FCC Measurement/Technical Report on

CONNECT-FLX Security Panel
CONNECT-FLX

FCC ID: U5X-CFLXRF
Contains FCC ID: RI7ME310G1WW; 2AC7Z-ESP32WROOM32E

IC: 8310A-CFLXRF
Contains IC: 5131A-ME310G1WW; 21098-ESPWROOM32E

Report Reference: MDE_M2MSE_2402_FCC_01

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche Akkreditierungsstelle D-PL-12140-01-00

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1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization
Certification for an Intentional Radiator (Periodic operation in the band above 70 MHz)

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15 (10-1-23 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.231 Periodic operation in the band 40.66-40.70 MHz, above 70 MHz

Note:
ANSI C63.4-2020 is applied

1.2 FCC-IC CORRELATION TABLE

Correlation of measurement requirements for Information Technology Equipment (ITE) from FCC and ISED Canada

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 5: 8.8
Transmitter spurious radiated emissions	§ 15.231 (b) / (e)	RSS Gen Issue 5: 8.9 RSS-210 Issue 11 Table A2
Duty cycle measurement (based on dwell time measurement)	§ 15.231 (a)	RSS-210 Issue 11
Maximum radiated field strength at fundamental frequency	§ 15.231 (b) / (e)	RSS-210 Issue 11 Table A2; RSS Gen Issue 5: 8.9
Occupied bandwidth	§ 15.231 (c)	RSS-210 Issue 11
Antenna requirement	§ 15.203 / 15.204	RSS Gen Issue 5: 8.3
Receiver spurious emissions	–	-

Remarks:

*) Receivers are exempted from certification besides if operating in stand-alone mode in the frequency range 30–960 MHz or if these are scanner receivers.

1.3 MEASUREMENT SUMMARY

47 CFR CHAPTER I FCC PART 15
Subpart C § 15.207

Conducted emissions (AC power line)
The measurement was performed according to ANSI C63.10 6.2

OP-Mode	Setup	Date	Final Result FCC	IC
AC mains connection, Test setup				
AC direct, computer peripheric, op-mode 4	S04_D01	2025-01-10	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart C § 15.231(a)

Transmitter Deactivation and Duty cycle
The measurement was performed according to ANSI C63.10 6.3

OP-Mode	Setup	Date	Final Result FCC	IC
Radio Technology				
433MHz, op-mode 2	S02_B01	2024-12-16	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart C § 15.231(b)(2)

Spurious Radiated Emissions
The measurement was performed according to ANSI C63.10 6.3; 6.10

OP-Mode	Setup	Date	Final Result FCC	IC
Radio Technology				
433MHz, op_mode 1	S01_A01	2024-12-16	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart C § 15.231

Maximum radiated field strength at fundamental frequency
The measurement was performed according to ANSI C63.10 6.3

OP-Mode	Setup	Date	Final Result FCC	IC
Radio Technology				
433MHz, op_mode 1	S01_A01	2024-12-16	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart C § 15.231(c)

Occupied Bandwidth
The measurement was performed according to ANSI C63.10 6.9

OP-Mode	Setup	Date	Final Result FCC	IC
Radio Technology				
433MHz, op_mode 3	S03_C01	2024-12-16	Passed	Passed

2 REVISION HISTORY / SIGNATURES

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2025-02-17	---	valid

COMMENT:

According to the applicant, the Device Connect-FLX Security Panel, type Connect-FLX is technically identical to HUB-FLX Security Panel, type HUB-FLX.

(responsible for accreditation scope)
Dipl.-Ing. Marco Kullik

(responsible for testing and report)
Dipl.-Ing. Robert Machulec

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3 ADMINISTRATIVE DATA

3.1 TESTING LABORATORY

Company Name:	7layers GmbH
Address:	Borsigstr. 11 40880 Ratingen Germany

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-00
FCC Designation Number:	DE0015
FCC Test Firm Registration:	929146
ISED CAB Identifier:	DE0007; ISED#: 3699A
Responsible for accreditation scope:	Dipl.-Ing. Marco Kullik
Report Template Version:	2024-12-12

3.2 PROJECT DATA

Responsible for testing and report:	Dipl.-Ing. Robert Machulec
Date of Report:	2025-02-17
Testing Period:	2024-12-16 to 2025-01-10

3.3 APPLICANT DATA

Company Name:	Alula
Address:	428 Minnesota Street, Suite 300 St. Paul, MN 55101 USA
Contact Person:	Mr. Joshua Gathje

3.4 MANUFACTURER DATA

Company Name:	Residence Control Ltd.
Address:	1 Kukush Str., Building M8 1309 Sofia Bulgaria
Contact Person:	Mr. Ivan Bonev

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	The EUT is a Security Panel. Wireless security system with WiFi, CAT-M1 and 433.92Mhz communication.
Product name	CONNECT-FLX Security Panel
Type	CONNECT-FLX
Declared EUT data by the supplier	
Power Supply Type	AC/DC; internal battery
Normal Voltage	120V AC/60Hz; 12V DC
Normal Temperature	25 °C
Operating frequency	433.92 MHz
Modulation	ASK
The EUT provides the following ports:	Enclosure, DC-Power, LAN
Special software used for testing	The test samples are prepared with a special FW

4.2 EUT MAIN COMPONENTS

Sample Name	**Sample Code**	**Description**
EUT A	DE1208014aa01	test sample
Sample Parameter	**Value**	
Serial No.	-	
HW Version	56-00115	
SW Version	75-00152	
Comment	FW for CW mode	

Sample Name	**Sample Code**	**Description**
EUT B	DE1208014ab01	test sample
Sample Parameter	**Value**	
Serial No.	-	
HW Version	56-00115	
SW Version	75-00152	
Comment	FW for normal operation	

Sample Name	**Sample Code**	**Description**
EUT C	DE1208014ac01	test sample
Sample Parameter	**Value**	
Serial No.	-	
HW Version	56-00115	
SW Version	75-00152	
Comment	FW for CM mode	

Sample Name	Sample Code	Description
EUT D	DE1208014ac01	test sample
Sample Parameter	**Value**	
Serial No.	-	
HW Version	56-00115	
SW Version	75-00152	
Comment	FW for CM mode	

4.3 ANCILLARY EQUIPMENT

Device	Details (Manufacturer, Type Model, OUT Code)	Reason for using
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4.4 AUXILIARY EQUIPMENT

Device	Details (Manufacturer, HW, SW, S/N)	Description
AUX 1	Amigo, AMS135-1201000FU, -, -, -	AC/DC powers supply

4.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup No.	Combination of EUTs	Description
S01_A01	EUT A + AUX 1	
S02_B01	EUT B + AUX 1	
S03_C01	EUT C + AUX 1	
S04_D01	EUT C + AUX 1	

4.6 OPERATING MODES

This chapter describes the operating modes of the EUTs used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	Continuous transmission CW	Transmitter sends continuously unmodulated signal
op-mode 2	Single burst	Normal operation Transmitter sends a single burst
op-mode 3	Continuous transmission CM	Transmitter sends continuously modulated signal
op-mode 4	Normal mode	Used for the test AC mains emissions

4.7 PRODUCT LABELLING

4.7.1 FCC ID label

Please refer to the documentation of the applicant.

4.7.2 IC Label

Please refer to the documentation of the applicant.

4.7.3 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

5 TEST RESULTS

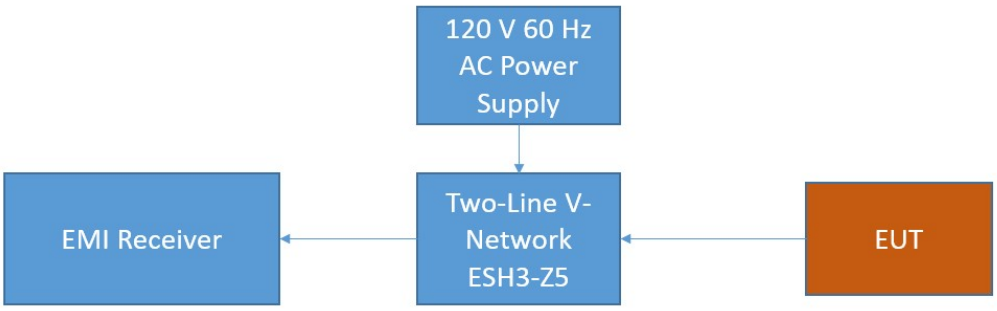
5.1 CONDUCTED EMISSIONS (AC POWER LINE)

Standard

The test was performed according to:
ANSI C63.10

5.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.4
The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50µH || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.



FCC Conducted Emissions on AC

The measurement procedure consists of two steps. It is implemented into the EMI test software EMC-32 from R&S.

Step 1: Preliminary scan
Intention of this step is, to determine the conducted EMI-profile of the EUT.
EMI receiver settings:
- Detector: Peak – Maxhold & Average
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 2.5 kHz
- IF–Bandwidth: 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)
- Measurement on phase + neutral lines of the power cords

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement
Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.
EMI receiver settings:
- Detector: Quasi-Peak & (CISPR) Average
- IF Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:
1) Neutral lead - reference ground (PE grounded)
2) Phase lead - reference ground (PE grounded)
3) Neutral lead - reference ground (PE floating)
4) Phase lead - reference ground (PE floating)

The highest value is reported.

5.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

Class B:

Frequency (MHz)	QP Limits (dBµV)	AV Limits (dBµV)
0.15 – 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Class A:

Frequency (MHz)	QP Limits (dBµV)	AV Limits (dBµV)
0.15 – 0.5	79	66
0.5 - 30	73	60

5.1.3 Test Protocol

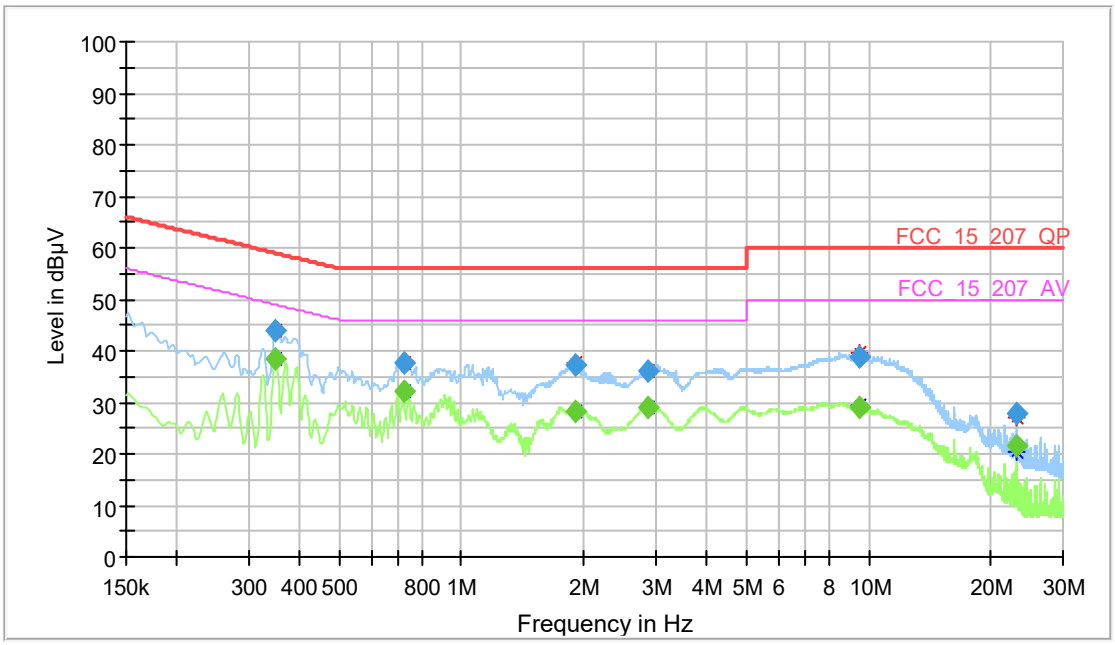
Temperature: 24 °C
Air Pressure: 1013 hPa
Humidity: 33 %
AC direct, computer peripheric

