FCC Measurement/Technical Report on

BCP-01
Vehicle Basic Central Platform

FCC ID: 2AA98-BCP01
IC: 11505A-BCP01

Test Report Reference: MDE_VIS_1908_FCC_01

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche Akkreditierungsstelle
D-PL-12140-01-01
D-PL-12140-01-02
D-PL-12140-01-03

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1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization
Certification for an Intentional Radiator.

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 (10-1-17 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

1.2 FCC-IC CORRELATION TABLE

Correlation of measurement requirements for FCC and IC for general radio equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 5: 8.8
Transmitter spurious radiated emissions	§ 15.209 (a)	RSS-Gen Issue 5: 6.13/8.9/8.10; RSS-210 Issue 10: 4.3/4.4
Restricted Bands	§ 15.205	RSS-Gen Issue 5: 8.10; RSS-210 Issue 10: 4.1;
Wanted Emission (Carrier)	§ 15.209	RSS-210 Issue 10: 4.4 RSS-Gen Issue 5: 6.12, 8.9
Other requirements, e.g. Transmitter frequency stability	–	RSS- Gen, Issue 5: 6.11/8.11
Receiver spurious emissions	–	RSS Gen Issue 5: 5/7
Occupied bandwidth	§2.1049	RSS Gen Issue 5: 6.7

Note: This EUT is subject to RSS-210, 4.4

1.3 MEASUREMENT SUMMARY

47 CFR CHAPTER I FCC PART 15 Subpart C §15.209 **§ 2.1049**

Occupied Bandwidth (99%)
The measurement was performed according to ANSI C63.10 **Final Result**

OP-Mode Radio Technology, Operating Mode	Setup	Date	FCC	IC
RF ID 125 kHz, Operating Mode 1 Remark: Ant 7 used	S01_KL_TX-All	2020-12-10	Passed	Passed
RF ID 125 kHz, Operating Mode 2 Remark: Ant Immo used	S02_IMMO	2020-12-10	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.209 **§ 15.209**

Wanted Emissions (Carrier)

The measurement was performed according to ANSI C63.10 **Final Result**

OP-Mode Radio Technology, Operating Mode	Setup	Date	FCC	IC
RF ID 125 kHz, Operating Mode 1 Remark: Unmodulated carrier used	S01_KL_TX-All	2020-12-08	Passed	Passed
RF ID 125 kHz, Operating Mode 2 Remark: Unmodulated carrier used	S02_IMMO	2020-12-08	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.209 **§ 15.209**

Spurious Emissions Radiated
The measurement was performed according to ANSI C63.10 **Final Result**

OP-Mode Radio Technology, Operating Mode, Measurement range	Setup	Date	FCC	IC
RF ID 125 kHz, Operating Mode 1, 30 MHz - 1 GHz Remark: None	S01_KL_TX-All	2020-12-08	Passed	Passed
RF ID 125 kHz, Operating Mode 1, 9 kHz - 30 MHz Remark: None	S01_KL_TX-All	2020-12-08	Passed	Passed
RF ID 125 kHz, Operating Mode 2, 30 MHz - 1 GHz Remark: None	S02_IMMO	2020-12-08	Passed	Passed
RF ID 125 kHz, Operating Mode 2, 9 kHz - 30 MHz Remark: None	S02_IMMO	2020-12-08	Passed	Passed

N/A: Not applicable
N/P: Not performed

2 REVISION HISTORY / SIGNATURES

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2021-02-03	--	valid
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COMMENT: -

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

(responsible for testing and report)
Dipl.-Ing. Dobrin Dobrinov

7layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

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-12140-01-01| -02 | -03
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:	2020-06-15

3.2 PROJECT DATA

Responsible for testing and report:	Dipl.-Ing. Dobrin Dobrinov
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2021-02-03
Testing Period:	2020-12-08 to 2020-12-10

3.3 APPLICANT DATA

Company Name:	Visteon Electronics Germany GmbH
Address:	Visteonstrasse 4-10 50170 Kerpen Germany
Contact Person:	Mr. Murat Guengoer

3.4 MANUFACTURER DATA

Please see Applicant Data

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	125 kHz Transmitterand Tagging System
Product name	Vehicle Basic Central Platform
Type	BCP-01
Declared EUT data by the supplier	
Power Supply Type	DC Car Battery
Nominal Voltage / Frequency	13.5 V
Test Voltage / Frequency	13.5 V
Highest internal frequency	100MHz
General Description	Electronic Control Unit (ECU) featured Immobilizer and Gateway, Base Central Controller
Ports	DC Connector, Ethernet connector, CAN, Enclosure,
Special software used for testing	Special test software based on serial software
Operating mode 1	Transmitter is on, working on Keyless mode
Operating mode 2	Transmitter is on, working on Immobilizer mode

4.2 EUT MAIN COMPONENTS

Sample Name	**Sample Code**	**Description**
EUT A	DE1105008ab01	Base Central Platform
Sample Parameter	**Value**	
Serial No.	258115-10	
HW Version	013.000.000	
SW Version	010.031.061	
Comment	-	

NOTE:The short description is used to simplify the identification of the EUT in this test report.

4.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Device	**Details (Manufacturer, Type Model, HW, SW, S/N)**	**Description**
ANC1-8	SUMIDA CA antenna 415 [µH], M01-080420 1504, 4A0AEB1, Serial Numbers: 2498, 2393, 2385, 2277, 1732, 1341, 1648	Antennas 1 to 8 CA Antennas (keyless)
ANC9	SUMIDA Ignition Start coil, S/N: 61 31 6 995 617	Immobiliser Antenna

4.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

Description	Details (Manufacturer, Type, S/N, HW, SW)	Reason for using
Identifier	BMW 5A1C6B9 Marquardt, S/N: 2120000003302036, HW: HW I370 B Sample, SW: SW 201325 – I370	KeyFOB
FBD	Continental, A2C96549607 220620, S/N: 00504	433 MHz Receiver

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	**Combination of EUTs**	**Description and Rationale**
S02_IMMO	EUT + ANC9+ FBD,	Immobilizer mode
S01_KL_TX-All	EUT + ANC1-8 + Identifier	Keyless TX mode

4.6 OPERATING MODES / TEST CHANNELS

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

4.7 PRODUCT LABELLING

4.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

4.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

5 TEST RESULTS

5.1 OCCUPIED BANDWIDTH (99%)

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.1.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up to perform the occupied bandwidth measurements.
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:

- Resolution Bandwidth (RBW): 200 Hz
- Video Bandwidth (VBW): 2 kHz
- Span: 2 kHz
- Trace: Maxhold
- Sweeps: 2000
- Sweeptime: 9.4 ms
- Detector: RMS

The 99 % measurement function of the spectrum analyser function was used to determine the 99 % bandwidth.

5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.209 does not contain any requirement related to the bandwidt.

