

Test Report



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

Equipment Under Test: Radio Modem

Trademark: Trimble

Model: 129681

Manufacturer: Trimble Inc.
4450 Gibson Drive
Tipp City, Ohio 45371
United States

Customer: Trimble Inc.
4450 Gibson Drive
Tipp City, Ohio 45371
United States

FCC Rule Part: 90
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)

Date: 23 August 2023

Issued by:

A blue ink signature of Pekka Kälviäinen.

Pekka Kälviäinen
Testing Engineer

Date:

29 August 2023

Checked by:

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Rauno Repo
Senior EMC Specialist

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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	23 August 2023

PRODUCT DESCRIPTION

Equipment Under Test

EUT information	
Equipment Under Test:	Radio Modem
Trademark:	Trimble
Model:	129681
Serial no:	2321000725
FCC ID:	S9E129681
IC:	5817A-129681
Bluetooth BR/EDR/LE module	Silicon Labs BT-122A FCC ID: QOQ-BT122 IC: 5123A-BT122

General Description

The equipment under test is a radio modem using 406.1 – 470 MHz band. It has also Bluetooth.

Classification

- Fixed device ☒
- Mobile Device (Human body distance > 20cm) ☒
- Portable Device (Human body distance < 20cm) ☐

Samples and modifications

No.	Name	Description
1	Sample 1	Normal sample

Specifications

Operating Frequency Range:	406.1 - 470 MHz
Channel width:	12.5 kHz, 25 kHz
Channel spacing:	12.5 kHz, 25 kHz
Modulation:	4FSK, 8FSK, 16FSK, GMSK
Carrier power:	1, 5, 10, 25, 35 W
Antenna port:	TNC connector
Operating Frequency Range:	2402 - 2480 MHz
Type of Modulation:	☒ FHSS ☒ Other
Channels:	79 / 39
Channel Separation:	1 / 2 MHz
Antenna Type:	integral
Antenna Count:	1
Power Requirements:	11.1 - 30.0 VDC; 9.0 - 11.0 VDC for TX power 5.0 W or less
EUT Dimensions:	230 x 151 x 75 mm

Ports and cables

Cable / Port	Description
Serial port RS232	Device configuration and data communication. Unshielded cable
DC input port	Unshielded cable

Peripherals

Peripheral	Description / Usage
Test PC	hp ProBook 450 G3, s/n 5CD6331CG2 Device configuration and monitoring with programs supplied by customer.

SUMMARY OF TESTING

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

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 the tests. The EUT was configured into the wanted channel and bandwidth using software provided by the manufacturer. Bluetooth was in stand-by mode.

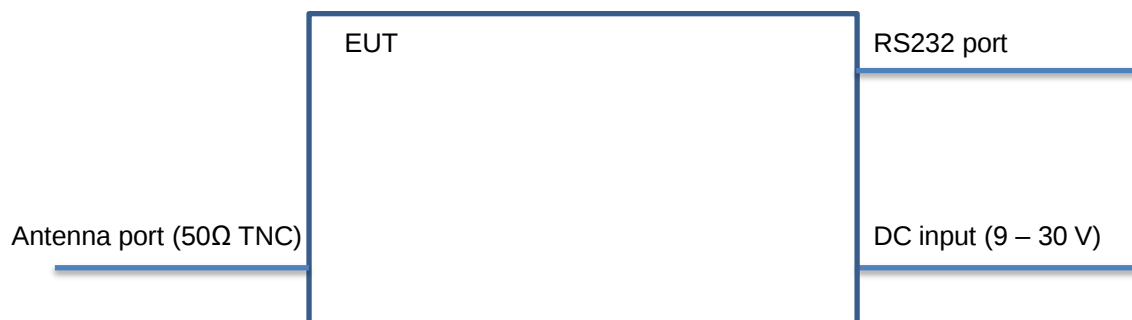


Figure 1: Test setup block diagram

Table 1: Test frequencies

Channel	Frequency (MHz)
Bottom	406.6
Middle 1	429.5
Middle 2	440.0
Middle 3	450.5
Top	469.5

Table 2: Test modulations

modulation	datarate (bps)	Channel spacing (kHz)
GMSK	9600	12.5
GMSK	19200	25

Test Facility

Testing Laboratory / address: FCC designation number: FI0002 ISED CAB identifier: T004	SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND
Test Site:	☐ K10LAB, ISED Canada registration number: 8708A-1 ☒ K5LAB, ISED Canada registration number: 8708A-2 ☐ T10LAB

TEST RESULTS

Transmitter output power

Standard:	ANSI C63.26-2015	
Tested by:	HAM	HAM
Date:	3 July 2023	10 July 2023
Temperature:	22 °C	23 °C
Humidity:	52 % RH	39 % RH
Barometric pressure	989 hPa	1021 hPa
Measurement uncertainty:	± 0.470 dB, level of confidence 95.45 % (k = 2)	
Test result:	PASS	

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 with a spectrum analyser with following settings:

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

Transmitter output power

Test result

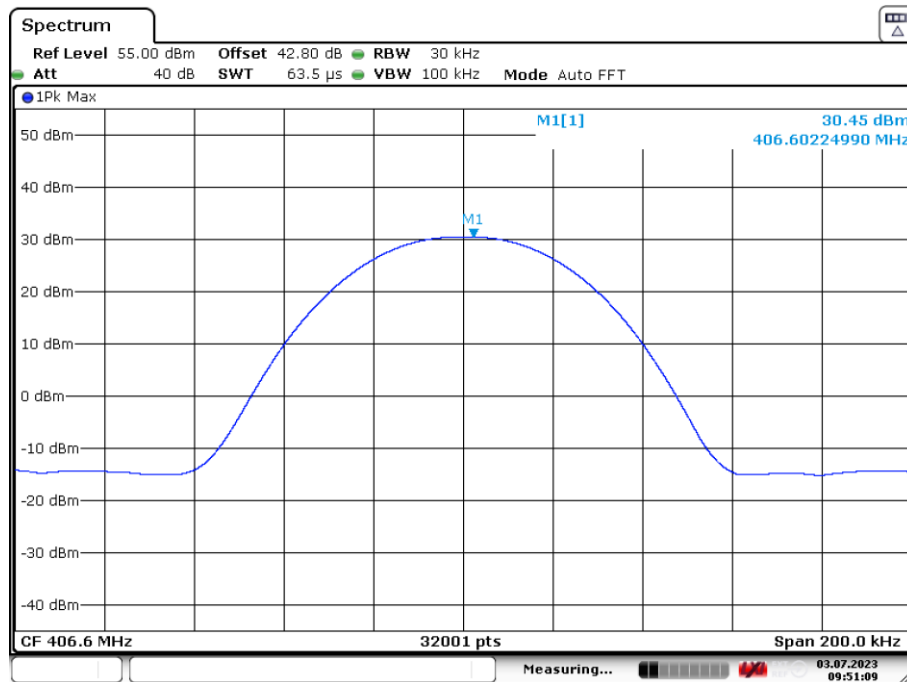
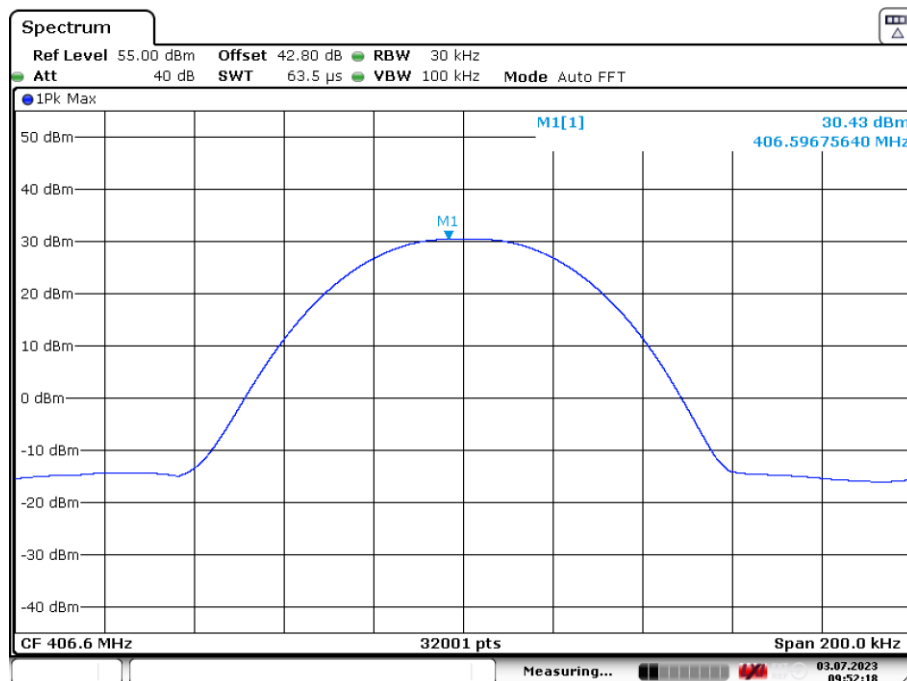
Table 3. Transmitter output power GMSK 9600 bps, 12.5 kHz

Frequency [MHz]	TX power [mW]	Ch. Width [kHz]	Modulation	Meas. Power [dBm]	Limit [±dB]	Result
406.6	1000	12.5	GMSK 9600bps	30.45	1.00	PASS
429.5	1000	12.5	GMSK 9600bps	30.45	1.00	PASS
440.0	1000	12.5	GMSK 9600bps	30.25	1.00	PASS
450.5	1000	12.5	GMSK 9600bps	30.19	1.00	PASS
469.5	1000	12.5	GMSK 9600bps	30.59	1.00	PASS
406.6	5000	12.5	GMSK 9600bps	37.20	1.00	PASS
429.5	5000	12.5	GMSK 9600bps	37.01	1.00	PASS
440.0	5000	12.5	GMSK 9600bps	36.96	1.00	PASS
450.5	5000	12.5	GMSK 9600bps	37.04	1.00	PASS
469.5	5000	12.5	GMSK 9600bps	37.18	1.00	PASS
406.6	10000	12.5	GMSK 9600bps	40.08	1.00	PASS
429.5	10000	12.5	GMSK 9600bps	40.06	1.00	PASS
440.0	10000	12.5	GMSK 9600bps	40.19	1.00	PASS
450.5	10000	12.5	GMSK 9600bps	40.11	1.00	PASS
469.5	10000	12.5	GMSK 9600bps	40.00	1.00	PASS
406.6	25000	12.5	GMSK 9600bps	44.10	1.00	PASS
429.5	25000	12.5	GMSK 9600bps	44.25	1.00	PASS
440.0	25000	12.5	GMSK 9600bps	44.09	1.00	PASS
450.5	25000	12.5	GMSK 9600bps	43.94	1.00	PASS
469.5	25000	12.5	GMSK 9600bps	43.98	1.00	PASS
406.6	35000	12.5	GMSK 9600bps	45.77	1.00	PASS
429.5	35000	12.5	GMSK 9600bps	45.77	1.00	PASS
440.0	35000	12.5	GMSK 9600bps	45.48	1.00	PASS
450.5	35000	12.5	GMSK 9600bps	45.24	1.00	PASS
469.5	35000	12.5	GMSK 9600bps	45.31	1.00	PASS

