Registration No. DAT-P-207/05

FCC ID: SP3-02201000

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

- FCC Part 15.231 -

Test Report No. : **T34252-00-02HS**	10. September 2010 Date of issue

Type / Model Name : 02201000

Product Description : FBDII transceiver of keyless entry system

Applicant : Kathrein-Werke KG

Address : Anton-Kathrein-Str. 1-3

83004 ROSENHEIM, GERMANY

Manufacturer : Kathrein-Werke KG

Address : Anton-Kathrein-Str. 1-3

83004 ROSENHEIM, GERMANY

Licence holder : Kathrein-Werke KG

Address : Anton-Kathrein-Str. 1-3

83004 ROSENHEIM, GERMANY

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

Deutscher Akkreditierungs Rat

DAT-P-207/05-00

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (October, 2009)

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 (October, 2009)

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 C63.4: 2003	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment

2 SUMMARY

GENERAL REMARKS:

The EUT is a device with dedicated antenna. The antenna is realised as a special structure in the rear window defroster of a car. For the firmware output power setting please see point 4.5 determination of worst case. The measurements with antenna were performed using an original installed window antenna in a trunk of a car in order to get real circumstances for radiating.

Operation modes:
TX modes, the EUT can be set into special operation modes for measurement purposes are not available in the application. As TX mode can be set TX continuous modulated and unmodulated.
RX mode, the EUT cannot be switched off; therefore the RX mode is similar as the standby mode. The lowest power consumption is reached, nearly all activities are stopped. If the key ID is received, the EUT wake up and works as intended.

The EUT may have the following options:

AM/FM-DIVERSITY/WB/FBDII 315	**F25**

This test report is based on the model with all options.

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 : 20 August 2010

Testing concluded on : 23 August 2010

Checked by:

Klaus Gegenfurtner
I confirm the correctness and integrity of this document
2010.09.17 10:57:04 +02'00'

Klaus Gegenfurtner
Dipl.-Ing.(FH)
Manager: Radio Group

Tested by:

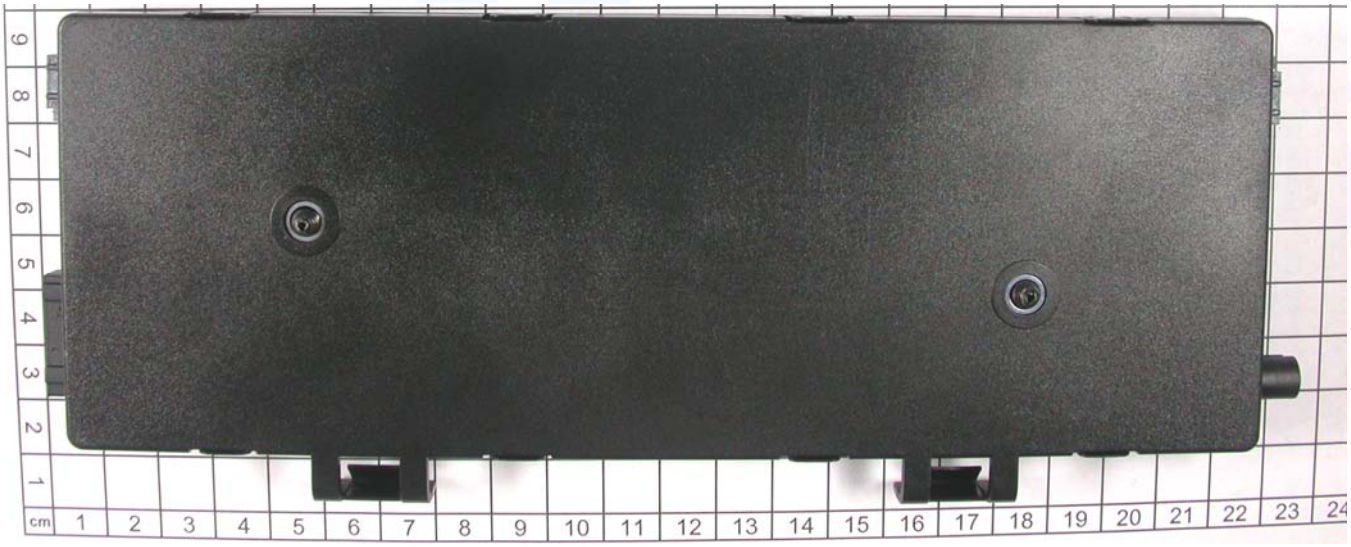
Hermann Smetana
I am the author of this document
2010.09.17 10:36:24 +02'00'