5.1.3 TEST PROTOCOL

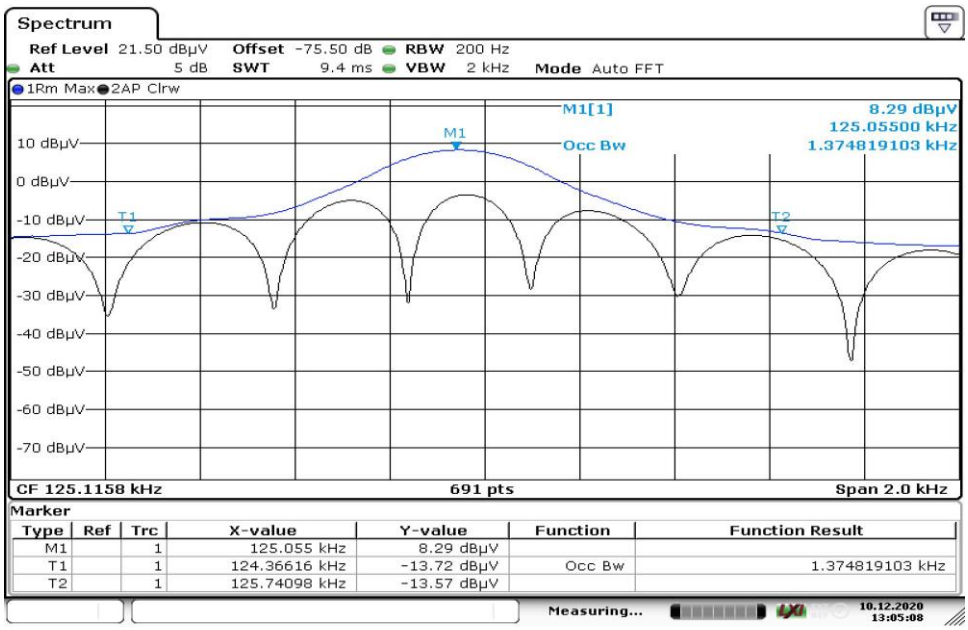
Ambient temperature: 23 °C
Air Pressure: 1006 hPa
Humidity: 42 %
RF ID 125 kHz

Band	Operating Mode	Frequency [kHz]	99 % Bandwidth [kHz]
125 kHz	Mode 1	125.00	1374.819
125 kHz	Mode 2	125.00	425.470

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

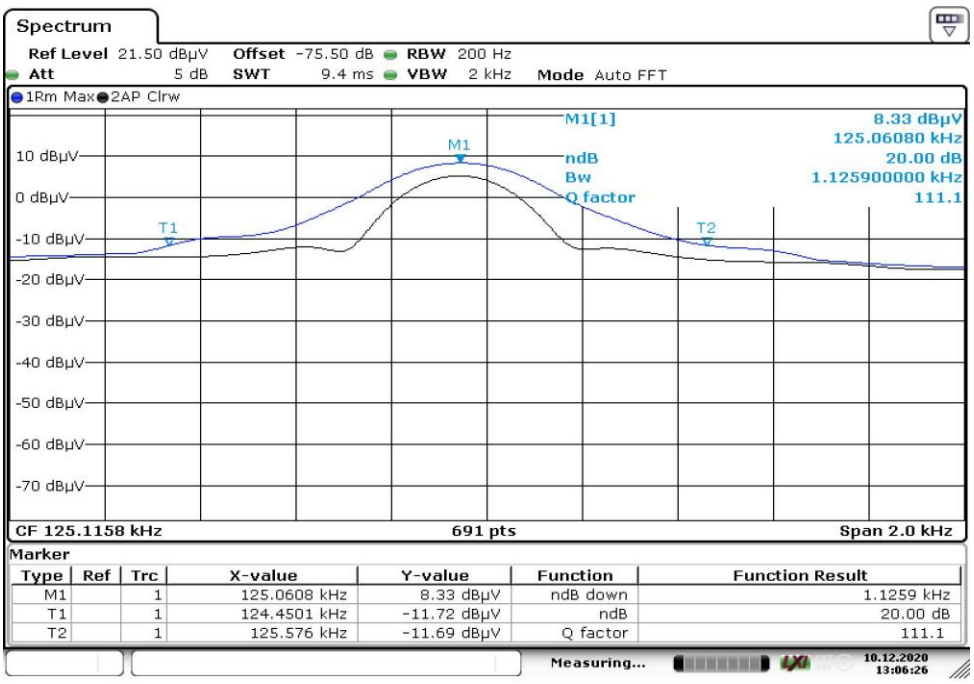
5.1.4 MEASUREMENT PLOTS

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 1 (S01_KL_TX-All) 99 % OccBW



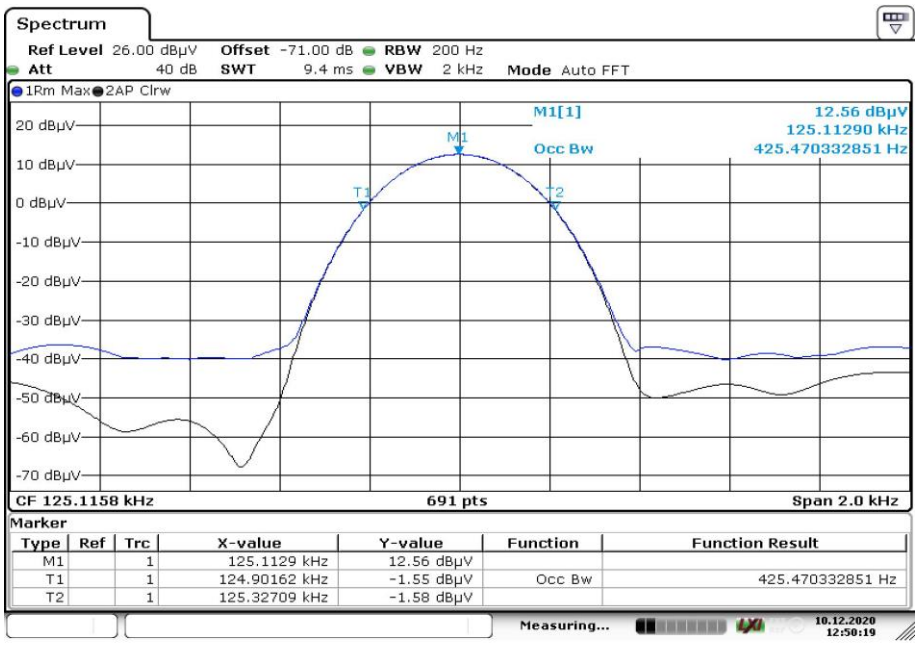
Date: 10.DEC.2020 13:05:09

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 1 (S01_KL_TX-All) 20 dB OccBW



