

# Test Report

HELEM2409000308-1 v1.1



## INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 90 AND ISED CANADA REQUIREMENTS

Equipment Under Test: Radio modem module

Model: SATEL-TR4+

Manufacturer: Satel Oy  
P.O. Box 142 (Meriniitynkatu 17)  
FI-24101, SALO  
FINLAND

Customer: Satel Oy  
P.O. Box 142 (Meriniitynkatu 17)  
FI-24101, SALO  
FINLAND

FCC Rule Part: 90: October 2019  
IC Rule Part: RSS-119, Issue 12, May 2015  
KDB: 971168 D01 Power Meas License Digital Systems v03r01  
Measurement Guidance for Certification of Licensed Digital Transmitters  
(April 9, 2018)

- *Partial testing; see Test Suite for details*

Date: 24 March 2025

Issued by:

A handwritten signature in blue ink, appearing to read 'Rauno Repo'.

Rauno Repo  
Senior EMC Specialist

Date: 24 March 2025

Checked by:

A handwritten signature in blue ink, appearing to read 'Henri Mäki'.

Henri Mäki  
Testing Engineer

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## **GENERAL REMARKS**

### **Disclaimer**

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*Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.*

**RELEASE HISTORY**

Version	Changes	Issued
1.0	Initial release	11 October 2024
1.1	Maximum value of the input voltage fixed	24 March 2025

**PRODUCT DESCRIPTION****Equipment Under Test**

Equipment Under Test: Radio modem module  
Model: SATEL-TR4+  
Type: SATEL-TA40  
Trademark: Satel  
Serial no: 2432000457 (radiated measurements)  
2432000456 (conducted measurements)  
FCC ID: MRBSATEL-TA40  
IC: 2422A-SATELA40

**General Description**

SATEL-TR4+ is a radio modem module. It uses 400 MHz frequency band.

**Classification**

Fixed device	<input checked="" type="checkbox"/>
Mobile Device (Human body distance > 20cm)	<input checked="" type="checkbox"/>
Portable Device (Human body distance < 20cm)	<input type="checkbox"/>

**Modifications Incorporated in the EUT**

No modifications.

**Specifications**

Frequency: 410-430 MHz and 450-470 MHz  
Channel width: 12.5 kHz, 25 kHz  
Channel spacing: 12.5 kHz, 25 kHz  
Modulation: 4FSK, 8FSK, 16FSK, GMSK  
Rated power: 10 mW ... 1000 mW  
Antenna type: External, 50Ω TNC (female) connector

**Power Supply**

Operating voltage range: 3.8 – 5.5 VDC

**Mechanical Size of the EUT**

Height: 6 mm      Width: 35 mm      Length: 56 mm

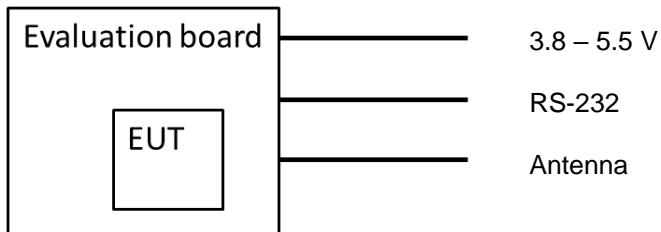
**SUMMARY OF TESTING**

Test Specification	Description of Test	Result
§90.205 / RSS-119 5.4	Transmitter output power	<b>PASS</b>
§90.210 / RSS-119 5.5	Occupied bandwidth	<b>N/T</b>
§90.210 / RSS-119 5.5	Spectrum emission mask	<b>N/T</b>
§90.210 / RSS-119 5.8	Spurious emissions (conducted)	<b>PASS</b>
§90.210 / RSS-119 5.8	Spurious emissions (radiated)	<b>PASS</b>
§90.213 / RSS-119 5.3	Frequency stability	<b>N/T</b>
§90.214 / RSS-119 5.9	Transient frequency behaviour	<b>N/T</b>

*The decision rule applied for the tests results stated in this test report is according to the requirements of section 1.3 of ANSI C63.26-2015.*

**EUT Test Conditions**

The EUT was in continuous transmit mode during all the tests. The EUT was configured into the wanted channel using software provided by the manufacturer. During the tests the EUT was mounted on an evaluation kit provided by the manufacturer (model M3-TR3 Evaluation kit).



**Figure 1:** Test setup block diagram

**Table 1:** Transmission modes of the EUT

Channel width (kHz)	Modulation
12.5	4FSK
	8FSK
	16FSK
	GMSK
25	4FSK
	8FSK
	16FSK
	GMSK

**Table 2:** Test frequencies used in the tests

Channel	Frequency (MHz)
LOW	410.0
MID 1	429.5
MID 2	450.5
HIGH	469.5

## Test Facility

Testing Laboratory / address: FCC designation number: <b>F10002</b> ISED CAB identifier: <b>T004</b>	SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND
Test Site:	<input type="checkbox"/> K10LAB, ISED Canada registration number: <b>8708A-1</b> <input checked="" type="checkbox"/> K5LAB, ISED Canada registration number: <b>8708A-2</b> <input type="checkbox"/> T10LAB

**TEST RESULTS****Transmitter output power**

<b>Standard:</b>	ANSI C63.26 (2015)
<b>Tested by:</b>	RRE
<b>Date:</b>	26 September 2024
<b>Temperature:</b>	23 ± 3°C
<b>Humidity:</b>	20 - 60 % RH
<b>Measurement uncertainty:</b>	± 0.470 dB
<b>Test result:</b>	<b>PASS</b>

**FCC Rule: 90.205****RSS-119 5.4**

The output power shall be within ±1 dB of the manufacturer's rated power listed in the equipment specifications.

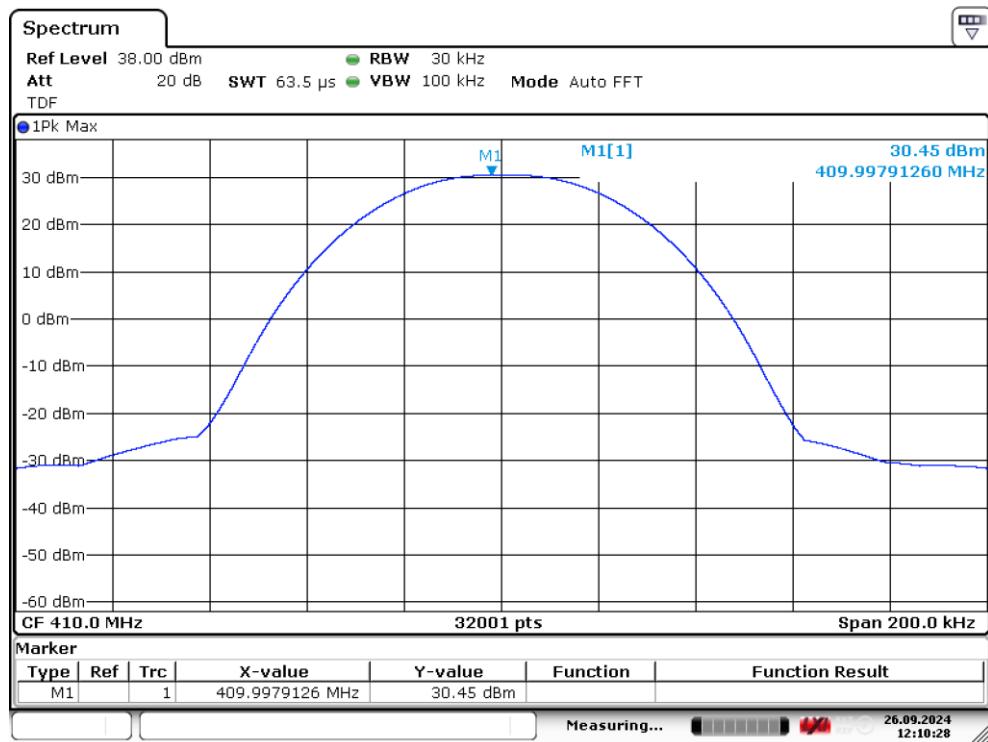
The test was performed only at maximum power level, and with a spectrum analyser with the following settings:

Span: 200 kHz  
RBW: 30 kHz  
VBW: 100 kHz  
Sweep points: 32001  
Sweep time: Auto  
Detector: Positive Peak

**Test results****Table 3.** Rated output power 1000 mW (30 dBm)

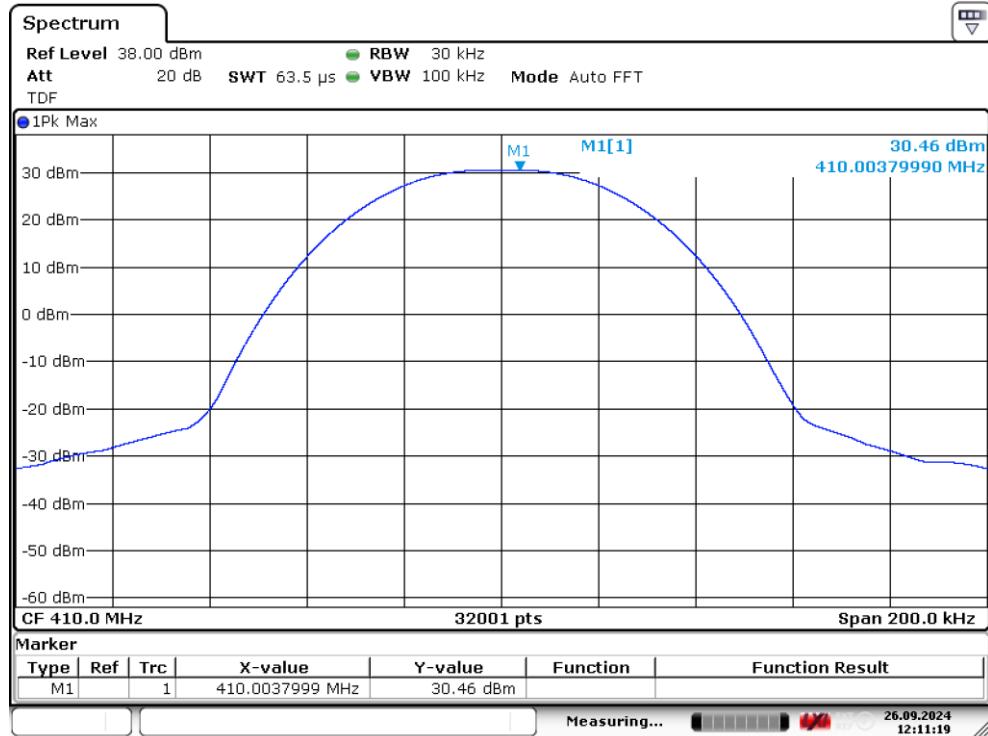
Frequency (MHz)	Ch. Spacing (kHz)	Modulation	Measured Output Power (dBm)	Result
410.0	12.5	4FSK	30.42	PASS
410.0	12.5	8FSK	30.37	PASS
410.0	12.5	16FSK	30.43	PASS
410.0	12.5	GMSK	30.45	PASS
410.0	25	4FSK	30.43	PASS
410.0	25	8FSK	30.39	PASS
410.0	25	16FSK	30.43	PASS
410.0	25	GMSK	30.46	PASS
429.5	12.5	4FSK	29.94	PASS
429.5	12.5	8FSK	29.90	PASS
429.5	12.5	16FSK	29.94	PASS
429.5	12.5	GMSK	29.96	PASS
429.5	25	4FSK	29.94	PASS
429.5	25	8FSK	29.94	PASS
429.5	25	16FSK	29.94	PASS
429.5	25	GMSK	29.96	PASS
450.5	12.5	4FSK	29.66	PASS
450.5	12.5	8FSK	29.65	PASS
450.5	12.5	16FSK	29.66	PASS
450.5	12.5	GMSK	29.68	PASS
450.5	25	4FSK	29.67	PASS
450.5	25	8FSK	29.67	PASS
450.5	25	16FSK	29.68	PASS
450.5	25	GMSK	29.68	PASS
469.5	12.5	4FSK	29.04	PASS
469.5	12.5	8FSK	29.03	PASS
469.5	12.5	16FSK	29.04	PASS
469.5	12.5	GMSK	29.05	PASS
469.5	25	4FSK	29.47	PASS
469.5	25	8FSK	29.05	PASS
469.5	25	16FSK	29.03	PASS
469.5	25	GMSK	29.05	PASS