Transmitter output power

Table 4. Transmitter output power GMSK 19200 bps, 25 kHz

Frequency [MHz]	TX power [mW]	Ch. Width [kHz]	Modulation	Meas. Power [dBm]	Limit [±dB]	Result
406.6	1000	25	GMSK 19200bps	30.43	1.00	PASS
429.5	1000	25	GMSK 19200bps	30.80	1.00	PASS
440.0	1000	25	GMSK 19200bps	29.97	1.00	PASS
450.5	1000	25	GMSK 19200bps	29.91	1.00	PASS
469.5	1000	25	GMSK 19200bps	30.67	1.00	PASS
406.6	5000	25	GMSK 19200bps	37.20	1.00	PASS
429.5	5000	25	GMSK 19200bps	37.02	1.00	PASS
440.0	5000	25	GMSK 19200bps	36.94	1.00	PASS
450.5	5000	25	GMSK 19200bps	36.99	1.00	PASS
469.5	5000	25	GMSK 19200bps	37.14	1.00	PASS
406.6	10000	25	GMSK 19200bps	40.08	1.00	PASS
429.5	10000	25	GMSK 19200bps	40.21	1.00	PASS
440.0	10000	25	GMSK 19200bps	40.06	1.00	PASS
450.5	10000	25	GMSK 19200bps	39.95	1.00	PASS
469.5	10000	25	GMSK 19200bps	39.91	1.00	PASS
406.6	25000	25	GMSK 19200bps	44.23	1.00	PASS
429.5	25000	25	GMSK 19200bps	44.22	1.00	PASS
440.0	25000	25	GMSK 19200bps	44.11	1.00	PASS
450.5	25000	25	GMSK 19200bps	44.00	1.00	PASS
469.5	25000	25	GMSK 19200bps	43.98	1.00	PASS
406.6	35000	25	GMSK 19200bps	45.73	1.00	PASS
429.5	35000	25	GMSK 19200bps	45.67	1.00	PASS
440.0	35000	25	GMSK 19200bps	45.45	1.00	PASS
450.5	35000	25	GMSK 19200bps	45.27	1.00	PASS
469.5	35000	25	GMSK 19200bps	45.34	1.00	PASS

Measurement figures 12.5 kHz and 25 kHz channel width

Figure 2: 406.6 MHz, GMSK 9600 bps, 12.5 kHz, 1W

Figure 3: 406.6 MHz, GMSK 19200 bps, 25 kHz, 1W

Occupied bandwidth

Standard: ANSI C63.26-2015
Tested by: HAM HAM
Date: 3 July 2023 10 July 2023
Temperature: 22 °C 23 °C
Humidity: 52 % RH 39 % RH
Barometric pressure: 989 hPa 1021 hPa
Measurement uncertainty: ± 0.0005 %, level of confidence 95.45 % (k = 2)
Test result: **PASS**

FCC Rule: §90.210
RSS-119 5.5

The occupied bandwidth is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

The maximum permissible occupied bandwidth shall not exceed the authorized bandwidth specified for the equipment's frequency band. The authorized bandwidth is defined as the maximum width of the band of frequencies used to derive spectrum masks and is not necessarily equivalent to the bandwidth found on radio and spectrum licenses.

Frequency Band (MHz)	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)
406.1 - 470	12.5	11.25
	25	20

Test results

Table 5: Occupied bandwidth test results

Frequency [MHz]	TX power [mW]	Ch. Width [kHz]	Modulation	OBW 99% [kHz]	Limit [kHz]	Result
406.6	35000	12.5	GMSK 9600 bps	8.738476923	11.25	PASS
429.5	35000	12.5	GMSK 9600 bps	8.742851786	11.25	PASS
440.0	35000	12.5	GMSK 9600 bps	8.739726884	11.25	PASS
450.5	35000	12.5	GMSK 9600 bps	8.737851942	11.25	PASS
469.5	35000	12.5	GMSK 9600 bps	8.740976844	11.25	PASS
406.6	35000	25	GMSK 19200 bps	14.988594106	20	PASS
429.5	35000	25	GMSK 19200 bps	14.990156558	20	PASS
440.0	35000	25	GMSK 19200 bps	14.987031655	20	PASS
450.5	35000	25	GMSK 19200 bps	14.980781851	20	PASS
469.5	35000	25	GMSK 19200 bps	14.994843911	20	PASS

Measurement figures 12.5 kHz and 25 kHz channel width

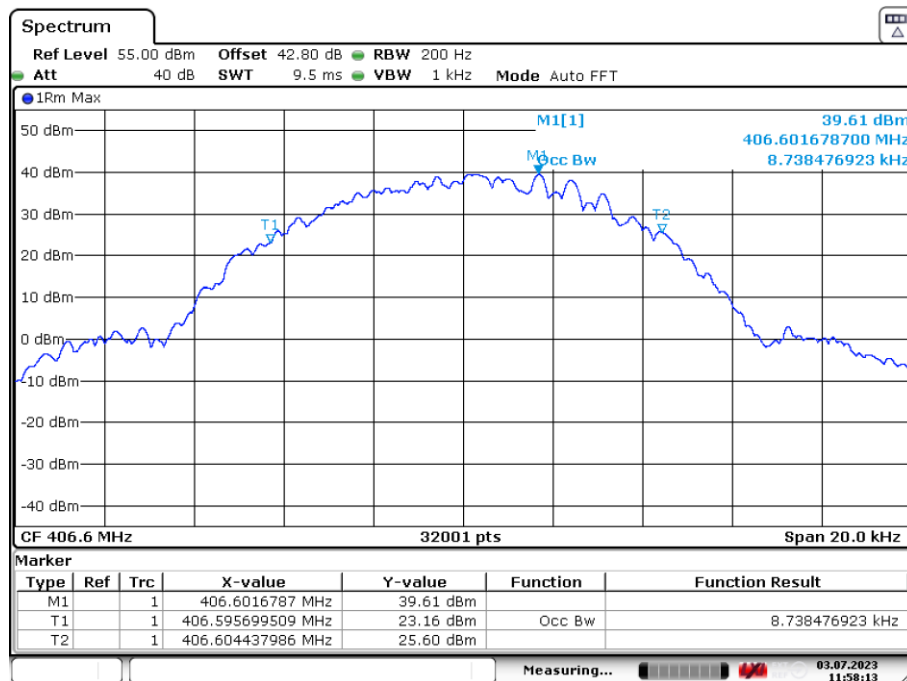


Figure 4: 406.6 MHz, GMSK 9600 bps, 12.5 kHz, 35 W

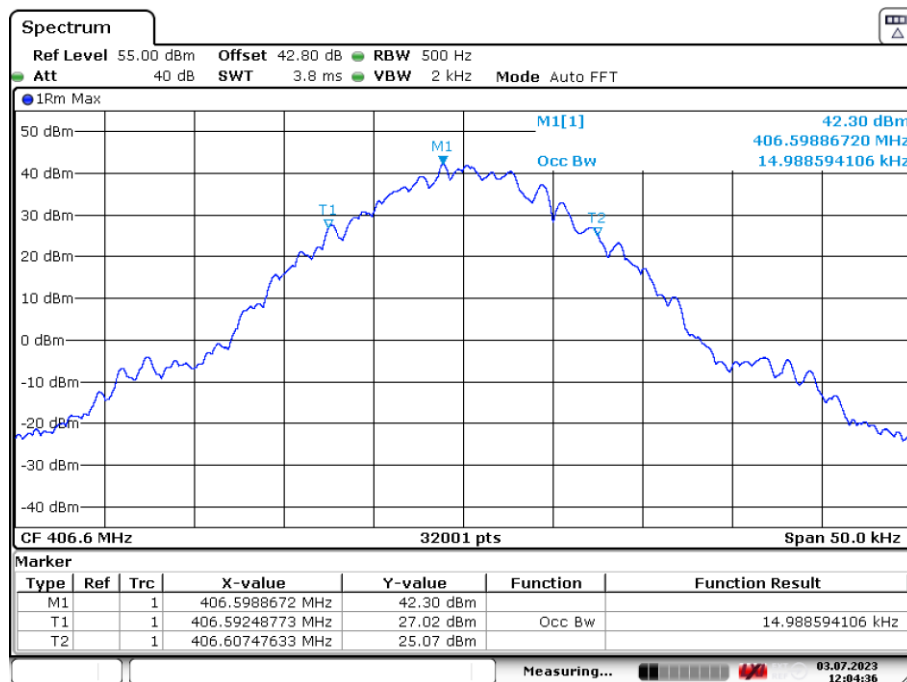


Figure 5: 406.6 MHz, GMSK 19200 bps, 25 kHz, 35 W

Spurious emission mask

Standard:	ANSI C63.26-2015
Tested by:	PKA
Date:	15 August 2023
Temperature:	23 °C
Humidity:	55 % RH
Barometric pressure:	1012 hPa
Measurement uncertainty:	± 2.90 dB (level of confidence 95.45 % (k = 2))
Test result:	PASS

FCC Rule: §90.210
RSS-119 5.5

Emission Mask C. 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:

- 1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz, but not more than 10 kHz: At least $83 \log(f_d/5)$ dB
- 2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least $29 \log(f_d^2/11)$ dB or 50 dB, whichever is the lesser attenuation
- 3) 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

Emission Mask D – 12.5 kHz channel bandwidth equipment. 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:

- 1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB
- 2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB
- 3) 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

Test Results

Frequency [MHz]	TX power [mW]	Ch. Width [kHz]	Modulation	Mask	Result
406.6	35000	12.5	GMSK 9600	D	PASS
429.5	35000	12.5	GMSK 9600	D	PASS
440.0	35000	12.5	GMSK 9600	D	PASS
450.5	35000	12.5	GMSK 9600	D	PASS
469.5	35000	12.5	GMSK 9600	D	PASS
406.6	35000	25.0	GMSK 19200	C	PASS
429.5	35000	25.0	GMSK 19200	C	PASS
440.0	35000	25.0	GMSK 19200	C	PASS
450.5	35000	25.0	GMSK 19200	C	PASS
469.5	35000	25.0	GMSK 19200	C	PASS