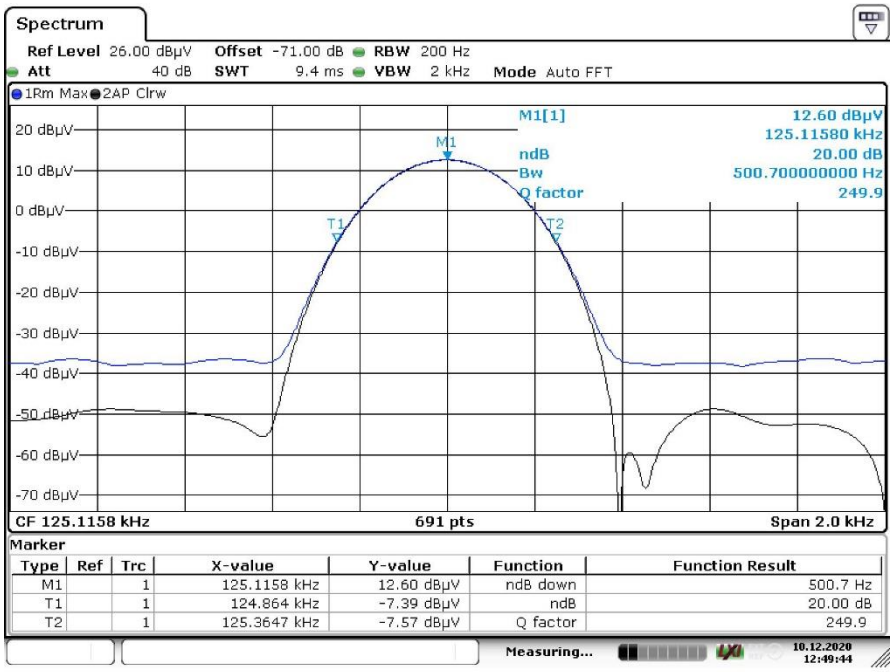
Date: 10.DEC.2020 13:06:26

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 2 (S02_IMMO) 99 % OccBW



Date: 10.DEC.2020 12:50:19

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 2 (S02_IMMO) 20 dB OccBW



Date: 10.DEC.2020 12:49:45

5.1.5 TEST EQUIPMENT USED

- R&S TS8997

5.2 WANTED EMISSIONS (CARRIER)

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.2.1 TEST DESCRIPTION

Please see test description for the test case "Spurious Radiated Emissions", abstract 1.

5.2.2 TEST REQUIREMENTS / LIMITS

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

The fundamental emission of the EUT must be outside the restricted bands of operation as defined in §15.205.

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (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 FCC 15.31 (2).

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (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

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

§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)

5.2.3 TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1006 hPa
Humidity: 42 %
RF ID 125 kHz

Band	Operating Mode	Frequency [MHz]	Output Power [dBµV/m]	Limit [dBµV/m]	Margin to Limit [dB]
125 kHz	Mode 1	125.00	8.2	46.2	38.0
125 kHz	Mode 2	125.00	12.8	46.2	33.4

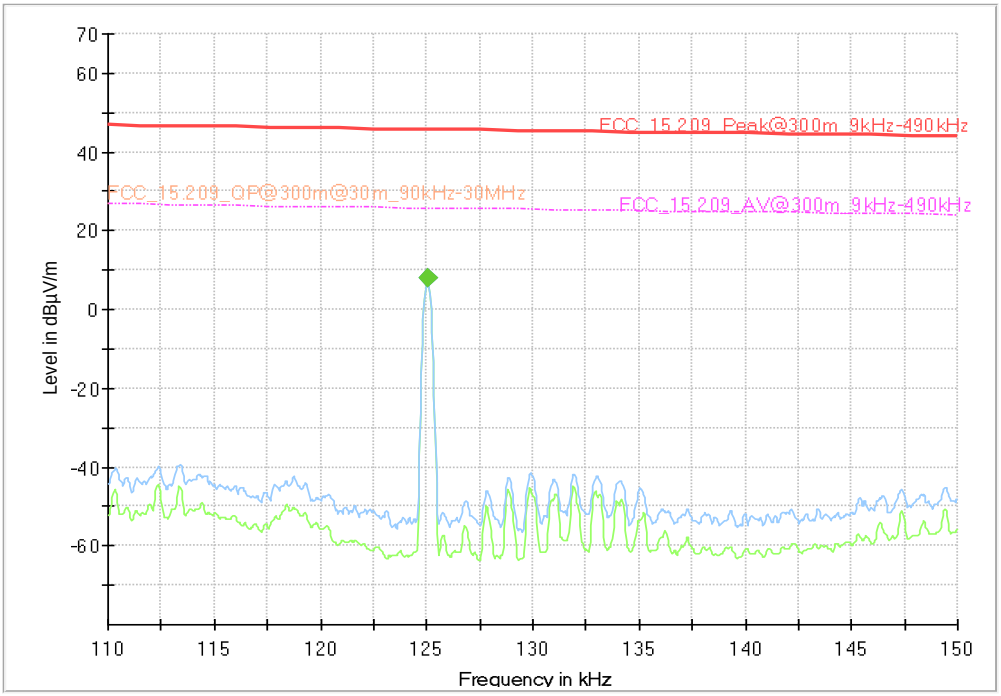
Remark: Please see next sub-clause for the measurement plot.

5.2.4 MEASUREMENT PLOTS

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 1 (S01_KL_TX-All)

Common Information

Test Description: Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard: FCC 15c.209
EUT / Setup Code: DE1105008ad01
Operating Conditions: 13.5 V DC, keyless (125kHz, constant carrier unmodulated, antenna 7)
Operator Name: MER/DOB
Comment: EUT vertical
Legend: Trace: blue = Peak; green = AV, Star: = critical frequency; Rhombus: blue = final QP



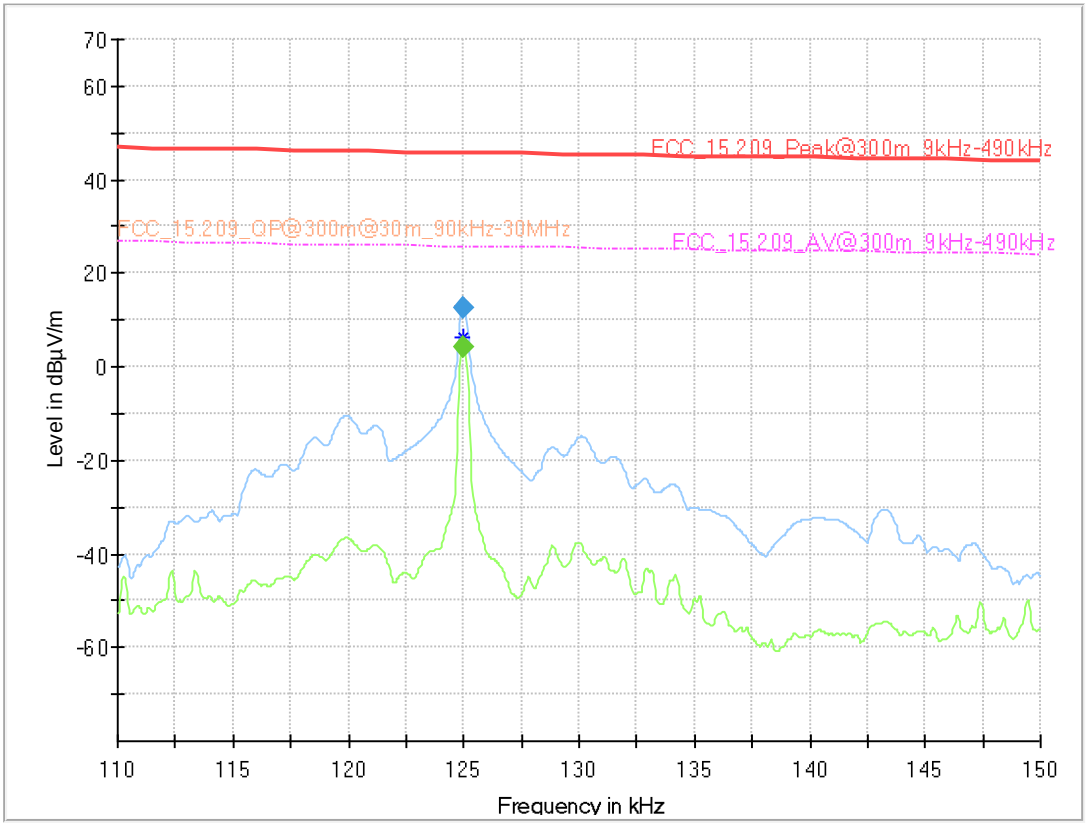
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Azimuth (deg)	Corr. (dB/m)
0.125050	---	25.68	17.54	1000.0	0.200	300.0	103.0	-59.6
0.125050	8.17	45.68	37.52	1000.0	0.200	300.0	103.0	-59.6

