InterLab®

FCC Measurement/Technical Report on

MARS Keyless

FCC ID: KR5MARSKEYLESS
IC: 7812D-MARSKEYLESS

Report Reference: MDE_HELLA_1603_FCCb

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche Akkreditierungsstelle D-PL-12140-01-00

Table of Contents

0 Summary

0.1 Technical Report Summary

Type of Authorization
Certification for an intentional radiator: 125 kHz transmitter

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 (10-1-15 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

§ 15.205 Restricted bands of operation

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.215 Additional provisions to the general radiated emission limitations

Note:
ANSI C63.10-2013 applied

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.

0.2 Measurement Summary / signatures

47 CFR Chapter I FCC Part 15, Subpart C §15.209

Radiated Emissions

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
op-mode 1	Setup_01	Antenna	passed
op-mode 2	Setup_01	Antenna	passed

47 CFR Chapter I FCC Part 15, Subpart C §15.209

Peak Output Power

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
op-mode 1	Setup_01	Antenna	passed
op-mode 2	Setup_01	Antenna	passed

47 CFR Chapter I FCC Part 15, Subpart C §15.207

Conducted Emissions AC Power line

The measurement shall be performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
-	-	-	N/A (1)

47 CFR Chapter I FCC Part 15, Subpart C §15.215

Occupied Bandwidth

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
op-mode 1	Setup_01	Antenna	passed
op-mode 2	Setup_01	Antenna	passed

Notes:

N/A = Not applicable

(1) The EUT is DC powered from vehicular lead acid battery.

Responsible for Accreditation Scope: _____

Responsible for Test Report: _____

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

1 Administrative Data

1.1 Testing Laboratory

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

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716.

This facility has been fully described in a report submitted to the IC and accepted under the registration number: Site# 3699A-1.

The test facility is also accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-00
Responsible for accreditation scope:	Dipl.-Ing. Andreas Petz
Report Template Version:	2016-08-19

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Dobrin Dobrinov
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2017-08-25
Testing Period:	2017-08-08 to 2017-08-10

1.3 Applicant Data

Company Name:	HELLA KGaA Hueck & Co.
Address:	Beckumer Str. 130 59552 Lippstadt Germany
Contact Person:	Mr. Christian Elbers

1.4 Manufacturer Data

Company Name:	Continental Automotive GmbH
Address:	Siemensstraße 12 93055 Regensburg Germany
	Mr. Thomas Heselberger

2 Test object Data

2.1 General EUT Description

Equipment under Test	Remote Keyless Entry Unit
Type Designation:	MARS Keyless
Kind of Device:	125 kHz LF Transmitter
Voltage Type:	DC powered from vehicular lead acid battery
Voltage level:	12.0 V

General product description:

The EUT is a Remote Keyless Entry (RKE) LF transmitter for vehicles working in the 125 kHz frequency band. The transmitter sends modulated carrier to the key-fob, which responds to the transmitter's inquiry in 433 MHz or 315 MHz frequency bands.

Specific product description for the EUT:

The EUT is an Electronic Control Unit (ECU) of the RKE system, used to activate / deactivate vehicle's immobilizer and lock / unlock the vehicle's doors, by reading a valid user ID, installed in a key-fob.
The object of this test report is the LF transmitter part of ECU unit.

The EUT provides the following ports:

- DC power
- Data
- 4 external antennas

The main components of the EUT are listed and described in Chapter 2.

2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
EUT A (Code: DE1232001af02)	RKE ECU	MARS Keyless	5000051843 0790321201 2201	17/10	17/24

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

2.3 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.

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
ANX1	LF antenna	A 177 905 05 00	0094	E03	–
ANX2	LF antenna	A 177 905 05 00	0095	E03	–
ANX3	LF antenna	A 177 905 09 01	0161	Q00	–
ANX4	LF antenna	A 177 905 09 01	0177	Q00	–

2.4 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.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status
AUX 1	key-fob	DM4	1047106	12	164001

2.5 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 and Rationale
Setup_01	EUT A + ANX1 – ANX4 + AUX 1	EUT sending ASK modulated signal

2.6 Operating Modes

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

Op. Mode	Description of Operating Modes	Remarks
Op-mode 1	Transmitter active in mode Immo GND	The LF transmitter is sending a pulse modulated carrier with pulse length of 1.25 s and period of 3.25 s. One antenna is active.
Op-mode 1	Transmitter active in mode Open LF	The LF transmitter is sending a pulse modulated carrier with burst of 4 pulses with length of 5.2 ms each and pause of 23 ms. Burst period is 370 ms. Four antennas are active.

