
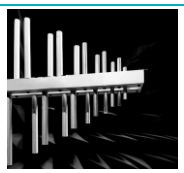
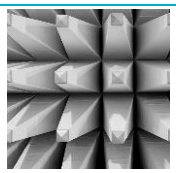

CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-2594/21-01-04

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

Continental Automotive GmbH
Heinrich-Hertz-Str. 45
78052 Villingen-Schwenningen / GERMANY
Phone: +49 7721 94 72-0
Contact: Marion Grüner
e-mail: Marion.Gruener@continental-corporation.com

Manufacturer

Continental Automotive GmbH
Heinrich-Hertz-Str. 45
78052 Villingen-Schwenningen / GERMANY

Test standard/s

FCC - Title 47 CFR Part 15	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 210 Issue 10	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**Access and Connected Car Module with Remote Cloud Key**
Model name:	**ACCM201-US4G-1B**
FCC ID:	**2AJW5ACCM**
IC:	**21979-ACCM**
Frequency:	312.0MHz to 318.0MHz, 431.9MHz to 435.9MHz, 868.1MHz to 868.5MHz, 902.375MHz to 927.675MHz
Technology tested:	proprietary
Antenna:	Integrated antenna
Power supply:	9 V to 18 V DC by battery
Temperature range:	-20°C to +55°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

cn=Christoph Schneider, o=CTC advanced GmbH, ou=SND-211129, email=christoph.schneider@ctcadvanced.com, c=DE
2021.12.13 12:13:51 +01'00'

Christoph Schneider
Lab Manager
Radio Communications

Test performed:

cn=Wolsdorfer Hans-Joachim, o=CTC advanced GmbH, ou=WLD-200810, email=joachim.wolsdorfer@ctcadvanced.com, c=DE
2021.12.10 13:34:26 +01'00'

Hans-Joachim Wolsdorfer
Lab Manager
Radio Communications

1 Table of contents

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

2.2 Application details

Date of receipt of order:	2021-06-01
Date of receipt of test item:	2021-08-11
Start of test:*	2021-08-11
End of test:*	2021-11-12
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 210 Issue 10	December 2019	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment
RSS - Gen Issue 5 incl. Amendment	March 2019	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

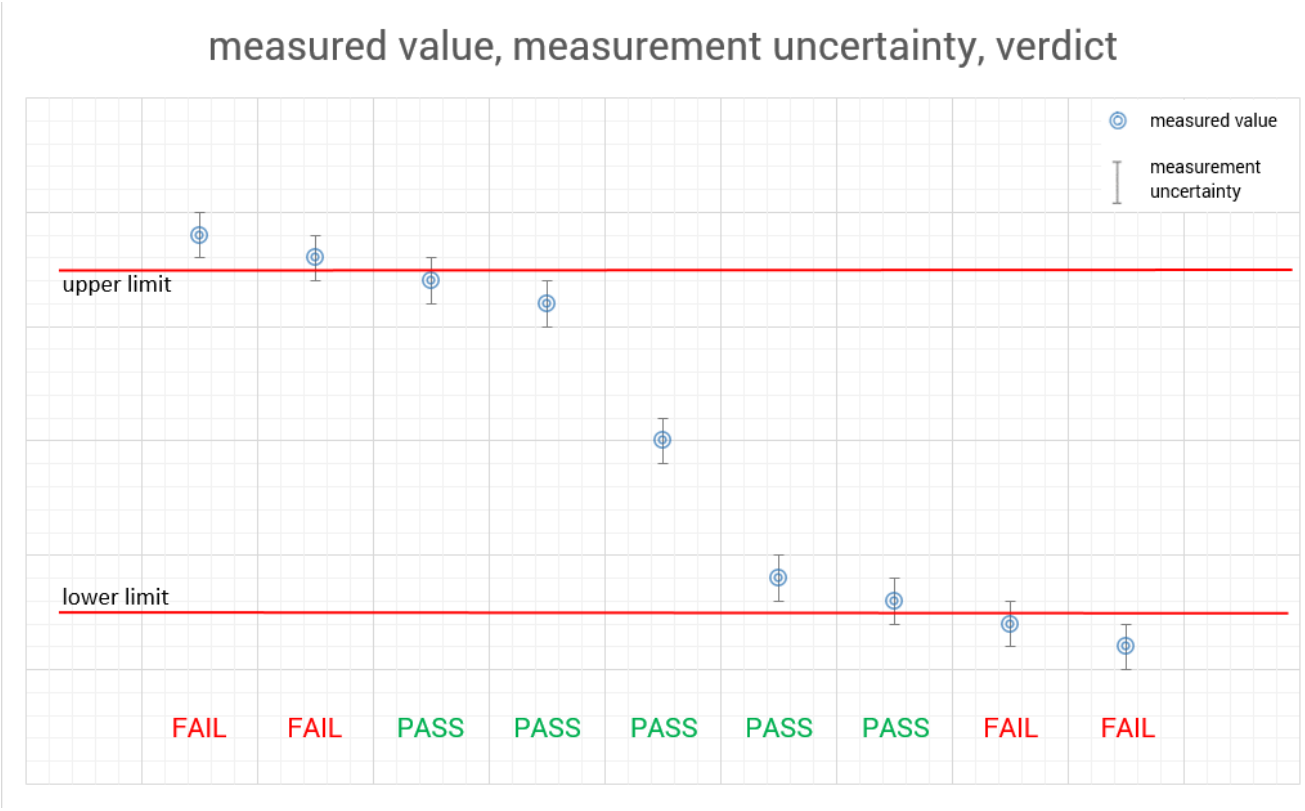
Guidance	Version	Description
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Accreditation	Description
D-PL-12076-01-04	Telecommunication and EMC Canada https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf

ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests +55 °C during high temperature tests -20 °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	12 V DC by battery 18 V 9 V

6 Test item

6.1 General description

Kind of test item	:	Access and Connected Car Module with Remote Cloud Key
Model name	:	ACCM201-US4G-1B
HMN	:	-/-
PMN	:	ACCM +
HVIN	:	ACCM +
FVIN	:	-/-
S/N serial number	:	Rad. ACCMb74fc589a882b6ab Cond. ACCMb74fc589a882b6ab
Hardware status	:	ACCM 6.0.11
Software status	:	-/-
Firmware status	:	-/-
Frequency band	:	312.0MHz to 318.0MHz, 431.9MHz to 435.9MHz, 868.1MHz to 868.5MHz, 902.375MHz to 927.675MHz
Type of radio transmission Use of frequency spectrum	: :	modulated carrier
Type of modulation	:	ASK, FSK
Number of channels	:	12
Antenna	:	Integrated antenna
Power supply	:	9 V to 18 V DC by battery
Temperature range	:	-20°C to +55°C

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report: 1-2594/21-01-01_AnnexA
1-2594/21-01-01_AnnexB
1-2594/21-01-01_AnnexD

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

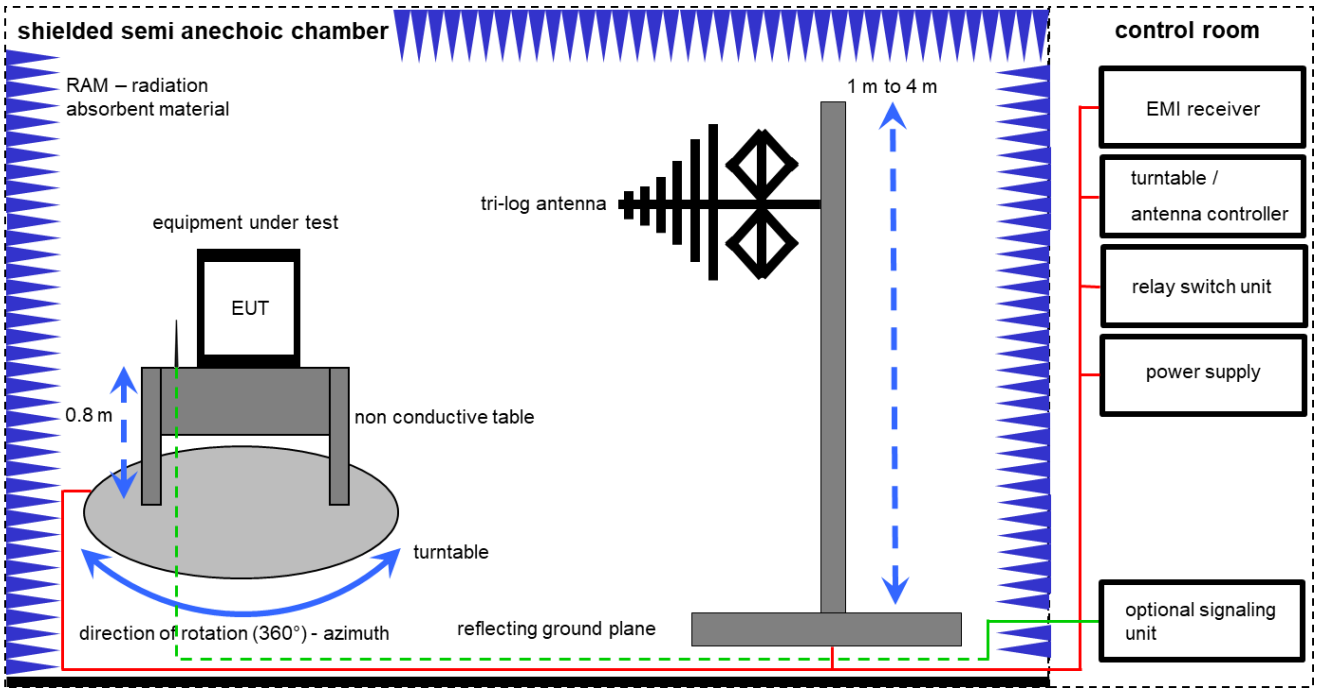
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter
EMC32 software version: 10.59.00

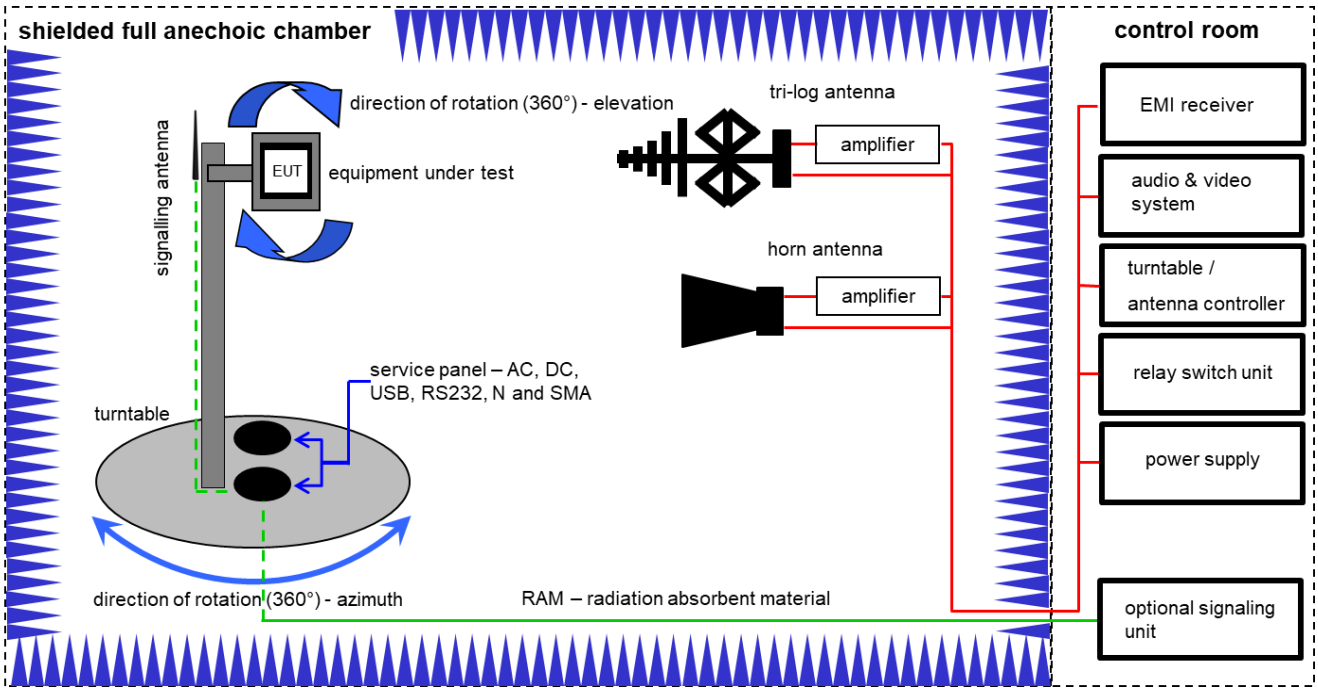
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
3	A	Semi anechoic chamber	3000023	MWB AG		300000551	ne	-/-	-/-
4	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
7	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	295	300003787	vIKI!	21.04.2021	20.04.2023
8	A	Turntable	2089-4.0	EMCO		300004394	ne	-/-	-/-
9	A	PC	TecLine	F+W		300004388	ne	-/-	-/-
10	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	10.12.2020	09.12.2021

7.2 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

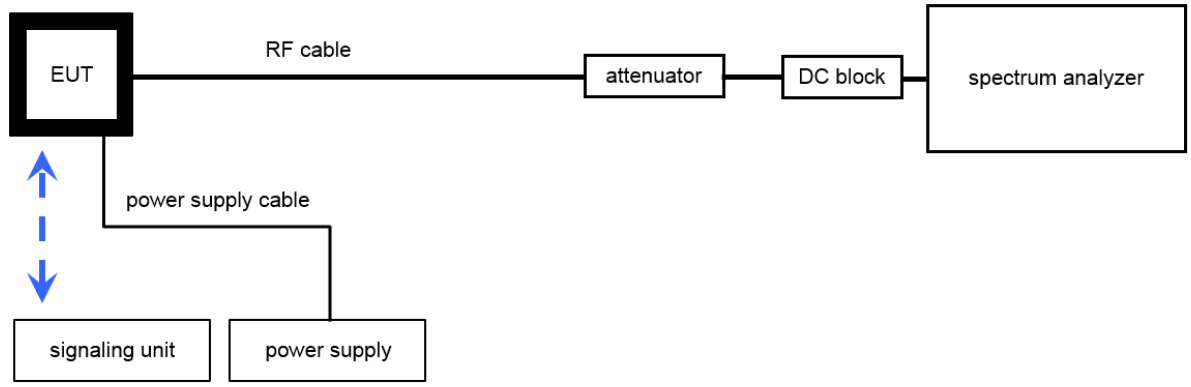
Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A,B	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vIKI!	09.12.2020	08.12.2023
2	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vIKI!	13.06.2019	12.06.2022
3	A,B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	vIKI!	12.03.2021	11.03.2023
5	A,B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
6	A,B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2020	10.12.2021
7	B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
8	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
9	A,B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
10	A,B	NEXIO EMV-Software	BAT EMC V3.20.0.26	EMCO		300004682	ne	-/-	-/-
11	A,B	PC	ExOne	F+W		300004703	ne	-/-	-/-

7.3 Conducted measurements

Conducted measurements normal conditions



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	RF Cable BNC	RG58	Huber & Suhner	-/-	400001209	ne	-/-	-/-
2	A	Power Supply	HMP2020	Rohde & Schwarz	101961	300006102	k	04.08.2020	03.08.2022
3	A	Signal analyzer	FSW26	Rohde&Schwarz	101455	300004528	k	25.02.2021	24.02.2022
4	A	Loop Antenna	-/-	ZEG TS Steinfurt	-/-	400001208	ne	-/-	-/-

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

*)Note: The sequence will be repeated three times with different EUT orientations.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

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9 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Occupied bandwidth	± used RBW
Field strength of the fundamental	± 3 dB
Field strength of the harmonics and spurious	± 3 dB
Receiver spurious emissions and cabinet radiations	± 3 dB
Conducted limits	± 2.6 dB

10 Summary of measurement results

☒	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☐	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15 RSS 210, Issue 10 RSS-Gen, Issue 5	See table!	2021-12-10	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	C	NC	NA	NP	Remark
§ 15.35 (c) RSS-Gen, Issue 5	Timing of the transmitter (Duty cycle correction factor)	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.231 (a) (1) RSS-210 Issue 10	Switch off time	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.231 (b) (3) (c) RSS-210 Issue 10	Emission bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.231 (b) RSS-210 Issue 10	Fieldstrength of Fundamental	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.209 RSS-210 Issue 10	Fieldstrength of harmonics and spurious	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.209 RSS-Gen, Issue 5	Receiver spurious emissions (radiated)	Nominal	Nominal	☐	☐	☒	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

10.1 Additional comments

Reference documents: Customer Questionnair1_ACCM_kvde_20210421.docx

Special test software: ACCM+ RCK test.exe (transmitter timing set in testsoftware)

Configuration descriptions: test-bin file table (see page 107)

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11 Measurement results

11.1 Timing of the transmitter

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Depends on the pulse train
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	Zero
Trace-Mode:	Single sweep
Test setup	7.3 A

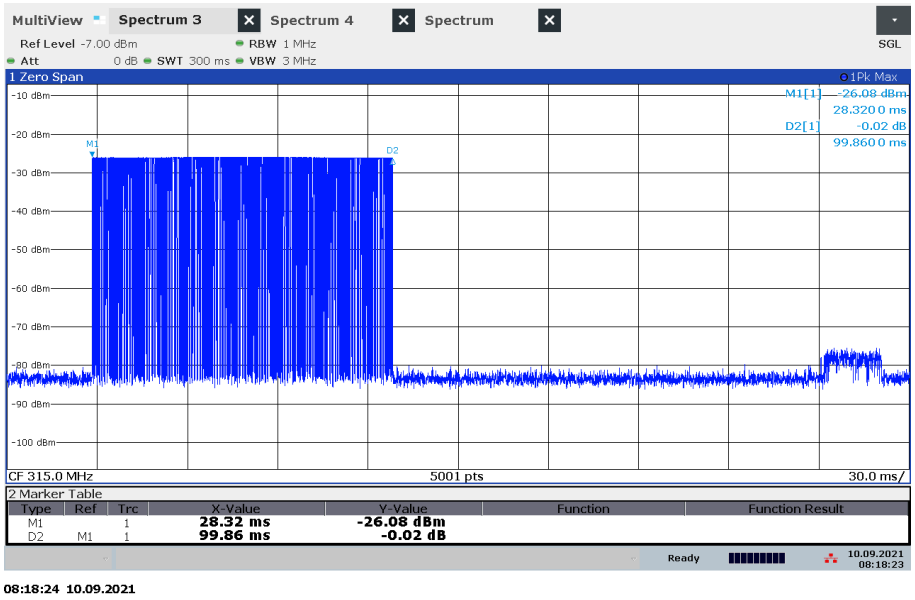
Limits:

FCC	IC
(c) Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.	

Results:

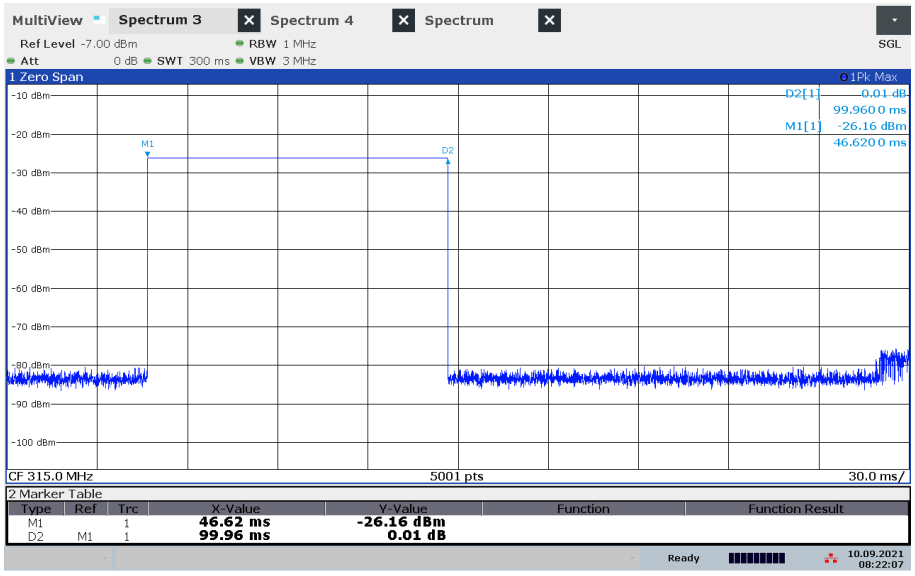
maximum frame length		
frequency	modulation	max. frame length / ms
315.0 MHz	ASK	99.86
	FSK	99.96
433.9 MHz	ASK	99.73
	FSK	102.4
868.3 MHz	ASK	99.7
	FSK	99.4
915.0 MHz	ASK	100.04
	FSK	99.8

Plot 1: 315 MHz ASK max. frame length



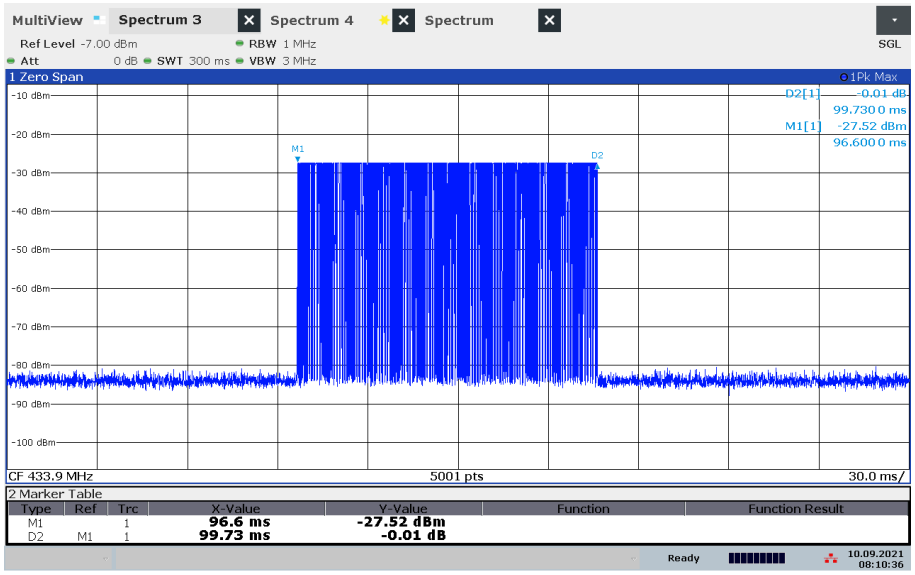
08:18:24 10.09.2021

Plot 2: 315 MHz FSK max. frame length



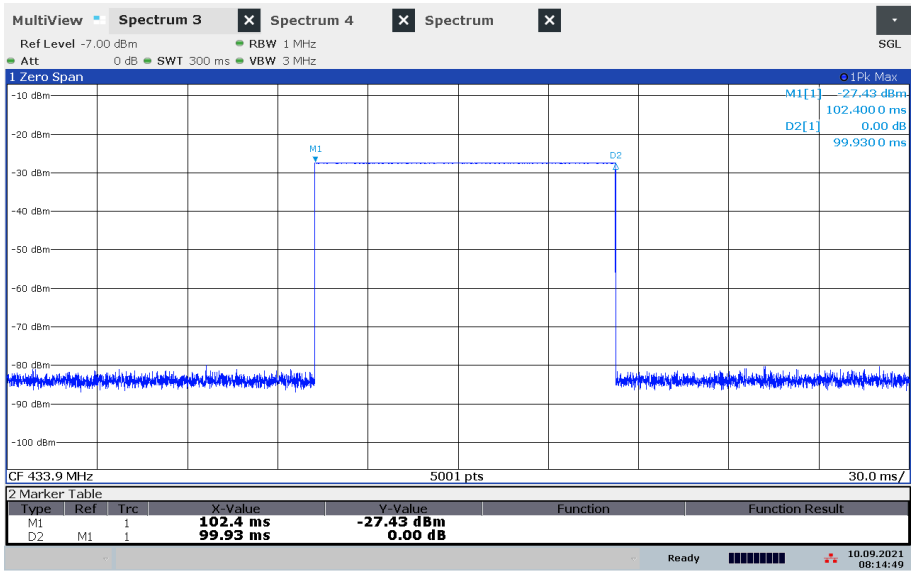
08:22:07 10.09.2021

Plot 3: 433.9 MHz ASK max. frame length



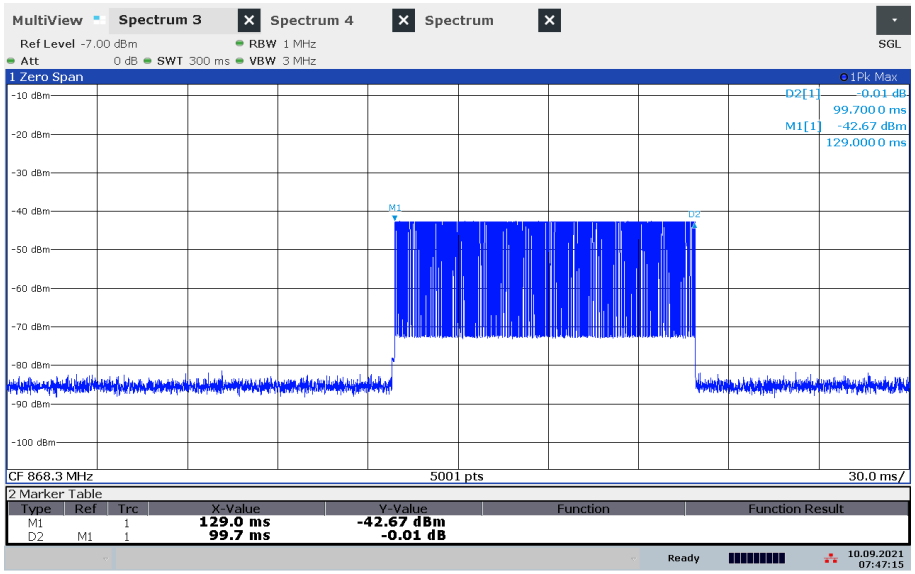
08:10:36 10.09.2021

Plot 4: 433.9 MHz FSK max. frame length



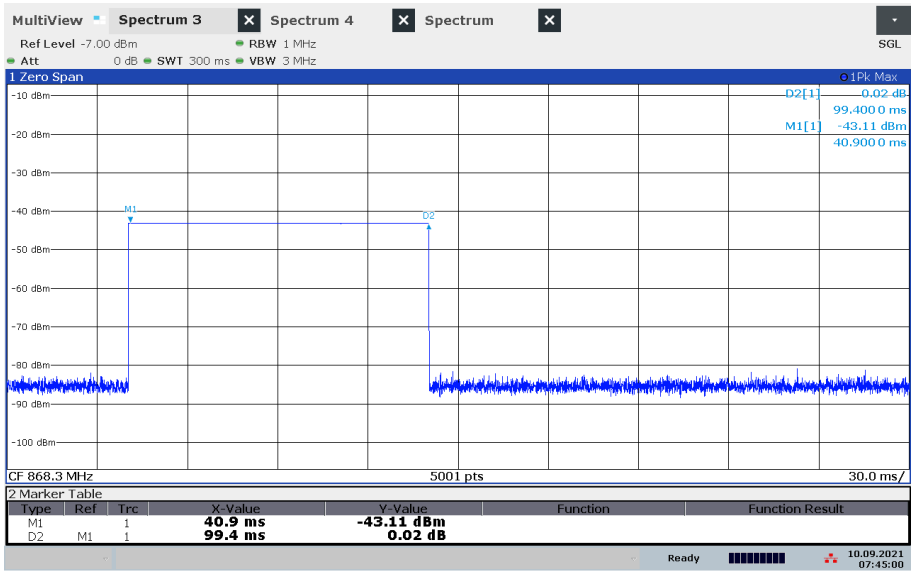
08:14:50 10.09.2021

Plot 5: 868.3 MHz ASK max. frame length



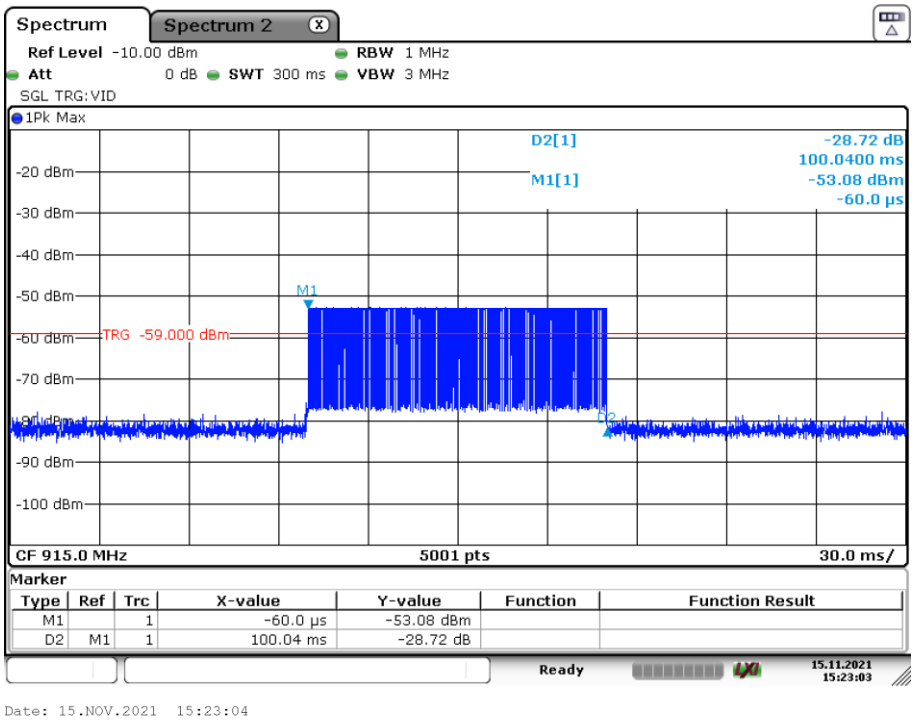
07:47:15 10.09.2021

Plot 6: 868.3 MHz FSK max. frame length



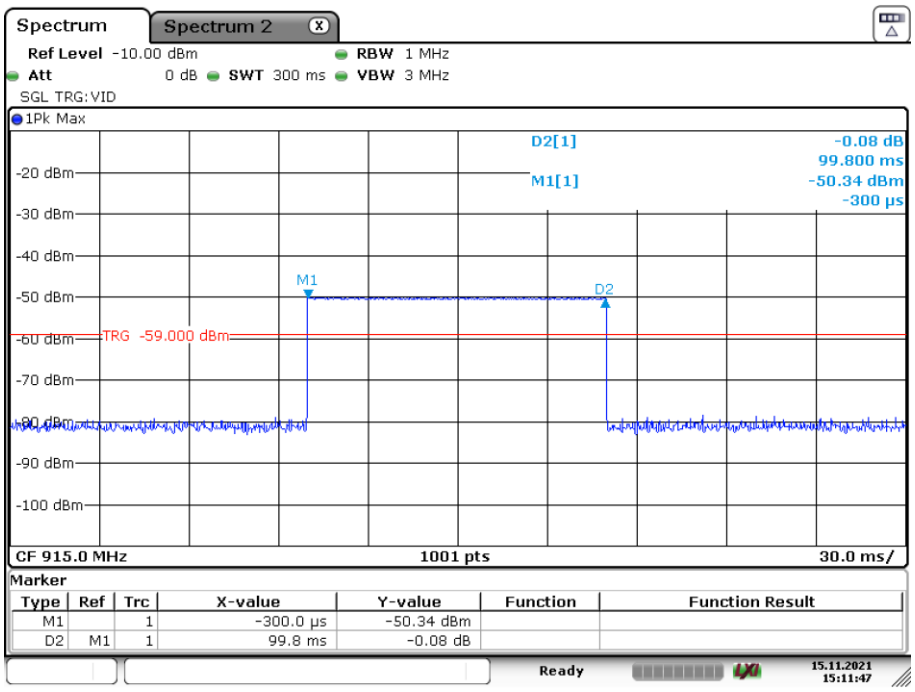
07:45:00 10.09.2021

Plot 7: 915.0 MHz ASK max. frame length



Date: 15.NOV.2021 15:23:04

Plot 8: 915.0 MHz FSK max. frame length



Date: 15.NOV.2021 15:11:48

11.2 Switch off time

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	6 s / 11 s
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	Zero
Trace-Mode:	Single sweep
Test setup	7.3 A
Measurement uncertainty	see chapter 9

Limits:

FCC	IC
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.	

