EMI – TEST REPORT

- FCC 15.231 -

Type / Model Name	:	3K FZV
Product Description	:	Keyless entry system
Applicant	:	FUBA Automotive Electronics GmbH
Address	:	TecCenter
		31162 BAD SALZDETFURTH, GERMANY
Manufacturer	:	FUBA Automotive Electronics GmbH
Address	:	TecCenter
		31162 BAD SALZDETFURTH, GERMANY
Licence holder	:	FUBA Automotive Electronics GmbH
Address	:	TecCenter
		31162 BAD SALZDETFURTH, GERMANY

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

Test Report No. : T36036-24-02HS	07. June 2016 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2015)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2015)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.231	Periodic operation in the band 40.66-40.70 MHz and above 70 MHz

ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
CISPR 16-4-2: 2013	Uncertainty in EMC measurement

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.2 Equipment type

Keyless entry system

2.3 Short description of the equipment under test (EUT)

The EUT is a remote keyless entry system fix installed in the car. The EUT is manual operated. The EUT has additionally an antenna preamplifier for AM/FM. The EUT is a multi-channel system using 3 RF channels and is controlled via LIN-Bus.

Number of tested samples: 6
Serial number: see variants

2.4 Variants of the EUT and antenna

The EUT has following variants:

Variants	Mercedes Part No.	Antenna	Kind of antenna	Ant. Gain	Serial number
V1	A218 905 12 02	C218	Screen antenna	2.9	0034
V2	A212 905 50 03	W212	Screen antenna	-3.0	28379208
V3	A212 905 81 03	S212	Screen antenna	2.2	28379220
V4	A218 905 10 02	X218	Screen antenna	-1.9	0028
V5	A207 905 64 03	A207	Screen antenna	-2.4	0011
V6	A207 905 62 03	C207	Screen antenna	-3.0	0022

2.5 Operation frequency and channel plan

Channel	Frequency
1	314.00 MHz
2	314.90 MHz
3	314.45 MHz

2.6 Transmit operating modes

The equipment under test was operated during the measurement under the following conditions:

- TX continuous carrier

- Polling mode

2.7 Power supply system utilised

Power supply voltage, V_{nom} : 12 VDC (car application)

2.8 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- Adapter board for remote control Model : self-made
- - Model : -
- Model :

2.9 Determination of worst case conditions for final measurement

Decision for the worst-case mode of the EUT:
- For final measurement the mode with the smallest duty cycle is selected, ID-Geber → FZV.
- The communication with THS has a lower duty cycle correction factor. This kind of transmission is identified by the EUT. This kind of acknowledge on this THS-request is appropriate reduced in output power. This is the reason why this case is not tested.

For the final test, the following channels and test modes are selected:

Entry system	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
315 MHz	1 to 3	1, 2, 3	2F	Digital	FSK	0.25 Mbps

CAR	Mercedes	DELPHI	Power Settings	PIN
C218	A218 905 12 02	28473060	1C	2
W212	A212 905 50 03	28379208	25	2
S212	A212 905 81 03	28379220	20	2
X218	A218 905 10 02	28473063	15	1
A207	A207 905 64 03	28473067	13	3
C207	A207 905 62 03	28473065	18	2

2.9.1 Test Jig

No test jig is used.

2.9.2 Test software

A special test software is used to set the EUT into TX-continuous. To measure the spurious emissions and the output power the carrier is unmodulated.

3 Test result summary

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	NA
15.231(b)	RSS210, A1.1.2	Field strength of the fundamental wave	P
15.231(b)	RSS-Gen, 6.5	Spurious emissions radiated (electric field)	P
15.231(c)	RSS-Gen, 6.10	Correction for pulse operation (duty cycle)	P
15.215(c)	RSS-Gen, 6.11	Frequency stability	P
15.231(a1)	RSS210, A1.1.1	Signal deactivation	P
-	RSS210, A1.1.3	Emission bandwidth and OBW99	P
1.1310	RSS 102, 2.5.2	Maximum permissible emission	P

Note: P (Pass), F (Fail), NT (Not tested), NA (Not applicable);

The mentioned RSS Rule Parts in the above table are related to:
RSS Gen, Issue 4, November 2014
RSS 210, Issue 8, December 2010
RSS 102, Issue 4, March 2010

3.1 FINAL ASSESSMENT:

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 11 November 2015

Testing concluded on : 11 December 2015

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this document
2016.06.07 09:35:44 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Hermann Smetana
I am the author of this document
2016.06.07 09:32:00 +02'00'

Hermann Smetana
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Environmental conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Measurement Protocol for FCC

4.4.1 GENERAL INFORMATION

4.4.1.1 Test methodology

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

The anechoic chamber site is a listed chamber under the Canadian Test-Sites File-No:

IC 3009A-02

In compliance with RSS 210, testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.1.3 General Standard information

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.10 “Testing Unlicensed Wireless Devices ". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

4.4.2 Conducted emission

Description of measurement

The final level in dBμV is taken directly from the EMI receiver. This level is compared to the FCC limit or to the CISPR limit.

To convert dBμV to μV, the following conversions apply:

dBμV = 20*log(μV);
μV = 10^(dBμV/20);

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50Ω/50 μH (CISPR 16) characteristics. Tabletop equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin of a peak mode measurement appears to be less than 20 dB, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

4.4.3 Radiated emission (electrical field 30 MHz - 1 GHz)

Description of measurement

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Tabletop equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.
The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency	Level	+	Factor	=	Level	-	CISPR Limit	=	Delta
(MHz)	(dBµV)		(dB)		(dBµV/m)		(dBµV/m)		(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.4.4 Radiated emission (electrical field 1 GHz - 40 GHz)

Description of measurement

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Tabletop equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

5 TEST RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: NONE

Remarks: Not applicable, the EUT is powered by battery.