Hermann Smetana
Dipl.-Ing.(FH)
Radio Expert

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT

External view:

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F25 AM/FM/FBD 315
S08
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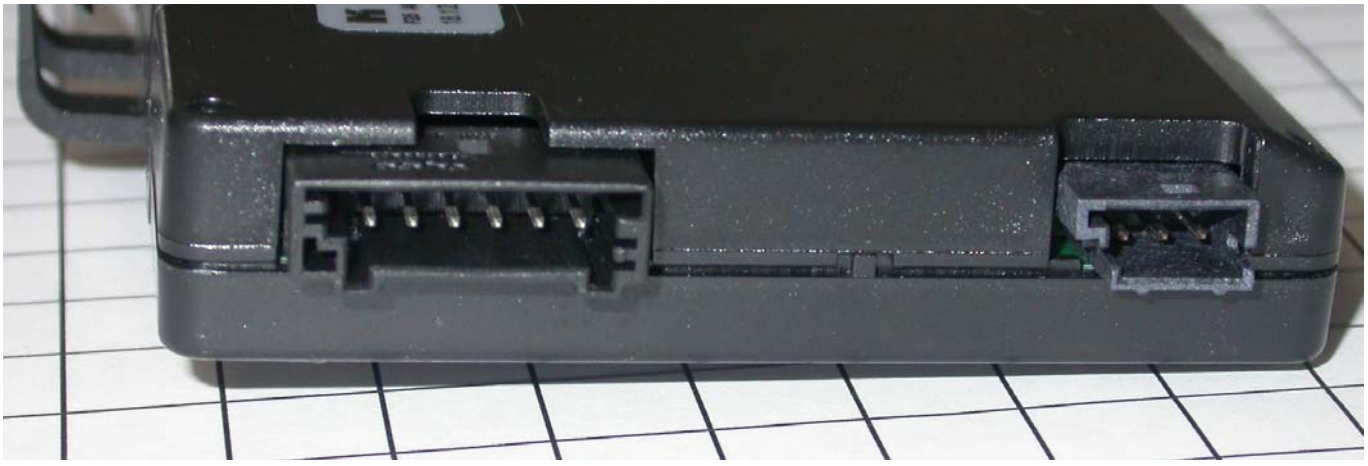
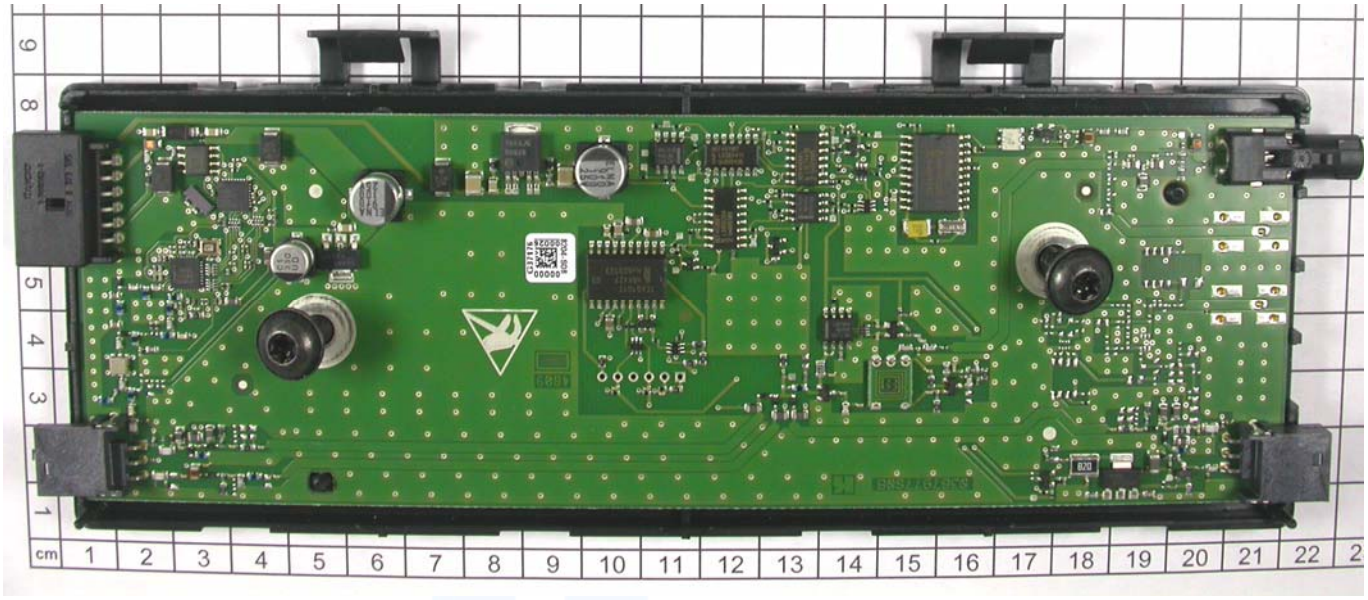
