Test Report

Customer:

Continental Automotive GmbH

Siemenstrasse 12
93055 Regensburg
Germany

Tel.: +49 941 790-0

RF test report

170415-AU01+W01

Industry Canada Industrie Canada

Continental Automotive GmbH

VAG Immobilizer System

17A.920.790

EMV **TESTHAUS** GmbH

Gustav-Hertz-Straße 35
94315 Straubing
Tel.: +49 9421 56868-0
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Email: info@emv-testhaus.com

Accreditation:

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-12155-01-00

FCC facility registration number: 221458
Test Firm Type “accredited”: Valid until 2019-05-06
MRA US-EU, FCC designation number: DE0010
BnetzA-CAB-02/21-02/04 Valid until 2018-11-27

Industry Canada test site numbers with registration expiry date:
3472A-1, expiring 2018-11-09
3472A-2, expiring 2018-11-12

Test Laboratory:

EMV **TESTHAUS** GmbH
Gustav-Hertz-Straße 35
94315 Straubing
Germany

The technical accuracy is guaranteed through the quality management of the
EMV **TESTHAUS** GmbH

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1 Test regulations

47 CFR Part 2: 10-2016	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)
47 CFR Part 15: 10-2016	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)
ANSI C63.10:2013-06	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ICES-003 Issue 6, January 2016	Spectrum Management and Telecommunications Interference-Causing Equipment Standard Information Technology Equipment (ITE) – Limits and methods of measurement
RSS-Gen Issue 4, November 2014	Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equimpment
RSS-102 Issue 5, March 2015	Spectrum Management and Telecommunications Radio Standards Specification Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
RSS-210 Issue 9, August 2016	Spectrum Management and Telecommunications Radio Standards Specification Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

2 Summary of test results

Standard	Test result
47 CFR Part 15, section 15.209, 15.111	Passed
RSS-210 Issue 9 Section 4.3 (with appropriate references to RSS-Gen Issue 4)	Passed

Straubing, August 31, 2017

Christian Kiermeier
Test engineer
EMV **TESTHAUS** GmbH

Rainer Heller
Head of EMC/Radio department
EMV **TESTHAUS** GmbH

3 Equipment under Test (EUT)

Product type:	VAG Immobilizer System
Model Name:	17A.920.790
Applicant:	Continental Automotive GmbH, Siemenstrasse 12, 93055 Regensburg, Germany
Manufacturer:	Continental Automotive GmbH, VDO-Strasse 1, 64832 Babenhausen, Germany
Serial number:	N/A
FCC ID:	KR517A920790
IC certification number:	7812D-170A920790
Application frequency band:	n/a
Frequency range:	125 kHz
Operating frequency:	125 kHz
Number of RF-channels:	1
Modulation:	ASK
Highest frequency generated or used in the device or on which the device operates or tunes:	4 MHz
Antenna type(s):	External antenna ☒ detachable ☐ not detachable
Power supply:	Battery powered nominal: 13.5 VDC minimal: 6.5 VDC maximal: 17.0 VDC
Temperature range:	-40°C to +85°C

3.1 Photo documentation

For external photos of the EUT see annex B, for internal ones see annex C.
For photos taken during testing including EUT positions see annex A.

3.2 Short description of the EUT

Immobilizer System for vehicles.

3.3 Operation mode

EUT was set to pulsed wave (125 kHz).
According to customer information there is no possibility to set another mode of operation.

The EUT was tested in 3 orthogonal positions. These are documented in annex A.

3.4 Configuration

The following peripheral devices and interface cables were connected during the tests:

Device	Model:	Serial or inventory no.
VAG Immobilizer System	17A.920.790	N/A
DC power supply (120 V / 60 Hz <-> 9.0 V DC)	Statron 3231.1	E00017
AC power supply (230 V / 50 Hz <-> 120 V / 60 Hz)	Chroma 61605	ASQ000000305

3.5 Used cables

Port	*Classification*	*Cable type*	*Cable length*	
			used	*maximum*
DC power	dc power	Unshielded	1.0 m	---

4 Radiated emission measurement (<1 GHz)

according to 47 CFR Part 15, section 15.205(a), 15.209(a), 15.111(b) and
RSS-210, section 4.3 with RSS-Gen, sections 8.10 ,8.9 and 7.1.2

4.1 Test Location

☒ Scan with peak detector in 3 m CDC.