5.2 Field strength of the fundamental wave

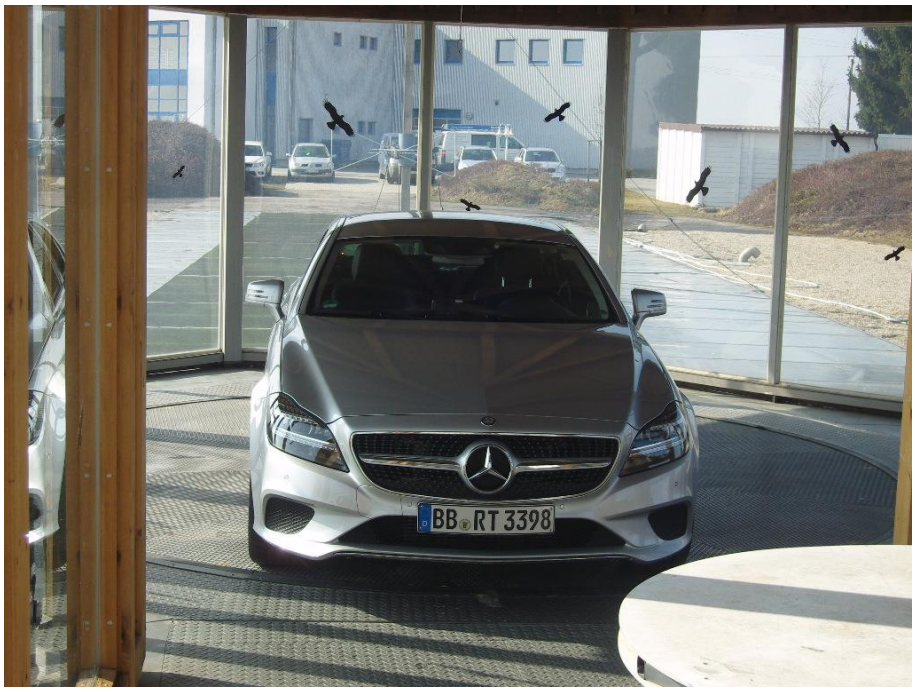
For test instruments and accessories used see section 6 Part **CPR 2, CPC2**.

5.2.1 Description of the test location

Test location: OATS 1

Test distance: 10 m

5.2.2 Photo documentation of the test set-up



5.2.3 Applicable standard

According to FCC Part 15C, Section 15.231(b):
The field strength of emissions from intentional radiators shall not exceed the effective field strength limits.

5.2.4 Description of Measurement

The radiated field strength of the fundamental wave from the EUT is measured in the frequency range of 30 to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The setup of the EUT will be in accordance to ANSI C63.4. The EUT is measured in TX continuous mode unmodulated under normal conditions. The measurement is done at distance 10 m because of the large dimension of the car. The measurement value is calculated to a distance of 3 m.
Spectrum analyser settings:
30 MHz – 1000 MHz: RBW: 100 kHz, VBW: 300 kHz, Detector: Peak;

5.2.5 Test result

CAR	Frequency	Level Pk	Bandwidth	Duty cycle	Level AV	Limit 315 MHz	Margin
	(MHz)	(dBµV/m)	(kHz)	(dB)	dB(µV/m)	dB(µV/m)	(dB)
C218	314.00	84.5	100	13.8	70.7	75.6	-4.9
C218	314.90	82.7	100	13.8	68.9	75.6	-6.7
C218	314.45	80.3	100	13.8	66.5	75.6	-9.1
W212	314.00	75.4	100	13.8	61.6	75.6	-14.0
W212	314.90	82.4	100	13.8	68.6	75.6	-7.0
W212	314.45	82.5	100	13.8	68.7	75.6	-6.9
S212	314.00	74.3	100	13.8	60.5	75.6	-15.1
S212	314.90	75.2	100	13.8	61.4	75.6	-14.2
S212	314.45	75.6	100	13.8	61.8	75.6	-13.8
X218	314.00	82.4	100	13.8	68.6	75.6	-7.0
X218	314.90	85.9	100	13.8	72.1	75.6	-3.5
X218	314.45	85.6	100	13.8	71.8	75.6	-3.8
A207	314.00	82.6	100	13.8	68.8	75.6	-6.8
A207	314.90	84.5	100	13.8	70.7	75.6	-4.9
A207	314.45	85.4	100	13.8	71.6	75.6	-4.0
C207	314.00	76.5	100	13.8	62.7	75.6	-12.9
C207	314.90	82.6	100	13.8	68.8	75.6	-6.8
C207	314.45	82.3	100	13.8	68.5	75.6	-7.1

Note: The C218 is measured radiated, the other cars are measured conducted and the field strength level is calculated by using the formula FS=A+G. Where A is the conducted level Pk and G the antenna gain. The antenna pin is used for measurement the other two pins are terminated with 50 Ohm.

Limit according to FCC Section 15.231(b):

Frequency	Field strength of fundamental @ 3m	
(MHz)	(µV/m)	dB(µV/m)
40.66 – 40.70	2250	67
70 - 130	1250	62
130 - 174	1250 to 3750*	62 to 71.4*
174 - 260	3750	71.4
260 - 470	3750 to 12500*	71.4 to 81.9*
Above 470	12500	81.9

*Linear interpolation

The requirements are **FULFILLED.**

Remarks: _____

_____

5.3 Spurious emissions radiated (electric field)

For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

5.3.1 Description of the test location

Test location:	OATS 1
Test distance:	10 m
Test location:	Anechoic chamber 1
Test distance:	3 m

5.3.2 Photo documentation of the test set-up

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.231(b), Section 15.209(a) and Section 15.205(a):
The emissions from intentional radiators shall not exceed the effective field strength limits.