## Transmitter output power



Date: 26.SEP.2024 12:10:28

Figure 2: 410 MHz, GMSK, 12.5 kHz



Date: 26.SEP.2024 12:11:20

Figure 3: 410 MHz, GMSK, 25 kHz

**Spurious emissions (conducted) 9 kHz – 5 GHz****Spurious emissions (conducted) 9 kHz – 5 GHz**

<b>Standard:</b>	ANSI C63.26 (2015)	
<b>Tested by:</b>	RRE	RRE
<b>Date:</b>	26 September 2024	27 September 2024
<b>Temperature:</b>	23 ± 3°C	
<b>Humidity:</b>	20 - 60 % RH	
<b>Measurement uncertainty:</b>	± 2.90 dB	Level of confidence 95.45 % (k = 2)
<b>Test result:</b>	<b>PASS</b>	

**FCC Rule: 90.210****RSS-119 5.8**

For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows: on any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth; at least  $43 + 10 \log (P)$  dB.

For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows: on any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz: at least  $50 + 10 \log (P)$  or 70 dB, whichever is the lesser attenuation.

Frequency Band (MHz)	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Limit (dBm)
406.1-430 and 450-470	12.5	11.25	-20
	25	20	-13

The test was performed at maximum power level, and with a spectrum analyser with following settings:

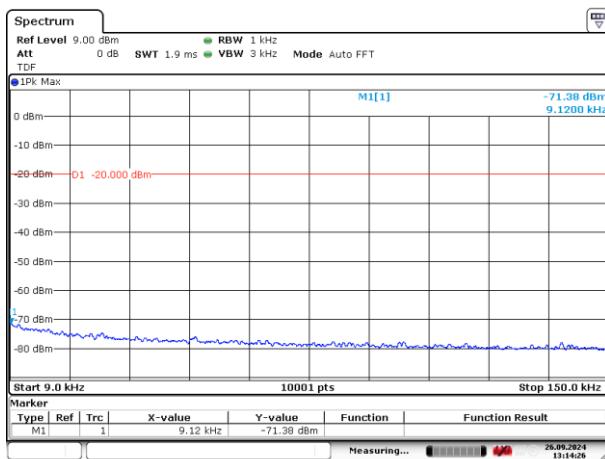
Frequency range:	9 kHz – 150 kHz	150 kHz – 30 MHz	30 MHz – 1 GHz	1 GHz – 5 GHz
RBW:	1 kHz	10 kHz	100 kHz	1 MHz
VBW:	3 kHz	30 kHz	300 kHz	3 MHz
Sweep points:	10001	10001	10001	10001
Sweep time:	Auto	Auto	Auto	Auto
Detector:	Positive Peak	Positive Peak	Positive Peak	Positive Peak

**Test results**

Worst case margins were more than 20 dB to the limits. Measurement results are presented in the following figures.

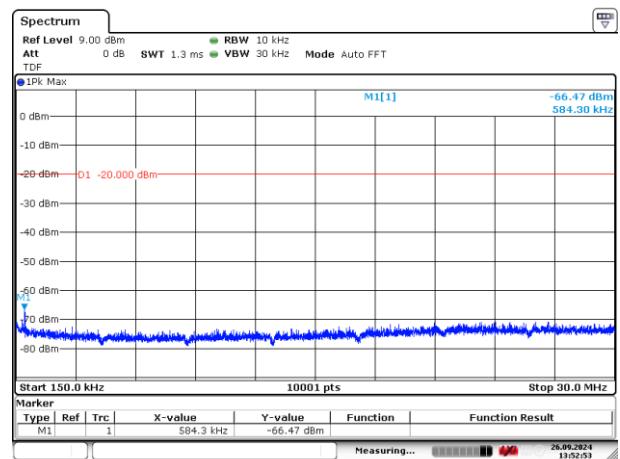
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 410.0 MHz, 12.5 kHz, 4FSK



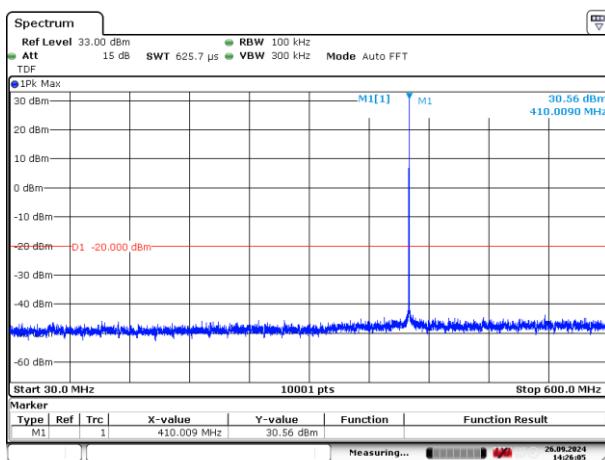
Date: 26.SEP.2024 13:14:27

Figure 4: 9 – 150 kHz



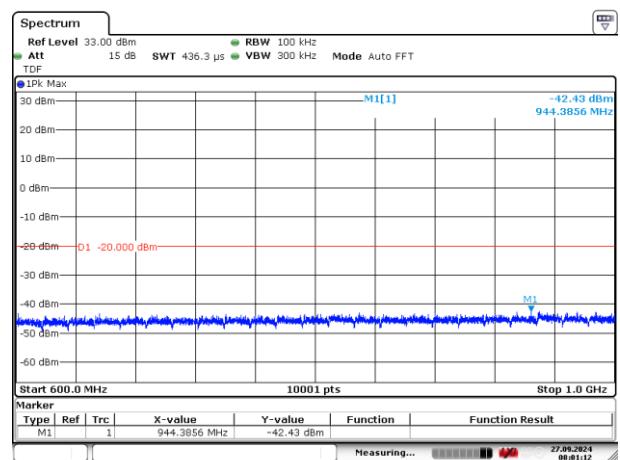
Date: 26.SEP.2024 13:52:53

Figure 5: 150 kHz – 30 MHz



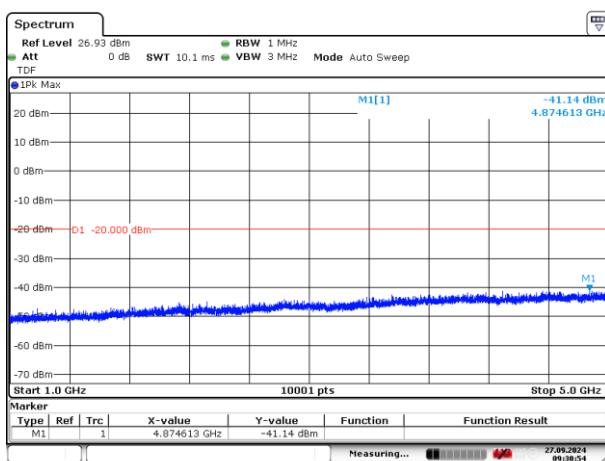
Date: 26.SEP.2024 14:26:05

Figure 6: 30 – 600 MHz



Date: 27.SEP.2024 08:01:12

Figure 7: 600 – 1000 MHz

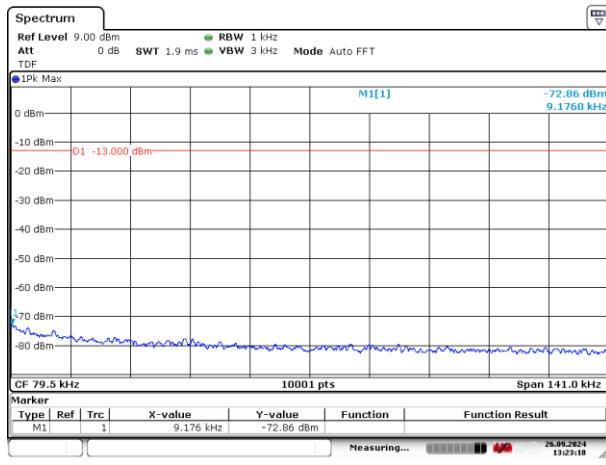


Date: 27.SEP.2024 09:30:54

Figure 8: 1 – 5 GHz

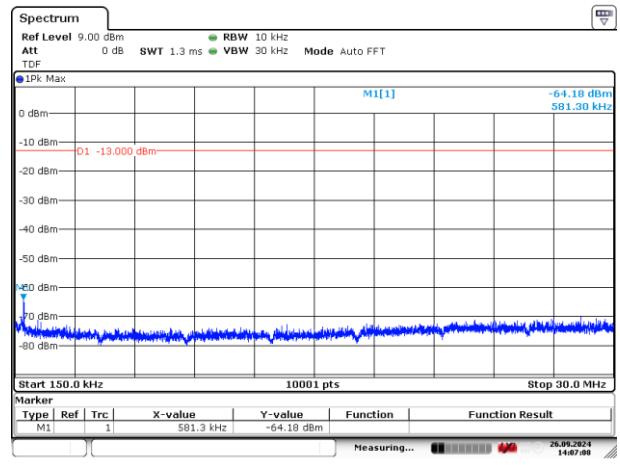
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 410.0 MHz, 25 kHz, 4FSK



