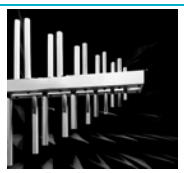
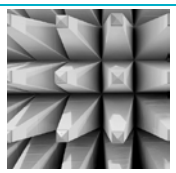




CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-7883/19-01-04-B

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-03

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: http://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 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-03

Applicant

Marquardt GmbH
Schloss-Str. 16
78604 Rietheim-Weilheim / GERMANY
Phone: +49 7424 99-0
Contact: Gerd Siegel
e-mail: Gerd.Siegel@marquardt.de
Phone: +49 (0) 74 24 - 99 1589

Manufacturer

Marquardt GmbH
Schloss-Str. 16
78604 Rietheim-Weilheim / GERMANY

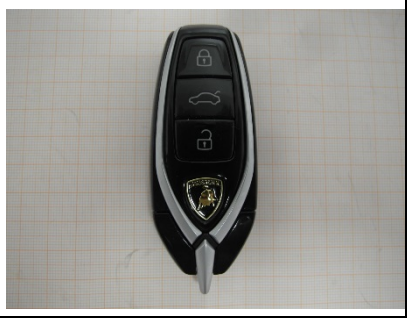
Test standard/s

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 9	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:	**Car Key**
Model name:	**LK1**
FCC ID:	IYZLK1
IC:	2701A-LK1
Frequency:	260 MHz to 470 MHz
Technology tested:	PCB loop antenna
Antenna:	Integrated antenna
Power supply:	2.5 V to 3.2 V DC by battery
Temperature range:	-20°C to +70°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-161128, email=Christoph.Schneider@ctcadvanced.com, c=DE
2019.03.06 08:13:09 +01'00'

Christoph Schneider
Lab Manager
Radio Communications & EMC

Test performed:

p.o.

cn=Tobias Wittenmeier, o=CTC advanced GmbH, ou=WIT-170519, email=tobias.wittenmeier@ctcadvanced.com, c=DE
2019.03.06 08:16:05 +01'00'

Sumit Kumar
Testing Manager
Radio Communications & EMC

1 Table of contents

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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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.

This test report replaces the test report with the number 1-7883/19-01-04-A and dated 2019-02-28.

2.2 Application details

Date of receipt of order:	2019-01-21
Date of receipt of test item:	2019-02-04
Start of test:	2019-02-05
End of test:	2019-02-06
Person(s) present during the test:	-/-

2.3 Test laboratories sub-contracted

None

3 Test standard/s and references

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 9	August 2016	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment
RSS - Gen Issue 5	April 2018	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

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	23 °C during room temperature tests +70 °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}	3.0 V DC by battery 3.2 V 2.5 V

5 Test item

5.1 General description

Kind of test item	:	Car Key
Type identification	:	LK1
HMN	:	-/-
PMN	:	LK1
HVIN	:	H10
FVIN	:	-/-
S/N serial number	:	-/-
Hardware status	:	-/-
Software status	:	-/-
Firmware status	:	-/-
Frequency band	:	260 MHz to 470 MHz Lowest Channel : 433.47 MHz Middle Channel: 433.92 MHz Highest Channel: 434.37 MHz
Type of radio transmission Use of frequency spectrum	: :	modulated carrier
Type of modulation	:	FSK
Number of channels	:	3
Antenna	:	Integrated antenna
Power supply	:	2.5 V to 3.2 V DC by battery
Temperature range	:	-20°C to +70°C

5.2 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: 1-7883/19-01-01_AnnexA
1-7883/19-01-01_AnnexB
1-7883/19-01-01_AnnexD

6 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).

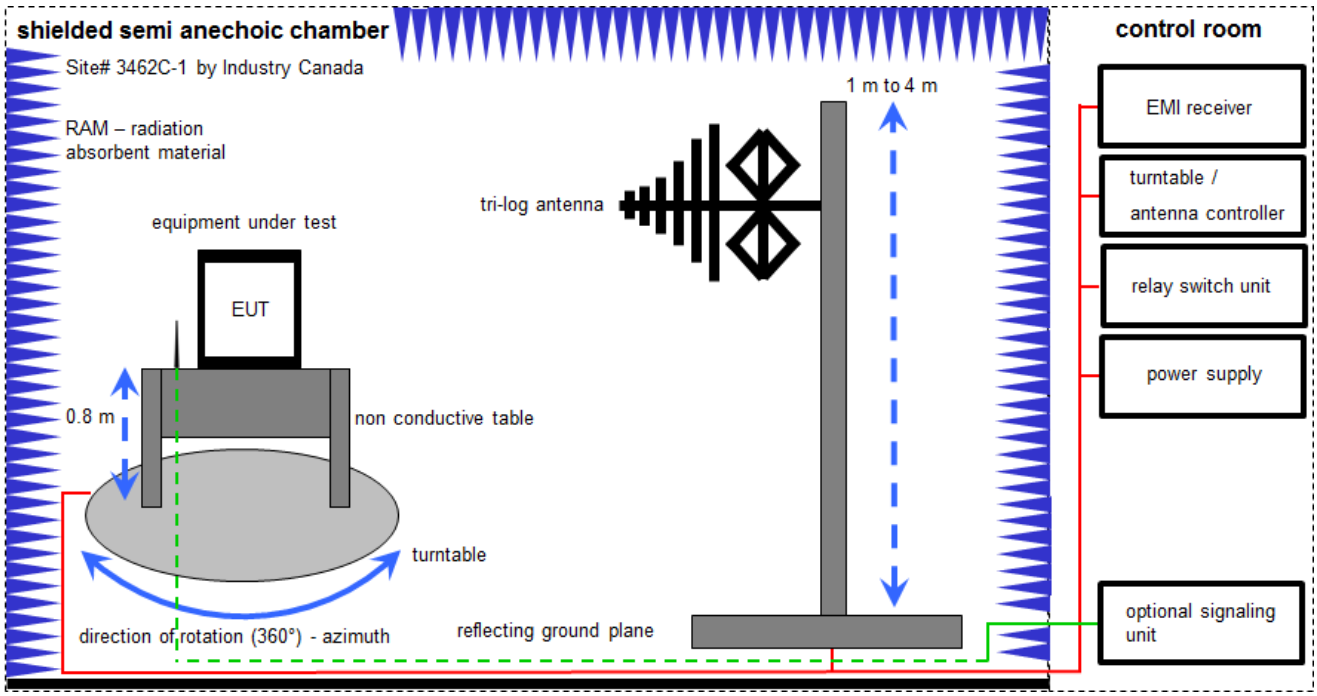
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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

6.1 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: 10.30.0

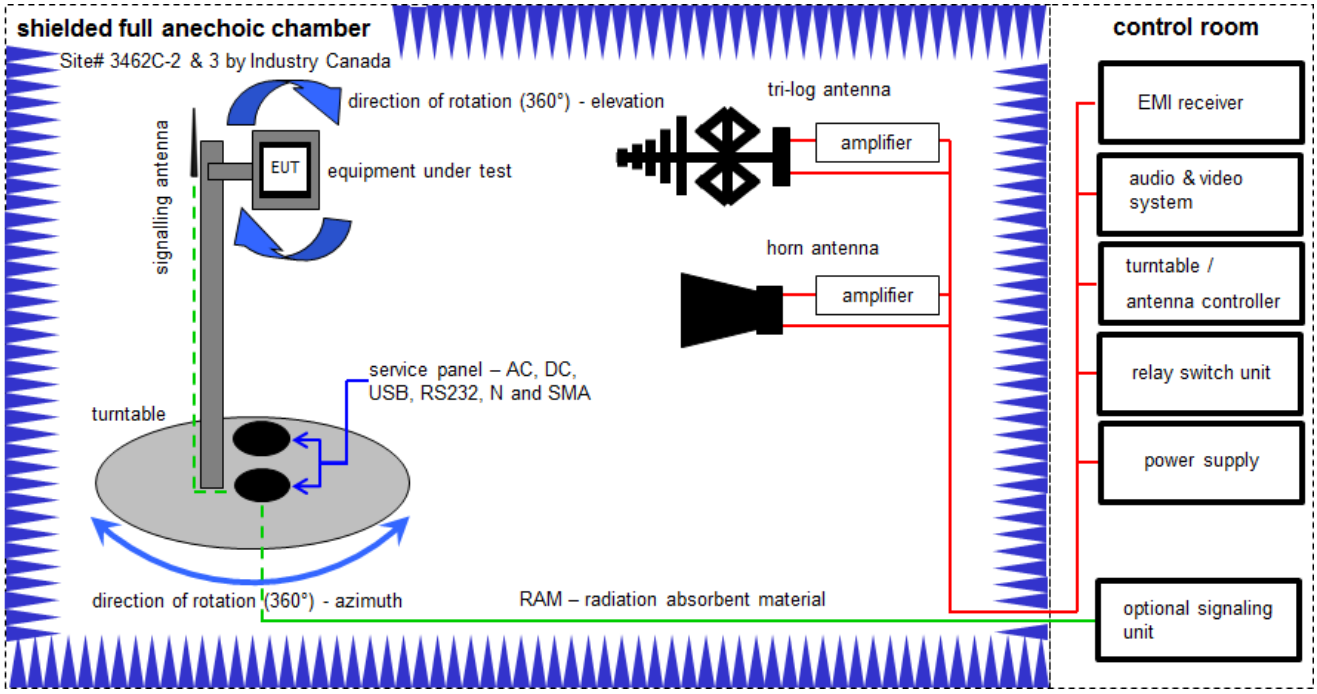
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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.	Lab / Item	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	Meßkabine 1	HF-Absorberhalle	MWB AG 300023	-/-	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	371	300003854	vlKl!	24.11.2017	23.11.2020
8	A.	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	12.12.2018	11.12.2019

6.2 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)

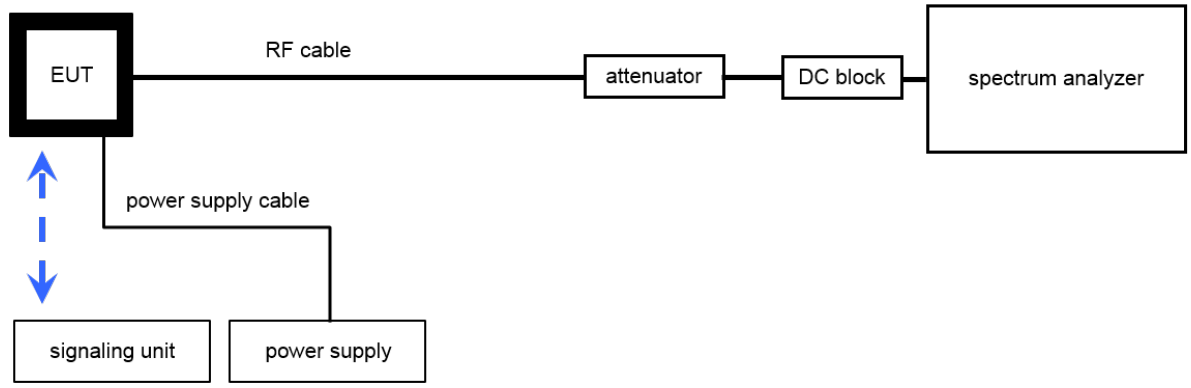
Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	k	14.02.2017	13.02.2019
2	A,B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	A,B.	Highpass Filter	WHKX2.9/18G-12SS	Wainwright	1	300003492	ev	-/-	-/-
4	A,B.	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	14.09.2018	13.12.2019
5	A,B.	Broadband Amplifier 5-13 GHz	CBLU5135235	CERNEX	22010	300004491	ev	-/-	-/-
6	A,B.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
7	A,B	NEXIO EMV-Software	BAT EMC V3.16.0.49	EMCO	-/-	300004682	ne	-/-	-/-
8	A,B	PC	ExOne	F+W	-/-	300004703	ne	-/-	-/-
9	A	TRILOG Broadband Test-Antenna	VULB9163	Schwarzbeck Mess Elektronik	01029	300005379	k	07.04.2017	06.04.2020

6.3 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.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal- and Spectrum Analyzer	FSW26	R&S	101455	300004528	k	19.12.2018	18.12.2019
2	A	Loop Antenna	-/-	ZEG TS Steinfurt	-/-	400001208	ev	-/-	-/-
3	A	RF Cable BNC	RG58	Huber & Suhner	-/-	400001209	ev	-/-	-/-

7 Sequence of testing

7.1 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.

7.2 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.