5.3.4 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.10, Item 6.5. If the emission level of the EUT in peak mode complies with the average limit, then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported.

Instrument settings:
30 MHz – 1000 MHz: RBW: 120 kHz
1000 MHz – 4500 MHz RBW: 1 MHz
Example:

Frequency	Level		Factor		Level		Limit		Delta
(MHz)	(dBµV)		(dB)		dB(µV/m)		dB(µV/m)		(dB)
170.5	5	+	20	=	25	-	30	=	-5

5.3.5 Test result f < 1 GHz

The measurement is done at distance 10 m because of the large dimension of the car. The measurement value is calculated to a distance of 3 m.
C208:

Frequency	Bandwidth	Level PK	Limit PK	Delta Pk	Level AV	Limit AV	Delta AV
(MHz)	(kHz)	dB(µV/m)	dB(µV/m)	(dB)	dB(µV/m)	dB(µV/m)	(dB)
628	1000	28.7	75.6	-46.9	-	55.6	-46.9
628.9	1000	28.7	75.6	-46.9	-	55.6	-46.9
629.8	1000	30.6	75.6	-45.0	-	55.6	-45.0
942	1000	32.2	75.6	-43.4	-	55.6	-43.4
943.3	1000	33.1	75.6	-42.5	-	55.6	-42.5
944.7	1000	33.6	75.6	-42.0	-	55.6	-42.0

5.3.6 Test result f > 1 GHz

Frequency	Bandwidth	Level PK	Limit PK	Delta Pk	Level AV	Limit AV	Delta AV
(MHz)	(kHz)	dB(µV/m)	dB(µV/m)	(dB)	dB(µV/m)	dB(µV/m)	(dB)
1036	1000	55.1	75.6	-20.5	-	55.6	-20.5
1420	1000	55.5	75.6	-20.1	-	55.6	-20.1
1942	1000	55.6	75.6	-20.0	-	55.6	-20.0
2158	1000	51.0	75.6	-24.6	-	55.6	-24.6

FCC ID:WNS31121678 IC ID:3432F-31121678

Limit according to FCC Section 15.231(b), Section 15.209(a) and Section 15.205(a):

Frequency	Field strength of spurious		Effective limit for 315 MHz	
(MHz)	(µV/m)	dB(µV/m)	(µV/m)	dB(µV/m)
40.66 – 40.70	225	47	-	-
70 - 130	125	42	-	-
130 - 174	125 to 375*	42 to 51.4*	-	-
174 - 260	375	51,4	-	-
260 - 470	**375 to 1250***	**51.4 to 61.9***	**604**	**55.6**
Above 470	1250	61.9	-	-

*Linear interpolation

Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in the table above or to the general limits shown in the table below according to § 15.209, whichever limit permits a higher field strength.

Frequency (MHz)	15.209 Limits (µV/m)	15.209 Limits dB(µV/m)
30 - 88	100	40
88 - 216	150	43,5
216 - 960	**200**	**46**
Above 960	500	54

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

Restricted bands of operation according to FCC Part 15C, Section 15.205(a):

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

The requirements are **FULFILLED.**

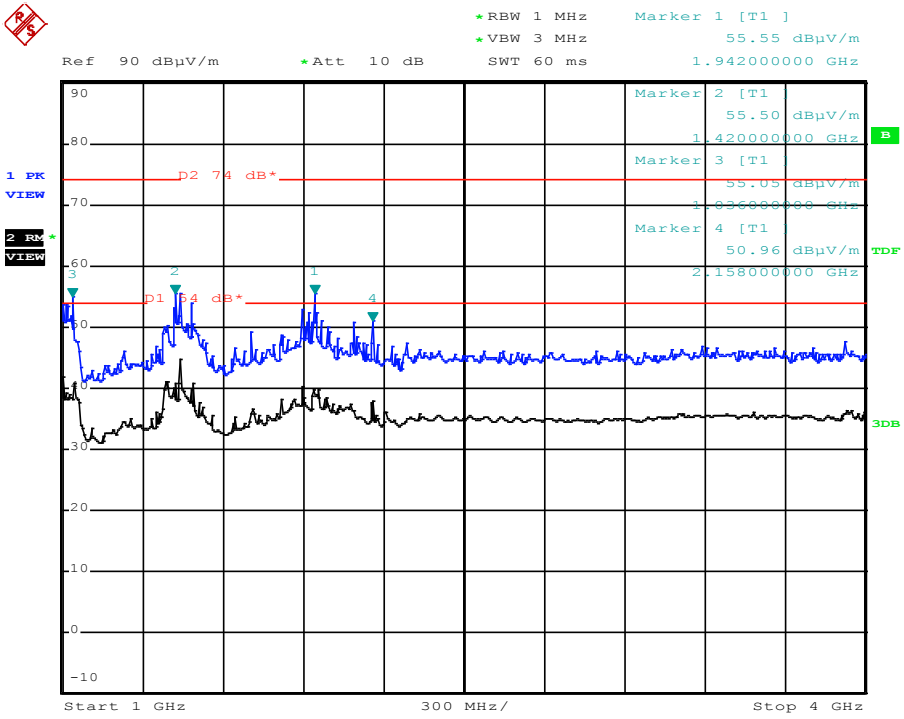
Remarks: The measurement was performed up to the 10th harmonic.

