

Chapter 1

Appendices

1.1 Appendix G - Technical details on jammer equipment

1.1.1 Introduction

The following section provides technical details on the jammer equipment used in the experiments. The jammers are categorized according to the following scheme:

1st Letter (Norwegian / English)	1St digit	2nd digit
S = Sigarett / Cigarette		
H = Håndholdt / Handheld		
U = USB / USB stick		
F = Fastmontert / Permanently installed (Fixed)	Number of antennas	# jammer within same category

Exempli gratia: S1.2, is a cigarette type jammer, that has 1 antenna, and is unit nr.2 in this category.

Additional information:

- Each chapter gives an overview of each jammer brought to Jammertest.
As far as possible, it gives information on
 - Centre frequency [MHz]
 - Bandwidth [MHz]
 - Power Spectral Density (PSD) [dBm/MHz] for the entire bandwidth
 - Total output power (TX total) [dBm] for the entire bandwidth
 - CF max [dBm] (maxhold power at the centre frequency)
 - Sweep rate [μ s] (if applicable)
 - Modulation
- Indicators such as “L1, L2, L5” etc. are used to indicate main bands of attack, used for convenience to distinguish between jammers’ modus operandi

- 2023 measurements

- Technical details on low power jammers given in this appendix are from uncalibrated measurements. They are rough estimates given for both the frequency and time domain. Power levels are not correctly displayed on the chart, because of external attenuators used during measurements with a signal analyser. There may also have been some constraints in the measurement device, causing fast frequency components to not be correctly displayed.

- 2024 measurements

- Measurements done with a R&S FSW. All measurements were performed connected directly to the jammers' antenna port, with the other antennas disconnected and (if applicable) DIP switches for the other antenna ports disabled. Powe levels etc. should be as close to reality as possible for output power at the antenna port.
- Throughout the measurements, bandwidth is defined as 3 dB from local (identifiable) maxima along the maxhold's descent.
- TX power is measured within said bandwidth. Note that TX total is measured over the entire bandwidth, so that peak output power is not equal to TX total.

1.1.2 Technical details on low-power jammer 'S1.1'



The jammer S1.1 belongs to the 'Cigarette jammer' category of jammers. Such jammers are often installed in the cigarette lighter outlet in cars. They are intended to cover the car, and a given radius around the car.

S1.1 is an one-antenna, so-called 'L1-only', jammer, disrupting only the upper L-band.

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Centre frequency [MHz]	Bandwidth [MHz]	PSD [dBm/MHz]	TX total [dBm]	CF max [dBm]	Sweep rate [μs]	Modulation
1577.40	29.96	7.58	22.34	7.89	37.1	Sawtooth