☒ Final CISPR measurement with quasi peak detector on 3 m open area test site.

Description	Manufacturer	Inventory No.
CDC	Albatross Projects	E00026
Open area test site (OATS)	EMV **TESTHAUS** GmbH	E00354

4.2 Test instruments

	Description	Manufacturer	Inventory No.
☐	ESU 26 (AC)	Rohde & Schwarz	W00002
☒	ESCI (CDC & OATS)	Rohde & Schwarz	E00001
☐	ESR7 (SAC)	Rohde & Schwarz	E00739
☒	VULB 9163 (OATS)	Schwarzbeck	E00013
☒	VULB 9160 (CDC)	Schwarzbeck	E00011
☐	VULB 9162-041 (SAC)	Schwarzbeck	E00643
☒	HFH2-Z2 (CDC & OATS)	Rohde & Schwarz	E00060
☒	Cable set CDC	Huber + Suhner	E00459, E00446
☐	Cable set AC 3 m	Huber + Suhner	W00095, E00432, E00307
☒	Cable set OATS 3 m	Huber + Suhner	E00453, E00456, E00458
☐	Cable set SAC 3 m	Huber + Suhner	E00804, E00806, E00807

4.3 Limits

The field strength of any emissions (including spurious emissions) falling into restricted bands as specified in 15.205(a) shall not exceed the general radiated emission limits as specified in 15.209.

Frequency [MHz]	Field strength Fs [µV/m]	Field strength [dBµV/m]	Measurement distance d [m]
0.009 – 0.490	266.6 – 4.9	48.5 – 13.8	300
0.490 – 1.705	48.98 – 14.08	33.8 – 22.97	30
1.705 – 30.0	30	29.54	30
30 – 88	100	40	3
88 – 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

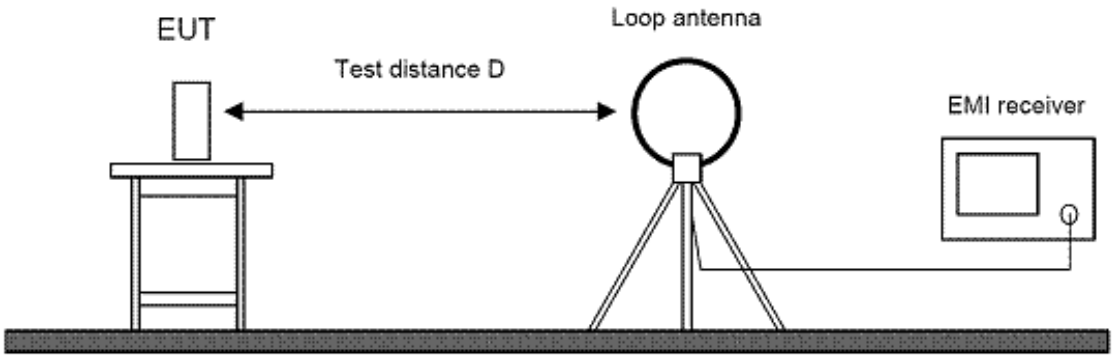
Note:
Limits for 3 m test distance are calculated according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”.

According to 15.35(b) on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. When average radiated emission measurements are specified, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions of 20 dB above the maximum permitted average emission limit.

