 - Frequency #1 – 1574.62 MHz
 - Frequency #2 – 1574.82 MHz
 - Frequency #3 – 1575.02 MHz
 - Frequency #4 – 1574.62 MHz
 - Frequency #5 – 1574.62 MHz
 - Frequency #6 – 1574.62 MHz



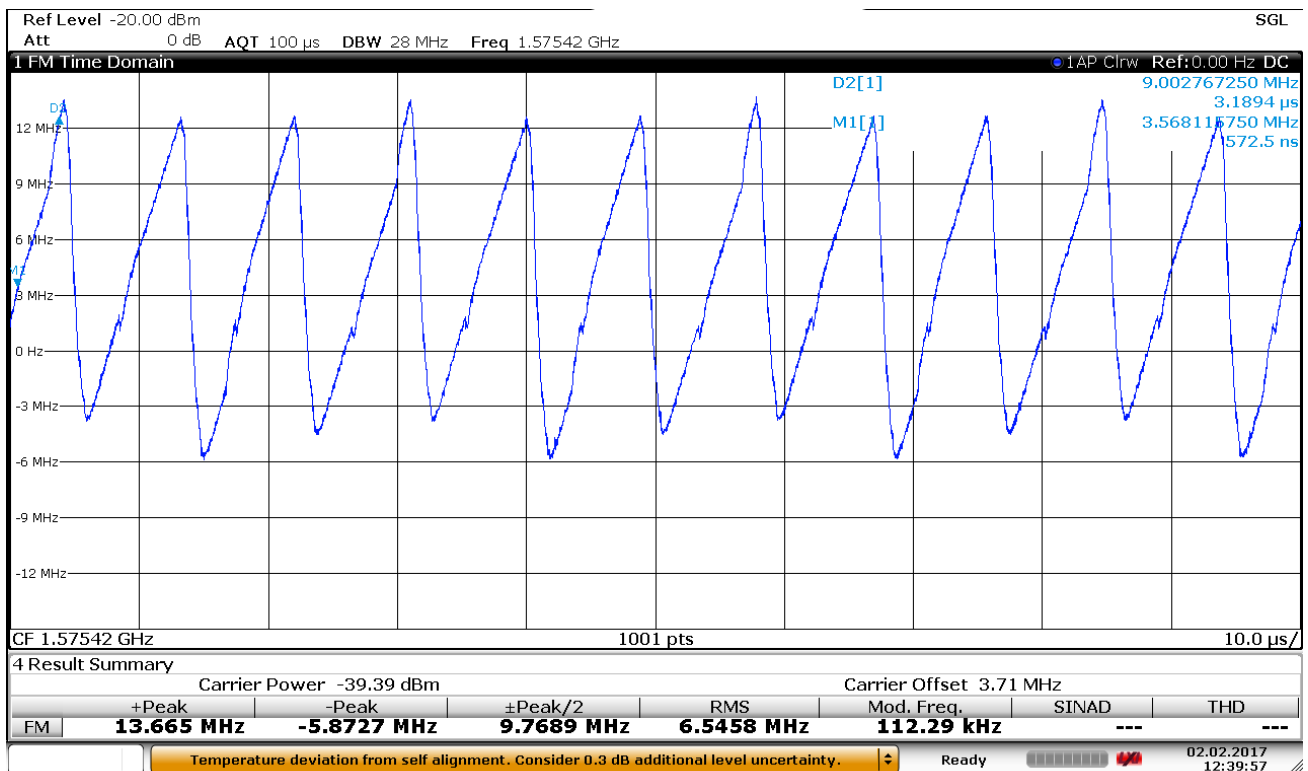
Jammer 13 – «China»



Frequency sweep details:

- Centre frequency at ~ 1575.42 MHz (L1)
- Signal width of ~ 20 MHz
- Period time ~ 9 μ s (112 kHz)
- Elevation time at ~ 7 μ s and return time at ~ 2 μ s

Equivalent frequency sweeps for L2 (1227.6 MHz).