Table 1.1: Technical characteristics of S1.1 jammer

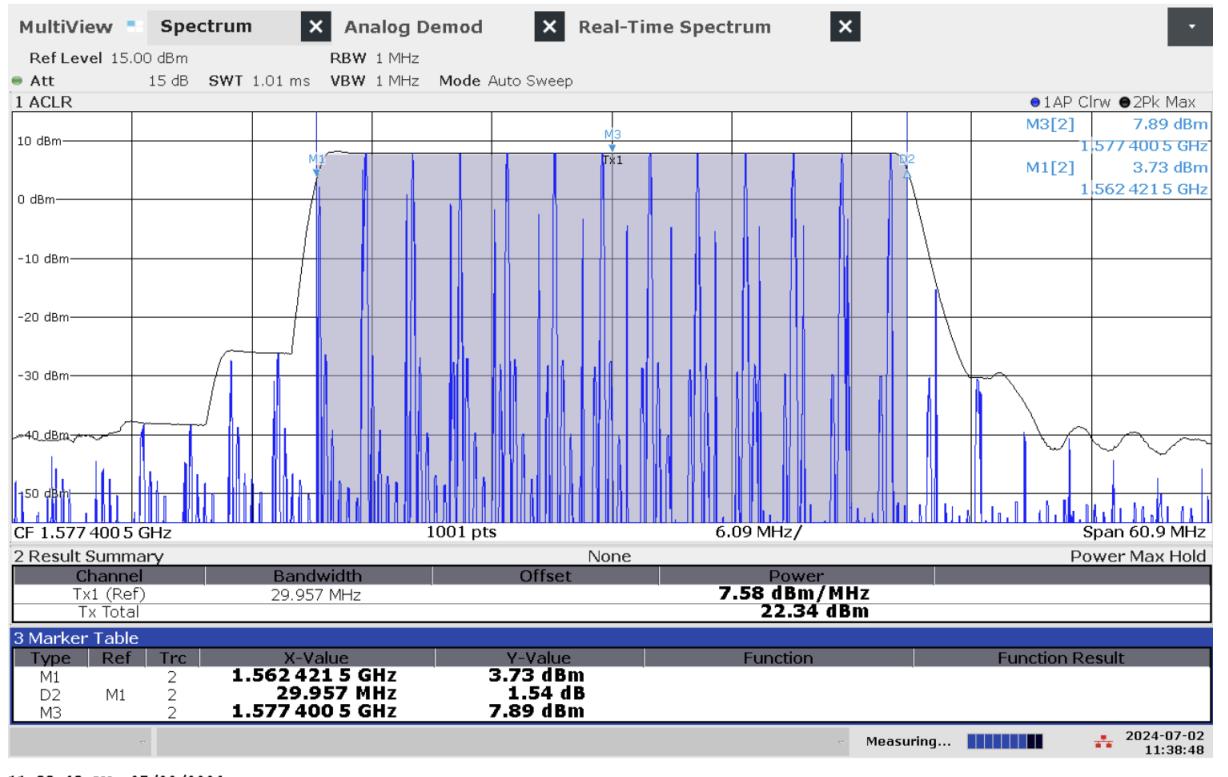


Figure 1.1: Frequency and power measurement of jammer S1.1

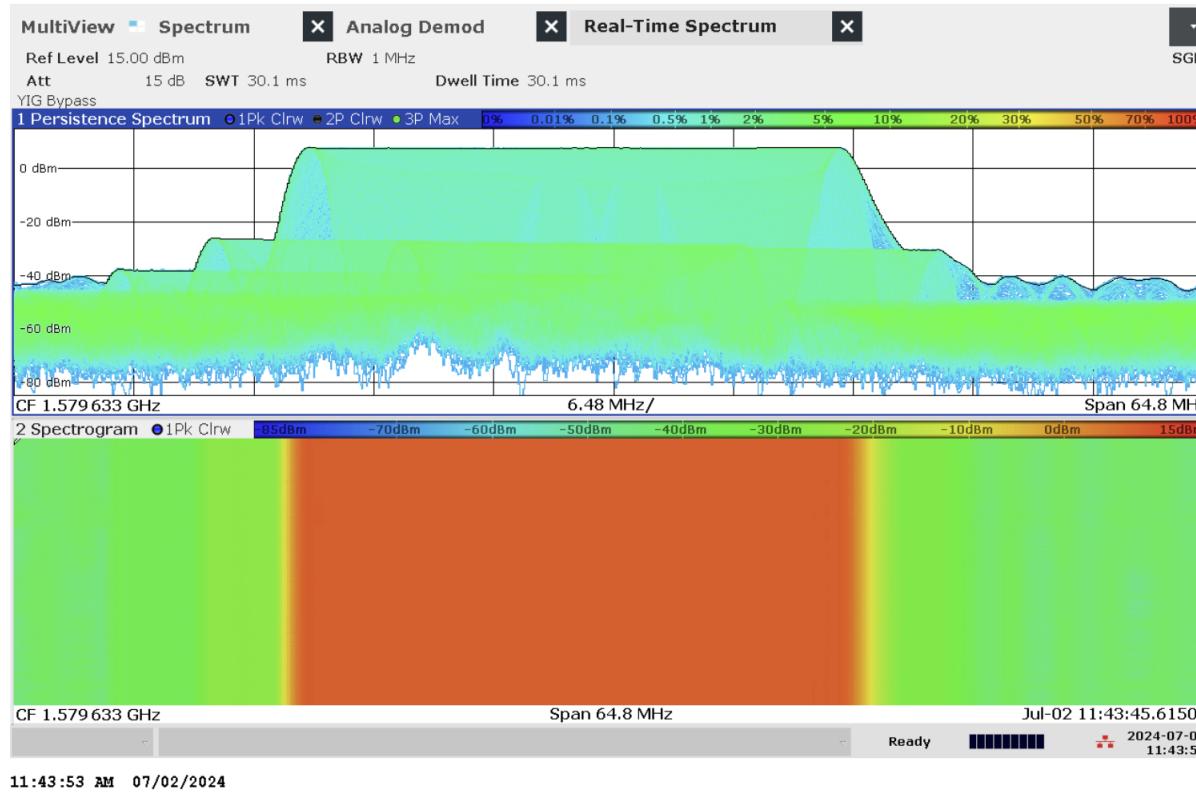


Figure 1.2: Real-time persistence and spectrogram measurement of jammer S1.1

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Figure 1.3: Time domain (analog demod) measurement of jammer S1.1

1.1.3 Technical details on low-power jammer 'S1.2'



The jammer S1.2 belongs to the 'Cigarette jammer' category of jammers. Such jammers are often installed in the cigarette lighter outlet in cars. They are

intended to cover the car, and a given radius around the car.

S1.2 is an one-antenna, so-called 'L1-only', jammer, disrupting only the upper L-band.

Centre frequency [MHz]	Bandwidth [MHz]	PSD [dBm/MHz]	TX total [dBm]	CF max [dBm]	Sweep rate [μs]	Modulation
1582.56	40.03	12.38	29.01	12.61	21.56	Sawtooth