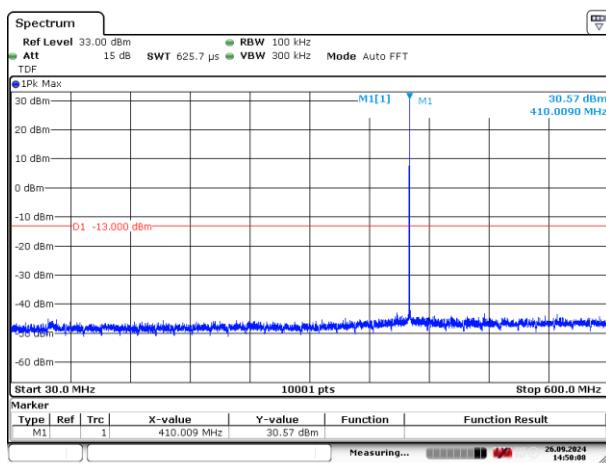
Date: 26.SEP.2024 13:23:18

Figure 9: 9 – 150 kHz



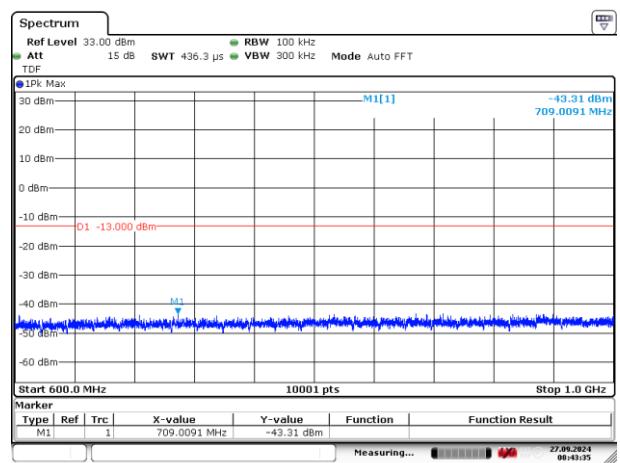
Date: 26.SEP.2024 14:07:08

Figure 10: 150 kHz – 30 MHz



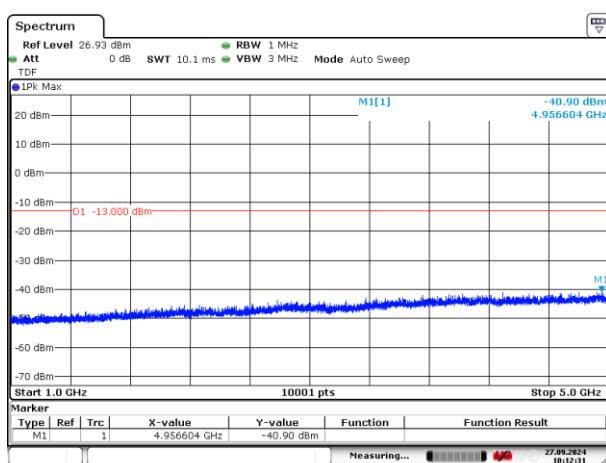
Date: 26.SEP.2024 14:50:08

Figure 11: 30 – 600 MHz



Date: 27.SEP.2024 08:43:36

Figure 12: 600 – 1000 MHz

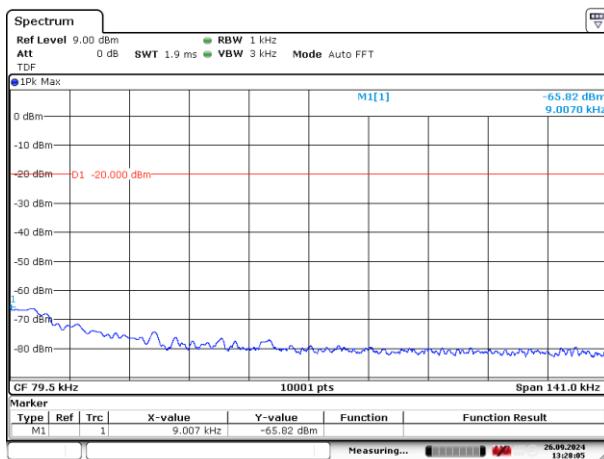


Date: 27.SEP.2024 10:12:31

Figure 13: 1 – 5 GHz

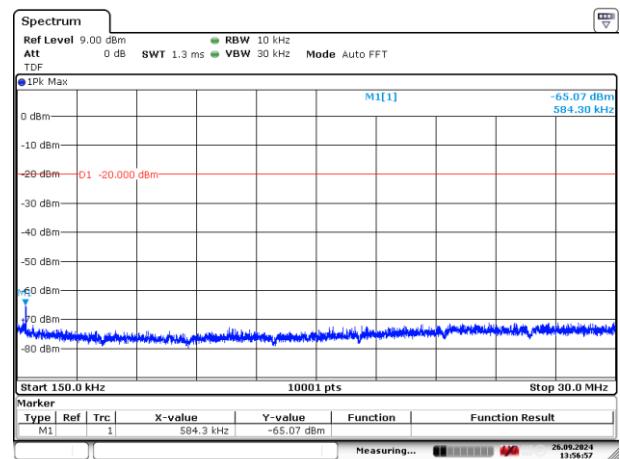
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 410.0 MHz, 12.5 kHz, 8FSK



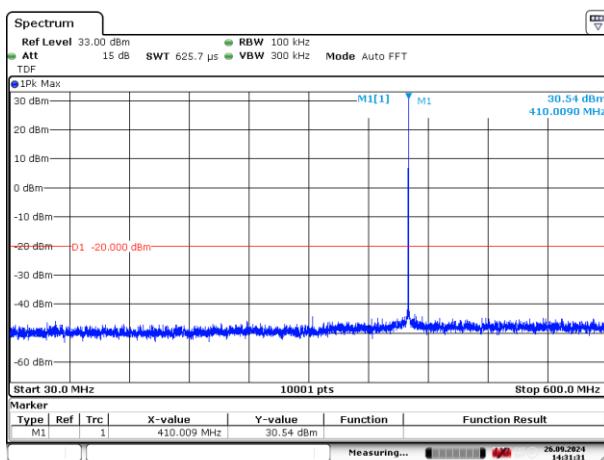
Date: 26.SEP.2024 13:28:06

Figure 14: 9 – 150 kHz



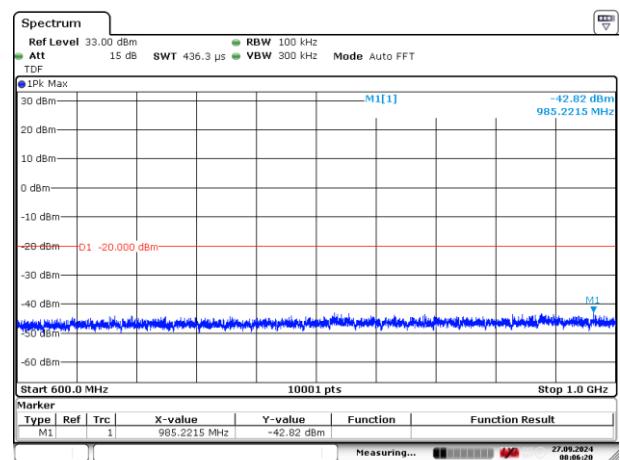
Date: 26.SEP.2024 13:56:57

Figure 15: 150 kHz – 30 MHz



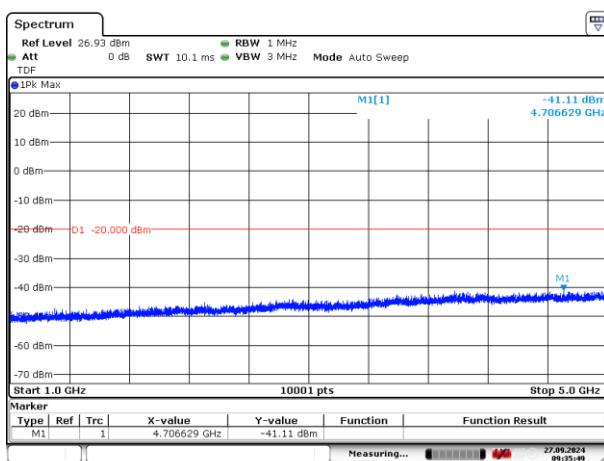
Date: 26.SEP.2024 14:31:31

Figure 16: 30 – 600 MHz



Date: 27.SEP.2024 08:06:20

Figure 17: 600 – 1000 MHz

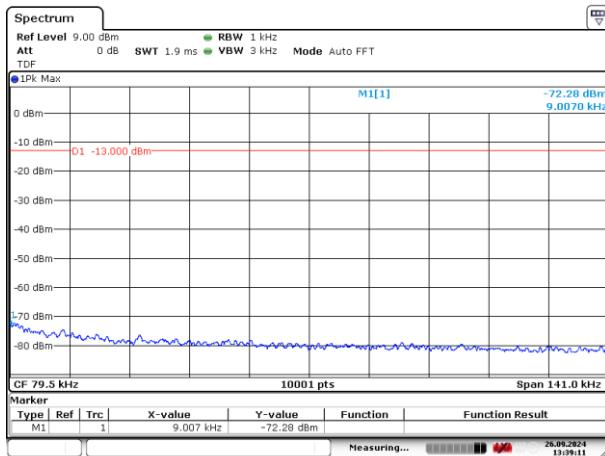


Date: 27.SEP.2024 09:35:49

Figure 18: 1 – 5 GHz

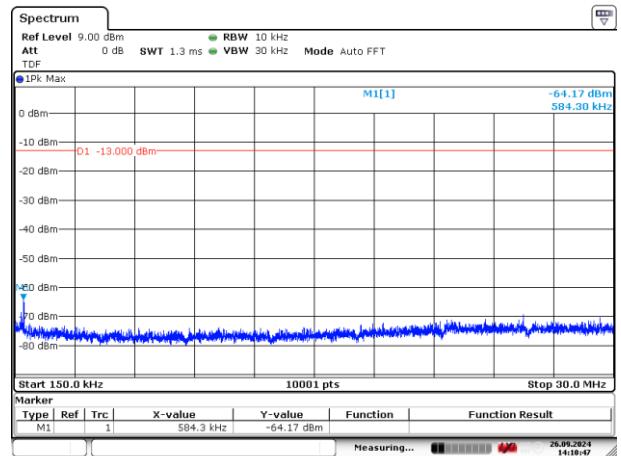
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 410.0 MHz, 25 kHz, 8FSK