Emission Mask D, GMSK 9600 bps, Ch Width 12.5 kHz

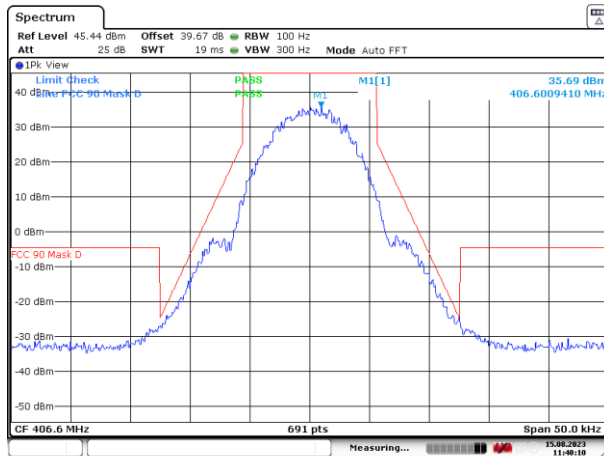


Figure 6: 406.6 MHz

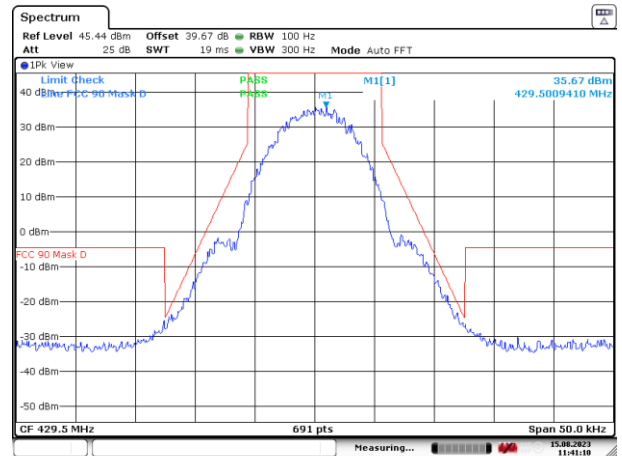


Figure 7: 429.5 MHz

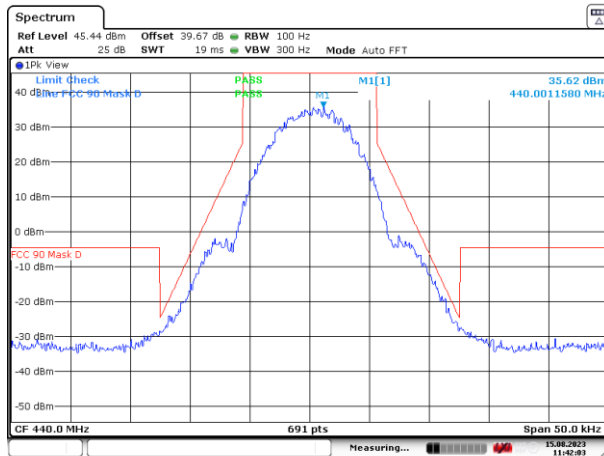


Figure 8: 440.0 MHz

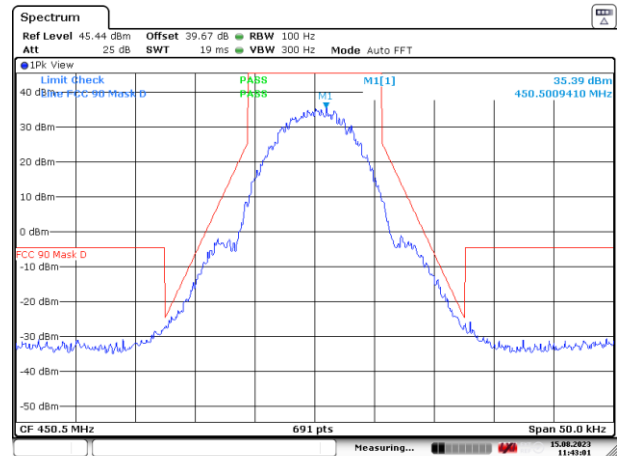


Figure 9: 450.5 MHz

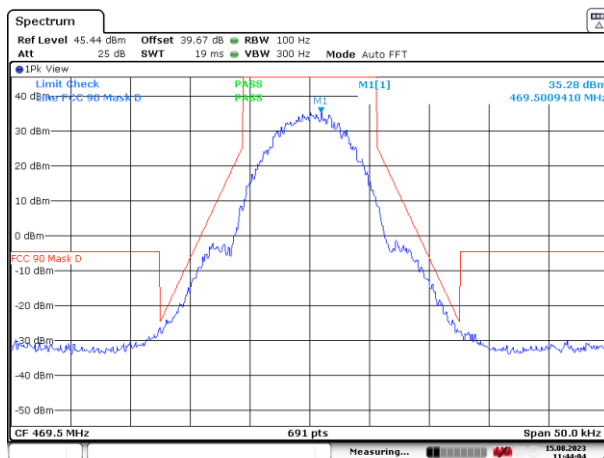


Figure 10: 469.5 MHz

Emission Mask C, GMSK 19200 bps, Ch Width 25 kHz

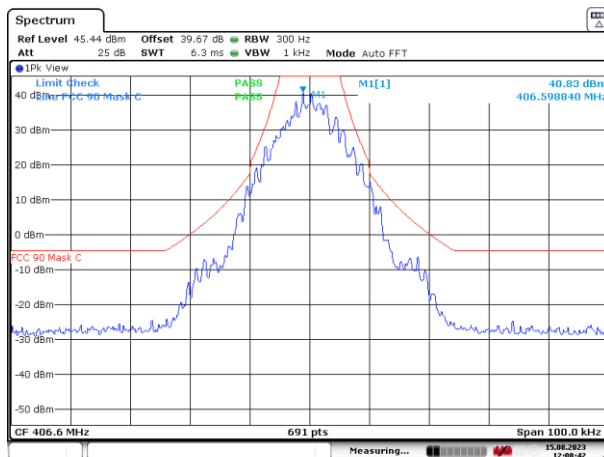


Figure 11: 406.6 MHz

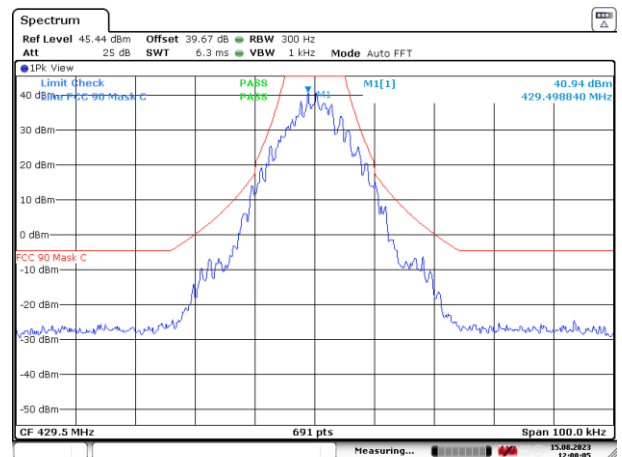


Figure 12: 429.5 MHz

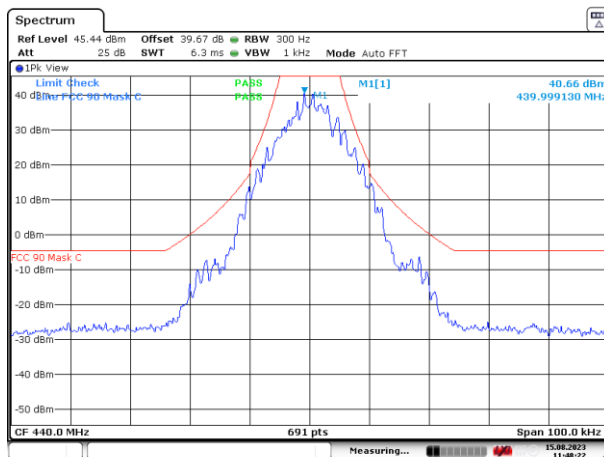


Figure 13: 440.0 MHz

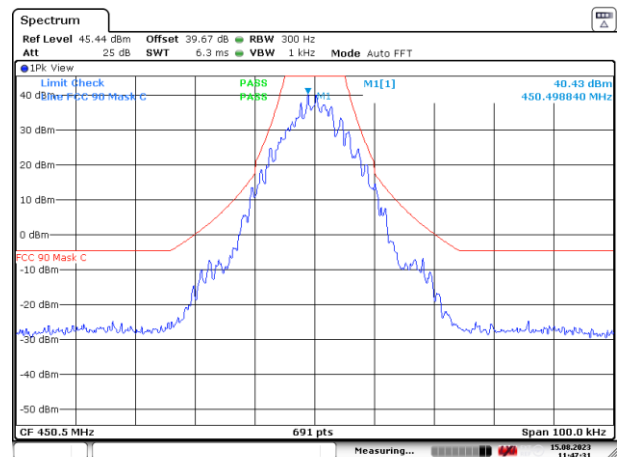


Figure 14: 450.5 MHz

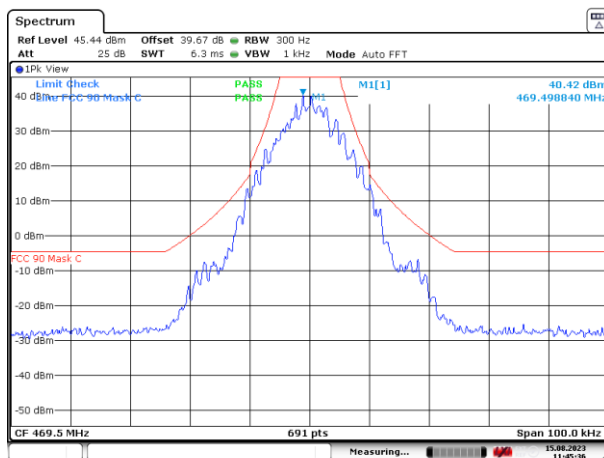


Figure 15: 469.5 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

Spurious emissions (conducted) 9 kHz – 5 GHz

Standard:	ANSI C63.26-2015	
Tested by:	HAM	HAM
Date:	4 July 2023	10 July 2023
Temperature:	25 °C	23 °C
Humidity:	42 % RH	39 % RH
Barometric pressure:	998 hPa	1021 hPa
Measurement uncertainty:	± 2.90 dB, level of confidence 95.45 % (k = 2)	
Test result:	PASS	

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 - 470	12.5	11.25	-20
	25	20	-13

The test was performed at maximum power level.

Spurious emissions (conducted) 9 kHz – 5 GHz
Test Results

Frequency [MHz]	TX power [mW]	Ch. Width [kHz]	Modulation	Result
406.6	35000	12.5	GMSK 9600	PASS
429.5	35000	12.5	GMSK 9600	PASS
440.0	35000	12.5	GMSK 9600	PASS
450.5	35000	12.5	GMSK 9600	PASS
469.5	35000	12.5	GMSK 9600	PASS
406.6	35000	25.0	GMSK 19200	PASS
429.5	35000	25.0	GMSK 19200	PASS
440.0	35000	25.0	GMSK 19200	PASS
450.5	35000	25.0	GMSK 19200	PASS
469.5	35000	25.0	GMSK 19200	PASS

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 406.6 MHz, GMSK 9600 bps, Ch Width 12.5 kHz