7.3 Sequence of testing radiated spurious 1 GHz to 12.75 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.

8 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

9 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 9 RSS-Gen, Issue 5	See table!	2019-03-06	-/-

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 9	Switch off time	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.231 (b) (3) (c) RSS-210 Issue 9	Emission bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.231 (b) RSS-210 Issue 9	Fieldstrength of Fundamental	Nominal	Nominal	☒	☐	☐	☐	-/-
§ 15.209 RSS-210 Issue 9	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

9.1 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

10 Measurement results

10.1 Timing of the transmitter

Measurement:

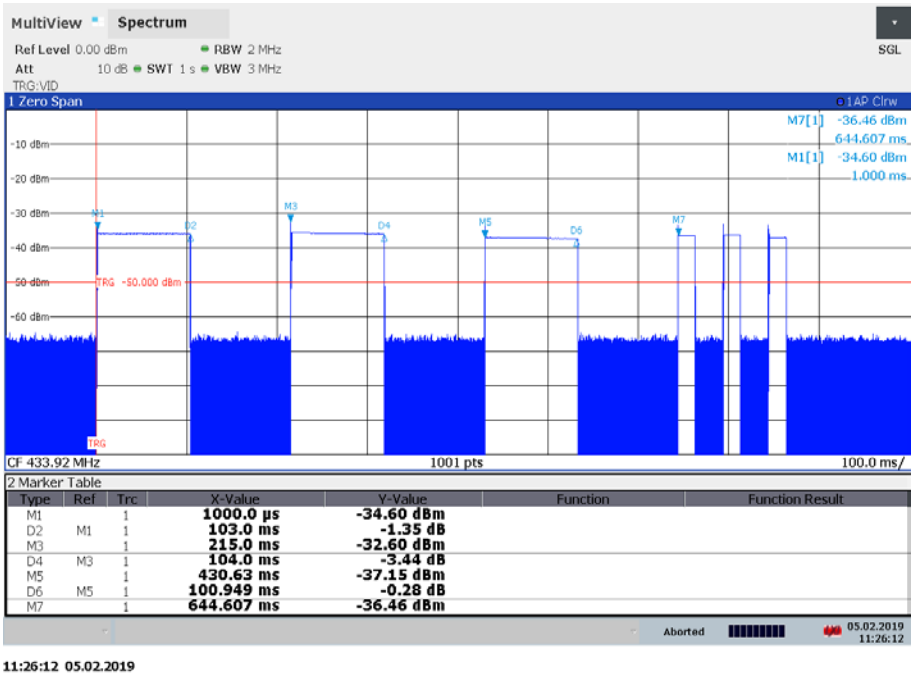
Measurement parameter	
Detector:	Peak
Sweep time:	1 s
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	Zero
Trace-Mode:	Single sweep
Test setup	See chapter 6.3 A

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.	

Result:

Plot 1: Transmit burst



Maximum transmit time (Tx on)	=	104 ms	(Plot 1)
Tx on + Tx off	>	100 ms	(Plot 1)

The peak-to-average correction factor is calculated with 20Log [Tx on/(Tx on + Tx off)].
Hereby the peak-to-average correction factor is 0 dB

10.2 Switch off time

Measurement:

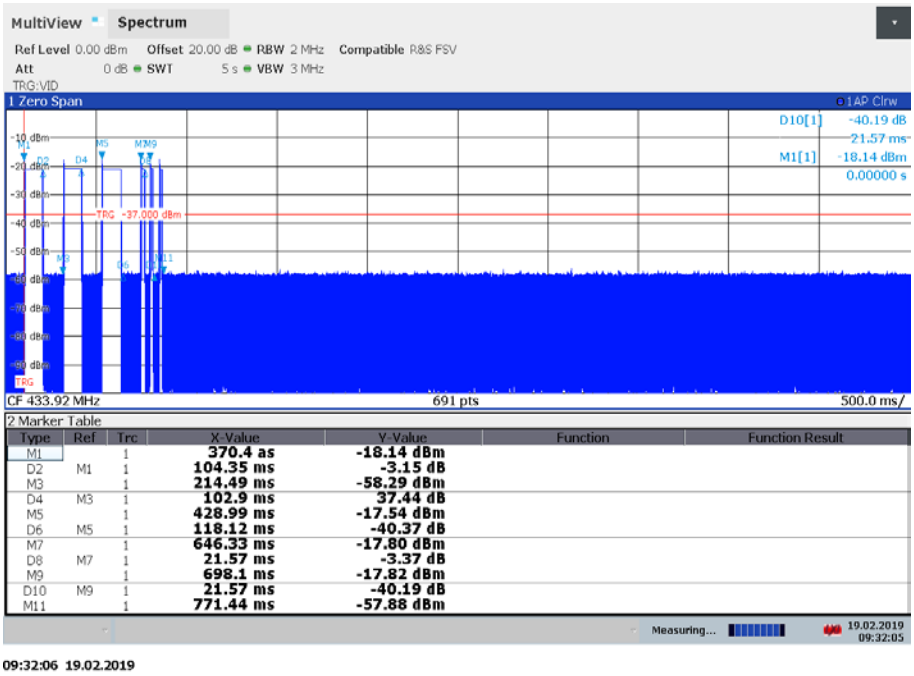
Measurement parameter	
Detector:	Peak
Sweep time:	5s
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	Zero
Trace-Mode:	Single sweep
Test setup	See chapter 6.3 A
Measurement uncertainty	8

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.	

Results:

Plot 1: TX on time



The EUT automatically ceases transmission within 771.44 ms after releasing the switch.

10.3 Emission bandwidth

Measurement:

Measurement of the 99 % bandwidth of the modulated signal

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 % of the span
Video bandwidth:	3 x RBW
Span:	500 kHz
Trace-Mode:	Max. hold

Limits:

FCC	IC
433.47 MHz: The OBW shall not be wider than 0.25 % of the center frequency, here maximum 1.0837 MHz.	
433.92 MHz: The OBW shall not be wider than 0.25 % of the center frequency, here maximum 1.0848 MHz.	
434.37 MHz: The OBW shall not be wider than 0.25 % of the center frequency, here maximum 1.0859 MHz.	

Result:

a) Modulated signal with data rate 5 Kbit/s

Channel / MHz	Test conditions		Signal bandwidth / kHz	
	Mode		OBW 99%	20 dB-bandwidth
433.47	T_{nom}	V_{nom}	39.81	28.47
433.92	T_{nom}	V_{nom}	39.62	28.97
434.37	T_{nom}	V_{nom}	40.38	28.97

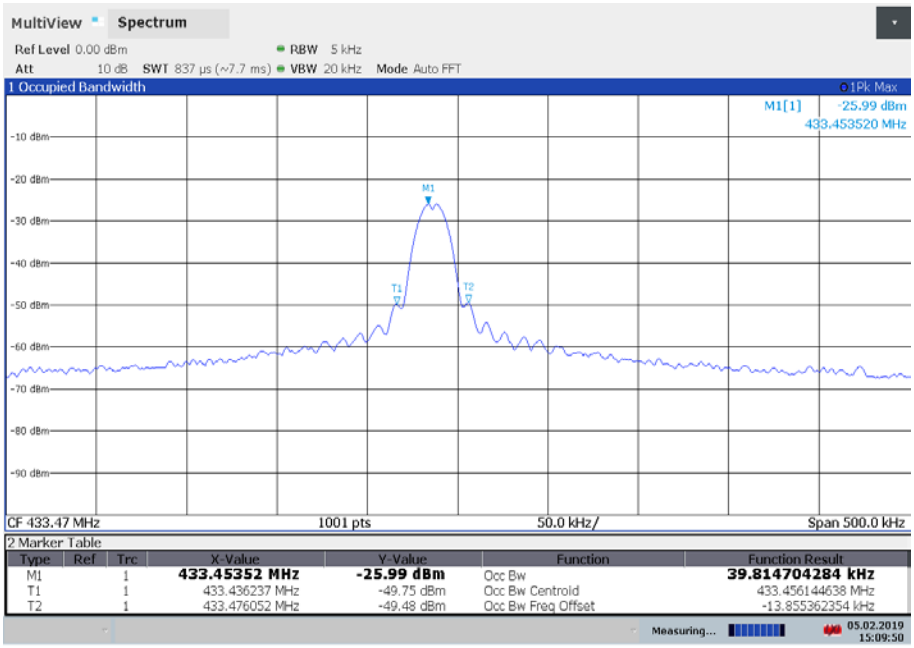
b) Modulated signal with data rate 20 Kbit/s

Channel / MHz	Test conditions		Signal bandwidth / kHz	
	Mode		OBW 99%	20 dB-bandwidth
433.47	T_{nom}	V_{nom}	158.92	159.84
433.92	T_{nom}	V_{nom}	158.98	159.84
434.37	T_{nom}	V_{nom}	160.56	159.84

Plots:

a) Modulated signal with date rate 5 Kbit/s

Plot 1: 99 % bandwidth lowest channel



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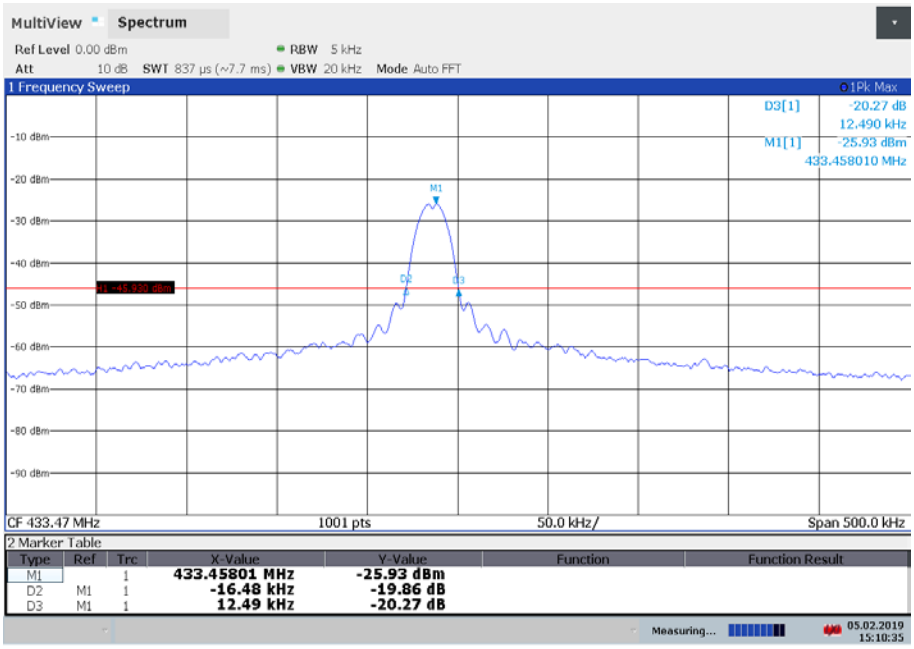
Plot 2: 20 dB bandwidth lowest channel



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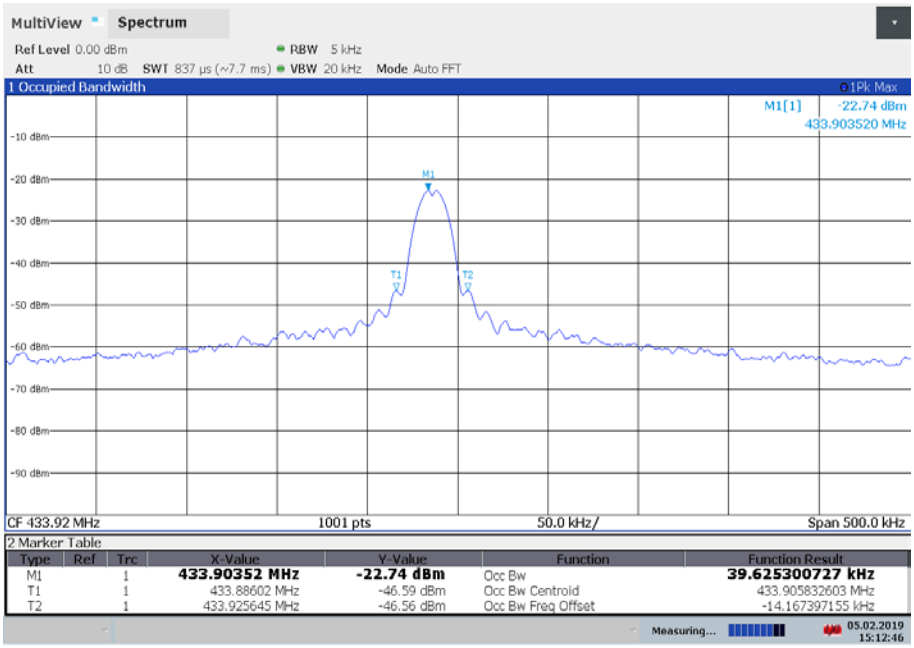
Plot 3: 99 % bandwidth middle channel