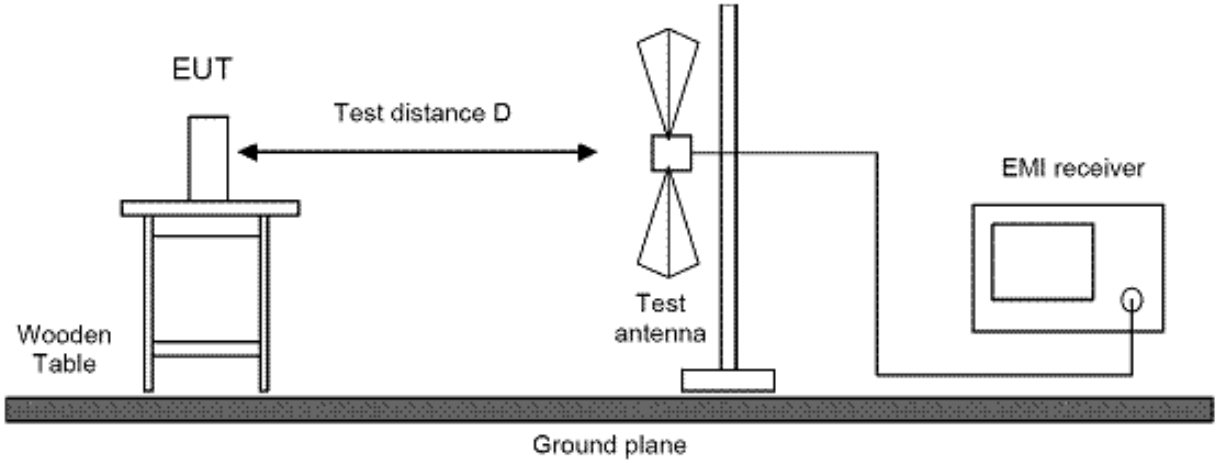
4.4 Test procedure

1. EUT was configured according to ANSI C63.10. It was placed on the top of the turntable 0.8 meter above ground. The receiving antenna was placed 3 meters from the turntable. The test setup was placed inside a compact diagnostic chamber.
2. EUT and all peripherals were powered on.
3. The broadband antenna was set to vertical polarization.
4. The EMI receiver performed a scan from 30 MHz to 1000 MHz with peak detector peak and measurement bandwidth set to 120 kHz.
5. The turn table was rotated to 6 different positions (360° / 6) and the antenna polarization was changed to horizontal.
6. Test procedure at step 4 and 5 was repeated.
7. The test setup was then placed in an OATS at 3 m distance and all peak values over or with less margin to the limit than 6dB were marked and re-measured with a quasi-peak detector.
8. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
9. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization. The highest value was recorded.
10. For emissions below 30 MHz measurements were done using a loop antenna. Prescan was performed with peak detector and final measurements with quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 k Hz where average detector applies. Antenna height was not changed during this test. Appropriate CISPR bandwidths of 200 Hz for frequencies up to 150 kHz and 9 or 10 kHz for frequencies above were used.

4.5 Test setup



Picture 1: Test setup for radiated emission measurement (< 30 MHz)



Picture 2: Test setup for radiated emission measurement (< 1 GHz)

4.6 Test deviation

There is no deviation from the standards referred to.

4.7 Test results

Temperature:	21°C	Humidity:	49%
Tested by:	Christian Kiermeier	Test date:	2017-08-08

Radiated Emission Measurement 9 kHz - 30 MHz

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”:

$d_{near\ field}$ = 47.77 / f_{MHz}, or

f_{MHz} = 47.77 / $d_{near\ field}$

The frequency f_{MHz} at which the near field distance is equal to the limit and/or test distance is important for selection of the right formula for determining the recalculation factor:

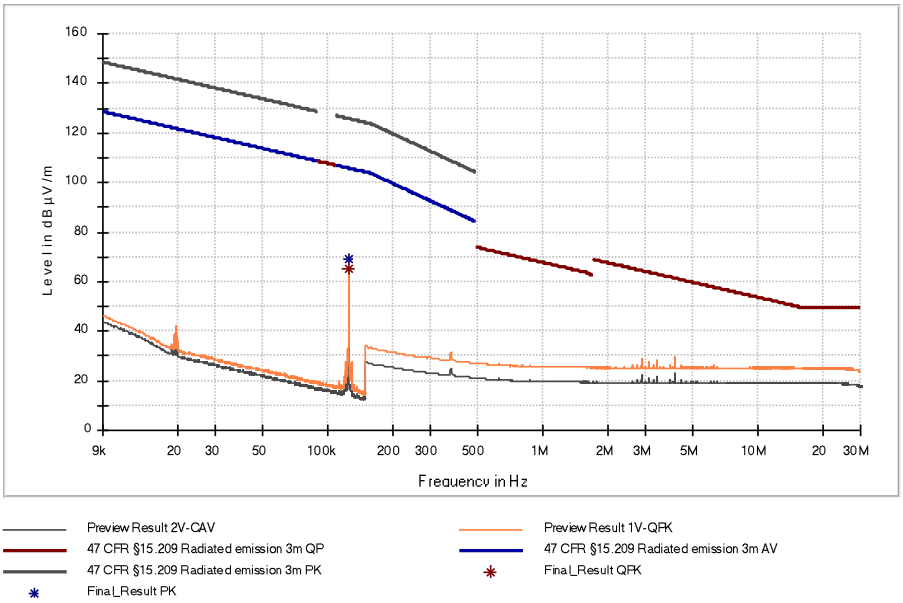
f_{MHz}(300 m) ≈ 0.159 MHz
f_{MHz}(30 m) ≈ 1.592 MHz
f_{MHz}(3 m) ≈ 15.923 MHz

For 9 kHz ≤ f ≤ 159 kHz and 490 kHz < f ≤ 1.592 MHz:
Recalculation factor = -40 log(d_{limit} / $d_{measure}$)
For 159 kHz < f ≤ 490 kHz and 1.592 MHz < f ≤ 15.923 MHz:
Recalculation factor = -40 log($d_{near\ field}$ / $d_{measure}$) - 20 log(d_{limit} / $d_{near\ field}$)
For f > 15.923 MHz:
Recalculation factor = -20 log(d_{limit} / $d_{near\ field}$)

The limits in the graphics and value lists are derived from the general radiated emission limits as specified in 15.209 using the recalculation factor as described above.

Frequency range	*Step size*	*IF Bandwidth*	*Detector*		*Measurement Time*		*Preamplifier*
			Prescan	*Final scan*	*Prescan*	*Final scan*	
9 kHz – 90 kHz	80 Hz	200 Hz	PK	AV	1 ms	100 ms	off
90 kHz – 110 kHz	80 Hz	200 Hz	PK	QPK	1 ms	1 s	off
110 kHz – 150 kHz	80 Hz	200 Hz	PK	AV	1 ms	100 ms	off
150 kHz – 490 kHz	4 kHz	9 kHz	PK	AV	1 ms	100 ms	off
490 kHz – 30 MHz	4 kHz	9 kHz	PK	QPK	1 ms	1 s	off

The following picture shows the worst-case-emissions for the spurious emissions at EUT-position 3, antenna in line.



Picture 3: Radiated emission 9 kHz – 30 MHz @ 3m distance

Frequency [kHz]	**Measured value [dBµV/m]**	**Detector**	**Recalculation factor [dB]**	**Field strength [dBµV/m]**	**Limit [dBµV/m]**	**Margin [dBµV/m]**	**Result**
125.050	69.05	PK	-80.0	-10.95	45,69	56.64	Pass
125.050	64.92	QP	-80.0	-15.08	25,69	40.77	Pass

Note: Final measurement was performed with QP detector instead of AV detector.