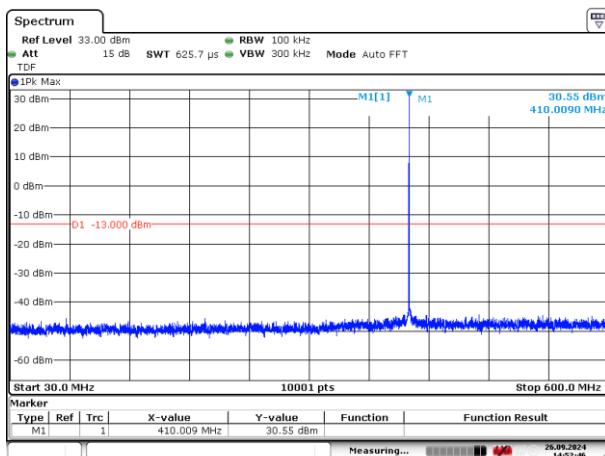
Date: 26.SEP.2024 13:39:12

Figure 19: 9 – 150 kHz



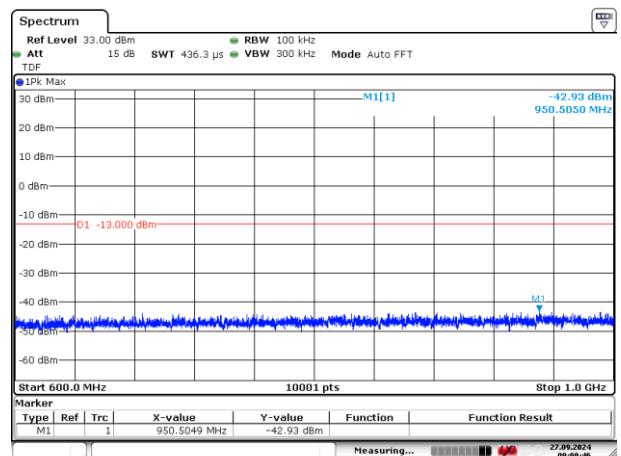
Date: 26.SEP.2024 14:10:47

Figure 20: 150 kHz – 30 MHz



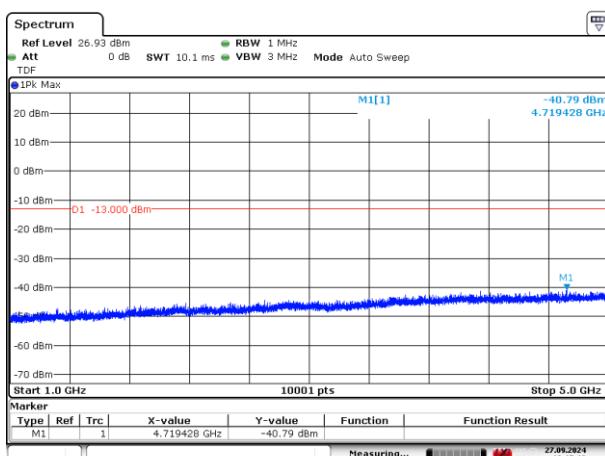
Date: 26.SEP.2024 14:52:47

Figure 21: 30 – 600 MHz



Date: 27.SEP.2024 09:00:46

Figure 22: 600 – 1000 MHz

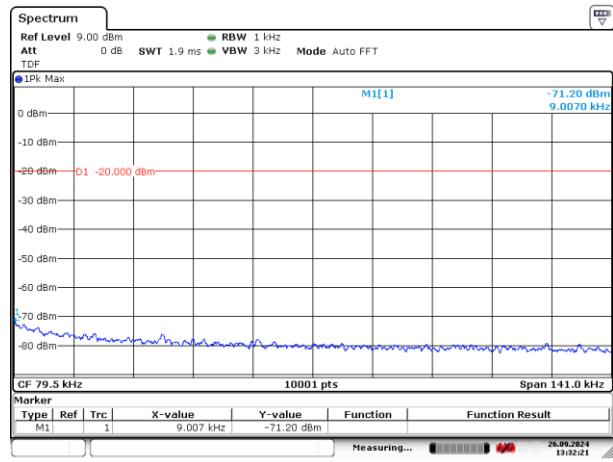


Date: 27.SEP.2024 10:17:13

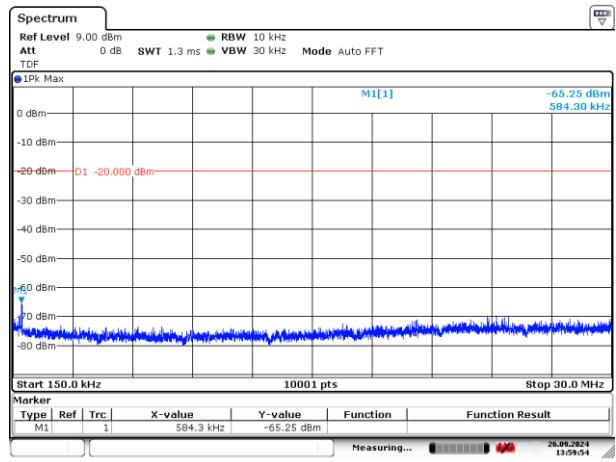
Figure 23: 1 – 5 GHz

## Spurious emissions (conducted) 9 kHz – 5 GHz

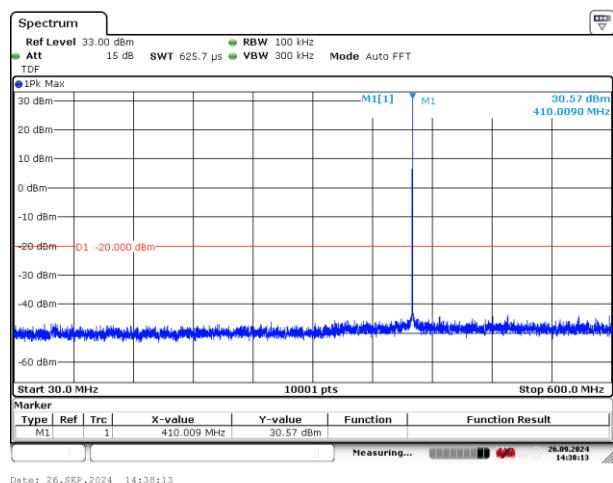
## Spurious emissions TX 410.0 MHz, 12.5kHz, 16FSK



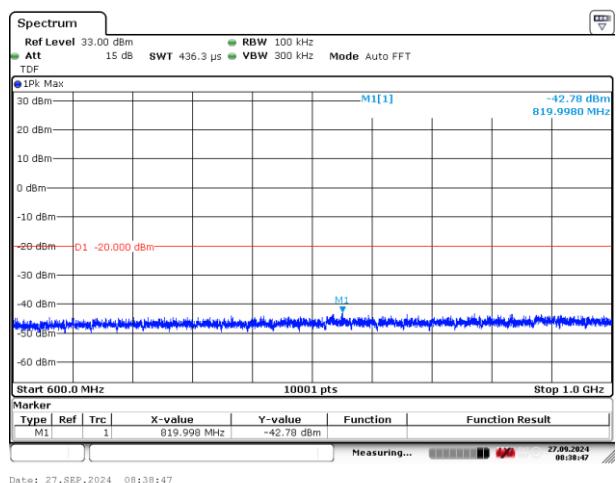
Date: 26.SEP.2024 13:32:21



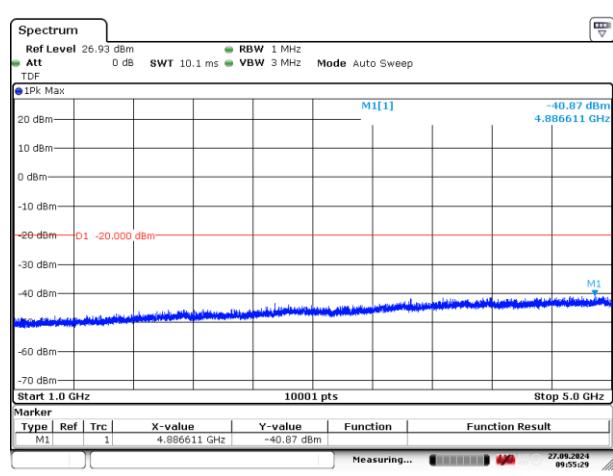
Date: 26.SEP.2024 13:59:54



Date: 26.SEP.2024 14:38:13



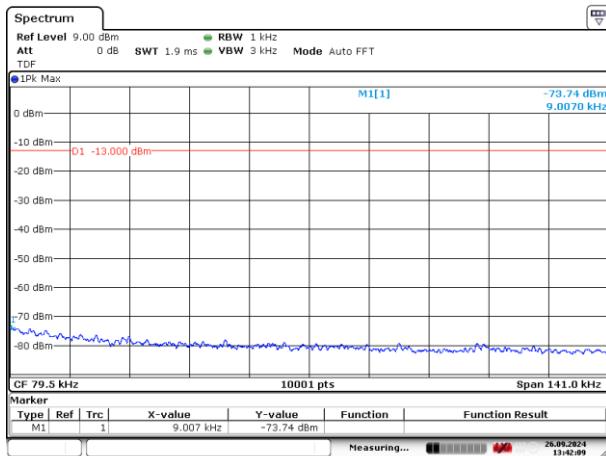
Date: 27.SEP.2024 08:38:47



Date: 27.SEP.2024 09:55:29

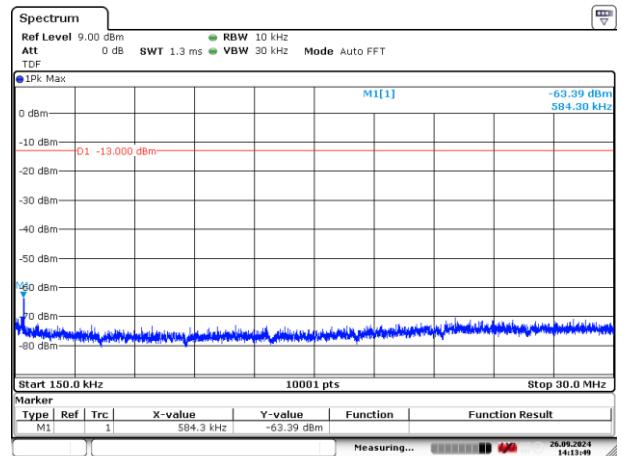
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 410.0 MHz, 25kHz, 16FSK