2.7 Special software used for testing

A software with identical function and the following modifications is used for testing:
– working independently from CAN-bus
– adapted periods / timings for testing purpose
– continuous, repetitive operation independent from any trigger

2.8 Product labelling

Please refer to the documentation of the applicant.

3 Test Results

3.1 Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

3.1.1. 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 also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

1. Measurement up to 30 MHz
The Loop antenna HFH2-Z2 is used.

Step 1: pre-measurement
- Anechoic chamber
- Antenna distance: 3 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.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- 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

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 – 3 m
- Height variation step size: 2 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 ± 45° around this value. 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 by ± 100 cm around the antenna height determined. 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: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- 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 this 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.

3.1.2. 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

§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)

3.1.3. Test Protocol

Temperature: 22 °C
Air Pressure: 1023 hPa
Humidity: 38 %

3.1.3.1. Measurement up to 30 MHz

Op. Mode	Setup	Port
op-mode 1	Setup_01	Antenna

Polari-sation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
–	–	–	–	–	–	–	–	–	–

Op. Mode	Setup	Port
op-mode 2	Setup_01	Antenna

Polari-sation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
–	–	–	–	–	–	–	–	–	–

Remark: No relevant spurious emissions in the range 20 dB below the limit found, therefore step 2 was not performed.
Please see annex for the measurement plots.

3.1.4. Test result: Spurious radiated emissions

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed

3.2 Peak power output

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

3.2.1 Test Description

Please refer to sub-clause 3.1.1.

3.2.2 Test Limits

Please refer to sub-clause 3.1.2.

3.2.3 Test Protocol

Temperature: 24 °C
Air Pressure: 1001 hPa
Humidity: 36 %

Op. Mode	Setup	Port
op-mode 1	Setup_01	Antenna

Output power dBµV/m	Frequency kHz	Limit dBµV/m at fundamental frequency for 300 m distance	Remarks
19.17	125.00	25.69	Maximum radiated field strength at fundamental frequency

Op. Mode	Setup	Port
op-mode 2	Setup_01	Antenna

Output power dBµV/m	Frequency kHz	Limit dBµV/m at fundamental frequency for 300 m distance	Remarks
-7.6	125.00	25.69	Maximum radiated field strength at fundamental frequency

Notes: 1) The EUT transmitted a continuously modulated signal.
2) According to FCC Part 15, Subpart C §15.209 (d), measurements are performed by using an average detector.
Please see annex for the measurement plots.

3.2.4 Test result: Peak power output

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed

3.3 Occupied bandwidth

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

3.3.1. Test Description

The Equipment Under Test (EUT) was setup in a shielded room 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 results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth.

3.3.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.215 (c)
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. …

3.3.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1011 hPa
Humidity: 42 %

Op. Mode	Setup	Port
op-mode 1	Setup_01	Antenna

EUT	20 dB bandwidth kHz	99% bandwidth kHz	Remarks
A (DE1232001af02)	3.972	8.292	The carrier is ASK modulated

Op. Mode	Setup	Port
op-mode 2	Setup_01	Antenna

EUT	20 dB bandwidth kHz	99% bandwidth kHz	Remarks
A (DE1232001af02)	8.987	9.313	The carrier is ASK modulated

Remark: Please see annex for the measurement plot.