Power line	PE	Frequency [MHz]	Level [dBµV]	Detector	Limit [dBµV]	Margin [dB]
N	GND	0.350250	38.48	AV	48.96	10.48
N	GND	0.350250	43.92	QP	58.96	15.04
N	FLO	0.719250	32.26	AV	46.00	13.74
N	FLO	0.719250	37.52	QP	56.00	18.48
N	GND	1.900500	37.42	QP	56.00	18.58
N	FLO	1.900500	28.42	AV	46.00	17.58
N	GND	2.872500	36.11	QP	56.00	19.89
N	GND	2.872500	29.04	AV	46.00	16.96
N	GND	9.503250	38.82	QP	60.00	21.18
N	GND	9.503250	29.14	AV	50.00	20.86
N	GND	23.127000	21.48	AV	50.00	28.52
N	GND	23.127000	27.87	QP	60.00	32.13

Remark: Please see next sub-clause for the measurement plot.

5.1.4 Measurement Plot

Test Description:	Conducted Emissions
Test Standard:	FCC §15.207, ANSI C63.10
EUT Code / Setup:	DE1208014, Setup S04_D01
Operating Conditions:	120 V 60 Hz, OP-Mode 4
Comment:	
Legend:	Trace: blue = QP, green = CISPR AV; Star: red or blue = critical frequency; Rhombus: blue = final QP, green = final CISPR AV
Tested Port / used LISN:	AC mains => 1st LISN ESH3-Z5
Termination of other ports:	N/A, AC of AUX => 2nd LISN ESH3-Z5 +50 Ohm



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.350250	---	38.48	48.96	10.48	1000.0	9.000	N	GND	10.1
0.350250	43.92	---	58.96	15.04	1000.0	9.000	N	GND	10.1
0.719250	---	32.26	46.00	13.74	1000.0	9.000	N	FLO	10.1
0.719250	37.52	---	56.00	18.48	1000.0	9.000	N	FLO	10.1
1.900500	37.42	---	56.00	18.58	1000.0	9.000	N	GND	10.2
1.900500	---	28.42	46.00	17.58	1000.0	9.000	N	FLO	10.2
2.872500	36.11	---	56.00	19.89	1000.0	9.000	N	GND	10.3
2.872500	---	29.04	46.00	16.96	1000.0	9.000	N	GND	10.3
9.503250	38.82	---	60.00	21.18	1000.0	9.000	N	GND	10.6
9.503250	---	29.14	50.00	20.86	1000.0	9.000	N	GND	10.6
23.127000	---	21.48	50.00	28.52	1000.0	9.000	N	GND	11.2
23.127000	27.87	---	60.00	32.13	1000.0	9.000	N	GND	11.2

5.1.5 Test Equipment used

- Conducted Emissions FCC

5.2 TRANSMITTER DEACTIVATION AND DUTY CYCLE

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.2.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was setup in a shielded room to perform the dwell time measurements. For analyzer settings please see measurement plots.

5.2.2 TEST REQUIREMENTS / LIMITS

Depending on the function of the EUT different paragraphs of FCC §15.231 apply:

Either
(a)(1): A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Or
(a)(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

And
(a)(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

Otherwise
(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation [...].
In addition, [...] 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.

This test is also performed to determine the pulse train of the transmitter and calculate the correction factor for pulse modulated transmitters according to FCC §15.35. This factor is used as a correction factor for the field strength measurements, both for
Spurious radiated emissions and Maximum radiated field strength at fundamental frequency.

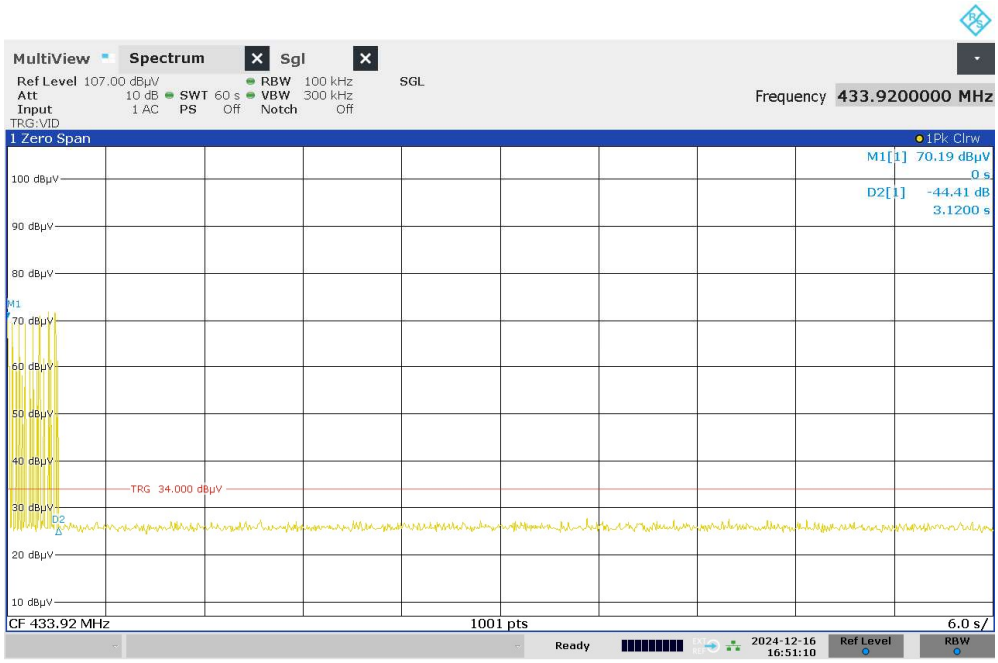
5.2.3 TEST PROTOCOL

Temperature: 23 °C
Air Pressure: 1009 hPa
Humidity: 32 %

OP-Mode 2; Setup S02_B01

Frequency	Time until transmission off	Limit	Verdict
433.92 MHz	3.12 s	5 s	passed

MEASUREMENT PLOTS TRANSMITTER DEACTIVATION



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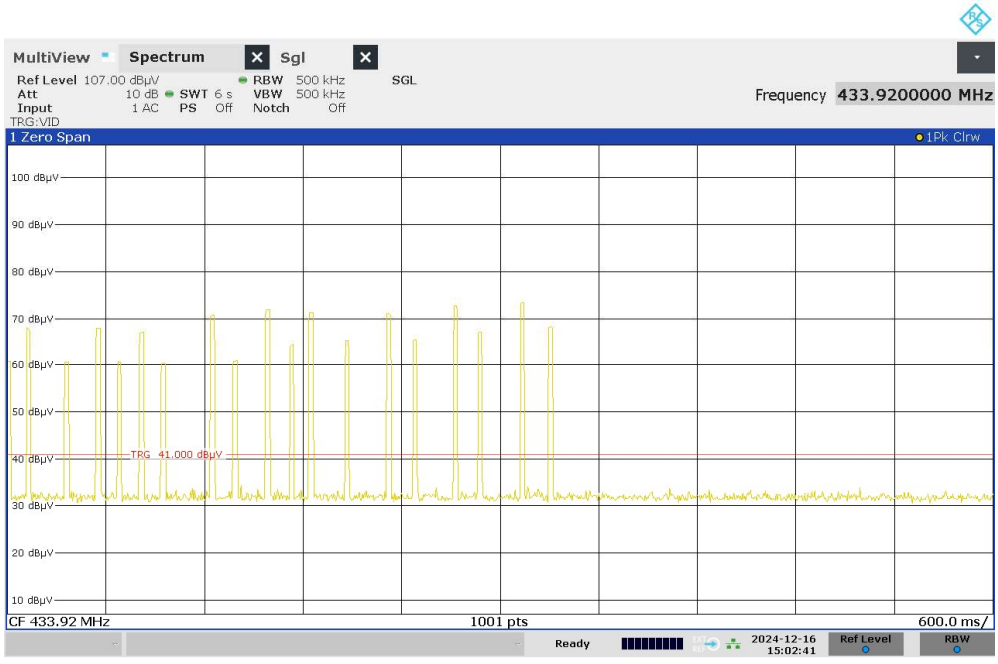

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Temperature: 23 °C
Air Pressure: 1009 hPa
Humidity: 32 %

OP-Mode 2, Setup S02_B01

Frequency	Duty cycle	Correction Factor	
433.92 MHz	0.08	-21.94 dB	

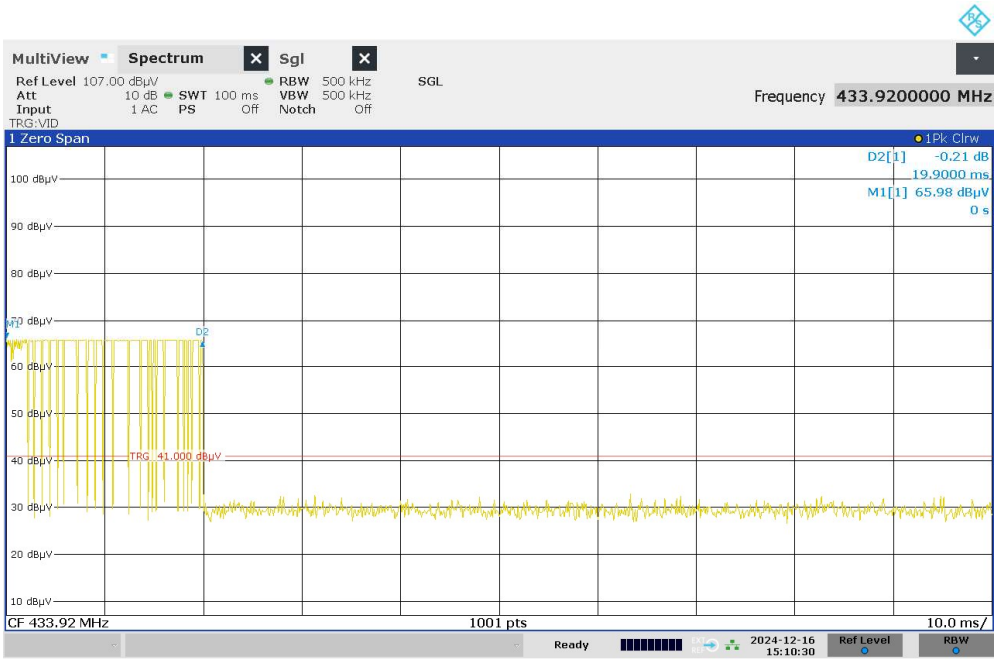
a) Determine the total duration of a transmission within 100 ms:
Duty cycle = ((L1*N1) + (L2*N2) + ... + (Ln*Nn)) / 100 ms or T, whichever is less
Correction factor = 20 * LOG (Duty cycle) [dB]