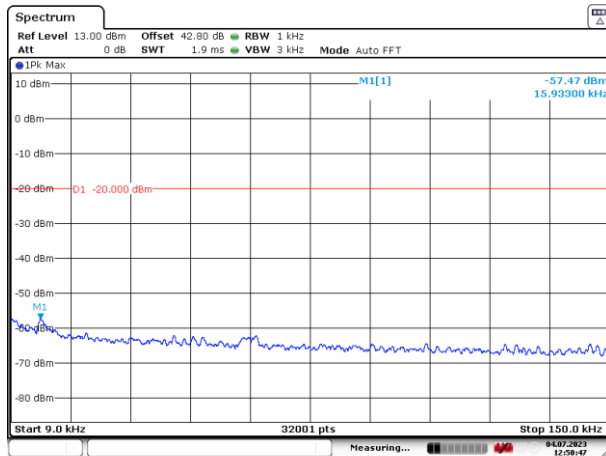


Figure 16: 9 – 150 kHz

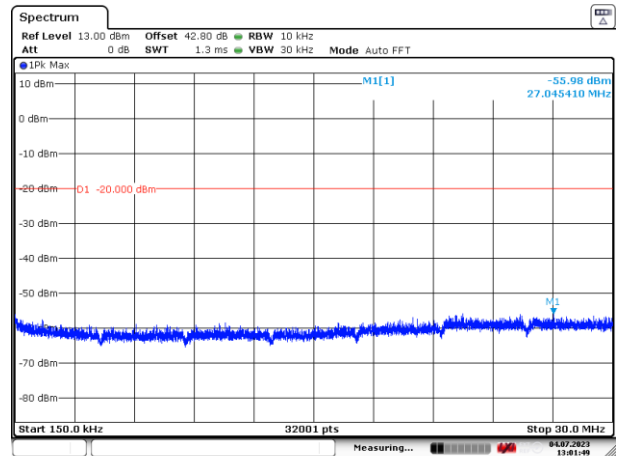


Figure 17: 150 kHz – 30 MHz

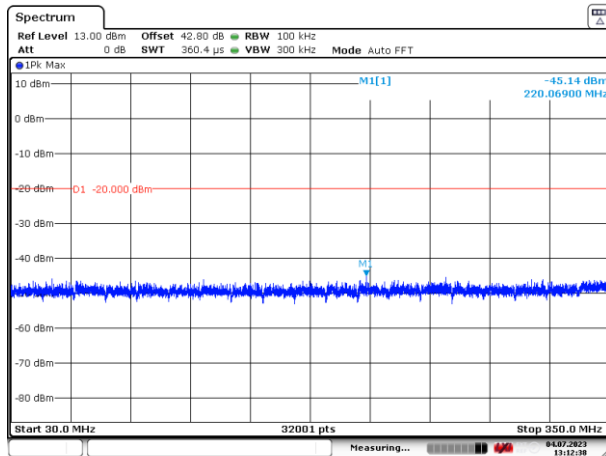


Figure 18: 30 – 350 MHz

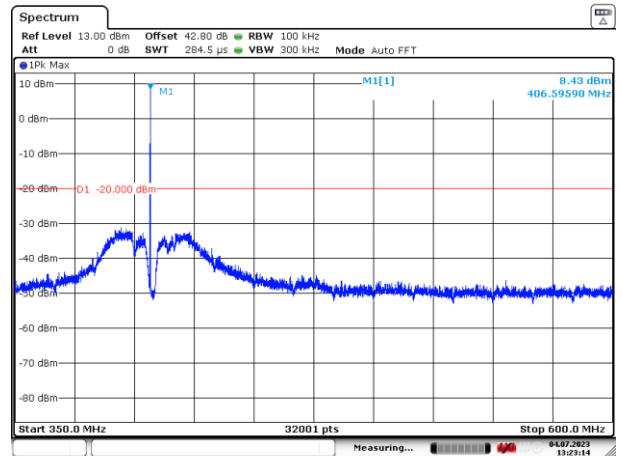


Figure 19: 350 – 600 MHz

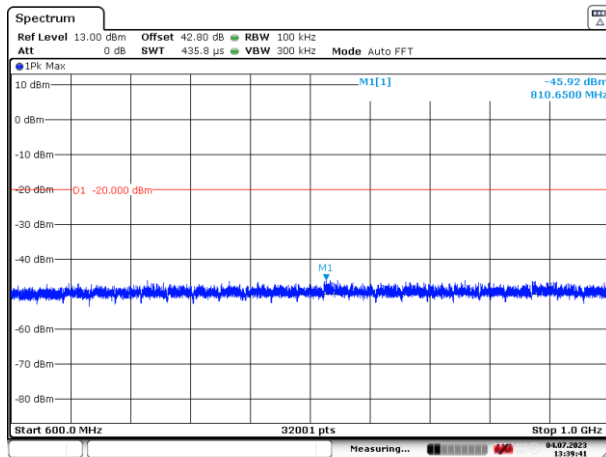


Figure 20: 600 – 1000 MHz

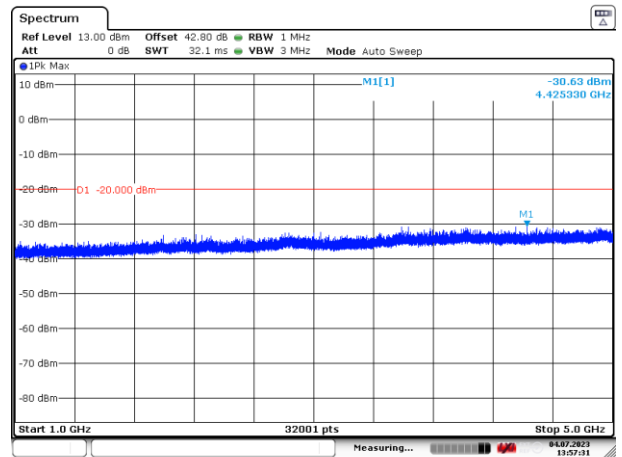


Figure 21: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 429.5 MHz, GMSK 9600 bps, Ch Width 12.5 kHz

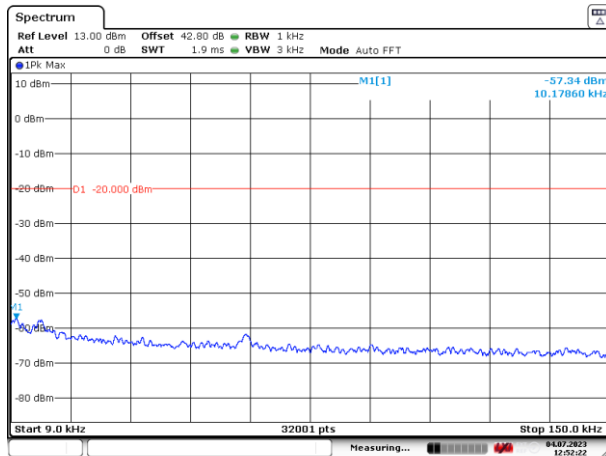


Figure 22: 9 – 150 kHz

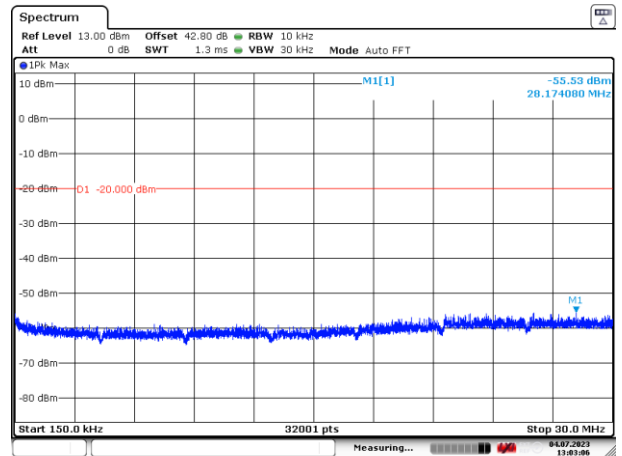


Figure 23: 150 kHz – 30 MHz

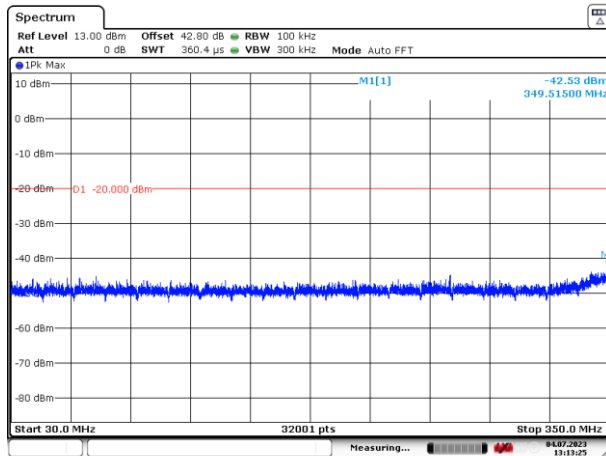


Figure 24: 30 – 350 MHz

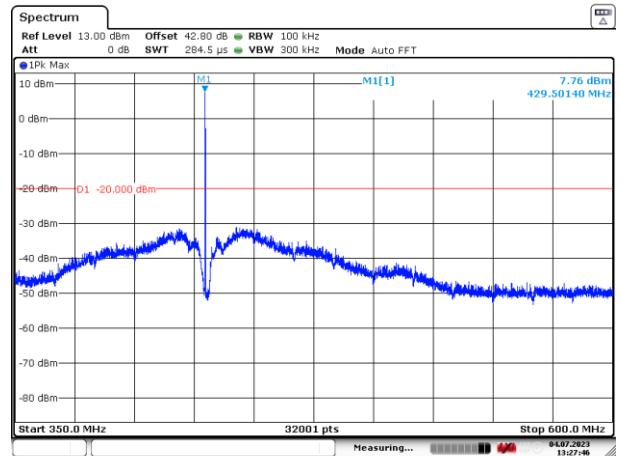


Figure 25: 350 – 600 MHz

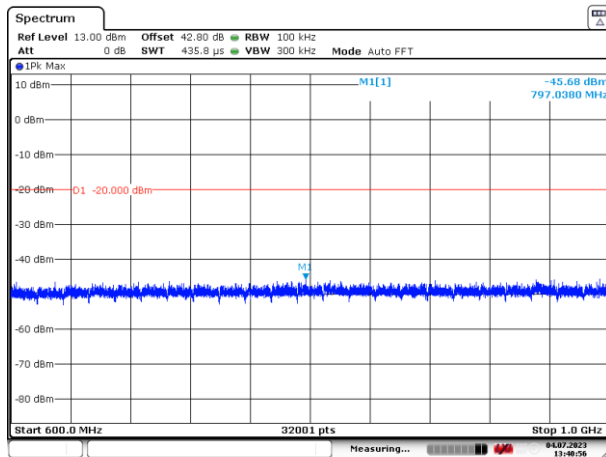


Figure 26: 600 – 1000 MHz

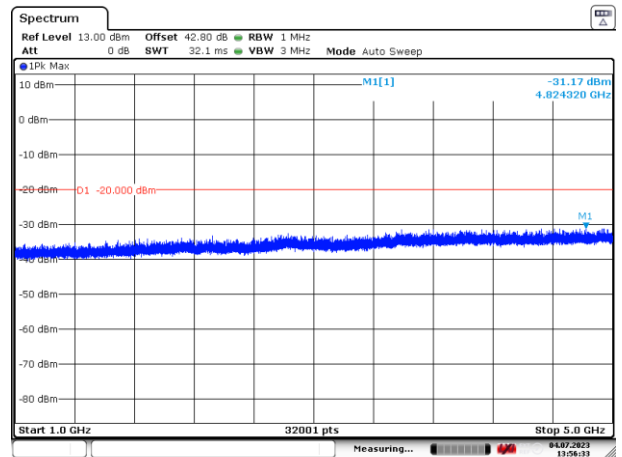


Figure 27: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 440.0 MHz, GMSK 9600 bps, Ch Width 12.5 kHz