For detailed test results please see the following test protocols.

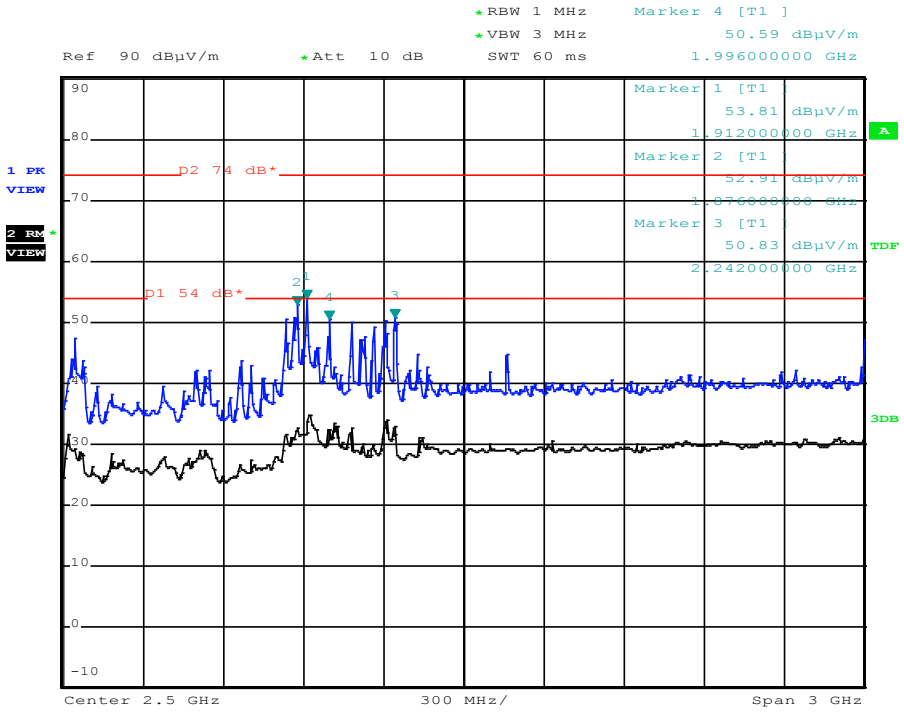
5.3.7 Test protocol spurious emissions

C208:

Emission 1-4 GHz, horizontal



Emission 1-4 GHz, vertical



5.4 Correction for pulse operation (duty cycle)

For test instruments and accessories used see section 6 Part **DC**.

5.4.1 Description of the test location

Test location: NONE

5.4.2 Applicable standard

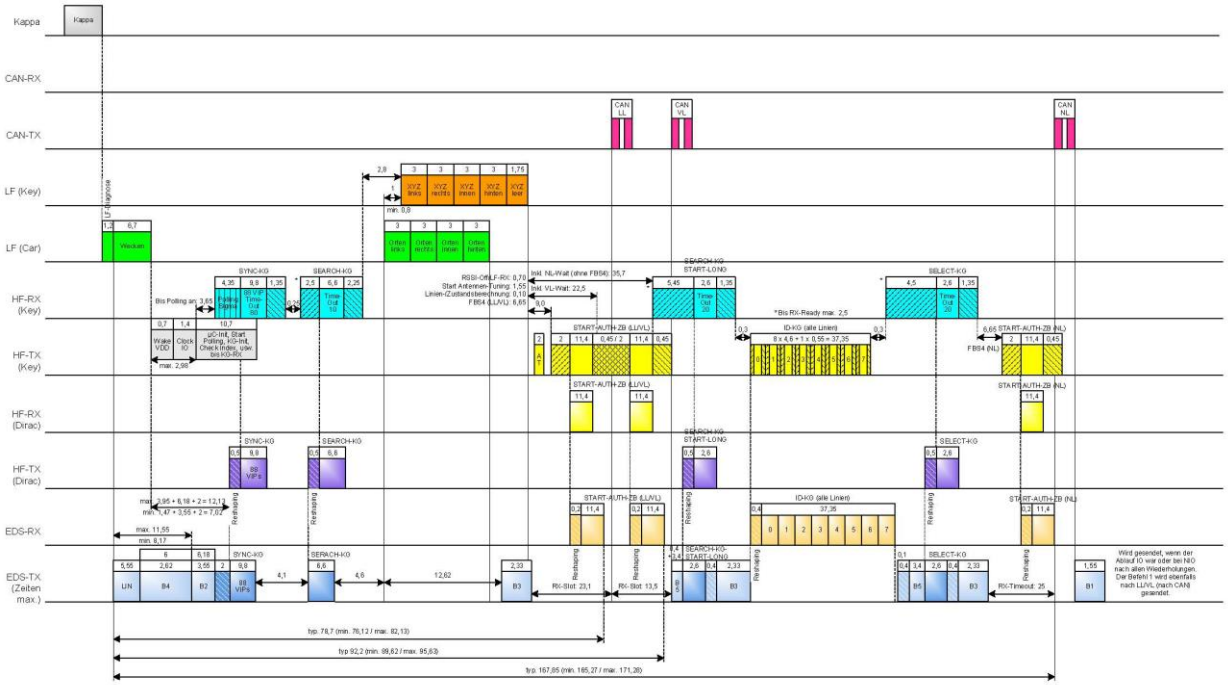
According to FCC Part 15C, Section 15.35(c):
The emissions from intentional radiators shall not exceed the effective field strength limits.

