



EMI - T E S T R E P O R T

- Human Exposure -

Type / Model Name : CSM 4

Product Description : Car Sharing Module with Bluetooth Low Energy

Applicant : Fuba Automotive Electronics GmbH

Address : TecCenter 1

31162 Bad Salzdetfurth, GERMANY

Manufacturer : Fuba Automotive Electronics GmbH

Address : TecCenter 1

31162 Bad Salzdetfurth, GERMANY

Test Result according to the standards listed in clause 1 test standards:	POSITIVE
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Test Report No. :	T45165-00-02KS	22. March 2019
		Date of issue



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

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test results
without the written permission of the test laboratory.

Contents

1 TEST STANDARDS	3
2 EQUIPMENT UNDER TEST	4
2.1 Photo documentation of the EUT – See ATTACHMENT A	4
2.2 Equipment type, category	4
2.3 Short description of the equipment under test (EUT)	4
2.4 Variants of the EUT	4
2.5 Operation frequency and channel plan	4
2.6 Transmit operating modes	5
2.7 Antennas	5
2.8 Power supply system utilised	5
3 TEST RESULT SUMMARY	6
3.1 Final assessment	6
4 TEST ENVIRONMENT	7
4.1 Address of the test laboratory	7
4.2 Environmental conditions	7
4.3 Statement of the measurement uncertainty	7
5 HUMAN EXPOSURE	8
5.1 Maximum permissible exposure (MPE)	8
5.2 Co-location and Co-transmission	10
5.3 SAR test exclusion considerations	10
5.4 Exemption limits for routine evaluation - SAR evaluation	10

ATTACHMENT A as separate supplement

FCC ID: WNS-CSM4

IC: 3432F-CSM4

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1091	Radiofrequency radiation exposure evaluation: mobile devices .
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable devices.
KDB 447498 D01 v06	Mobile and portable devices RF Exposure procedures and equipment authorisation policies, October 23, 2015.
KDB 865664 D01 v01r04	SAR Measurement Requirements for 100 MHz to 6 GHz, August 7, 2015.
ANSI C95.1: 2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
ETSI TR 100 028 V1.3.1: 2001-03,	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2

FCC ID: WNS-CSM4

IC: 3432F-CSM4

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – See ATTACHMENT A

2.2 Equipment type, category

BLE device mobile equipment.

2.3 Short description of the equipment under test (EUT)

The CSM4 (EUT) is a car sharing module using BLE wireless technology. The EUT is compatible with IEEE Standard 802.15.1. It supports the 2.4 GHz frequency band and supports no beam forming. The EUT has only one integrated antenna, no temporary connector and no external antenna can be connected. The modulation used by the EUT is GFSK with a data rate of 1 Mbit/s.

Number of tested samples:	1 conducted sample	1 radiated sample
Serial number:	1190170002	FUBA SN 003
HW version:	30005171	D1 – Muster
SW version:	000.028.017	TI Standard Software

2.4 Variants of the EUT

None.

2.5 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel	Frequency	Channel	Frequency
37	2402	18	2442
0	2404	19	2444
1	2406	20	2446
2	2408	21	2448
3	2410	22	2450
4	2412	23	2452
5	2414	24	2454
6	2416	25	2456
7	2418	26	2458
8	2420	27	2460
9	2422	28	2462
10	2424	29	2464
38	2426	30	2466
11	2428	31	2468
12	2430	32	2470
13	2432	33	2472
14	2434	34	2474
15	2436	35	2476
16	2438	36	2478
17	2440	39	2480

Note: the marked frequencies are determined for final testing.

FCC ID: WNS-CSM4

IC: 3432F-CSM4

2.6 Transmit operating modes

The EUT uses GFSK modulation and may provide following data rates:

- 1000 kbps

(kbps = *kilobits per second*)

2.7 Antennas

The following antenna shall be used with the EUT:

Number	Characteristic	Type	Plug	f-range (GHz)	Gain (dBi)
1	Omni	PCB antenna	none	2.4 - 2.4835	5.0

2.8 Power supply system utilised

Power supply voltage, V_{nom} : 12 VDC

FCC ID: WNS-CSM4

IC: 3432F-CSM4

3 TEST RESULT SUMMARY

Operating in the 2400 MHz – 2483.5 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.247(i)	RSS 102, 2.5.2	MPE	passed
KDB 447498	RSS 102, 2.5.1	SAR exclusion consideration	not applicable
OET Bulletin 65	RSS102, 3.2	Co-location, Co-transmission	not applicable

The mentioned RSS Rule Parts in the above table are related to:
RSS 102, Issue 5, March 2015

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 : 01 March 2019

Testing concluded on : 11 March 2019

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Kathrin Schiebl
Radio Team

FCC ID: WNS-CSM4

IC: 3432F-CSM4

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.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 30000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	± 2.71 dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	± 2.71 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	± 2.15 dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	± 3.47 dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	± 3.53 dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	± 4.44 dB
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	± 2.34 dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	± 5.13 dB

FCC ID: WNS-CSM4

IC: 3432F-CSM4

5 HUMAN EXPOSURE

5.1 Maximum permissible exposure (MPE)

5.1.1 Description of the test location

Test location: NONE

5.1.2 Applicable standard

According to FCC Part 15, Section 15.247(i):

Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

The test methods used comply with ANSI/IEEE C95.1, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".

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).

5.1.3 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/cm²)

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)

FCC ID: WNS-CSM4

IC: 3432F-CSM4

5.1.4 Test result

For FCC:

Rated output power:	5 dBm	3.2 mW
Tune-up tolerance:	2.00 dB	
Maximum output power:	7.1 dBm	5.1 mW
Antenna gain max:	5.00 dBi	
Maximum EIRP:	12.1 dBm	16.0 mW
Minimum distance r:	20.0 cm	

Channel	Antgain	EIRP	EIRP	G	EIRP	S	Limit S _{eq}	Margin	Exposure ratio
No.	(dBi)	(dBm)	(mW)	linear	(W)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
37	5.0	12.1	16.04	3.16	0.0160	0.0032	1.0	-0.9968	0.32
17	5.0	12.1	16.04	3.16	0.0160	0.0032	1.0	-0.9968	0.32
39	5.0	12.1	16.04	3.16	0.0160	0.0032	1.0	-0.9968	0.32

Limits for maximum permissible exposure (MPE):

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 – 1.34	614	1.63	100	30
1.34 – 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

For ISED:

Frequency	Antgain	EIRP	Factor	f ^{0.6834}	Limit	Margin
MHz	(dBi)	(W)		(W)	(W)	(W)
2402	5.0	0.016	0.0131	204.3072	2.676	-2.6604
2440	5.0	0.016	0.0131	206.5105	2.705	-2.6892
2480	5.0	0.016	0.0131	208.8182	2.736	-2.7195

Exemption limits for routine Evaluation – RF exposure evaluation according RSS102, 2.5.2:

At or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;

At or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance)

The requirements are **FULFILLED**.

Remarks: _____

FCC ID: WNS-CSM4

IC: 3432F-CSM4

5.2 Co-location and Co-transmission

Remarks: Not applicable, the EUT is a single transmitter.

5.3 SAR test exclusion considerations

Remarks: Not applicable, the distance between the user and the EUT is more than 20 cm, therefore MPE is considered.

5.4 Exemption limits for routine evaluation - SAR evaluation

Remarks: Not applicable, the distance between the user and the EUT is more than 20 cm, therefore MPE is considered.