



EMI - TEST REPORT

- FCC Part 15.209 -

Type / Model Name : HFM403

Product Description : Radio frequency transmitter-receiver

Applicant : Continental Automotive GmbH

Address : Siemensstrasse 12
93055 Regensburg, Germany

Manufacturer : Continental Automotive GmbH

Address : Siemensstrasse 12
93055 Regensburg, Germany

Test Result according to the standards listed in clause 1 test standards:	POSITIVE
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Test Report No. : T46946-01-00HU	22. June 2021 Date of issue
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DAkkS
Deutsche
Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

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2 SUMMARY

GENERAL REMARKS:

The EuT is working at frequency of 125.0 kHz.

The EUT is a part of a locking system, the test was performed in all three orientations; X, Y and Z-axis (flat, upright and side position of the EuT). The values in the table are show the maximum measured value in the worst case position of the EuT.

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 : 19. October 2020

Testing concluded on : 20. October 2020

Checked by:

Tested by:

Gegenfurtner Klaus
Teamleader Radio

Huber Markus

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see Attachment A

3.2 Power supply system utilised

Power supply voltage: : 12.0 V / DC (vehicle battery)

3.3 Short description of the Equipment under Test (EUT)

The EUT is an immobilizer system for vehicular use. It will be powered via vehicle battery.

Number of tested samples: 1 System

Serial number: Prototype

EUT operation mode:

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

- Tx mode at 125.0 kHz (APRUN Radiated)

-

-

EUT configuration:

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

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

- _____ Model : _____

- customer specific cables

- unscreened power cables

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 Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
20 dB Bandwidth	Center frequency of EuT	95%	$\pm 2.5 \times 10^{-7}$
99% Occupied Bandwidth	Center frequency of EuT	95%	$\pm 2.5 \times 10^{-7}$
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Peak conducted output power	902 MHz to 928 MHz	95%	± 0.35 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB

FCC ID: KR5HFM403**4.4 Measurement Protocol for FCC, VCCI and AUSTEL****4.4.1 GENERAL INFORMATION****4.4.1.1 Test methodology**

The test methods used comply with ANSI C63.10, „Testing Unlicensed Wireless Devices “.

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 information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011**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 C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". 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 C63.4 and applying the CISPR 22 limits.

4.5 Deviations or Exclusions from the Requirements and Standards

- NONE -

5 TEST CONDITIONS AND 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

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

5.1.4 Test result

Frequency range:

Min. limit margin

Remarks: The measurement is not applicable. The EuT is powered via vehicle battery.

FCC ID: KR5HFM403**5.2 Field strength of the fundamental wave**

For test instruments and accessories used see section 6 Part **CPR 1**.

5.2.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.2.2 Photo documentation of the test set-up – See attachment B**5.2.3 Applicable standard**

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

5.2.4 Description of Measurement

The spurious emissions of the EUT have to be measured at an open area test site in the frequency range from 9 kHz to 1000 MHz using a tuned EMI receiver. The setup of the equipment under test will be in accordance with ANSI C63.4. The measurement has been performed at 3 m. The results have been compared to the limits defined at 30 m or 300 m distances according to FCC Part 15C, Section 15.31(f)(2) using an inverse linear distance extrapolation factor of 40 dB/decade. The final measurement has been performed with the EMI receiver using Quasi peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used, according to Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz:	RBW:	200 Hz
150 kHz – 30 MHz:	RBW:	9 kHz

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Example:

$$\begin{array}{rclclclclcl}
 \text{Frequency} & & \text{Level} & + & \text{Factor} & = & \text{Level} & - & \text{Limit} & = & \text{Delta} \\
 \text{(MHz)} & & \text{(dB}\mu\text{V)} & & \text{(dB)} & & \text{dB}(\mu\text{V/m)} & & \text{dB}(\mu\text{V/m)} & & \text{(dB)} \\
 1.705 & & 5 & + & 20 & = & 25 & - & 30 & = & -5
 \end{array}$$

5.2.5 Test result

Measurement distance: 3 m

Frequency (kHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Bandwidth (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
125.0	88.7	78.5	77.9	0.2	20	108.7	98.5	97.9	105.67	-7.8

Calculated value at distance: 300 m

Frequency (kHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Bandwidth (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
125.0	8.7	-1.5	-2.1	0.2	20	28.7	18.5	17.9	25.67	-7.8

Note: To find out the maximum magnetic field strength, test was performed in all three orientations; X, Y and Z-axis (flat, upright and side position of the EuT). The values in the table are show the maximum measured value in the worst-case position of the EuT (Photo documentation of the test set-up).