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”:

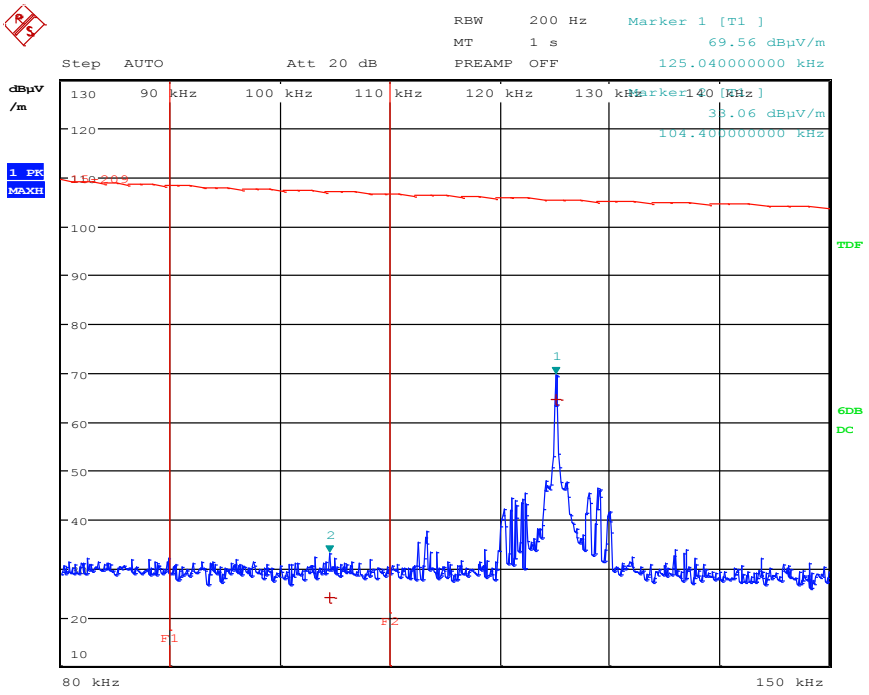
$d_{near\ field}$ = 47.77 / f_{MHz}

Recalculation factor = -40 log(d_{limit} / $d_{measure}$)

f_{MHz} [kHz]	$d_{near\ field}$ [m]	$d_{measure}$ [m]	d_{limit} [m]	Recalculation factor [dB]
125.050	382.007	3.0	300.0	-80.0

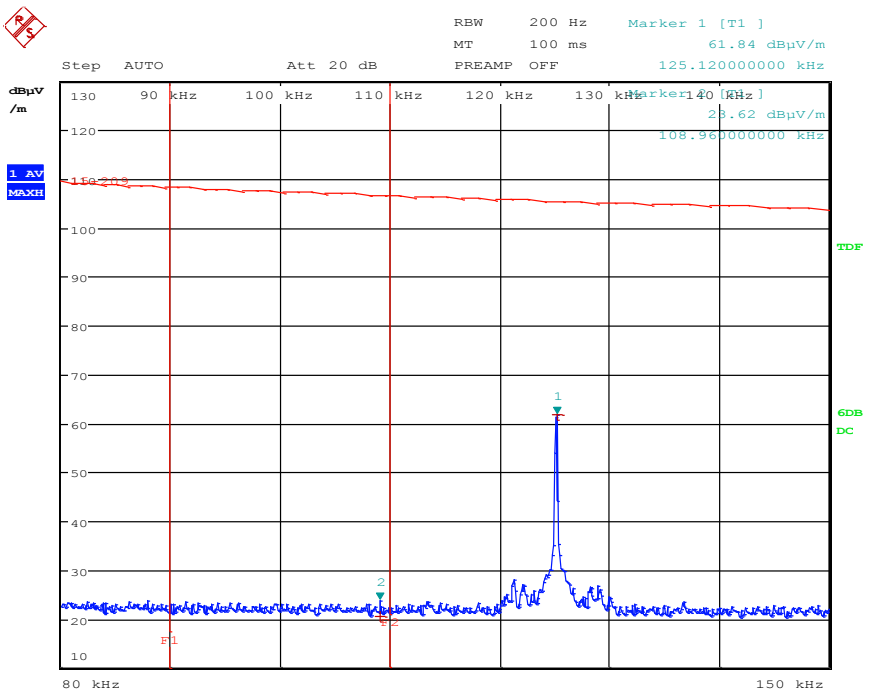
Restricted band of operation from 0.090 MHz to 0.110 MHz

The following pictures show the worst-case-emissions for the spurious emissions at EUT-position 3, antenna in line.