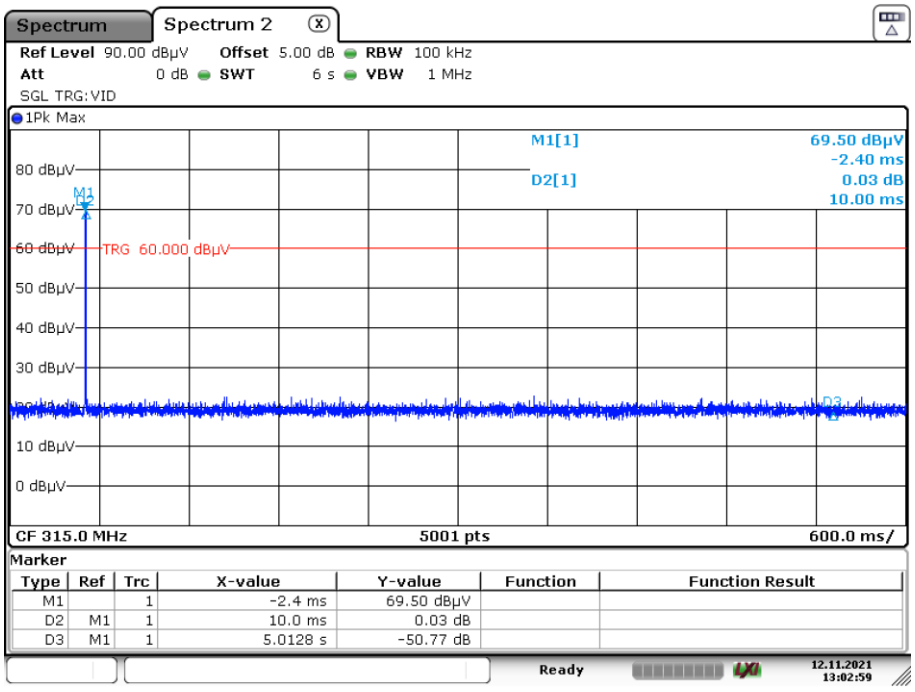
In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Results:

The EUT automatically ceases transmission within 5000 ms after activation

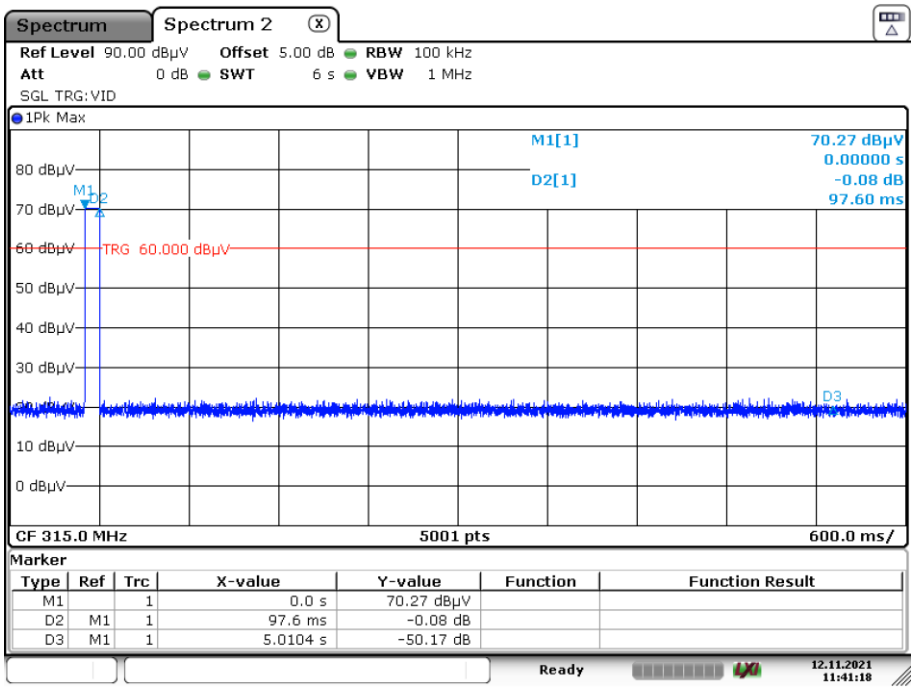
transmitter ceasing time after activation (limit < 5 sec.)		
frequency	duty cycle	ceasing time
315.0 MHz	10 ms	10 ms
	100 ms	97.6 ms
433.9 MHz	10 ms	10 ms
	100 ms	100 ms
868.3 MHz	10 ms	10 ms
	100 ms	100 ms
915.0 MHz	10 ms	10 ms
	100 ms	100 ms

Plot 1: TX on time 315 MHz low duty cycle



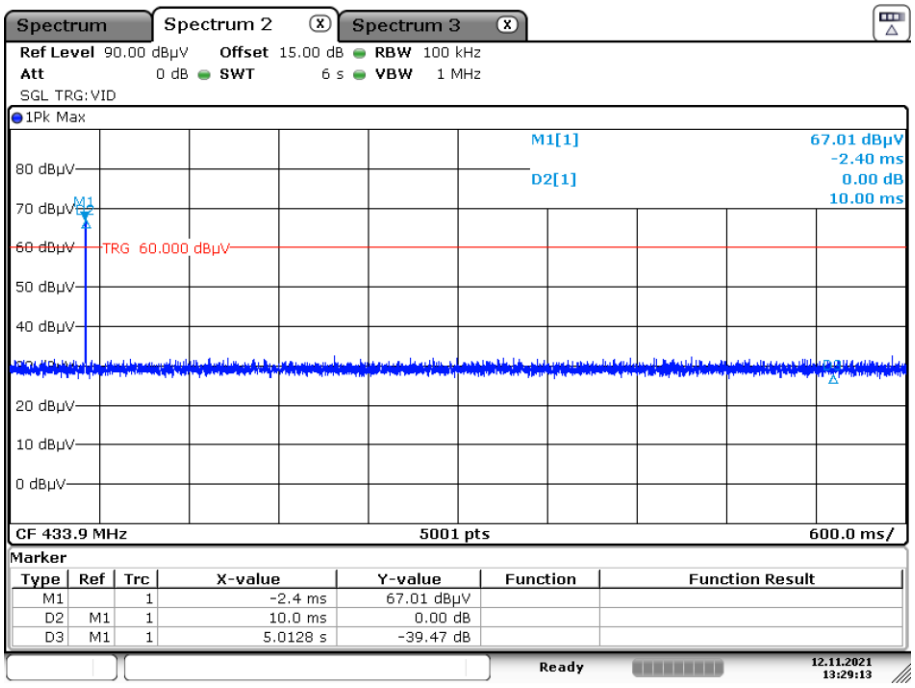
Date: 12.NOV.2021 13:03:00

Plot 2: TX on time 315 MHz high duty cycle



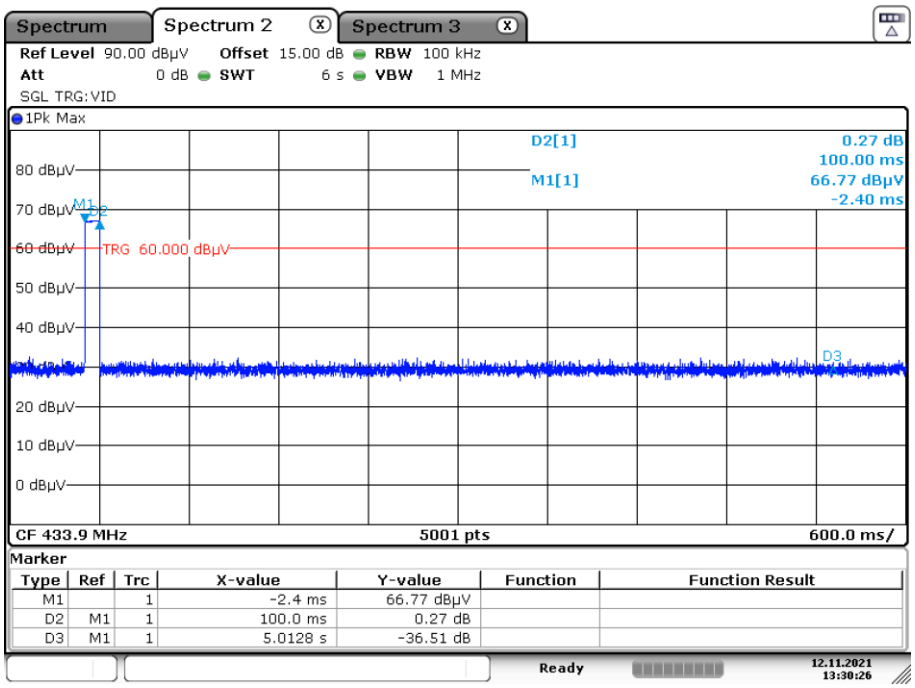
Date: 12.NOV.2021 11:41:19

Plot 3: TX on time 433 MHz low duty cycle



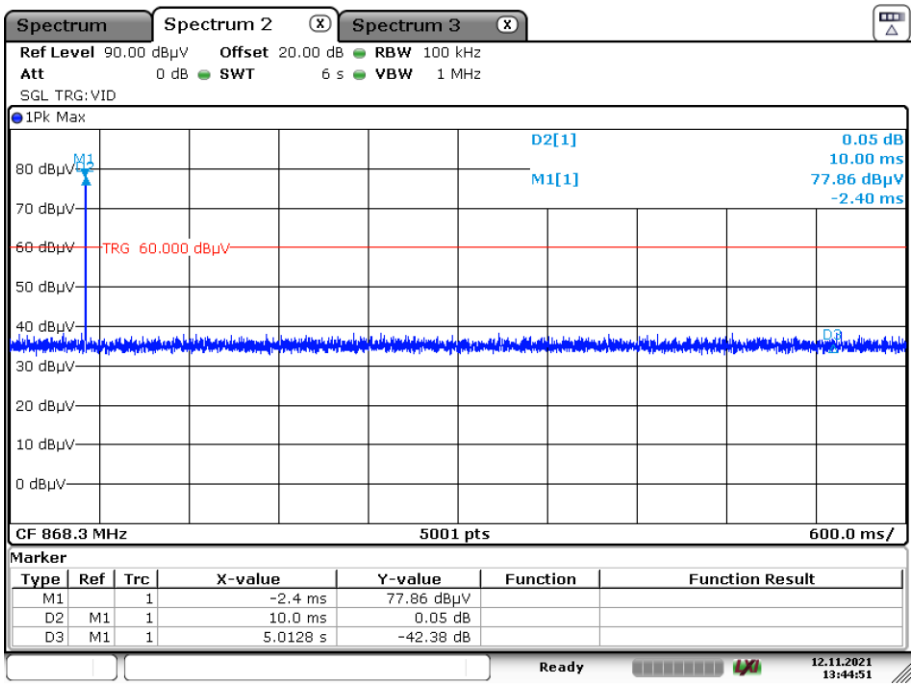
Date: 12.NOV.2021 13:29:14

Plot 4: TX on time 433 MHz high duty cycle



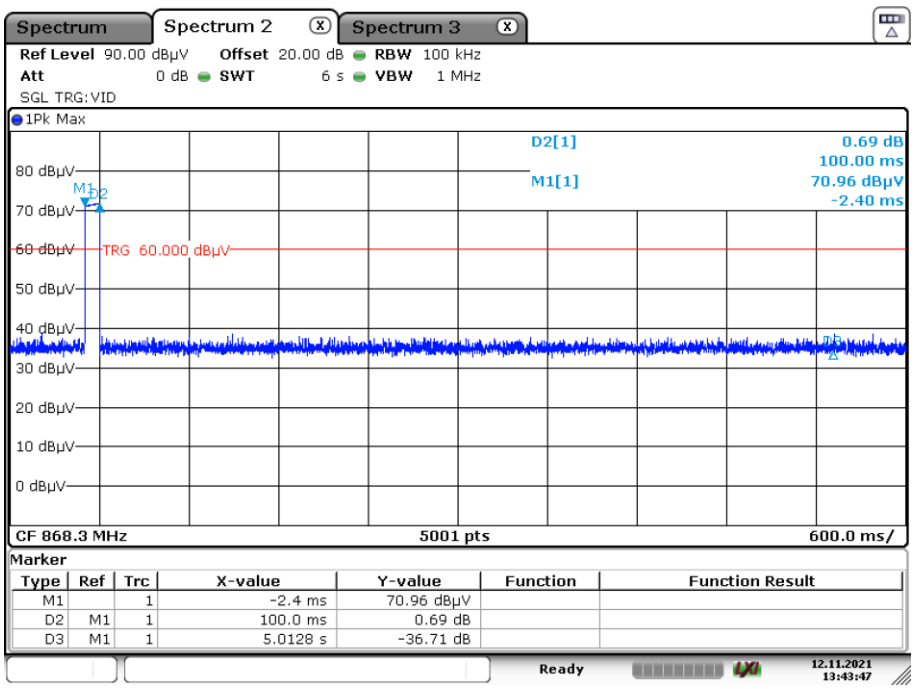
Date: 12.NOV.2021 13:30:27

Plot 5: TX on time 868.3 MHz low duty cycle



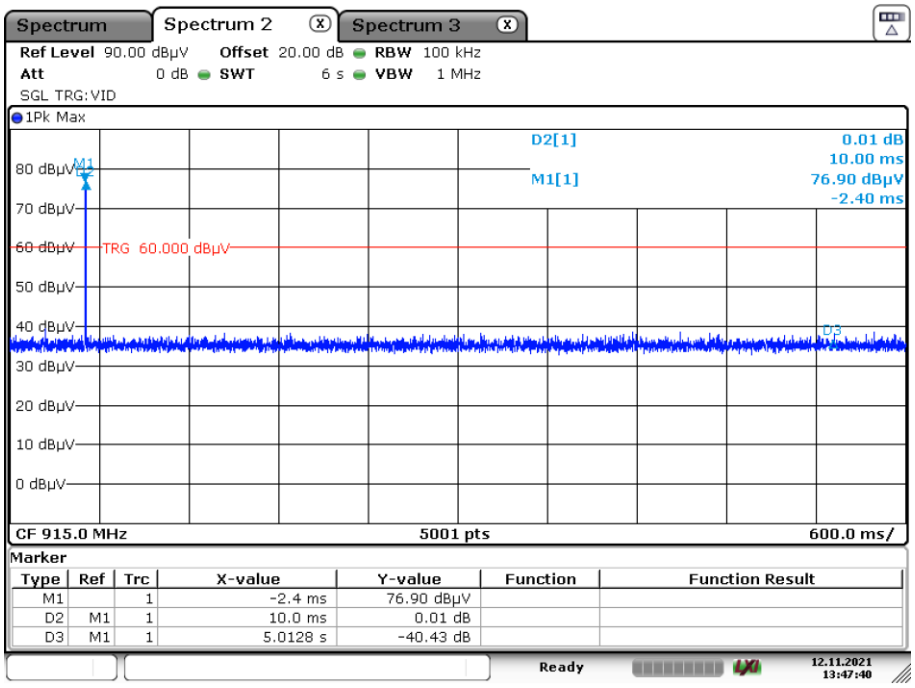
Date: 12.NOV.2021 13:44:51

Plot 6: TX on time 868.3 MHz high duty cycle



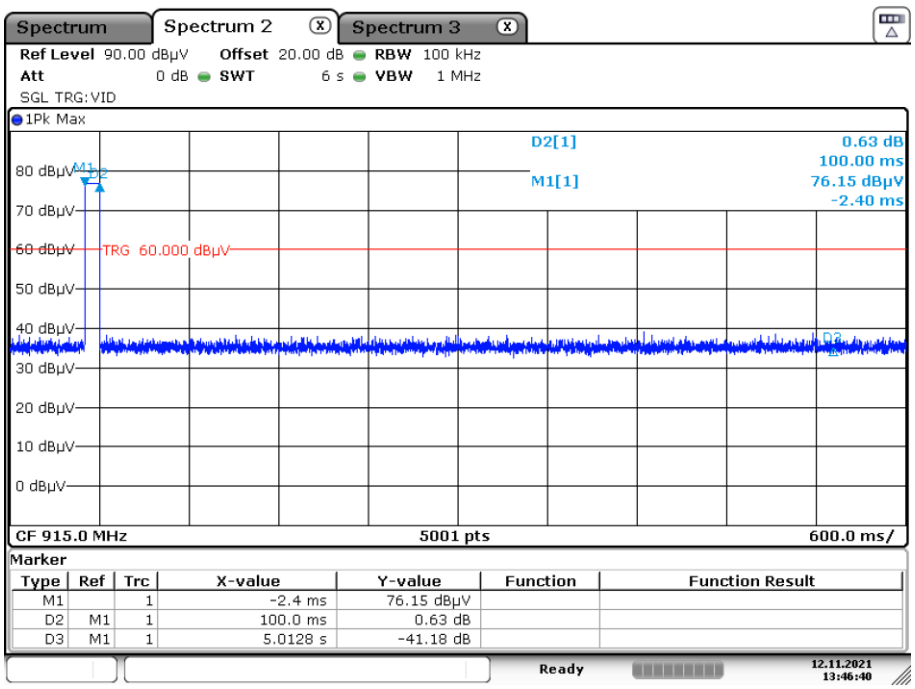
Date: 12.NOV.2021 13:43:48

Plot 7: TX on time 915 MHz low duty cycle



Date: 12.NOV.2021 13:47:40

Plot 8: TX on time 915 MHz high duty cycle



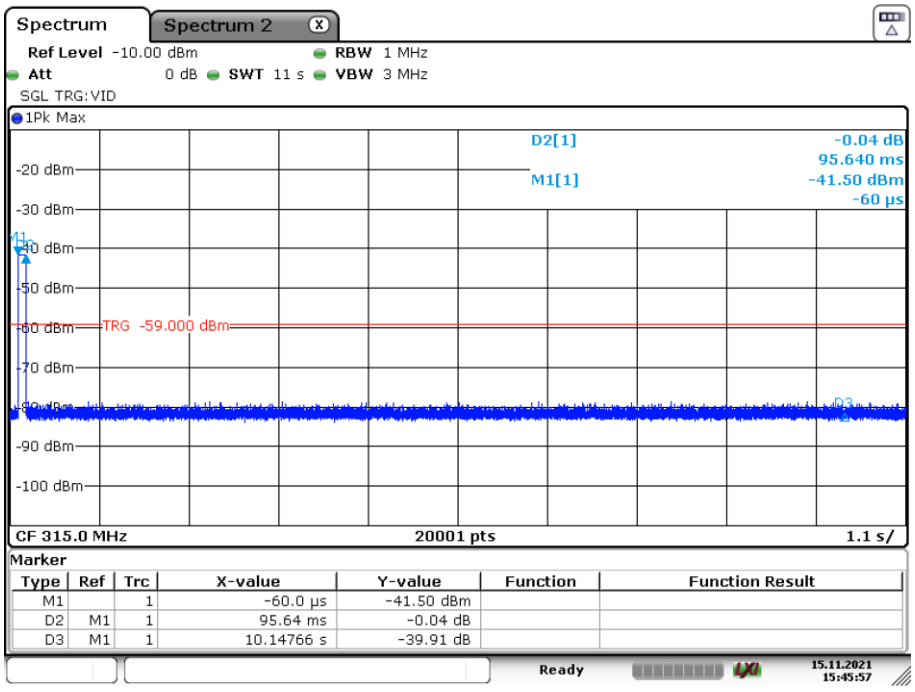
Date: 12.NOV.2021 13:46:41

Results:

silent period between two transmissions > 10 seconds, see following plots

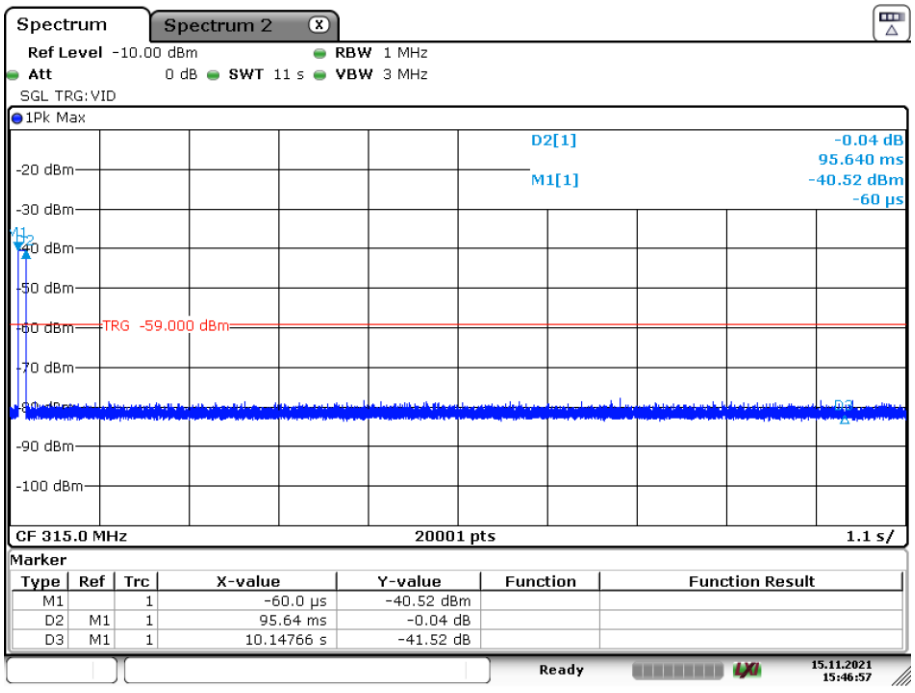
silent period between two transmissions (limit > 10 sec.)		
frequency	modulation	silent period
315.0 MHz	ASK	> 10 sec.
	FSK	> 10 sec.
433.9 MHz	ASK	> 10 sec.
	FSK	> 10 sec.
868.3 MHz	ASK	> 10 sec.
	FSK	> 10 sec.
915.0 MHz	ASK	> 10 sec.
	FSK	> 10 sec.

Plot 1: silent time 315 MHz ASK modulation



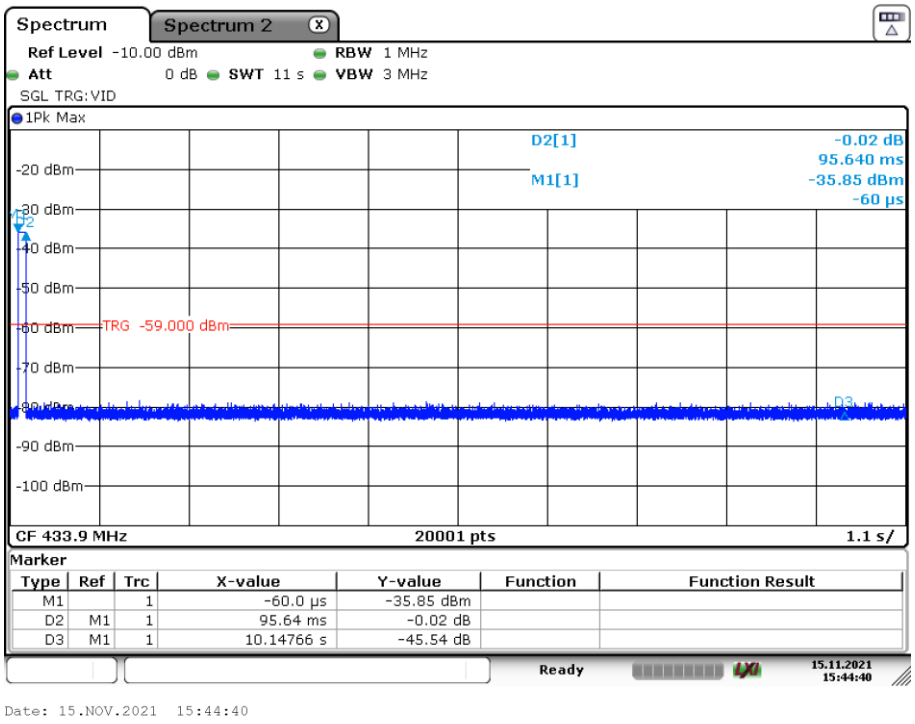
Date: 15.NOV.2021 15:45:57

Plot 2: silent time 315 MHz FSK modulation



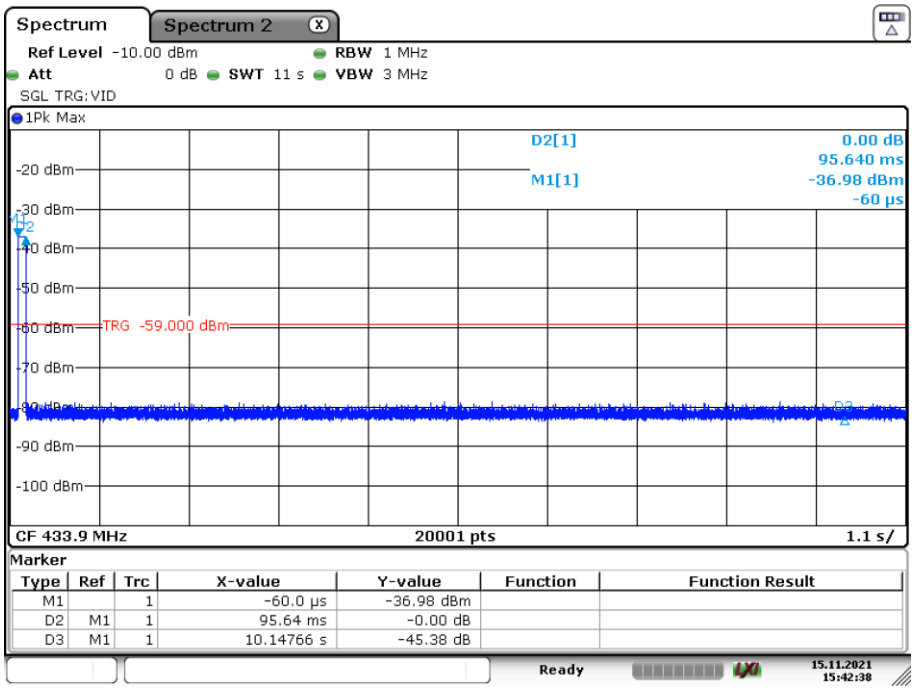
Date: 15.NOV.2021 15:46:57

Plot 3: silent time 433.9 MHz ASK modulation



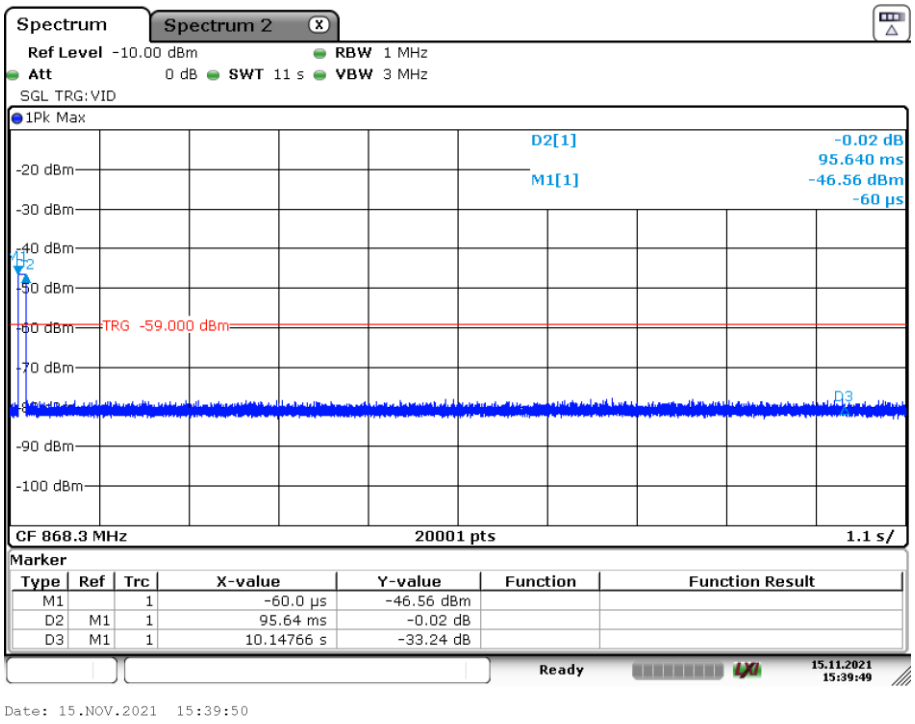
Date: 15.NOV.2021 15:44:40

Plot 4: silent time 433.9 MHz FSK modulation



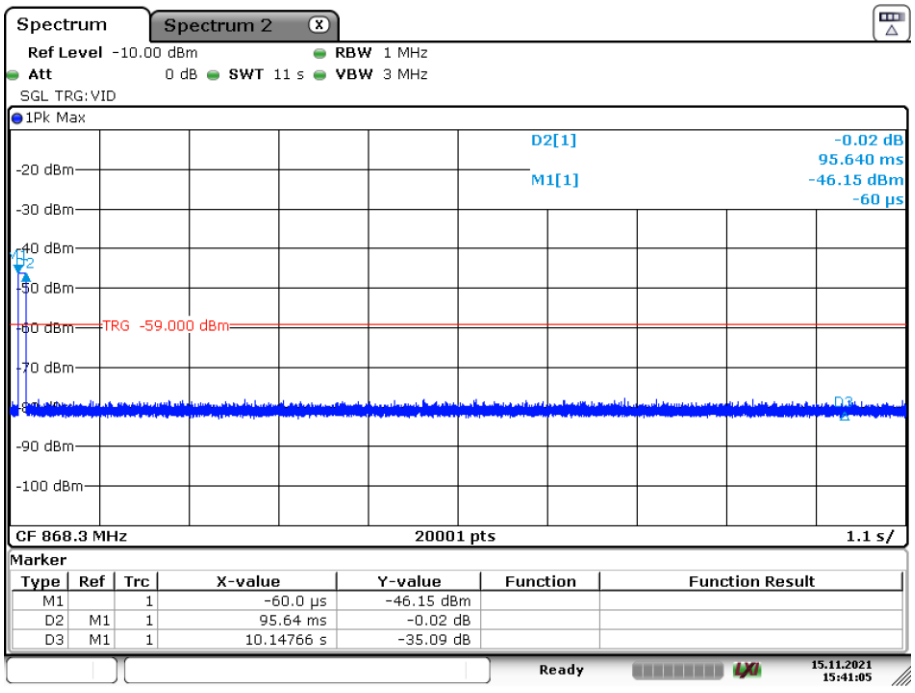
Date: 15.NOV.2021 15:42:38

Plot 5: silent time 868.3 MHz ASK modulation



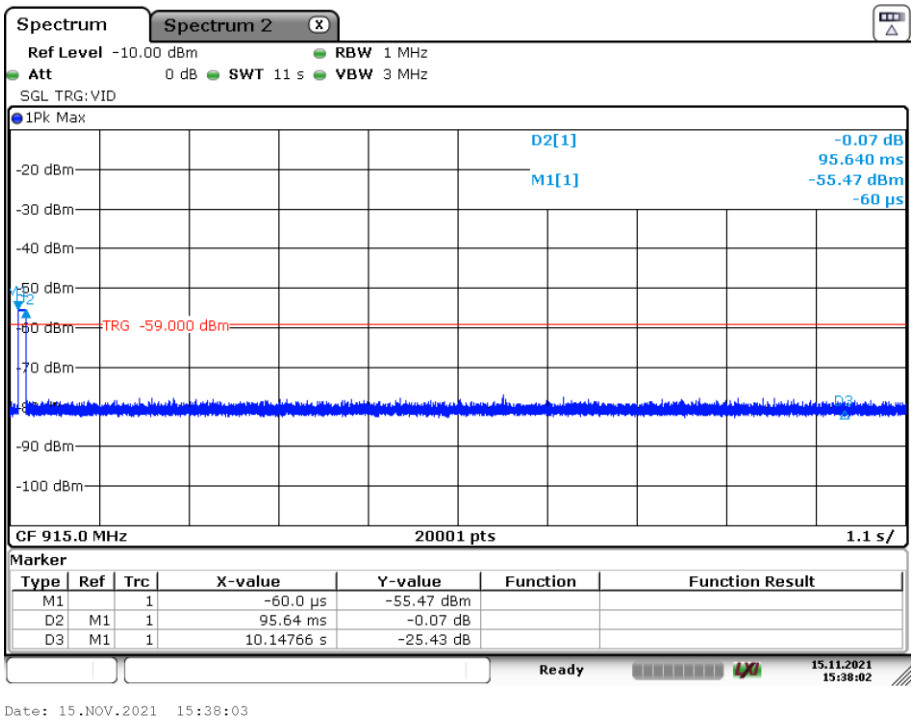
Date: 15.NOV.2021 15:39:50

Plot 6: silent time 868.3 MHz FSK modulation



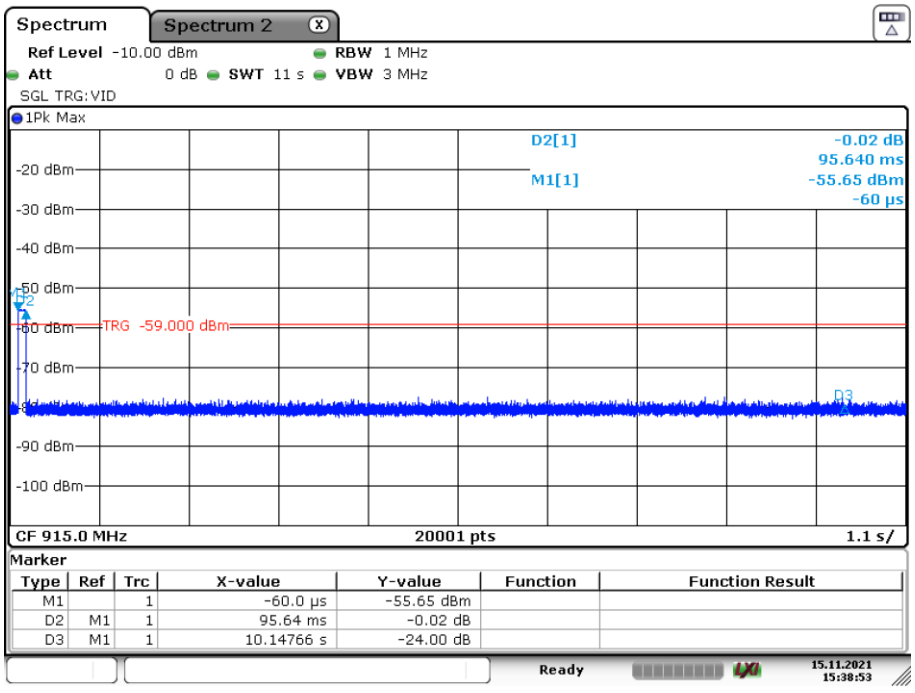
Date: 15.NOV.2021 15:41:05

Plot 7: silent time 915.0 MHz ASK modulation



Date: 15.NOV.2021 15:38:03

Plot 8: silent time 915.0 MHz FSK modulation



Date: 15.NOV.2021 15:38:54

11.3 Emission bandwidth

Measurement:

Measurement of the 99 % bandwidth of the modulated signal

Measurement parameter	
Detector:	Peak
Sweep time:	see plots
Resolution bandwidth:	1% to 5% of the OBW
Video bandwidth:	3 x RBW
Span:	500 kHz
Trace-Mode:	Max. hold

Limits:

FCC	IC
The OBW shall not be wider than 0.25% of the centre frequency in the frequency range 70 MHz to 900 MHz and 0.50% above 900 MHz	

Result:

- **ASK modulation**

Center Frequency (MHz)	ASK modulation		
	Signal bandwidth / kHz		
	OBW 99% limit 20 dB-bandwidth limit	OBW 99%	20 dB-bandwidth
312.0	780.0	103.359	31.910
318.0	795.0	104.916	31.870
431.9	1079.75	108.872	31.990
435.9	1089.75	107.538	31.960
868.3	2170.75	115.291	31.870
902.0	4510.00	117.362	31.830
915.0	4575.00	125.626	31.790
928.0	4640.00	125.500	31.910

- **FSK modulation**

Center Frequency (MHz)	FSK modulation		
	Signal bandwidth / kHz		
	OBW 99% limit 20 dB-bandwidth limit	OBW 99%	20 dB-bandwidth
312.0	780.0	109.576	107.880
318.0	795.0	93.782	92.380
431.9	1079.75	100.237	93.180
435.9	1089.75	115.769	94.480
868.3	2170.75	122.514	101.480
902.0	4510.00	125.955	108.480
915.0	4575.00	126.159	108.780
928.0	4640.00	108.667	92.880