Calculation of Duty Cycle / Correction Factor:
T > 100 ms => T = 100 ms;
L1 = 0.01 ms; N1 = 60;
L2 = 0.02 ms; N2 = 20;
T_{on} = 8 ms

Duty cycle = 8ms / 100ms = 0.08

CORRECTION FACTOR = 20*log (0.08) ≈ -21.94 dB

MEASUREMENT PLOTS DUTY CYCLE



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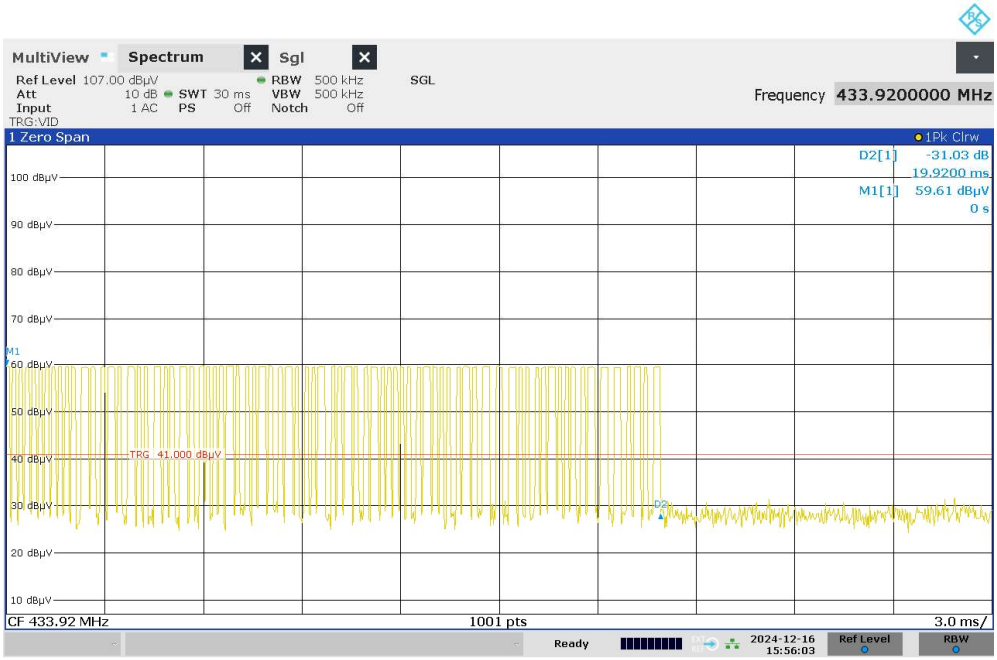
Active time with in 100ms



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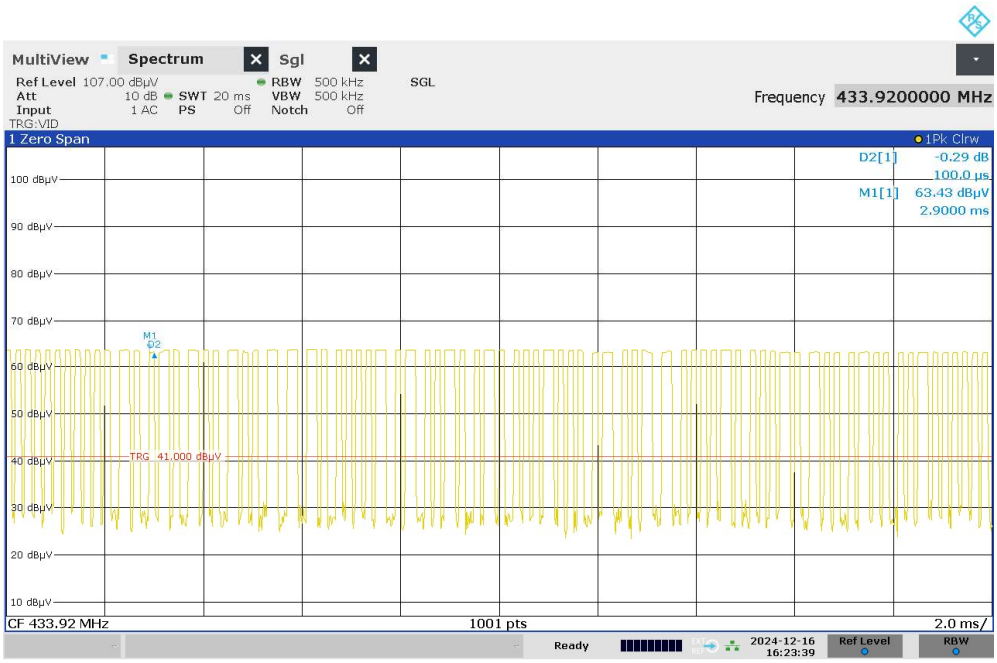
Zoom Plot1



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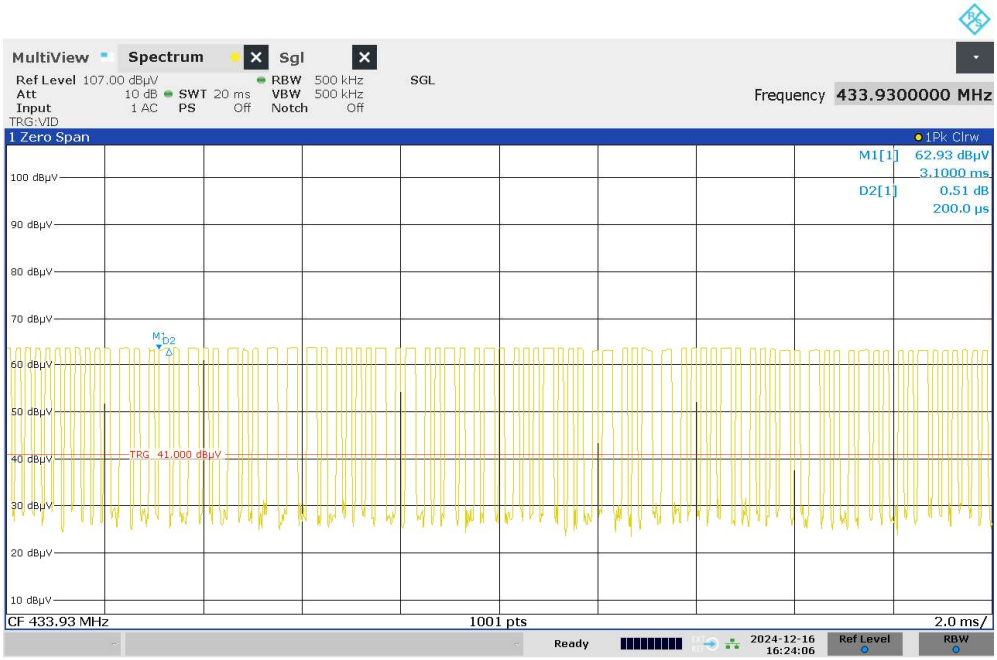
N1 60 Short pulses, L1 duration 100µs



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N2 Long pulses, L2 duration 200µs

5.3 SPURIOUS RADIATED EMISSIONS

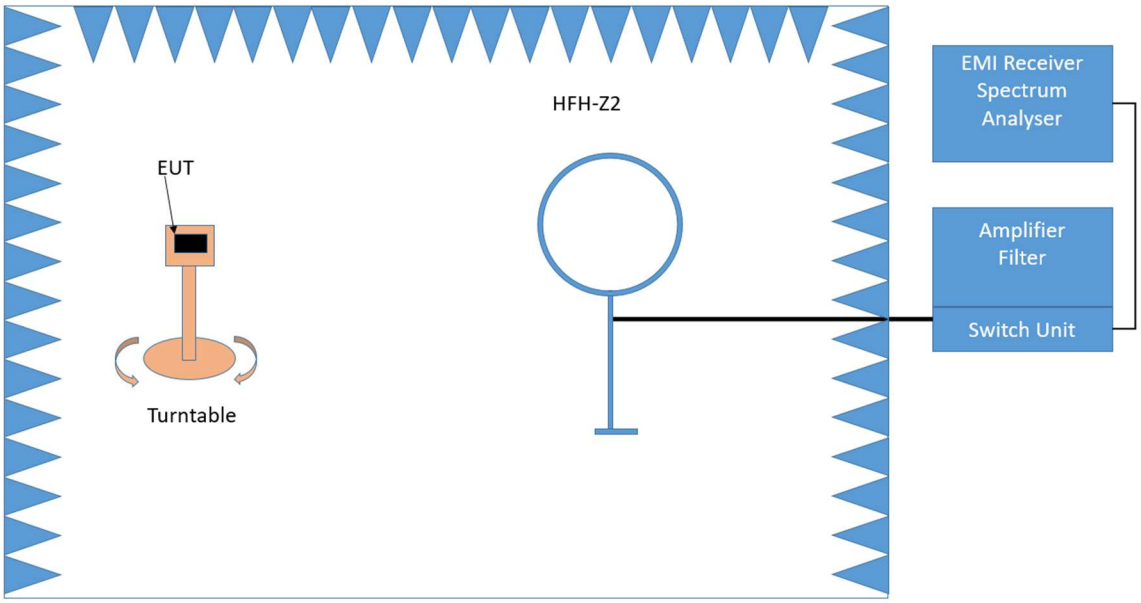
Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.3.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software EMC32 from R&S. (Exploratory) Tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is also performed while the EUT is powered from DC (battery) power in order to find the worst-case operating condition.

1. Measurement up to 30 MHz



Test Setup; Spurious Emission Radiated (SAC), 9 kHz – 30 MHz

The Loop antenna HFH2-Z2 is used.