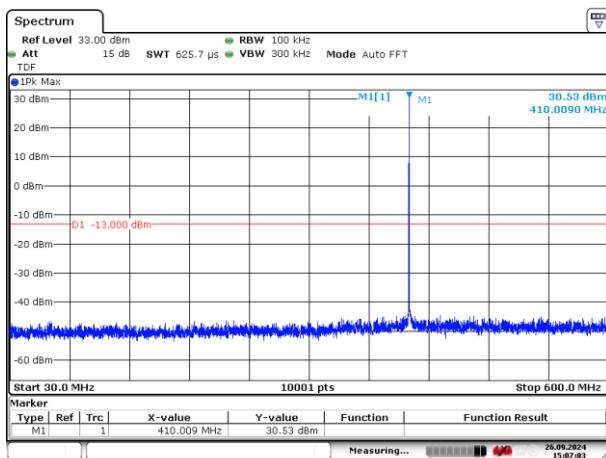
Date: 26.SEP.2024 13:42:10

Figure 29: 9 – 150 kHz



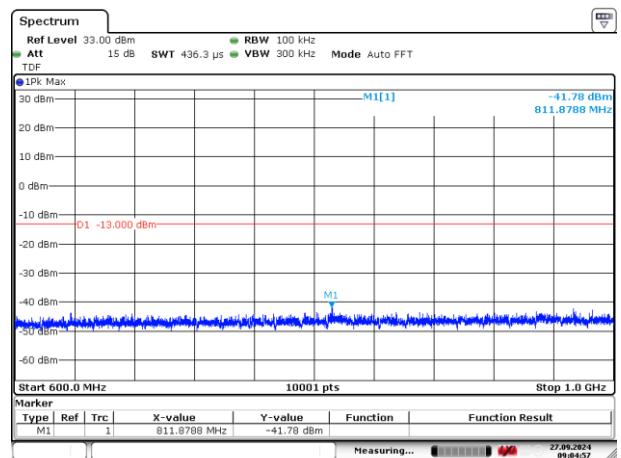
Date: 26.SEP.2024 14:13:50

Figure 30: 150 kHz – 30 MHz



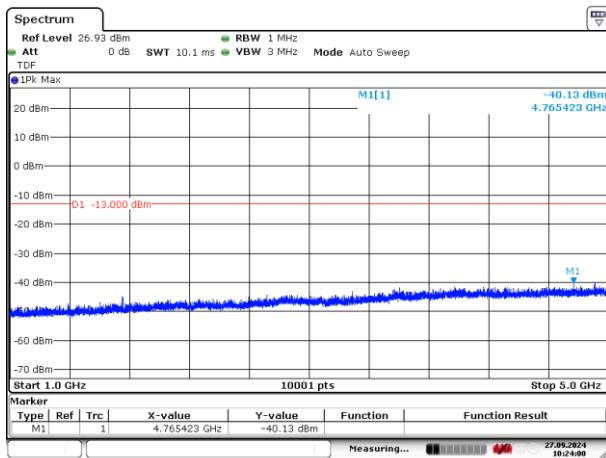
Date: 26.SEP.2024 15:07:04

Figure 31: 30 – 600 MHz



Date: 27.SEP.2024 09:04:57

Figure 32: 600 – 1000 MHz

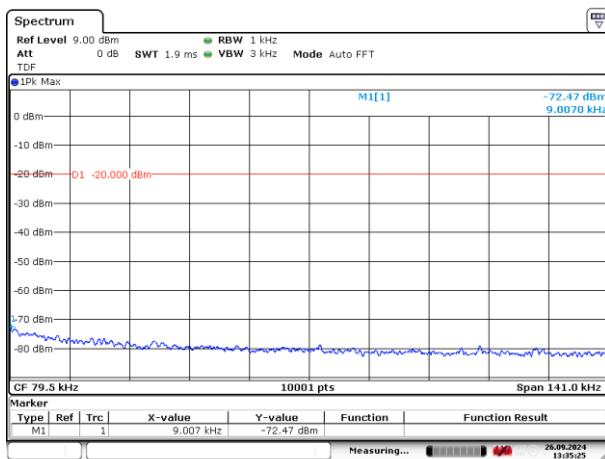


Date: 27.SEP.2024 10:24:00

Figure 33: 1 – 5 GHz

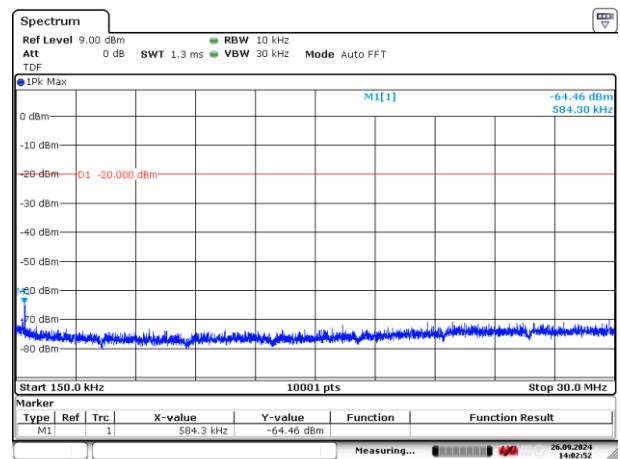
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 410.0 MHz, 12.5 kHz, GMSK



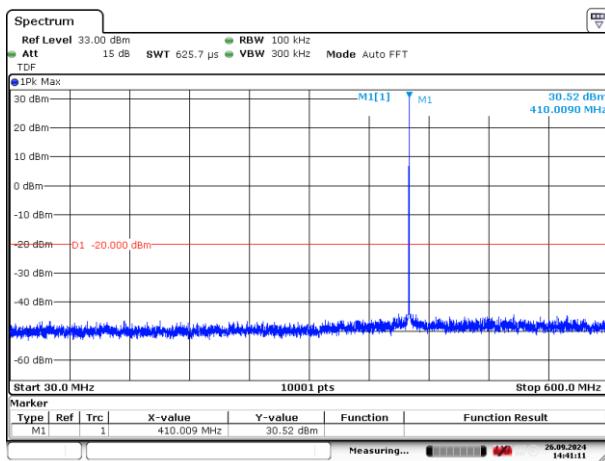
Date: 26.SEP.2024 13:35:25

Figure 34: 9 – 150 kHz



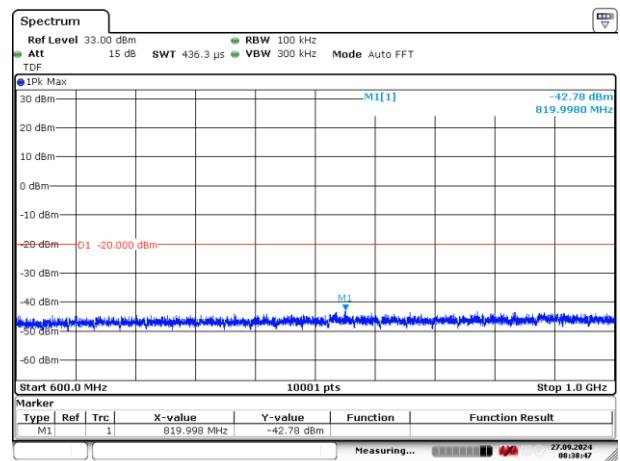
Date: 26.SEP.2024 14:02:52

Figure 35: 150 kHz – 30 MHz



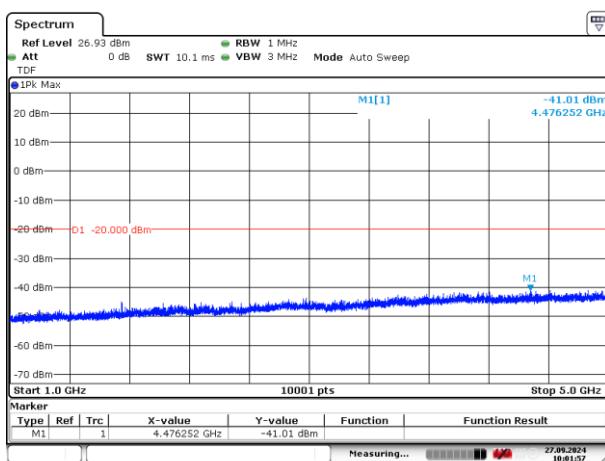
Date: 26.SEP.2024 14:41:12

Figure 36: 30 – 600 MHz



Date: 27.SEP.2024 08:38:47

Figure 37: 600 – 1000 MHz

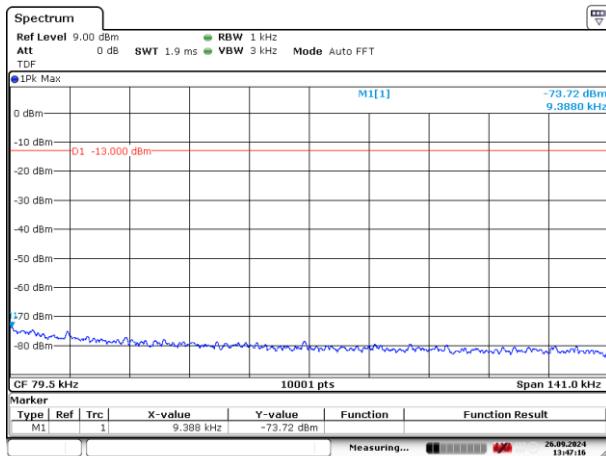


Date: 27.SEP.2024 10:01:57

Figure 38: 1 – 5 GHz

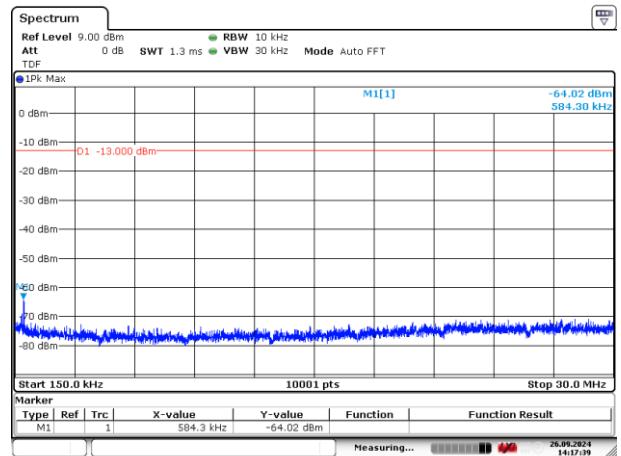
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 410.0 MHz, 25 kHz, GMSK