Limit according to FCC Part 15C, Section 15.209(a):

Frequency (MHz)	Field strength of fundamental wave (μV/m)	Field strength of fundamental wave dB(μV/m)	Measurement distance (metres)
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED**.

Remarks:

FCC ID: KR5HFM403**5.3 Spurious emissions (magnetic field) 9 kHz – 30 MHz**

For test instruments and accessories used see section 6 Part SER 1.

5.3.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

5.3.2 Photo documentation of the test set- up – See attachment B**5.3.3 Applicable standard**

According to FCC Part 15C, Section 15.209:

The emissions from intentional radiators shall not exceed the effective field strength limits.

5.3.4 Description of Measurement

The spurious emissions of the EUT have to be measured at an open area test site in the frequency range from 9 kHz to 1000 MHz using a tuned EMI receiver. The setup of the equipment under test will be in accordance with ANSI C63.4. The measurement has been performed at 3 m. The results have been compared to the limits defined at 30 m or 300 m distances according to FCC Part 15C, Section 15.31(f)(2) using an inverse linear distance extrapolation factor of 40 dB/decade. The final measurement has been performed with the EMI receiver using Quasi peak detector except for the frequency bands 9 kHz to 90 kHz and 110 to 490 kHz where an average detector will be used, according to Section 15.209(d).

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz:	RBW:	200 Hz
150 kHz – 30 MHz:	RBW:	9 kHz

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Example:

Frequency (MHz)	Level (dBμV)	+	Factor (dB)	=	Level dB(μV/m)	-	Limit dB(μV/m)	=	Delta (dB)
1.705	5	+	20	=	25	-	30	=	-5

5.3.5 Test result

Measurement distance: 3 m

Frequency (MHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
0.250	29.71	21.34	10.57	9	20	49.71	41.34	30.57	99.65	-69.1
0.375	19.48	9.52	1.31	9	20	39.48	29.52	21.31	96.12	-74.8

Calculated value at distance: 300m

Frequency (MHz)	Level PK (dBμV)	Level QP (dBμV)	Level AV (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level QP dB(μV/m)	Corrected Level AV dB(μV/m)	Limit AV dB(μV/m)	Delta (dB)
0.250	-50.29	-58.69	-69.43	9	20	-30.29	-38.69	-49.43	19.65	-69.1
0.375	-60.52	-70.48	-78.69	9	20	-40.52	-50.48	-58.69	16.12	-74.8

Values at distance: 30m

Frequency (MHz)	Level PK (dBμV)	Level AV (dBμV)	Level QP (dBμV)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μV/m)	Corrected Level AV dB(μV/m)	Corrected Level QP dB(μV/m)	Limit dB(μV/m)	Delta (dB)
0.49 – 30.0				9	20				29.5	> 70

Note: To find out the maximum magnetic field strength, test was performed in all three orientations; X, Y and Z-axis (flat, upright and side position of the EuT). The values in the table are show the maximum measured value in the worst-case position of the EuT (Photo documentation of the test set-up).

Limit according to FCC Part 15 Subpart 15.209(a):

Frequency (MHz)	Field strength of spurious emissions (μV/m)	Field strength of spurious emissions dB(μV/m)	Measurement distance (metres)
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F (kHz)	--	30
1.705-30.0	30	29.5	30

The requirements are **FULFILLED**.

Remarks:

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5.4 Emission Bandwidth

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

5.4.1 Description of the test location

Test location: AREA4

5.4.2 Photo documentation of the test set-up – See attachment B

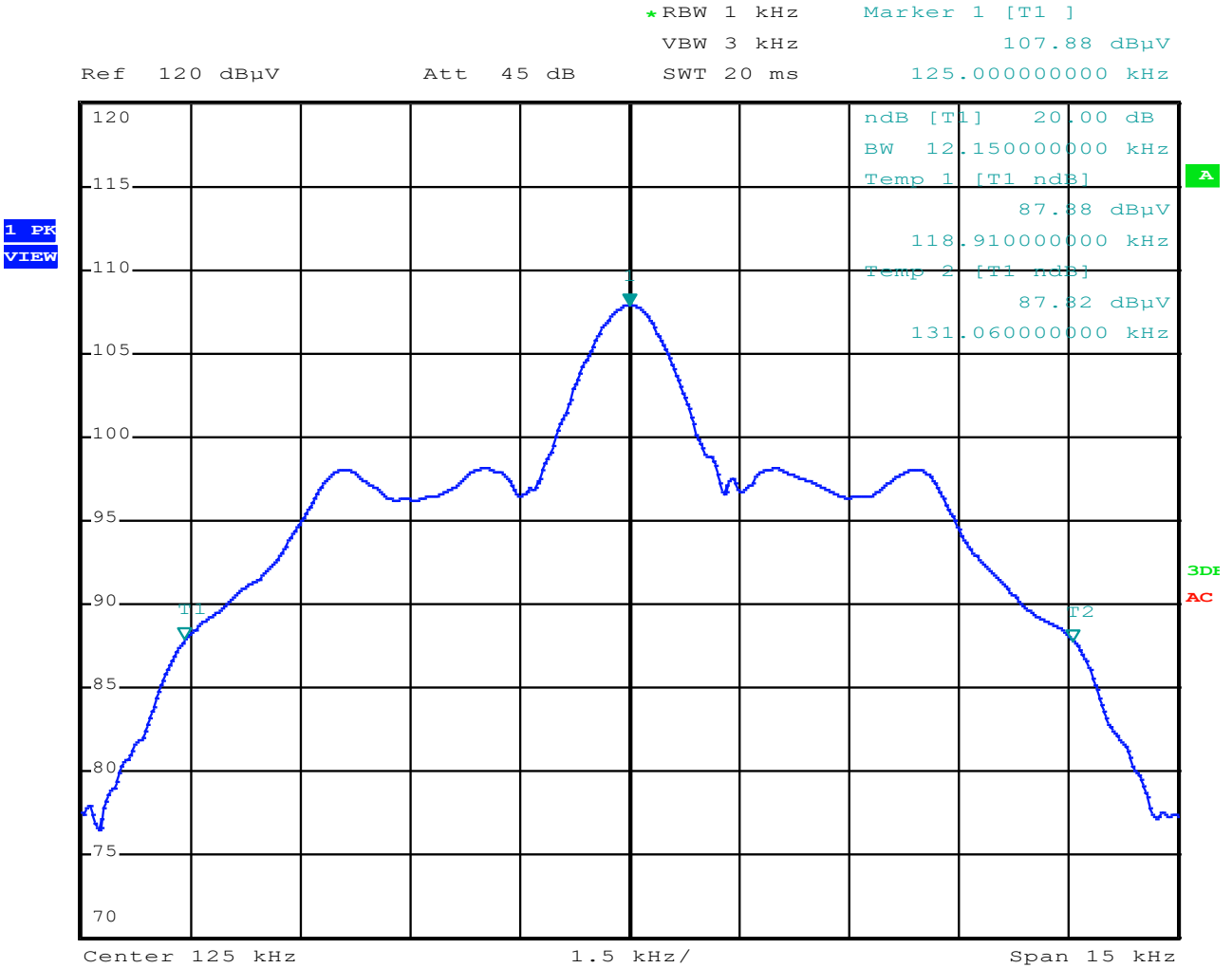
Fundamental [kHz] See Plot 1	20dB Bandwidth F1	20dB Bandwidth F2	Measured Bandwidth [kHz]
125.0	118.91	131.06	12.15

Remarks:

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5.4.3 Test protocol

Emission Bandwidth plots



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6 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.
CPR 1	ESCI	02-02/03-05-005	04/12/2020	04/12/2019		
	HFH 2 - Z 2	02-02/24-15-001	01/04/2021	01/04/2020		
	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				
MB	ESCI	02-02/03-05-005	04/12/2020	04/12/2019		
	HFRAE 5161 _ 50 kHz-120	02-02/24-11-004				
	METRAHIT WORLD	02-02/32-15-001	16/12/2020	16/12/2019		
	6543A	02-02/50-05-157				
SER 1	ESCI	02-02/03-05-005	04/12/2020	04/12/2019		
	HFH 2 - Z 2	02-02/24-15-001	01/04/2021	01/04/2020		
	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	02-02/03-05-006	15/07/2021	15/07/2020		
	VULB 9168	02-02/24-05-005	17/09/2021	28/09/2020		
	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				