Table 1.2: Technical characteristics of S1.2 jammer

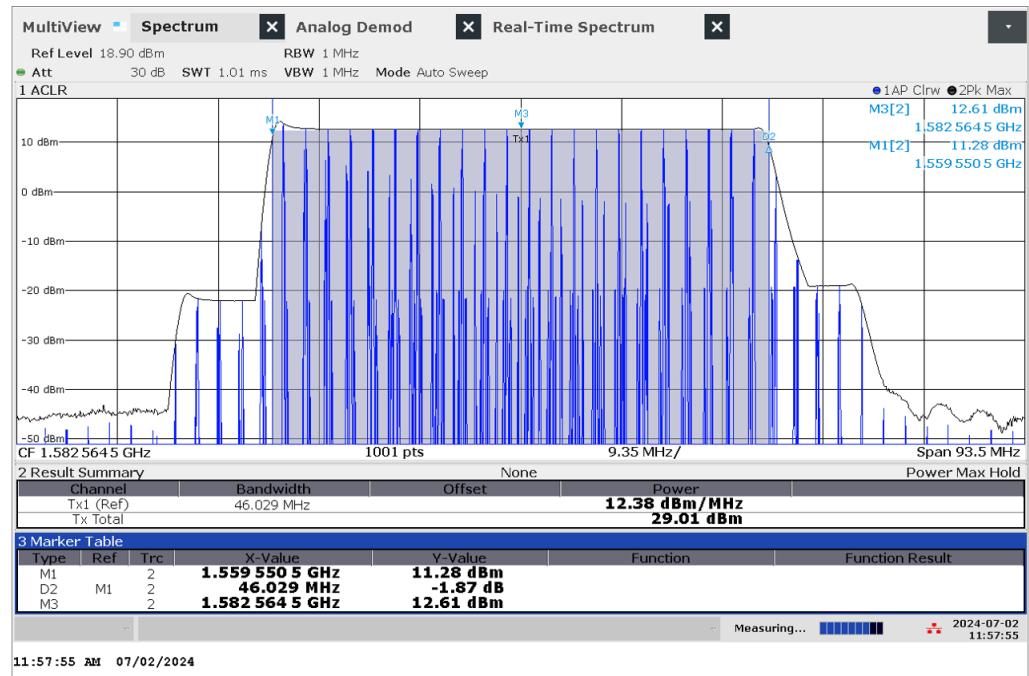


Figure 1.4: Frequency and power measurement of jammer S1.2

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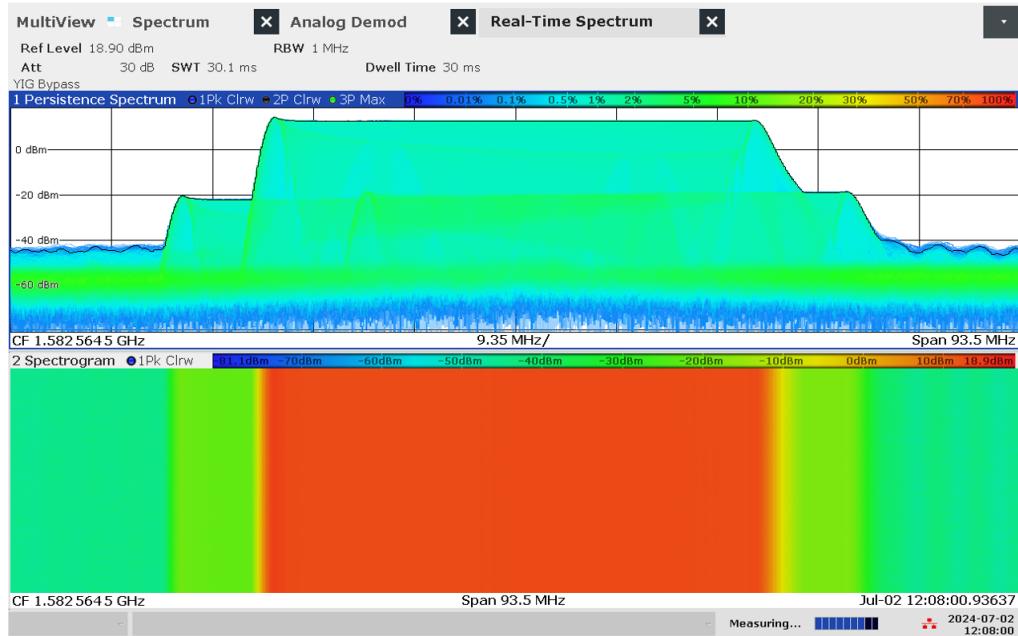


Figure 1.5: Real-time persistence and spectrogram measurement of jammer S1.2



Figure 1.6: Time domain (analog demod) measurement of jammer S1.2

1.1.4 Technical details on low-power jammer 'S1.3'



The jammer S1.3 belongs to the 'Cigarette jammer' category of jammers. Such jammers are often installed in the cigarette lighter outlet in cars. They are intended to cover the car, and a given radius around the car. S1.3 is an one-antenna, so-called 'L1-only', jammer, disrupting only the upper L-band.

Centre frequency [MHz]	Bandwidth [MHz]	PSD [dBm/MHz]	TX total [dBm]	CF max [dBm]	Sweep rate [μs]	Modulation
1579.63	31.88	7.56	22.60	7.93	37.5	Sawtooth

Table 1.3: Technical characteristics of S1.3 jammer

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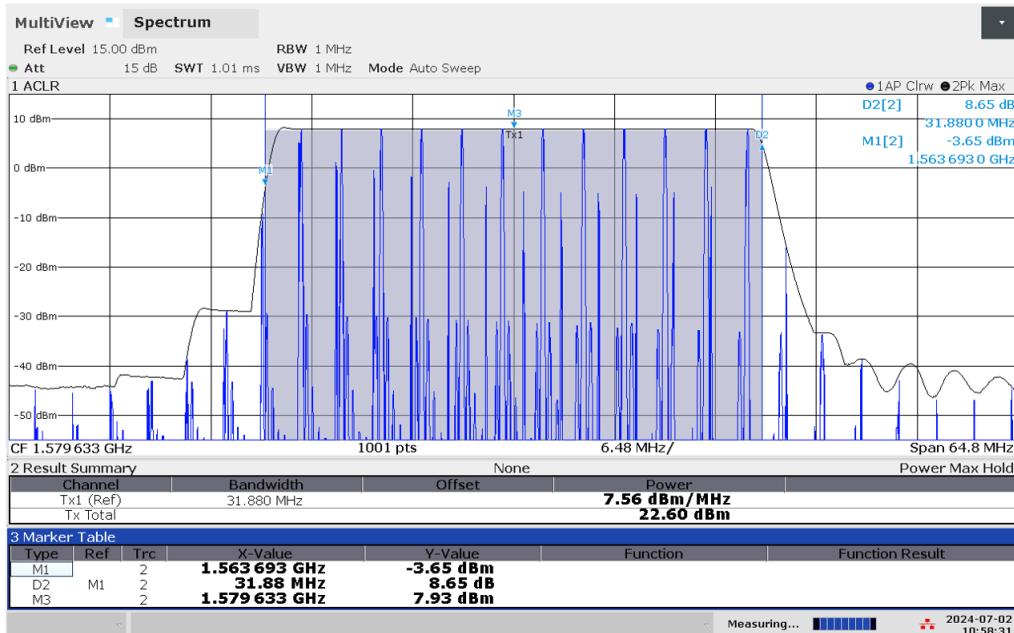