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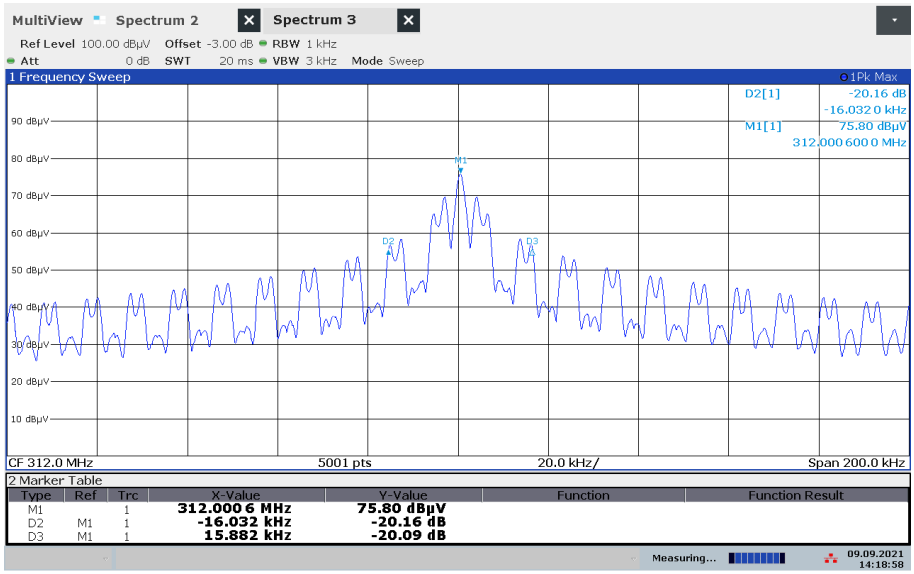
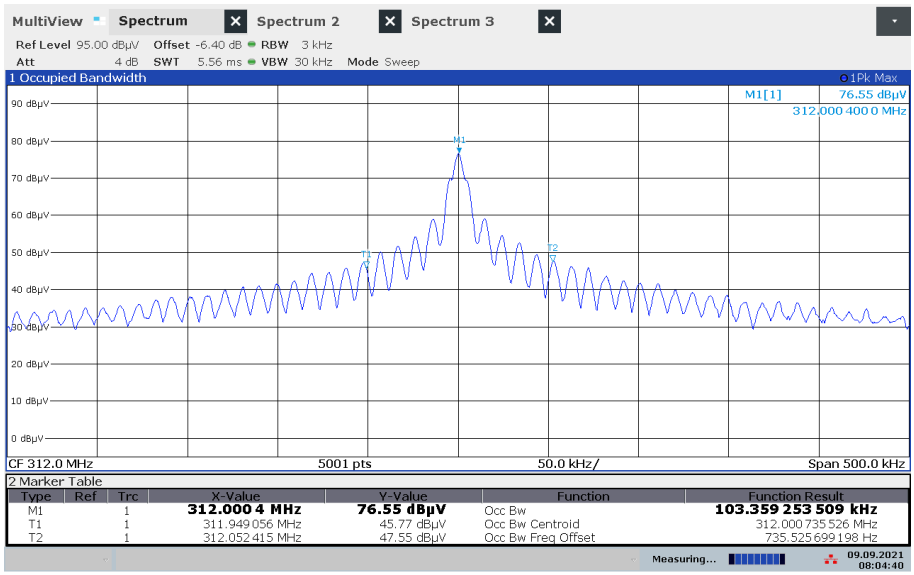
Plot 1: Emissions bandwidth – 312.0 MHz ASK