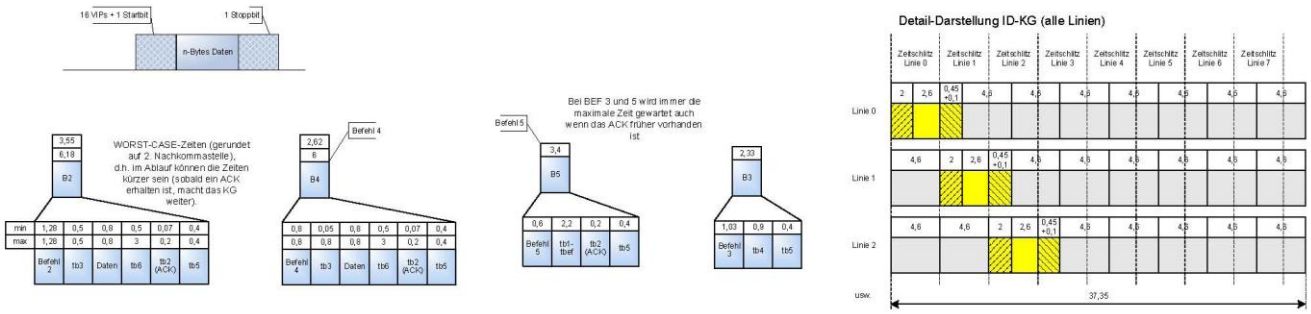
5.4.3 Description of measurement

The duty cycle timing is declared by the manufacturer with the following timing schedules

5.4.4 Test result

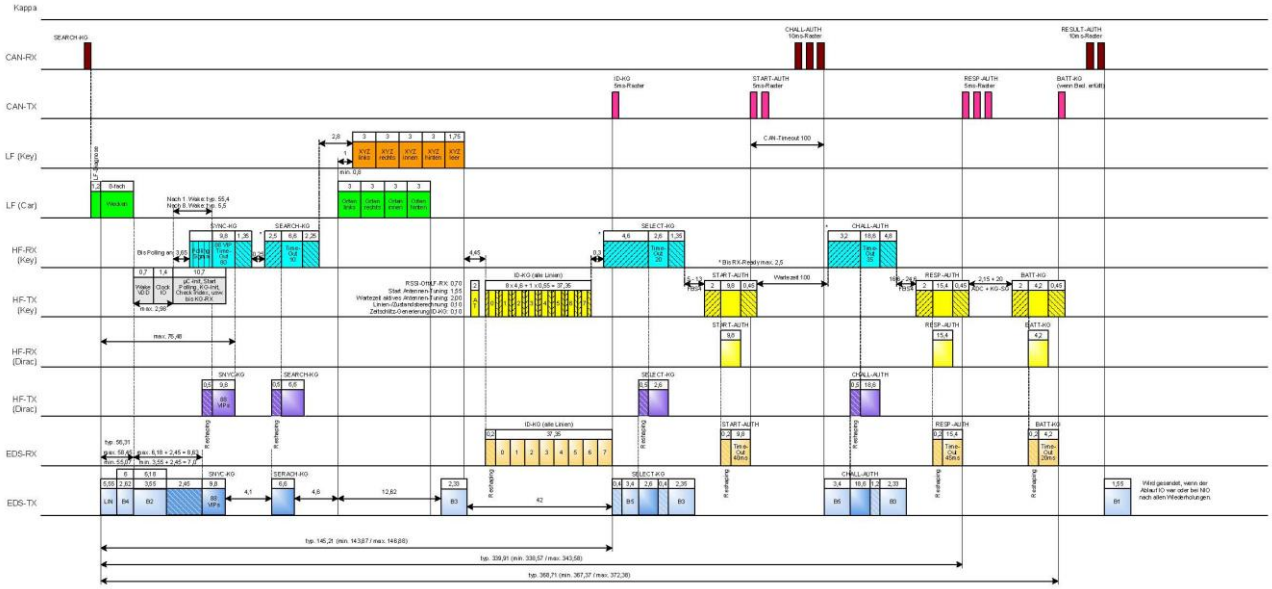
ZB timing





RF on time (puls train longer than 100 ms) 10.3 ms+7.1 ms + 3.1 ms = 20.5 ms

FB timing



The worst case of all kinds of pulses are puls trains with more than 2 pulses as described in the timing schedule before.

RF on time (puls train longer than 100 ms) 10.3 ms + 7.1 ms + 3.1 ms = 20.5 ms;

Duty cycle correction factor: 20 log (RF on time / 0.1 ms) = -13.8 dB;

Remarks: The pulse train (*Tw*) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulse widths over the 100 ms width with the highest average value.

5.5 Emission bandwidth and OBW99

For test instruments and accessories used see section 6 Part **MB**.

5.5.1 Description of the test location

Test location: NONE

Remarks: Not tested.