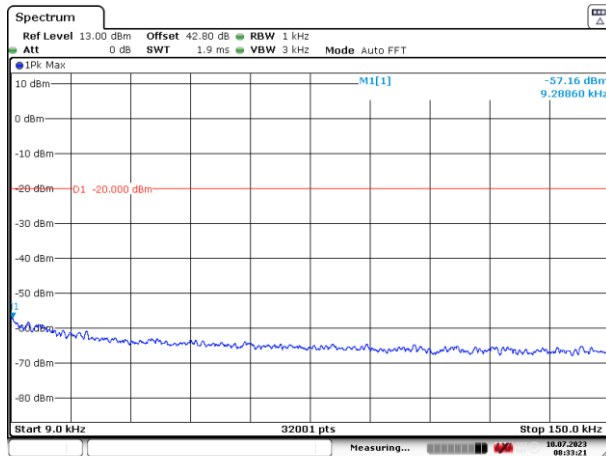


Figure 28: 9 – 150 kHz

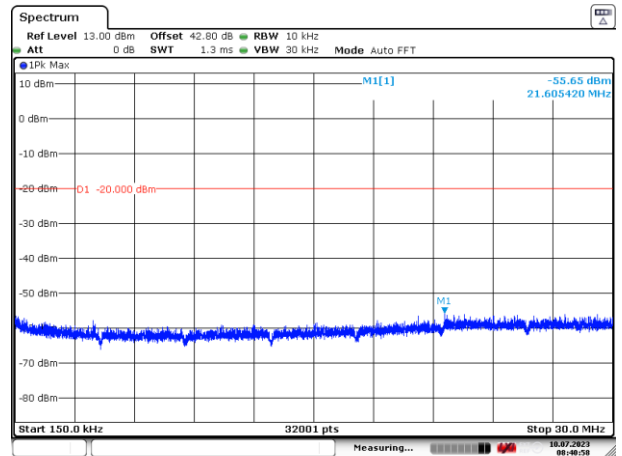


Figure 29: 150 kHz – 30 MHz

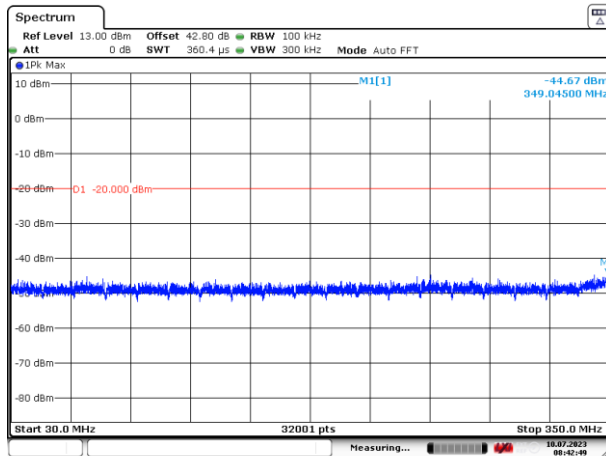


Figure 30: 30 – 350 MHz

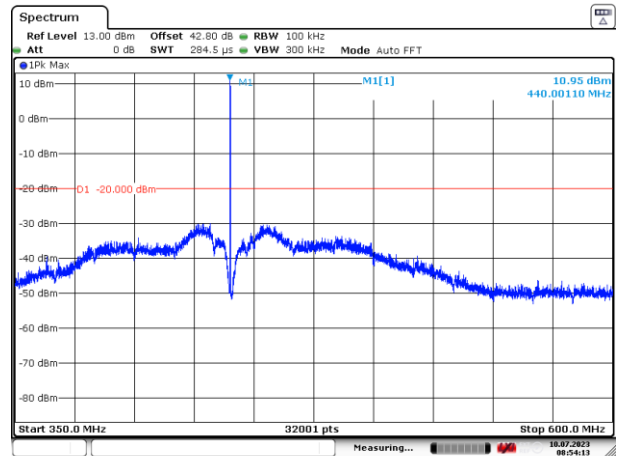


Figure 31: 350 – 600 MHz

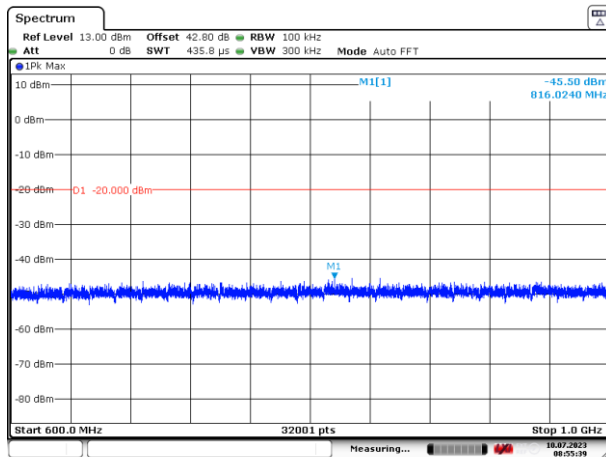


Figure 32: 600 – 1000 MHz

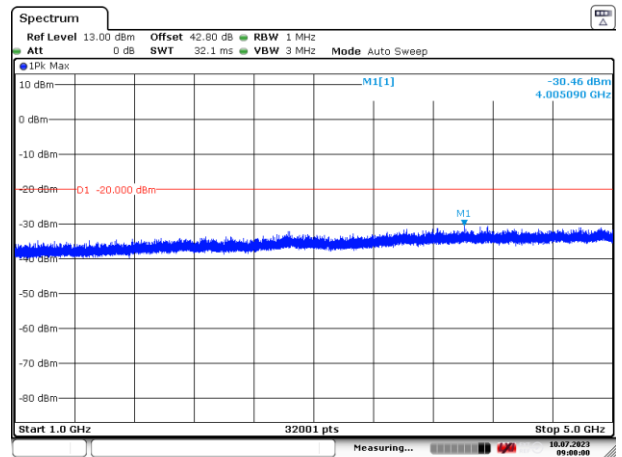


Figure 33: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 450.5 MHz, GMSK 9600 bps, Ch Width 12.5 kHz

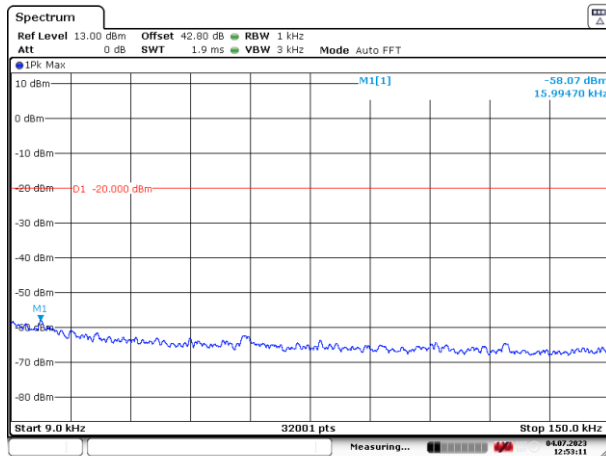


Figure 34: 9 – 150 kHz

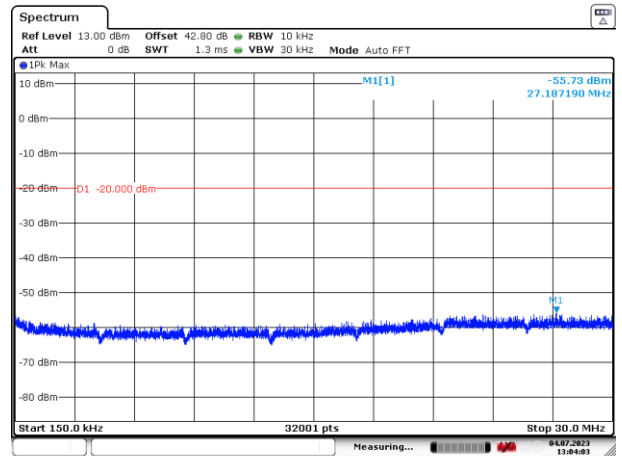


Figure 35: 150 kHz – 30 MHz

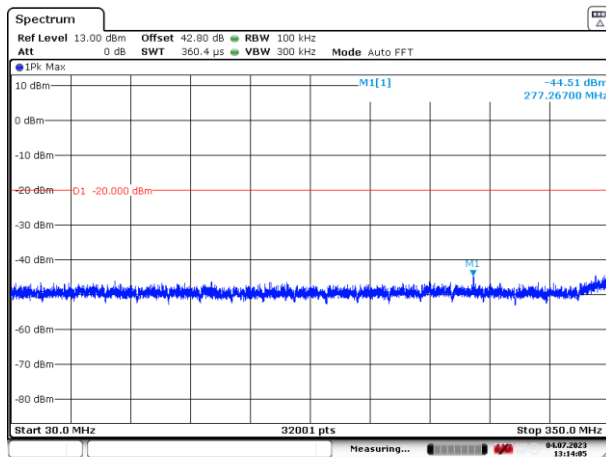


Figure 36: 30 – 350 MHz

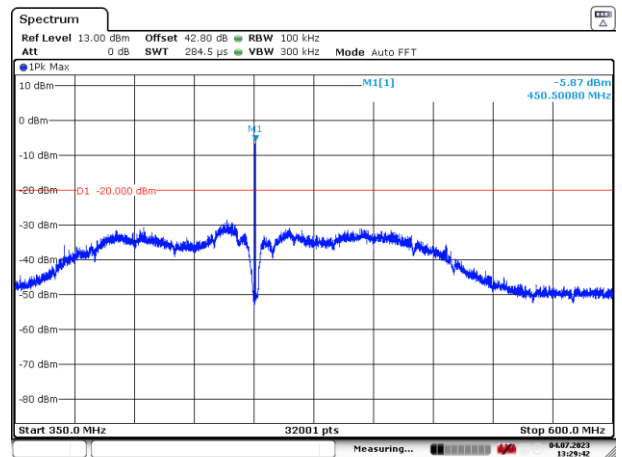


Figure 37: 350 – 600 MHz

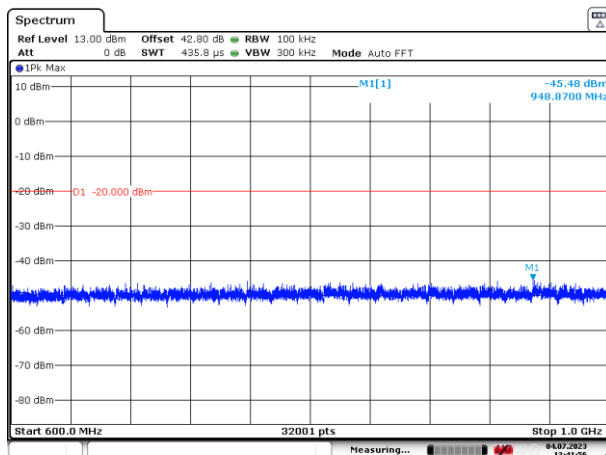


Figure 38: 600 – 1000 MHz

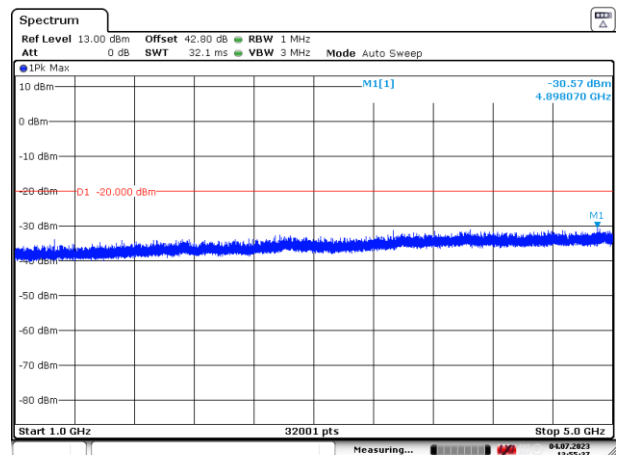


Figure 39: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 469.5 MHz, GMSK 9600 bps, Ch Width 12.5 kHz