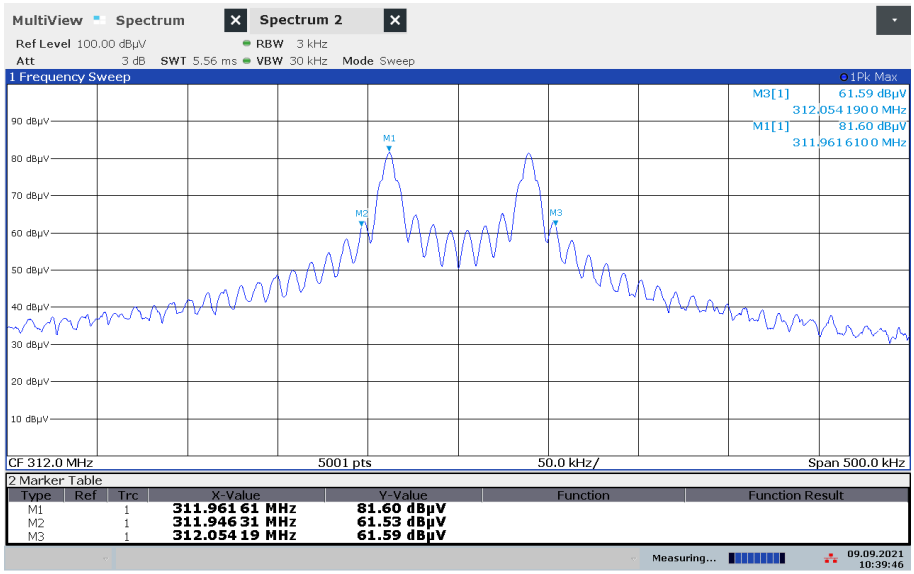
14:18:59 09.09.2021

Plot 2: 99 % emission bandwidth – 312.0 MHz ASK



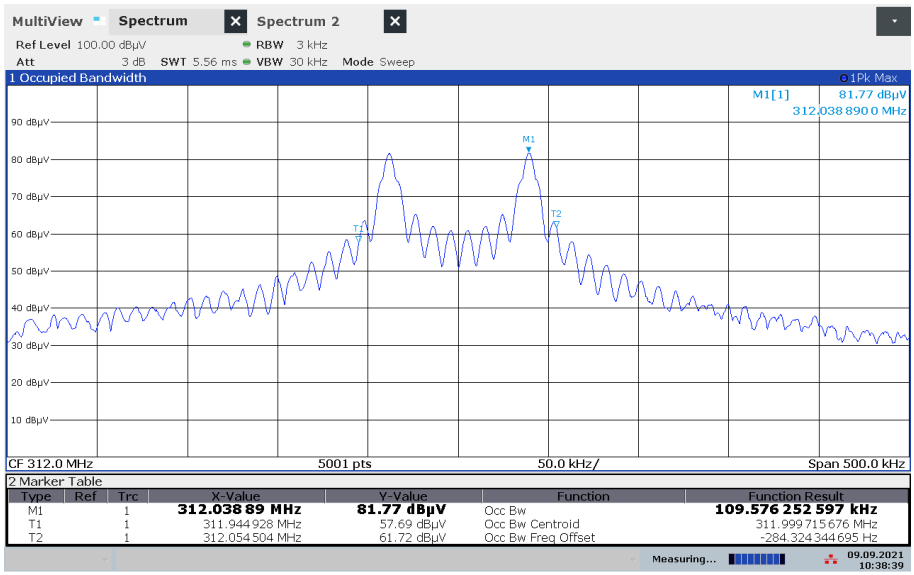
08:04:41 09.09.2021

Plot 3: Emissions bandwidth – 312.0 MHz FSK



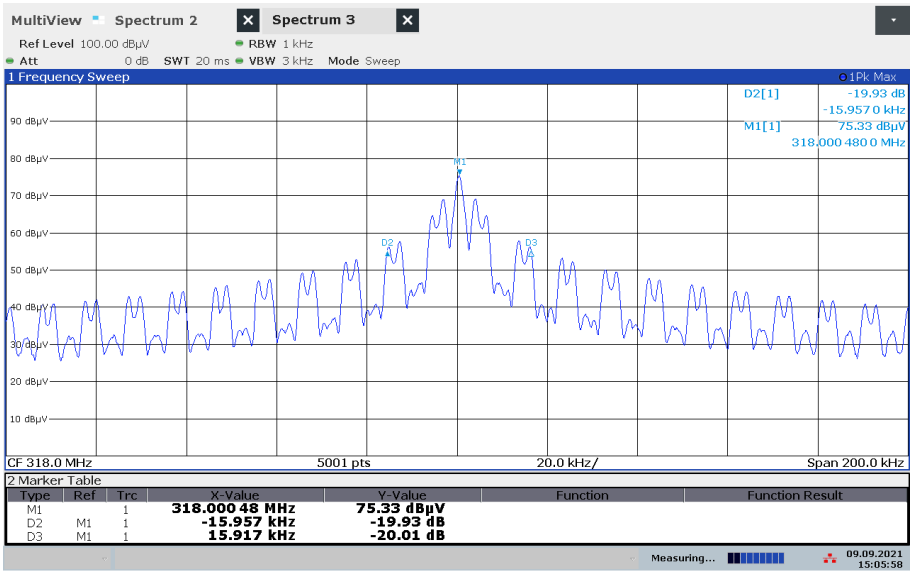
10:39:47 09.09.2021

Plot 4: 99 % emission bandwidth – 312.0 MHz FSK



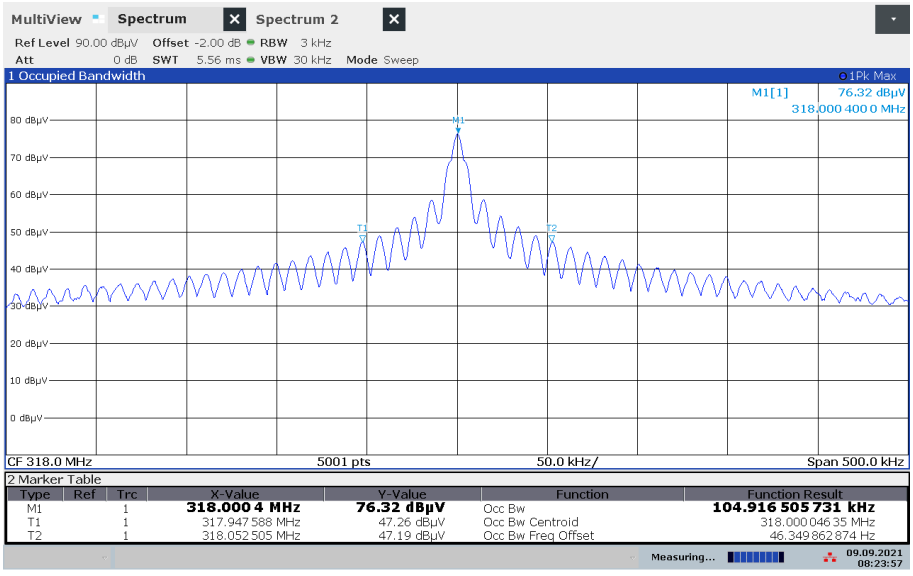
10:38:39 09.09.2021

Plot 1: Emissions bandwidth – 318.0 MHz ASK



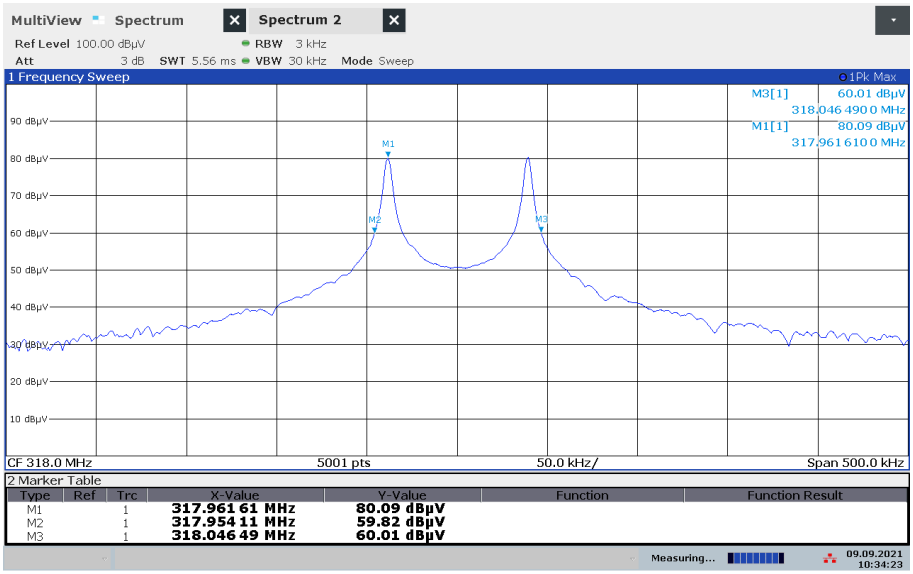
15:05:58 09.09.2021

Plot 2: 99 % emission bandwidth – 318.0 MHz ASK



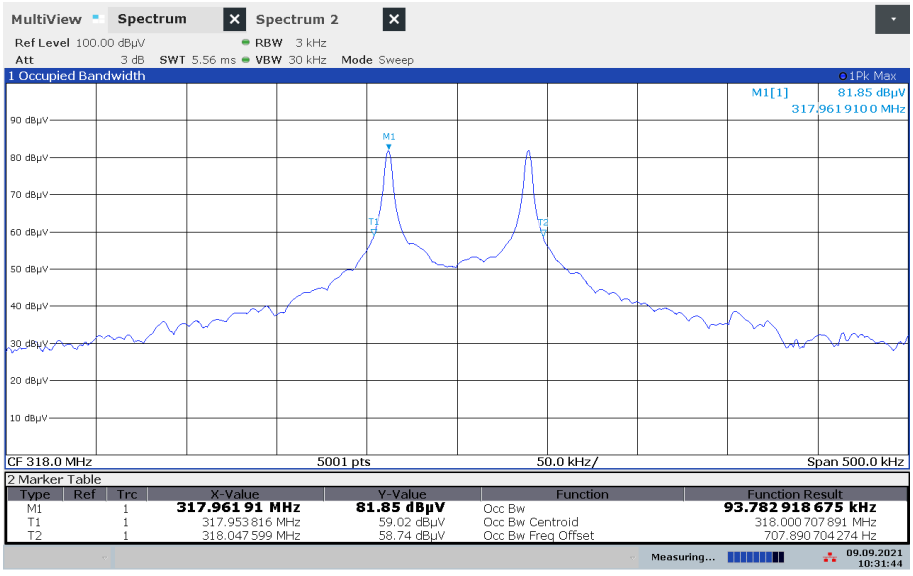
08:23:57 09.09.2021

Plot 3: Emissions bandwidth – 318.0 MHz FSK



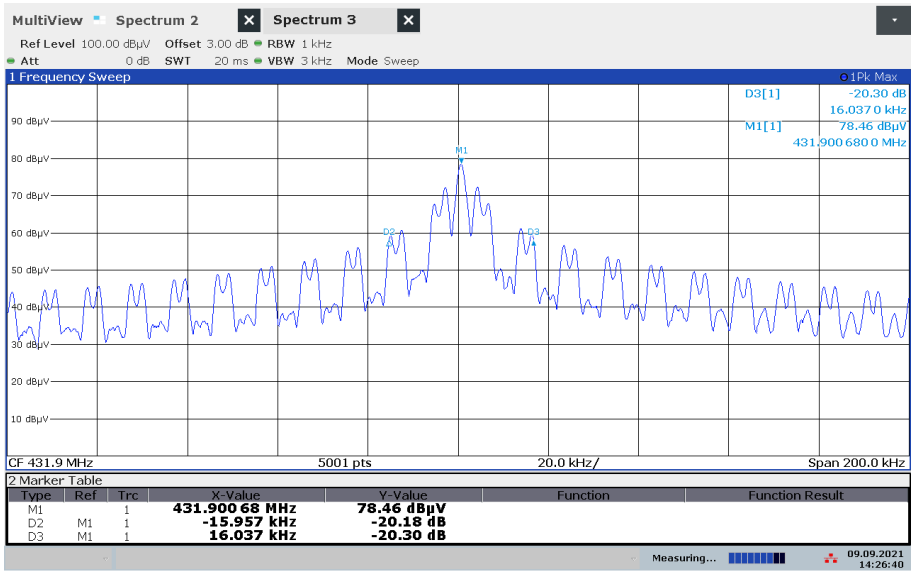
10:34:23 09.09.2021

Plot 4: 99 % emission bandwidth – 318.0 MHz FSK



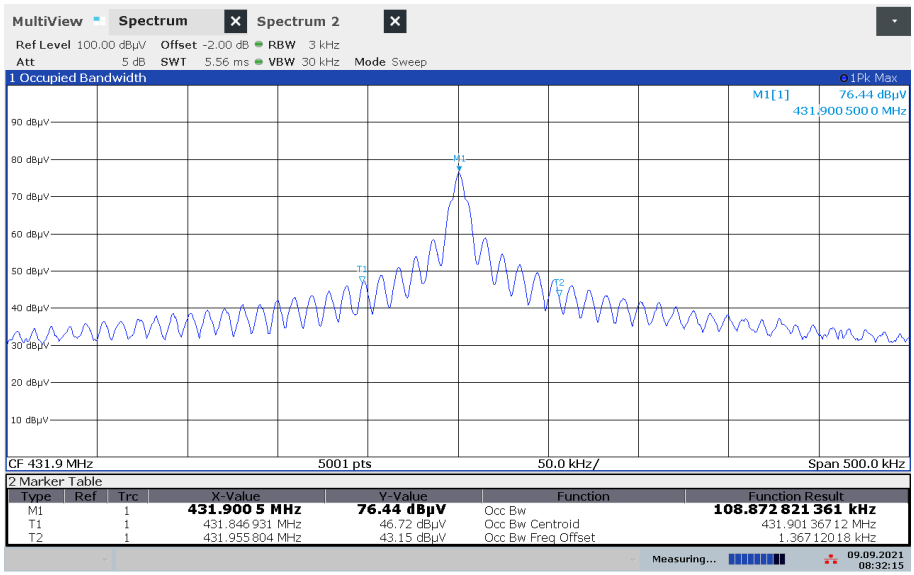
10:31:44 09.09.2021

Plot 1: Emissions bandwidth – 431.9 MHz ASK



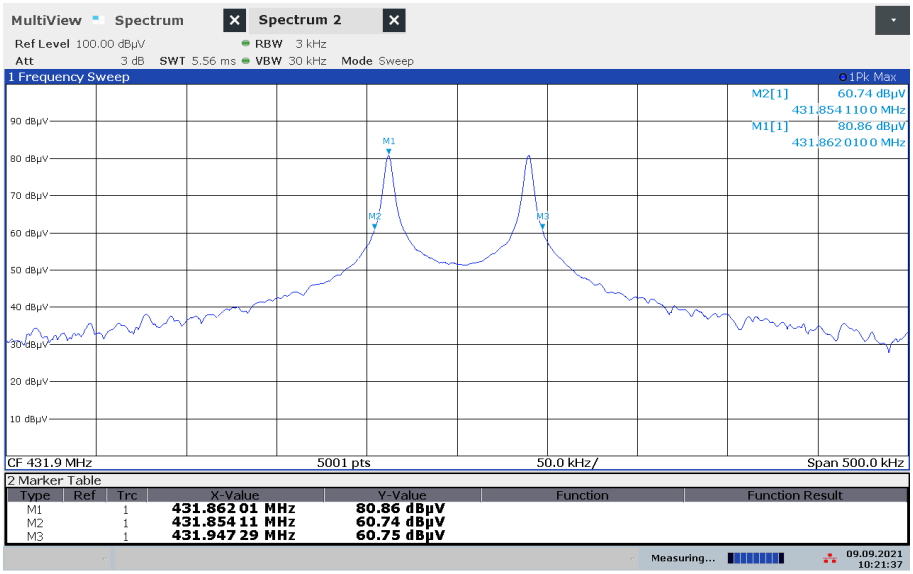
14:26:40 09.09.2021

Plot 2: 99 % emission bandwidth – 431.9 MHz ASK



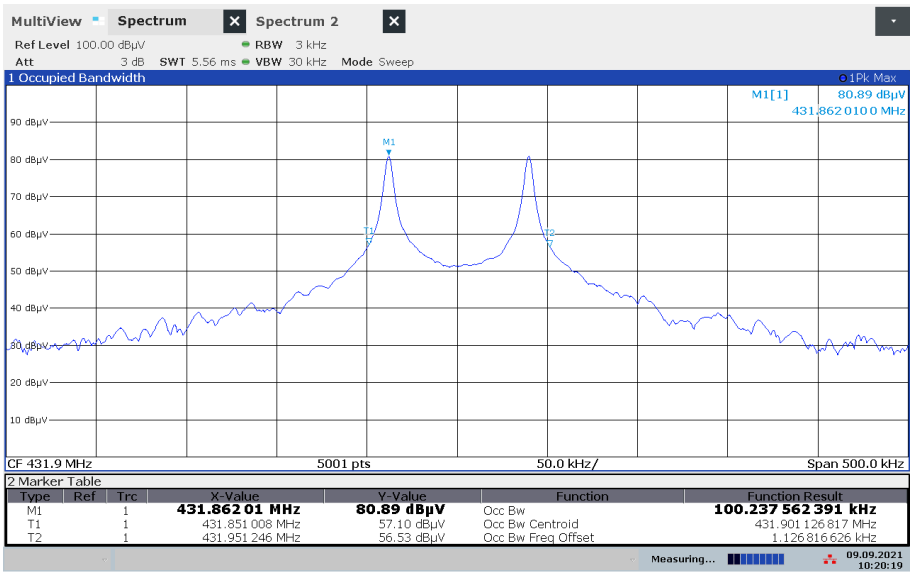
08:32:16 09.09.2021

Plot 3: Emissions bandwidth – 431.9 MHz FSK



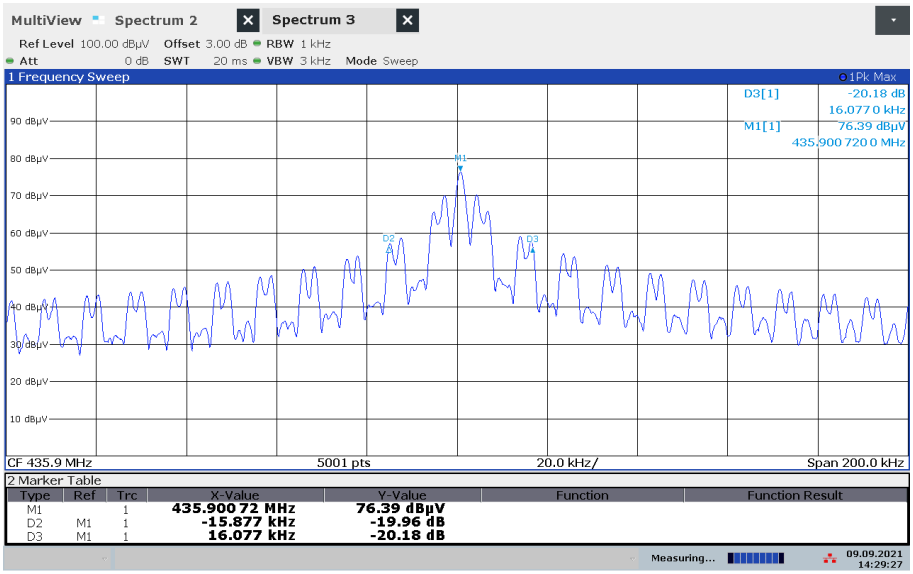
10:21:38 09.09.2021

Plot 4: 99 % emission bandwidth – 431.9 MHz FSK



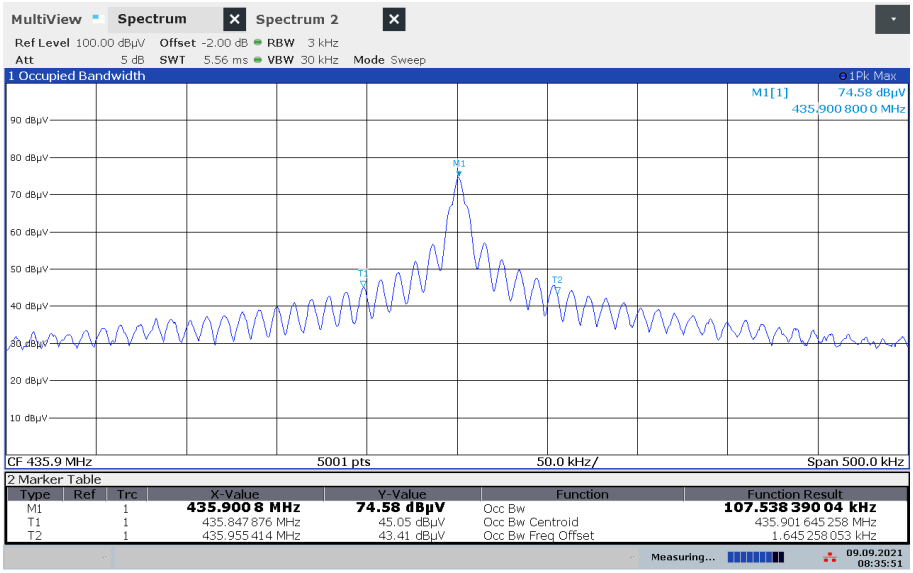
10:20:20 09.09.2021

Plot 1: Emissions bandwidth – 435.9 MHz ASK



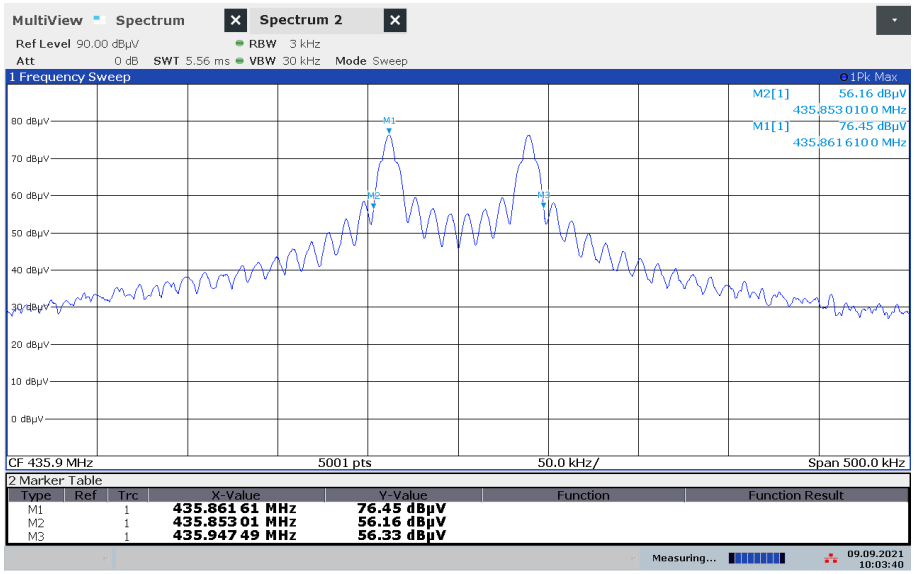
14:29:28 09.09.2021

Plot 2: 99 % emission bandwidth – 435.9 MHz ASK



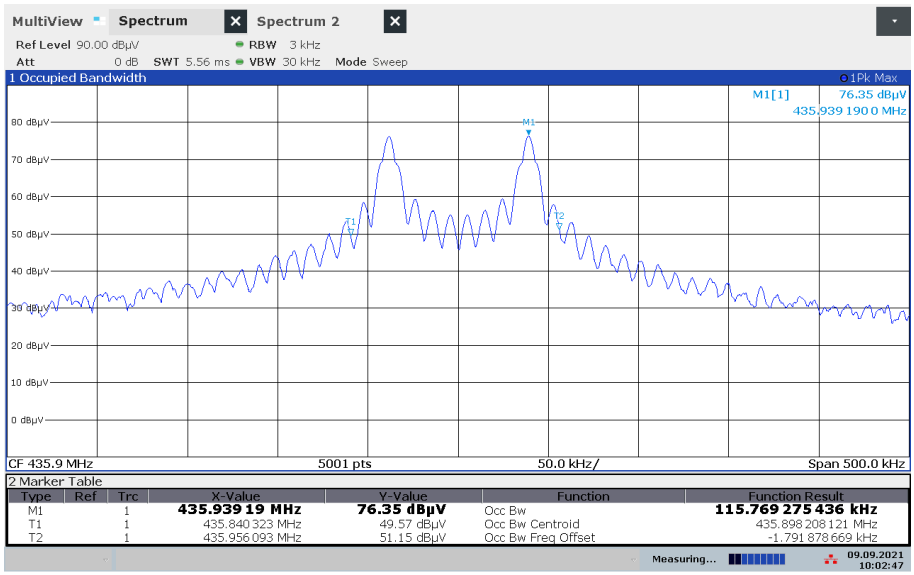
08:35:51 09.09.2021

Plot 3: Emissions bandwidth – 435.9 MHz FSK



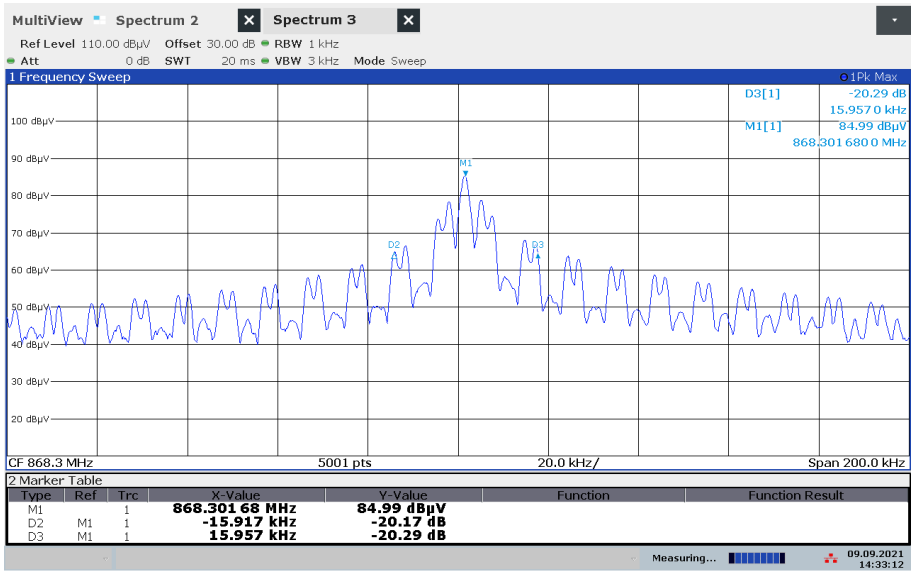
10:03:40 09.09.2021

Plot 4: 99 % emission bandwidth – 435.9 MHz FSK



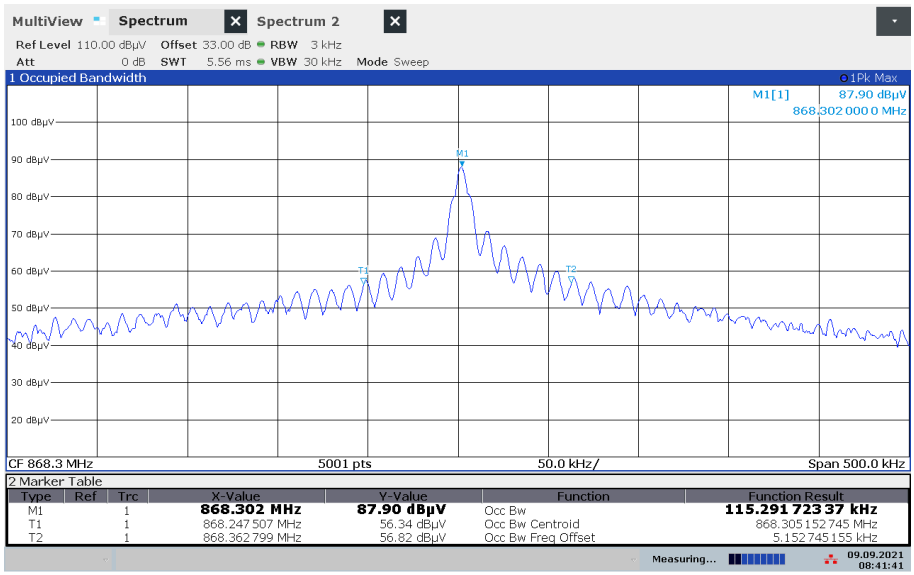
10:02:47 09.09.2021

Plot 1: Emissions bandwidth – 868.3 MHz ASK



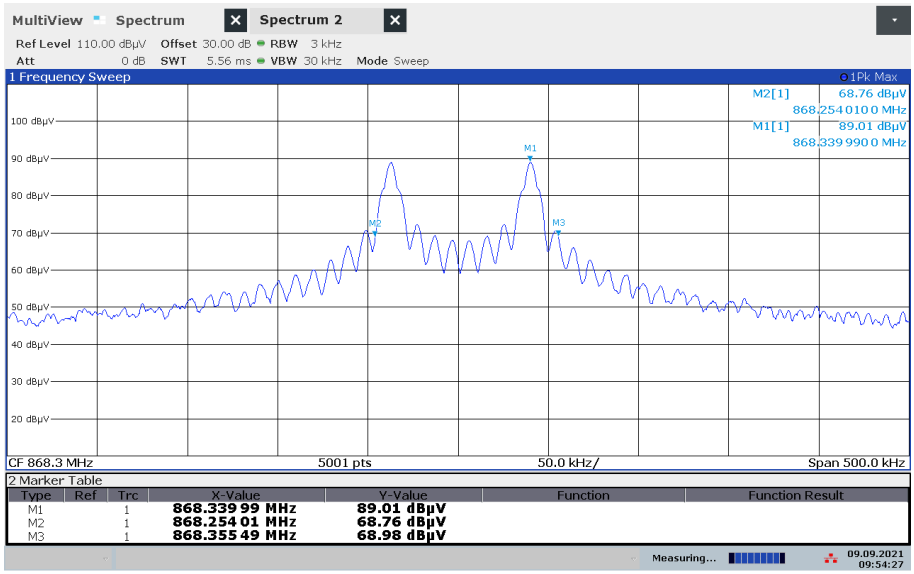
14:33:12 09.09.2021

Plot 2: 99 % emission bandwidth – 868.3 MHz ASK



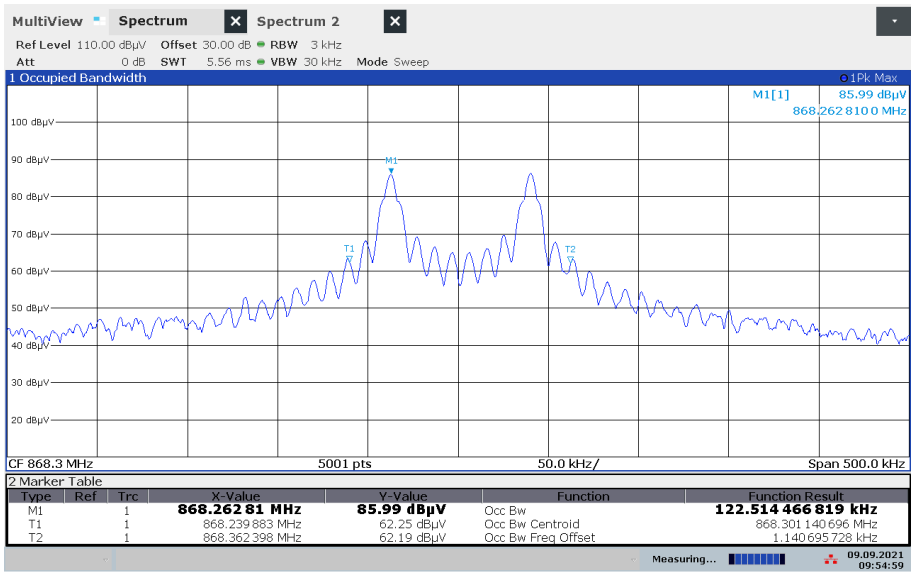
08:41:42 09.09.2021

Plot 3: Emissions bandwidth – 868.3 MHz FSK



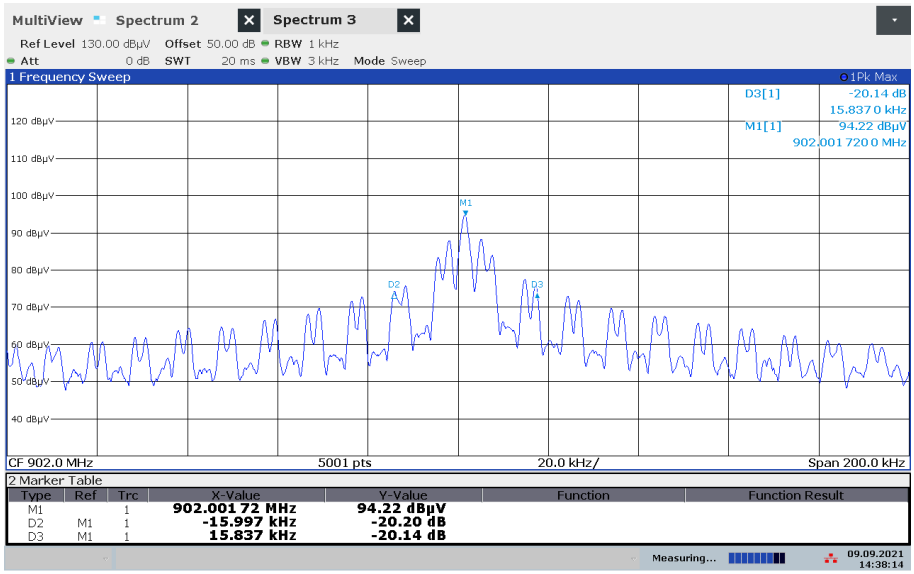
09:54:27 09.09.2021

Plot 4: 99 % emission bandwidth – 868.3 MHz FSK



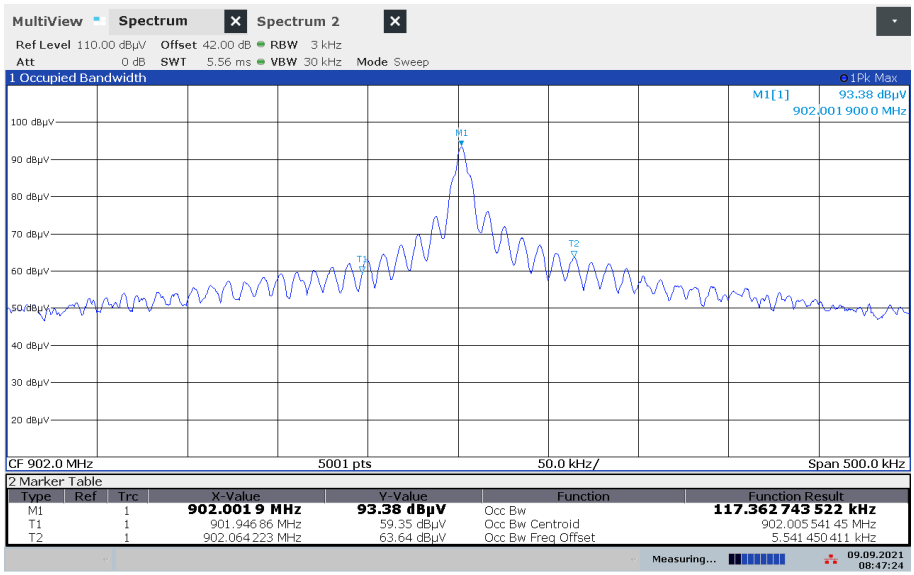
09:55:00 09.09.2021

Plot 1: Emissions bandwidth – 902.0 MHz ASK



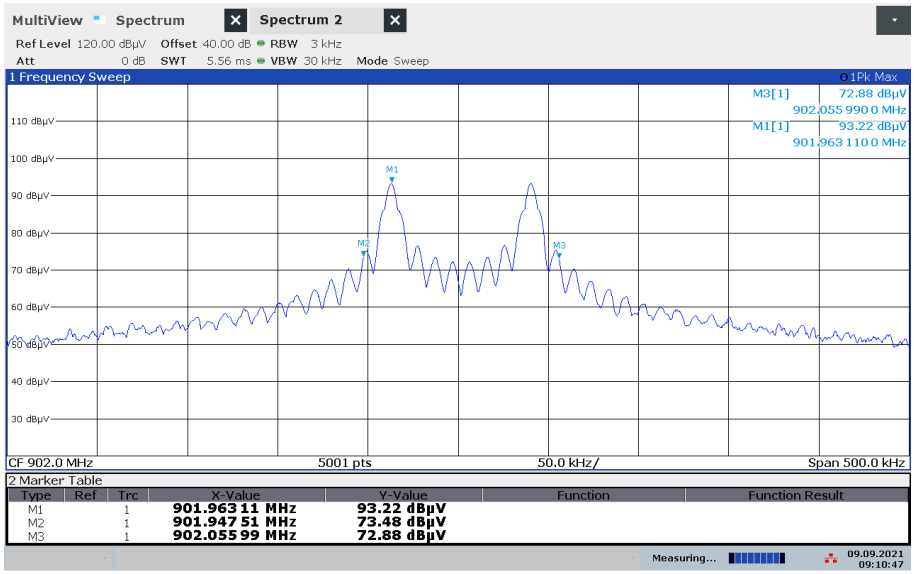
14:38:15 09.09.2021

Plot 2: 99 % emission bandwidth – 902.0 MHz ASK



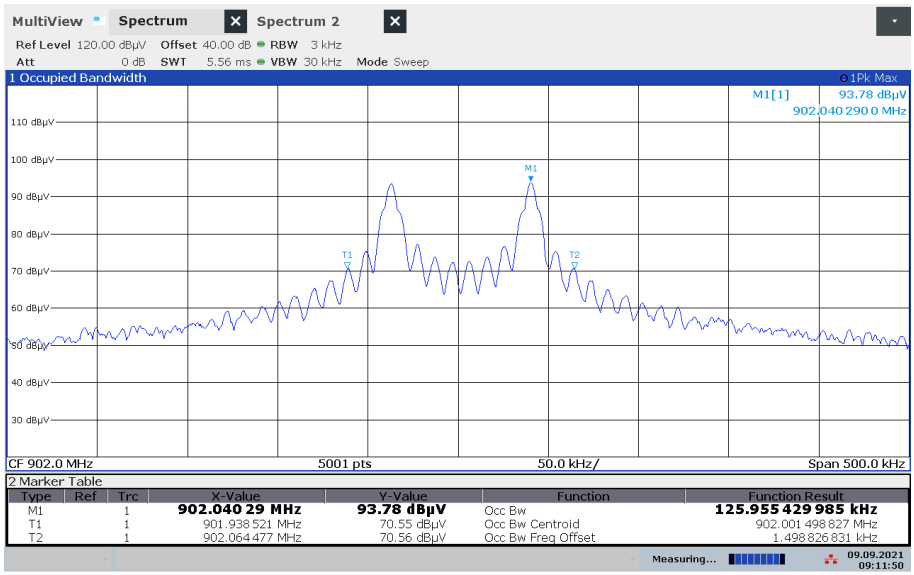
08:47:24 09.09.2021

Plot 3: Emissions bandwidth – 902.0 MHz FSK



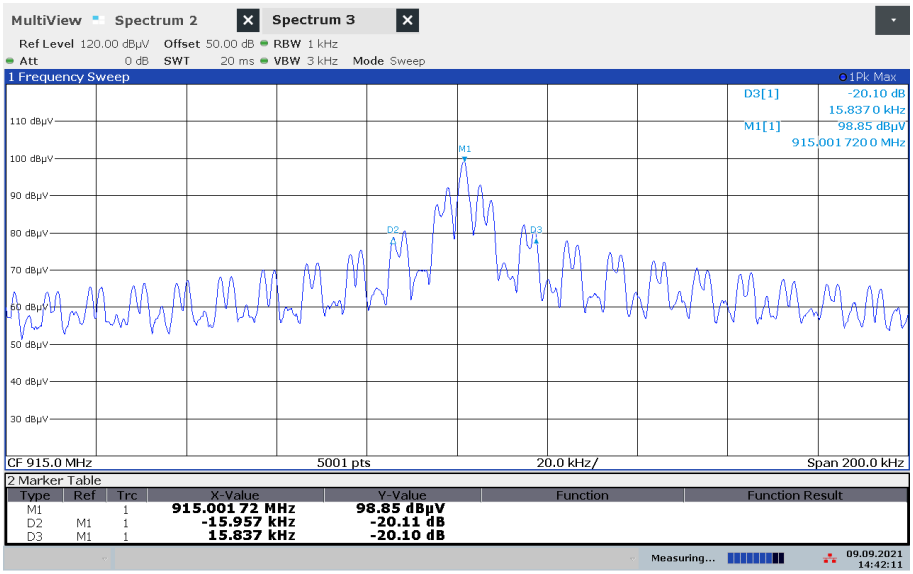
09:10:47 09.09.2021

Plot 4: 99 % emission bandwidth – 902.0 MHz FSK



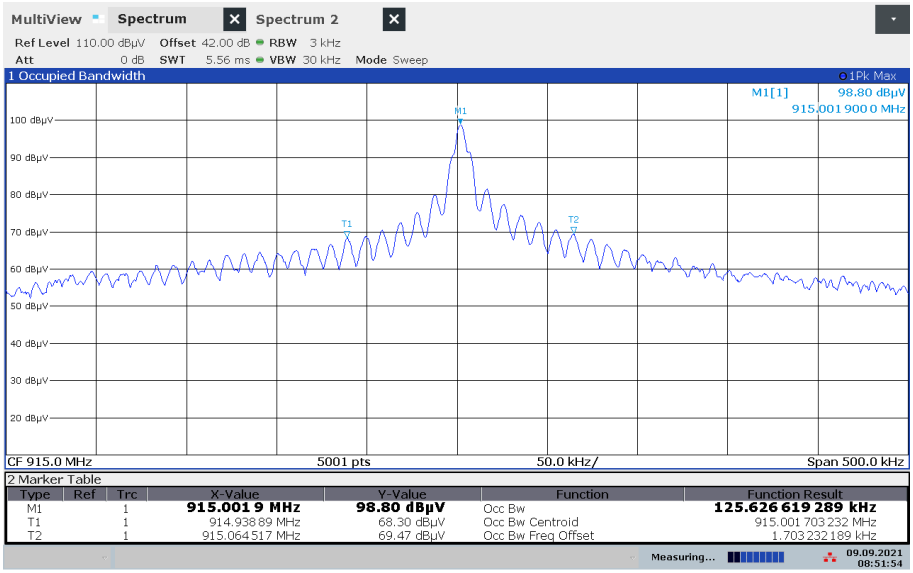
09:11:50 09.09.2021

Plot 1: Emissions bandwidth – 915.0 MHz ASK



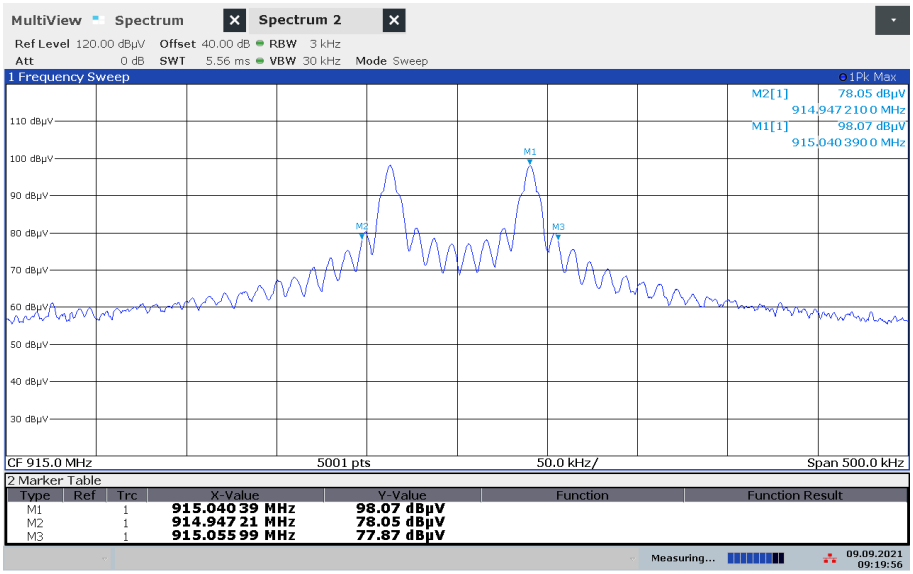
14:42:11 09.09.2021

Plot 2: 99 % emission bandwidth – 915.0 MHz ASK



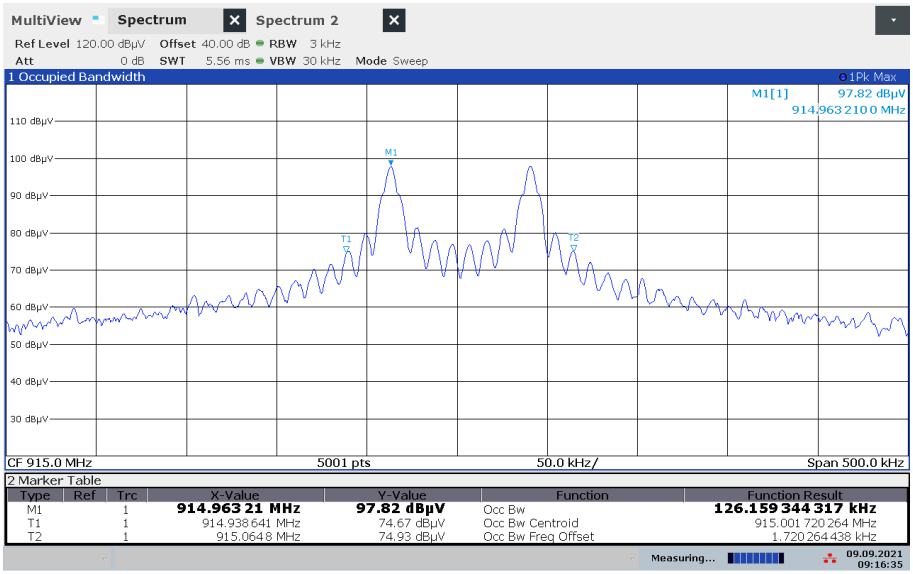
08:51:54 09.09.2021

Plot 3: Emissions bandwidth – 915.0 MHz FSK



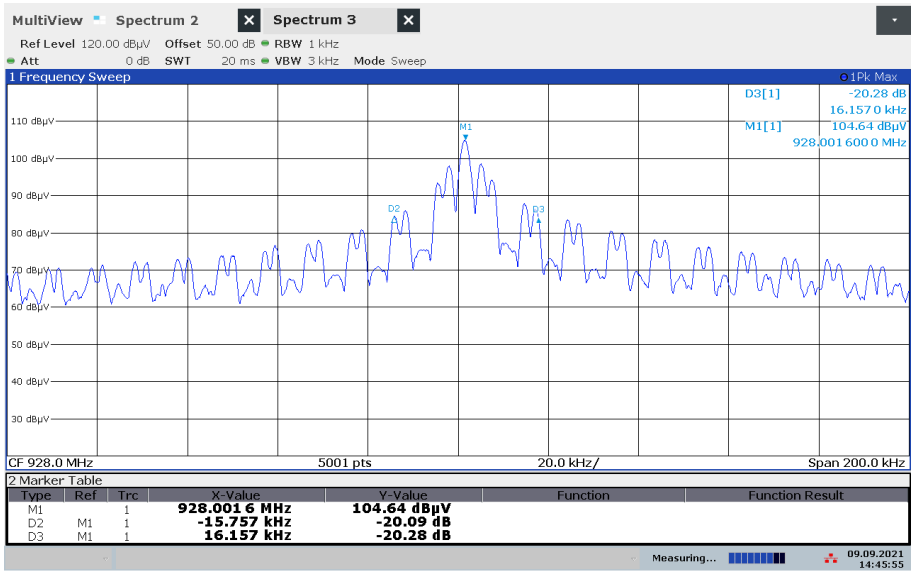
09:19:57 09.09.2021

Plot 4: 99 % emission bandwidth – 915.0 MHz FSK



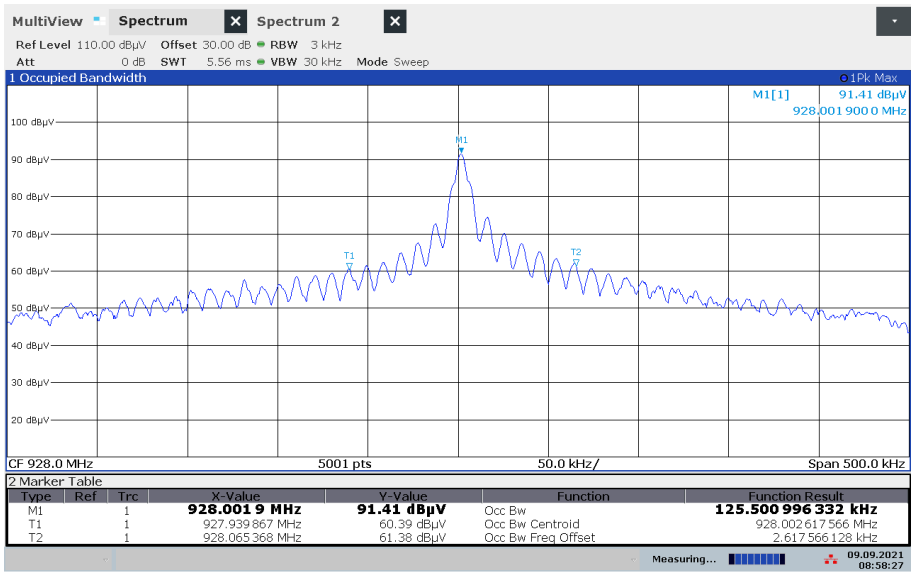
09:16:36 09.09.2021

Plot 1: Emissions bandwidth – 928.0 MHz ASK



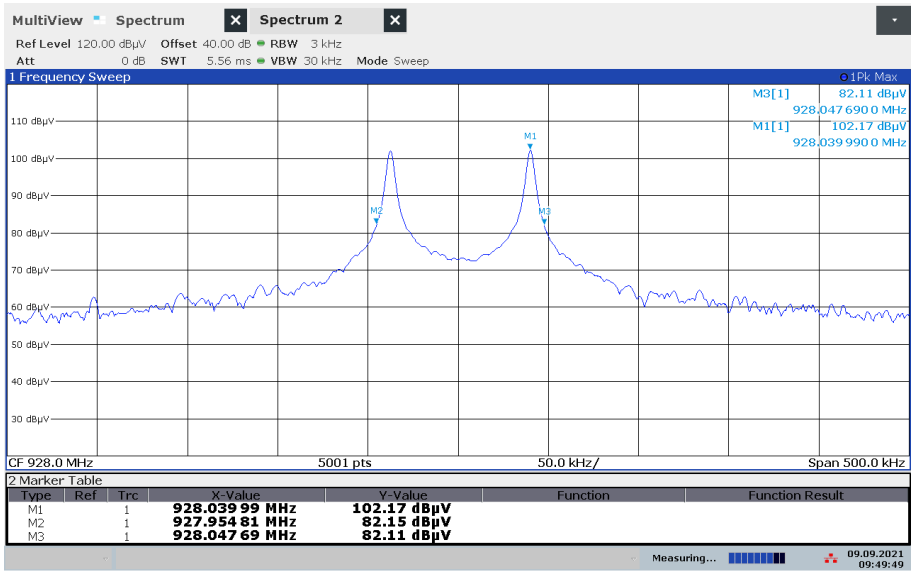
14:45:56 09.09.2021

Plot 2: 99 % emission bandwidth – 928.0 MHz ASK



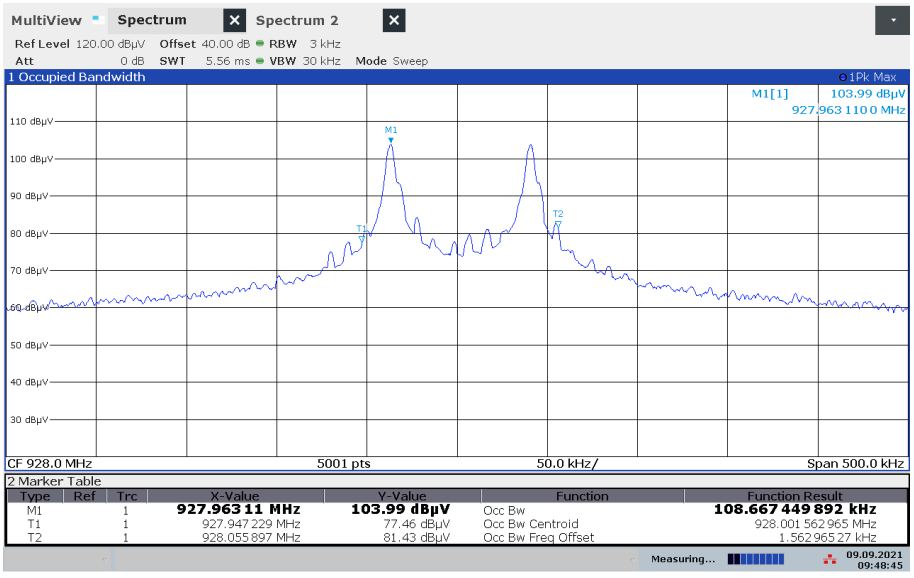
08:58:27 09.09.2021

Plot 3: Emissions bandwidth – 928.0 MHz FSK



09:49:49 09.09.2021

Plot 4: 99 % emission bandwidth – 928.0 MHz FSK



09:48:45 09.09.2021

Verdict: compliant

11.4 Field strength of the fundamental

Measurement:

Measurement parameter	
Detector:	Peak / pulse averaging / quasi peak
Sweep time:	Auto
Resolution bandwidth:	120 kHz
Video bandwidth:	3 x RBW
Span:	zero
Trace-Mode:	Max. hold
Test setup	7.1 A
Measurement uncertainty	see chapter 9

Limits:

FCC	IC	
Field strength of the fundamental. In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:		
Fundamental Frequency (MHz)	**Field strength of Fundamental (µV/m)**	**Measurement distance (m)**
40.66 – 40.70	2,250	3
70-130	1,250	3
130-174	1,250 to 3,750	3
174-260	3,750	3
260-470	3,750 to 12,500	3
Above 470	12,500	3

Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows:

- for the band 130-174 MHz, µV/m at 3 meters = 56.81818(F) - 6136.3636;
- for the band 260-470 MHz, µV/m at 3 meters = 41.6667(F) - 7083.3333.

Result:

TEST CONDITIONS		MAXIMUM POWER (dBµV/m at 3 m distance) *	
frequency / mode	**limit average**	**peak**	**average**
312.0 MHz ASK	75.44 dBµV/m	71.51	69.27
312.0 MHz FSK	75.44 dBµV/m	71.64	69.30
318.0 MHz ASK	75.80 dBµV/m	75.55	73.25
318.0 MHz FSK	75.80 dBµV/m	74.50	72.33
431.9 MHz ASK	80.75 dBµV/m	77.80	76.08
431.9 MHz FSK	80.75 dBµV/m	76.63	74.51
435.9 MHz ASK	80.89 dBµV/m	77.63	76.03
435.9 MHz FSK	80.89 dBµV/m	76.63	74.51
868.3 MHz ASK	81.93 dBµV/m	81.17	79.50
868.3 MHz FSK	81.93 dBµV/m	79.65	78.05
902.0 MHz ASK	81.93 dBµV/m	76.24	73.89
902.0 MHz FSK	81.93 dBµV/m	75.13	72.85
915.0 MHz ASK	81.93 dBµV/m	77.36	75.57
915.0 MHz FSK	81.93 dBµV/m	75.59	73.26
928.0 MHz ASK	81.93 dBµV/m	79.77	77.25
928.0 MHz FSK	81.93 dBµV/m	79.60	77.29

* Calculated from 10 meter to 3 meter with 10.46 dB

11.5 Field strength of the harmonics and spurious

Measurement:

Measurement parameter	
Detector:	Peak / average / quasi peak
Sweep time:	Auto
Resolution bandwidth:	200 Hz / 9 kHz / 120 kHz
Video bandwidth:	3 x RBW
Span:	See plots
Trace-Mode:	Max. hold
Test setup	7.1 A, 7.2 A
Measurement uncertainty	see chapter 9

Limits: Part 15.231

In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

FCC		IC
FCC Part 15.231		
Fundamental Frequency (MHz)	Field strength of spurious (µV/m)	Measurement distance (m)
40.66 – 40.70	225	3
70-130	125	3
130-174	125 to 375	3
174-260	375	3
260-470	375 to 1,250	3
Above 470	1,250	3

Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits a higher field strength.

FCC		IC
FCC Part 15.209		
Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
above 960	500	3

Results:

Spurious emissions within the restricted bands (Part15.205 & 15.209)

Fundamental Frequency	Spurious Frequency	Detector	Limit max. allowed [dBµV/m]	Amplitude of emission [dBµV/m]
312 MHz (ASK)	1560.0 MHz	Peak	74	36.86
		AVG	54	25.16
431.9 MHz (FSK)	4319.22 MHz	Peak	74	50.06
		AVG	54	44.89
	4750.40 MHz	Peak	74	51.19
		AVG	54	45.60
435.9 MHz (FSK)	1418.32 MHz	Peak	74	46.03
		AVG	54	30.12
868.1 MHz (FSK)	1412.72 MHz	Peak	74	46.21
		AVG	54	31.10
902.0 MHz (ASK)	3607.73 MHz	Peak	74	49.96
		AVG	54	45.50
928.0 MHz (FSK)	8351.80 MHz	Peak	74	51.98
		AVG	54	48.04

For emissions below 1 GHz, see table below the plots.

Results: Spurious emissions outside the restricted bands (Part15.231)

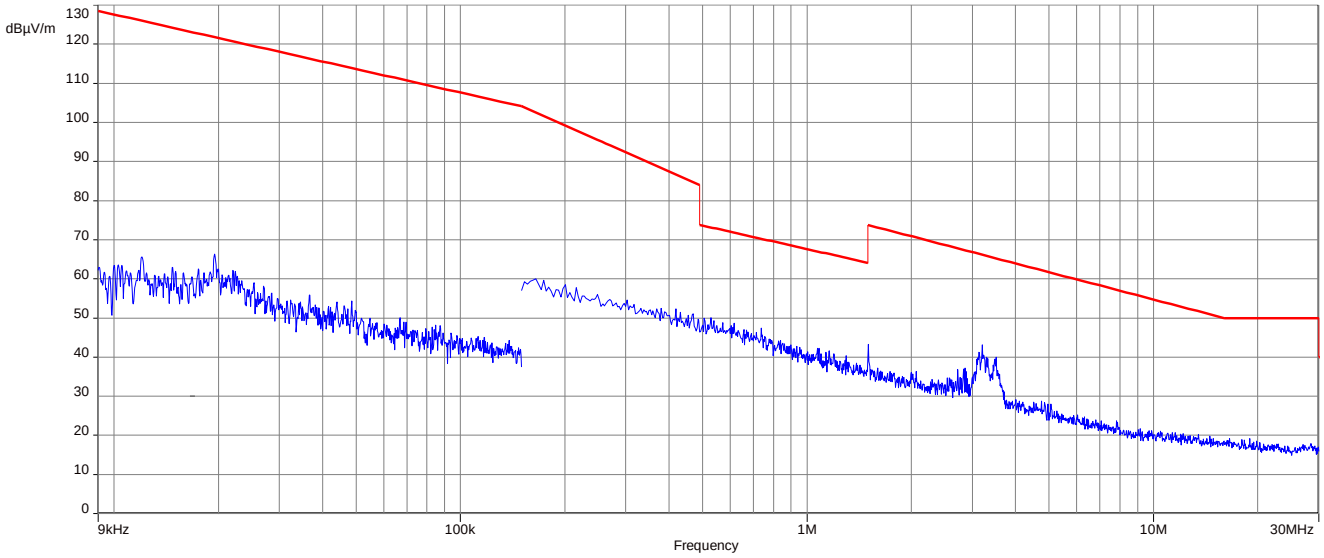
Fundamental Frequency	Spurious Frequency	Detector	Limit max. allowed [dBµV/m]	Amplitude of emission [dBµV/m]
312 MHz (ASK)	1247.94 MHz	Peak	-/-	49.99
		AVG	62	48.45
431.9 MHz (FSK)	1295.82 MHz	Peak	-/-	58.56
		AVG	62	57.92
	1727.44 MHz	Peak	-/-	51.30
		AVG	62	49.85
435.9 MHz (FSK)	1743.82 MHz	Peak	-/-	51.04
		AVG	62	49.54
868.3 MHz (FSK)	1716.38 MHz	Peak	-/-	37.83
		AVG	62	25.71
868.5 MHz (ASK)	1737.10 MHz	Peak	-/-	59.98
		AVG	62	59.47
	9553.9 MHz	Peak	-/-	61.69
		AVG	62	59.22

For emissions below 1 GHz, see table below the plots.