Picture 4: Restricted band of operation, QP @ 3m distance

Frequency [kHz]	Measured value [dBµV/m]	Detector	Recalculation factor [dB]	Field strength [dBµV/m]	Limit [dBµV/m]	Margin	Result
104.40	23.97	QP	-80.0	-56.03	24.23	80.26	Pass



Picture 5: Restricted band of operation, AV @ 3m distance

Frequency [kHz]	Measured value [dBµV/m]	Detector	Recalculation factor [dB]	Field strength [dBµV/m]	Limit [dBµV/m]	Margin	Result
125.12	61.91	AV	-80.0	-18.09	25.65	43,74	Pass

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”:

$d_{near\ field}$ = 47.77 / f_{MHz}

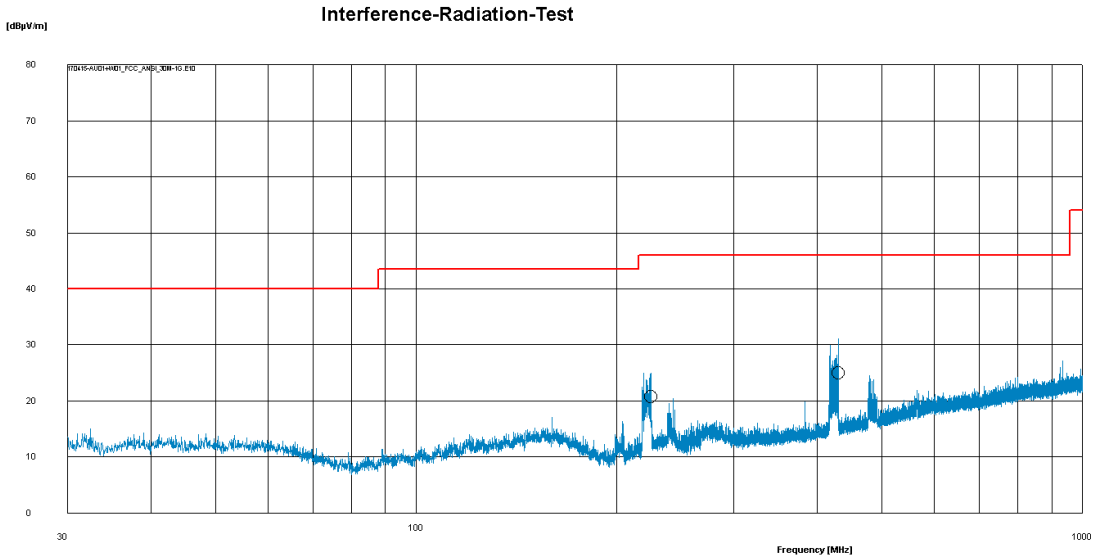
Recalculation factor = -40 log(d_{limit} / $d_{measure}$)

f_{MHz} [MHz]	$d_{near\ field}$ [m]	$d_{measure}$ [m]	d_{limit} [m]	Recalculation factor [dB]
0.10440	457.56	3.0	300.0	-80.0
0.12512	381.79	3.0	300.0	-80.0

Radiated Emission Measurement 30 MHz - 1000 MHz

Frequency range	*Polari-sation*	*Step size*	*IF Band-width*	*Detector*		*Measurement Time*		*Pre-amplifier*
				Prescan	*Final scan*	*Prescan*	*Final scan*	
30 MHz – 1 GHz	H / V	60 kHz	120 kHz	PK	QPK	1 ms	1 s	20 dB

The following pictures show the worst-case-emissions at EUT-position 1.