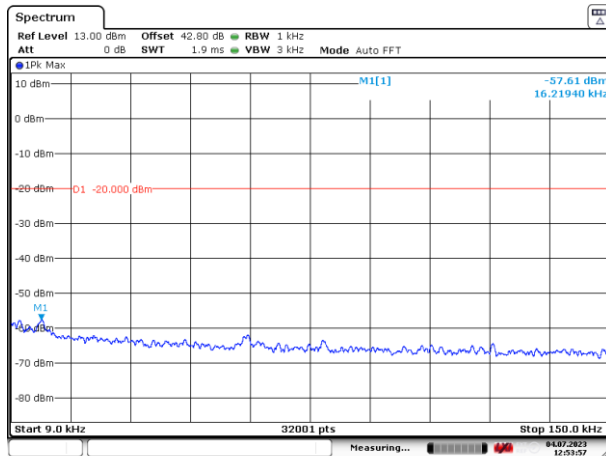


Figure 40: 9 – 150 kHz

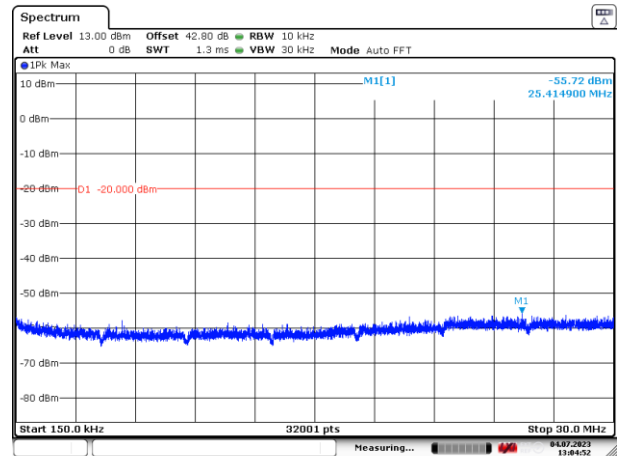


Figure 41: 150 kHz – 30 MHz

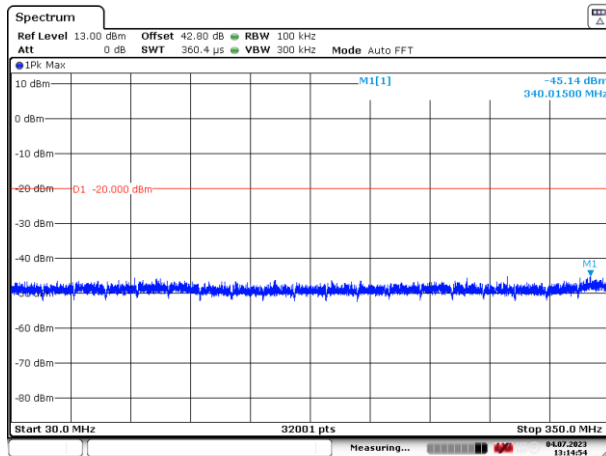


Figure 42: 30 – 350 MHz

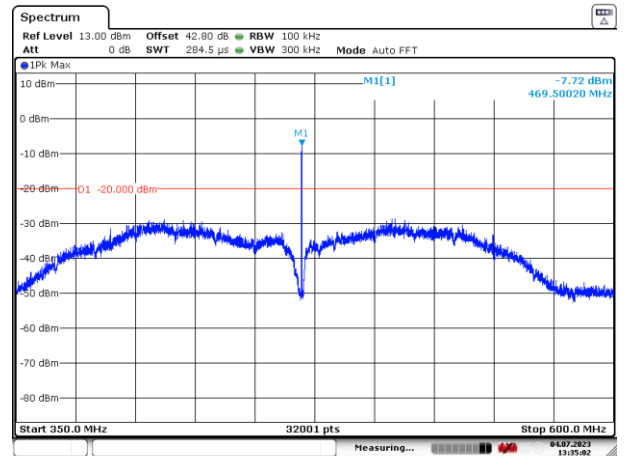


Figure 43: 350 – 600 MHz

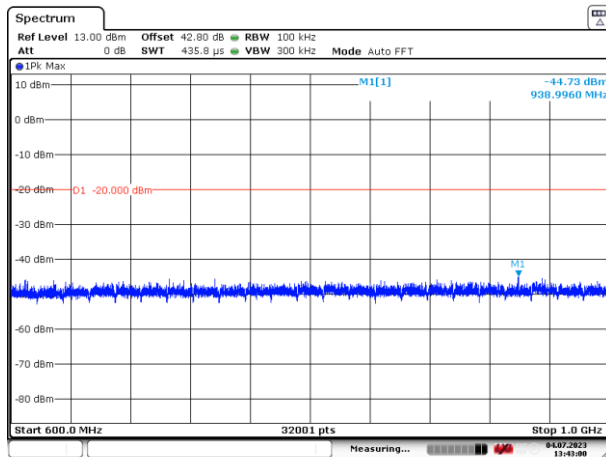


Figure 44: 600 – 1000 MHz

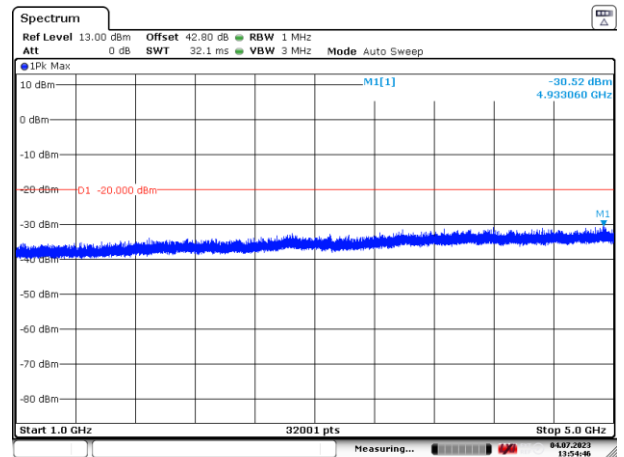


Figure 45: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 406.6 MHz, GMSK 9600 bps, Ch Width 25 kHz

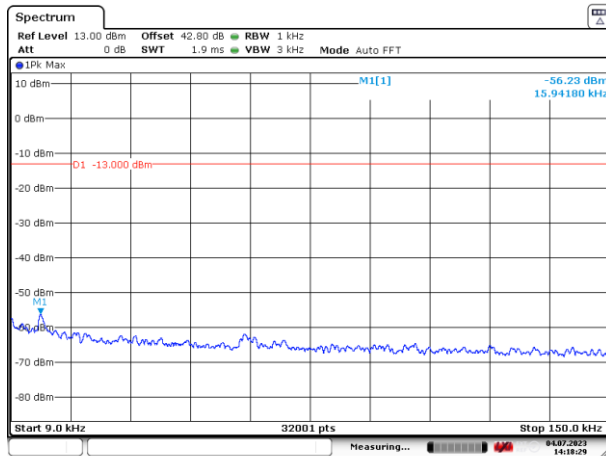


Figure 46: 9 – 150 kHz

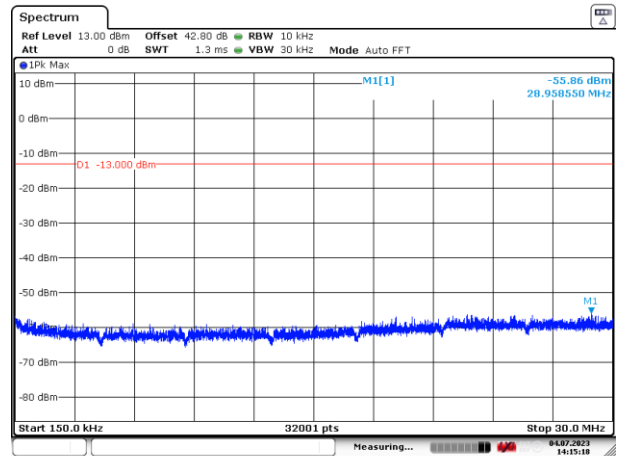


Figure 47: 150 kHz – 30 MHz

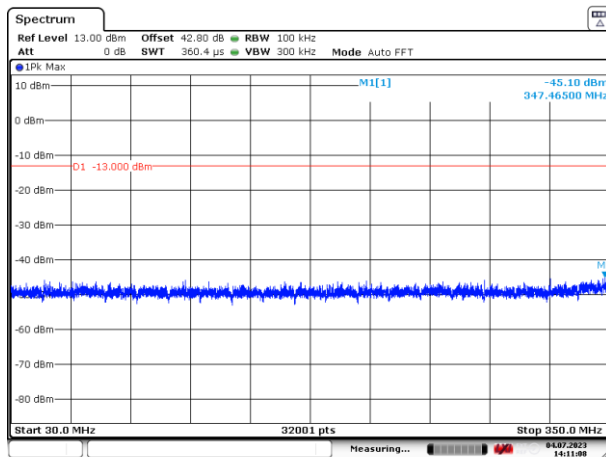


Figure 48: 30 – 350 MHz

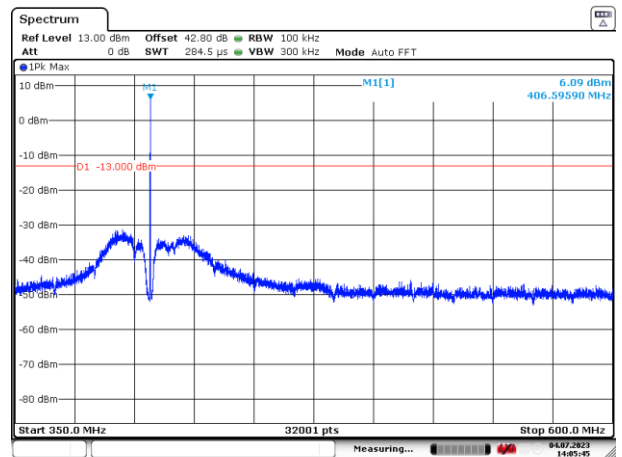


Figure 49: 350 – 600 MHz

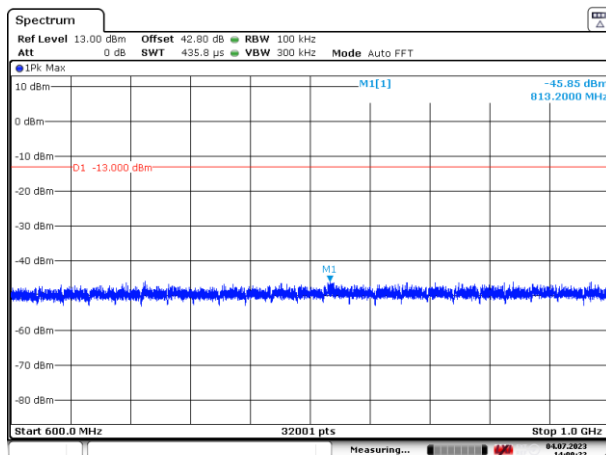


Figure 50: 600 – 1000 MHz

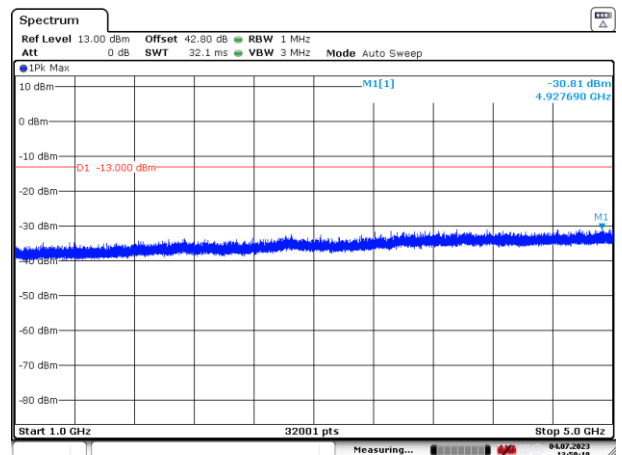


Figure 51: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 429.5 MHz, GMSK 9600 bps, Ch Width 25 kHz