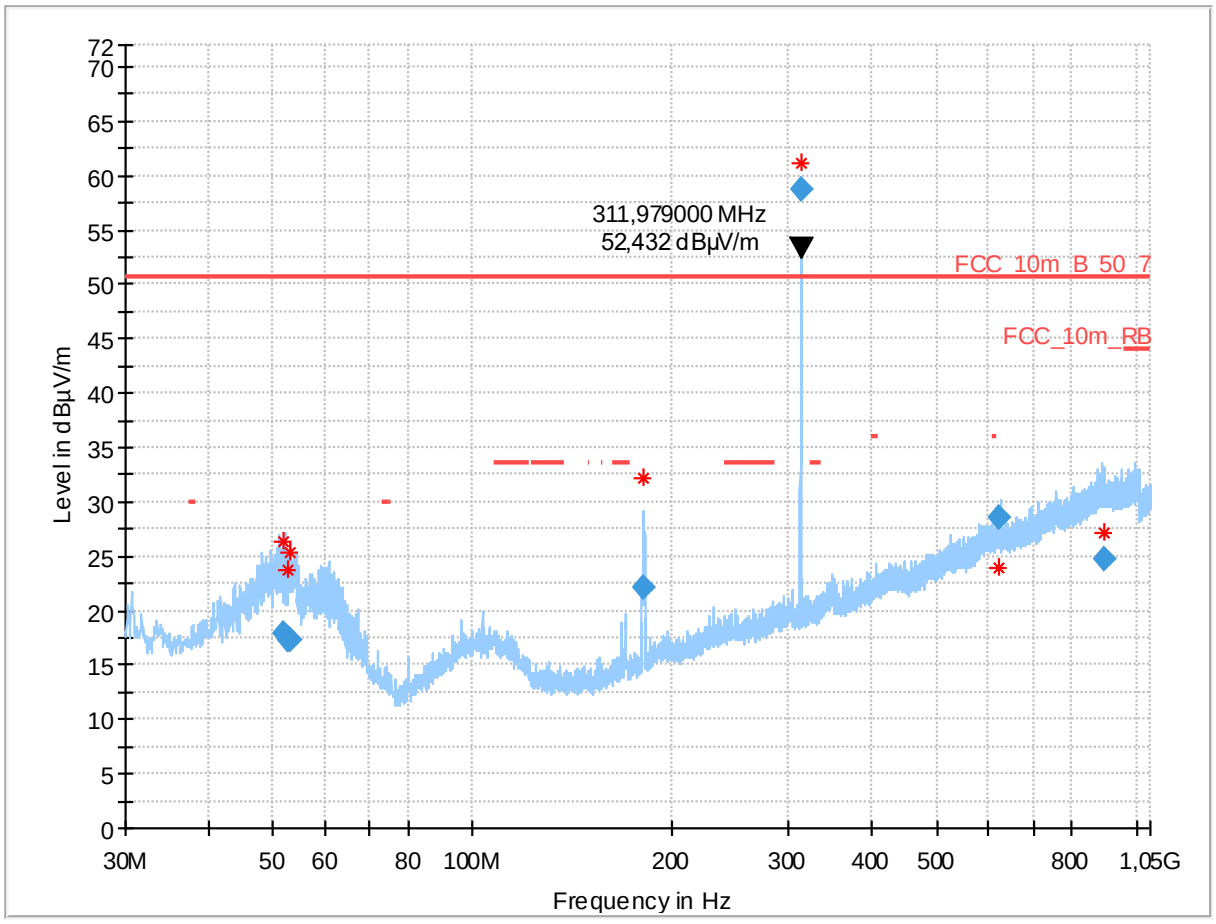
Plots:

- **TX 312.0MHz**

Plot 1: TX@312MHz, ASK, 9 kHz to 30 MHz



Plot 2: TX@312MHz, ASK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

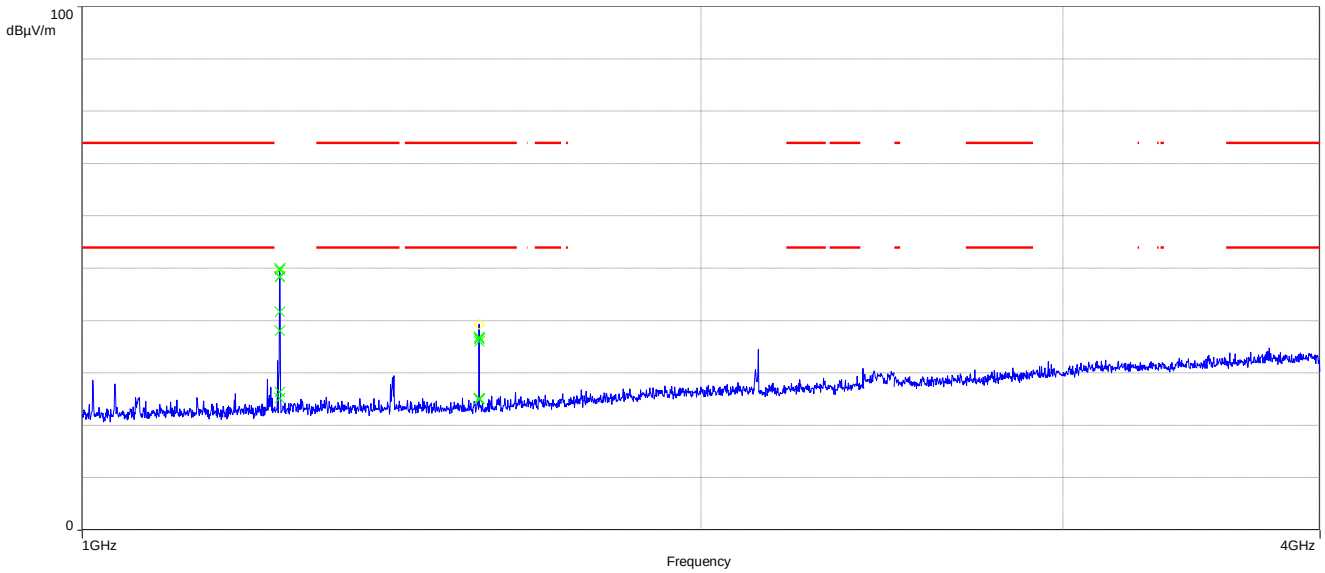


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
51.767	17.85	50.7	32.9	1000	120.0	98.0	V	68	15
52.816	17.21	50.7	33.5	1000	120.0	98.0	V	104	15
53.275	17.21	50.7	33.5	1000	120.0	170.0	V	95	15
181.401	22.21	50.7	28.5	1000	120.0	170.0	V	292	11
312.002	wanted signal								
623.084	28.64	50.7	22.1	1000	120.0	170.0	H	157	22
891.498	24.71	50.7	26.0	1000	120.0	170.0	H	-22	25

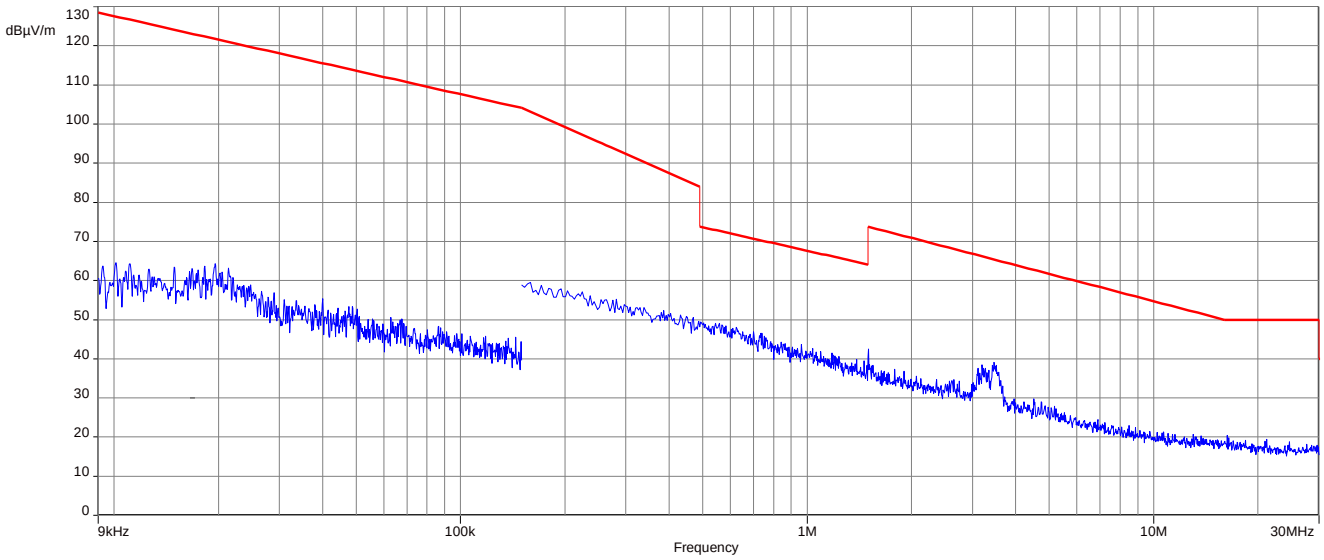
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@312MHz, ASK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

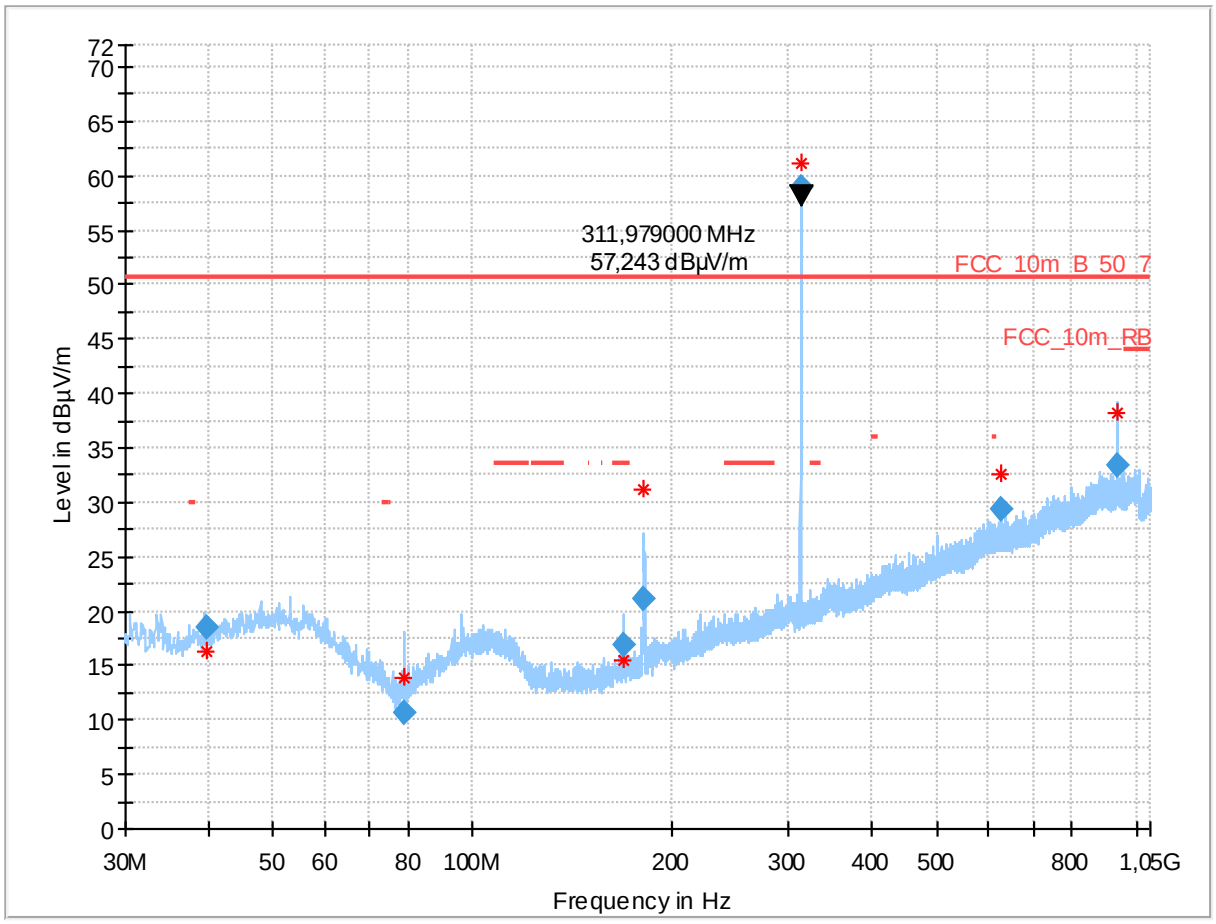


- **TX 312.0MHz**

Plot 1: TX@312MHz, FSK, 9 kHz to 30 MHz



Plot 2: TX@312MHz, FSK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

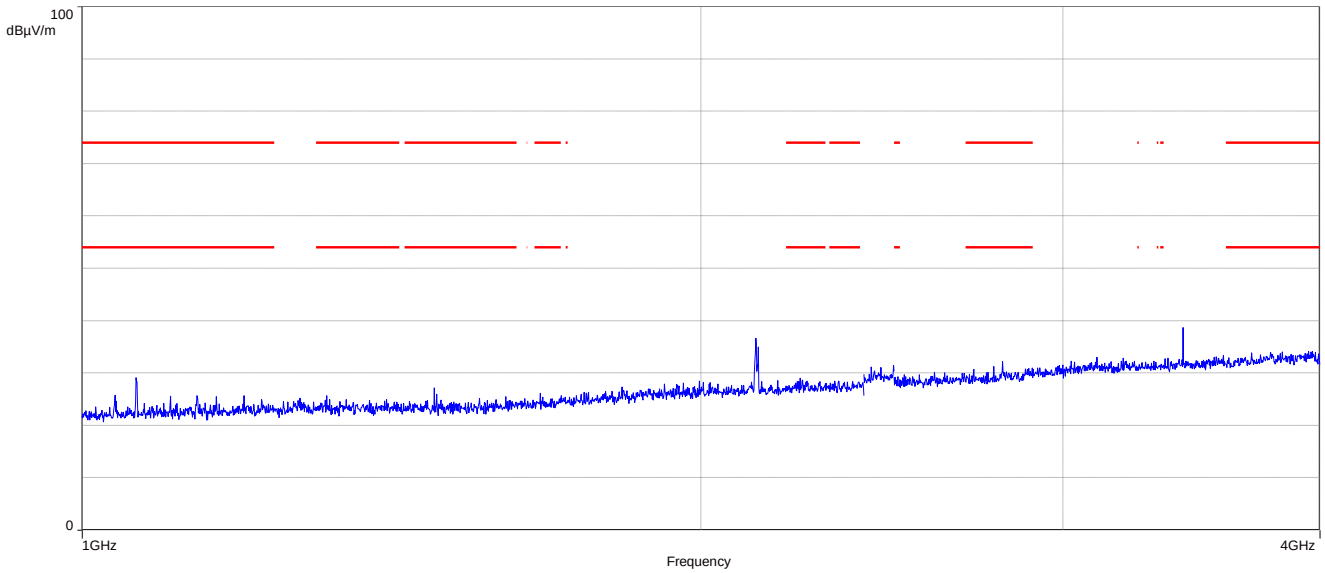


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39.679	18.52	50.7	32.2	1000	120.0	170.0	V	247	14
78.767	10.74	50.7	40.0	1000	120.0	170.0	V	192	8
169.081	16.83	50.7	33.9	1000	120.0	170.0	V	276	11
181.396	21.20	50.7	29.5	1000	120.0	121.0	V	292	11
312.071	wanted signal								
623.922	29.46	50.7	21.2	1000	120.0	170.0	V	105	22
935.910	33.35	50.7	17.4	1000	120.0	120.0	H	165	26

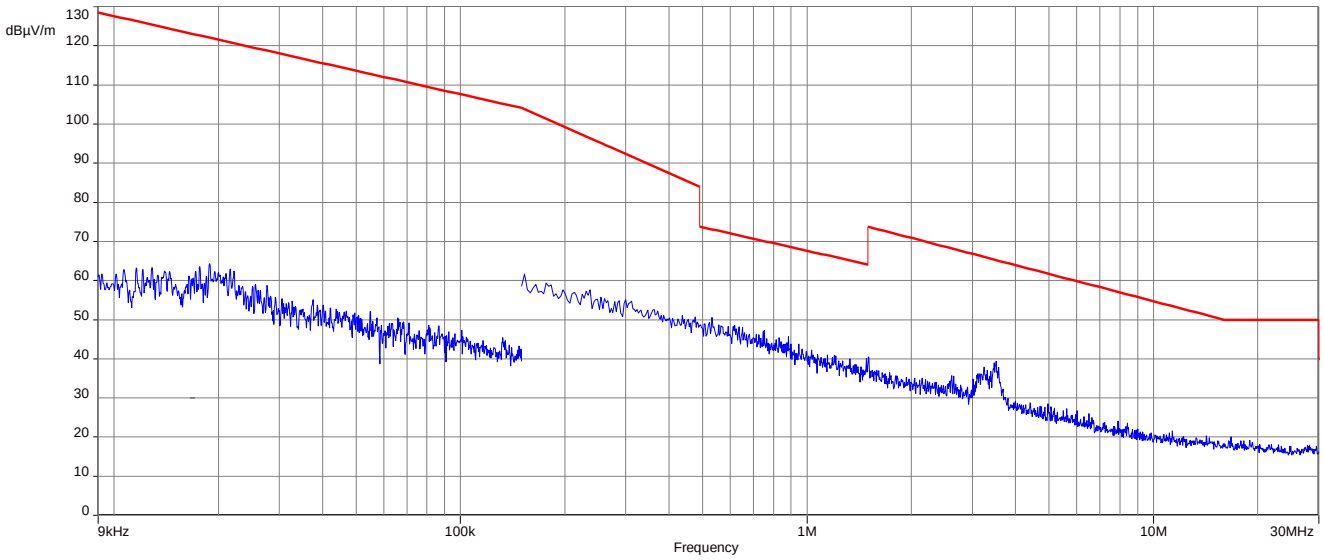
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@312MHz, FSK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

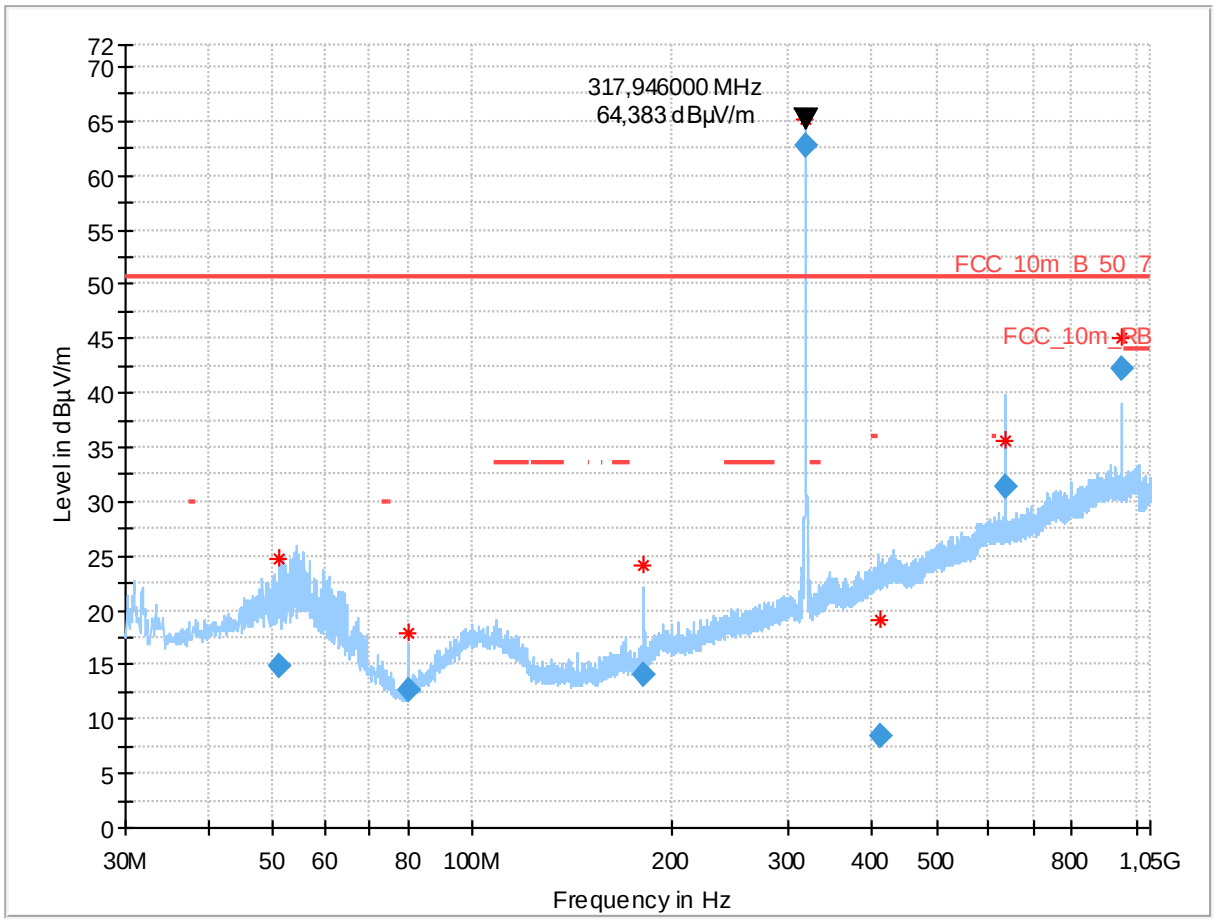


- **TX 318.0MHz**

Plot 1: TX@318MHz, ASK, 9 kHz to 30 MHz



Plot 2: TX@318MHz, ASK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

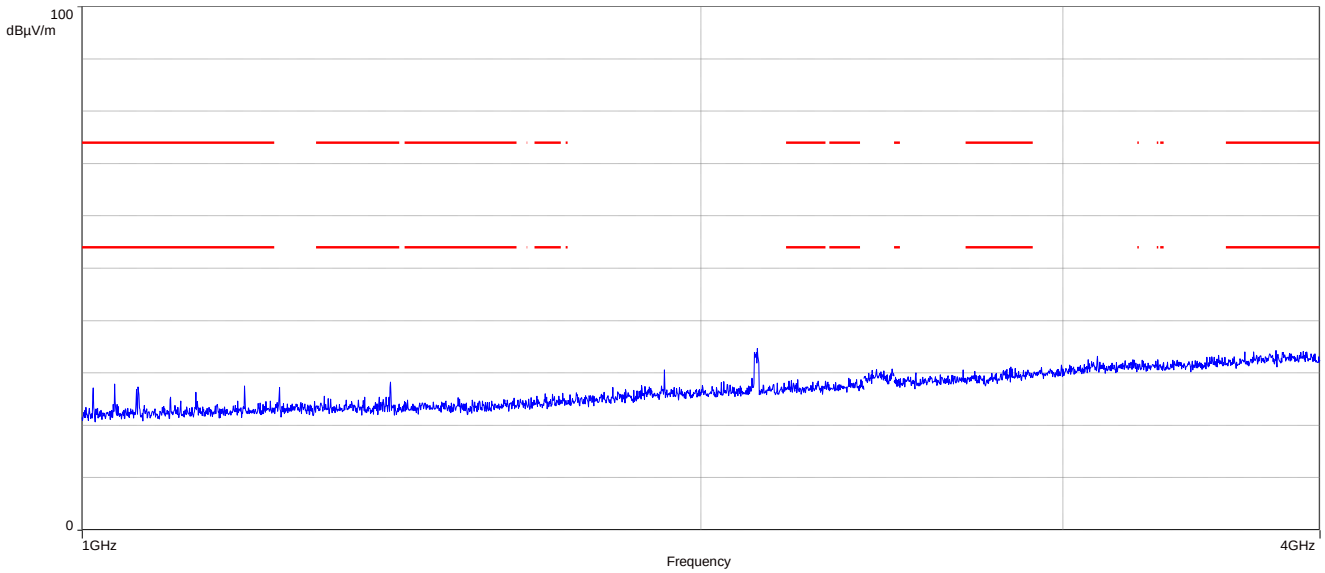


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
51.230	14.90	50.7	35.8	1000	120.0	203.0	V	194	15
79.997	12.68	50.7	38.0	1000	120.0	328.0	V	110	8
180.870	14.05	50.7	36.7	1000	120.0	200.0	V	339	11
318.004	wanted signal								
410.306	8.37	50.7	42.3	1000	120.0	242.0	H	184	18
635.944	31.33	50.7	19.4	1000	120.0	262.0	V	203	22
954.002	42.14	50.7	8.6	1000	120.0	200.0	V	166	25

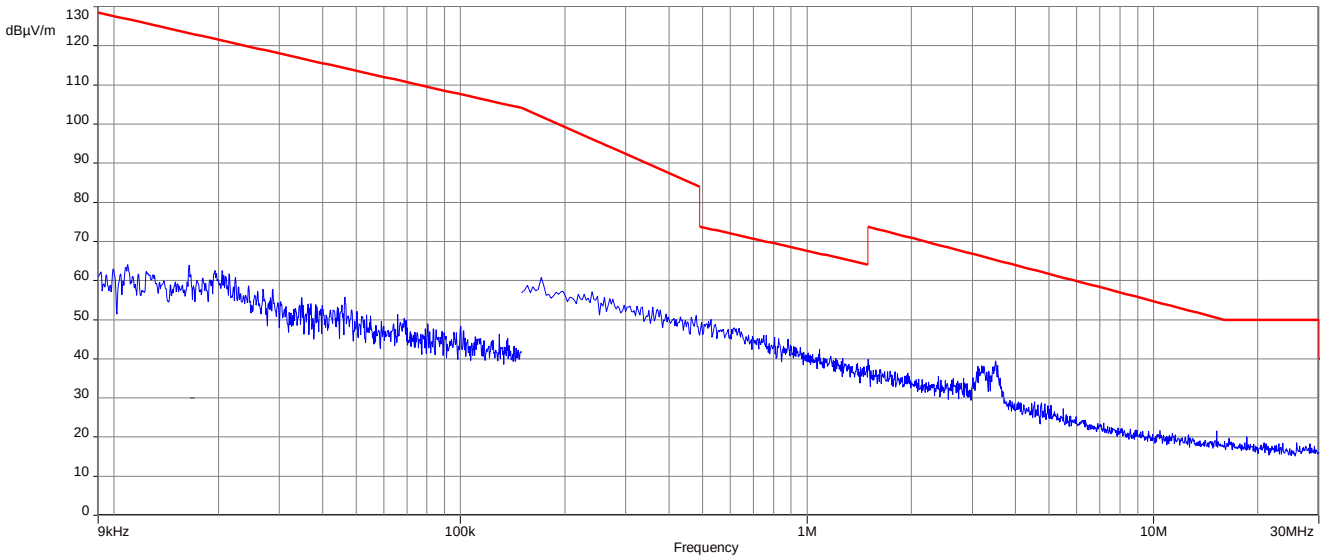
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@318MHz, ASK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

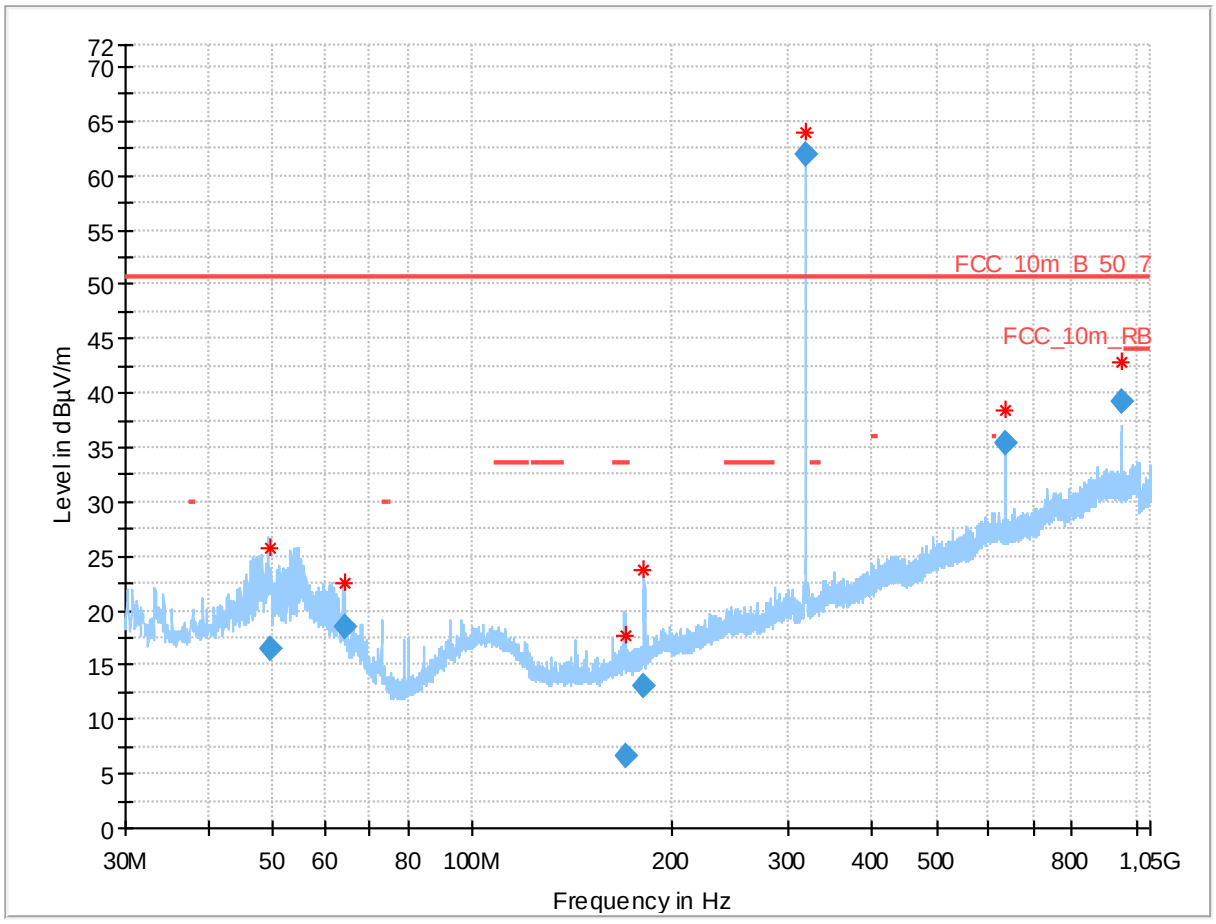


- **TX 318.0MHz**

Plot 1: TX@318MHz, FSK, 9 kHz to 30 MHz



Plot 2: TX@318MHz, FSK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

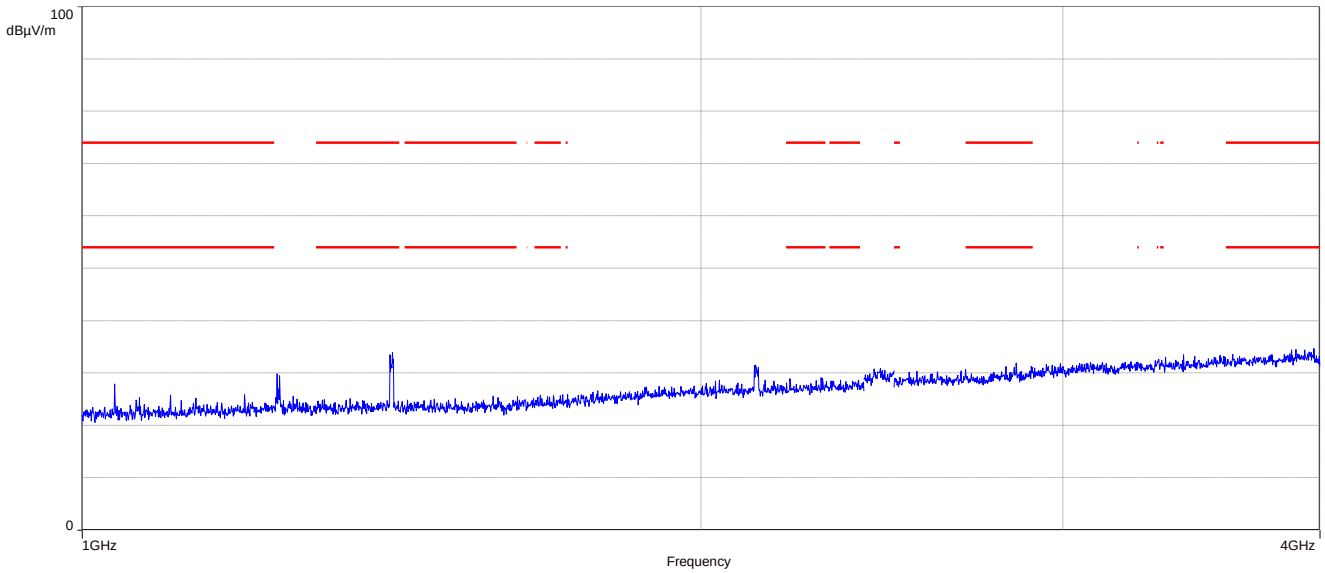


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
49.758	16.56	50.7	34.1	1000	120.0	100.0	V	110	15
64.029	18.42	50.7	32.3	1000	120.0	255.0	V	164	13
169.559	6.73	50.7	44.0	1000	120.0	200.0	V	180	11
181.448	13.06	50.7	37.6	1000	120.0	120.0	V	12	11
317.966	wanted signal								
636.079	35.37	50.7	15.3	1000	120.0	268.0	V	225	22
953.846	39.24	50.7	11.5	1000	120.0	200.0	V	181	25

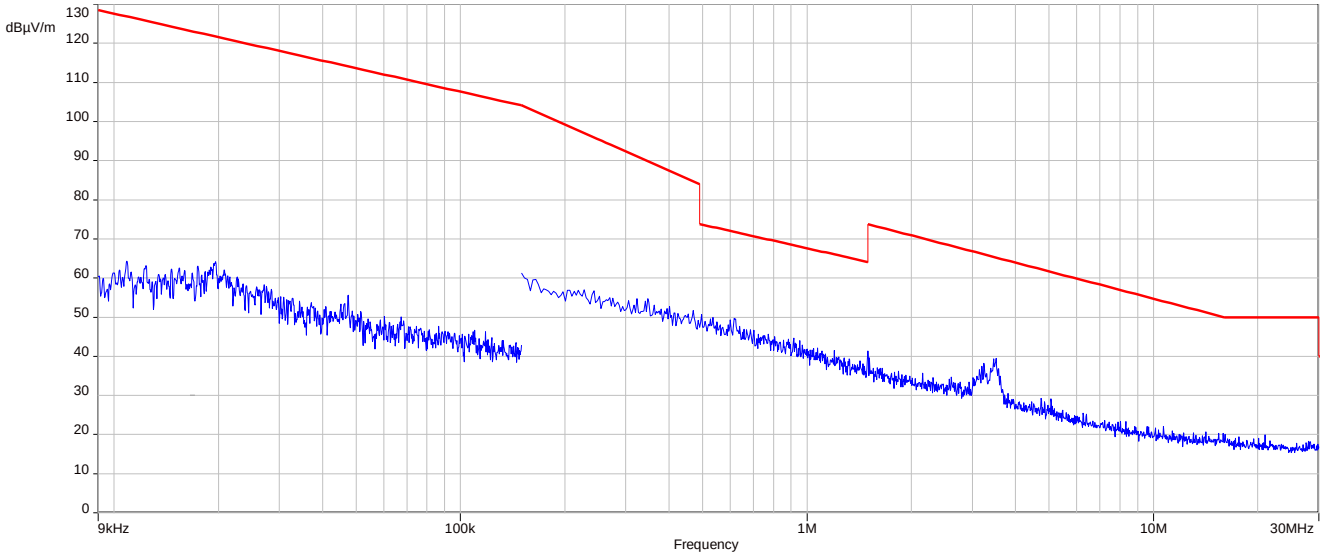
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@318MHz, FSK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