Step 1: premeasurement
- Anechoic chamber
- Antenna distance: 3 m
- Antenna height: 1 m (lowest part to ground)
- Antenna polarisation: 3 axis
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 MHz and 0.15 – 30 MHz
- Frequency steps: 0.05 kHz and 2.25 kHz

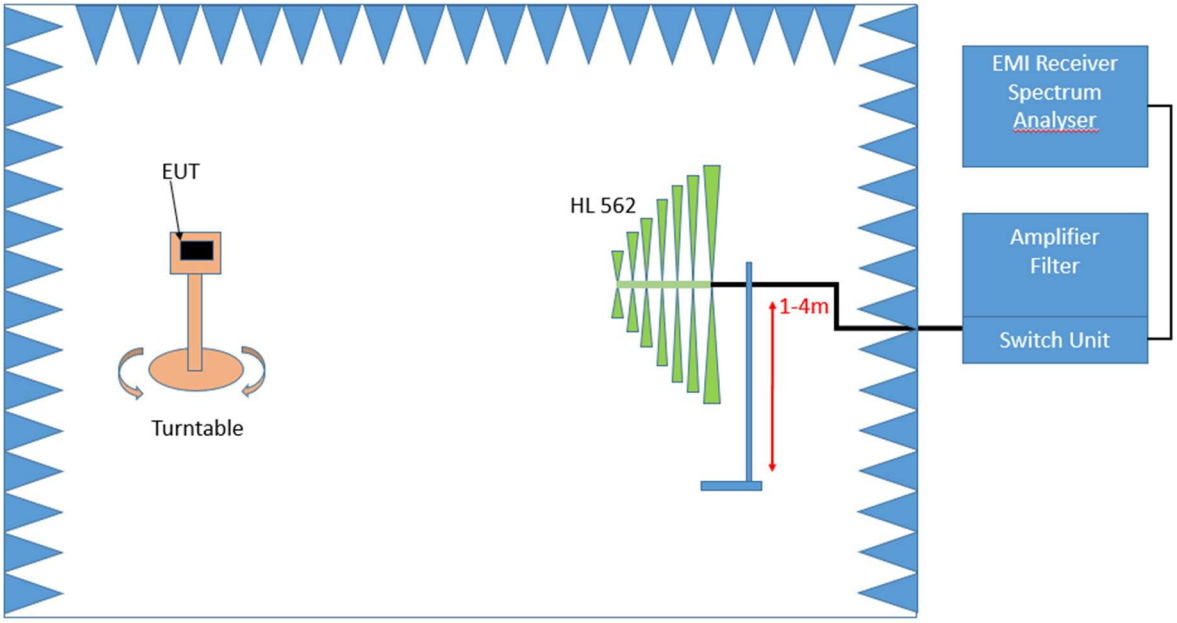
- IF–Bandwidth: 0.2 kHz and 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement will be performed with the following changed settings. Intention of this step is to find the maximum emission level.

- Detector: Quasi-Peak besides 9–90 kHz and 110–490 kHz: Average and Peak
- Measuring time / Frequency step: 1 s

2. Measurement above 30 MHz and up to 1 GHz



Test Setup; Spurious Emission Radiated (SAC), 30 MHz- 1GHz

Step 1: Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 4 m
- Height variation step size: 1.5 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: 360°
- Height variation range: 1 – 4 m
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector
With the settings determined in step 2, the final measurement will be performed:
EMI receiver settings for step 3:

- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement, a plot will be generated. It contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

Above 1 GHz:

The following changes apply to the measurement procedure for the frequency range > 1 GHz:

Step 1:
- Turntable step size: 45°
- Detector: Peak, Average (Maxhold)
- IF – Bandwidth: 1 MHz
- Frequency steps: 250 kHz
- Measuring time: 500 ms / GHz

Step 2:
- IF – Bandwidth: 1 MHz

Step 3:
- Detector: Peak / CISPR Average
- IF – Bandwidth: 1 MHz

After every measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

Floor absorbers are placed between test volume and measurement antenna.

5.3.2 Test Requirements / Limits

1) FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
0.009 – 0.49	2400/F(kHz)@300m	3	(48.5 – 13.8)@300m
0.49 – 1.705	24000/F(kHz)@30m	3	(33.8 – 23.0)@30m
1.705 – 30	30@30m	3	29.5@30m

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according to FCC §15.31 (2).

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 – 88	100@3m	3	40.0@3m
88 – 216	150@3m	3	43.5@3m
216 – 960	200@3m	3	46.0@3m
960 - 26000	500@3m	3	54.0@3m
26000 - 40000	500@3m	1	54.0@3m

§15.35(b)
..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

5.3.3 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.231 (b)
... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Calculate Limit (dBµV/m @10m)	Limit (dBµV/m) @10m
0.009 – 0.49	2400/F (kHz)	300	(48.5 – 13.8) + 59.1 dB	107.6 – 72.9
0.49 – 1.705	24000/F (kHz)	30	(33.8 – 23.0) + 19.1 dB	52.9 – 42.1
1.705 – 30	30	30	29.5 + 19.1 dB	39.5

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
above 960	500	3	54.0

§15.35(b)
..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

§15.35(b) ..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit ...

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

§15.35(c):
[...] 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 [...].

§15.231 (b) emissions table

Fundamental frequency (MHz)	**Field strength of fundamental (microvolts/meter)**	**Field strength of spurious emissions (microvolts/meter)**
40.66-40.70	2,250	225
70-130	1,250	125
130-174	[1]1,250 to 3,750	[1]125 to 375
174-260	3,750	375
260-470	[1]3,750 to 12,500	[1]375 to 1,250
Above 470	12,500	1,250

[1]Linear interpolations.

§15.231(b)(3)
The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator.
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 §15.209, whichever limit permits a higher field strength.

Interpretation of the test laboratory:
The last subordinate clause of §15.231(b)(3) is overruled by §15.205/209, therefore within the restricted bands the limits defined at §15.205/209 and outside the restricted bands the limits defined at §15.231(b) resp. §15.231(e) are applied.

§15.231 (e) emissions table

Fundamental frequency (MHz)	**Field strength of fundamental (microvolts/meter)**	**Field strength of spurious emission (microvolts/meter)**
40.66-40.70	1,000	100
70-130	500	50
130-174	500 to 1,500[1]	50 to 150[1]
174-260	1,500	150
260-470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

[1]Linear interpolations.

5.3.4 TEST PROTOCOL

5.3.4.1 MEASUREMENT UP TO 30 MHz

Temperature: 24 °C
Air Pressure: 1009 hPa
Humidity: 35 %

OP-Mode 1, Antenna 1, Setup S01_A01

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]
-	433.92	-	-	-	-	-	> 6

OP-Mode 1, Antenna 2, Setup S01_A01

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]
-	433.92	-	-	-	-	-	> 6

Remark: In step 1 no spurious emissions in the range 20 below the limit were found, using a peak detector, therefore step 2 (using a QP-detector) was not performed. For this test, the EUT was sending a continuously modulated signal. Please see the measurement plot.

5.3.4.2 MEASUREMENT ABOVE 30 MHz TO 5 GHz

Temperature: 24 °C
Air Pressure: 1009 hPa
Humidity: 35 %

OP-Mode 1, Antenna 1, Setup S01_A01

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]
-	433.92	-	-	-	-	-	> 6

OP-Mode 1, Antenna 2, Setup S01_A01

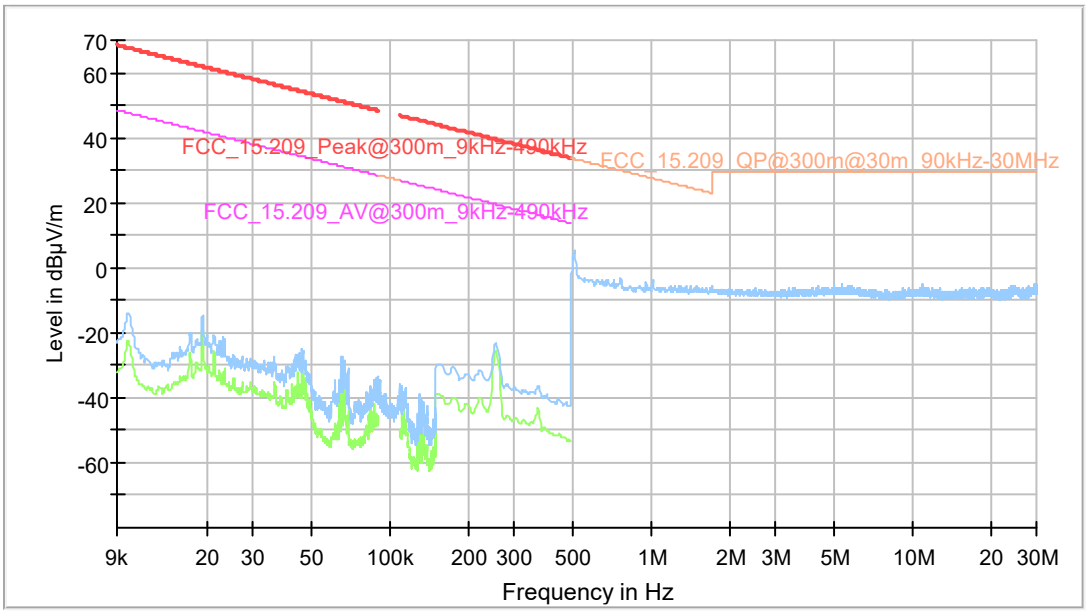
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]
-	433.92	-	-	-	-	-	> 6

Remarks: No other spurious emissions in the range 15 dB below the limit were found.

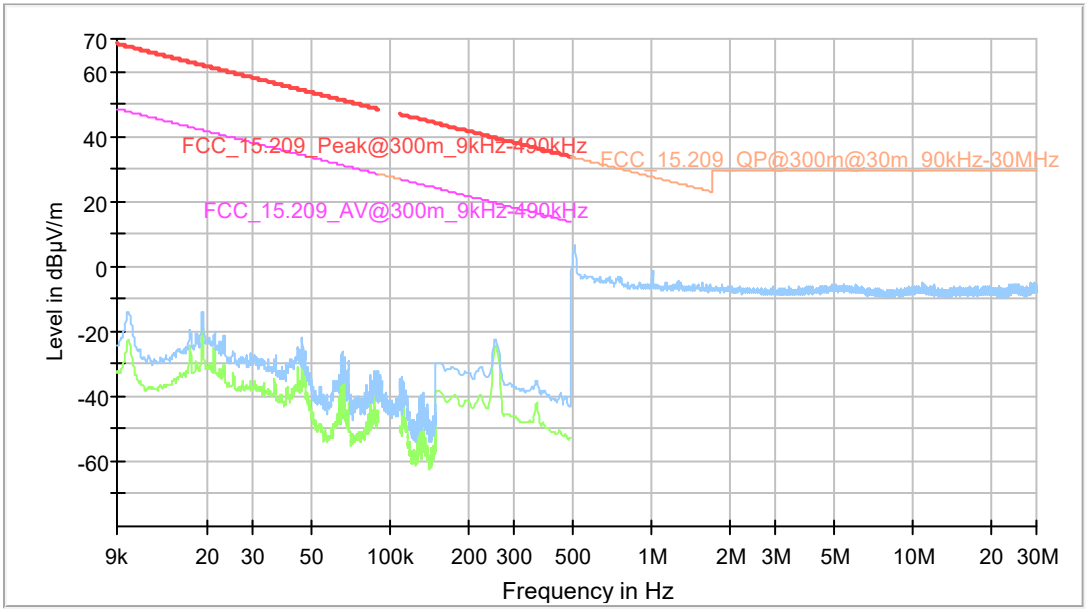
5.3.5 MEASUREMENT PLOTS

5.3.5.1 RADIATED EMISSIONS (f < 30 MHz)

Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15c.209
EUT code / Setup:	DE1208014, Setup S01_A01
Operating Conditions:	OP-Mode 1
Comment:	**Antenna 1**
x-Orientation (indicate h=100)	loop plane vertical, vector in measurement axis directed to EUT
y-Orientation (indicate h=200)	loop plane vertical, vector perpendicular to measurement axis
z-Orientation (indicate h=300)	loop plane horizontal, normal vector directed to ground
Legend:	Trace: blue = Peak; green = AV, Star: = critical frequency; Rhombus: blue = final QP