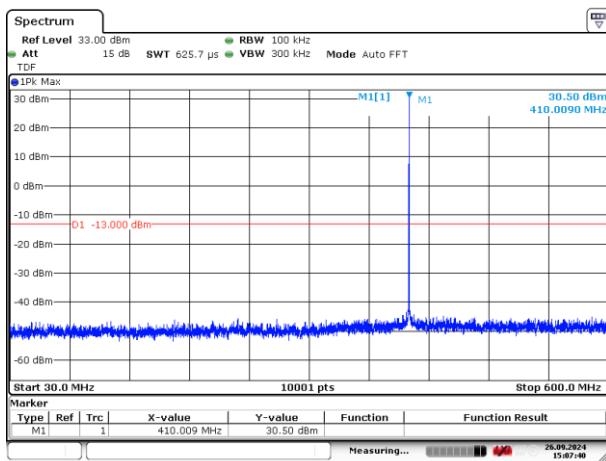
Date: 26.SEP.2024 13:47:16

Figure 39: 9 – 150 kHz



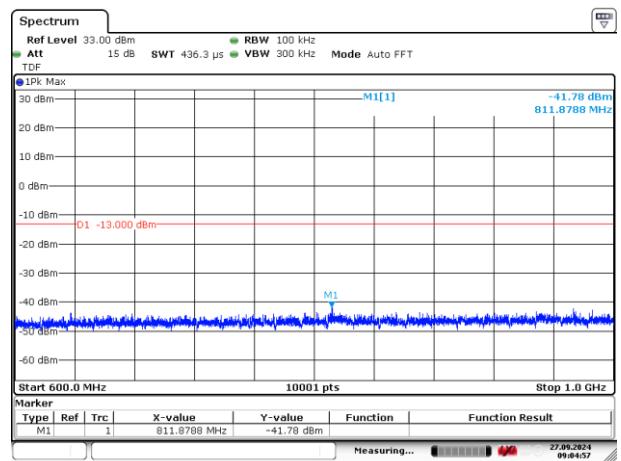
Date: 26.SEP.2024 14:17:39

Figure 40: 150 kHz – 30 MHz



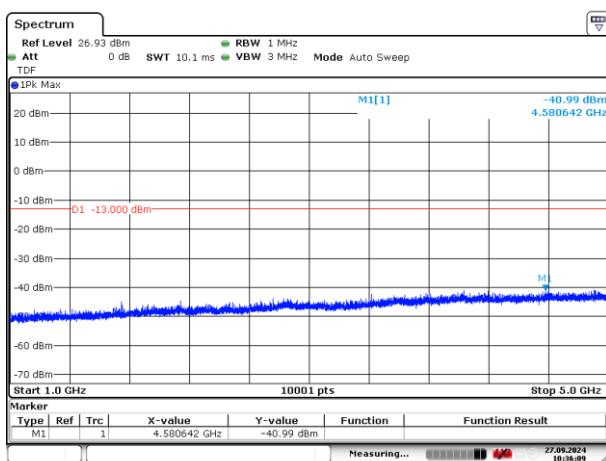
Date: 26.SEP.2024 15:07:41

Figure 41: 30 – 600 MHz



Date: 27.SEP.2024 09:04:57

Figure 42: 600 – 1000 MHz

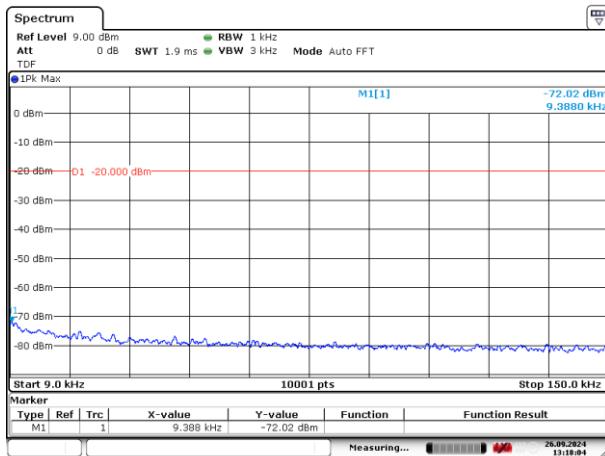


Date: 27.SEP.2024 10:36:09

Figure 43: 1 – 5 GHz

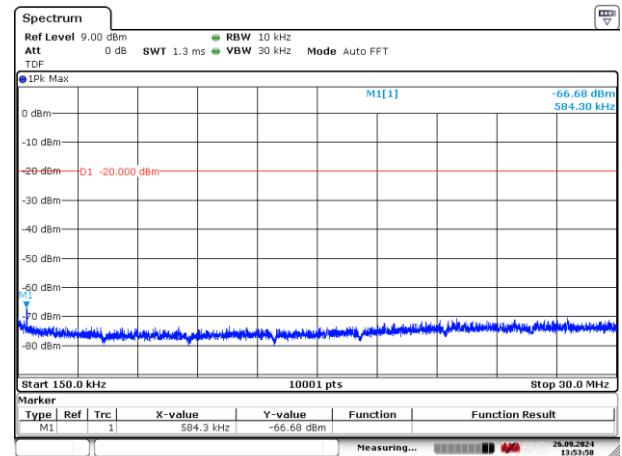
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 429.5 MHz, 12.5 kHz, 4FSK