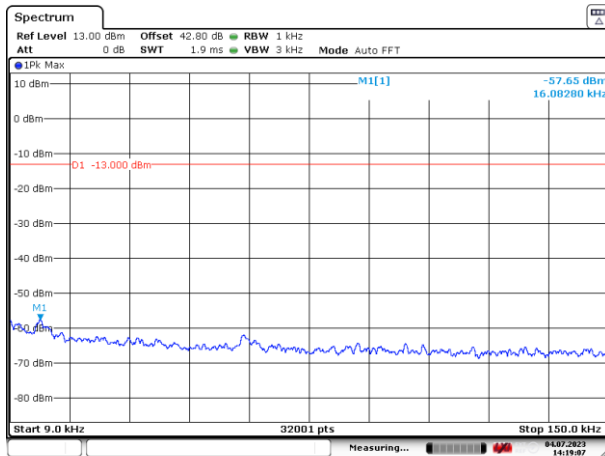


Figure 52: 9 – 150 kHz

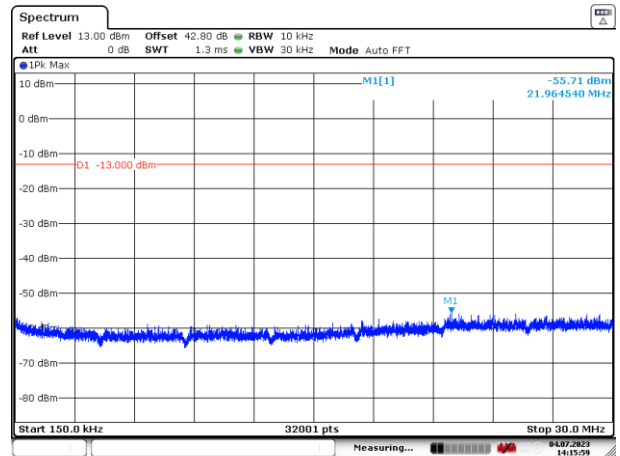


Figure 53: 150 kHz – 30 MHz

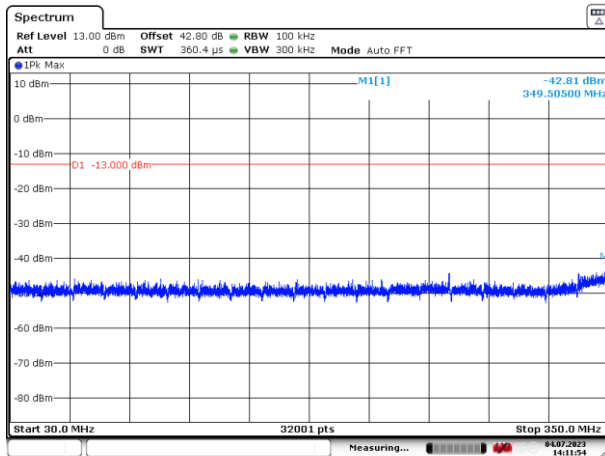


Figure 54: 30 – 350 MHz

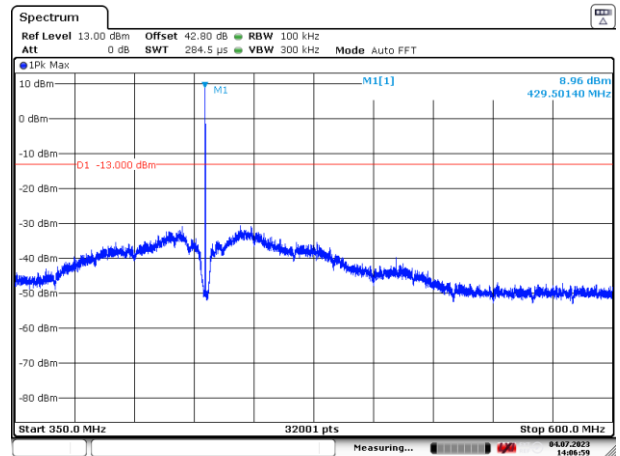


Figure 55: 350 – 600 MHz

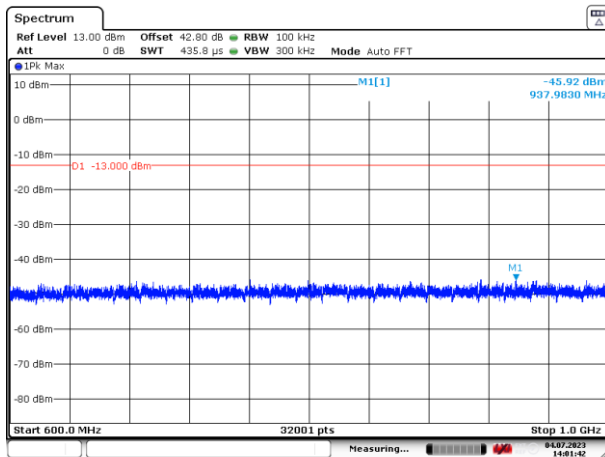


Figure 56: 600 – 1000 MHz

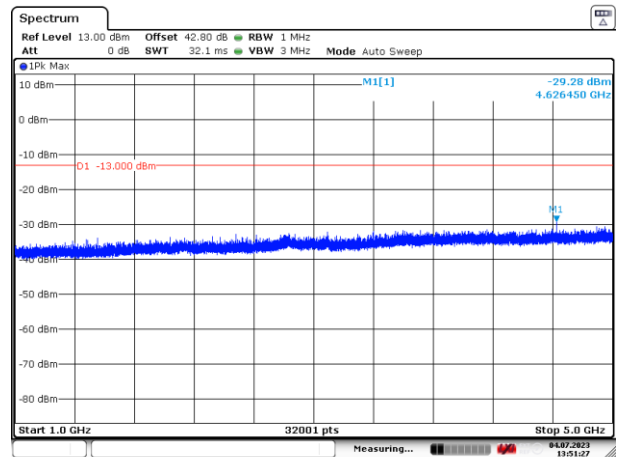


Figure 57: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 440.0 MHz, GMSK 9600 bps, Ch Width 25 kHz

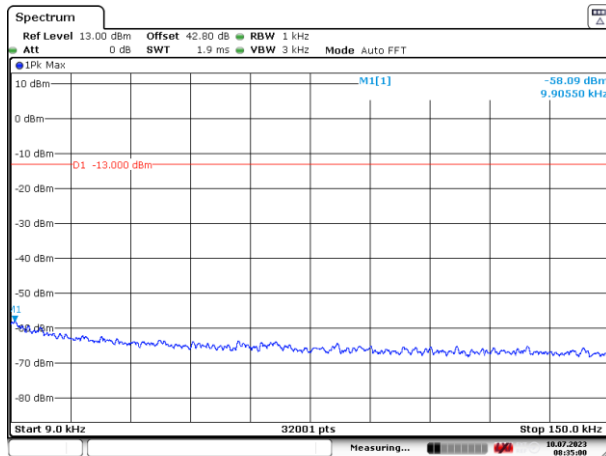


Figure 58: 9 – 150 kHz

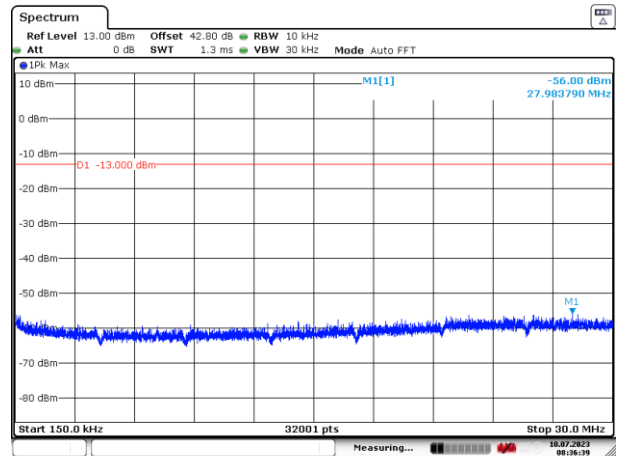


Figure 59: 150 kHz – 30 MHz

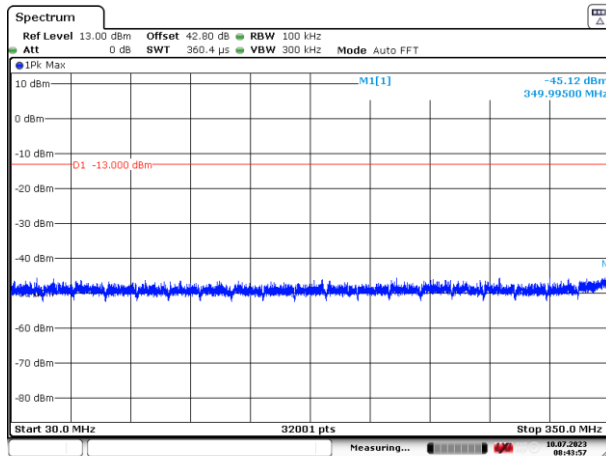


Figure 60: 30 – 350 MHz

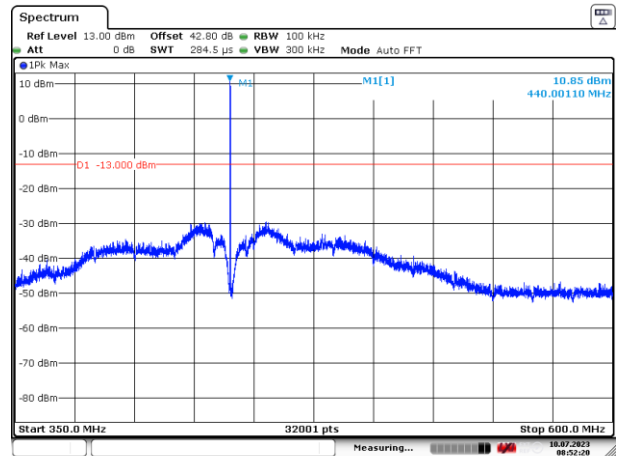


Figure 61: 350 – 600 MHz

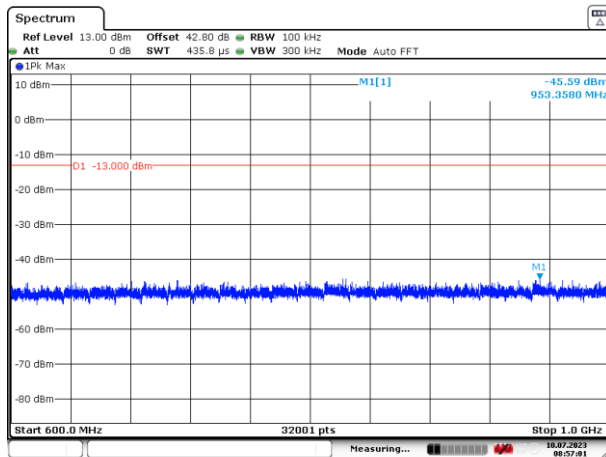


Figure 62: 600 – 1000 MHz

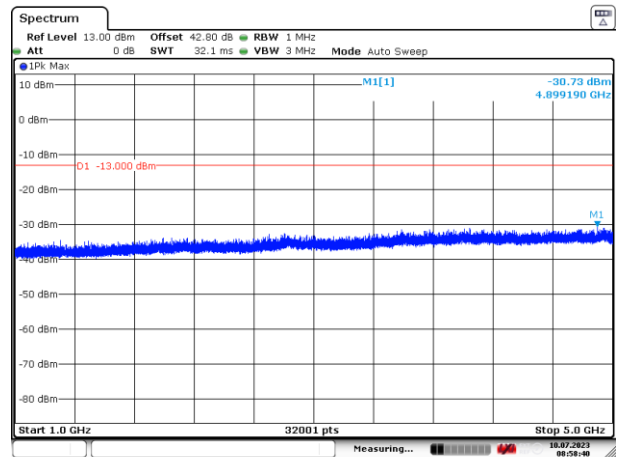


Figure 63: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 450.5 MHz, GMSK 9600 bps, Ch Width 25 kHz