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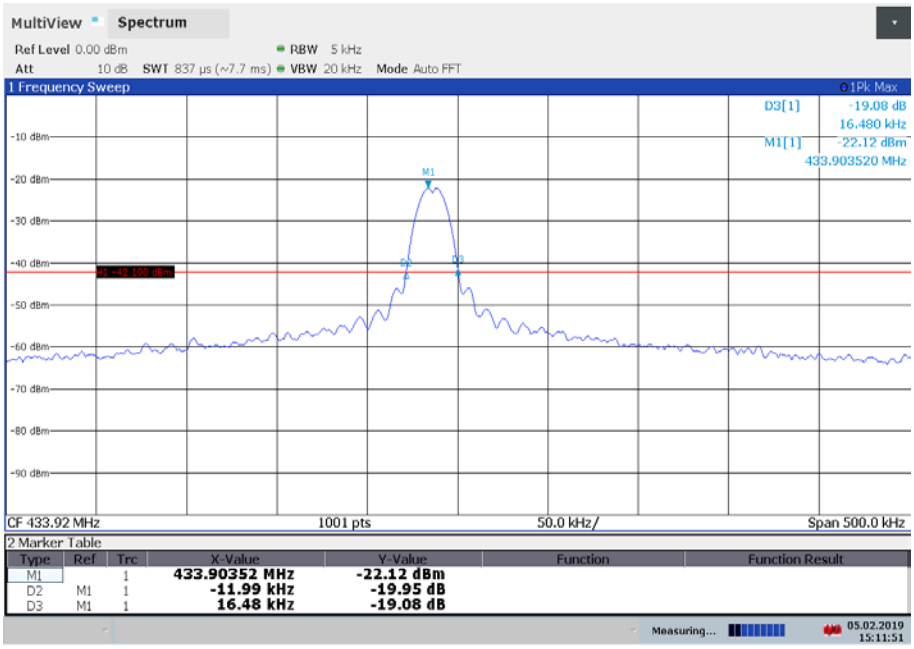
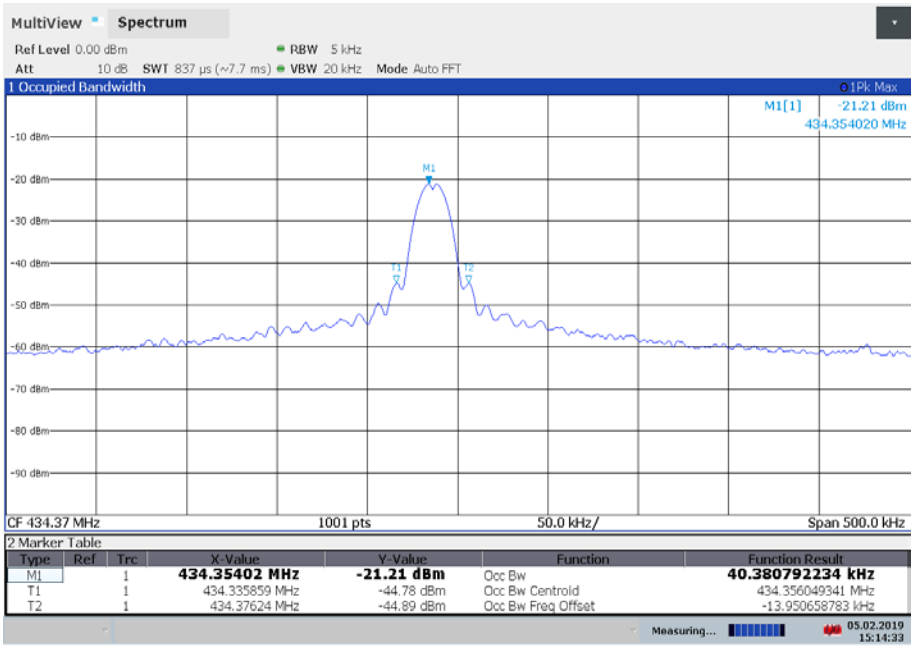
Plot 4: 20 dB bandwidth middle channel



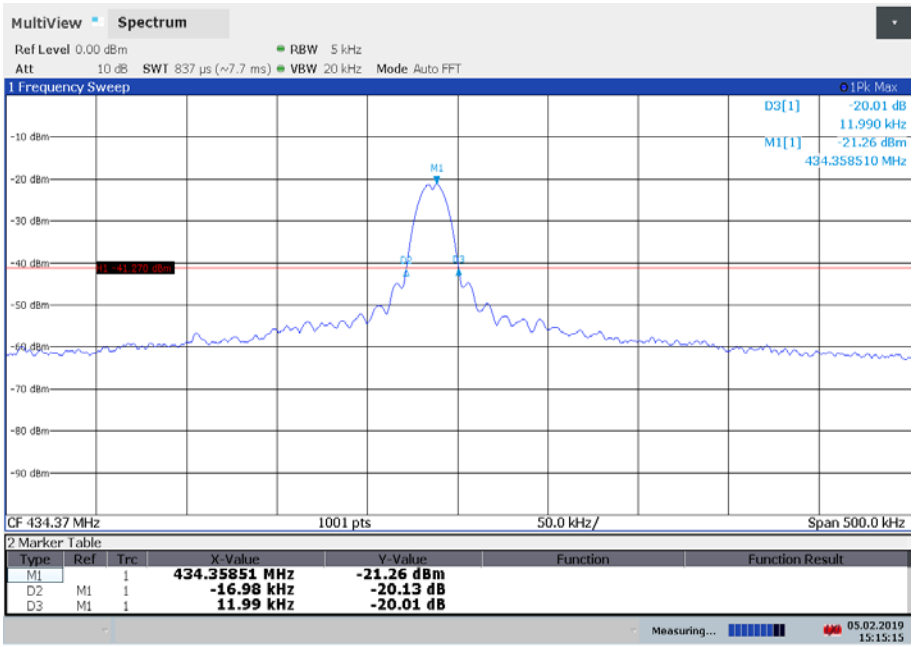
15:11:52 05.02.2019

Plot 5: 99 % bandwidth highest channel



15:14:33 05.02.2019

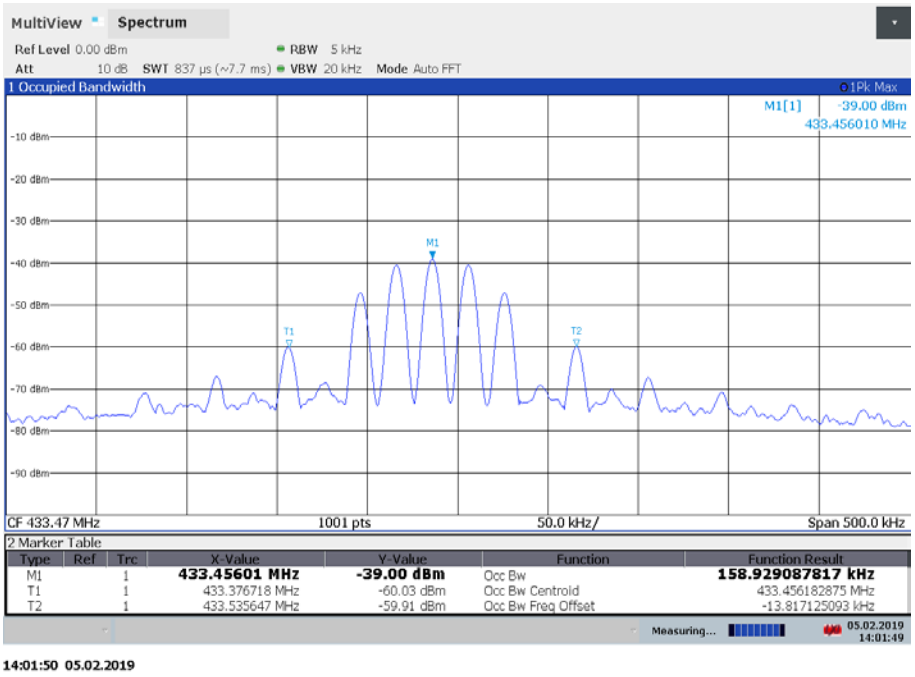
Plot 6: 20 dB bandwidth highest channel



15:15:16 05.02.2019

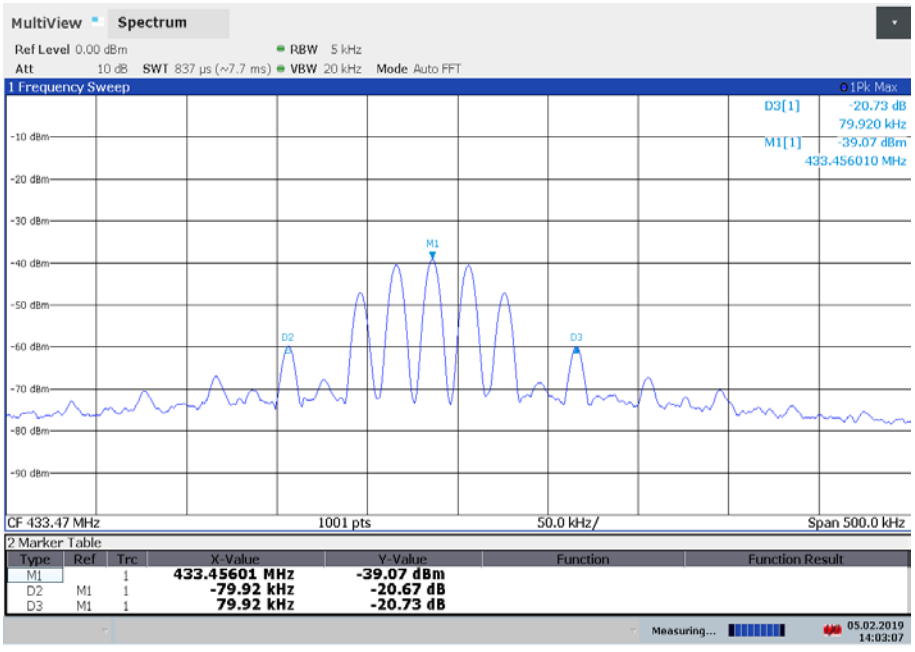
b) Modulated signal with date rate 20 Kbit/s