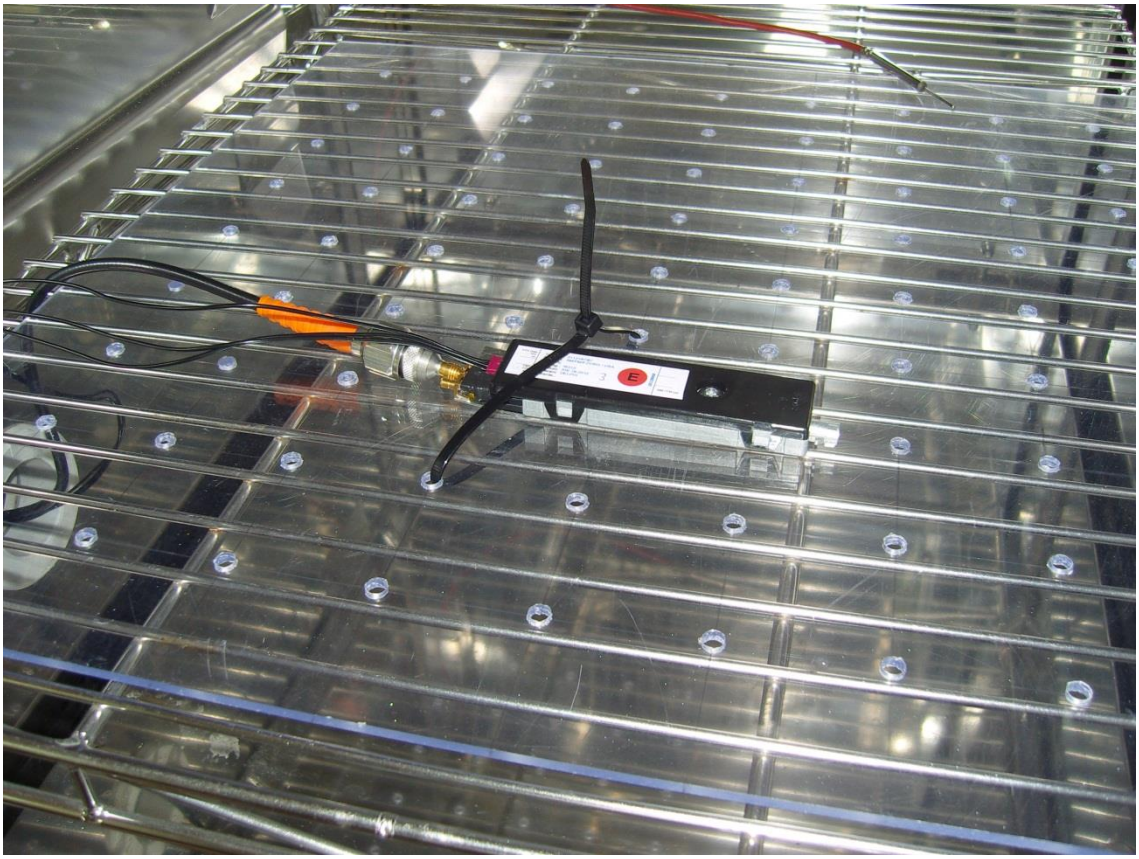
5.6 Frequency tolerance

For test instruments and accessories used see section 6 Part **FE**.

5.6.1 Description of the test location

Test location: AREA4

5.6.2 Photo documentation of the test set-up



5.6.3 Applicable standard

According to FCC Part 15C, Section 15.231(d):
The frequency tolerance of the carrier signal shall be maintained within a limit of the operating frequency over extreme conditions for devices operating in the frequency range of 40.66 MHz – 40.70 MHz.

5.6.4 Description of Measurement

The frequency tolerance is measured with the spectrum analyzer. The sweep points were set to maximum for higher the frequency resolution or the function “frequency counter” is used. The signal is unmodulated; the marker of the analyzer is set to maximum amplitude at normal temperature, the frequency was recorded. Than the maximum supply voltage is set and the marker of the analyzer is set to maximum amplitude. This procedure is done again for the minimum supply voltage. The EUT was now driven at normal supply voltage but in the climatic chamber to range the temperature from -20 °C to +50 °C in steps of 10 degrees. The drifting carrier is measured by setting the marker at the analyzer.

5.6.5 Test result

Test conditions		Test result
		Frequency (MHz)
T_{min} (-20)°C	V_{nom}	314.451383
T (-10)°C	V_{nom}	314.451847
T (0)°C	V_{nom}	314.451166
T (10)°C	V_{nom}	314.449928
T_{nom} (20)°C	V_{min} (10.2 V)	314.446921
T_{nom} (20)°C	V_{nom} (12 V)	314.446943
T_{nom} (20)°C	V_{max} (13.8 V)	314.446914
T (30)°C	V_{nom}	314.446971
T (40)°C	V_{nom}	314.444241
T_{max} (50)°C	V_{nom}	314.443292

Carrier frequency f_c	314.446943 MHz
Max tolerance	no limit
Highest frequency f_h	314.451847 MHz
Lowest frequency f_l	314.443292 MHz
Negative tolerance $f_l - f_c$	-3.651 kHz
Positive tolerance $f_h - f_c$	4.904 kHz

Limit according to FCC Part 15C, Section 15.231(d):

For devices operating in the frequency range of 40.66 MHz – 40.70 MHz the frequency tolerance of t he carrier signal shall be maintained within ±0.01 % of the operating frequency over a temperature range of -20 °C to +50 °C at normal supply voltage and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of 20 °C. For battery operated equipment, the equipment shall be performed using a new battery.

The requirements are **FULFILLED.**

Remarks: No limit for 315 MHz devices.