Figure 1.7: Frequency and power measurement of jammer S1.3

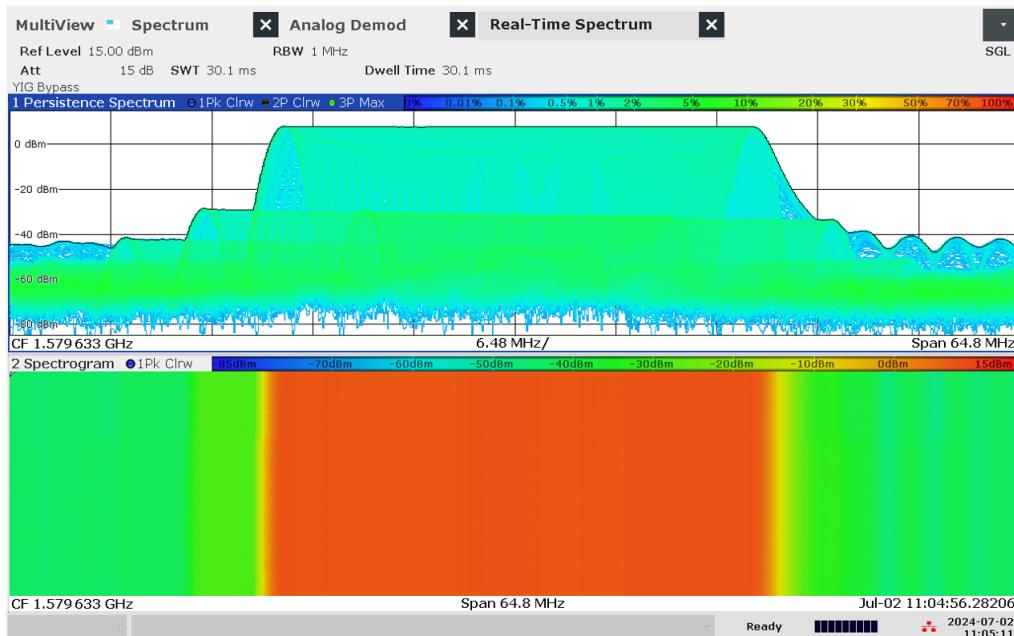


Figure 1.8: Real-time persistence and spectrogram measurement of jammer S1.3



Figure 1.9: Time domain (analog demod) measurement of jammer S1.3

1.1.5 Technical details on low-power jammer 'S2.1'



The jammer S2.1 belongs to the 'Cigarette jammer' category of jammers. Such jammers are often installed in the cigarette lighter outlet in cars. They are intended to cover the car, and a given radius around the car. S2.1 is a two-antenna, so-called 'L1+L2', jammer, disrupting both the upper and lower L-band.

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Antenna	Centre frequency [MHz]	Bandwidth [MHz]	PSD [dBm/MHz]	TX total [dBm]	CF max [dBm]	Sweep rate [μs]	Modulation
L1	1581.59	85.41	13.36	32.68	16.64	40.63	Sawtooth+burst
L2	1198.05	96.58	13.92	33.75	17.30	42.1	Sawtooth+burst

Table 1.4: Technical characteristics of S2.1 jammer

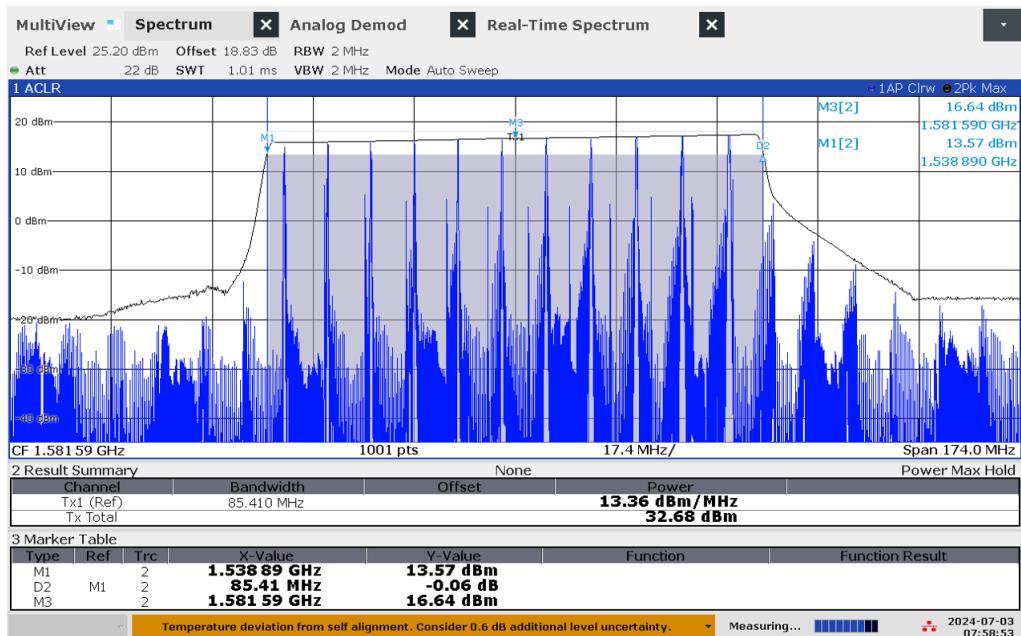


Figure 1.10: Frequency and power measurement of jammer S2.1 on antenna 'L1'

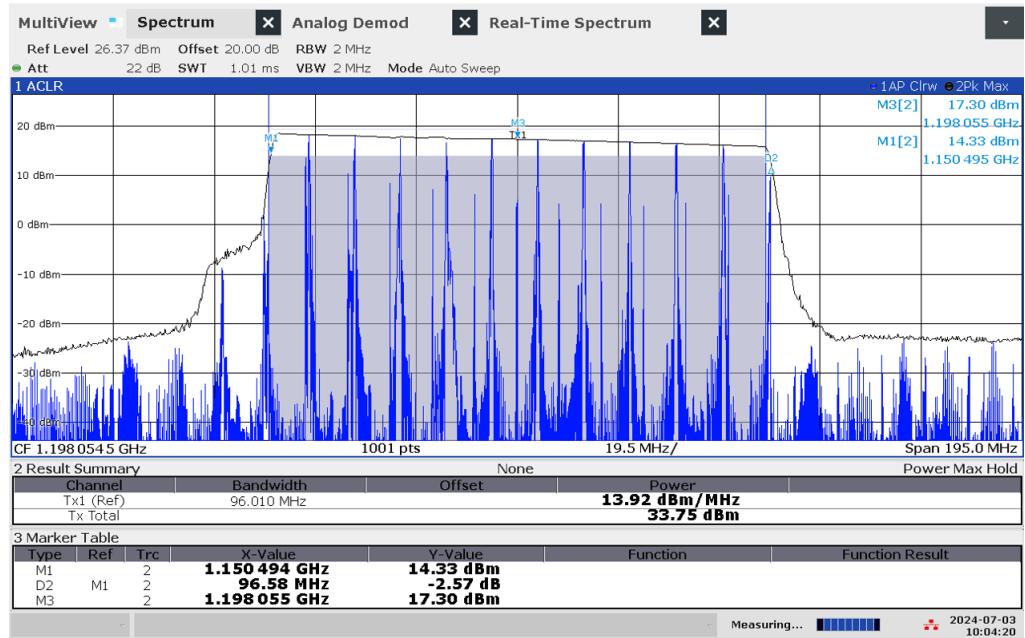


Figure 1.11: Frequency and power measurement of jammer S2.1 on antenna 'L2'