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 2 (S02_IMMO)

Common Information

Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15.209
EUT / Setup Code:	DE1105008ab01
Operating Conditions:	13.5 V DC, immobilizer (125kHz without key-fob, 700ms period)
Operator Name:	MER/DOB
Comment:	EUT vertical, modulated
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



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Azimuth (deg)	Corr. (dB/m)
0.125000	---	25.69	21.57	1000.0	0.200	200.0	-134.0	-59.6
0.125000	12.78	45.69	32.91	1000.0	0.200	200.0	-134.0	-59.6

5.2.5 TEST EQUIPMENT USED

- Radiated Emissions

5.3 SPURIOUS EMISSIONS RADIATED

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 measurements were performed according the following sub-chapters of ANSI C63.10:

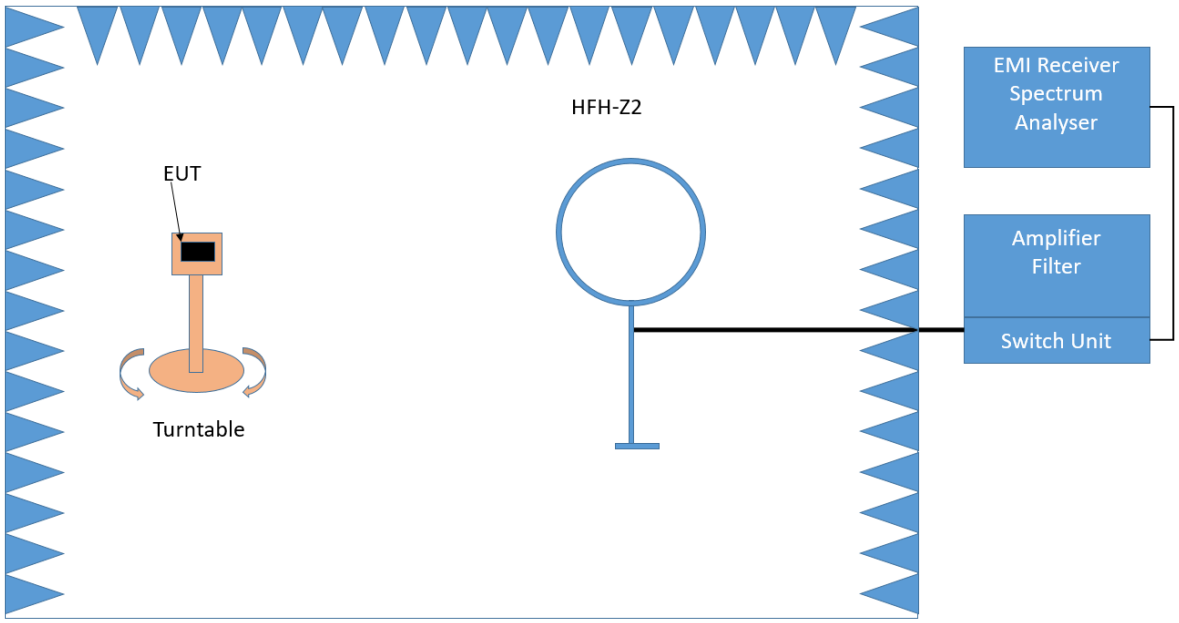
- < 30 MHz: Chapter 6.4
- 30 MHz – 1 GHz: Chapter 6.5
- > 1 GHZ: Chapter 6.6 (procedure according 6.6.5 used)

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 also performed at 3 axes. A pre-check is performed while the EUT is powered.

Below 1 GHz:

The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

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: pre measurement

- Anechoic chamber
- Antenna distance: 3 m
- Antenna height: 1 m
- 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)

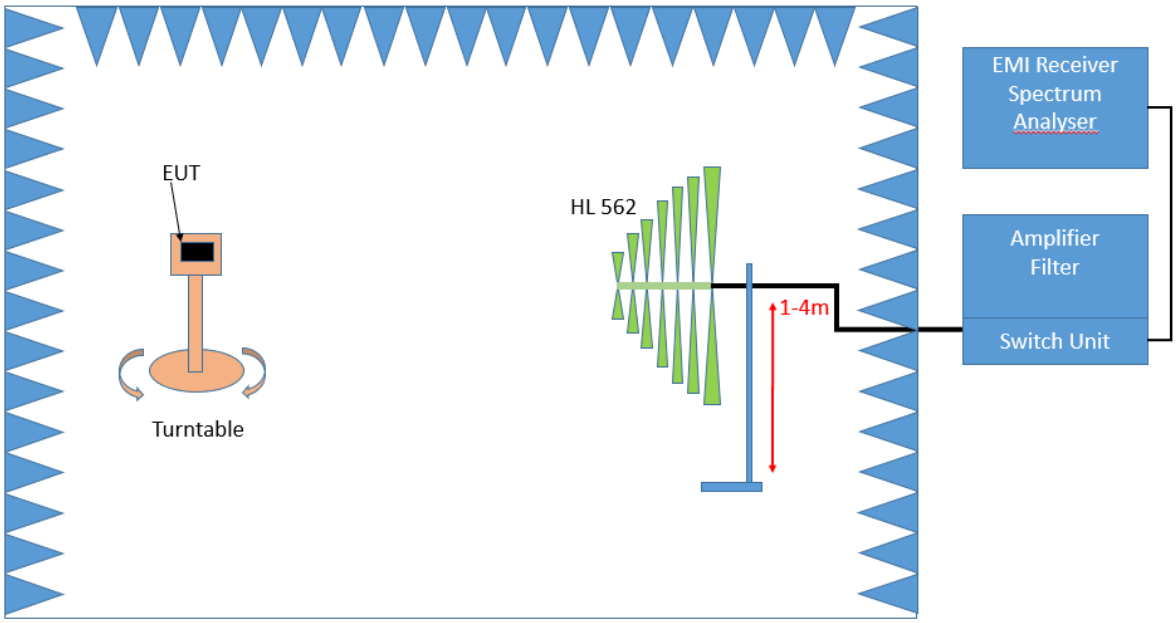
Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement

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

- Detector: Quasi-Peak (9 kHz – 150 kHz, Peak / Average 150 kHz- 30 MHz)
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 0.2 - 10 kHz
- 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 by 360°. 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 between 1 – 4 meter. 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 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.