3.3.4 Test result: Occupied bandwidth

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed

4 Measurement uncertainty

Test Case	Parameter	Uncertainty
Peak power output	Power	± 4.5 dB
Occupied bandwidth	Power Frequency:	± 4.5 dB ± 0.125 kHz
Spurious radiated emissions	Power Frequency:	± 4.5 dB ± 11.2 kHz

5 Test equipment

1 Radiated Emissions

Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Calibration Due
1.1	Fully Anechoic Room	8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	-
1.2	AM 4.0	Antenna mast	Maturo GmbH	AM4.0/180/11920513	-
1.3	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2018-11-29
1.4	Anechoic Chamber	10.58 x 6.38 x 6.00 m³	Frankonia	none	-
1.5	ESIB 26	Spectrum Analyzer	Rohde & Schwarz	830482/004	2017-12-08
1.6	Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	Maturo GmbH	TD1.5-10kg/024/3790709	-
1.7	AS 620 P	Antenna mast	HD GmbH	620/37	
1.8	NRV-Z1	Sensor Head A	Rohde & Schwarz	827753/005	2018-05-16
1.9	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785	-
1.10	HL 562	Ultralog new biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2018-06-30
1.11	Opus10 THI (8152.00)	ThermoHygro Datalogger 12 (Environ)	Lufft Mess- und Regeltechnik GmbH	12482	
1.12	HFH2-Z2	Loop Antenna	Rohde & Schwarz GmbH & Co. KG	829324/006	2017-11-27
1.13	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2018-12-02
1.14	Chroma 6404	AC Power Source	Chroma ATE INC.	64040001304	
1.15	HF 907	Double-ridged horn	Rohde & Schwarz GmbH & Co. KG	102444	2018-05-11
1.16	DE 325	Dreheinheit	HD GmbH		

2 Radio lab

Lab to perform frequency bandwidth measurements

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Calibration Due
2.1	FSV30	Signal Analyzer	Rohde & Schwarz	103005	2018-02-24
2.2	Weinschel 56-10	10 dB attenuator	Weinschel	W3711	-
2.3	Weinschel 4T-10	10 dB attenuator	Weinschel	F9401	-
2.4	WA1515	6 dB coupler	Weinschel	A855	-
2.5	5-4 Rev.0	20 dB coupler	-	07-00	-
2.6	ST18/SMAm/ SMAm/36	Coaxial cable (RLC-1)	-	Batch No. 12424	-
2.7	ST18/SMAm/ SMAm/36	Coaxial cable (RLC-2)	-	Batch No. 625905	-
2.8	ST18/SMAm /Nm/48	Coaxial cable (RL-RX spuri cable)	-	Batch No. 625626	-
2.9	7006-1	DC blocker	Weinschel	W0026	-
2.10	OPUS 10	Thermo-Hydrometer	Lufft	12482	
2.11	177	Digital Voltmeter	Fluke	86670383	2018-02-03
2.12	VT4002	Temperature Chamber	Vötsch	585660021 50010	2018-03-08

6 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.

6.1 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

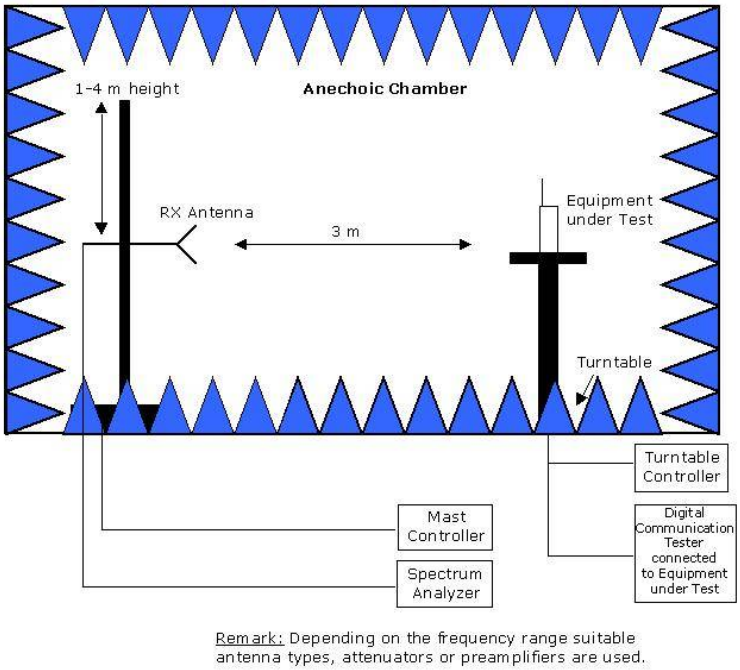
Sample calculation

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 Photo Report

Photos are included in an external report.