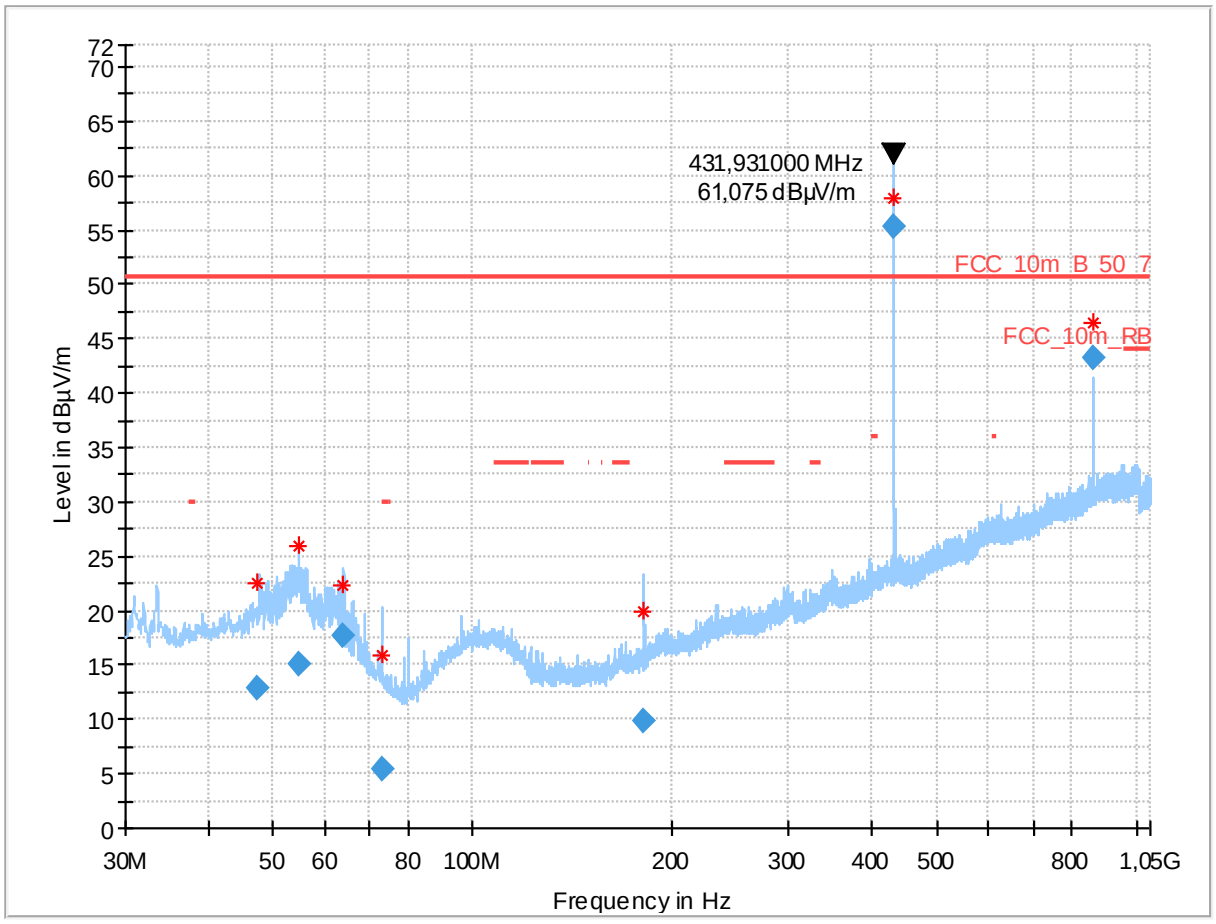


- **TX 431.9MHz**

Plot 1: TX@431.9MHz, ASK, 9 kHz to 30 MHz



Plot 2: TX@431.9MHz, ASK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

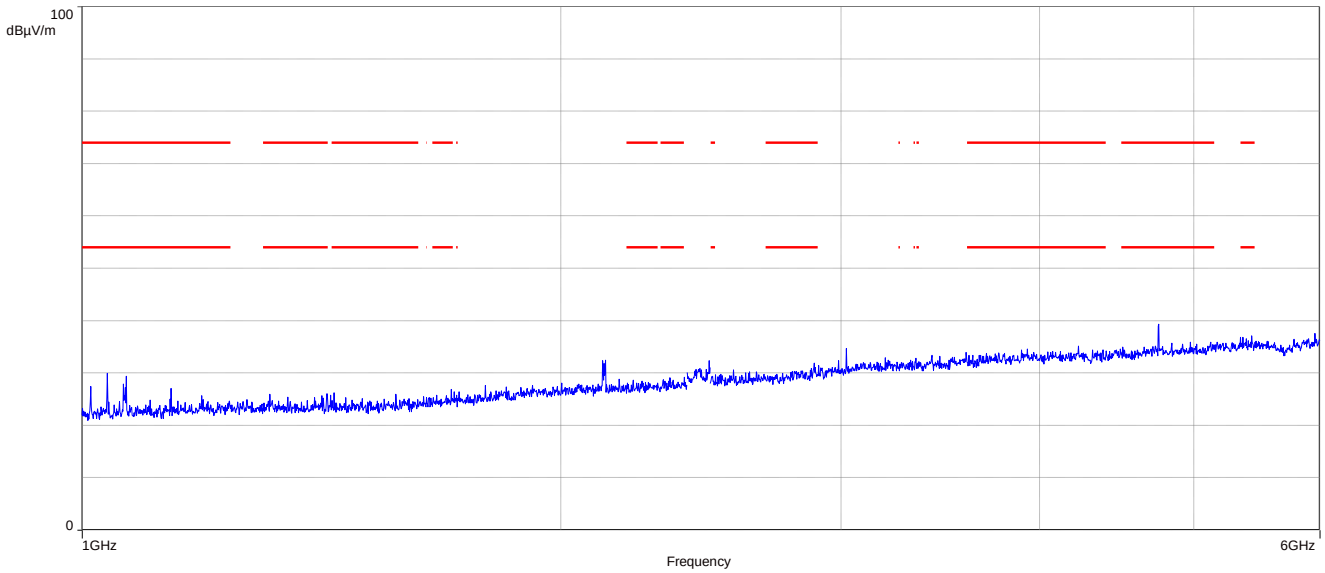


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
47.264	12.85	50.7	37.9	1000	120.0	208.0	V	90	15
54.728	15.02	50.7	35.7	1000	120.0	307.0	V	25	15
63.988	17.64	50.7	33.1	1000	120.0	291.0	V	-45	13
73.184	5.40	50.7	45.3	1000	120.0	400.0	V	112	9
181.292	9.80	50.7	40.9	1000	120.0	200.0	V	167	11
431.849	wanted signal								
863.818	43.26	50.7	7.4	1000	120.0	203.0	V	90	25

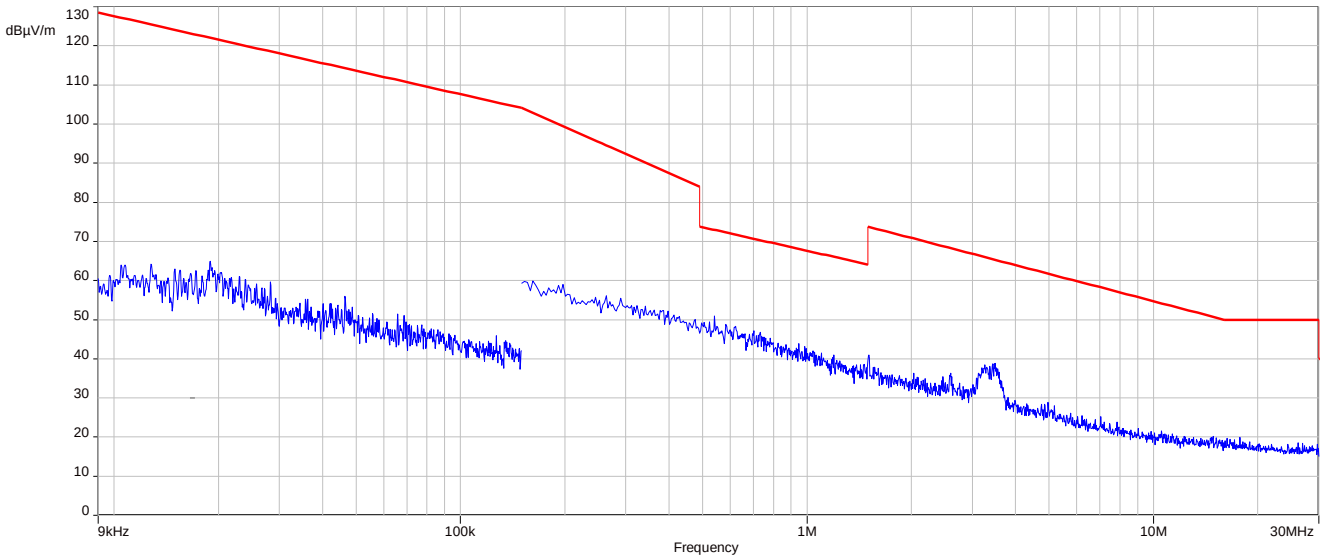
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@431.9MHz, ASK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

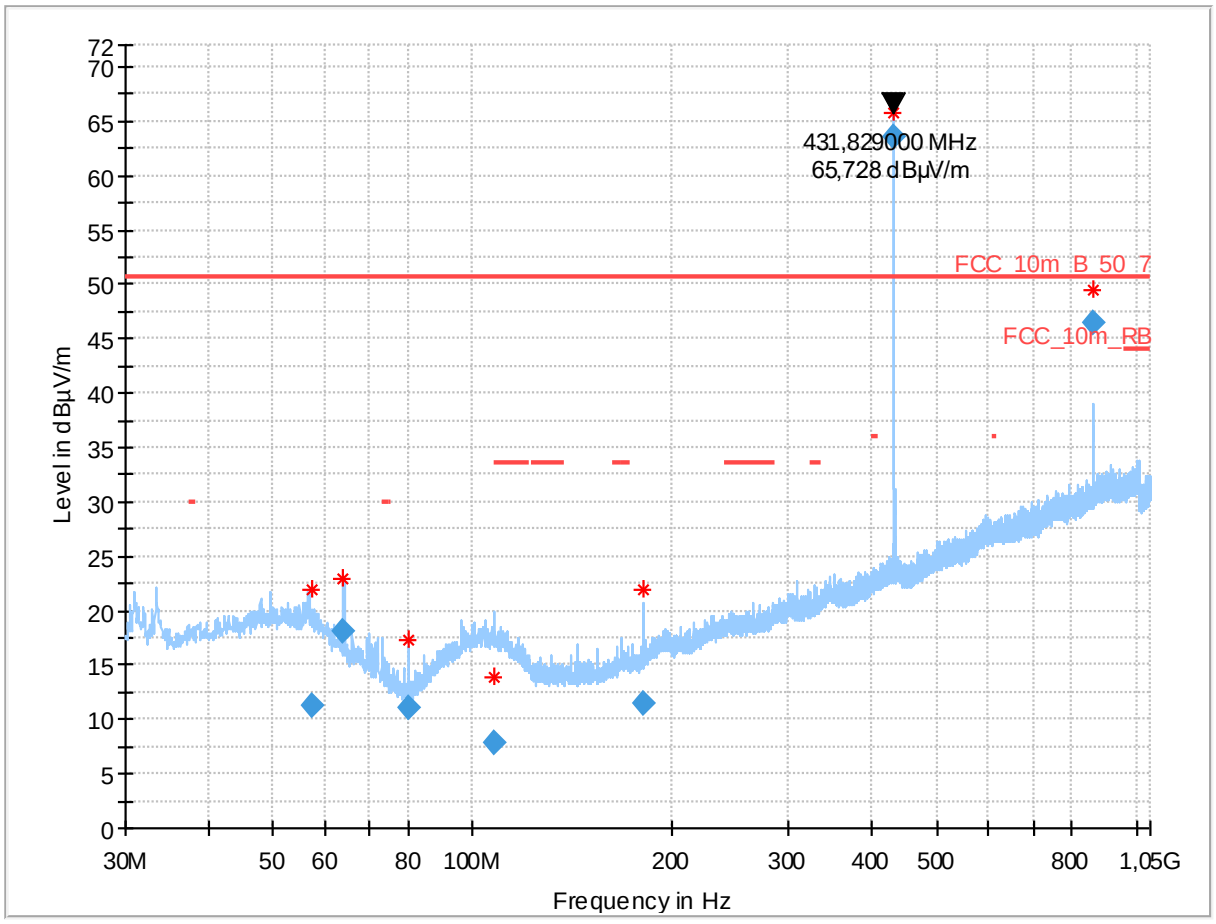


- **TX 431.9MHz**

Plot 1: TX@431.9MHz, FSK, 9 kHz to 30 MHz



Plot 2: TX@431.9MHz, FSK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

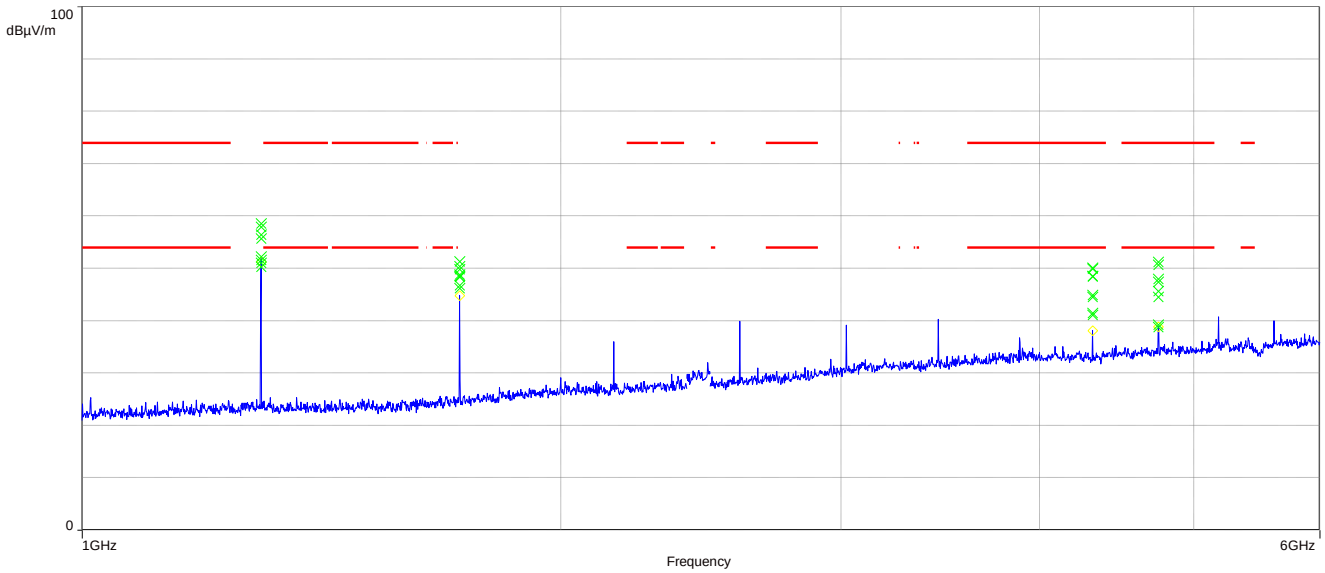


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
57.167	11.33	50.7	39.4	1000	120.0	200.0	V	343	16
63.982	18.19	50.7	32.5	1000	120.0	246.0	V	135	13
80.000	11.07	50.7	39.6	1000	120.0	206.0	V	90	8
107.965	7.93	50.7	42.8	1000	120.0	200.0	V	11	14
180.940	11.40	50.7	39.3	1000	120.0	200.0	V	218	11
431.859	wanted signal								
863.722	46.55	50.7	4.2	1000	120.0	203.0	V	118	25

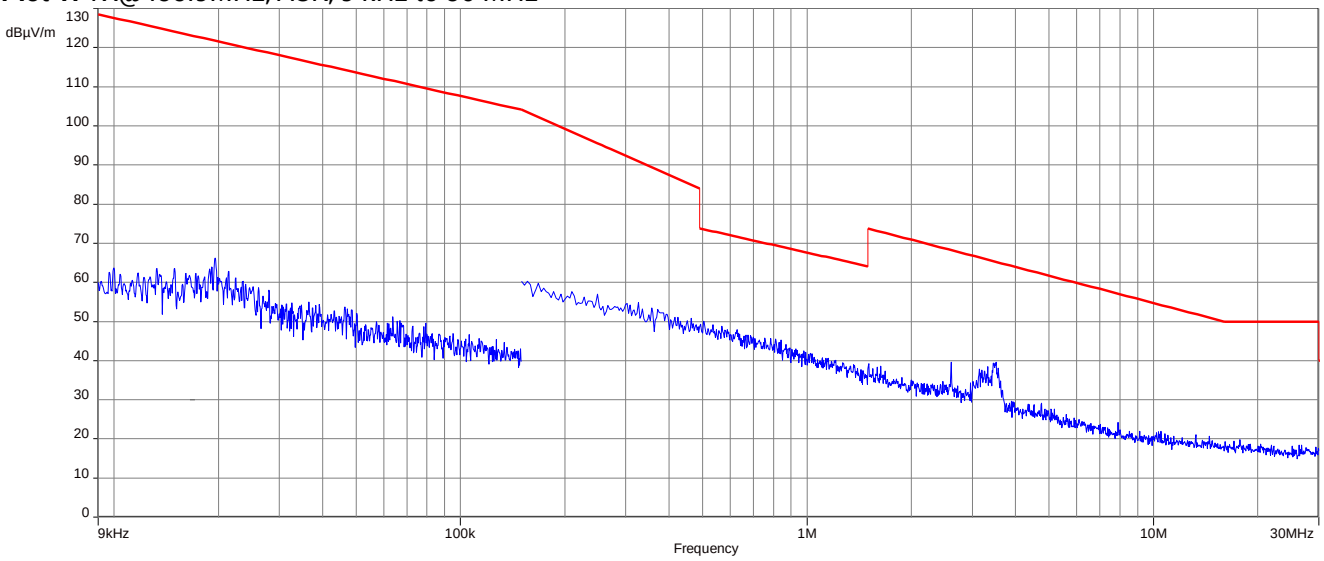
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@431.9MHz, FSK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

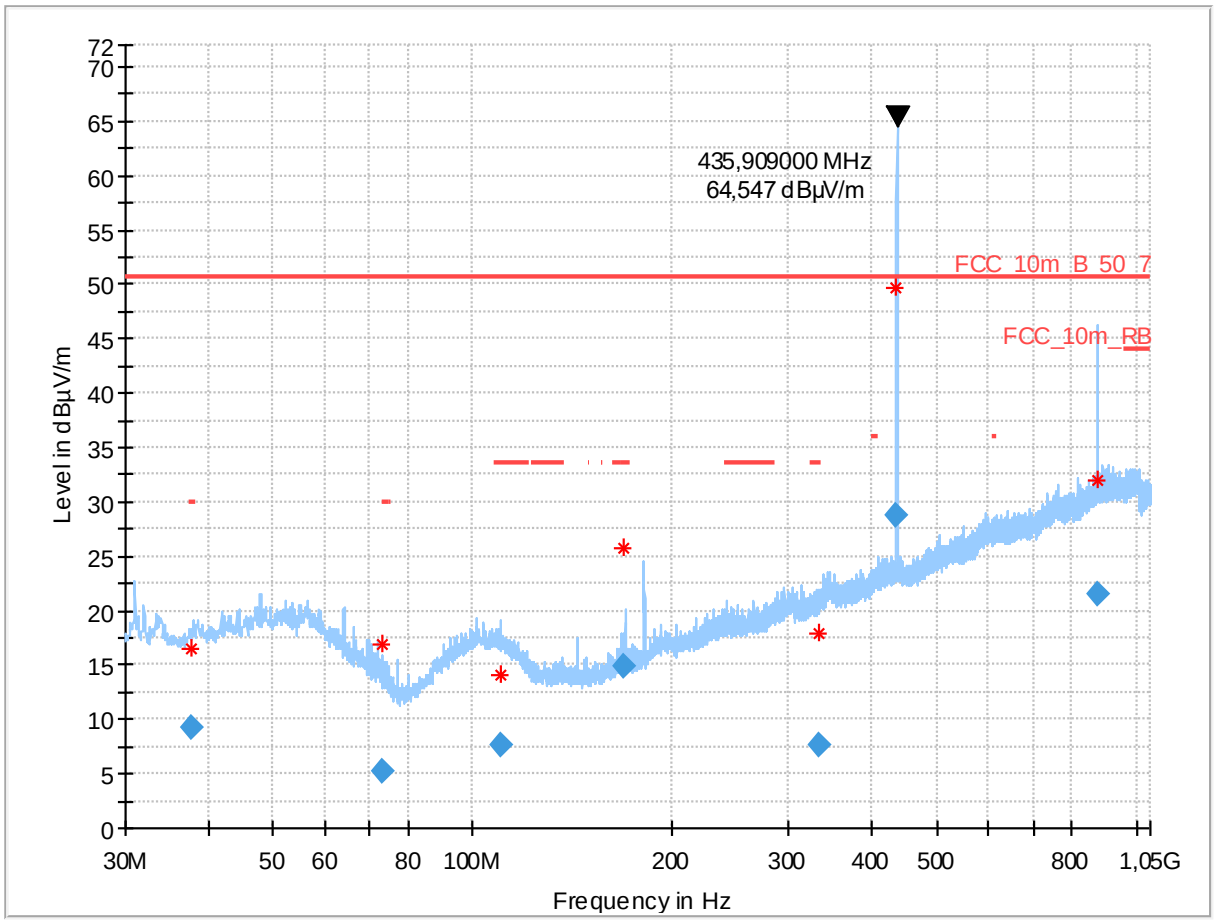


- **TX 435.9MHz**

Plot 1: TX@435.9MHz, ASK, 9 kHz to 30 MHz



Plot 2: TX@435.9MHz, ASK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

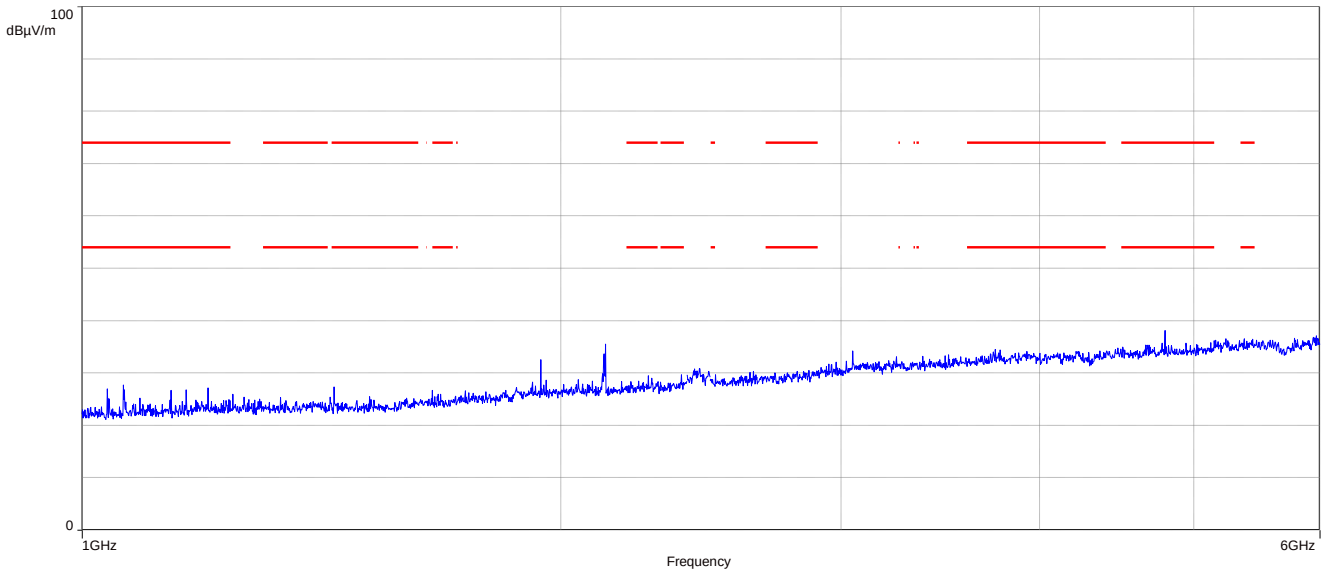


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.820	9.33	50.7	41.4	1000	120.0	190.0	V	0	14
72.997	5.23	50.7	45.5	1000	120.0	400.0	V	299	9
110.512	7.61	50.7	43.1	1000	120.0	200.0	V	0	13
169.541	14.80	50.7	35.9	1000	120.0	135.0	V	136	11
332.019	7.64	50.7	43.1	1000	120.0	400.0	V	9	16
435.690	wanted signal								
871.968	21.45	50.7	29.3	1000	120.0	111.0	H	253	25

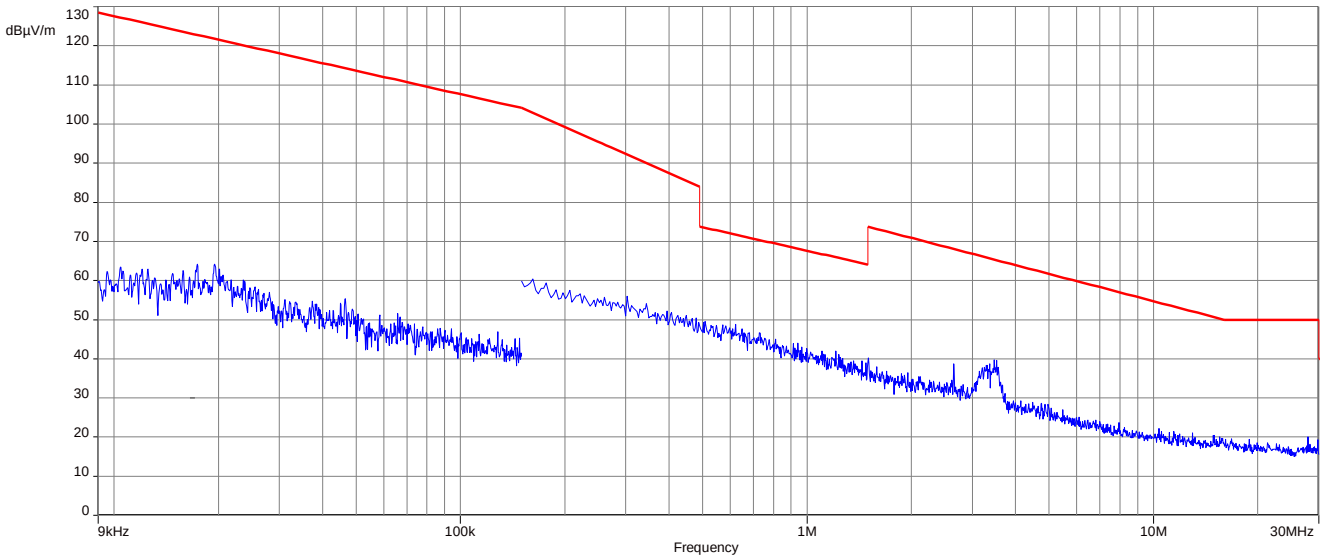
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@435.9MHz, ASK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

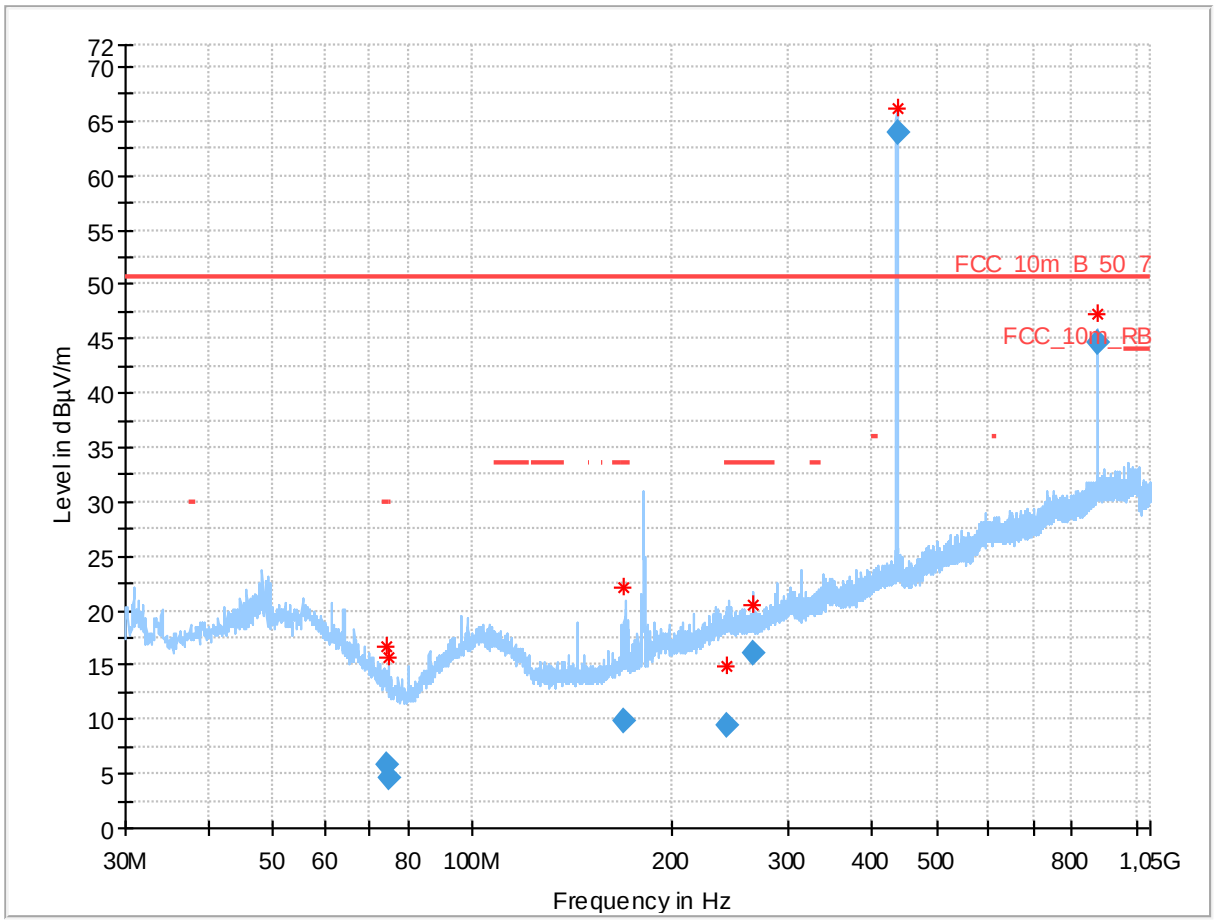


- **TX 435.9MHz**

Plot 1: TX@435.9MHz, FSK, 9 kHz to 30 MHz



Plot 2: TX@435.9MHz, FSK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

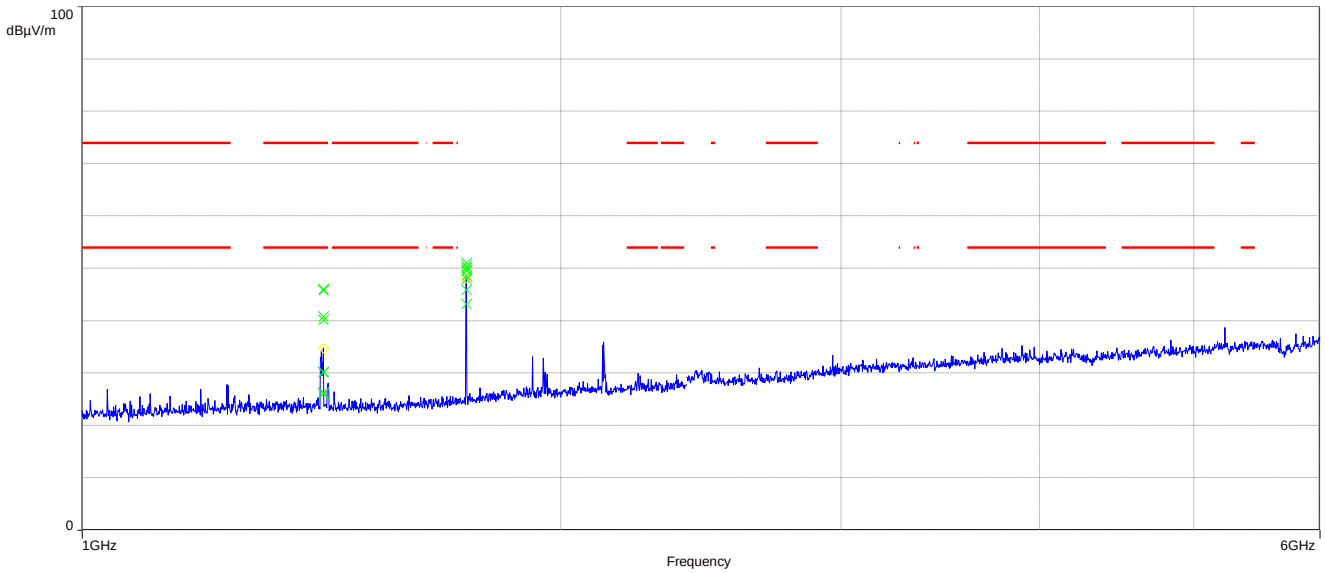


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
74.228	5.74	50.7	45.0	1000	120.0	400.0	V	0	9
74.751	4.69	50.7	46.0	1000	120.0	400.0	V	137	9
169.510	9.82	50.7	40.9	1000	120.0	109.0	V	161	11
242.461	9.43	50.7	41.3	1000	120.0	289.0	V	83	14
264.014	16.05	50.7	34.7	1000	120.0	200.0	V	196	14
435.863	wanted signal								
871.730	44.56	50.7	6.1	1000	120.0	307.0	H	243	25

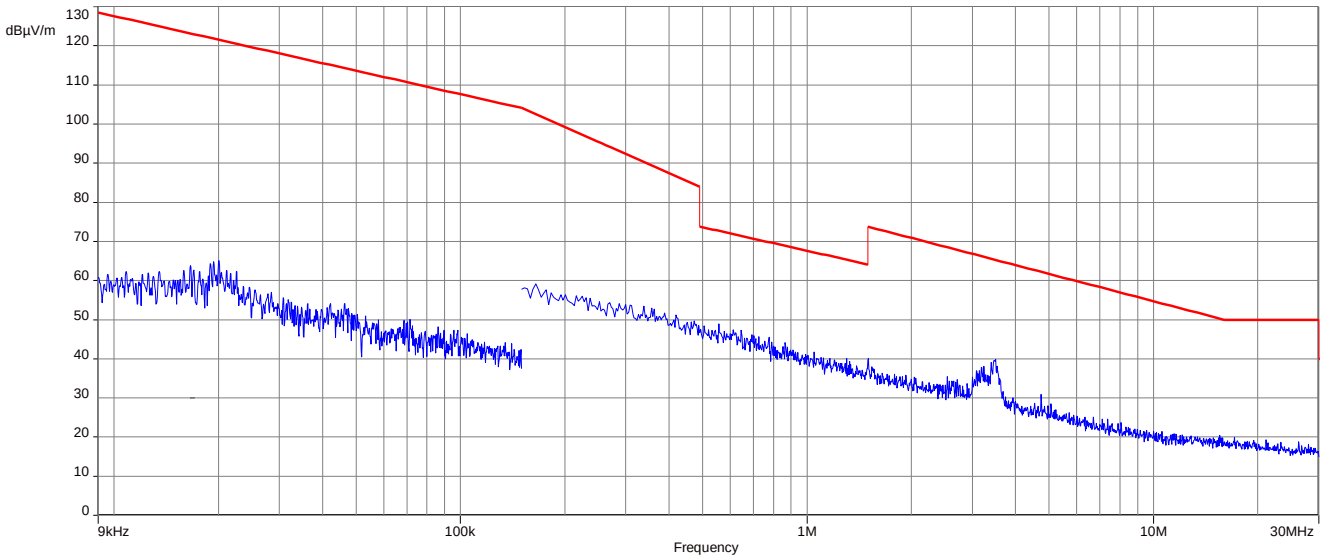
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@435.9MHz, FSK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