f [MHz]	E_{final} [dBV/m]	Limit [dBµV/m]	Height [cm]	TT [°]	Polarisation	Result
225.36	20.80	46.00	200	213.0	H	Pass
430.20	25.0	46.00	200	98.0	H	Pass

Picture 6: Radiated emission 30 MHz - 1000MHz @ 3m distance

5 Radiated emission measurement (>1 GHz)

according to 47 CFR Part 15, section 15.209(a), RSS-210, section 4.3 with RSS-Gen, section 8.9

Remark:

This measurement needs not to be applied for the RFID part because

- the intentional radiator operates below 10 GHz and tenth harmonic of the highest fundamental frequency is lower than 1 GHz (see 47 CFR Part 15, section 15.33(a)(1), and RSS-Gen, section 6.13), and
- the digital part of the device does not generate or use internal frequencies higher than 108 MHz (see 47 CFR Part 15 section 15.33(b)(1), and RSS-Gen, section 2.3.3 with ICES-003, section 6.2).

6 Bandwidths

according to CFR 47 Part 2, section 2.202(a), and RSS-Gen, section 6.6

6.1 Test Location

See clause 4.1 on page 10.

6.2 Test instruments

See clause 4.2 on page 10.

6.3 Limits

The bandwidths are recorded only. There are no limits specified in CFR 47 Part 15, section 15.209, and RSS-210, section 4.3

6.4 Test setup

See clause 4.5 on page 13.

6.5 Test deviation

There is no deviation from the standards referred to.

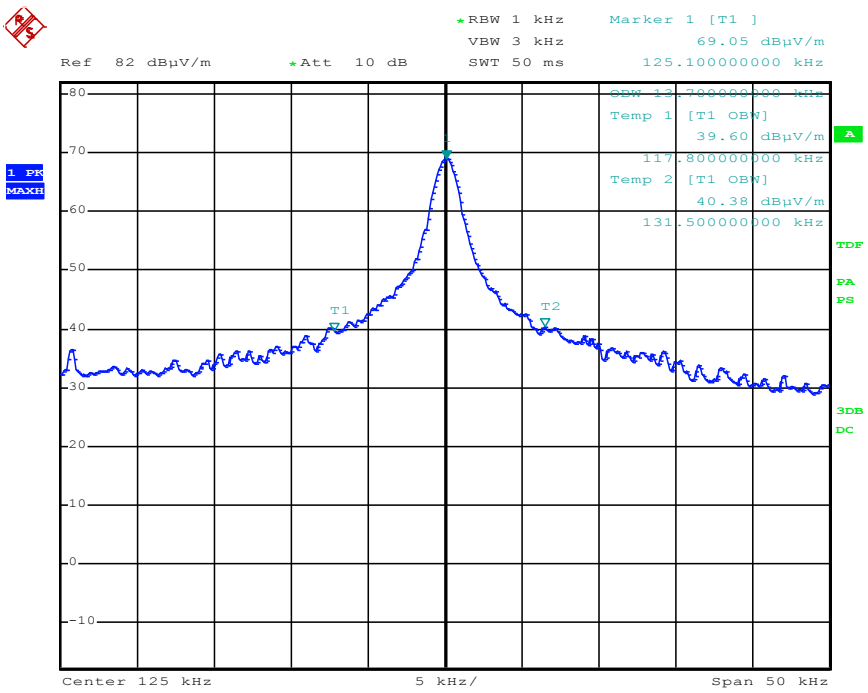
6.6 Test results

Temperature:	22°C	Humidity:	49%
Tested by:	Christian Kiermeier	Test date:	2017-08-08

Occupied bandwidth (99 %)

Test procedure

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured. The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.
The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth. For this purpose the appropriate measurement function of the spectrum analyzer is used.