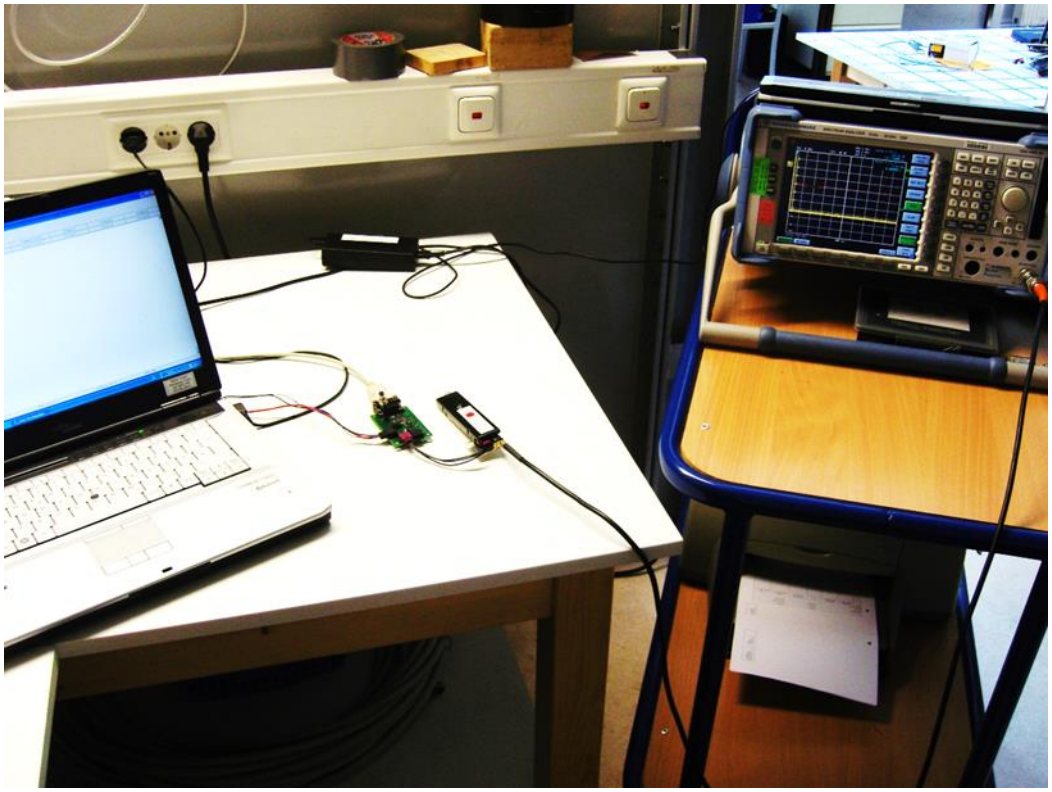
5.7 Signal deactivation

For test instruments and accessories used see section 6 Part **MB**.

5.7.1 Description of the test location

Test location: AREA4

5.7.2 Photo documentation of the test set-up



5.7.1 Applicable standard

According to FCC Part 15C, Section 15.231(a)(1):
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter not exceeding the defined on time limit.

5.7.2 Description of measurement

The duration of transmission is measured with the spectrum analyzer. The sweep points were set to maximum for higher the time resolution. The signal is modulated; the analyser is set to zero span, single sweep and triggered on the button, the marker was set to the edges in order to measure the duration time and than recorded.

5.7.3 Test result

Duration of transmission (ms)	Duration after releasing the button (ms)
20.5	126.4

Limit according to FCC Part 15C, Section 15.231(a):
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released and a transmitter activated automatically shall cease transmission within 5 seconds after activation.