8 Setup Drawings



Drawing 1: Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting ground plane.

9 FCC and ISED Correlation of measurement requirements for General Radio Equipment from FCC and ISED

General radio equipment

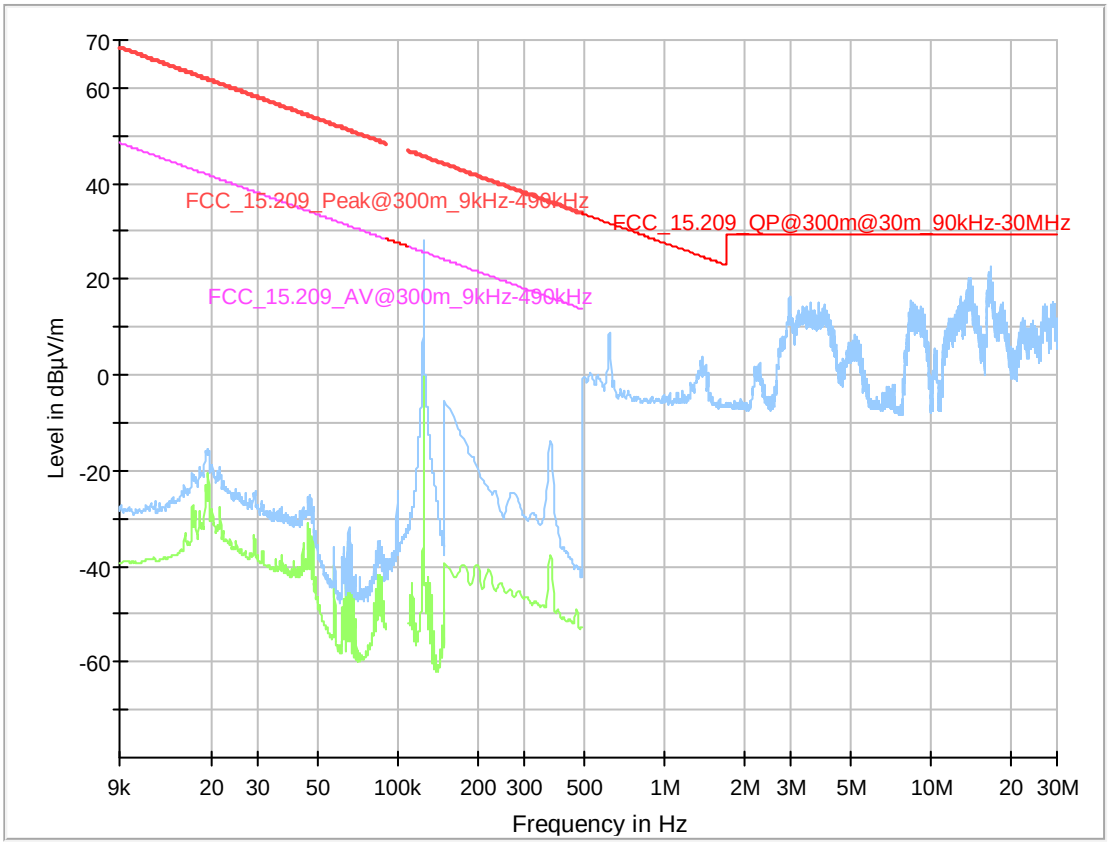
Measurement	FCC reference	ISED reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Transmitter spurious radiated emissions	§ 15.209	RSS-Gen Issue 4: 6.13/8.9/8.10; RSS-210 Issue 9: 2.5
Spurious radiated emissions below 490 kHz and restricted to emission level	§ 15.201, CFR47, Part 2, Subpart J; if all emissions ≤ 40 dB below the limit listed in §15.209	RSS-Gen Issue 4: 8.9/8.10; RSS-210 Issue 9: 2.5.1; RSS-310 Issue 4 if all emissions ≤ 40 dB below the limit listed in RSS-Gen
Wanted Emission (Carrier)	§ 15.209	RSS-210 Issue 9: 2.5.1 RSS-Gen Issue 4: 6.12, 8.9
Other requirements, e.g. Transmitter frequency stability	§15.215	RSS- Gen, Issue 4: 6.11/8.11
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	–	RSS-210 Issue 9: 2.3; RSS Gen Issue 4: 5/7 *)