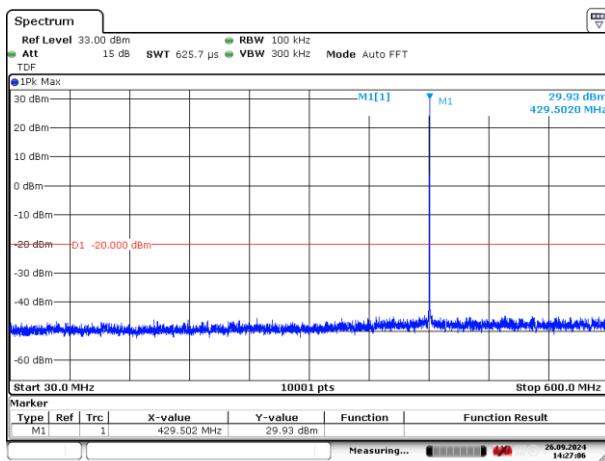
Date: 26.SEP.2024 13:18:04

Figure 44: 9 – 150 kHz



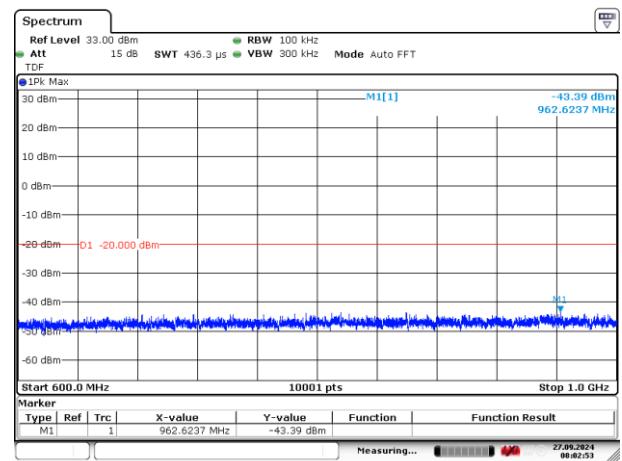
Date: 26.SEP.2024 13:53:59

Figure 45: 150 kHz – 30 MHz



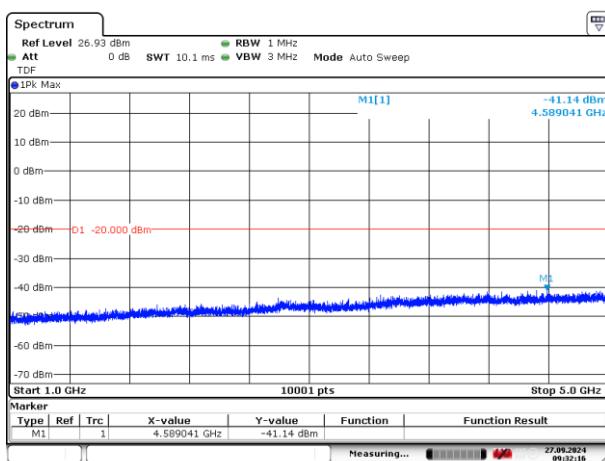
Date: 26.SEP.2024 14:27:06

Figure 46: 30 – 600 MHz



Date: 27.SEP.2024 08:02:53

Figure 47: 600 – 1000 MHz



Date: 27.SEP.2024 09:32:16

Figure 48: 1 – 5 GHz

## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 429.5 MHz, 25 kHz, 4FSK

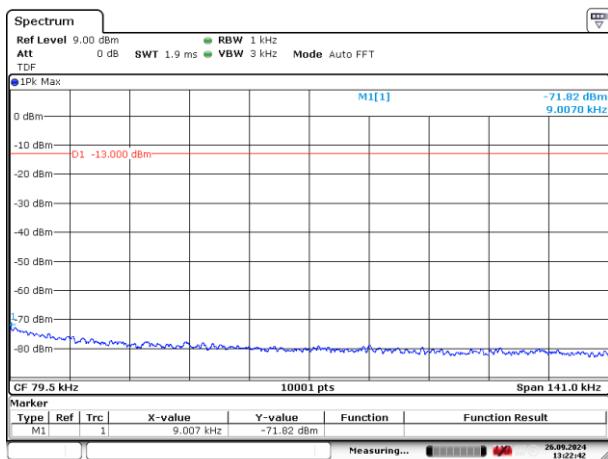


Figure 49: 9 – 150 kHz

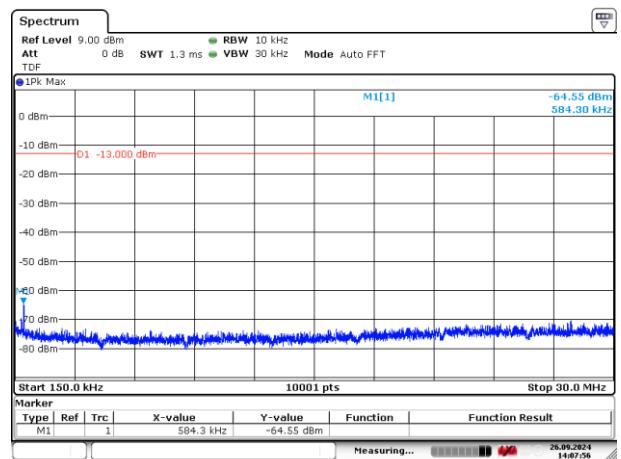


Figure 50: 150 kHz – 30 MHz

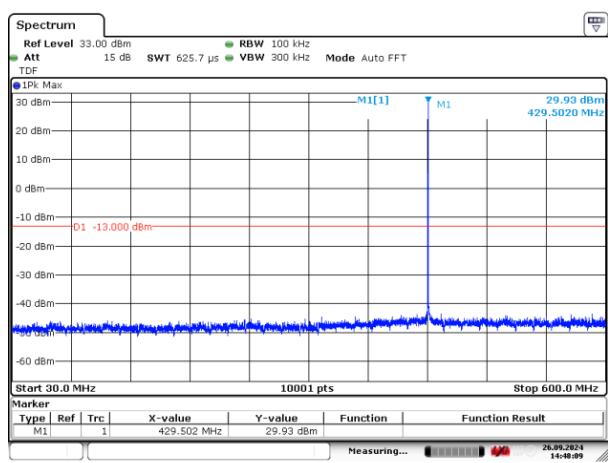


Figure 51: 30 – 600 MHz

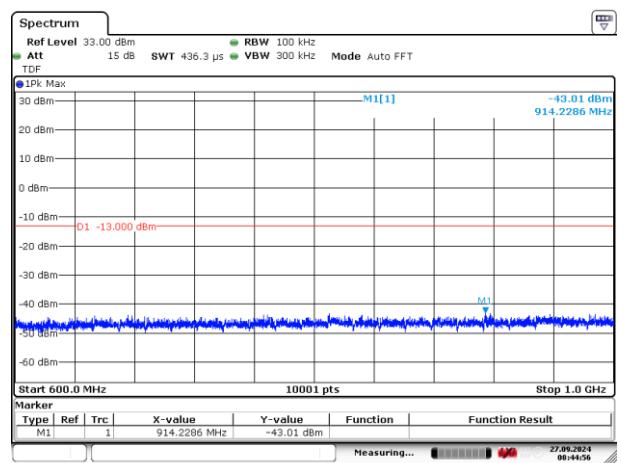


Figure 52: 600 – 1000 MHz

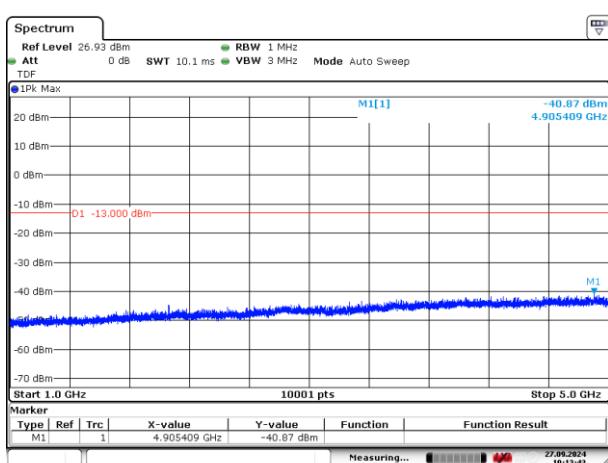
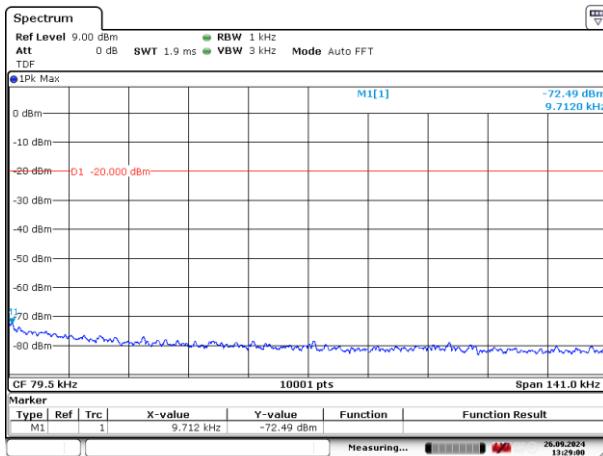


Figure 53: 1 – 5 GHz

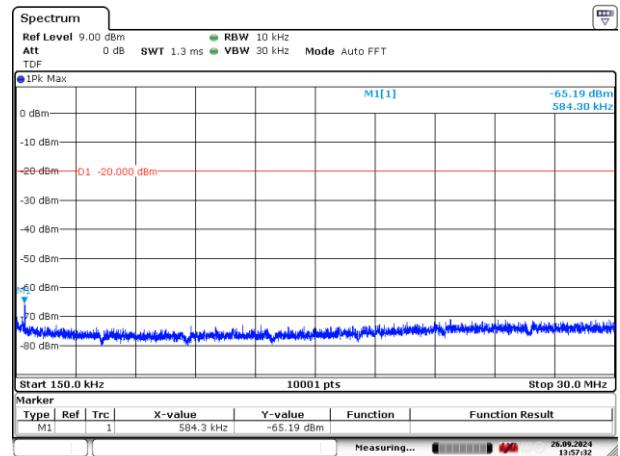
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 429.5 MHz, 12.5 kHz, 8FSK



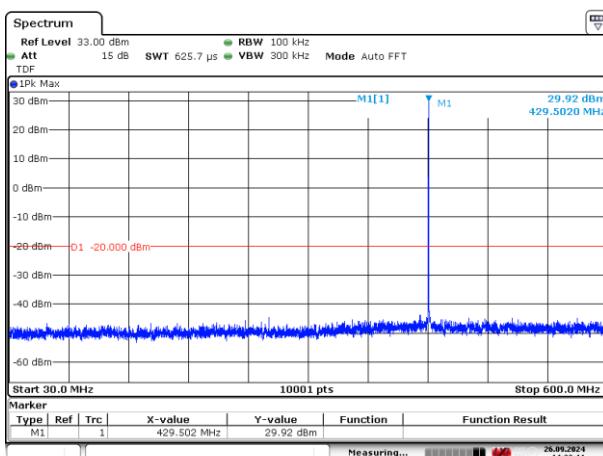
Date: 26.SEP.2024 13:29:00

Figure 54: 9 – 150 kHz



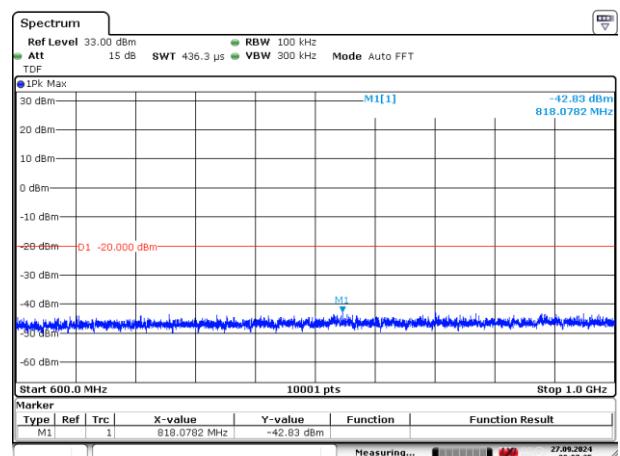
Date: 26.SEP.2024 13:57:32

Figure 55: 150 kHz – 30 MHz



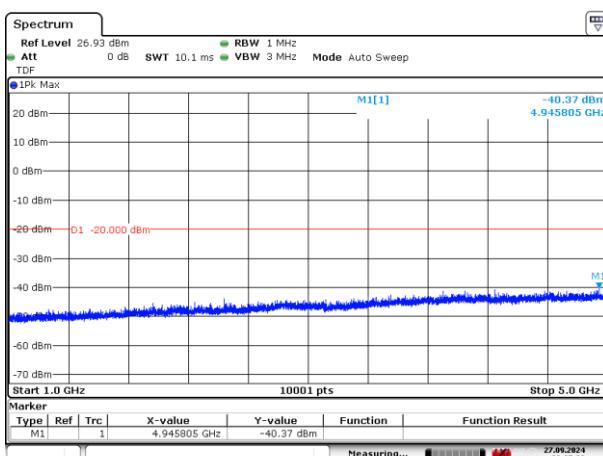
Date: 26.SEP.2024 14:32:12

Figure 56: 30 – 600 MHz



Date: 27.SEP.2024 08:07:25

Figure 57: 600 – 1000 MHz

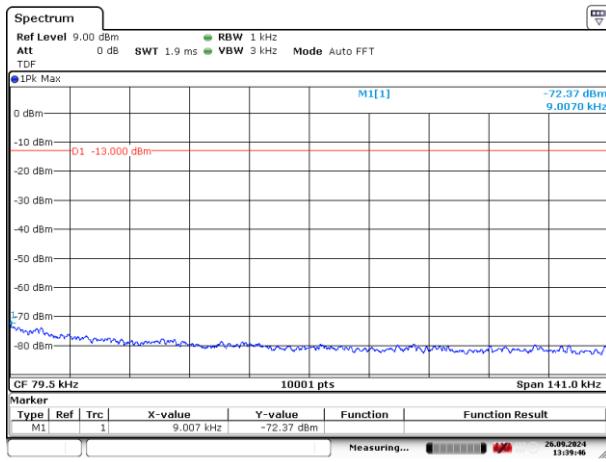


Date: 27.SEP.2024 09:37:03

Figure 58: 1 – 5 GHz

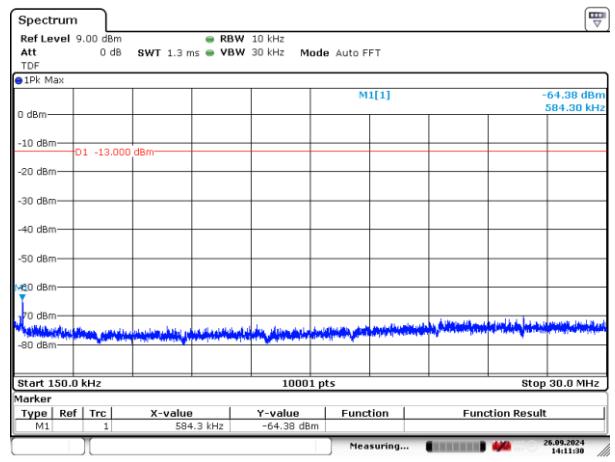
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 429.5 MHz, 25 kHz, 8FSK