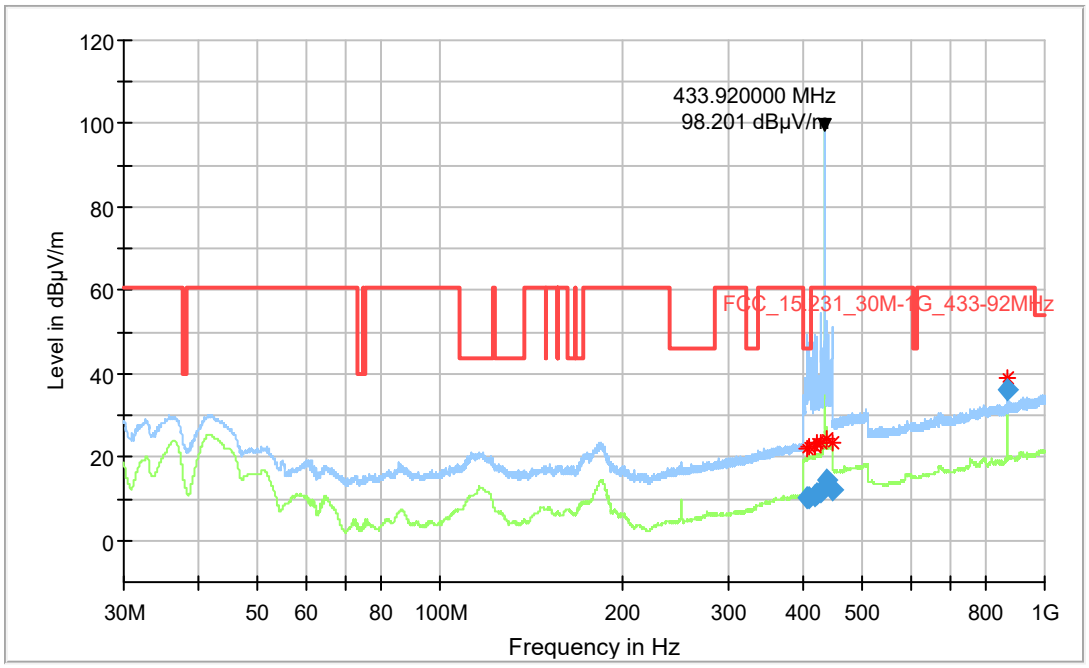


Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15c.209
EUT code / Setup:	DE1208014, Setup S01_A01
Operating Conditions:	OP-Mode 1
Comment:	**Antenna 2**
x-Orientation (indicate h=100)	loop plane vertical, vector in measurement axis directed to EUT
y-Orientation (indicate h=200)	loop plane vertical, vector perpendicular to measurement axis
z-Orientation (indicate h=300)	loop plane horizontal, normal vector directed to ground
Legend:	Trace: blue = Peak; green = AV, Star: = critical frequency; Rhombus: blue = final QP



5.3.5.2 RADIATED EMISSIONS (30 MHz < f < 1 GHz)

Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15c.231
EUT code / Setup:	DE1208014, Setup S01_A01
Operating Conditions:	OP-Mode 1
Comment:	**Antenna 1**
Legend:	Trace (preview): blue = PK, green = QP; Star: red or blue = critical frequency; Rhombus: blue = final QP

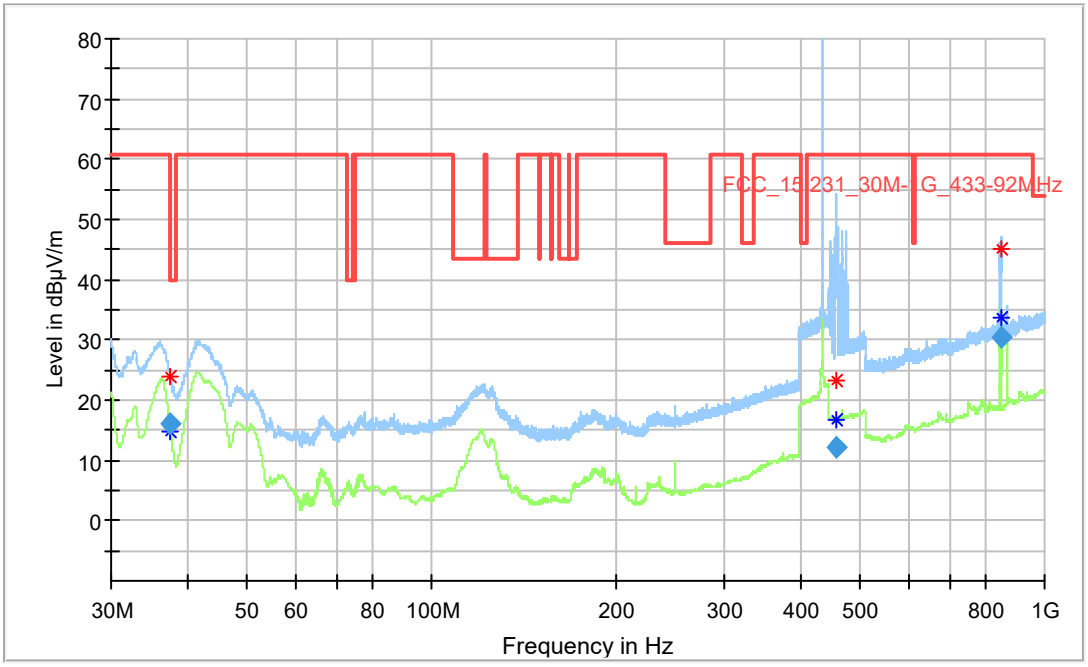


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
405.180000	10.33	---	46.00	35.67	1000.0	120.000	108.0	H	92.0	18.2
408.690000	10.42	---	46.00	35.58	1000.0	120.000	153.0	H	92.0	18.3
415.530000	10.76	---	60.80	50.04	1000.0	120.000	118.0	H	111.0	18.6
419.550000	11.18	---	60.80	49.62	1000.0	120.000	200.0	H	135.0	18.6
426.450000	11.69	---	60.80	49.11	1000.0	120.000	185.0	H	127.0	18.8
437.400000	14.47	---	60.80	46.33	1000.0	120.000	110.0	H	54.0	19.1
444.750000	12.31	---	60.80	48.49	1000.0	120.000	166.0	H	47.0	19.4
867.840000	36.03	---	60.80	24.77	1000.0	120.000	158.0	H	132.0	27.3

Note: The peak value over the limit line is the modulated carrier in the exclusion band. Below is a detailed plot.

Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15c.231
EUT code / Setup:	DE1208014, Setup S01_A01
Operating Conditions:	OP-Mode 1
Comment:	**Antenna 2**
Legend:	Trace (preview): blue = PK, green = QP; Star: red or blue = critical frequency; Rhombus: blue = final QP