10 Annex measurement plots

10.1 Radiated emissions and peak output power

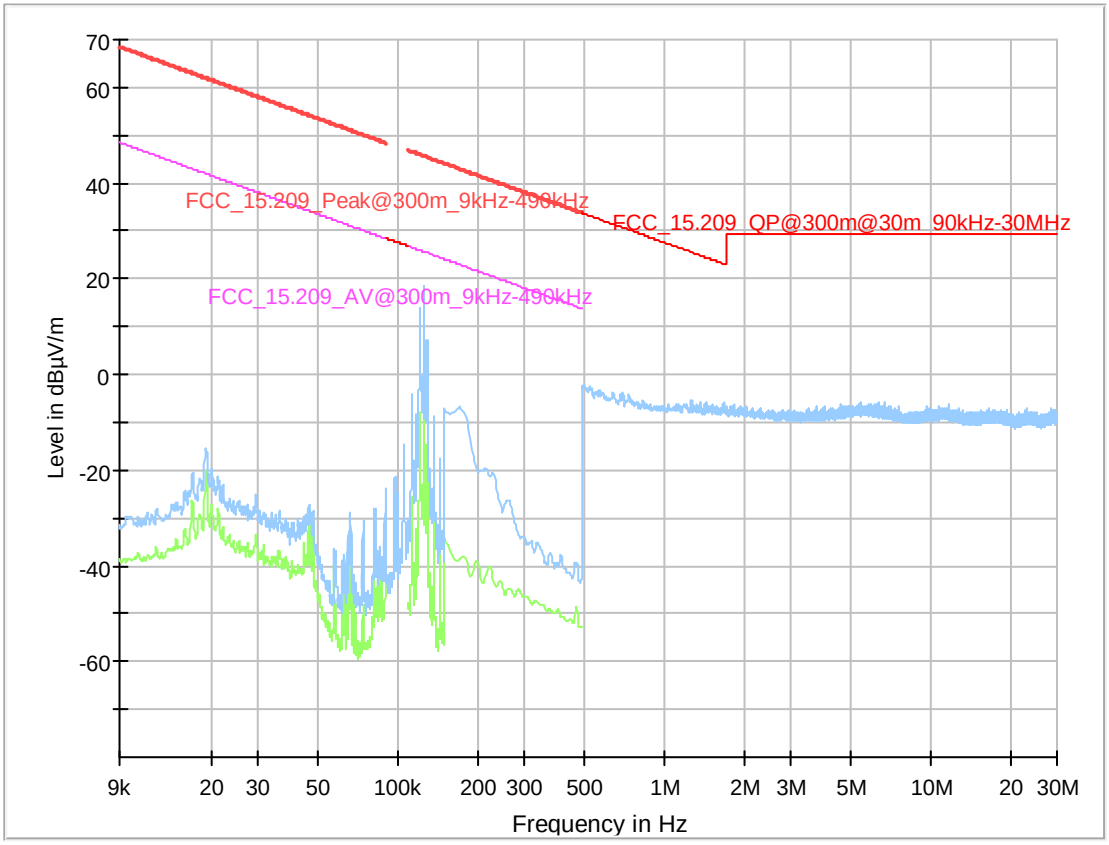
10.1.1. Spurious radiated emissions up to 30 MHz – Op-Mode 1

Test Description:	H-Field 9 kHz - 30 MHz Spurious emissions
Test Standard	FCC §15.209 / ANSI C63.10
OUT Code:	DE1232001af02
Operating Conditions:	NTNV, Immo GND Mode
Operator Name:	MER
Comment:	EUT Horizontal, Ant. Hor + Vert