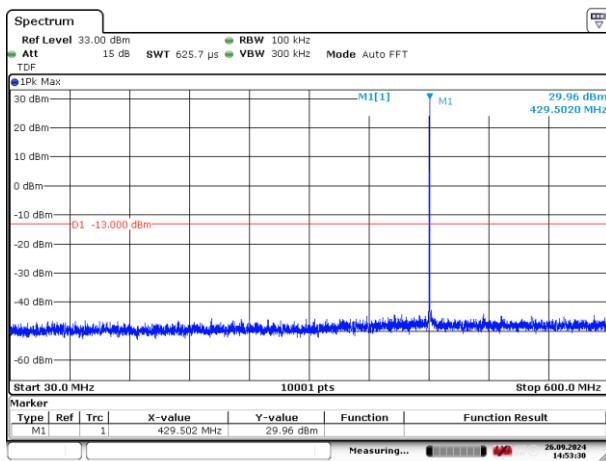
Date: 26.SEP.2024 13:39:46

Figure 59: 9 – 150 kHz



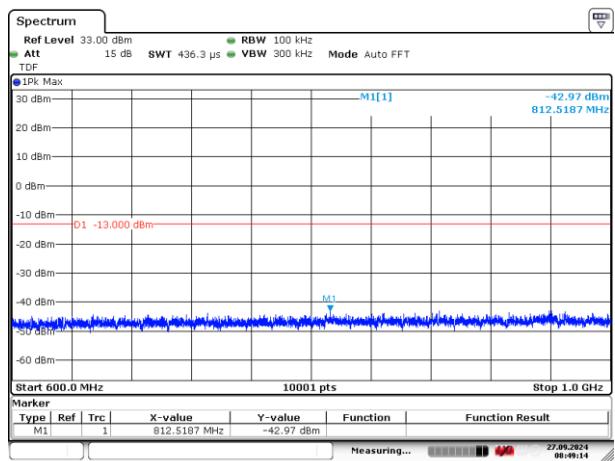
Date: 26.SEP.2024 14:11:30

Figure 60: 150 kHz – 30 MHz



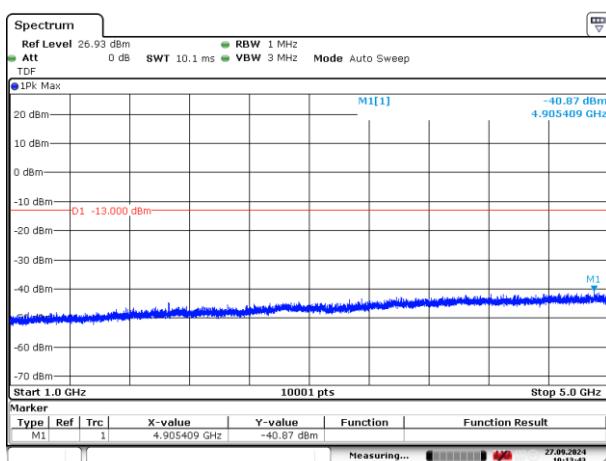
Date: 26.SEP.2024 14:53:31

Figure 61: 30 – 600 MHz



Date: 27.SEP.2024 08:49:14

Figure 62: 600 – 1000 MHz

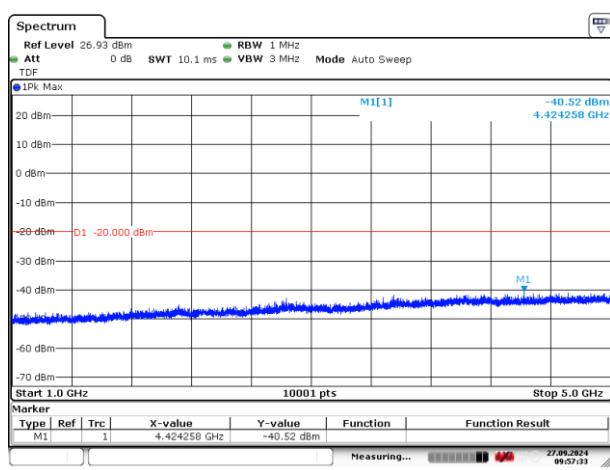
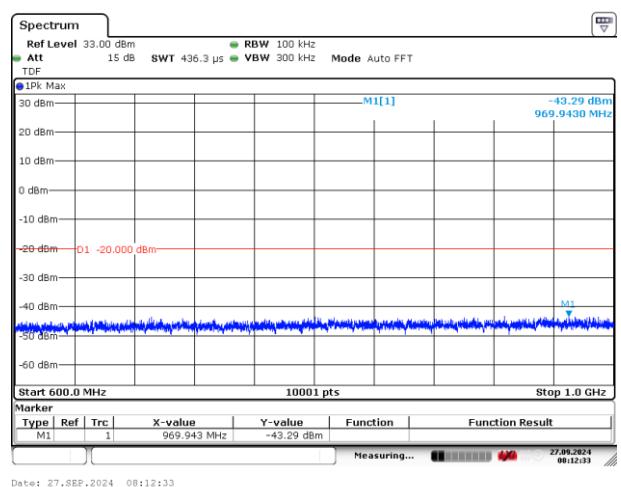
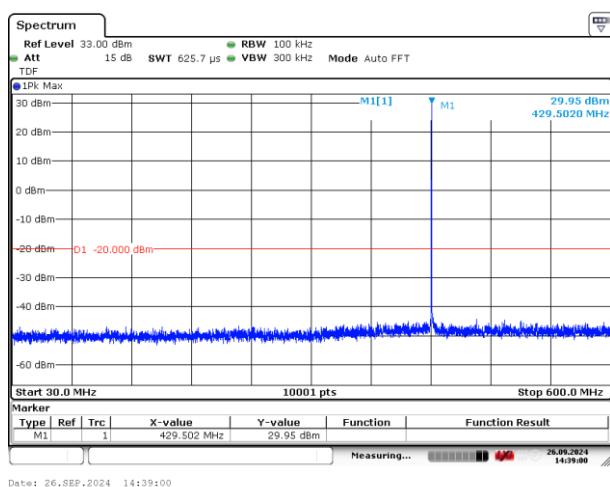
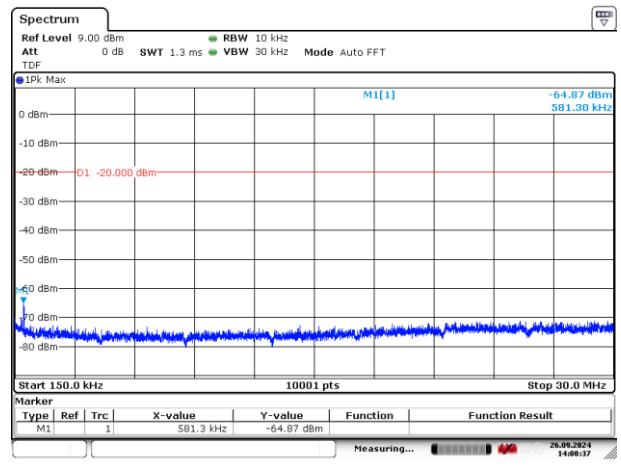
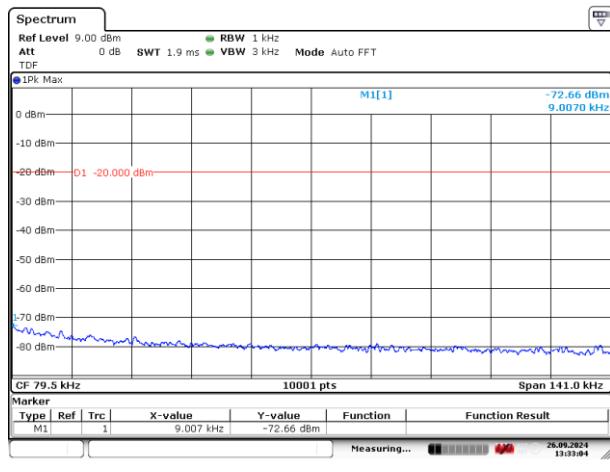


Date: 27.SEP.2024 10:13:43

Figure 63: 1 – 5 GHz

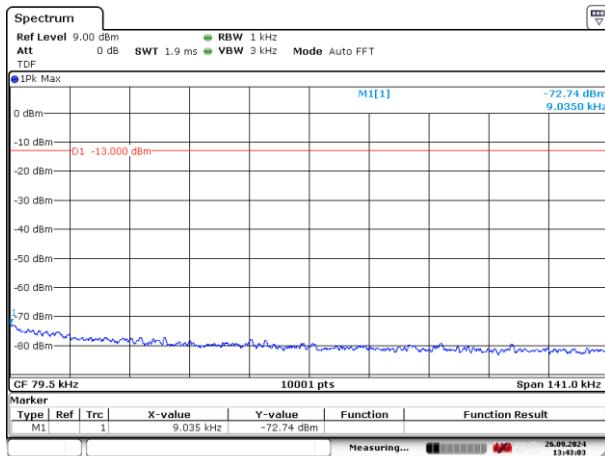
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 429.5 MHz, 12.5 kHz, 16FSK



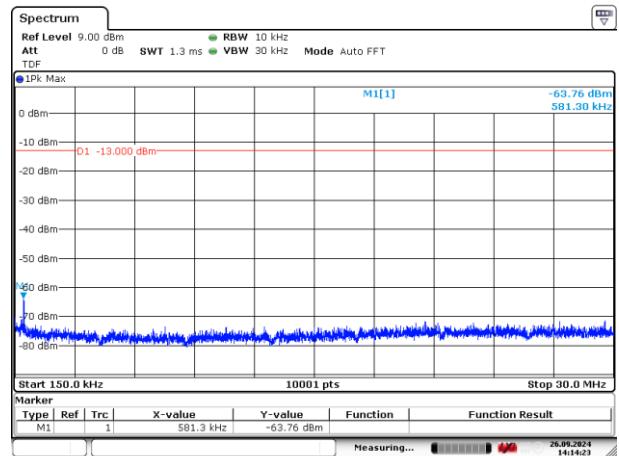
## Spurious emissions (conducted) 9 kHz – 5 GHz

## Spurious emissions TX 429.5 MHz, 25 kHz, 16FSK



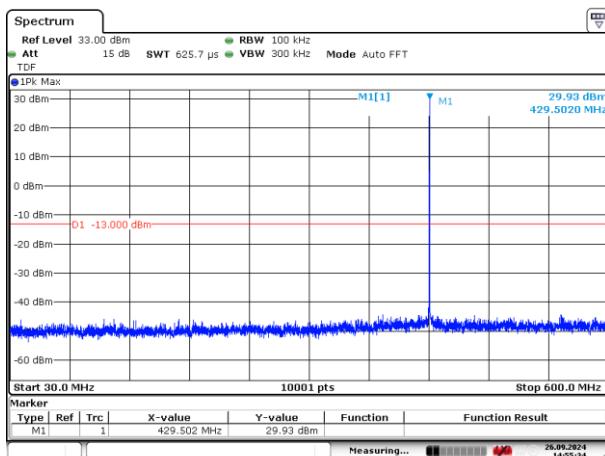
Date: 26.SEP.2024 13:43:03

Figure 69: 9 – 150 kHz



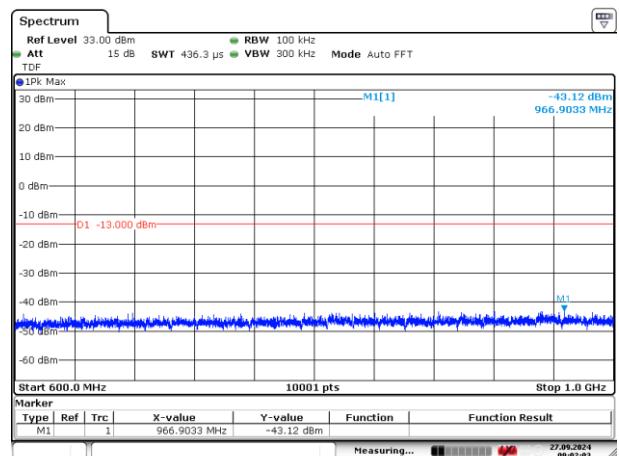
Date: 26.SEP.2024 14:14:24

Figure 70: 150 kHz – 30 MHz



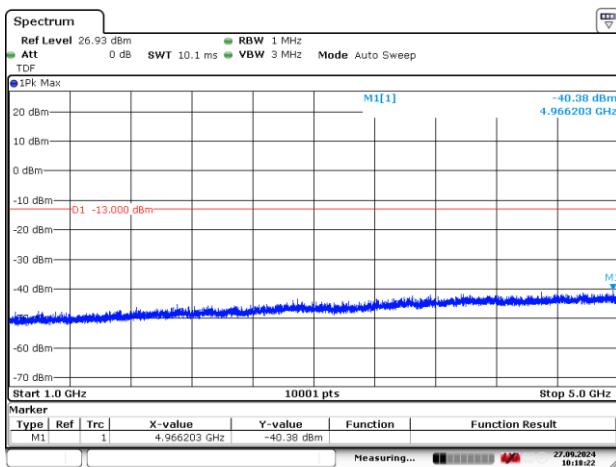
Date: 26.SEP.2024 14:55:35

Figure 71: 30 – 600 MHz



Date: 27.SEP.2024 09:02:03

Figure 72: 600 – 1000 MHz



Date: 27.SEP.2024 10:18:22

Figure 73: 1 – 5 GHz