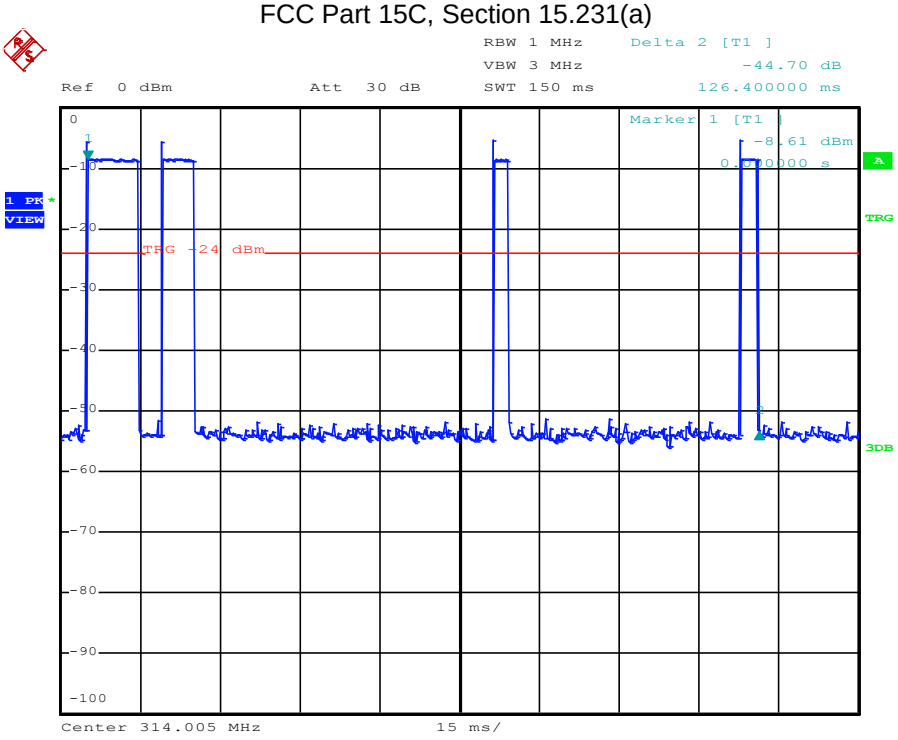
The requirements are **FULFILLED.**

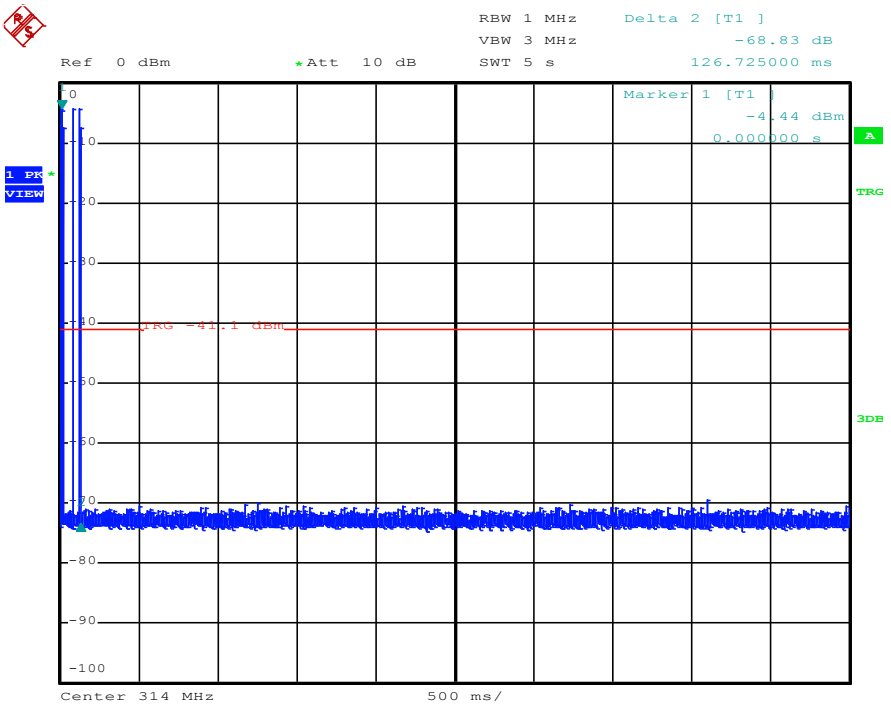
Remarks: For detailed test results, please see the test protocol below.

5.7.4 Test protocol

Signal deactivation

FCC Part 15C, Section 15.231(a)





6 HUMAN EXPOSURE

6.1 Maximum permissible exposure (MPE)

For test instruments and accessories used see section 6 Part **CPC 3**.

- **Description of the test location**

Test location: AREA4

- **Applicable standard**

This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

- **Description of Measurement**

The maximum total power input to the antenna has been measured conducted as described in clause 5.3 of this document. Through the Friis transmission formula, the known maximum gain of the antenna and the maximum power, can be calculated the MPE in a defined distance away from the product.

Friis transmission formula: $$P_d = \frac{P_{out} * G}{4 * \Pi * r^2}$$

Where:
P_d =power density (mW/cm^2)
P_{out} = output power to antenna (mW)
G = gain of antenna (linear scale)
r = distance between antenna and observation point (cm)

According to FCC Rules 47CFR 2.1093(b) the EUT is not a portable device. The EUT is designed to be used that radiating structures are 20 cm outside of the body of the user. (r = 20 cm)

- **Test result**

Power calculation:

Car	FS (dBµV/m	conversion	EIRP (dBm)	EIRP (mW)
C218	70.7	95.2	-24.5	0.003548
W212	68.6	95.2	-26.6	0.002188
S212	61.8	95.2	-33.4	0.000457
X218	72.1	95.2	-23.1	0.004898
A207	71.6	95.2	-23.6	0.004365
C207	68.8	95.2	-26.4	0.002291

FCC ID:WNS31121678 IC ID:3432F-31121678

MPE:

Car	frequency	P_{EIRP} max	P	P	P_d	Limit P_d
	(MHz)	(dBm)	(mW)	(W)	(mW/cm^2)	(mW/cm^2)
C218	315	-24.5	0.004	0.000004	0.0000007	0.13
W212	315	-26.6	0.002	0.000002	0.0000004	0.13
S212	315	-33.4	0.000	0.000000	0.0000001	0.13
X218	315	-23.1	0.005	0.000005	0.0000010	0.13
A207	315	-23.6	0.004	0.000004	0.0000009	0.13
C207	315	-26.4	0.002	0.000002	0.0000005	0.13

Limits for maximum permissible exposure (MPE) according FCC Part 1, Section 1.1310:

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(B) Limits for General Population / Uncontrolled Exposure				
0.3 – 3.0	614	1.63	100	30
3.0 – 30	824/*f*	2.19/*f*	180/ f^2	30
30 - 300	27.5	0.073	0.2	30
300-1500	**---**	**---**	***f*/1500**	**30**
1500-100000	---	---	1.0	30

f = Frequency in MHz

Limit according RSS102:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	**Electric Field (V/m rms)**	**Magnetic Field (A/m rms)**	**Power Density (W/m2)**	**Reference Period (minutes)**
0.003-1021	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1,291	6
300-6000	$\mathbf{3.142 f^{0.3417}}$	$\mathbf{0.008335 f^{0.3417}}$	$\mathbf{0.02619 f^{0.6834}}$	**6**
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR

Limit calculation:

Applied frequency (MHz)	RSS102 Power density limit (W/m^2)	RSS102 Power density limit (mW/cm^2)	FCC-limit (mW/cm2)
315	1.3	0.13	0.21

The requirements are **FULFILLED.**

Remarks: _____

7 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPC 2	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
CPR 2	ESVS 30	02-02/03-05-003	09/07/2016	09/07/2015		
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015	29/02/2016	31/08/2015
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 2	ESVS 30	02-02/03-05-003	09/07/2016	09/07/2015		
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015	29/02/2016	31/08/2015
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSP 40	02-02/11-11-001	28/10/2016	28/10/2015		
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	BBHA 9120 E 251	02-02/24-05-006	27/04/2016	27/04/2015	13/07/2016	13/01/2016
	Sucoflex N-2000-SMA	02-02/50-05-075				
	SF104/11N/11N/1500MM	02-02/50-13-015				
	SF104/11SMA/11N/1500MM	02-02/50-13-016				