5.3.2 TEST REQUIREMENTS / LIMITS

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

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (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 FCC 15.31 (2).

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (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

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

§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 PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1006 hPa
Humidity: 42 %
RF ID 125 kHz

Ch. Center Freq. [kHz]	**Operating Mode**	**Spurious Freq. [MHz]**	**Spurious Level [dBµV/m]**	**Detec-tor**	**RBW [kHz]**	**Limit [dBµV/m]**	**Margin to Limit [dB]**
125	Mode 1	249.990	39.2	QP	120	46.0	6.8
125	Mode 1	331.890	32.9	QP	120	46.0	13.1
125	Mode 1	624.960	36.1	QP	120	46.0	9.9
125	Mode 1	874.920	35.3	QP	120	46.0	10.7
125	Mode 2	249.990	39.2	QP	120	46.0	6.8
125	Mode 2	331.890	32.9	QP	120	46.0	13.1
125	Mode 2	624.960	36.1	QP	120	46.0	9.9
125	Mode 2	874.920	35.3	QP	120	46.0	10.7

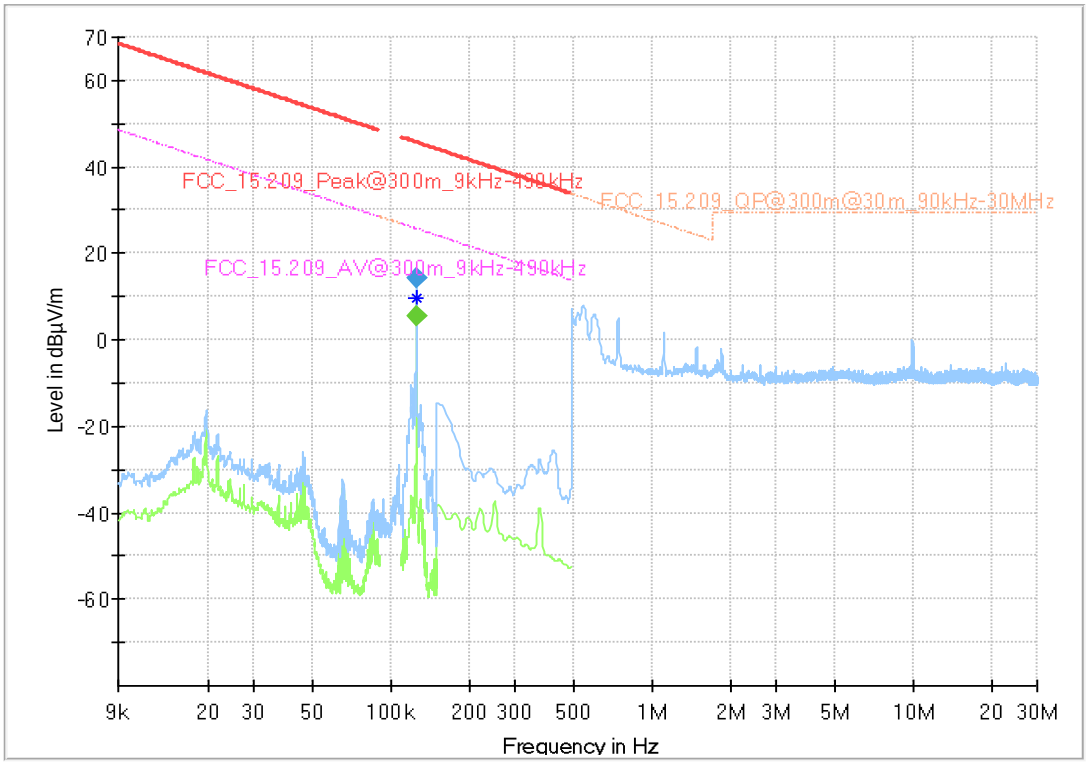
Remark: Please see next sub-clause for the measurement plot.

5.3.4 MEASUREMENT PLOTS

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 2, Measurement range = 9 kHz - 30 MHz
(S02_IMMO)

Common Information

Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15c.209
EUT / Setup Code:	DE1105008ab01
Operating Conditions:	13.5 V DC, immobilizer (125kHz without key-fob, 700ms period)
Operator Name:	MER/DOB
Comment:	EUT vertical
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



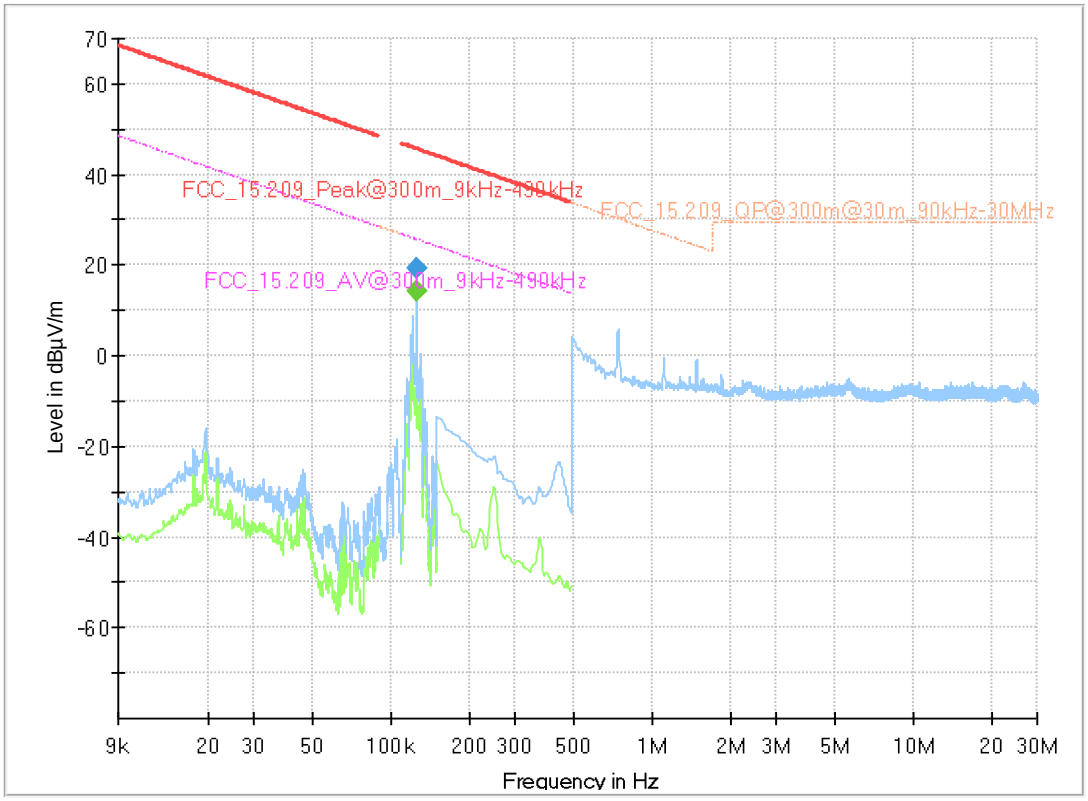
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Azimuth (deg)	Corr. (dB/m)
0.125000	---	25.69	20.10	1000.0	0.200	100.0	191.0	-59.6
0.125000	14.48	45.69	31.21	1000.0	0.200	100.0	191.0	-59.6