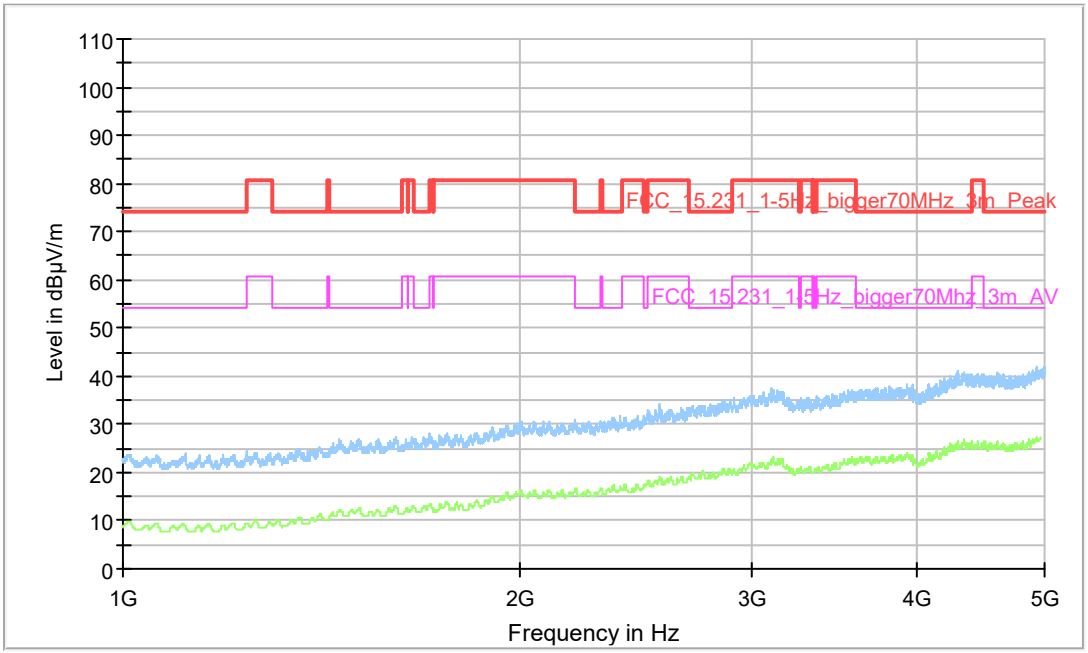


Final_Result

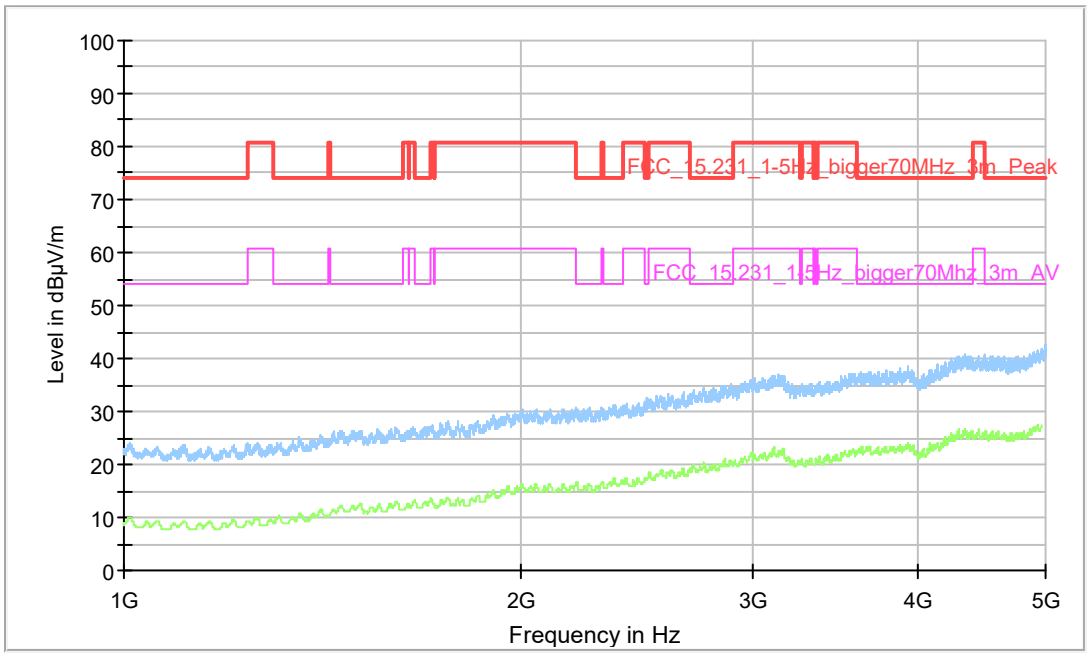
Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.530000	16.25	---	40.00	23.75	1000.0	120.000	106.0	V	-160.0	15.3
455.910000	12.21	---	60.80	48.59	1000.0	120.000	196.0	V	16.0	19.7
847.950000	30.48	---	60.80	30.32	1000.0	120.000	112.0	V	96.0	26.9

5.3.5.3 RADIATED EMISSIONS (1 GHz < f < 5 GHz)

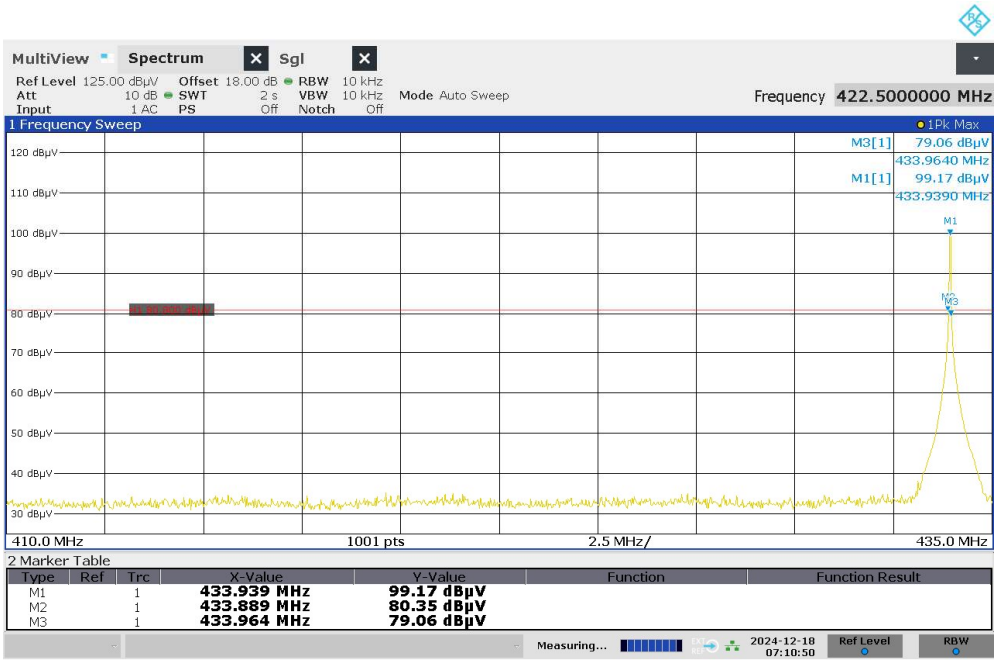
Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15c.231
EUT code / Setup:	DE1208014, Setup S01_A01
Operating Conditions:	OP-Mode 1
Comment:	**Antenna 1**
Legend:	Trace (preview): blue = PK, green = AV; Star: red or blue = critical frequency; Rhombus: blue = final Peak, green = Final CISPR AV



Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15c.231
EUT code / Setup:	DE1208014, Setup S01_A01
Operating Conditions:	OP-Mode 1
Comment:	**Antenna 2**
Legend:	Trace (preview): blue = PK, green = AV; Star: red or blue = critical frequency; Rhombus: blue = final Peak, green = Final CISPR AV



Test Description:	Band Edge compliance measurement
Test Standard:	FCC 15c.231
EUT code / Setup:	DE1208014, Setup S03_C01
Operating Conditions:	OP-Mode 3, Worst case, Antenna 1



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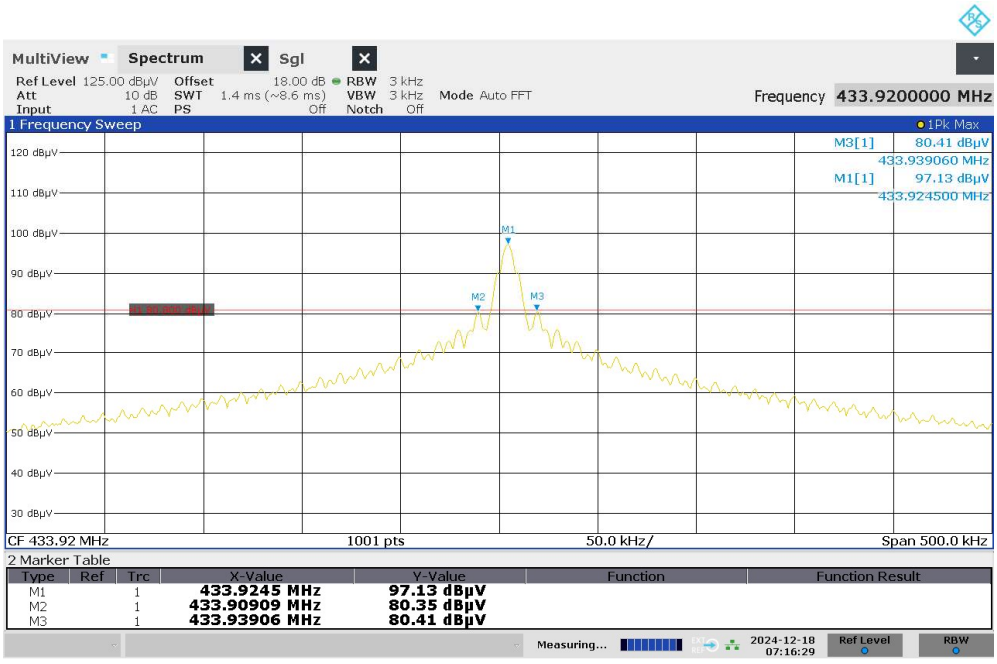

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5.4 MAXIMUM RADIATED FIELD STRENGTH AT FUNDAMENTAL FREQUENCY

Standard FCC Part 15, Subpart C

The test was performed according to:
ANSI C63.10

5.4.1 TEST DESCRIPTION

Please refer to sub-clause 5.2.1

5.4.2 TEST LIMITS

Please refer to sub-clause 5.2.2 FCC 15.231 b) applies.

5.4.3 TEST PROTOCOL

Temperature: 24 °C
Air Pressure: 1009 hPa
Humidity: 38 %

OP-Mode 1, Antenna 1, S01_A01

Frequency [MHz]	Output power [dBµV/m]	Limit [dBµV/m]	Margin to Limit [dB]	Remarks
433.92	77.29	80.83	3.54	Maximum radiated field strength

OP-Mode 1, Antenna 2, S01_A01

Frequency [MHz]	Output power [dBµV/m]	Limit [dBµV/m]	Margin to Limit [dB]	Remarks
433.92	76.98	80.83	3.85	Maximum radiated field strength

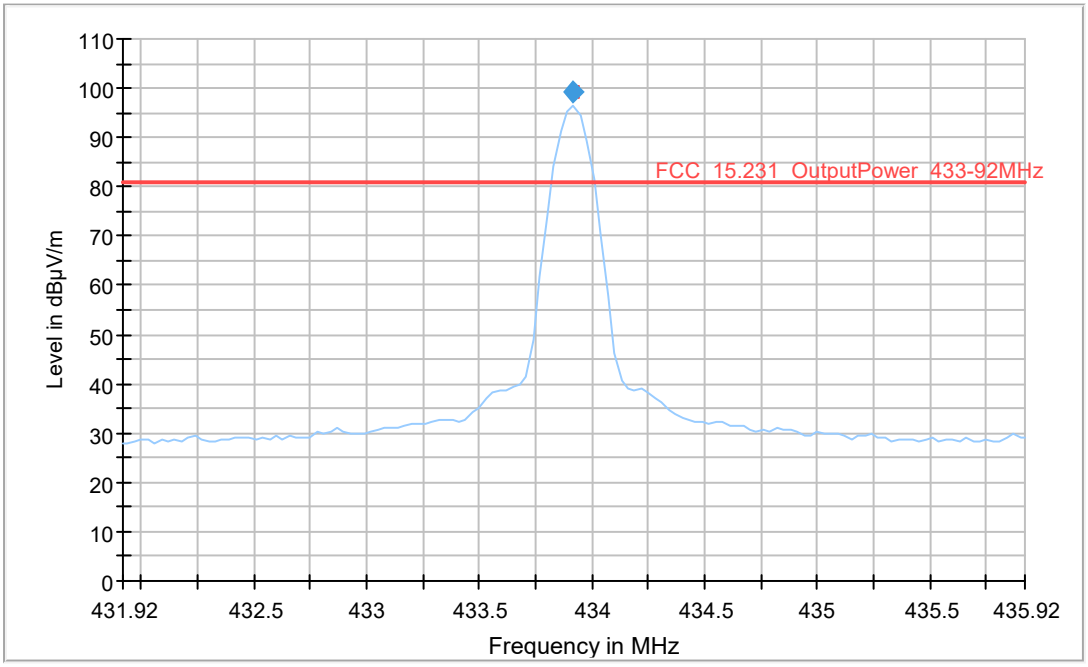
Notes: The values shown in the table above are corrected by using the corresponding Duty Cycle Correction Factors, calculated in chapter 5.2.3. The measured and calculated values can be found in chapter 5.4.4.1.

The EUT transmitted continuously modulated carrier.