Plot 1: 99 % bandwidth lowest channel



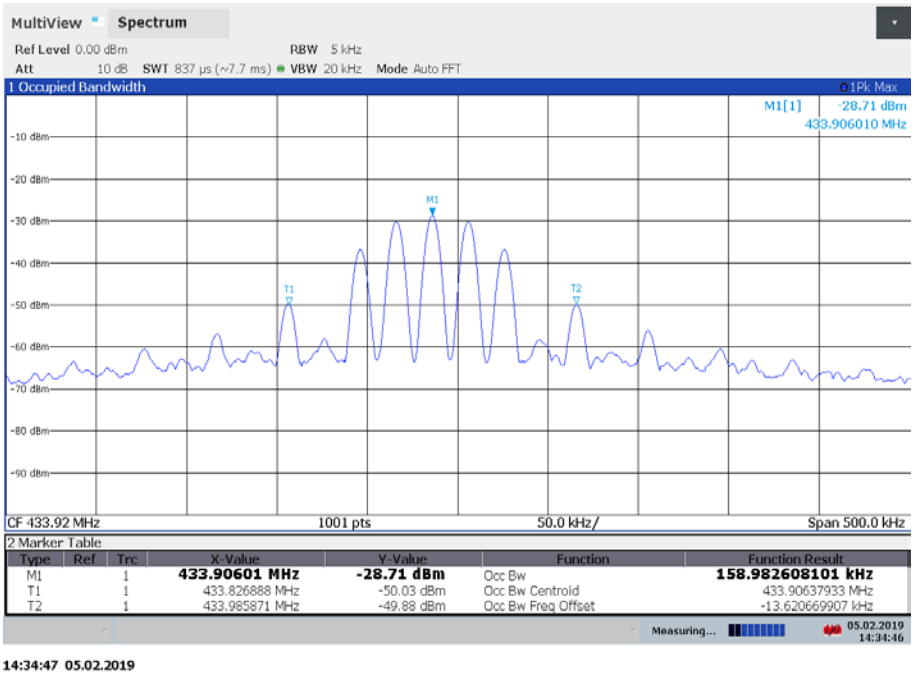
14:01:50 05.02.2019

Plot 2: 20 dB bandwidth lowest channel



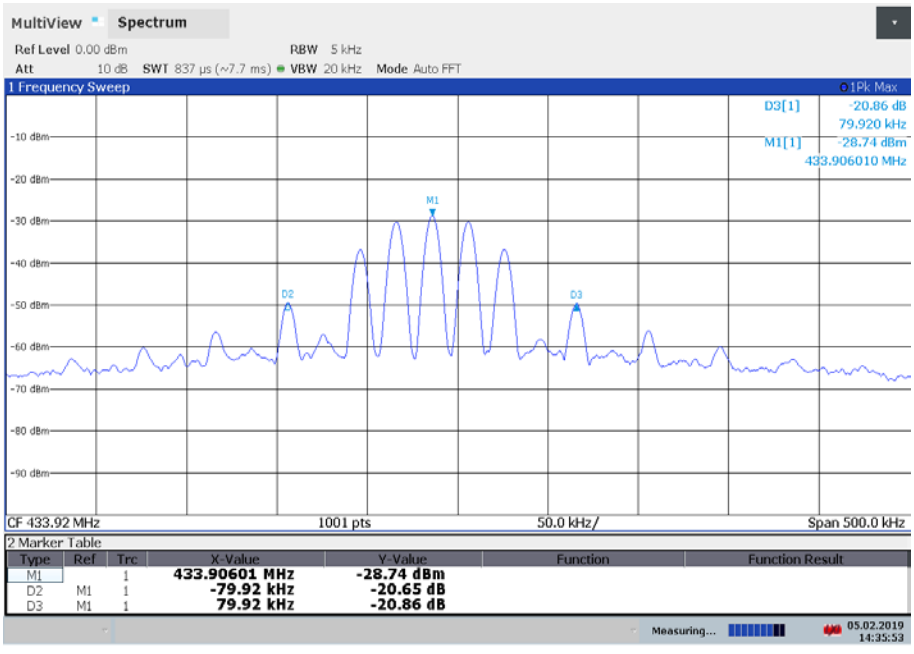
14:03:08 05.02.2019

Plot 3: 99 % bandwidth middle channel



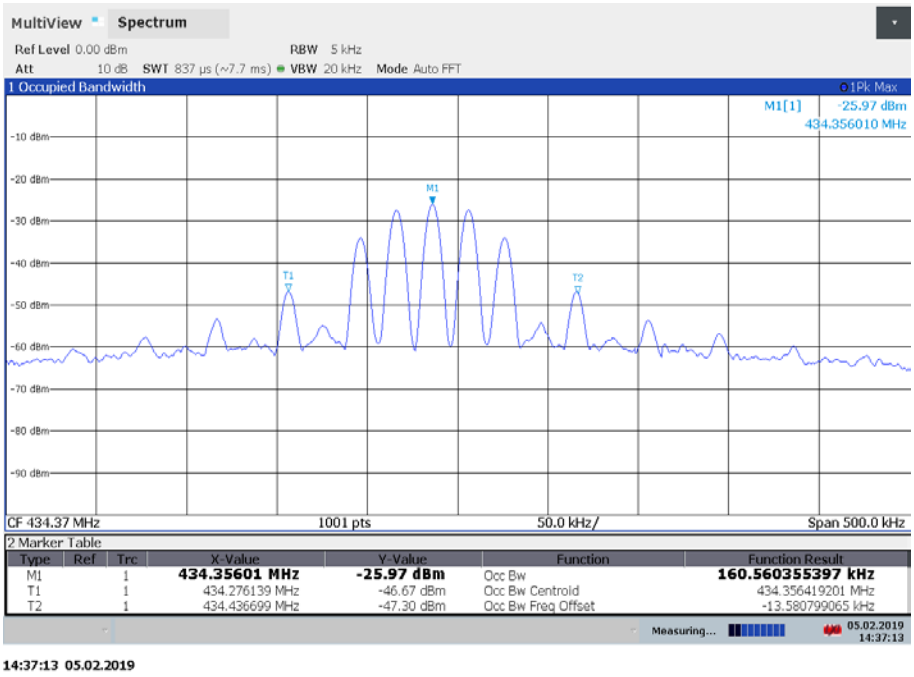
14:34:47 05.02.2019

Plot 4: 20 dB bandwidth middle channel



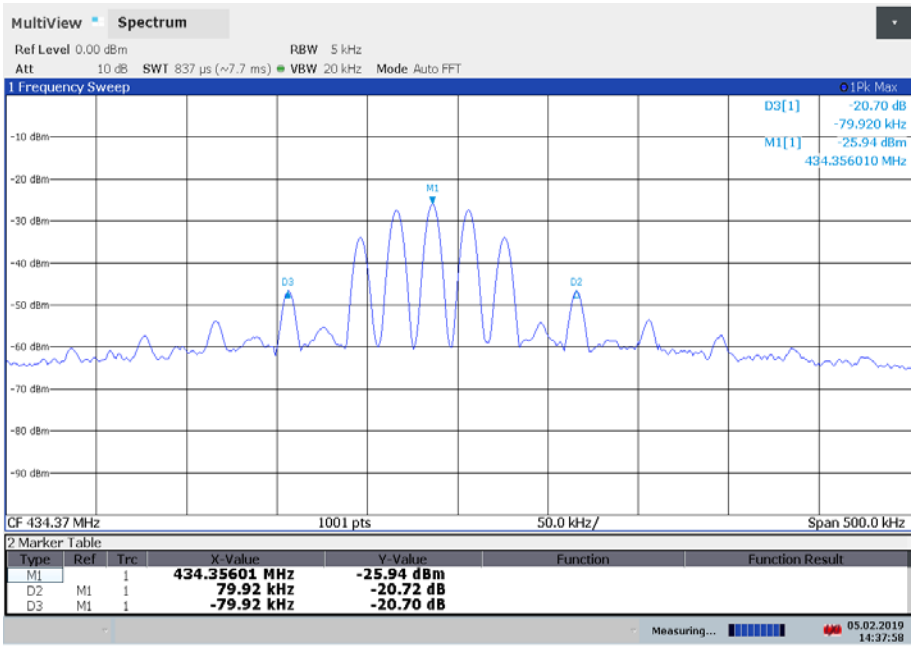
14:35:53 05.02.2019

Plot 5: 99 % bandwidth highest channel



14:37:13 05.02.2019

Plot 6: 20 dB bandwidth highest channel



14:37:59 05.02.2019

10.4 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	See chapter 6.1 A
Measurement uncertainty	8

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:

a) Modulated signal with data rate 5 Kbit/s

Test conditions	Maximum power (dBµV/m at 3 m distance)		Limit
Channel / MHz	Peak	Average	Average
433.47	71.71	70.67	80.8
433.92	71.29	70.25	80.8
434.37	71.19	70.17	80.8

*Value recalculated from the peak value with a correction factor of 0 dB acc. Chapter 10.1

b) Modulated signal with data rate 20 Kbit/s

Test conditions	Maximum power (dBµV/m at 3 m distance)		Limit
Channel / MHz	Peak	Average	Average
433.47	71.73	70.69	80.8
433.92	70.88	69.75	80.8
434.37	71.13	70.11	80.8

*Value recalculated from the peak value with a correction factor of 0 dB acc. Chapter 10.1

10.5 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	See chapter 6.1 A & 6.2 A, B
Measurement uncertainty	8

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 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
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:

a) Modulated signal with data rate 5 Kbit/s

Fundamental Frequency	Spurious Frequency	Detector	Limit max. allowed [dBµV/m]	Amplitude of emission [dBµV/m]
433.47 MHz	No Spurious Emissions detected.			
433.92 MHz				
434.37 MHz	2418 MHz	RMS	54.0	26.7

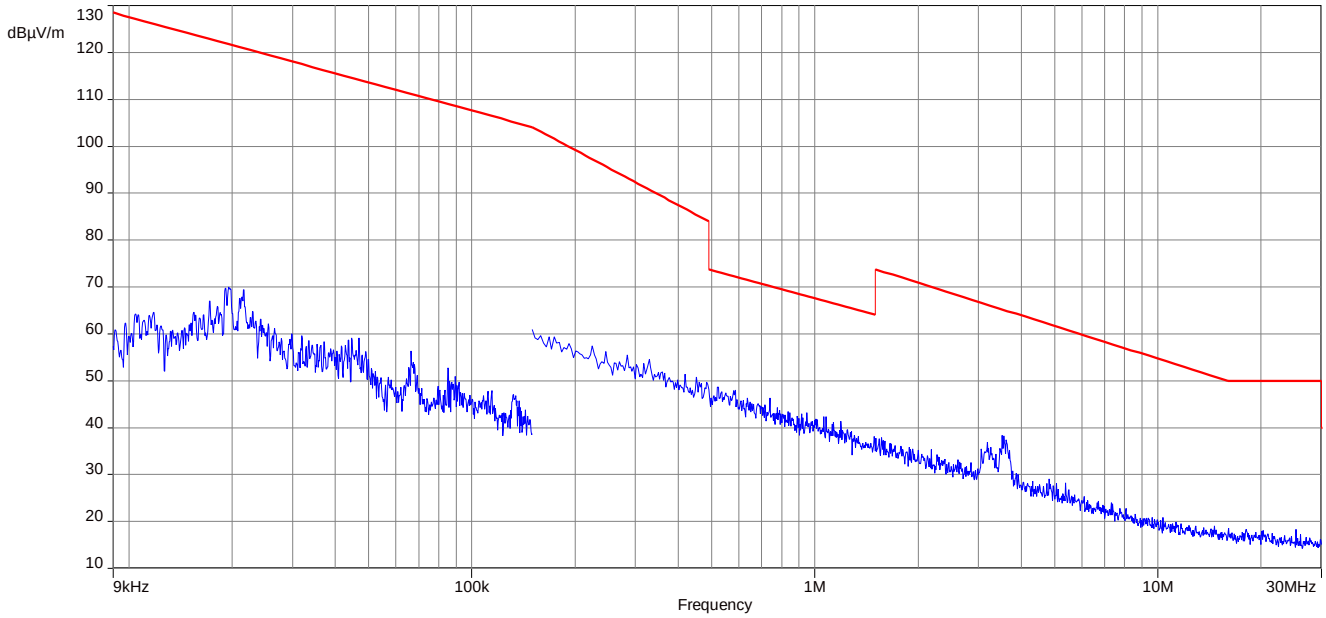
b) Modulated signal with data rate 20 Kbit/s

Fundamental Frequency	Spurious Frequency	Detector	Limit max. allowed [dBµV/m]	Amplitude of emission [dBµV/m]
433.47 MHz	No Spurious Emissions detected.			
433.92 MHz				
434.37 MHz				

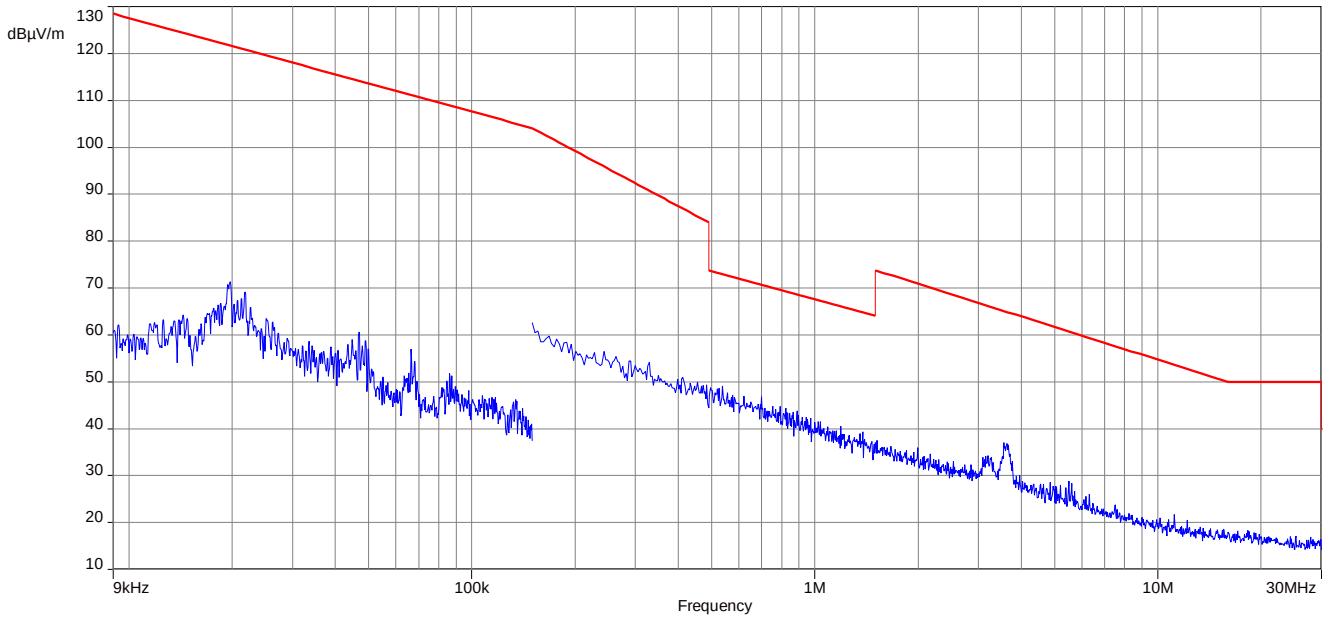
Plots:

a) Modulated Signal with date rate 5 Kbit/s

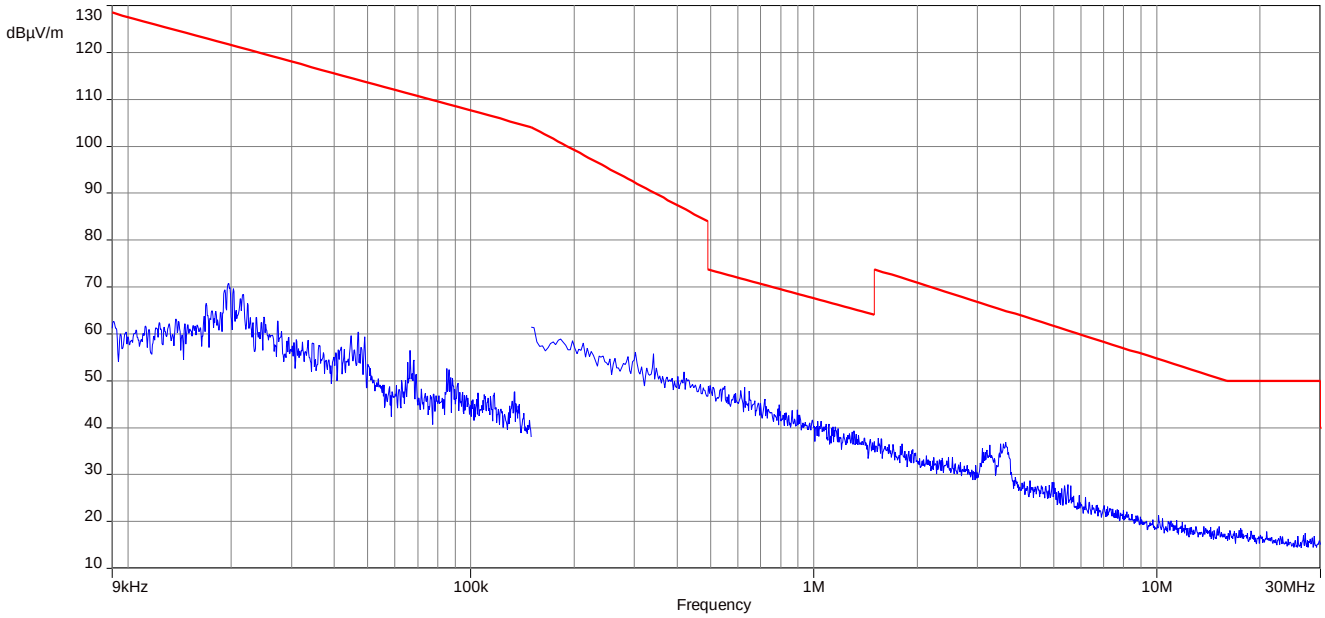
Plot 1: 9 kHz to 30 MHz (lowest channel)



Plot 2: 9 kHz to 30 MHz (middle channel)

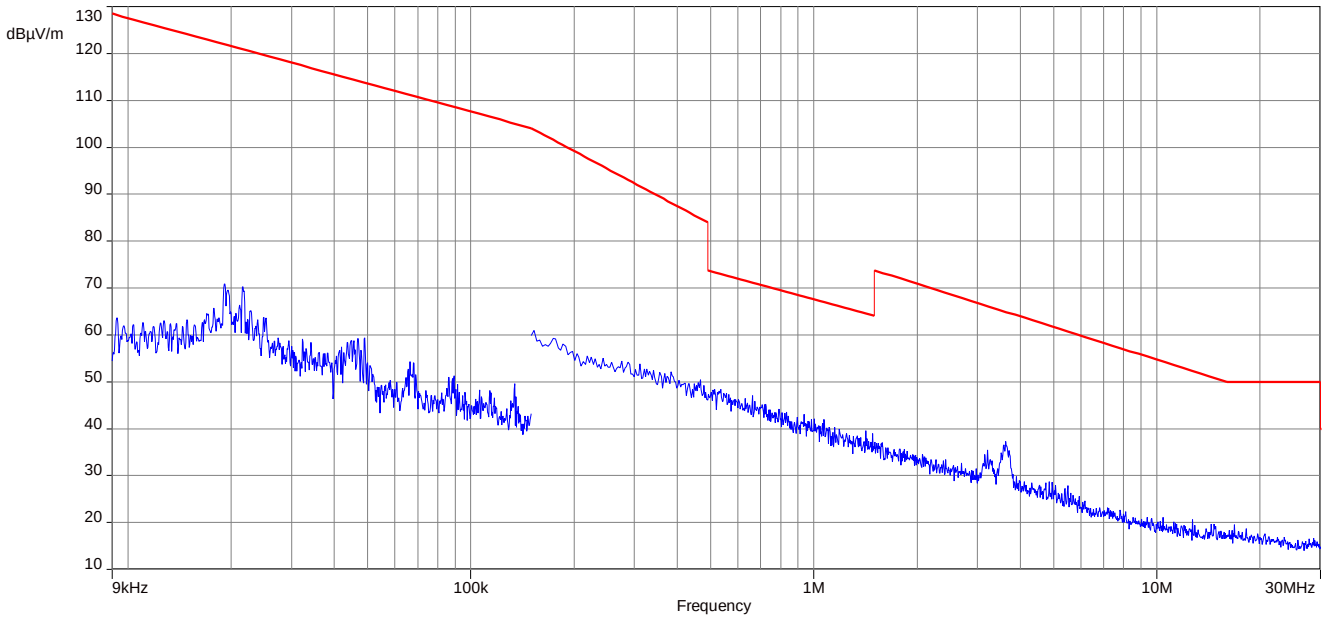


Plot 3: 9 kHz to 30 MHz (highest channel)

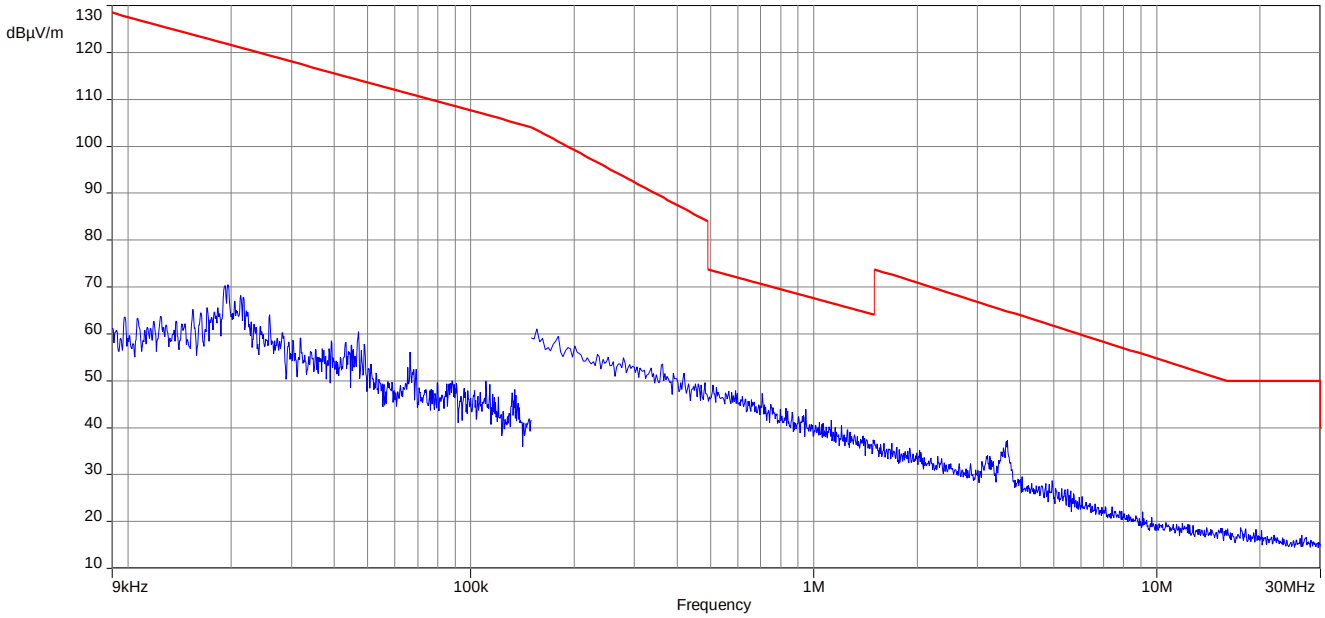


b) Modulated signal with date rate 20 Kbit/s

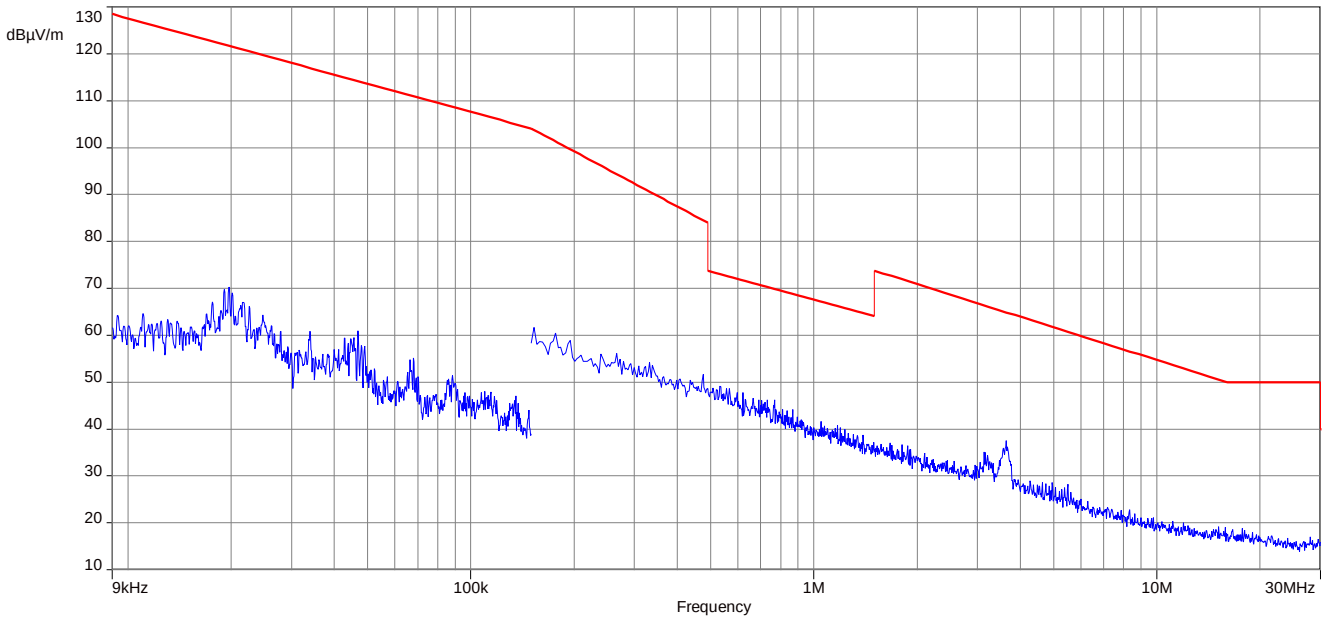
Plot 1: 9 kHz to 30 MHz (lowest channel)



Plot 2: 9 kHz to 30 MHz (middle channel)