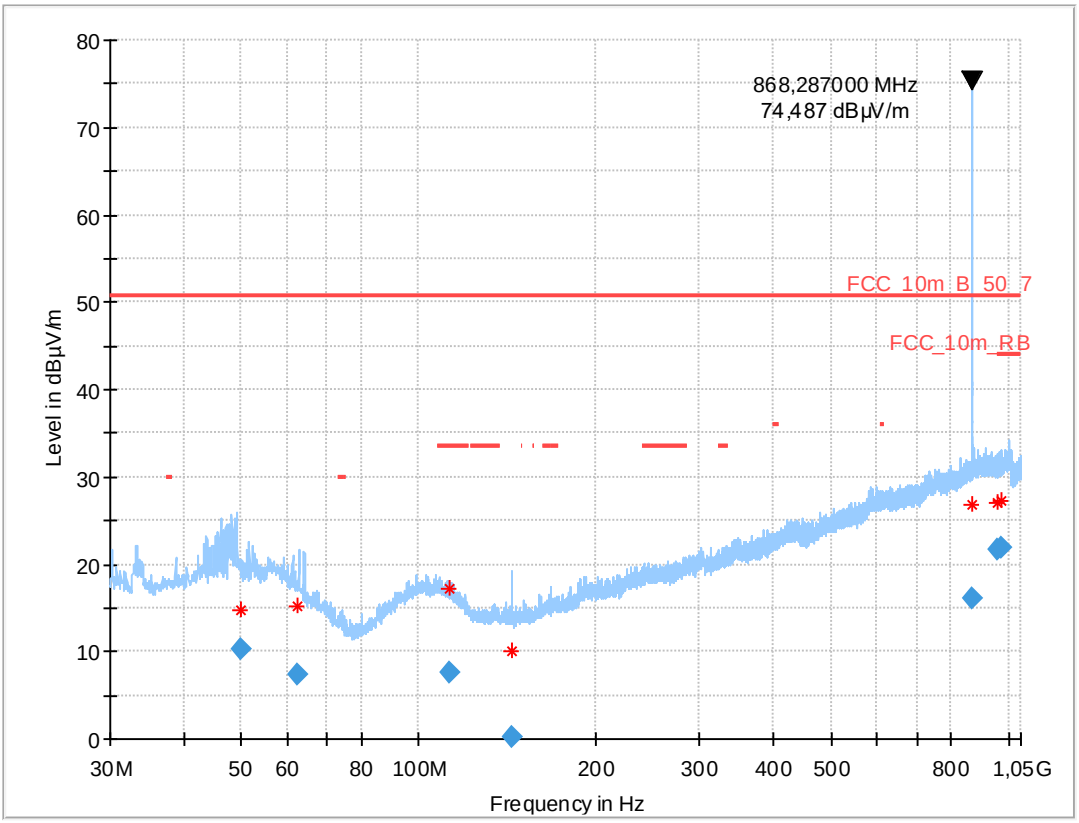


- **TX 868.3MHz**

Plot 1: TX@868.3MHz, ASK, 9 kHz to 30 MHz



Plot 2: TX@868.3MHz, ASK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

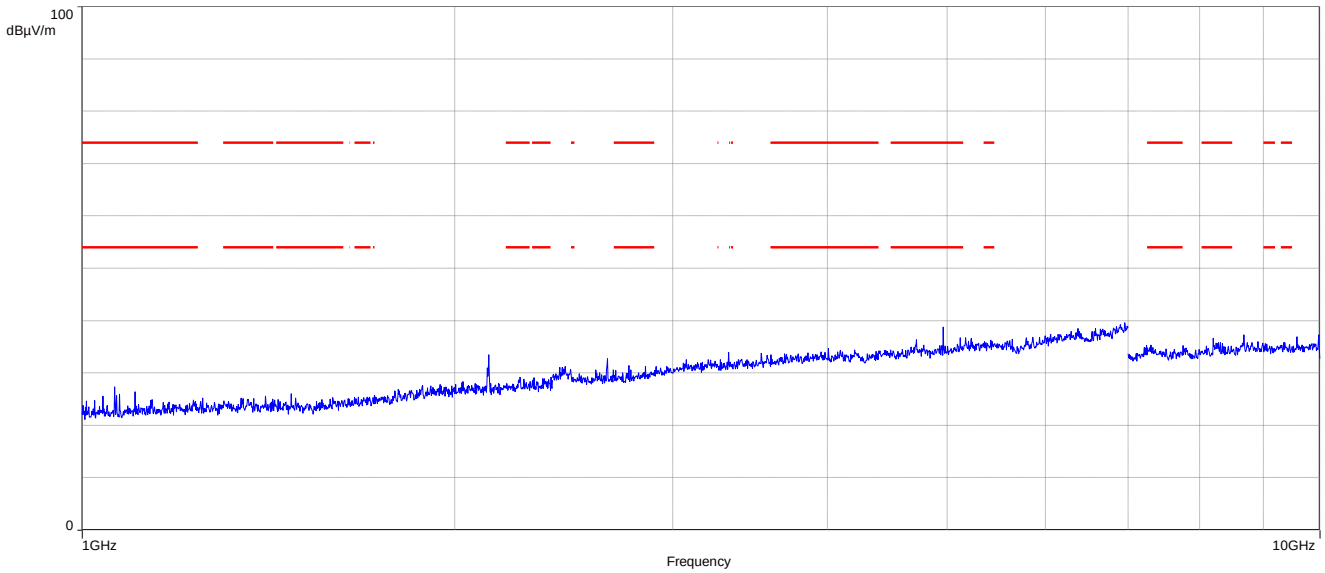


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
49.784	10.23	50.7	40.5	1000	120.0	104.0	V	22	15
62.109	7.40	50.7	43.3	1000	120.0	200.0	V	225	13
112.659	7.50	50.7	43.2	1000	120.0	194.0	H	60	13
143.977	0.23	50.7	50.5	1000	120.0	200.0	V	-37	10
868.010	wanted signal								
961.943	21.61	50.7	29.1	1000	120.0	112.0	V	-45	25
974.155	21.94	50.7	28.8	1000	120.0	400.0	H	135	26

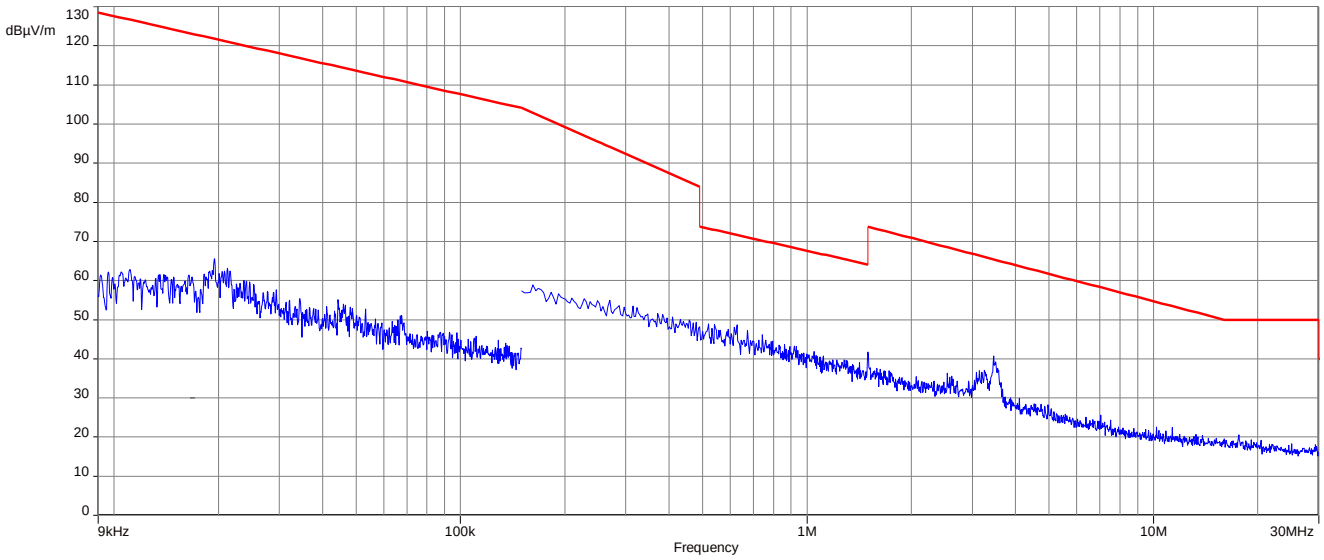
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@868.3MHz, ASK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

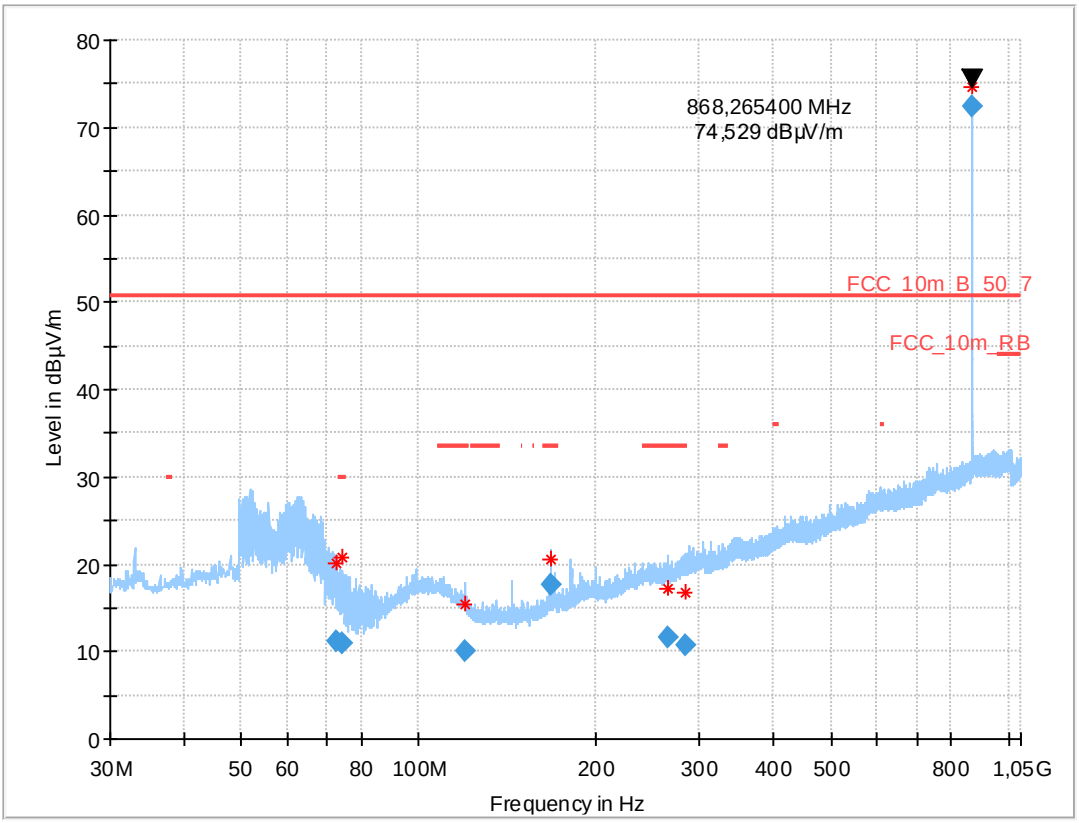


- **TX 868.3MHz**

Plot 1: TX@868.3MHz, FSK, 9 kHz to 30 MHz



Plot 2: TX@868.3MHz, FSK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

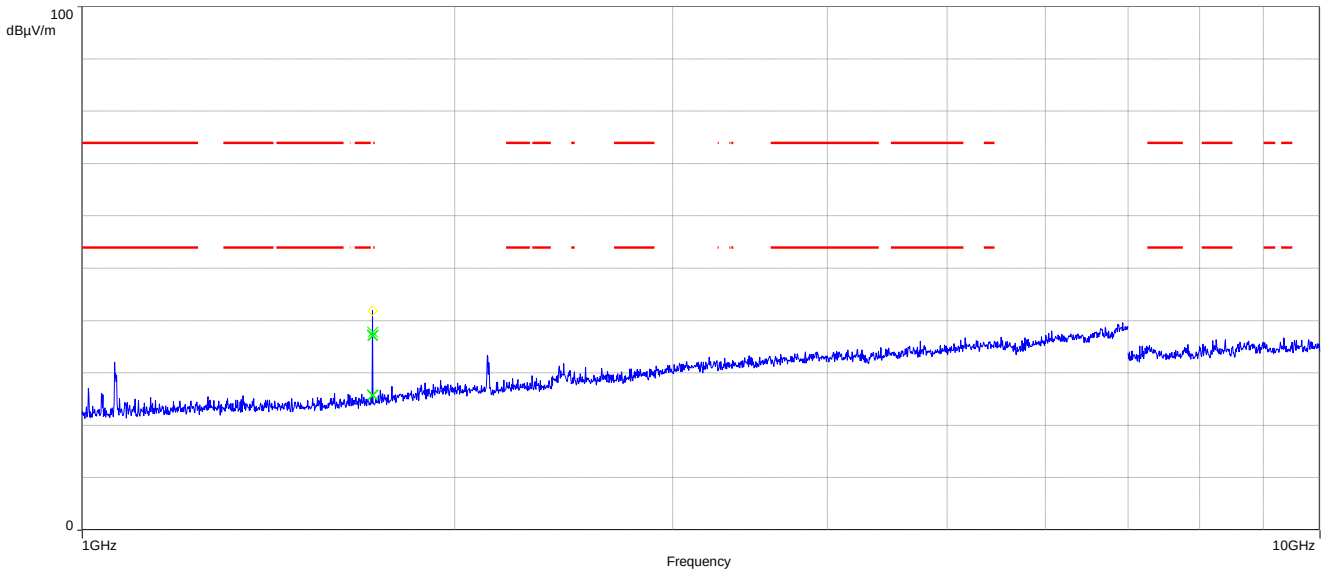


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.786	11.20	50.7	39.5	1000	120.0	186.0	V	205	10
74.247	11.03	50.7	39.7	1000	120.0	200.0	V	180	9
119.997	10.14	50.7	40.6	1000	120.0	135.0	V	90	11
168.001	17.74	50.7	33.0	1000	120.0	106.0	V	193	11
264.002	11.73	50.7	39.0	1000	120.0	118.0	V	180	14
283.909	10.62	50.7	40.1	1000	120.0	200.0	V	22	15
868.265	wanted signal								

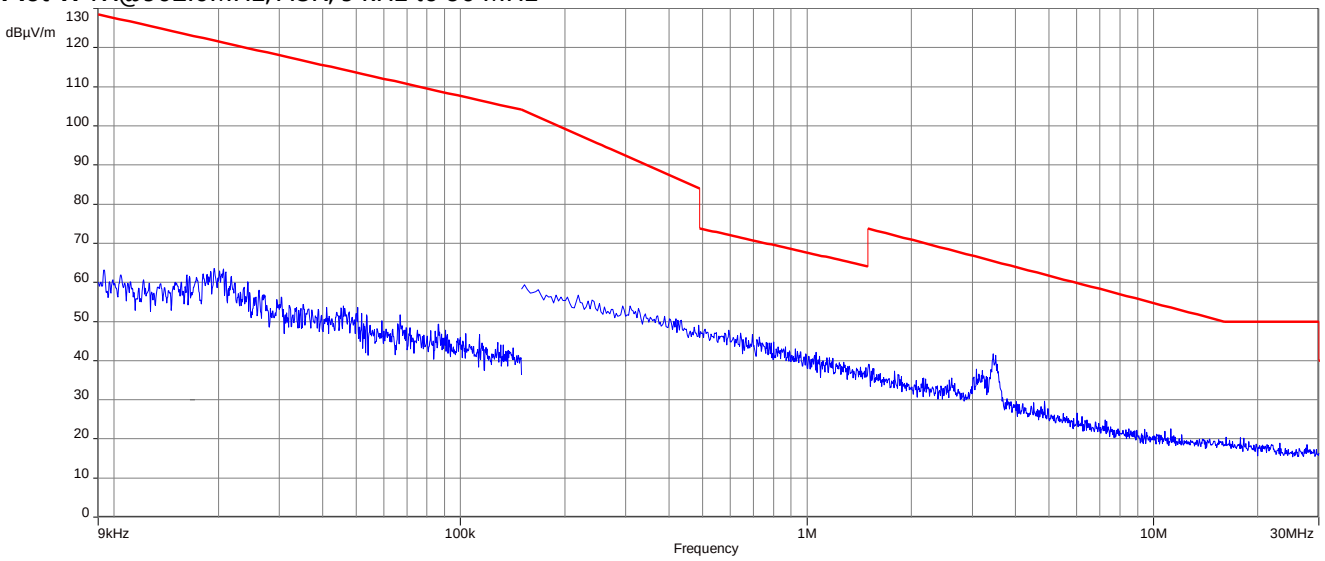
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@868.3MHz, FSK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

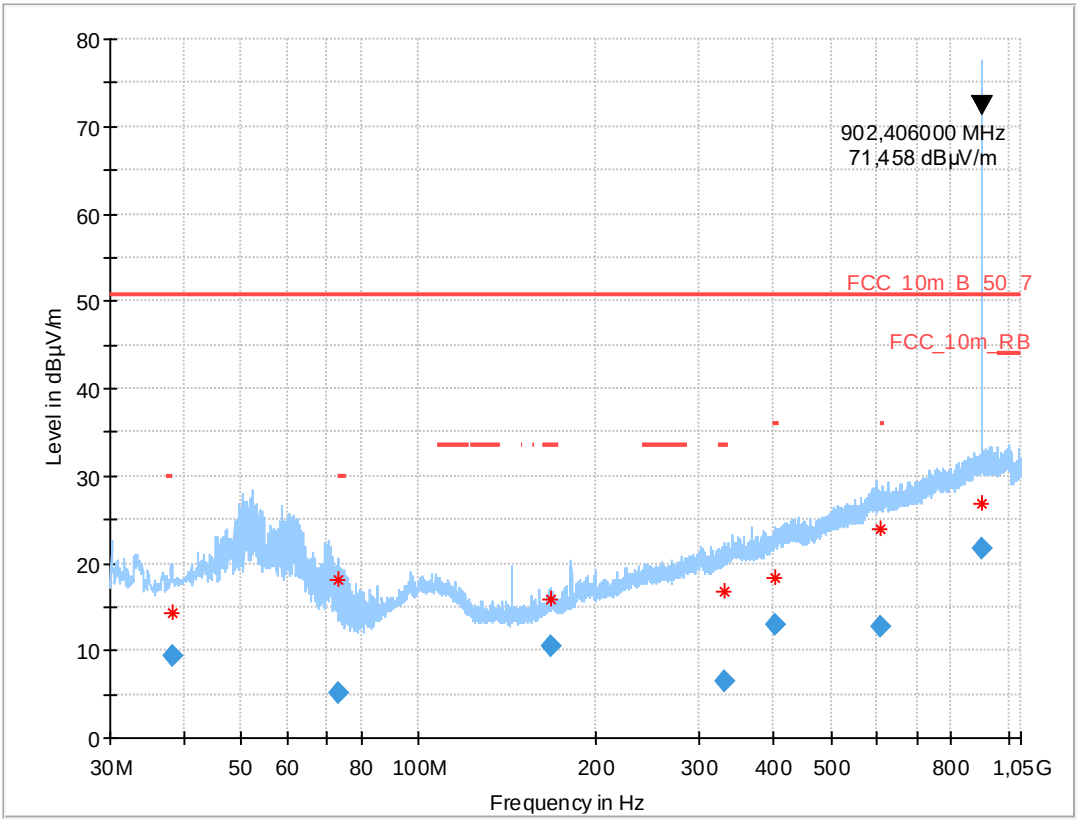


- **TX 902.0MHz**

Plot 1: TX@902.0MHz, ASK, 9 kHz to 30 MHz



Plot 2: TX@902.0MHz, ASK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

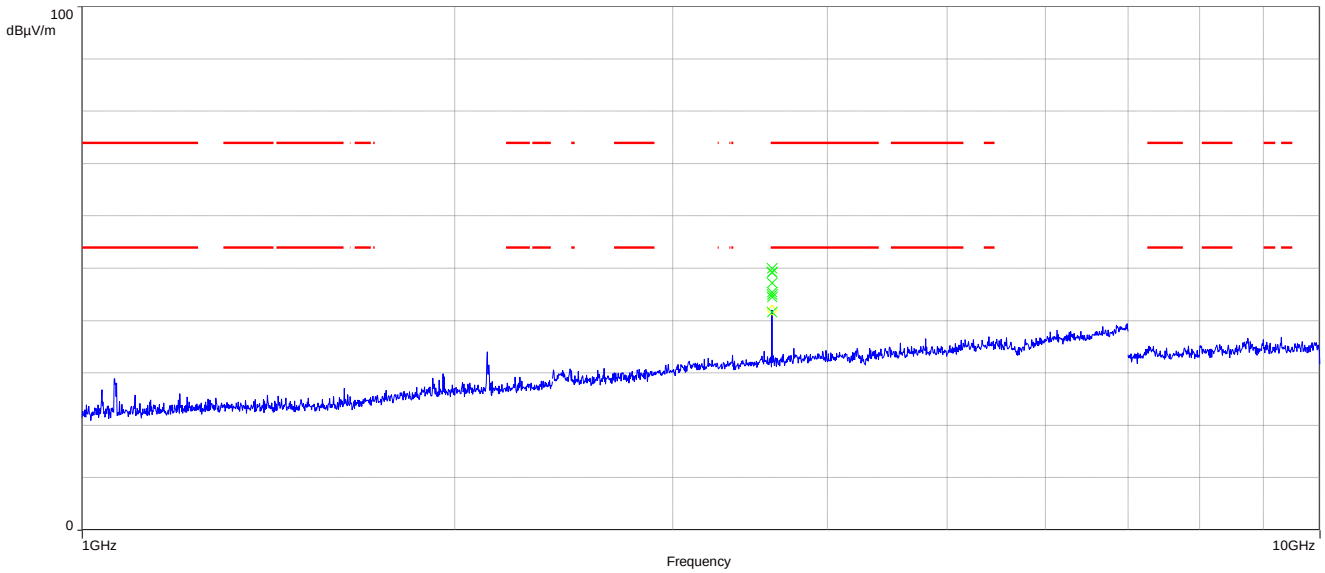


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.179	9.41	50.7	41.3	1000	120.0	203.0	V	90	14
73.026	5.13	50.7	45.6	1000	120.0	382.0	V	315	9
168.011	10.52	50.7	40.2	1000	120.0	116.0	V	266	11
330.953	6.45	50.7	44.3	1000	120.0	200.0	V	11	16
401.193	13.00	50.7	37.7	1000	120.0	196.0	H	-45	18
609.158	12.82	50.7	37.9	1000	120.0	325.0	H	-45	22
902.552	wanted signal								

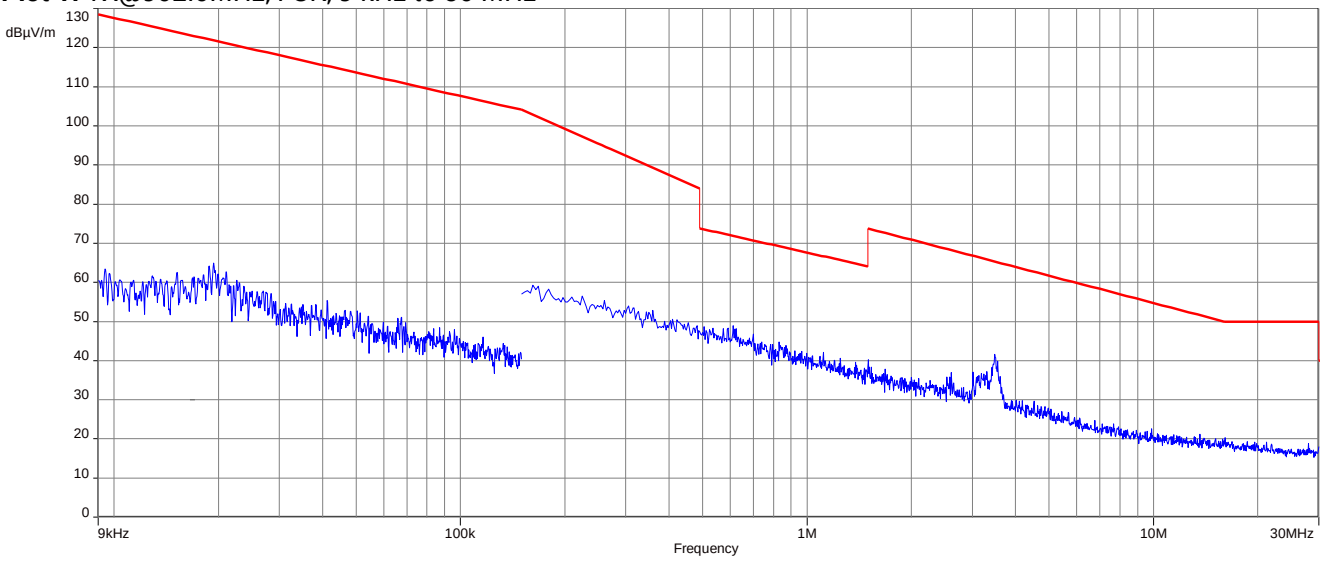
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@902.0MHz, ASK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

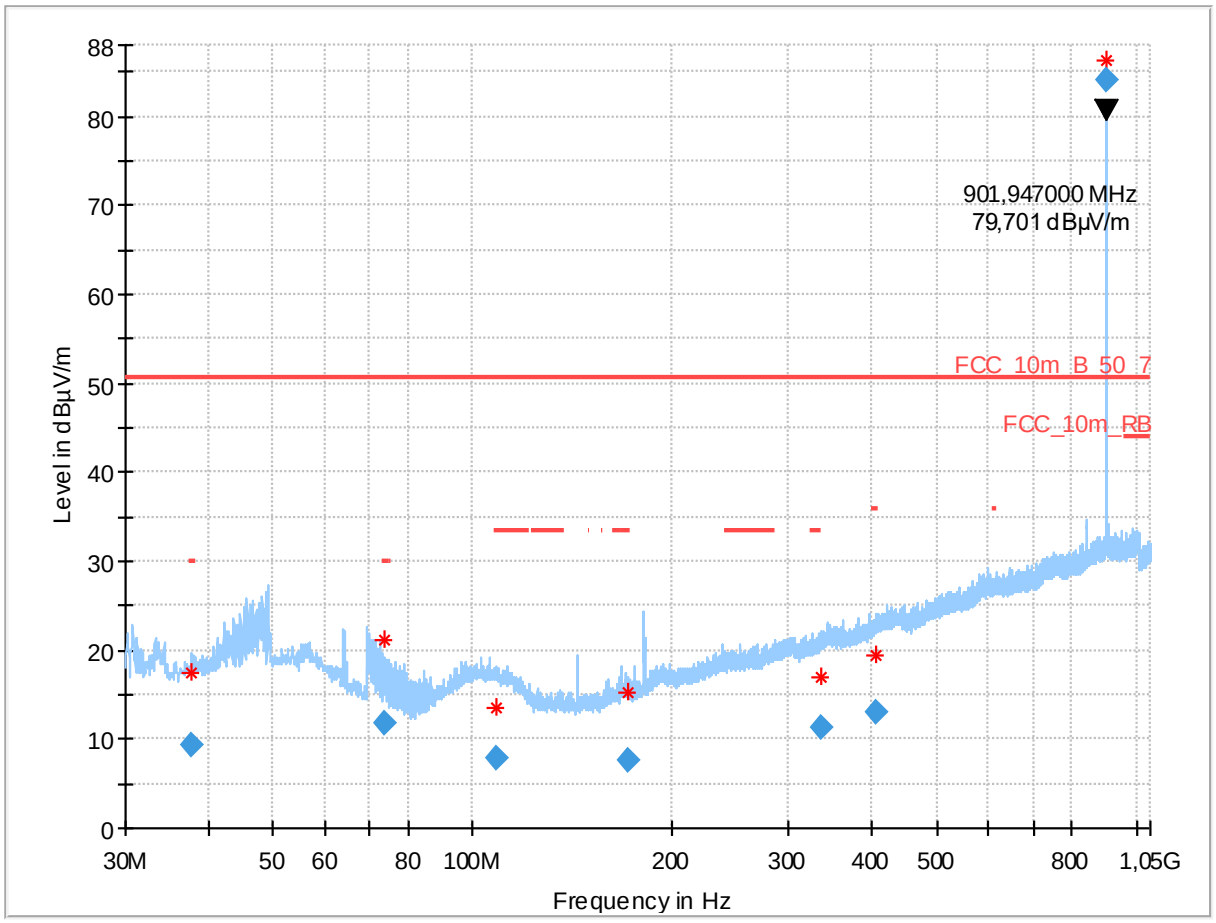


- **TX 902.0MHz**

Plot 1: TX@902.0MHz, FSK, 9 kHz to 30 MHz



Plot 2: TX@902.0MHz, FSK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

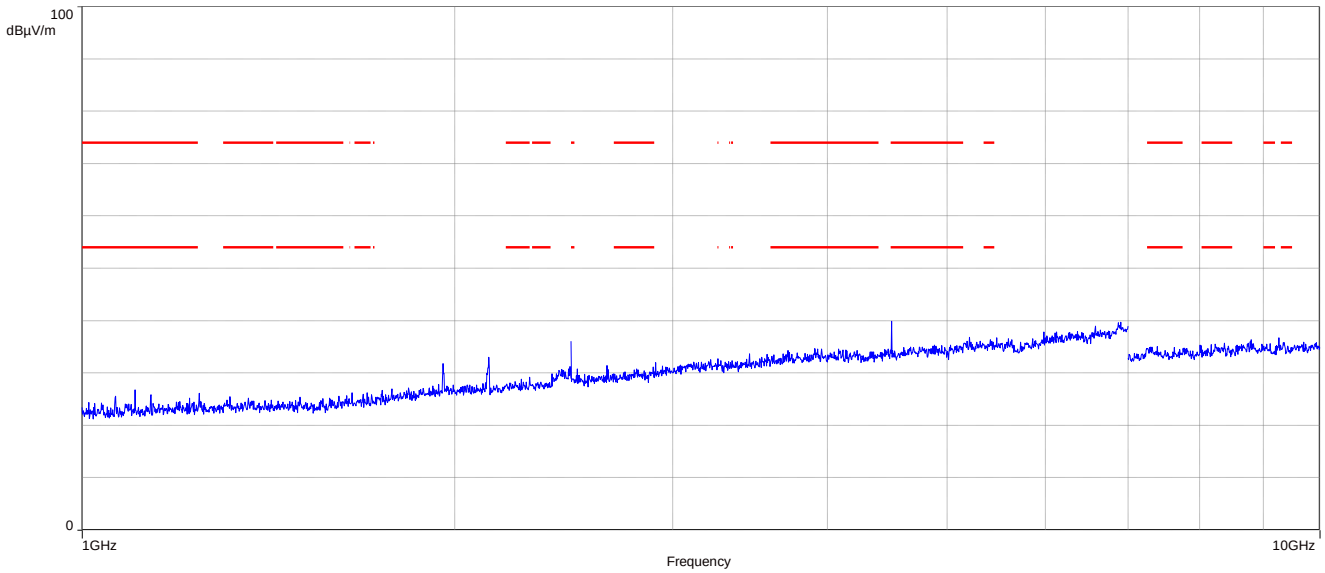


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.777	9.39	50.7	41.3	1000	120.0	200.0	V	170	14
73.733	11.88	50.7	38.8	1000	120.0	400.0	V	122	9
108.684	7.90	50.7	42.8	1000	120.0	357.0	H	225	13
171.237	7.72	50.7	43.0	1000	120.0	221.0	V	243	11
333.926	11.41	50.7	39.3	1000	120.0	200.0	V	-45	16
405.305	13.14	50.7	37.6	1000	120.0	400.0	V	45	18
902.044	wanted signal								

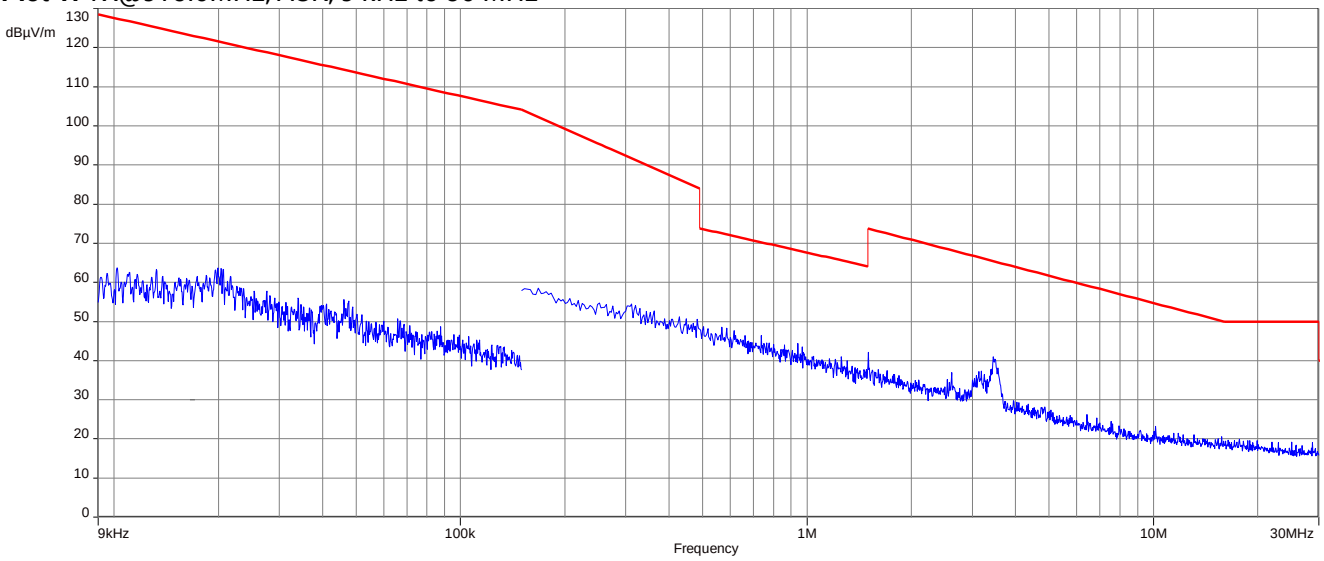
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@902.0MHz, FSK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