5.4.4 MEASUREMENT PLOTS

5.4.4.1 MAXIMUM RADIATED FIELD STRENGTH AT FUNDAMENTAL FREQUENCY

Test Description:	Output Power
Test Standard:	FCC 15c.231
EUT code / Setup:	DE1208014, S01_A01
Operating Conditions:	OP-Mode 1
Comment:	**Antenna 1**
Legend:	Trace (preview): blue = PK, green = QP; Star: red or blue = critical frequency; Rhombus: blue = final QP



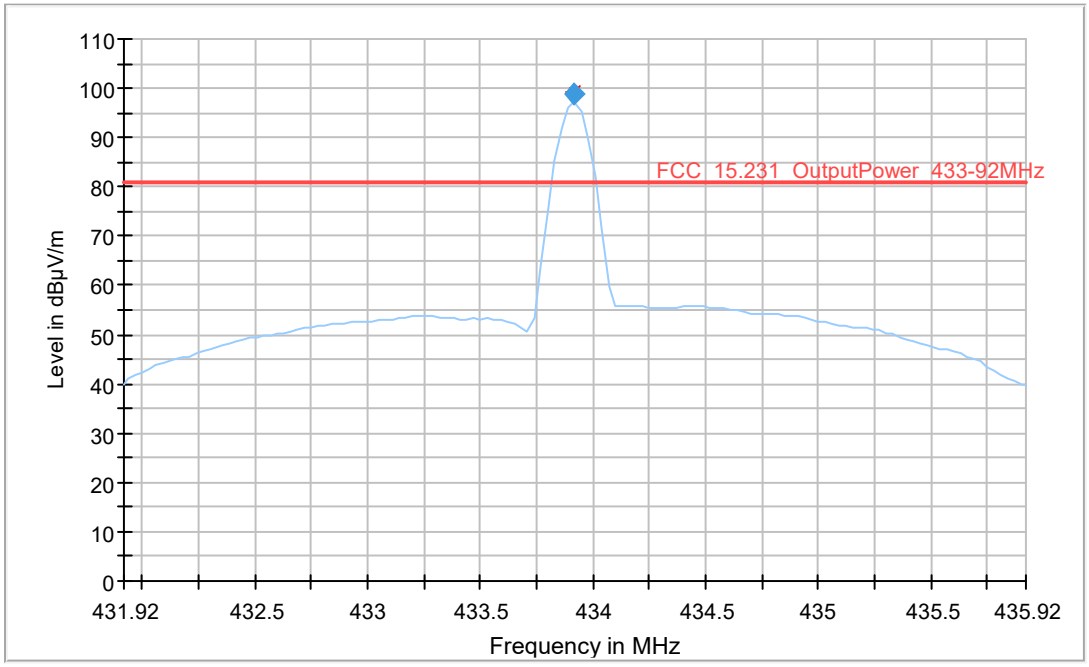
Final Result – without Duty Cycle correction

Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
433.920000	99.23	---	80.83	-18.41	1000.0	120.000	194.0	H	5.0	19.0

Final Result – with Duty Cycle correction

Frequency (MHz)	QuasiPeak (dBµV/m)	DC Corr. (dB)	QuasiPeak (dBµV/m) corrected	Limit (dBµV/m)	Margin (dB)
433.92	99.23	-21.94	77.29	80.83	3.54

Test Description:	Output Power
Test Standard:	FCC 15c.231
EUT code / Setup:	DE1208014, S01_A01
Operating Conditions:	OP-Mode 1
Comment:	**Antenna 2**
Legend:	Trace (preview): blue = PK, green = QP; Star: red or blue = critical frequency; Rhombus: blue = final QP



Final Result – without Duty Cycle correction

Frequency (MHz)	QuasiPeak (dBµV/m)	DET 2 (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
433.920000	98.92	---	80.83	-18.10	1000.0	120.000	125.0	V	-96.0	19.0

Final Result – with Duty Cycle correction

Frequency (MHz)	QuasiPeak (dBµV/m)	DC Corr. (dB)	QuasiPeak (dBµV/m) corrected	Limit (dBµV/m)	Margin (dB)
433.92	98.92	-21.94	76.98	80.83	3.85

5.5 OCCUPIED BANDWIDTH

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.5.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.
For analyzer settings please see the measurement plots.

5.5.2 TEST LIMITS

FCC Part 15, Subpart C, §15.231(c)
The maximum 20 dB bandwidth of a transmitter operating at a frequency range:
70 to 900 MHz is 0.25% of the centre frequency
above 900 MHz is 0.5% of the centre frequency

5.5.3 TEST PROTOCOL

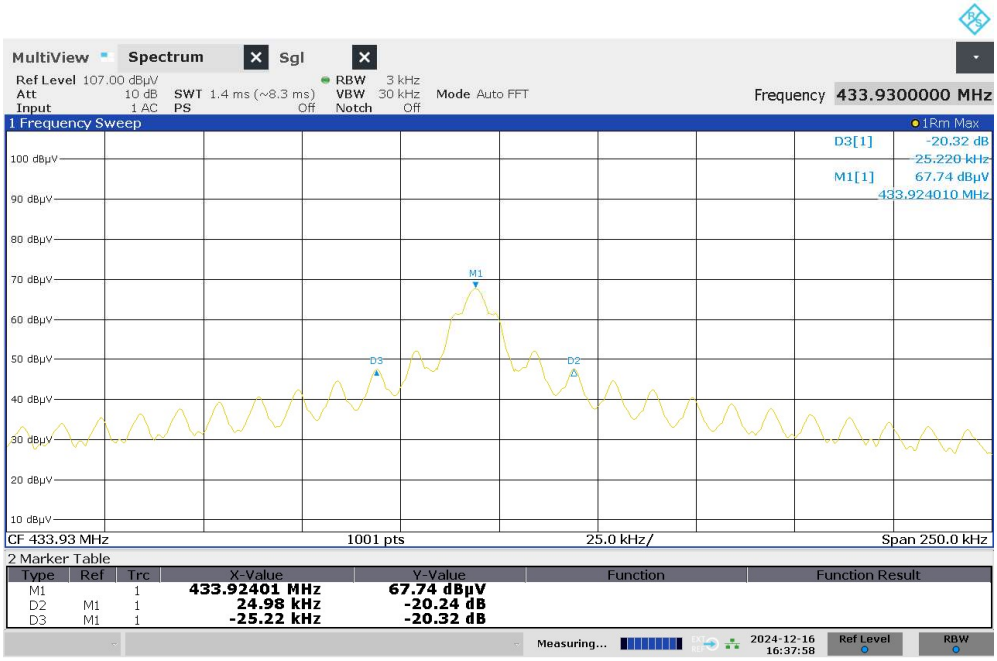
Temperature: 23 °C
Air Pressure: 1009 hPa
Humidity: 42 %

OP-Mode 3, Antenna 1, S03_C01

Cannel Frequency [MHz]	20 dB bandwidth [kHz]	99% bandwidth [kHz]	Limit [kHz]	Remarks
433.92	50.2	87.82	1084.8	Limit calculated as: 433.93 MHz (declared by applicant) * 0.25% = 1084.8 kHz.

Remark: Please see the measurement plots.

5.5.4 MEASUREMENT PLOTS OCCUPIED BANDWIDTH



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20 dB bandwidth

04:42:35 PM 12/16/2024

99% bandwidth

6 TEST EQUIPMENT

6.1 TEST EQUIPMENT HARDWARE

1 Conducted Emissions FCC
Conducted Emissions AC Mains for FCC standards

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
1.2	CMWC	Control PC for the CMX500	Rohde & Schwarz GmbH & Co. KG	103129-gL	N/A	N/A
1.3	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
1.4	ESH3-Z5	Two-Line V-Network (AUX)	Rohde & Schwarz GmbH & Co. KG	828304/029	2023-09	2025-09
1.5	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
1.6	SMBV100B	Vector Signal Generator	Rohde & Schwarz Messgerätebau GmbH	102458	2022-12	2025-12
1.7	Chroma 6404	AC Source	Chroma ATE INC.	64040001304	N/A	N/A
1.8	Shielded Room 02	Shielded Room 4m x 3m	Frankonia Germany EMC Solution GmbH	-	N/A	N/A
1.9	ESH3-Z5	Two-Line V-Network (EUT)	Rohde & Schwarz GmbH & Co. KG	829996/002	2023-09	2025-09
1.10	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2023-01	2025-01
1.11	CMW500	Callbox OIL-RE, SUA-160 MHz	Rohde & Schwarz GmbH & Co. KG	167766-By	2022-05	2025-05
1.12	Opus10 THI (8152.00)	T/H Logger 02	Lufft Mess- und Regeltechnik GmbH	7489	2023-12	2025-12
1.13	SMU200A	Vector Signal Generator	Rohde & Schwarz GmbH & Co. KG	104316		
1.14	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100321	2023-10	2025-10

2 Radiated Emissions SAC above 1 GHz

Radiated emission tests above 1 GHz in a semi anechoic room with floor absorbers

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
2.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
2.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
2.4	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia Germany EMC Solution GmbH	none	N/A	N/A
2.5	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
2.6	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2023-12	2025-12
2.7	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
2.8	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
2.9	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368	N/A	N/A
2.10	MA4985-XP-ET	Bore Sight Antenna Mast	innco systems GmbH	none	N/A	N/A
2.11	BB4312-C30-H3x	Filter Universal 1A	Siemens Matsushita Components	none	N/A	N/A
2.12	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100321	2023-10	2025-10
2.13	HF 907-2	Double-ridged horn	Rohde & Schwarz	102817	2022-07	2025-07

3 Radiated Emissions SAC H-Field

Radiated emission tests in the H-Field in a semi anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
3.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
3.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
3.4	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia Germany EMC Solution GmbH	none	N/A	N/A
3.5	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
3.6	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2023-12	2025-12
3.7	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
3.8	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
3.9	HFH2-Z2	Loop Antenna + 3 Axis Tripod	Rohde & Schwarz GmbH & Co. KG	829324/006	2024-04	2027-04
3.10	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100321	2023-10	2025-10

4 Radiated Emissions SAC up to 1 GHz
Radiated emission tests up to 1 GHz in a semi anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
4.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
4.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
4.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
4.4	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia Germany EMC Solution GmbH	none	N/A	N/A
4.5	HL 562 ULTRALOG	Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003		
4.6	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
4.7	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2023-12	2025-12
4.8	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
4.9	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
4.10	HL562E ULTRALOG	Biconical-log-per Antenna (30 MHz - 6 GHz)	Rohde & Schwarz GmbH & Co. KG	102299	2024-07	2027-07
4.11	Chase CBL6111C + INMET 64671 18N-6dB	Hybrid Antenna with 6dB Attenuator		2624 | Kartei-Nr E-003226/K1026	2023-03	2026-03
4.12	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100321	2023-10	2025-10
4.13	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/11920513	N/A	N/A