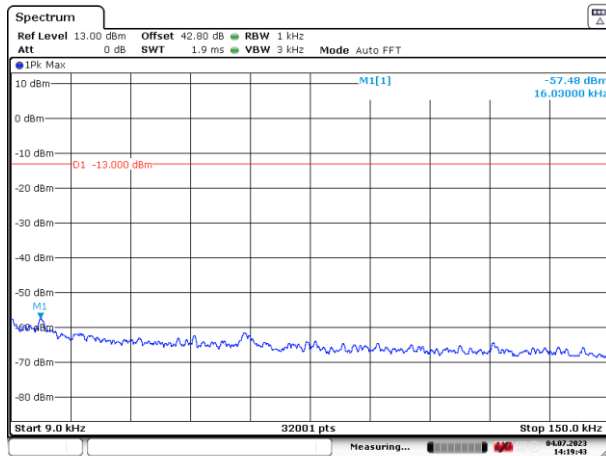


Figure 64: 9 – 150 kHz

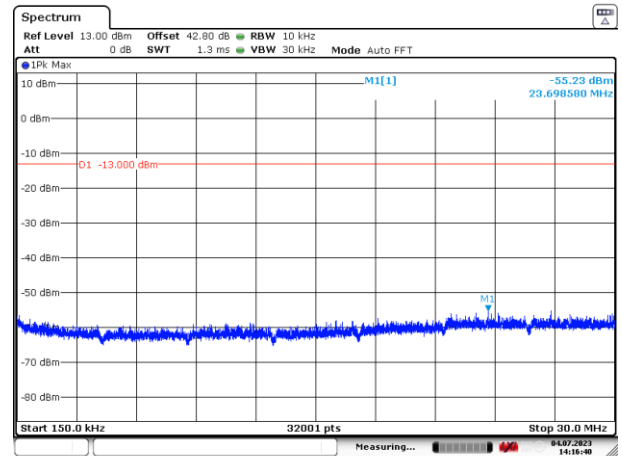


Figure 65: 150 kHz – 30 MHz

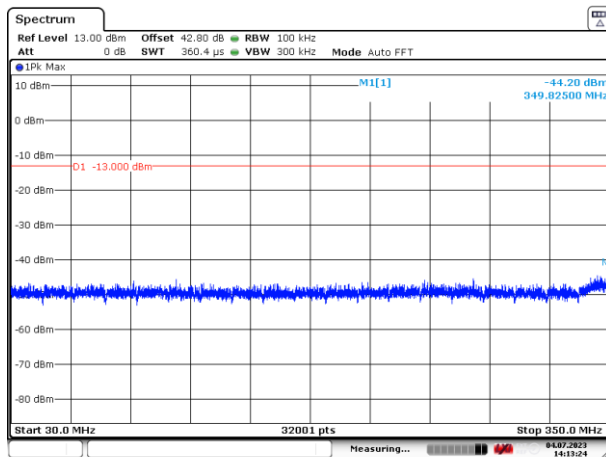


Figure 66: 30 – 350 MHz

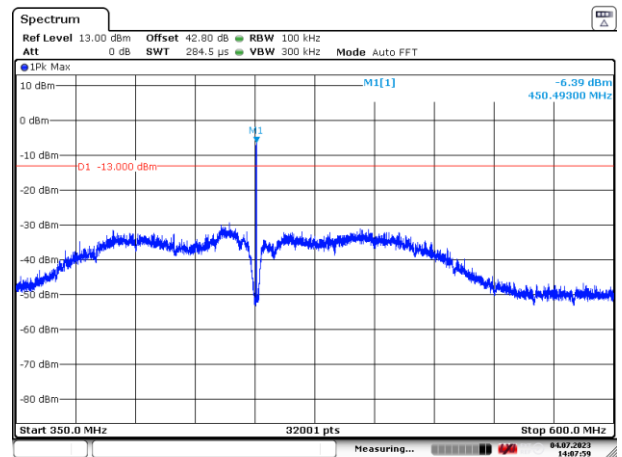


Figure 67: 350 – 600 MHz

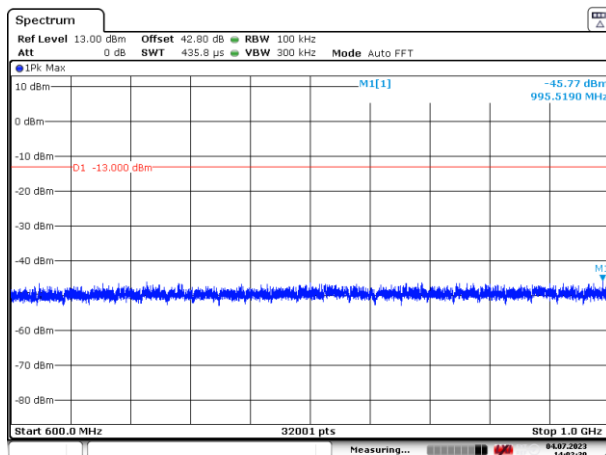


Figure 68: 600 – 1000 MHz

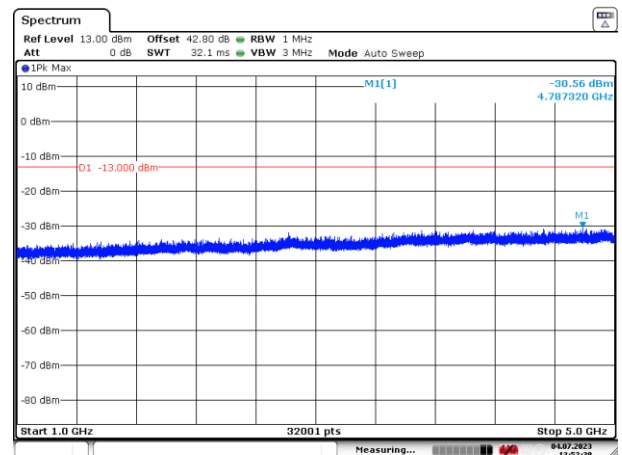


Figure 69: 1000 – 5000 MHz

Spurious emissions (conducted) 9 kHz – 5 GHz

TX 469.5 MHz, GMSK 9600 bps, Ch Width 25 kHz

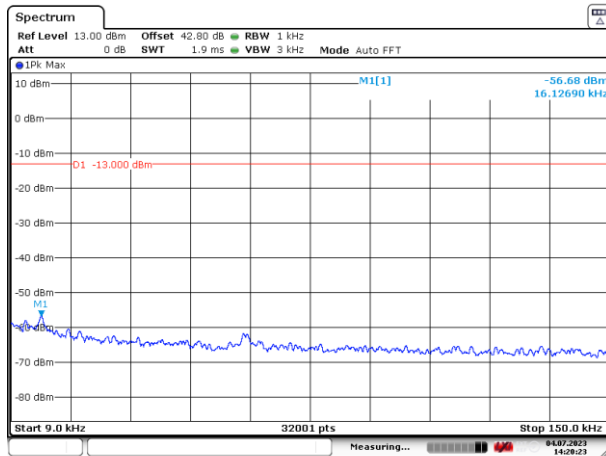


Figure 70: 9 – 150 kHz

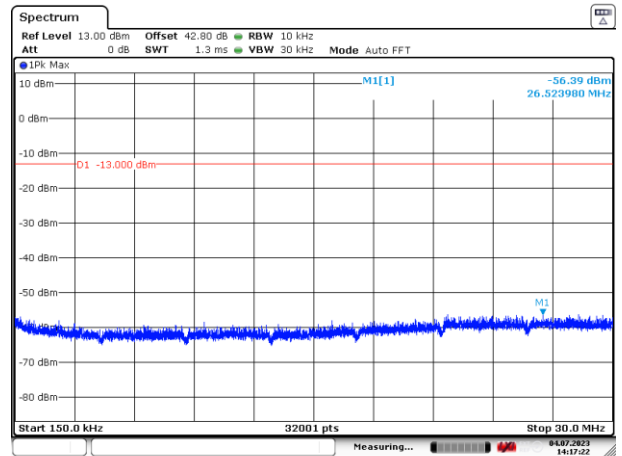


Figure 71: 150 kHz – 30 MHz

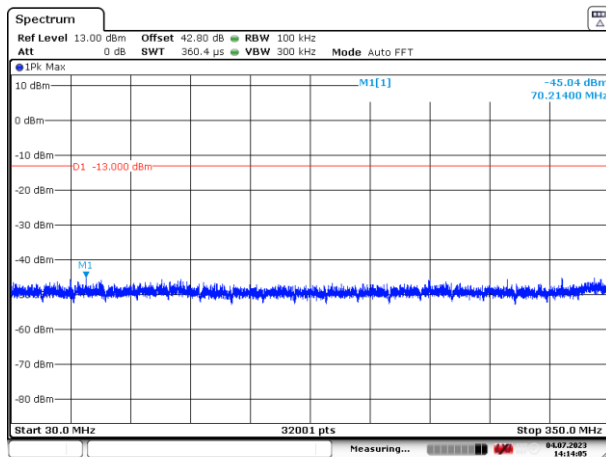


Figure 72: 30 – 350 MHz

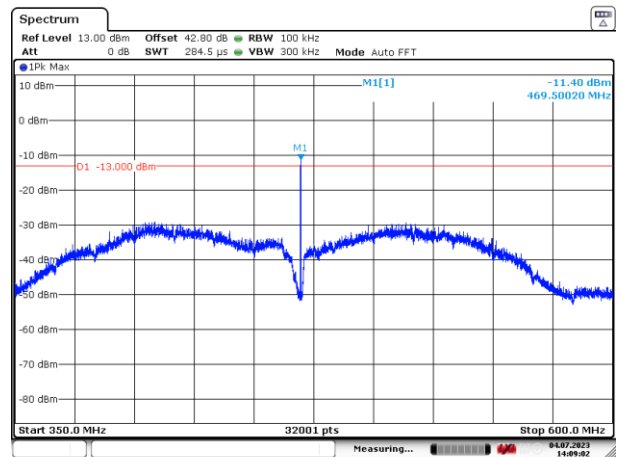


Figure 73: 350 – 600 MHz

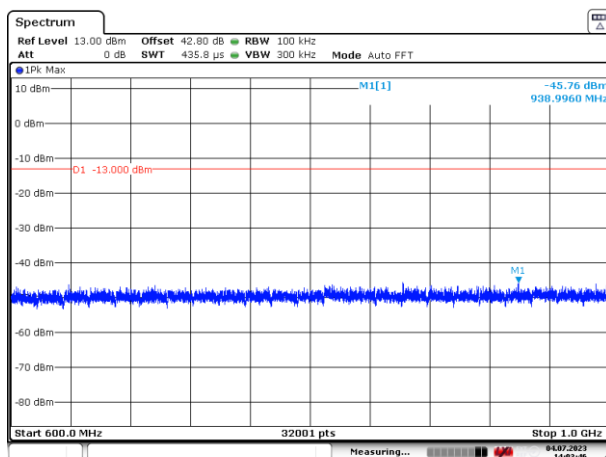


Figure 74: 600 – 1000 MHz

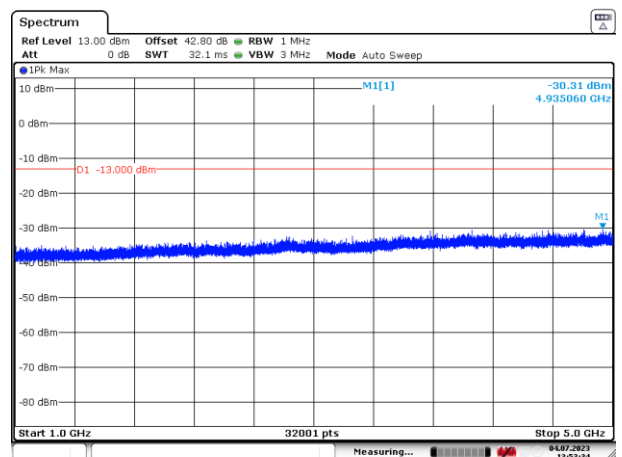


Figure 75: 1000 – 5000 MHz