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 1, Measurement range = 9 kHz - 30 MHz
(S01_KL_TX-All)

Common Information

Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard:	FCC 15c.209
EUT / Setup Code:	DE1105008ad01
Operating Conditions:	13.5 V DC, keyless (125kHz, continous modulated, antenna 7)
Operator Name:	MER/DOB
Comment:	EUT vertical, modulated
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



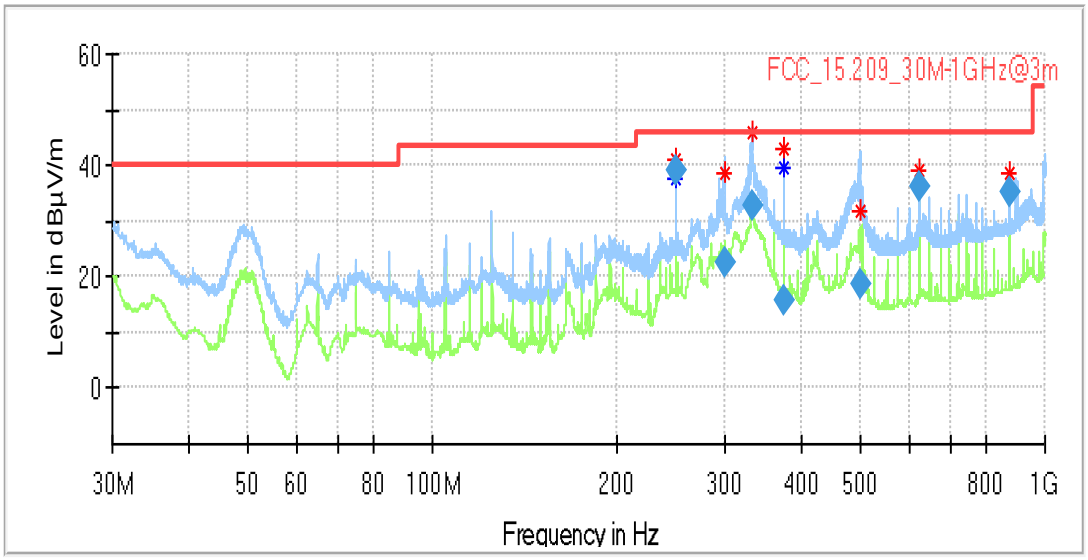
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Azimuth (deg)	Corr. (dB/m)
0.125050	---	25.68	11.35	1000.0	0.200	300.0	102.0	-59.6
0.125050	19.24	45.68	26.44	1000.0	0.200	300.0	102.0	-59.6

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 1,
Measurement range = 30 MHz - 1 GHz
(S01_KL_TX-All)

Common Information

Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard	FCC 15c.209
EUT / Setup Code:	DE1105008ad01
Operating Conditions:	13.5 V DC, keyless (125kHz, continous modulated, antenna 7)
Operator Name:	MER/DOB
Comment:	EUT vertical, modulated



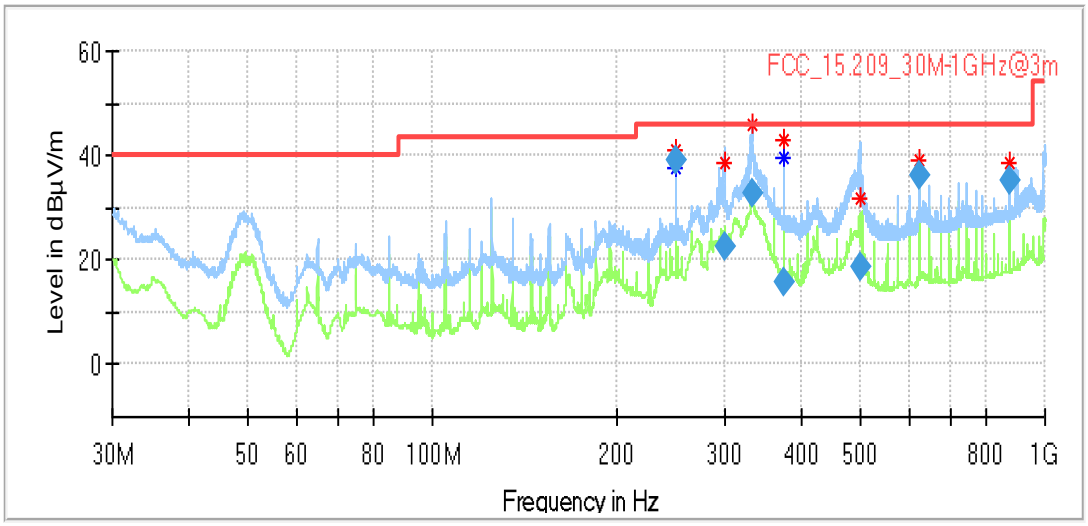
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
249.990000	39.23	46.00	6.77	1000.0	120.000	117.0	H	-118.0	11.3
299.190000	22.76	46.00	23.24	1000.0	120.000	139.0	V	225.0	12.9
331.890000	32.90	46.00	13.10	1000.0	120.000	103.0	V	6.0	14.2
374.970000	16.00	46.00	30.00	1000.0	120.000	128.0	V	-72.0	15.4
499.860000	18.66	46.00	27.34	1000.0	120.000	108.0	V	-23.0	18.2
624.960000	36.14	46.00	9.86	1000.0	120.000	102.0	V	-35.0	20.3
874.920000	35.32	46.00	10.68	1000.0	120.000	107.0	V	-171.0	23.9

Radio Technology = RF ID 125 kHz, Operating Mode = Operating Mode 2, Measurement range = 30 MHz - 1 GHz
(S02_IMMO)

Common Information

Test Description:	Radiated Emissions, Test Site: Semi Anechoic Chamber @ 3 m
Test Standard	FCC 15c.209
EUT / Setup Code:	DE1105008ad01
Operating Conditions:	13.5 V DC, keyless (125kHz, continous modulated, antenna 7)
Operator Name:	MER/DOB
Comment:	EUT vertical, modulated



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
249.990000	39.23	46.00	6.77	1000.0	120.000	117.0	H	-118.0	11.3
299.190000	22.76	46.00	23.24	1000.0	120.000	139.0	V	225.0	12.9
331.890000	32.90	46.00	13.10	1000.0	120.000	103.0	V	6.0	14.2
374.970000	16.00	46.00	30.00	1000.0	120.000	128.0	V	-72.0	15.4
499.860000	18.66	46.00	27.34	1000.0	120.000	108.0	V	-23.0	18.2
624.960000	36.14	46.00	9.86	1000.0	120.000	102.0	V	-35.0	20.3
874.920000	35.32	46.00	10.68	1000.0	120.000	107.0	V	-171.0	23.9