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

6.2 TEST EQUIPMENT SOFTWARE

Semi-Anechoic Chamber:		
Software	Version	
EMC32 Measurement Software	10.60.10	
INNCO Mast Controller	1.02.62	
INNCO Mast Height	34.10	
INNCO Mast Elevation	36.11	
MATURO Controller	1.24	
MATURO Mast	12.19	
MATURO Turn-Table	30.10	
Fully-Anechoic Chamber:		
Software	Version	
EMC32 Measurement Software	10.60.10	
MATURO Controller	1.30	
MATURO Turn-Unit	11.10	
MATURO Mast	12.10	
MATURO Turntable	12.11	
INNCO Controller	1.03.02	
INNCO Mast Height	34.10	
INNCO Mast Elevation	36.11	
TS 8997		
WMS32 Measurement Software	11.60.00 (till 2024-03-19), 11.70.00 + Hotfix 01	
Conducted AC Emissions:		
Software	Version	
EMC32 Measurement Software	10.60.20	

7 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

7.1 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
0.009	20.50	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.01	20.45	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.015	20.37	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.02	20.36	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.025	20.38	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.03	20.32	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.05	20.35	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.08	20.30	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.1	20.20	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.2	20.17	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.3	20.14	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.49	20.12	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.490001	20.12	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.5	20.11	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.8	20.10	-39.6	0.1	0.1	0.1	0.1	-40	30	3
1	20.09	-39.6	0.1	0.1	0.1	0.1	-40	30	3
2	20.08	-39.6	0.1	0.1	0.1	0.1	-40	30	3
3	20.06	-39.6	0.1	0.1	0.1	0.1	-40	30	3
4	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
5	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
6	20.02	-39.5	0.2	0.1	0.1	0.1	-40	30	3
8	19.95	-39.5	0.2	0.1	0.1	0.1	-40	30	3
10	19.83	-39.4	0.2	0.1	0.2	0.1	-40	30	3
12	19.71	-39.4	0.2	0.1	0.2	0.1	-40	30	3
14	19.54	-39.4	0.2	0.1	0.2	0.1	-40	30	3
16	19.53	-39.3	0.3	0.1	0.2	0.1	-40	30	3
18	19.50	-39.3	0.3	0.1	0.2	0.1	-40	30	3
20	19.57	-39.3	0.3	0.1	0.2	0.1	-40	30	3
22	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
24	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
26	19.54	-39.3	0.3	0.1	0.2	0.1	-40	30	3
28	19.46	-39.2	0.3	0.1	0.3	0.1	-40	30	3
30	19.73	-39.1	0.4	0.1	0.3	0.1	-40	30	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

7.2 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18.6	0.6	0.29	0.04	0.23	0.02	0.0	3	3
50	6.0	0.9	0.39	0.09	0.32	0.08	0.0	3	3
100	9.7	1.2	0.56	0.14	0.47	0.08	0.0	3	3
150	7.9	1.6	0.73	0.20	0.59	0.12	0.0	3	3
200	7.6	1.9	0.84	0.21	0.70	0.11	0.0	3	3
250	9.5	2.1	0.98	0.24	0.80	0.13	0.0	3	3
300	11.0	2.3	1.04	0.26	0.89	0.15	0.0	3	3
350	12.4	2.6	1.18	0.31	0.96	0.13	0.0	3	3
400	13.6	2.9	1.28	0.35	1.03	0.19	0.0	3	3
450	14.7	3.1	1.39	0.38	1.11	0.22	0.0	3	3
500	15.6	3.2	1.44	0.39	1.20	0.19	0.0	3	3
550	16.3	3.5	1.55	0.46	1.24	0.23	0.0	3	3
600	17.2	3.5	1.59	0.43	1.29	0.23	0.0	3	3
650	18.1	3.6	1.67	0.34	1.35	0.22	0.0	3	3
700	18.5	3.6	1.67	0.42	1.41	0.15	0.0	3	3
750	19.1	4.1	1.87	0.54	1.46	0.25	0.0	3	3
800	19.6	4.1	1.90	0.46	1.51	0.25	0.0	3	3
850	20.1	4.4	1.99	0.60	1.56	0.27	0.0	3	3
900	20.8	4.7	2.14	0.60	1.63	0.29	0.0	3	3
950	21.1	4.8	2.22	0.60	1.66	0.33	0.0	3	3
1000	21.6	4.9	2.23	0.61	1.71	0.30	0.0	3	3

(d_{Limit} = 10 m)

30	18.6	-9.9	0.29	0.04	0.23	0.02	-10.5	10	3
50	6.0	-9.6	0.39	0.09	0.32	0.08	-10.5	10	3
100	9.7	-9.2	0.56	0.14	0.47	0.08	-10.5	10	3
150	7.9	-8.8	0.73	0.20	0.59	0.12	-10.5	10	3
200	7.6	-8.6	0.84	0.21	0.70	0.11	-10.5	10	3
250	9.5	-8.3	0.98	0.24	0.80	0.13	-10.5	10	3
300	11.0	-8.1	1.04	0.26	0.89	0.15	-10.5	10	3
350	12.4	-7.9	1.18	0.31	0.96	0.13	-10.5	10	3
400	13.6	-7.6	1.28	0.35	1.03	0.19	-10.5	10	3
450	14.7	-7.4	1.39	0.38	1.11	0.22	-10.5	10	3
500	15.6	-7.2	1.44	0.39	1.20	0.19	-10.5	10	3
550	16.3	-7.0	1.55	0.46	1.24	0.23	-10.5	10	3
600	17.2	-6.9	1.59	0.43	1.29	0.23	-10.5	10	3
650	18.1	-6.9	1.67	0.34	1.35	0.22	-10.5	10	3
700	18.5	-6.8	1.67	0.42	1.41	0.15	-10.5	10	3
750	19.1	-6.3	1.87	0.54	1.46	0.25	-10.5	10	3
800	19.6	-6.3	1.90	0.46	1.51	0.25	-10.5	10	3
850	20.1	-6.0	1.99	0.60	1.56	0.27	-10.5	10	3
900	20.8	-5.8	2.14	0.60	1.63	0.29	-10.5	10	3
950	21.1	-5.6	2.22	0.60	1.66	0.33	-10.5	10	3
1000	21.6	-5.6	2.23	0.61	1.71	0.30	-10.5	10	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.3 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit, atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24.4	-19.4	0.99	0.31	-21.51	0.79		
2000	28.5	-17.4	1.44	0.44	-20.63	1.38		
3000	31.0	-16.1	1.87	0.53	-19.85	1.33		
4000	33.1	-14.7	2.41	0.67	-19.13	1.31		
5000	34.4	-13.7	2.78	0.86	-18.71	1.40		
6000	34.7	-12.7	2.74	0.90	-17.83	1.47		
7000	35.6	-11.0	2.82	0.86	-16.19	1.46		

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit, atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31.0	-23.4	0.47	1.87	0.53	-27.58	1.33	
4000	33.1	-23.3	0.56	2.41	0.67	-28.23	1.31	
5000	34.4	-21.7	0.61	2.78	0.86	-27.35	1.40	
6000	34.7	-21.2	0.58	2.74	0.90	-26.89	1.47	
7000	35.6	-19.8	0.66	2.82	0.86	-25.58	1.46	

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35.6	-57.3	0.56	1.28	-62.72	2.66	0.94	1.46
8000	36.3	-56.3	0.69	0.71	-61.49	2.84	1.00	1.53
9000	37.1	-55.3	0.68	0.65	-60.80	3.06	1.09	1.60
10000	37.5	-56.2	0.70	0.54	-61.91	3.28	1.20	1.67
11000	37.5	-55.3	0.80	0.61	-61.40	3.43	1.27	1.70
12000	37.6	-53.7	0.84	0.42	-59.70	3.53	1.26	1.73
13000	38.2	-53.5	0.83	0.44	-59.81	3.75	1.32	1.83
14000	39.9	-56.3	0.91	0.53	-63.03	3.91	1.40	1.77
15000	40.9	-54.1	0.98	0.54	-61.05	4.02	1.44	1.83
16000	41.3	-54.1	1.23	0.49	-61.51	4.17	1.51	1.85
17000	42.8	-54.4	1.36	0.76	-62.36	4.34	1.53	2.00
18000	44.2	-54.7	1.70	0.53	-62.88	4.41	1.55	1.91

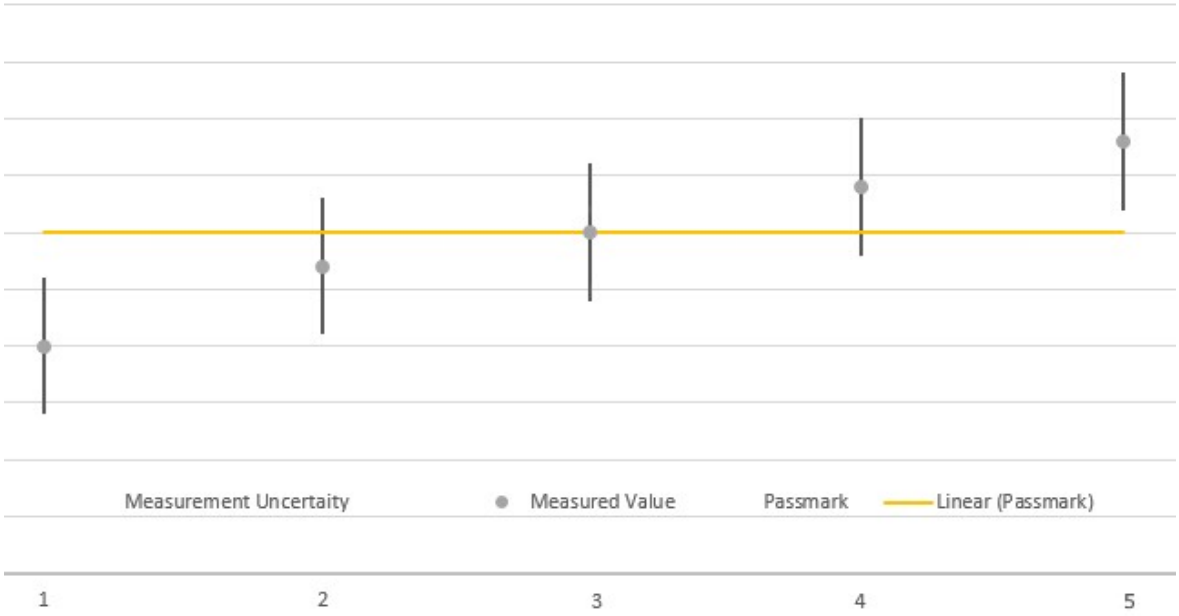
Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

8 MEASUREMENT UNCERTAINTIES

Test Case(s)	Parameter	Uncertainty
- Field strength of spurious radiation	Field Strength	± 5.5 dB
- Emission and Occupied Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
- RF Output Power - Peak to Average Ratio	Power	± 2.2 dB
- Band Edge Compliance - Spurious Emissions at Antenna Terminal	Power Frequency	± 2.2 dB ± 11.2 kHz
- Frequency Stability	Frequency	± 25 Hz

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) k = 1.96. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	on pass mark	within pass mark	Passed
4	above pass mark	within pass mark	Failed
5	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so-called shared risk principle.

9 PHOTO REPORT

Please see separate photo report.

**********END OF TEST REPORT**********