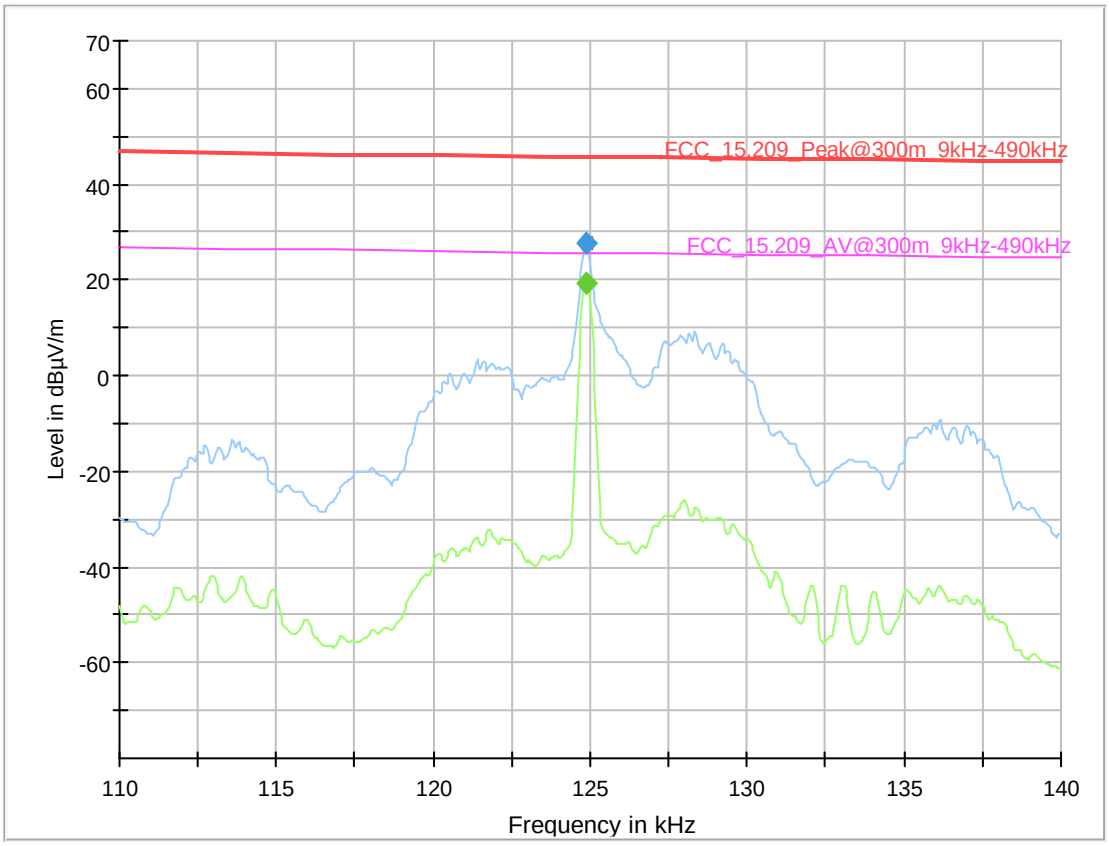
10.1.2. Spurious radiated emissions up to 30 MHz – Op_Mode 2

Test Description:	H-Field 9 kHz - 30 MHz Spurious emissions
Test Standard:	FCC §15.209 / ANSI C63.10
OUT Code:	DE1232001af02
Operating Conditions:	NTNV, Open LF Mode
Operator Name:	Pet/MER
Comment:	EUT Horizontal, Ant. Hor + Vert