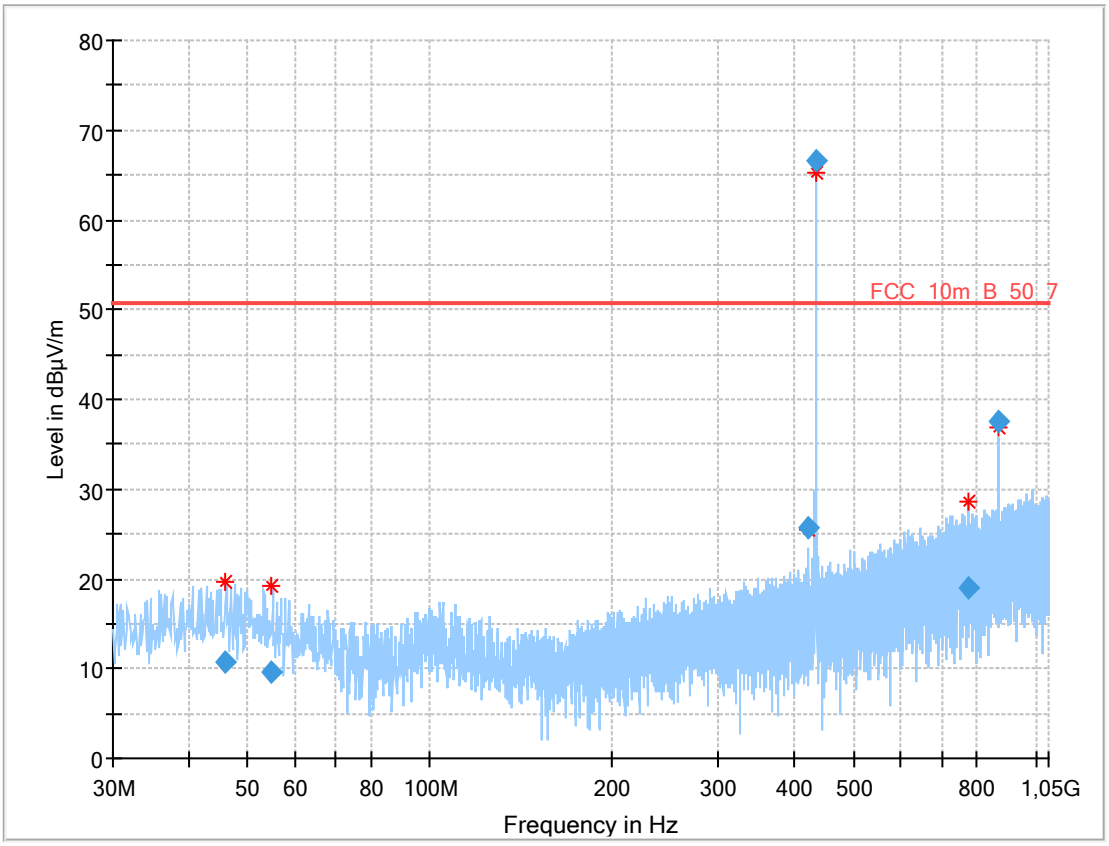


Plot 3: 9 kHz to 30 MHz (highest channel)



a) Modulated Signal with data rate 5 Kbit/s

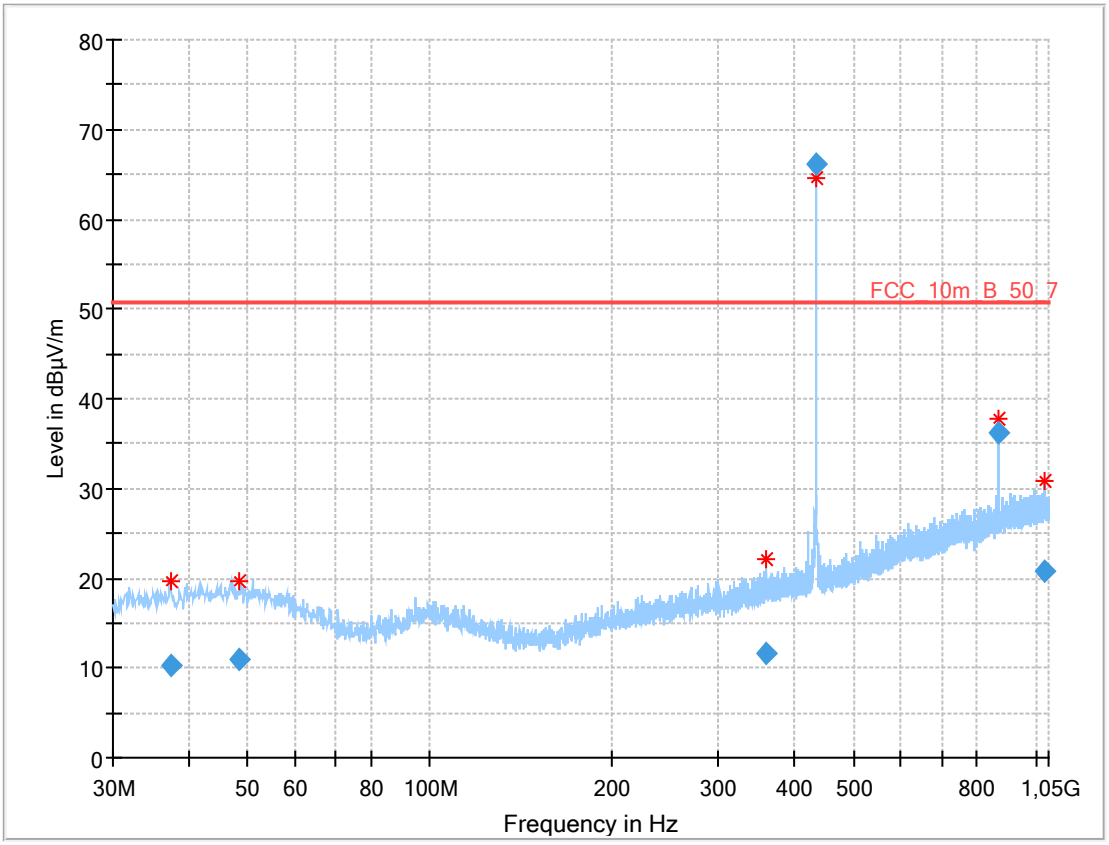
Plot 1: 30 MHz to 1000 MHz, vertical & horizontal polarisation **433.47 MHz**



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
46.000	10.76	50.7	39.94	1000	120	103.0	H	91.0
54.713	9.57	50.7	41.13	1000	120	273.0	H	226.0
420.365	25.72	50.7	24.98	1000	120	200.0	H	24.0
433.453	66.63	50.7	-15.93	1000	120	203.0	H	23.0
775.311	18.91	50.7	31.79	1000	120	400.0	V	70.0
866.920	37.45	50.7	13.25	1000	120	100.0	H	336.0

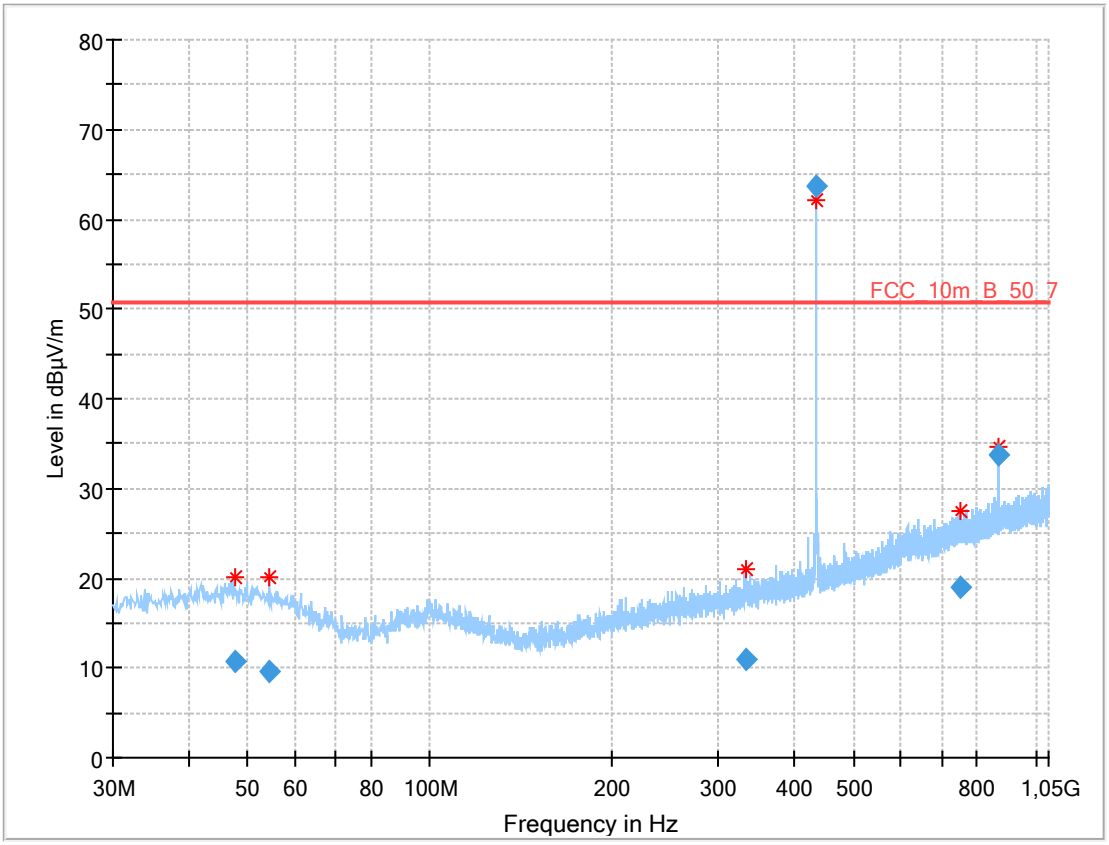
Plot 2: 30 MHz to 1000 MHz, vertical & horizontal polarisation **433.92 MHz**



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
37.291	10.35	50.7	40.35	1000	120	173.0	V	263.0
48.292	10.91	50.7	39.79	1000	120	200.0	V	270.0
358.991	11.56	50.7	39.14	1000	120	200.0	H	161.0
433.902	66.15	50.7	-15.45	1000	120	203.0	H	25.0
867.806	36.18	50.7	14.52	1000	120	100.0	H	115.0
1033.603	20.87	50.7	29.83	1000	120	400.0	H	279.0

Plot 3: 30 MHz to 1000 MHz, vertical & horizontal polarisation 434.37 MHz

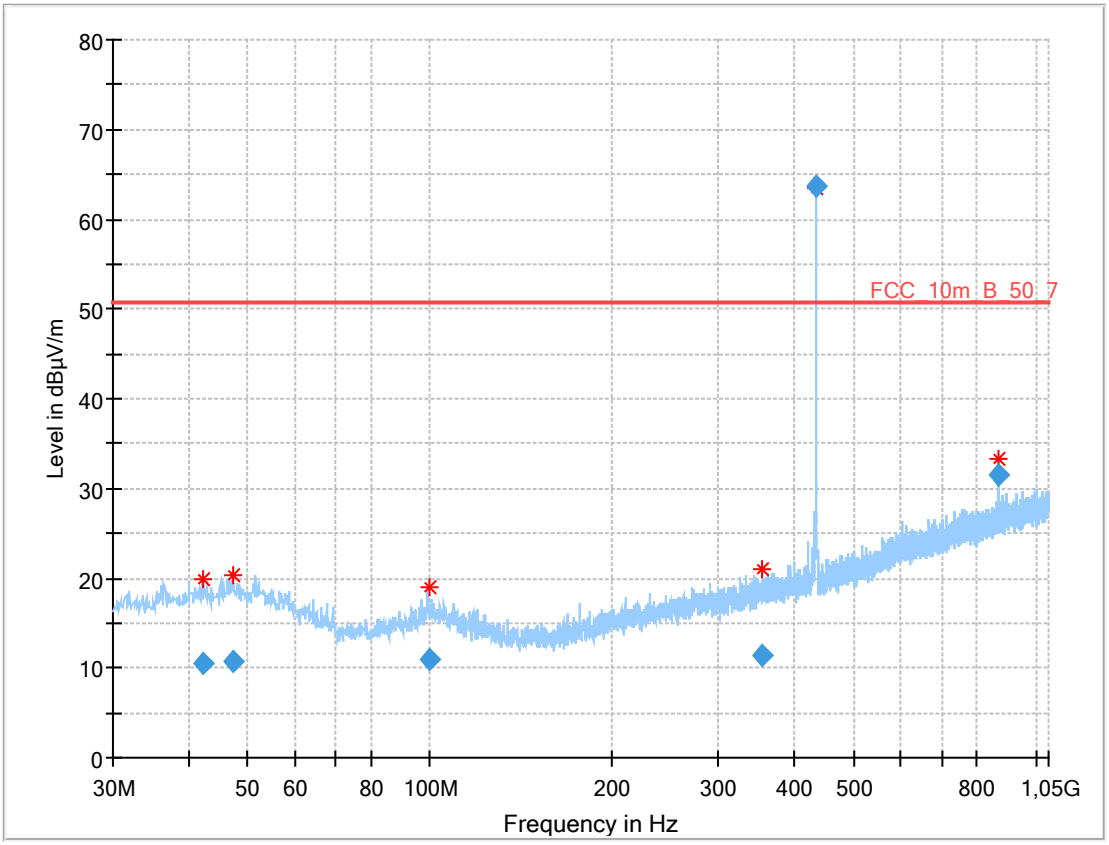


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
47.602	10.71	50.7	39.99	1000	120	203.0	V	271.0
54.527	9.58	50.7	41.12	1000	120	203.0	H	353.0
333.134	10.90	50.7	39.80	1000	120	349.0	V	315.0
434.355	63.60	50.7	-12.90	1000	120	400.0	V	71.0
749.344	18.96	50.7	31.74	1000	120	200.0	V	25.0
868.710	33.69	50.7	17.01	1000	120	100.0	H	-19.0