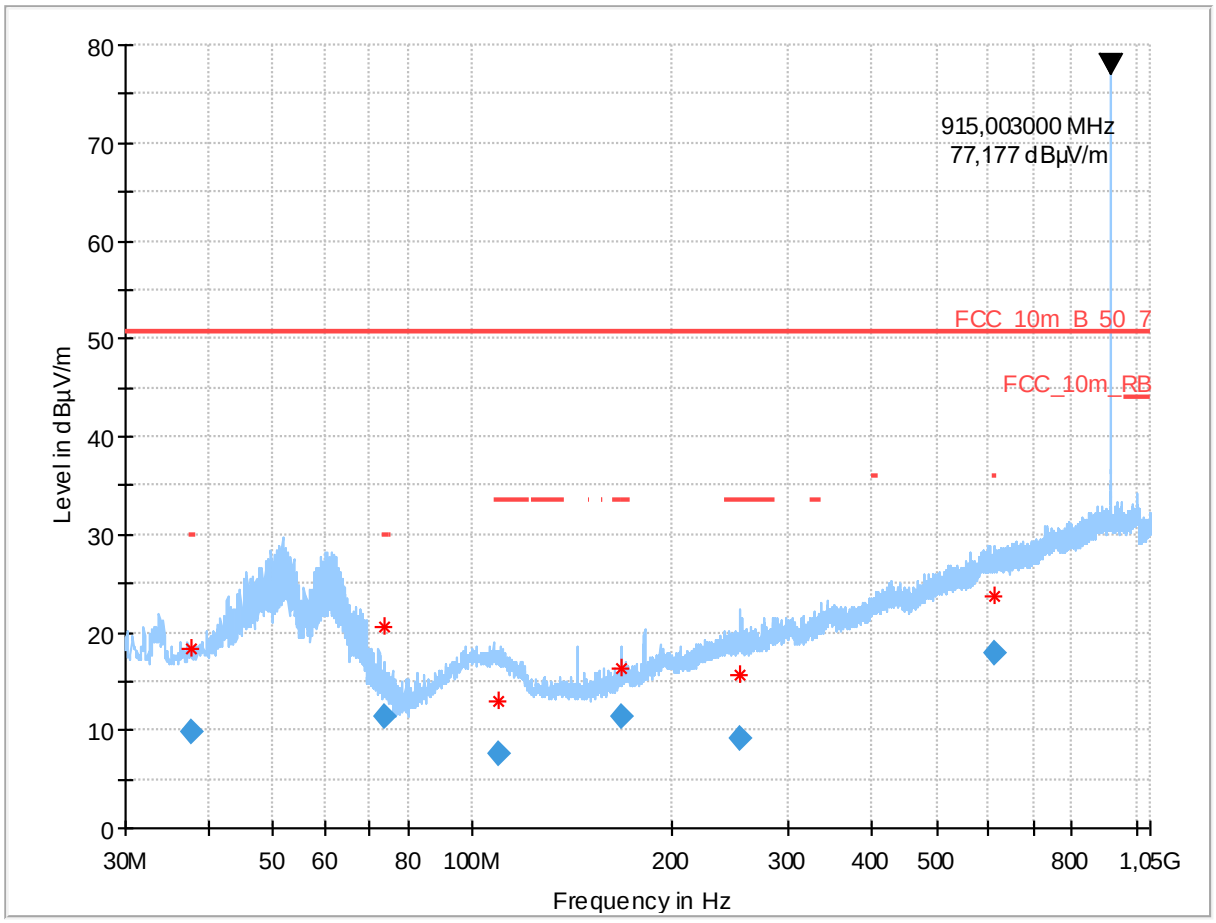


- **TX 915.0MHz**

Plot 1: TX@915.0MHz, ASK, 9 kHz to 30 MHz



Plot 2: TX@915.0MHz, ASK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

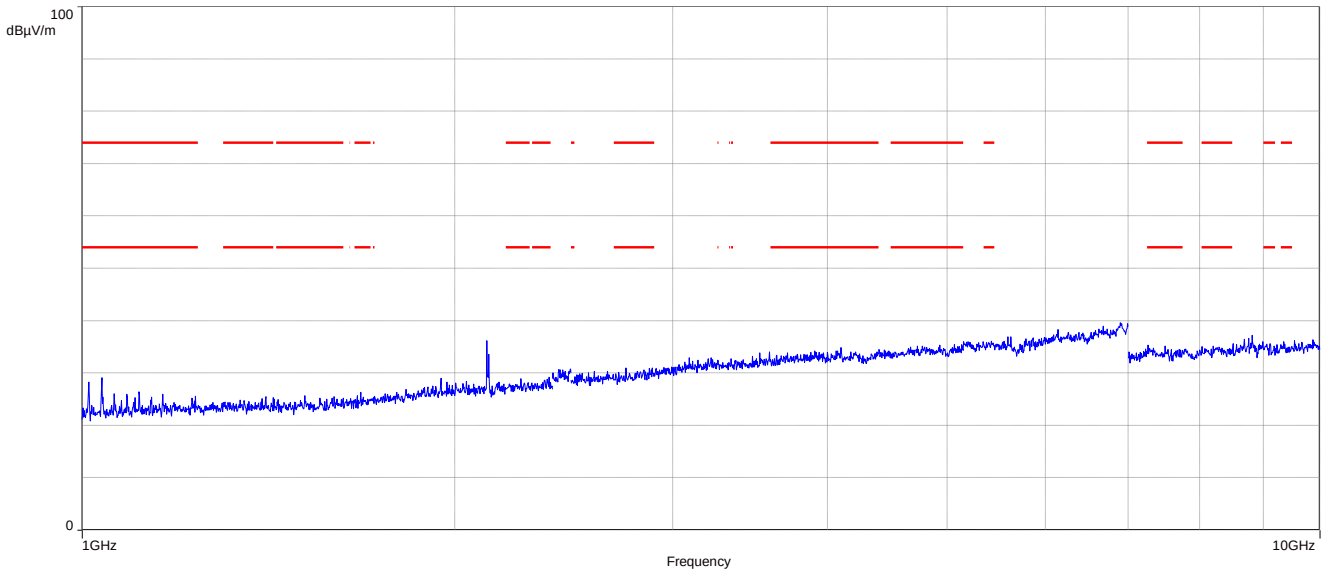


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.762	9.73	50.7	41.0	1000	120.0	123.0	V	225	14
73.766	11.32	50.7	39.4	1000	120.0	200.0	V	90	9
109.784	7.58	50.7	43.1	1000	120.0	209.0	H	135	13
168.006	11.40	50.7	39.3	1000	120.0	111.0	V	180	11
252.640	9.21	50.7	41.5	1000	120.0	376.0	V	32	14
610.873	17.82	50.7	32.9	1000	120.0	400.0	V	193	22
915.002	wanted signal								

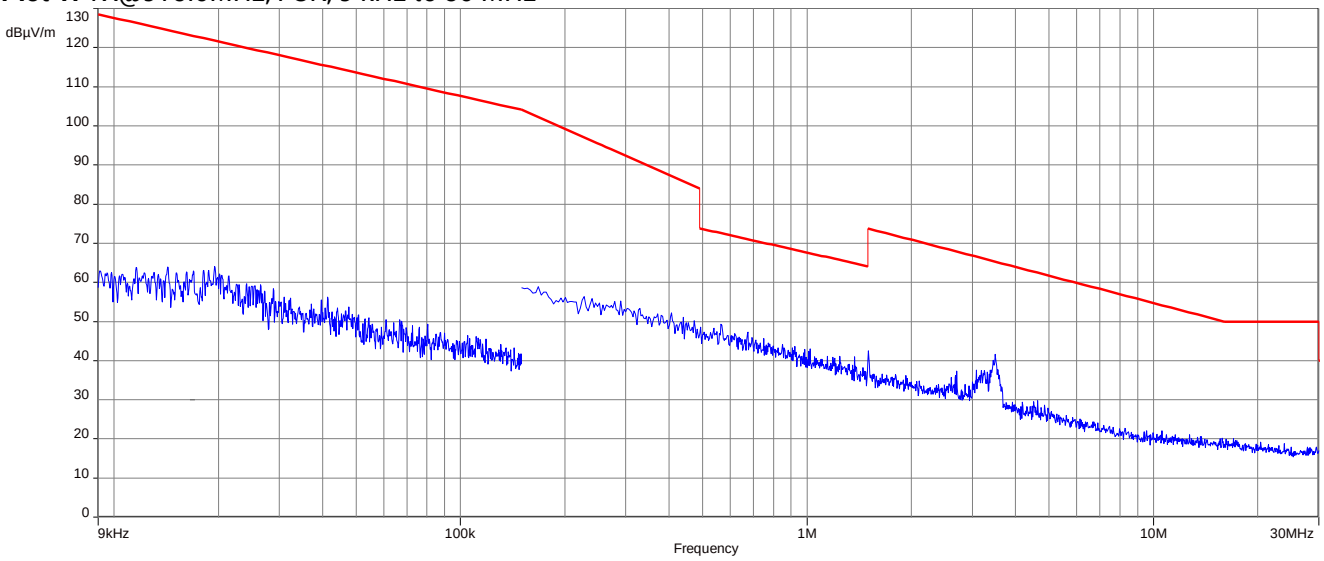
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@915.0MHz, ASK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

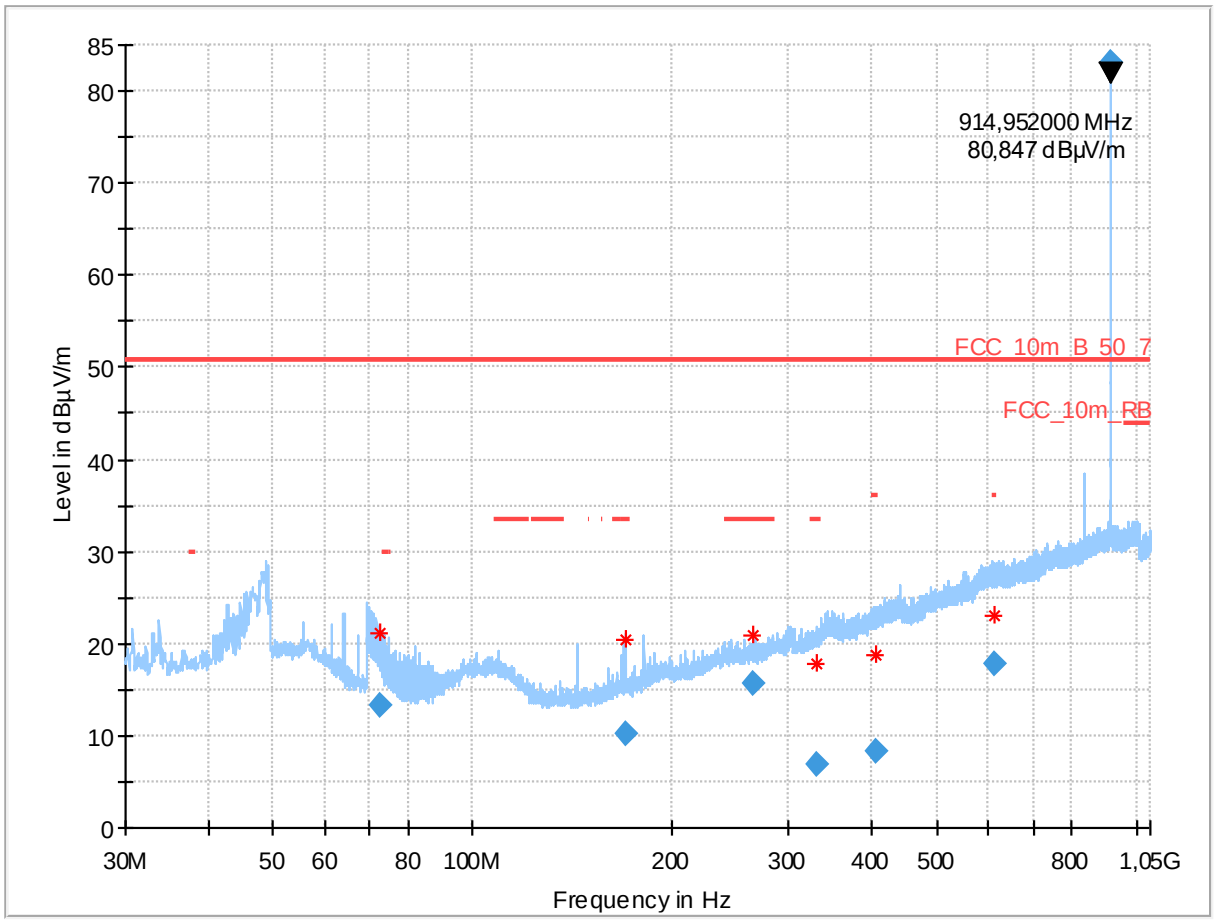


- **TX 915.0MHz**

Plot 1: TX@915.0MHz, FSK, 9 kHz to 30 MHz



Plot 2: TX@915.0MHz, FSK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

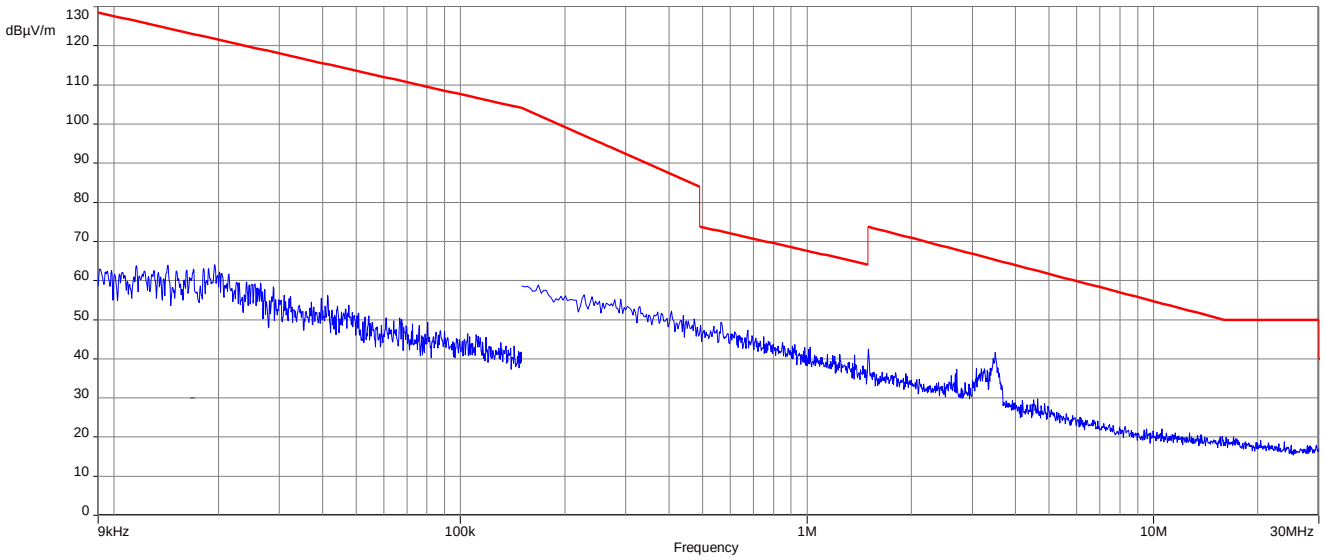


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.704	13.24	50.7	37.5	1000	120.0	400.0	V	77	10
169.901	10.12	50.7	40.6	1000	120.0	121.0	V	140	11
264.014	15.64	50.7	35.1	1000	120.0	400.0	V	-9	14
329.867	6.79	50.7	43.9	1000	120.0	322.0	V	112	16
405.904	8.23	50.7	42.5	1000	120.0	400.0	V	0	18
611.201	17.79	50.7	32.9	1000	120.0	400.0	V	180	22
914.962	wanted signal								

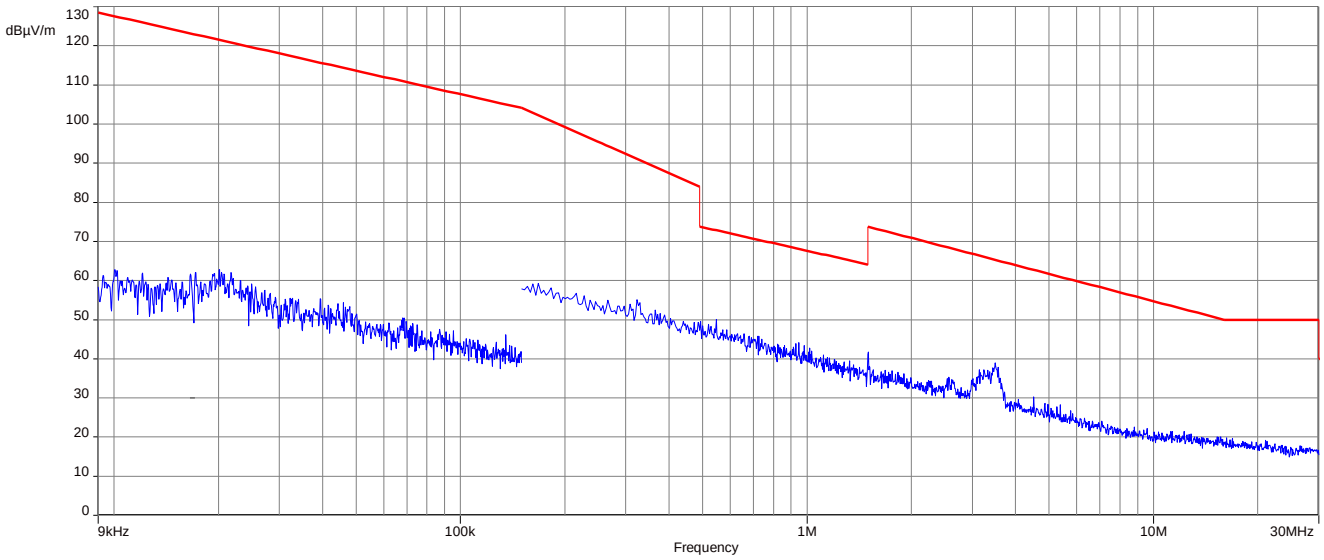
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@915.0MHz, FSK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

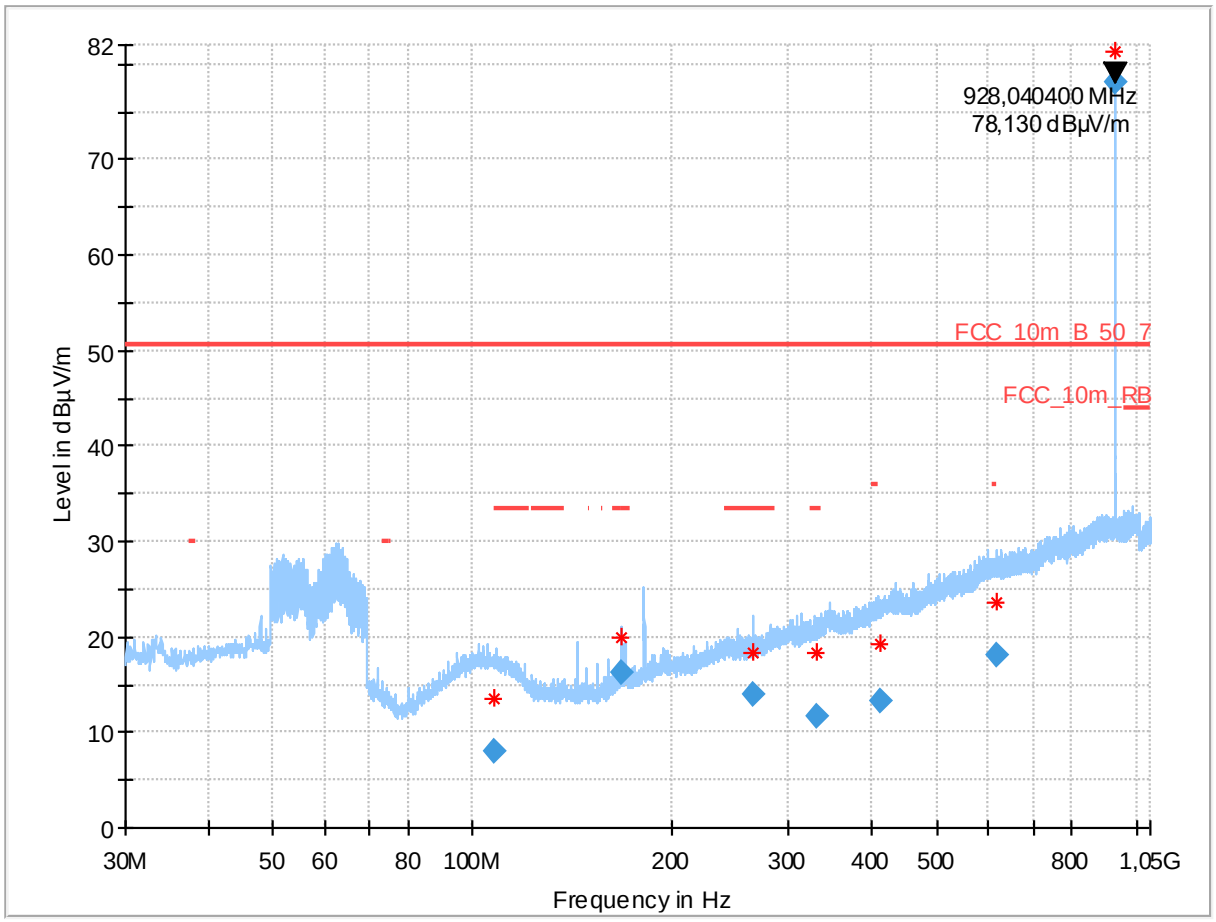


- **TX 928.0MHz**

Plot 1: TX@928.0MHz, ASK, 9 kHz to 30 MHz



Plot 2: TX@928.0MHz, ASK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

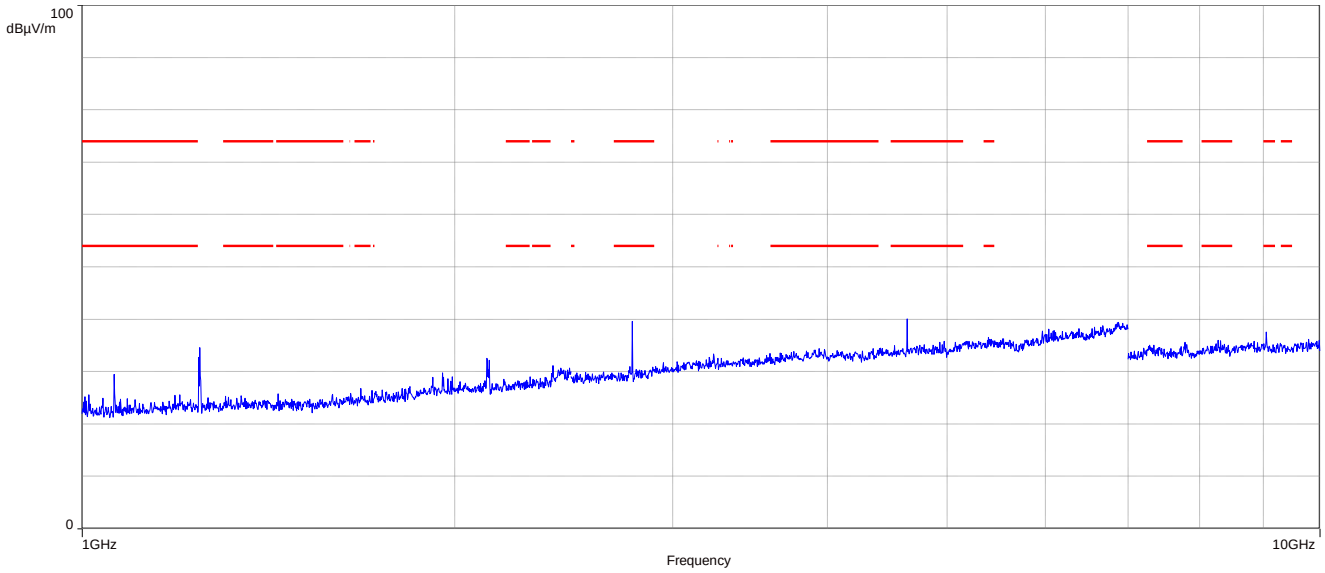


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
108.149	8.08	50.7	42.6	1000	120.0	128.0	V	135	14
167.984	16.15	50.7	34.6	1000	120.0	150.0	V	253	11
264.006	13.88	50.7	36.8	1000	120.0	400.0	V	90	14
330.277	11.75	50.7	39.0	1000	120.0	200.0	V	33	16
410.133	13.33	50.7	37.4	1000	120.0	215.0	H	180	18
614.637	18.06	50.7	32.6	1000	120.0	200.0	H	180	22
928.040	wanted signal								

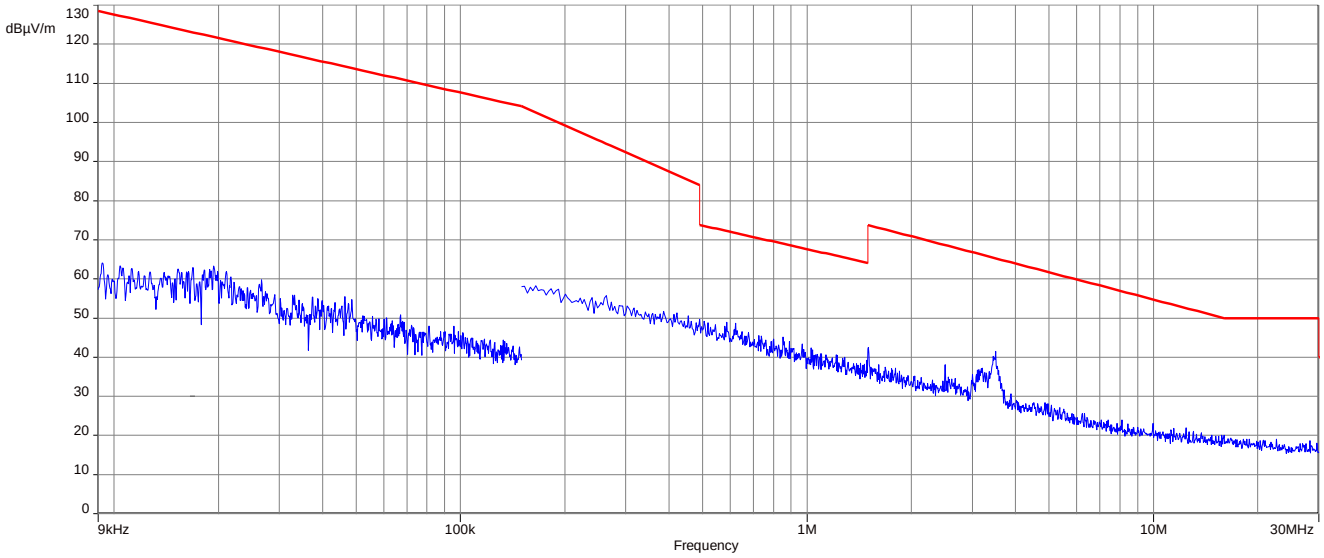
In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@928.0MHz, ASK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation

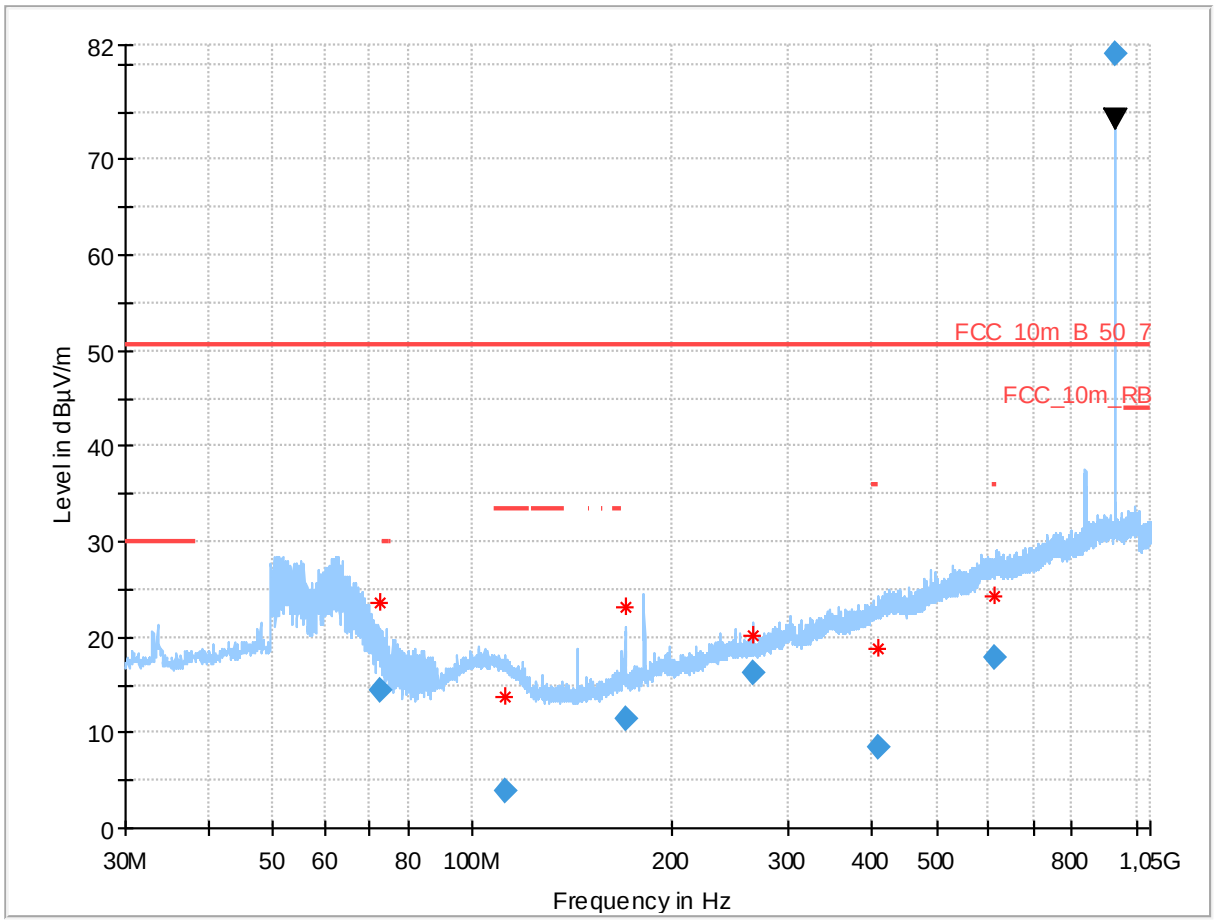


- **TX 928.0MHz**

Plot 1: TX@928.0MHz, FSK, 9 kHz to 30 MHz



Plot 2: TX@928.0MHz, FSK, 30 MHz to 1000 MHz, vertical & horizontal polarisation

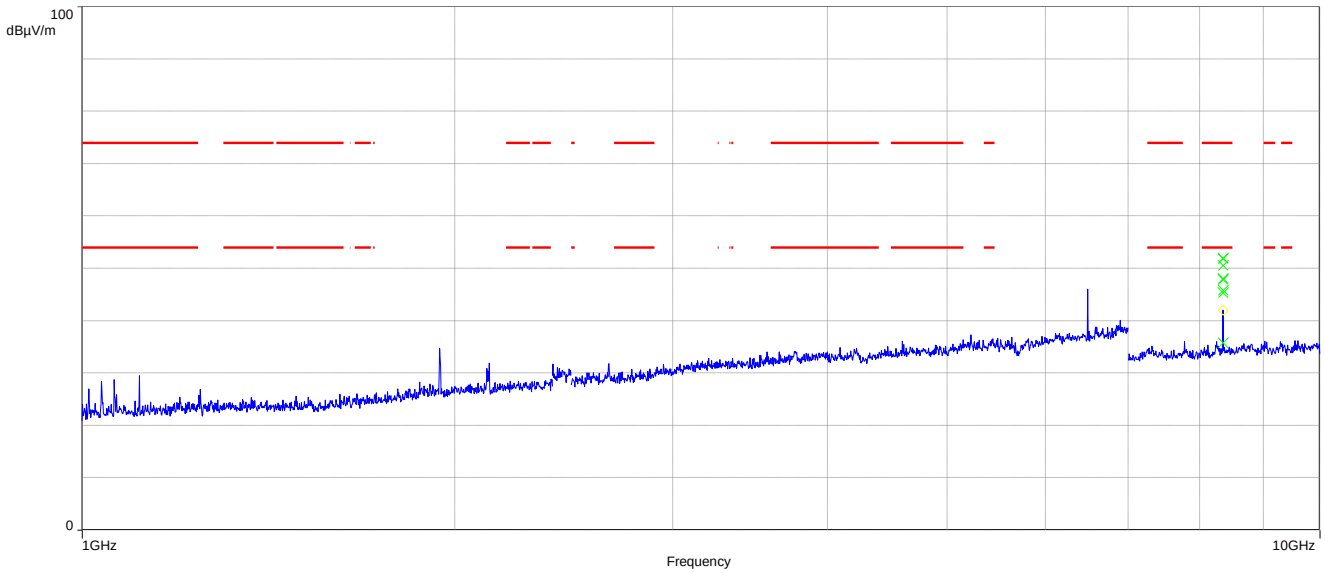


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
72.726	14.38	50.7	36.3	1000	120.0	400.0	V	215	10
112.012	3.85	50.7	46.9	1000	120.0	281.0	V	48	13
170.219	11.49	50.7	39.2	1000	120.0	159.0	V	208	11
263.998	16.17	50.7	34.5	1000	120.0	308.0	V	180	14
409.784	8.38	50.7	42.3	1000	120.0	200.0	H	225	18
613.712	17.91	50.7	32.8	1000	120.0	330.0	V	188	22
928.041	wanted signal								

In addition to the limit according to Part 15.209 shown in the plot, the limit according to Part 15.231 also applies!

Plot 3: TX@928.0MHz, FSK, 1000 MHz to 6000 MHz, vertical & horizontal polarisation



12 Observations

No observations except those reported with the single test cases have been made.

13 Test bin file tables

bin files ASK modulation
FCC_CM_ASK_100ms_9.6KHz_312.0MHz_0x77.bin
FCC_CM_ASK_100ms_9.6KHz_315.0MHz_0x77.bin
FCC_CM_ASK_100ms_9.6KHz_318.0MHz_0x77.bin
FCC_CM_ASK_100ms_9.6KHz_431.9MHz_0x77.bin
FCC_CM_ASK_100ms_9.6KHz_435.9MHz_0x77.bin
FCC_CM_ASK_100ms_9.6KHz_868.3MHz_0x63.bin
FCC_CM_ASK_100ms_9.6KHz_902.0MHz_0x57.bin
FCC_CM_ASK_100ms_9.6KHz_915.0MHz_0x58.bin
FCC_CM_ASK_100ms_9.6KHz_928.0MHz_0x54.bin

bin files FSK modulation
FCC_CM_FSK_100ms_9.6KHz_312.0MHz_0x77.bin
FCC_CM_FSK_100ms_9.6KHz_315.0MHz_0x77.bin
FCC_CM_FSK_100ms_9.6KHz_318.0MHz_0x77.bin
FCC_CM_FSK_100ms_9.6KHz_431.9MHz_0x77.bin
FCC_CM_FSK_100ms_9.6KHz_435.9MHz_0x77.bin
FCC_CM_FSK_100ms_9.6KHz_868.3MHz_0x63.bin
FCC_CM_FSK_100ms_9.6KHz_902.0MHz_0x57.bin
FCC_CM_FSK_100ms_9.6KHz_915.0MHz_0x58.bin
FCC_CM_FSK_100ms_9.6KHz_928.0MHz_0x54.bin

FCC_CM_FSK_10ms_9.6KHz_315.0MHz_0x77.bin
FCC_CM_FSK_10ms_9.6KHz_433.2MHz_0x77.bin
FCC_CM_FSK_10ms_9.6KHz_868.3MHz_0x6f.bin
FCC_CM_FSK_10ms_9.6KHz_915.0MHz_0x6f.bin

14 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

15 Document history

Version	Applied changes	Date of release
-/-	Initial release	2021-12-10

16 Accreditation Certificate – D-PL-12076-01-04

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Note: The current certificate annex is published on the websites (link see below).

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04.pdf

or

https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-04_Canada_TCEMC.pdf

17 Accreditation Certificate – D-PL-12076-01-05

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Note: The current certificate annex is published on the websites (link see below).

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05.pdf

or
https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf

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