Figure 1.12: Real-time persistence and spectrogram measurement of jammer S2.1 on antenna 'L1'

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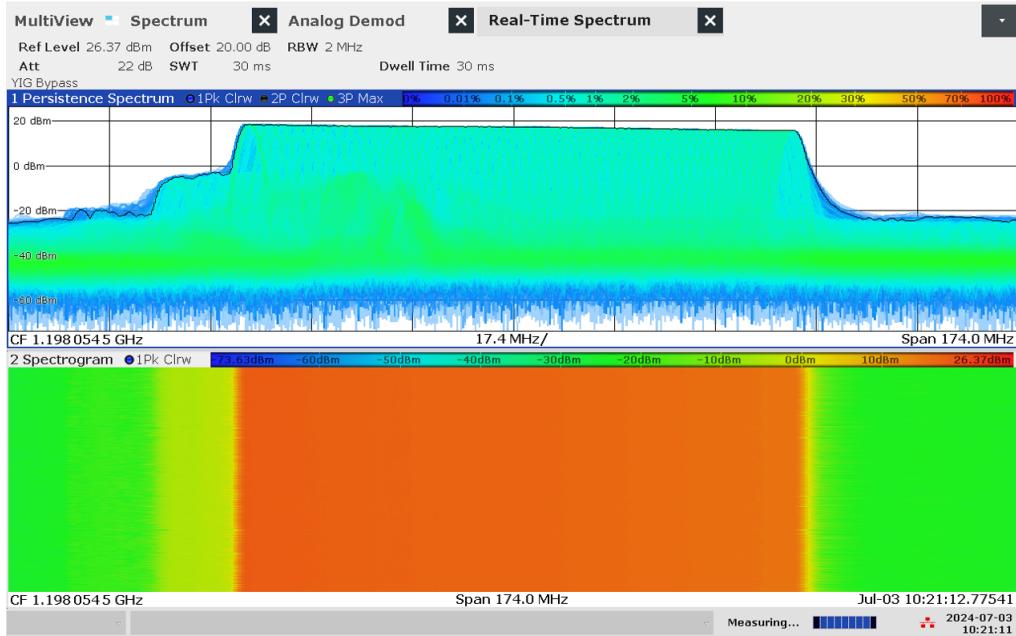


Figure 1.13: Real-time persistence and spectrogram measurement of jammer S2.1 on antenna 'L2'

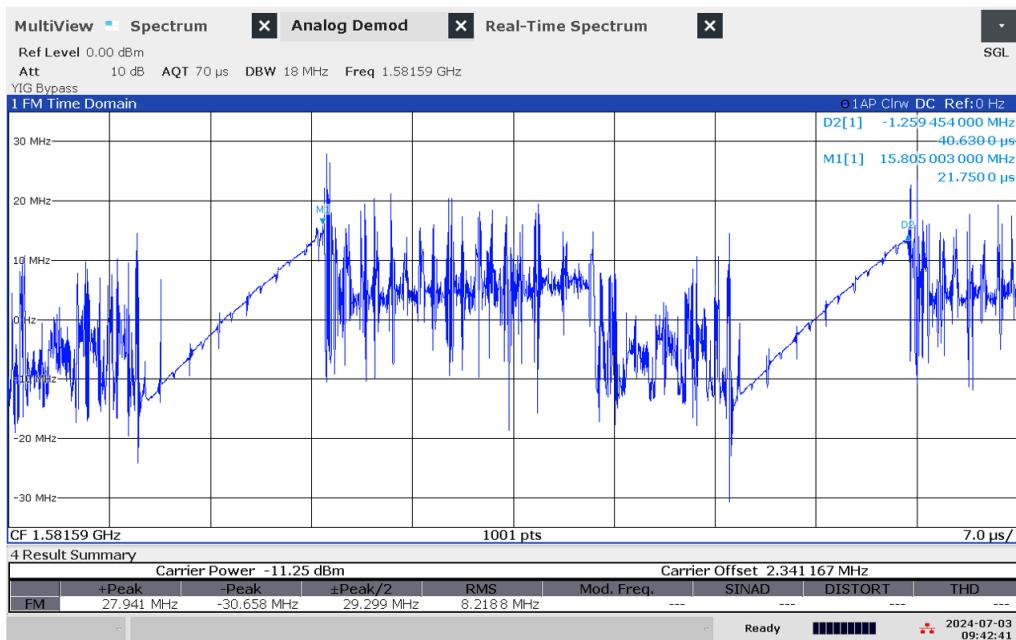


Figure 1.14: Time domain (analog demod) measurement of jammer S2.1 on antenna 'L1'