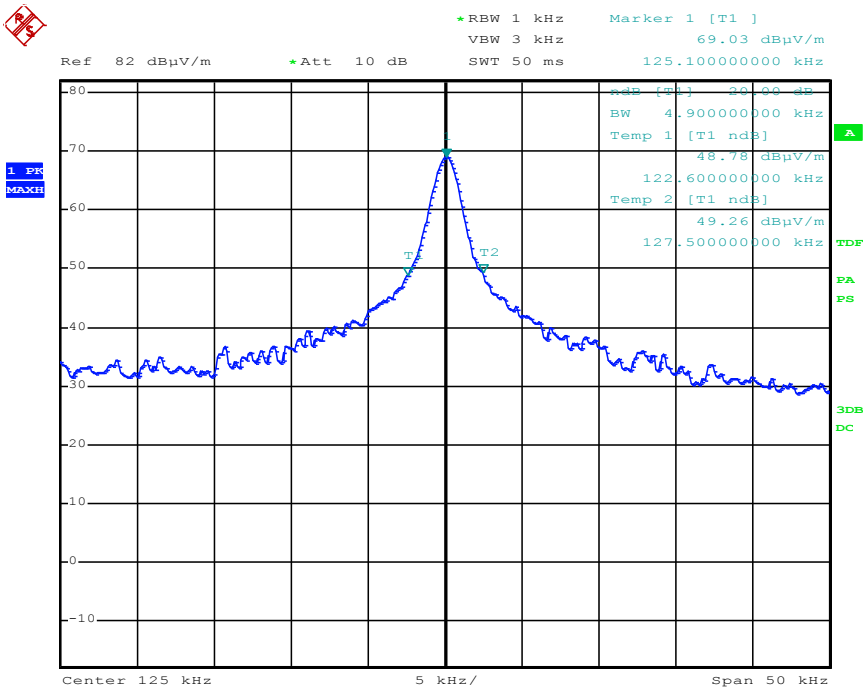
Picture 7: Occupied bandwidth (99 %)

Measured occupied bandwidth (99 %): 13.700 kHz

-20 dB emission bandwidth

Test procedure

Where indicated, the -20 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 20 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.



Picture 8: -20 dB emission bandwidth

Measured -20 dB emission bandwidth: 4.900 kHz

7 Equipment calibration status

Description	Modell number	Serial number	Inventory number(s)	Last calibration	Next calibration
Test receiver	ESCI	100013	E00001	2016-02	2018-02
Test receiver	ESR7	101059	E00739	2016-02	2018-02
Broadband antenna	VULB 9160	9160-3050	E00011	2014-09 (see note 1)	2017-09
Broadband antenna	VULB 9163	9163-114	E00013	2015-09	2017-09
Loop antenna	HFH2-Z2	871398/0050	E00060	2016-09	2018-09
Preamplifier	AMF-5D-00501800	1319793	W00089	2017-05	2019-05
Compact diagnostic chamber (CDC)	VK041.0174	D62128-A502-A69-2-0006	E00026	N/A	
Open area test site (OATS)	OATS	---	E00354	2015-10	2017-10
Semi-anechoic chamber (SAC)	P26726	C62128-A520-A643-x-0006	E00716	2017-03	2019-03
Cable set CDC	Cables no. 37 and 38	---	E00459 E00460	2017-05	2019-05
Cable set OATS 3 m	Cables no. 19, 34 and 36	---	E00453 E00456 E00458	2015-11	2017-11
Cable set SAC 3 m	Cables no. 57, 58 and 59	---	E00453 E00455 E00458	2015-10	2017-10

Table 1: Equipment calibration status

Note 1: Used for prescans only.

8 Measurement uncertainty

Description	Max. deviation	k
Conducted emission AMN (9kHz to 30 MHz)	± 4.0 dB	2
Radiated emission open field (30 MHz to 1 GHz)	± 4.5 dB	2
Radiated emission absorber chamber (> 1000 MHz)	± 5.4 dB	2

Table 2: Measurement uncertainty

The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k. For a confidence level of 95 % the coverage factor k is 2.

9 Revision History

Date	Description	Person	Revision
2017-08-31	First edition	Ch.Kiermeier	0