5.3.5 TEST EQUIPMENT USED

- Radiated Emissions

6 TEST EQUIPMENT

1 R&S TS8997
2.4 and 5 GHz Bands Conducted Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	107695	2020-08	2023-08
1.2	EX520	Digital Multimeter 12	Extech Instruments Corp	05157876	2020-04	2022-04
1.3	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2020-05	2022-05
1.4	Opus10 THI (8152.00)	T/H Logger 15	Lufft Mess- und Regeltechnik GmbH	13985	2019-06	2021-06
1.5	NGSM 32/10	Power Supply	Rohde & Schwarz GmbH & Co. KG	3456	2020-01	2022-01
1.6	Temperature Chamber KWP 120/70	Temperature Chamber Weiss 01	Weiss	59226012190010	2020-05	2022-05
1.7	SMB100A	Signal Generator 100 kHz - 40 GHz	Rohde & Schwarz Vertriebs-GmbH	181486	2019-11	2021-11
1.8	Temperature Chamber VT 4002	Temperature Chamber Vötsch 03	Vötsch	58566002150010	2020-05	2022-05
1.9	Opus10 THI (8152.00)	T/H Logger 14	Lufft Mess- und Regeltechnik GmbH	13993	2019-06	2021-06
1.10	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2019-11	2022-11
1.11	OSP120	Contains Power Meter and Switching Unit OSP-B157W8	Rohde & Schwarz	101158	2018-05	2021-05

2 Radiated Emissions
Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2020-11	2021-11
2.2	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515		
2.3	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2019-05	2021-05
2.4	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2019-12	2021-12
2.5	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia	none	2018-06	2021-06

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.6	FS-Z60	Harmonic Mixer 40 - 60 GHz	Rohde & Schwarz Messgerätebau GmbH	100178	2020-03	2023-03
2.7	FS-Z220	Harmonic Mixer 140 - 220 GHz	Rohde & Schwarz Messgerätebau GmbH	101005	2020-03	2023-03
2.8	SGH-05	Standard Gain / Pyramidal Horn Antenna (140 - 220 GHz)	RPG-Radiometer Physics GmbH	075		
2.9	HL 562 ULTRALOG	Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2018-07	2021-07
2.10	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq			
2.11	5HC2700/12750-1.5-KK	High Pass Filter	Trilithic	9942012		
2.12	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
2.13	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB		
2.14	SMBV100A	Vector Signal Generator 9 kHz - 3.2 GHz (GNSS / Broadcast Signalling Unit)	Rohde & Schwarz GmbH & Co. KG	260001	2018-01	2021-01
2.15	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2020-04	2022-04
2.16	WRD1920/1980-5/22-5EESD	Tunable Band Reject Filter	Wainwright Instruments GmbH	11		
2.17	TDS 784C	Digital Oscilloscope [SA2] (Aux)	Tektronix	B021311		
2.18	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2019-06	2021-06
2.19	foRS232 Unit 2	Fibre optic link RS232	PONTIS Messtechnik GmbH	4031516037		
2.20	PONTIS Con4101	PONTIS Camera Controller		6061510370		
2.21	NRVD	Power Meter	Rohde & Schwarz GmbH & Co. KG	828110/016	2020-08	2021-08
2.22	OLS-1 R	Fibre optic link USB 1.1	Ingenieurbüro Scheiba	018		
2.23	HF 906	Double-ridged horn	Rohde & Schwarz	357357/002	2018-09	2021-09

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.24	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
2.25	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2019-02	2021-02
2.26	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278		
2.27	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic GmbH	00083069		
2.28	foRS232 Unit 1	Fibre optic link RS232	PONTIS Messtechnik GmbH	4021516036		
2.29	FSP3	Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	836722/011		
2.30	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09		
2.31	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99		
2.32	4HC1600/12750-1.5-KK	High Pass Filter	Trilithic	9942011		
2.33	foUSB-M Converter 2	Fibre optic link USB 2.0	PONTIS Messtechnik GmbH	4471520061		
2.34	WRCD1879.8-0.2/40-10EE	Notch Filter Ultra Stable	Wainwright Instruments GmbH	16		
2.35	Temperature Chamber KWP 120/70	Temperature Chamber Weiss 01	Weiss	59226012190010	2020-05	2022-05
2.36	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
2.37	HL 562 ULTRALOG	Biconical-log-per Antenna (30 MHz - 3 GHz)	Rohde & Schwarz GmbH & Co. KG	100609	2019-05	2022-05
2.38	HF 906	Double-ridged horn	Rohde & Schwarz	357357/001	2018-03	2021-03
2.39	foCAN (v 4.0)	Fibre optic link CAN	Audivo GmbH (PONTIS EMC)	492 1607 014		
2.40	FS-Z325	Harmonic Mixer 220 - 325 GHz	Rohde & Schwarz Messgerätebau GmbH	101006	2020-03	2023-03
2.41	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2019-01	2021-01
2.42	SB4-100.OLD20-3T/10 Airwin 2 x 1.5 kW	Air compressor (oil-free)	airWin Kompressoren UG	901/00503		
2.43	UNI-T UT195E	True RMS Digital Multimeter	UNI-T UNI-TREND TECHNOLOGY (CHINA) CO., LTD.	C190729561		
2.44	foEthernet_M	Fibre optic link Ethernet / Gb-LAN	PONTIS Messtechnik GmbH	4841516022		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.45	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
2.46	AS 620 P	Antenna Mast (pneumatic polarisation)	HD GmbH	620/37		
2.47	CMW500	Callbox OIL-RE, SUA-160 MHz	Rohde & Schwarz GmbH & Co. KG	167766-By		
2.48	FSU26	Spectrum Analyser (20 Hz to 26.5 GHz)	Rohde & Schwarz GmbH & Co. KG	100136		
2.49	6005D (30 V / 5 A)	Laboratory Power Supply 120 V 60 Hz	PeakTech	81062045		
2.50	foUSB-M Converter 1	Fibre optic link USB 2.0	Audivo GmbH (PONTIS EMC)	4461520060		
2.51	FS-Z90	Harmonic Mixer 60 - 90 GHz	Rohde & Schwarz Messgerätebau GmbH	101686	2020-03	2023-03
2.52	NRV-Z1	Sensor Head B	Rohde & Schwarz GmbH & Co. KG	827753/006	2020-08	2021-08
2.53	HF 907-2	Double-ridged horn	Rohde & Schwarz	102817	2019-04	2022-04
2.54	foCAN (v 4.0)	Fibre optic link CAN	Audivo GmbH (PONTIS EMC)	492 1607 013		
2.55	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
2.56	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324		
2.57	WRCA800/960-0.2/40-6EEK	Tunable Notch Filter	Wainwright Instruments GmbH	20		
2.58	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/1192 0513		
2.59	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2018-07	2021-07
2.60	E4408B	Spectrum Analyser (9 kHz to 26.5 GHz)	Agilent Technologies Deutschland GmbH	MY45103714		