10.1.3. Peak output power

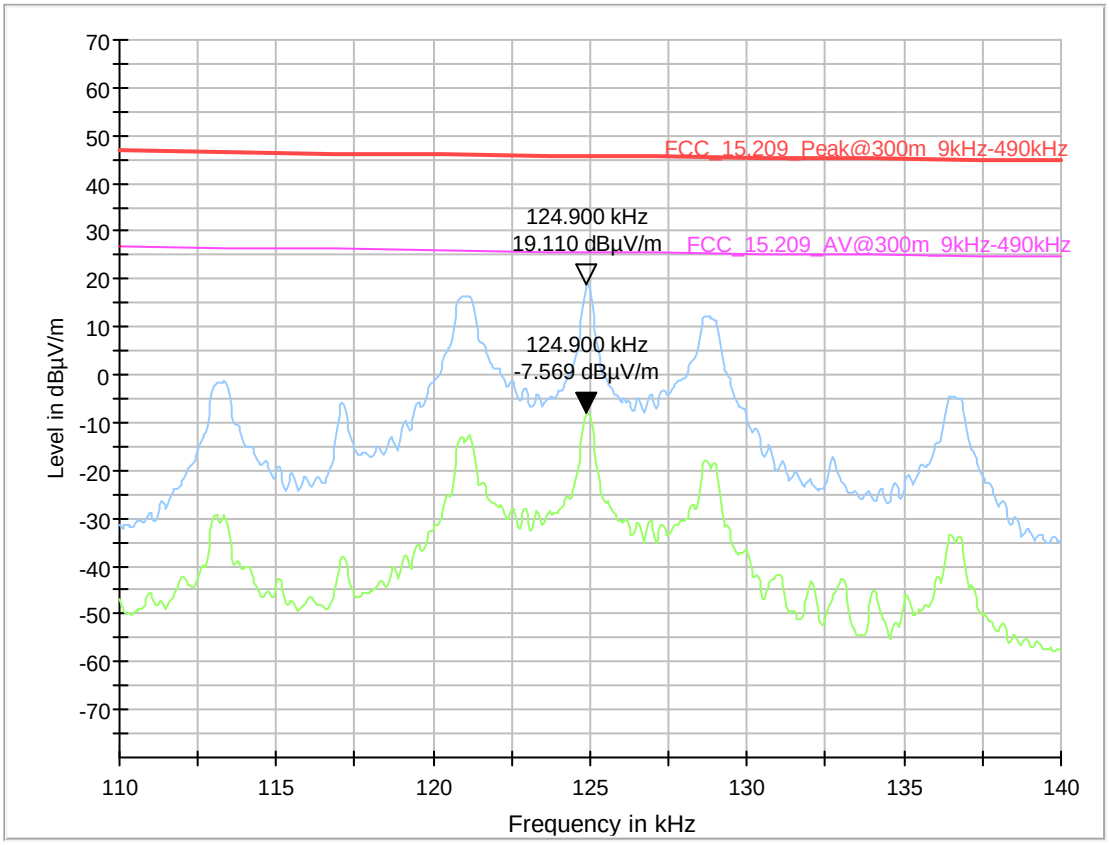
Test Description:	H-Field 9kHz - 30MHz
Test Standard	FCC §15.209 / ANSI C63.10
OUT Code	DE1232001af02
Operating Conditions:	**Mode: Immo GND Transmission**
Operator Name:	Pet/MER
Comment:	EUT Hor, Ant Hor+Vert, Scantime: 5 s



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
0.124850	27.75	---	45.70	17.95	5000.	0.200	100.0	V	76.0	-59.5
0.124850	---	19.17	25.70	6.53	5000.	0.200	100.0	V	76.0	-59.5

Test Description:	H-Field 9kHz - 30MHz
Test Standard	FCC §15.209 / ANSI C63.10
OUT Code	DE1232001af02
Operating Conditions:	**Mode: Open LF Transmission**
Operator Name:	Pet/MER
Comment:	EUT Hor, Ant Hor+Vert, Scantime: 1 s