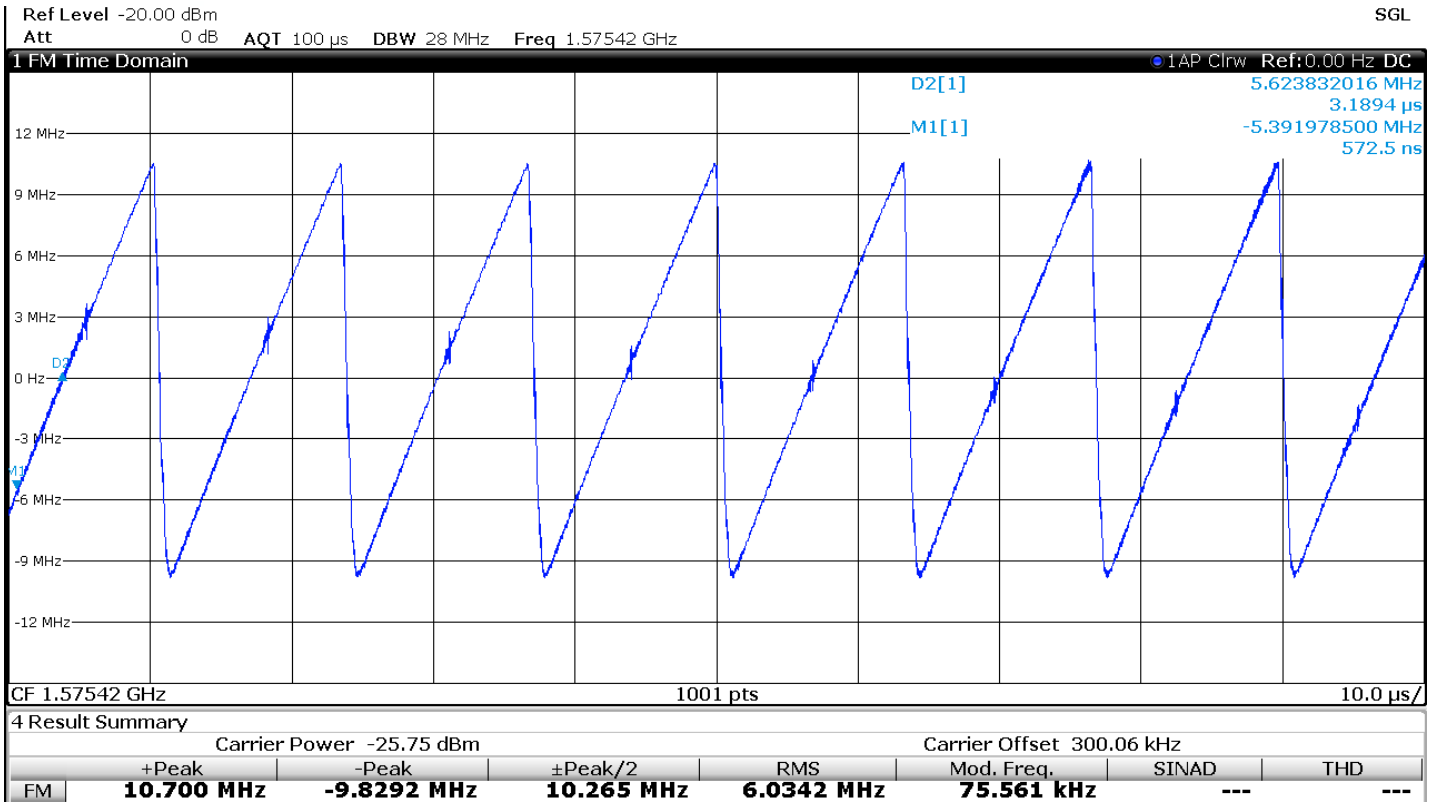
Jammer 14 – «Multi-china»



Frequency sweep details:

- Centre frequency at ~ 1575.42 MHz (L1)
- Signal width of ~20 MHz
- Period time ~13 μ s (75 kHz)
- Elevation time at ~12 μ s and return time at ~1 μ s

Equivalent frequency sweeps for L2 (1227.6 MHz) and L5 (1176.45 MHz).



Categorisation of jammers

Type of band	Jammer number
Single band jammers	<ul style="list-style-type: none"> • Jammer 1 • Jammer 2 • Jammer 3.1 & 3.2 • Jammer 6.1 & 6.2 • Jammer 7.1 & 7.2 • Jammer 8.1, 8.2, 8.3 & 8.4 • Jammer 10 • Jammer 11 • Jammer 12 • Jammer 13
Dual band jammers	<ul style="list-style-type: none"> • Jammer 4.1 & 4.2 • Jammer 5.1 & 5.2
Multi band jammers	<ul style="list-style-type: none"> • Jammer 9 • Jammer 14