3 Radio Lab
Conducted Radio Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.1	1575	Broadband Resistive Power Divider DC to 40 GHz	API Weinschel, Inc.	4070		
3.2	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2020-05	2022-05
3.3	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2020-04	2022-04

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.4	SMP03	Signal Generator 2 GHz - 27 GHz	Rohde & Schwarz	833680/003		
3.5	Temperature Chamber KWP 120/70	Temperature Chamber Weiss 01	Weiss	59226012190010	2020-05	2022-05
3.6	FSIQ26	Signal Analyser 20 Hz to 26.5 GHz	Rohde & Schwarz GmbH & Co. KG	840061/005	2019-06	2021-06
3.7	SMB100A	Signal Generator 100 kHz - 40 GHz	Rohde & Schwarz Vertriebs-GmbH	181486	2019-11	2021-11
3.8	Chroma 6404	AC Source	Chroma ATE INC.	64040001304		
3.9	EX520	Digital Multimeter 07	Extech Instruments Corp	06110393	2020-04	2022-04
3.10	Temperature Chamber VT 4002	Temperature Chamber Vötsch 03	Vötsch	58566002150010	2020-05	2022-05
3.11	A8455-4	4 Way Power Divider (SMA)		-		
3.12	Opus10 THI (8152.00)	T/H Logger 03	Lufft Mess- und Regeltechnik GmbH	7482	2019-06	2021-06
3.13	FSU26	Spectrum Analyser (20 Hz to 26.5 GHz)	Rohde & Schwarz GmbH & Co. KG	100136		
3.14	Temperature Chamber VT 4002	Temperature Chamber Vötsch 05	Vötsch	58566080550010	2020-05	2022-05

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

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 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB atten-uator)
MHz		dB	dB	dB
0.15		10.1	0.1	10.0
5		10.3	0.1	10.2
7		10.5	0.2	10.3
10		10.5	0.2	10.3
12		10.7	0.3	10.4
14		10.7	0.3	10.4
16		10.8	0.4	10.4
18		10.9	0.4	10.5
20		10.9	0.4	10.5
22		11.1	0.5	10.6
24		11.1	0.5	10.6
26		11.2	0.5	10.7
28		11.2	0.5	10.7
30		11.3	0.5	10.8

Sample calculation

U_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

7.2 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

7.3 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.

7.4 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.

7.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

Frequency	AF EMCO 3160-09	Corr.	cable loss 1 (inside chamber)	cable loss 2 (pre-amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable loss 5 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB
18000	40.2	-23.5	0.72	-35.85	6.20	2.81	2.65
18500	40.2	-23.2	0.69	-35.71	6.46	2.76	2.59
19000	40.2	-22.0	0.76	-35.44	6.69	3.15	2.79
19500	40.3	-21.3	0.74	-35.07	7.04	3.11	2.91
20000	40.3	-20.3	0.72	-34.49	7.30	3.07	3.05
20500	40.3	-19.9	0.78	-34.46	7.48	3.12	3.15
21000	40.3	-19.1	0.87	-34.07	7.61	3.20	3.33
21500	40.3	-19.1	0.90	-33.96	7.47	3.28	3.19
22000	40.3	-18.7	0.89	-33.57	7.34	3.35	3.28
22500	40.4	-19.0	0.87	-33.66	7.06	3.75	2.94
23000	40.4	-19.5	0.88	-33.75	6.92	3.77	2.70
23500	40.4	-19.3	0.90	-33.35	6.99	3.52	2.66
24000	40.4	-19.8	0.88	-33.99	6.88	3.88	2.58
24500	40.4	-19.5	0.91	-33.89	7.01	3.93	2.51
25000	40.4	-19.3	0.88	-33.00	6.72	3.96	2.14
25500	40.5	-20.4	0.89	-34.07	6.90	3.66	2.22
26000	40.5	-21.3	0.86	-35.11	7.02	3.69	2.28
26500	40.5	-21.1	0.90	-35.20	7.15	3.91	2.36

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.
Table shows an extract of values.

7.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

Frequency	AF EMCO 3160-10	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)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

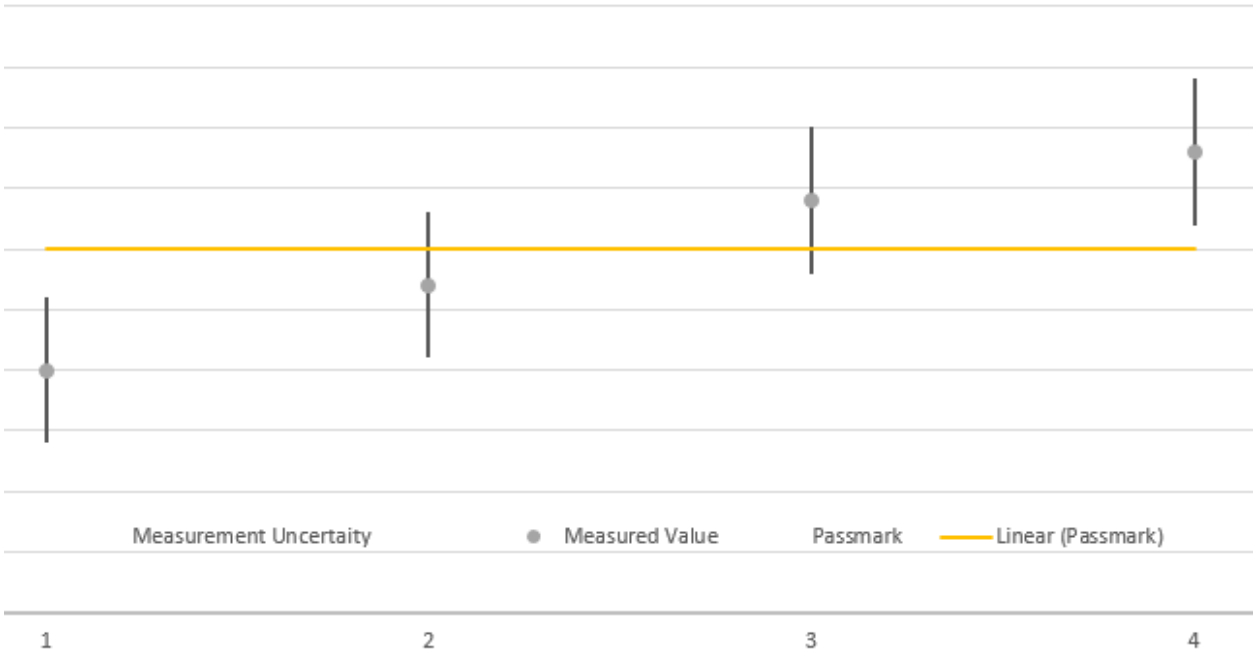
Sample calculation

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.
distance correction = -20 * 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.

8 MEASUREMENT UNCERTAINTIES

Test Case	Parameter	Uncertainty
AC Power Line	Voltage	± 3.4 dB
Field Strength of spurious radiation	Voltage	± 5.5 dB

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	above pass mark	within pass mark	Failed
4	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.