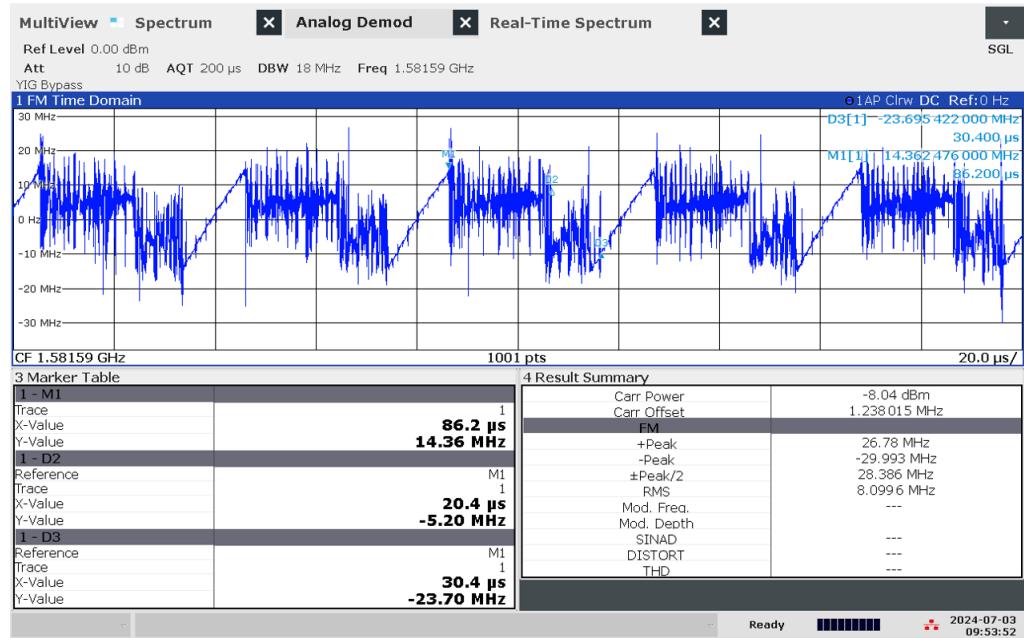


Figure 1.15: Time domain (analog demod) measurement with wider span of jammer S2.1 on antenna 'L1'

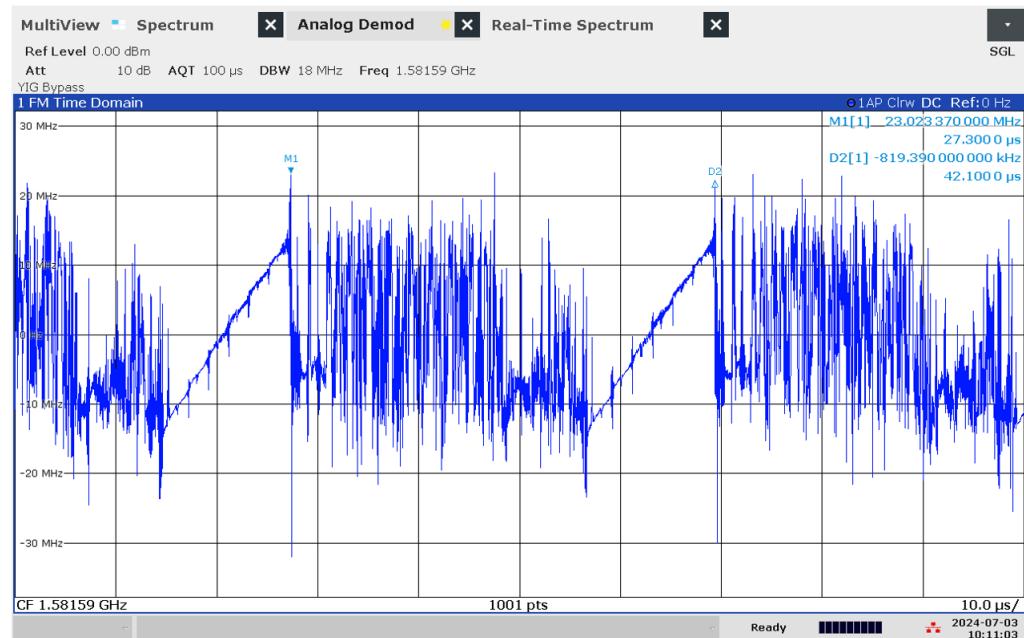


Figure 1.16: Time domain (analog demod) measurement of jammer S2.1 on antenna 'L2'

1.1.6 Technical details on low-power jammer 'S2.2'



The jammer S2.2 belongs to the 'Cigarette jammer' category of jammers. Such jammers are often installed in the cigarette lighter outlet in cars. They are intended to cover the car, and a given radius around the car.

S2.2 is a two-antenna, so-called 'L1+L2', jammer, disrupting both the upper and lower L-band.

Antenna	Centre frequency [MHz]	Bandwidth [MHz]	PSD [dBm/MHz]	TX total [dBm]	CF max [dBm]	Sweep rate [μs]	Modulation
L1	1580.86	87.69	12.82	32.25	16.17	40.7	Sawtooth+burst
L2	1207.55	102.04	11.95	32.04	17.02	41.0	Sawtooth+burst

Table 1.5: Technical characteristics of S2.2 jammer

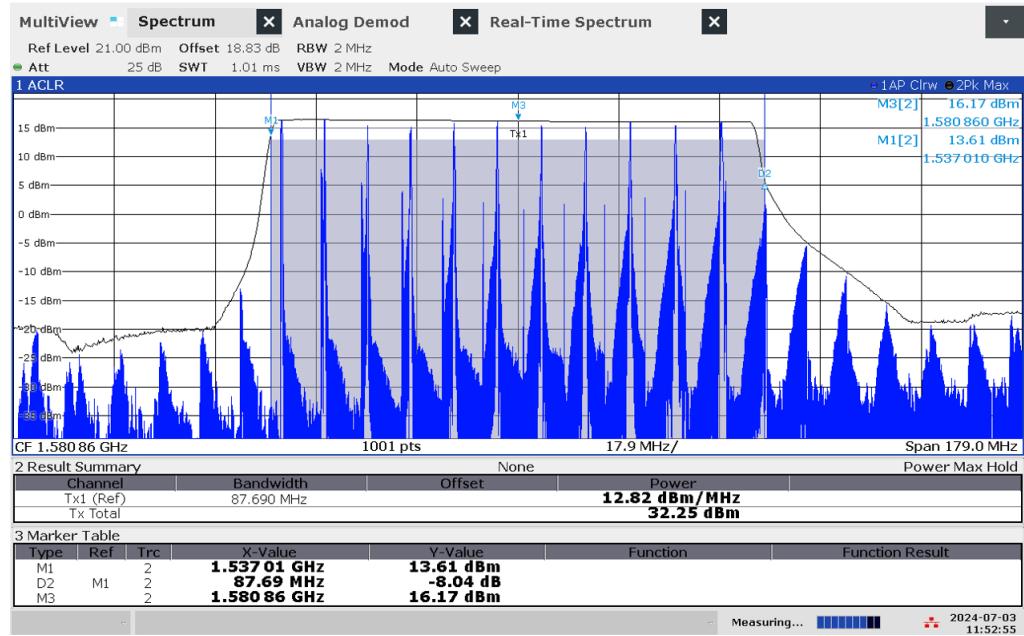


Figure 1.17: Frequency and power measurement of jammer S2.2 on antenna 'L1'