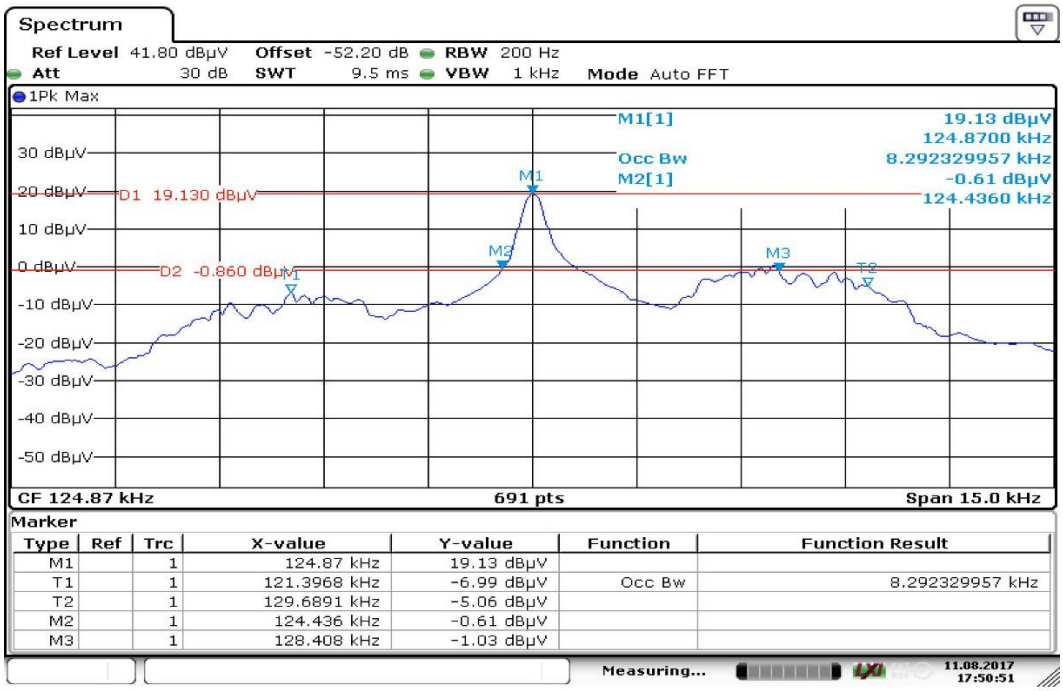


Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
0.124900	19.11	---	45.70	26.59	1000.	0.200	100.0	V	76.0	-59.5
0.124900	---	-7.57	25.70	33.27	1000.	0.200	100.0	V	76.0	-59.5

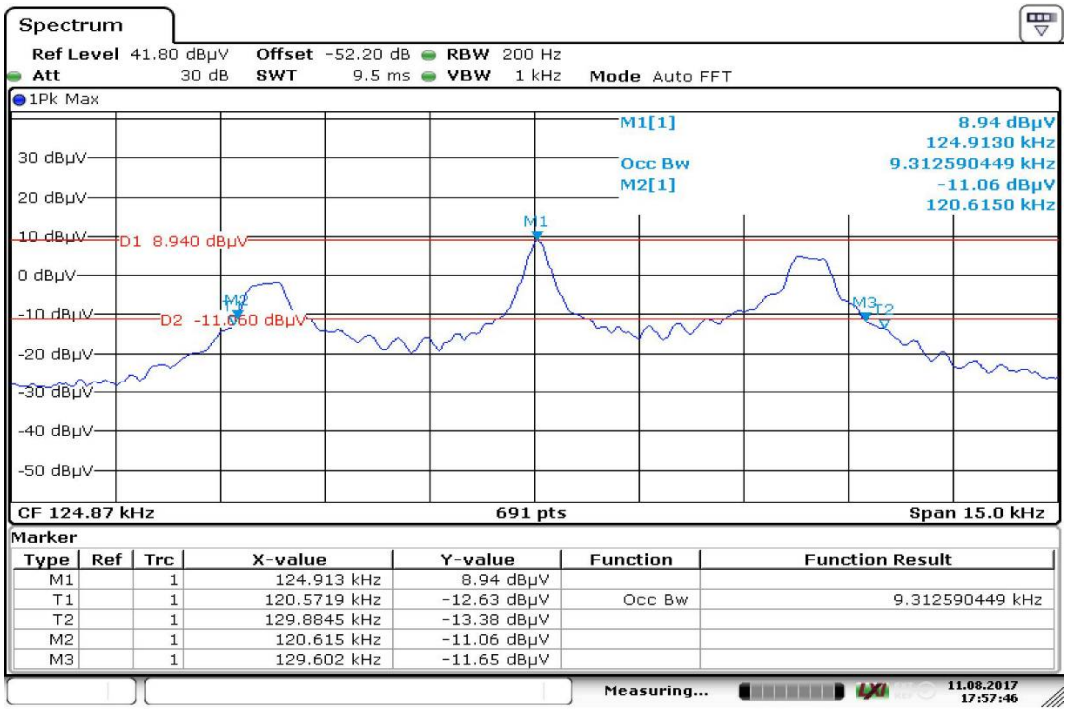
10.2 Occupied Bandwidth

10.2.1. Mode Immo GND occupied bandwidth



Date: 11.AUG.2017 17:50:52

10.2.2. Mode Open LF occupied bandwidth



Date: 11.AUG.2017 17:57:46

Note: 20 dB bandwidth is between markers T1and T2;
99% bandwidth is between markers M2 and M3