b) Modulated Signal with data rate 20 Kbit/s

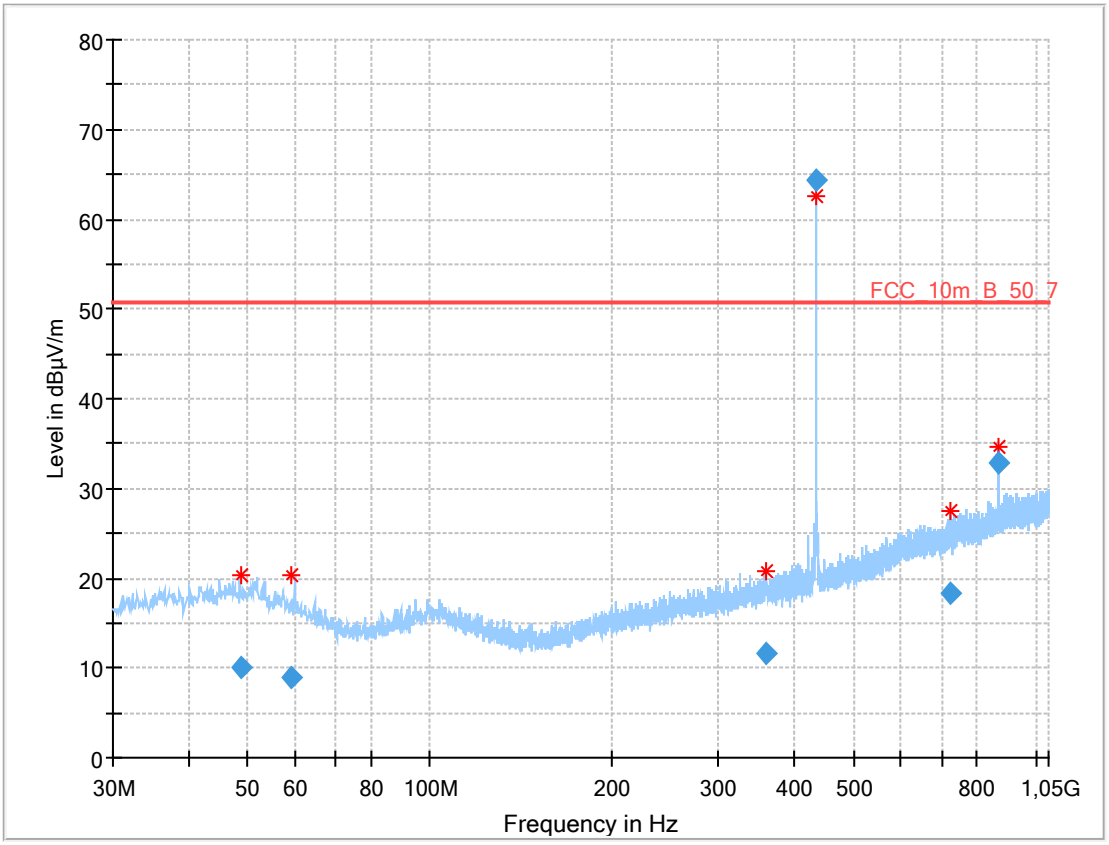
Plot 1: 30 MHz to 1000 MHz, vertical & horizontal polarisation 433.47 MHz



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
42.326	10.48	50.7	40.22	1000	120	349.0	V	136.0
47.526	10.73	50.7	39.97	1000	120	200.0	H	181.0
99.552	11.04	50.7	39.66	1000	120	349.0	V	261.0
352.859	11.39	50.7	39.31	1000	120	357.0	H	225.0
433.437	63.64	50.7	-12.94	1000	120	100.0	V	89.0
866.943	31.53	50.7	19.17	1000	120	103.0	H	161.0

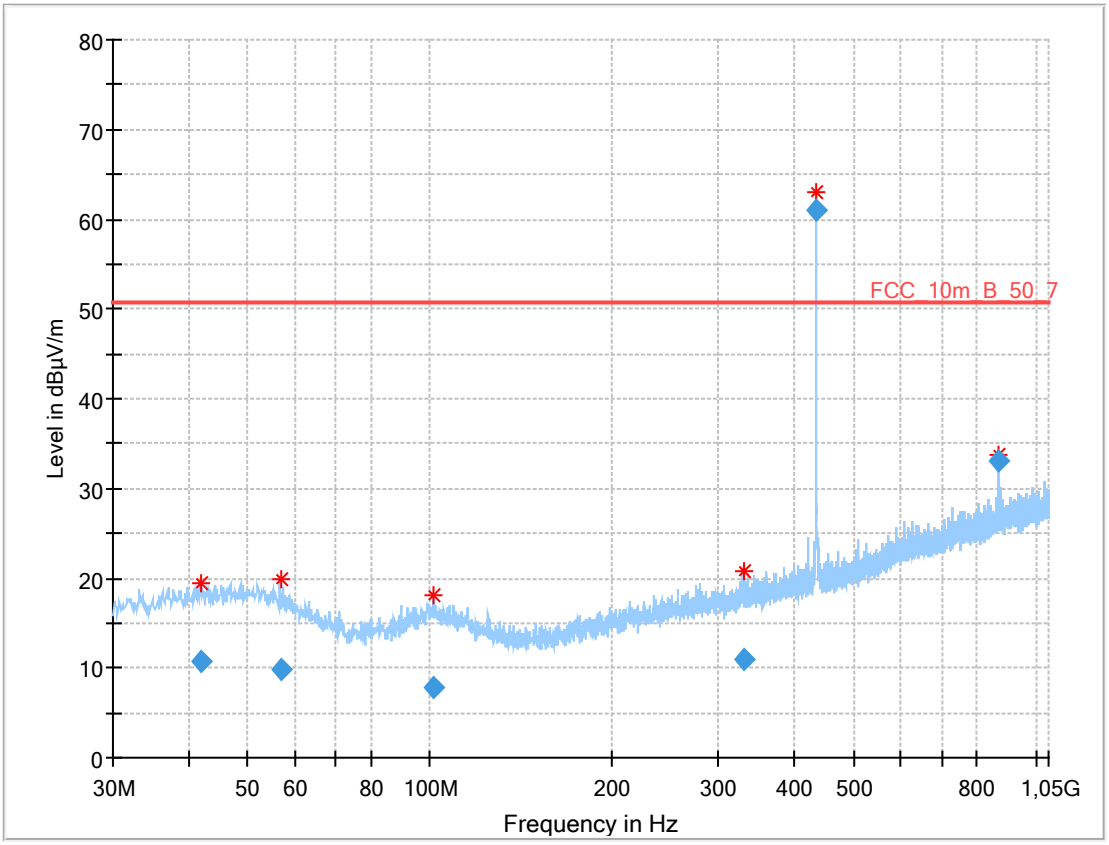
Plot 2: 30 MHz to 1000 MHz, vertical & horizontal polarisation 433.92 MHz



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
48.850	10.13	50.7	40.57	1000	120	100.0	V	352.0
59.297	8.91	50.7	41.79	1000	120	102.0	V	0.0
357.809	11.52	50.7	39.18	1000	120	271.0	V	202.0
433.887	64.43	50.7	-13.73	1000	120	400.0	V	251.0
724.697	18.38	50.7	32.32	1000	120	349.0	H	218.0
867.792	32.93	50.7	17.77	1000	120	100.0	H	2.0

Plot 3: 30 MHz to 1000 MHz, vertical & horizontal polarisation 434.37 MHz



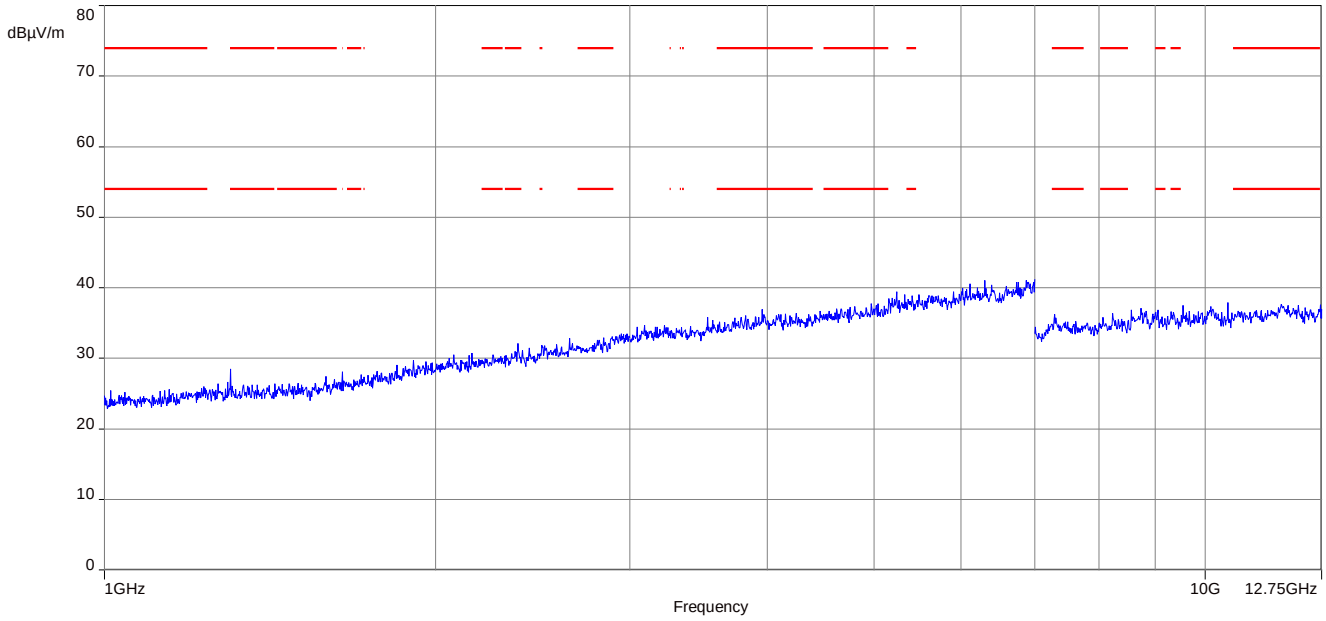
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
41.785	10.73	50.7	39.97	1000	120	103.0	H	245.0
56.687	9.79	50.7	40.91	1000	120	273.0	H	53.0
101.377	7.82	50.7	42.88	1000	120	350.0	H	181.0
329.076	10.88	50.7	39.82	1000	120	203.0	H	270.0
434.338	61.02	50.7	-10.32	1000	120	272.0	V	251.0
868.762	32.98	50.7	17.72	1000	120	100.0	H	-36.0

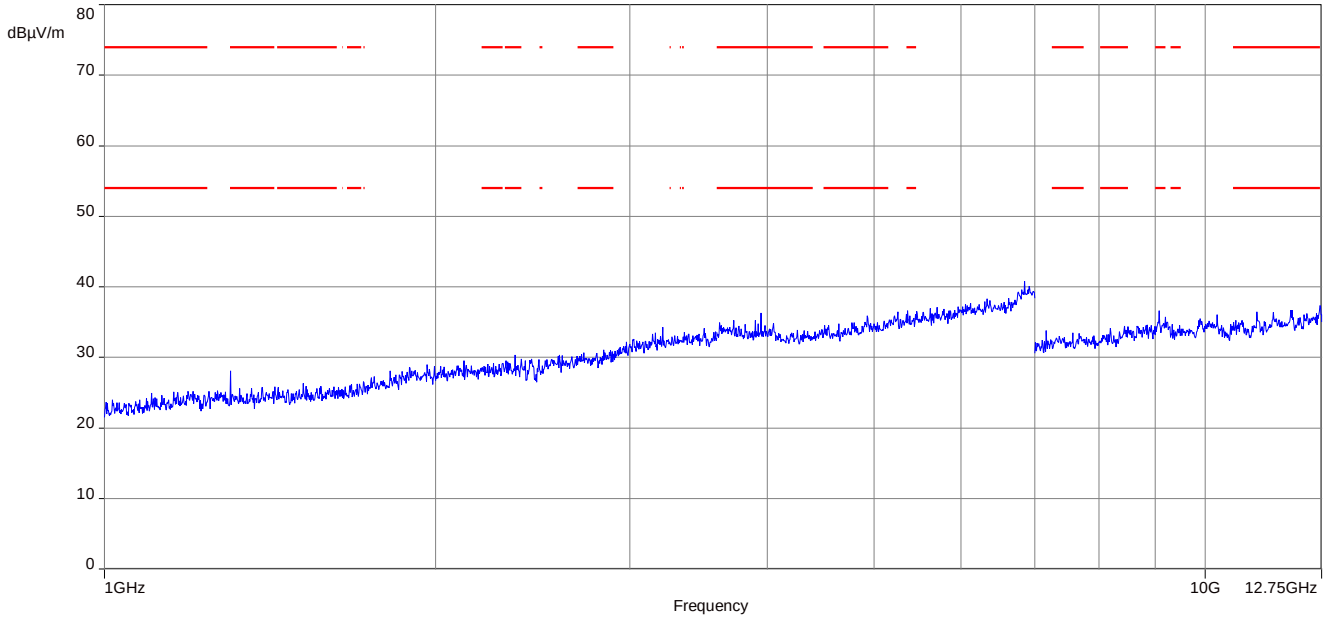
Plots:

a) Modulated signal with date rate 5 Kbit/s

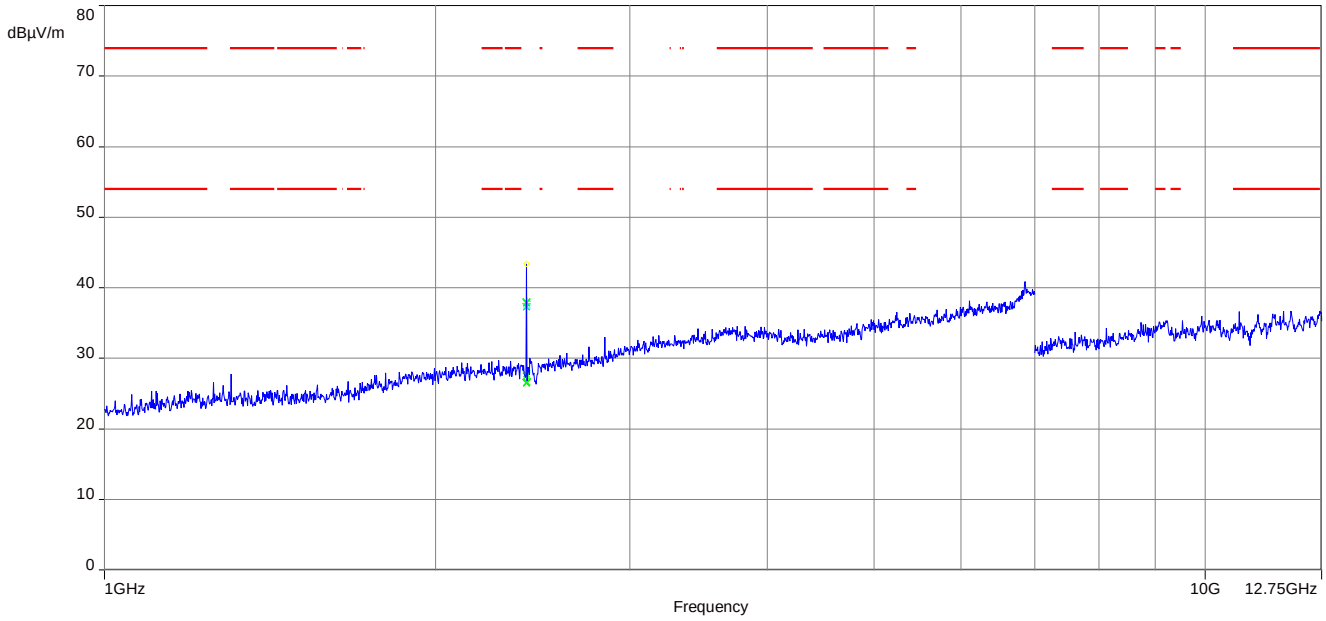
Plot 1: 1 GHz to 12.75 GHz, vertical & horizontal polarisation (lowest channel)



Plot 2: 1 GHz to 12.75 GHz, vertical & horizontal polarisation (middle channel)

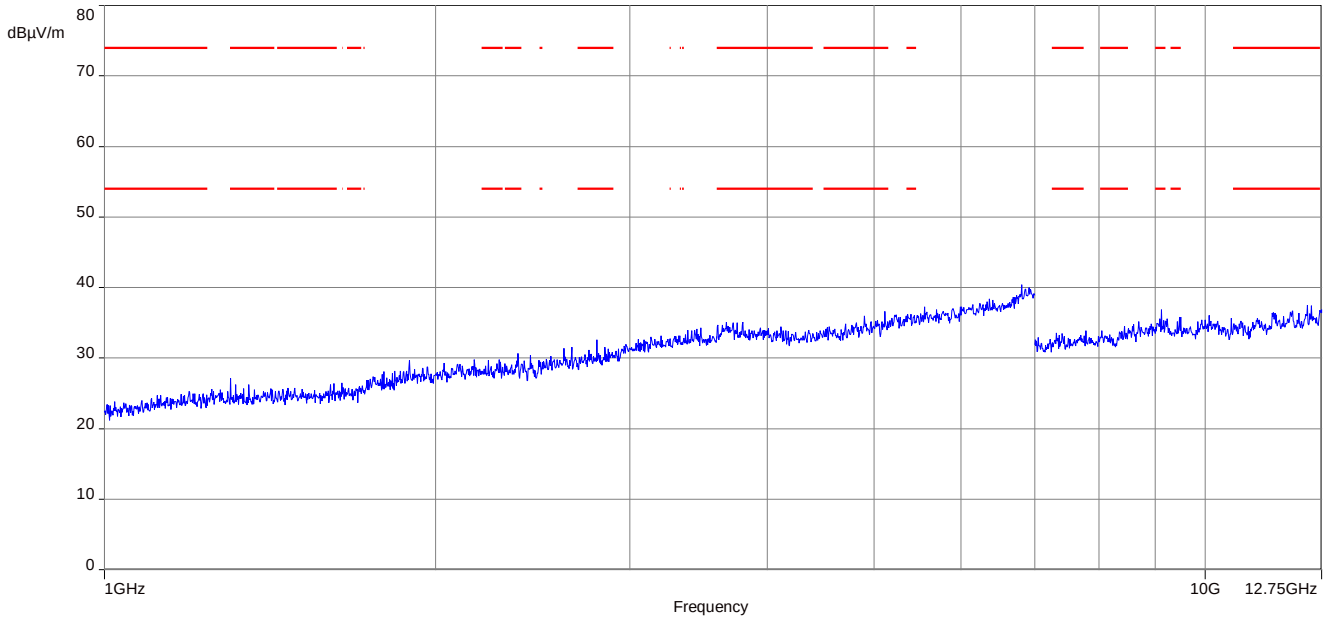


Plot 3: 1 GHz to 12.75 GHz, vertical & horizontal polarisation (highest channel)

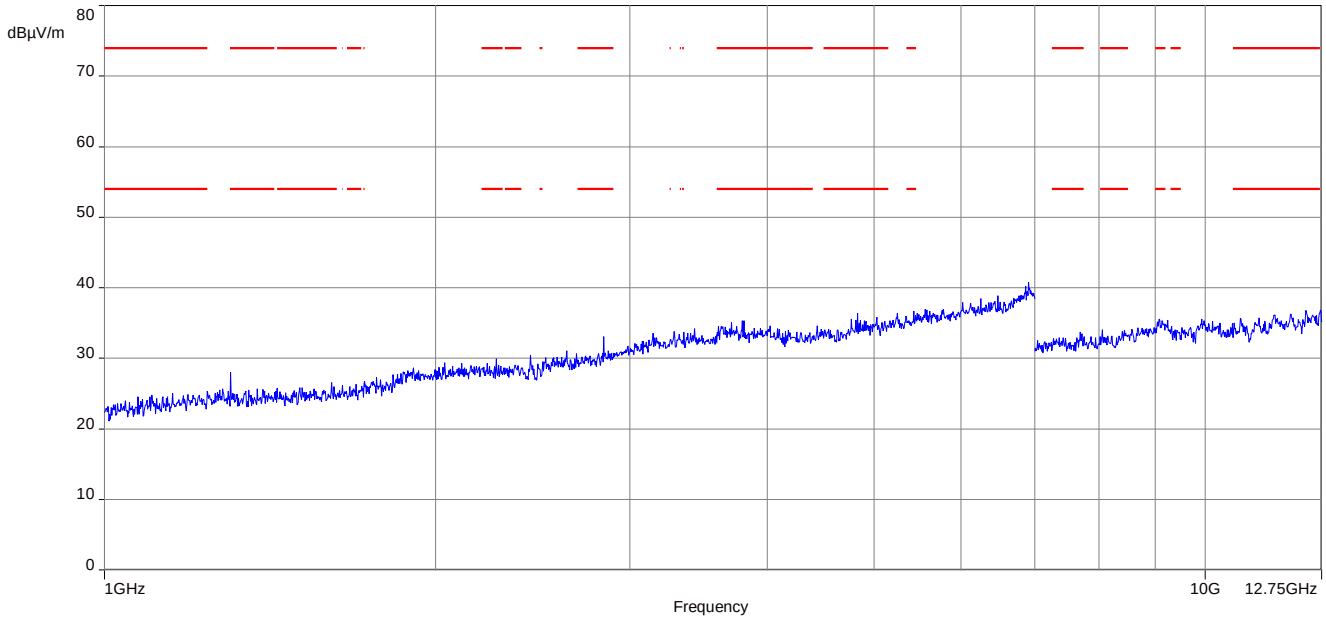


b) Modulated signal with date rate 20 Kbit/s

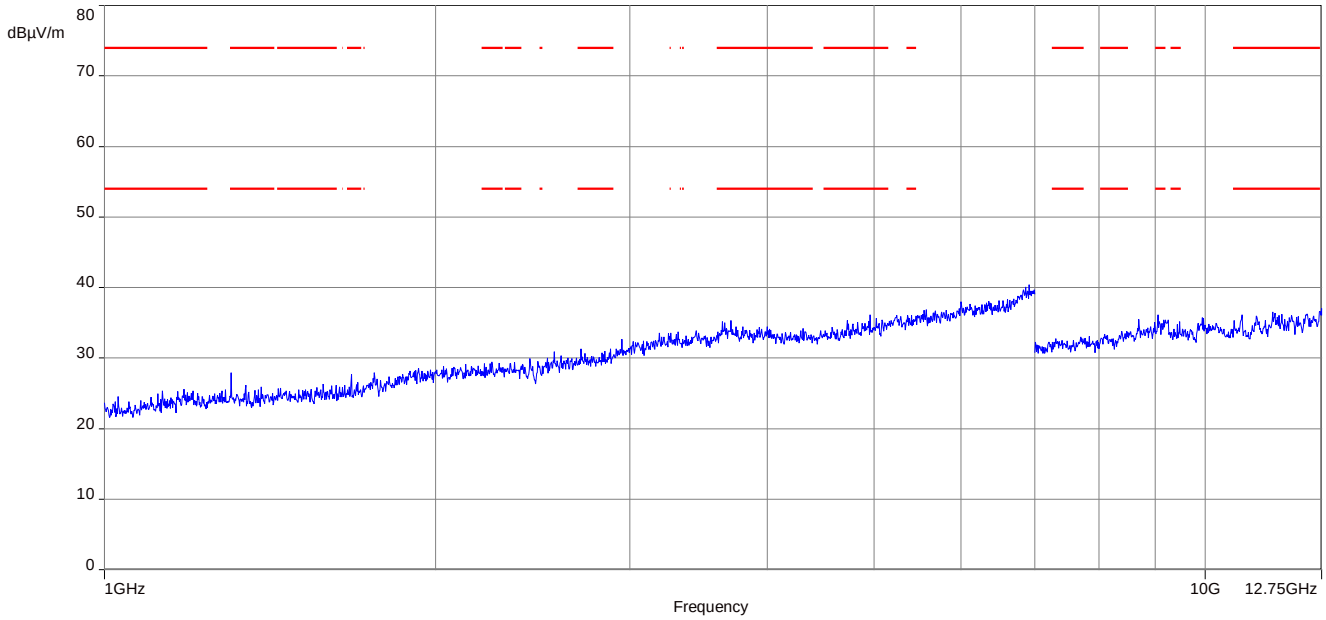
Plot 1: 1 GHz to 12.75 GHz, vertical & horizontal polarisation (lowest channel)



Plot 2: 1 GHz to 12.75 GHz, vertical & horizontal polarisation (middle channel)



Plot 3: 1 GHz to 12.75 GHz, vertical & horizontal polarisation (highest channel)



11 Observations

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

Annex A 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

Annex B Document history

Version	Applied changes	Date of release
-/-	Initial release	2019-02-22
A	Version of RSS GEN corrected	2019-02-28
B	Result on page 28 added	2019-03-06

Annex C Accreditation Certificate

first page	last page
	

Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request

https://www.dakks.de/as/ast/d/D-PL-12076-01-03.pdf

########## END OF TEST REPORT ##########