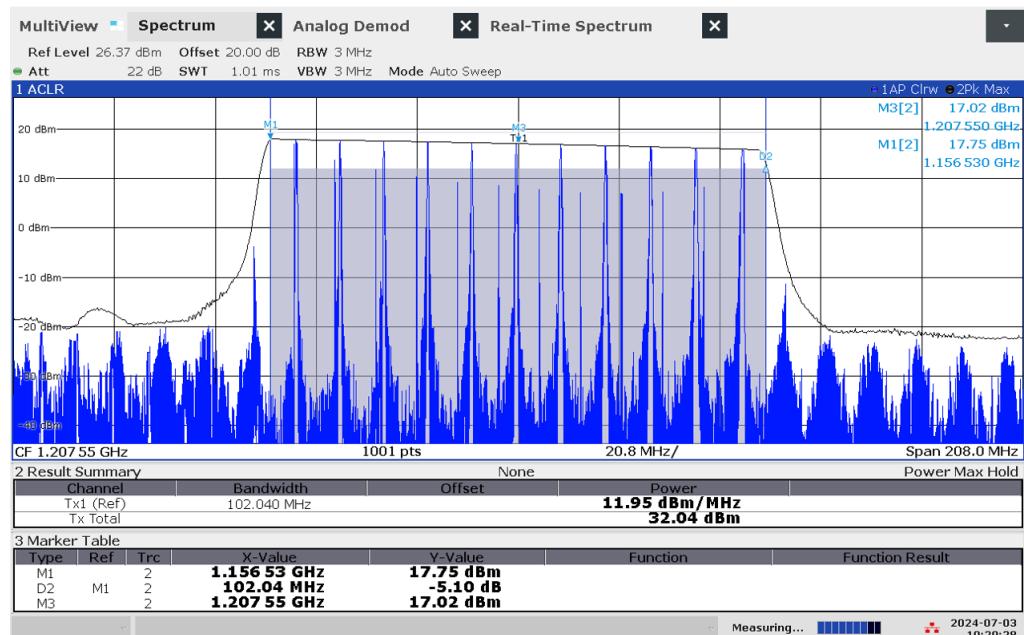


Figure 1.18: Frequency and power measurement of jammer S2.2 on antenna 'L2'

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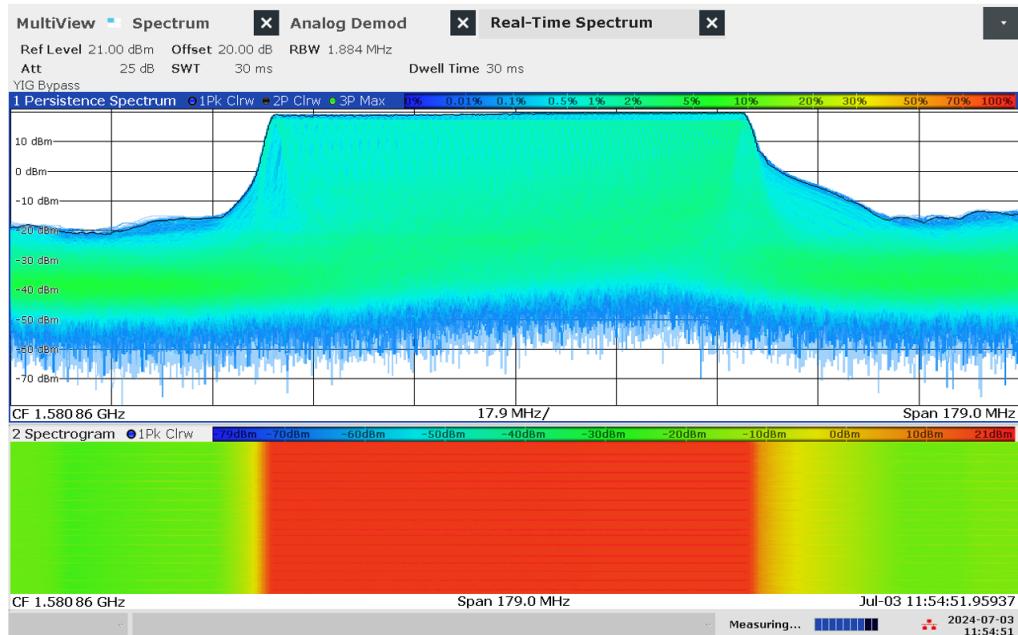


Figure 1.19: Real-time persistence and spectrogram measurement of jammer S2.2 on antenna 'L1'

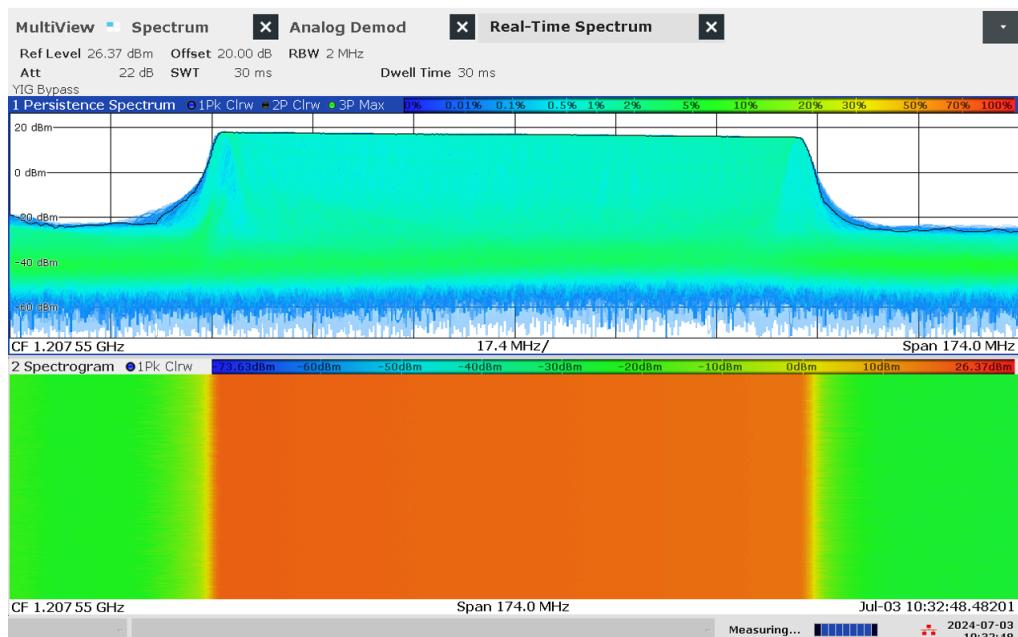


Figure 1.20: Real-time persistence and spectrogram measurement of jammer S2.2 on antenna 'L2'

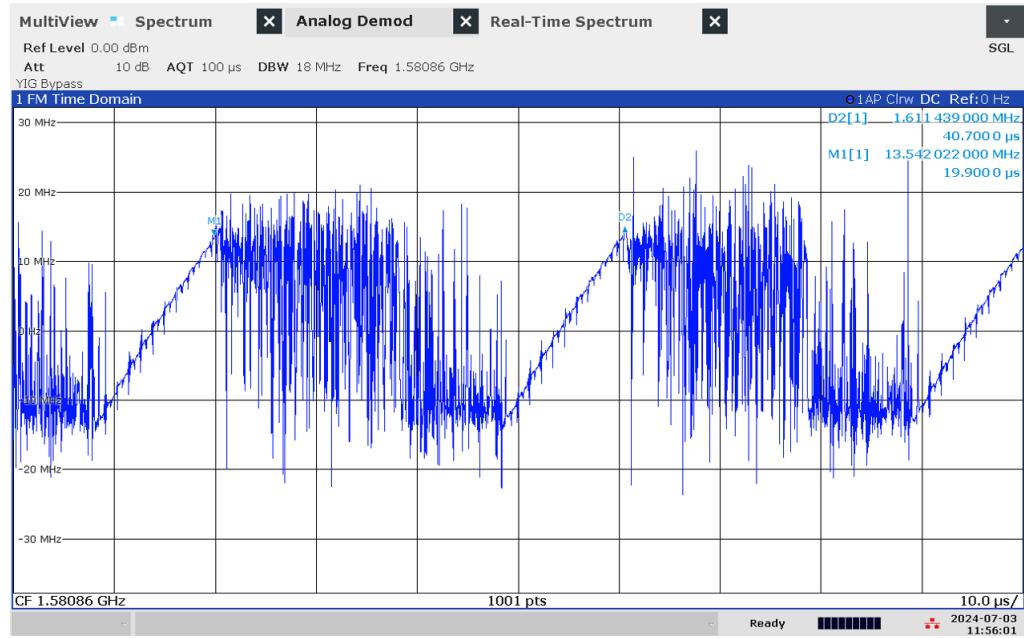


Figure 1.21: Time domain (analog demod) measurement of jammer S2.2 on antenna 'L1'

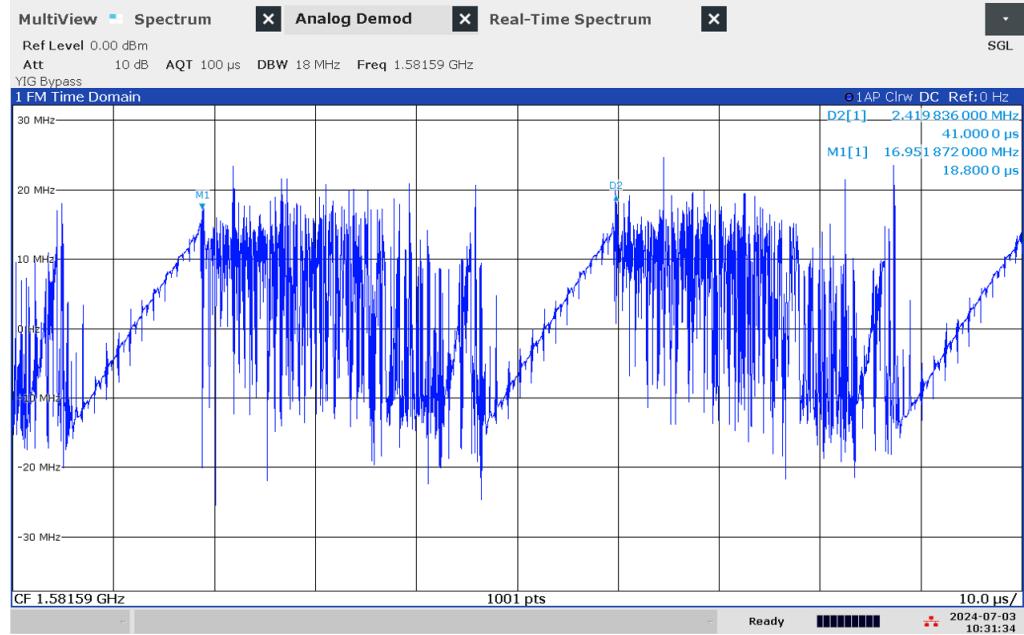


Figure 1.22: Time domain (analog demod) measurement of jammer S2.2 on antenna 'L2'