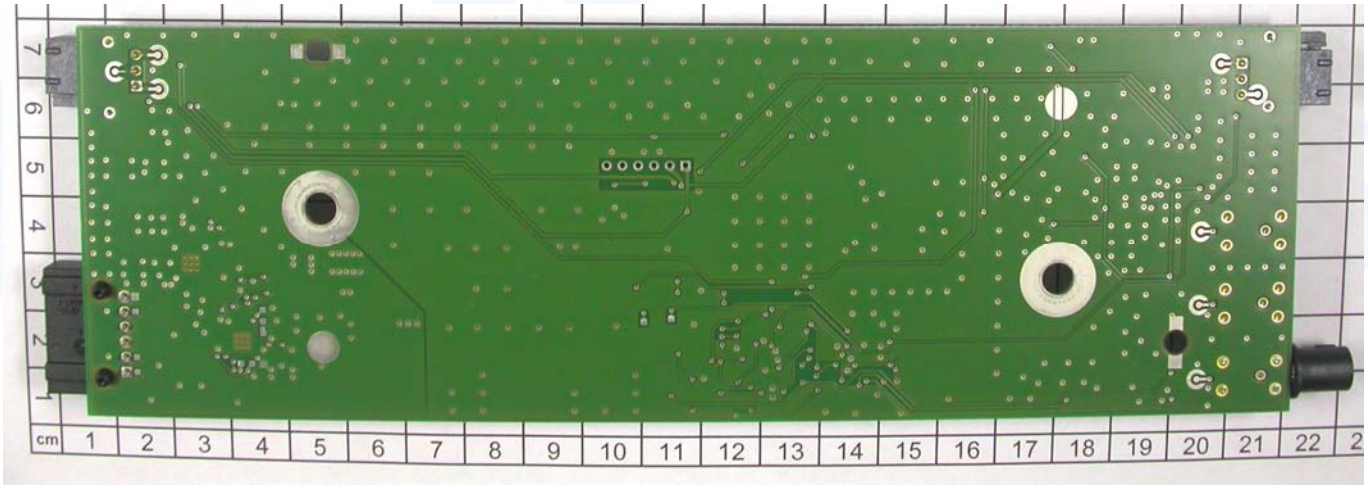
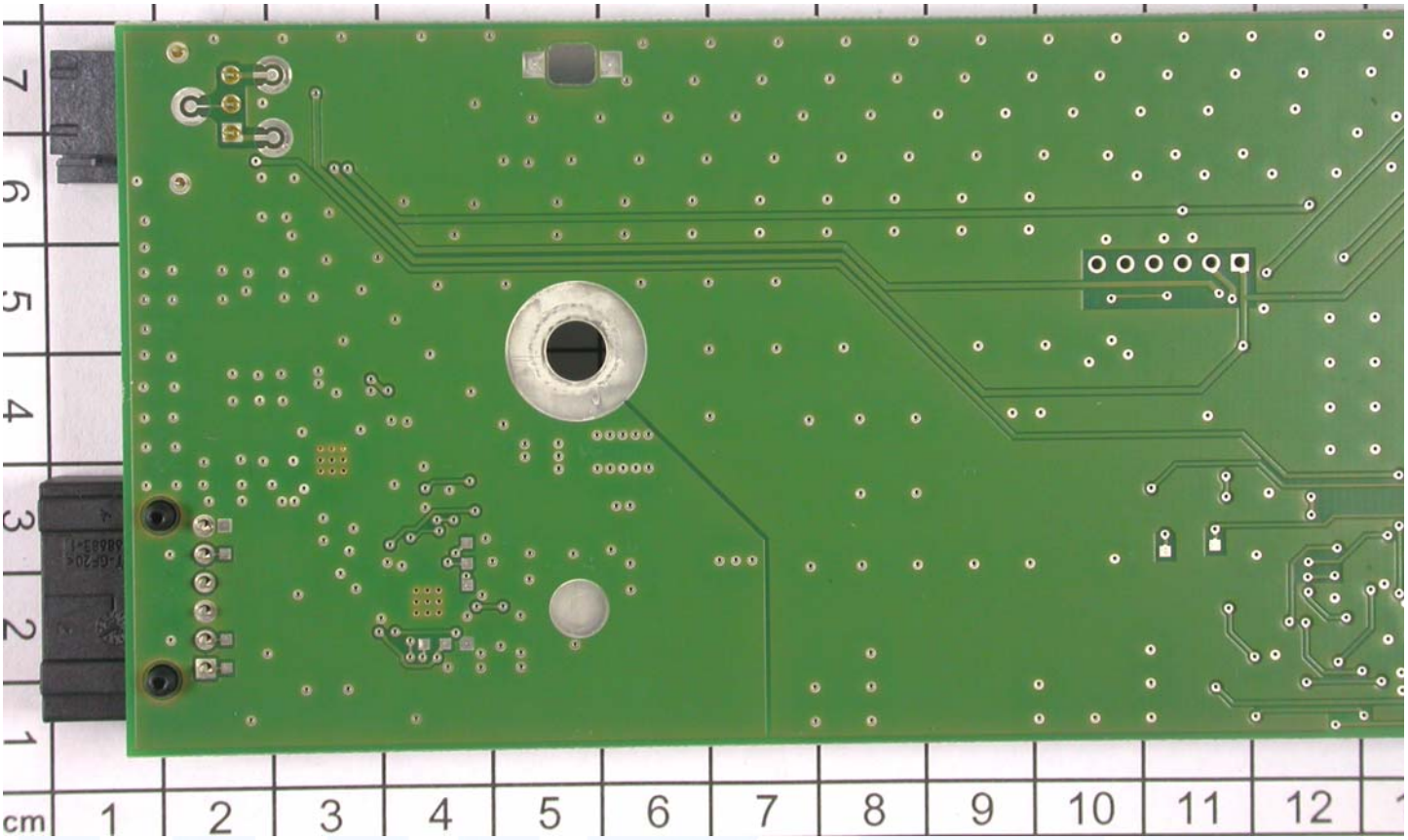


Internal view:



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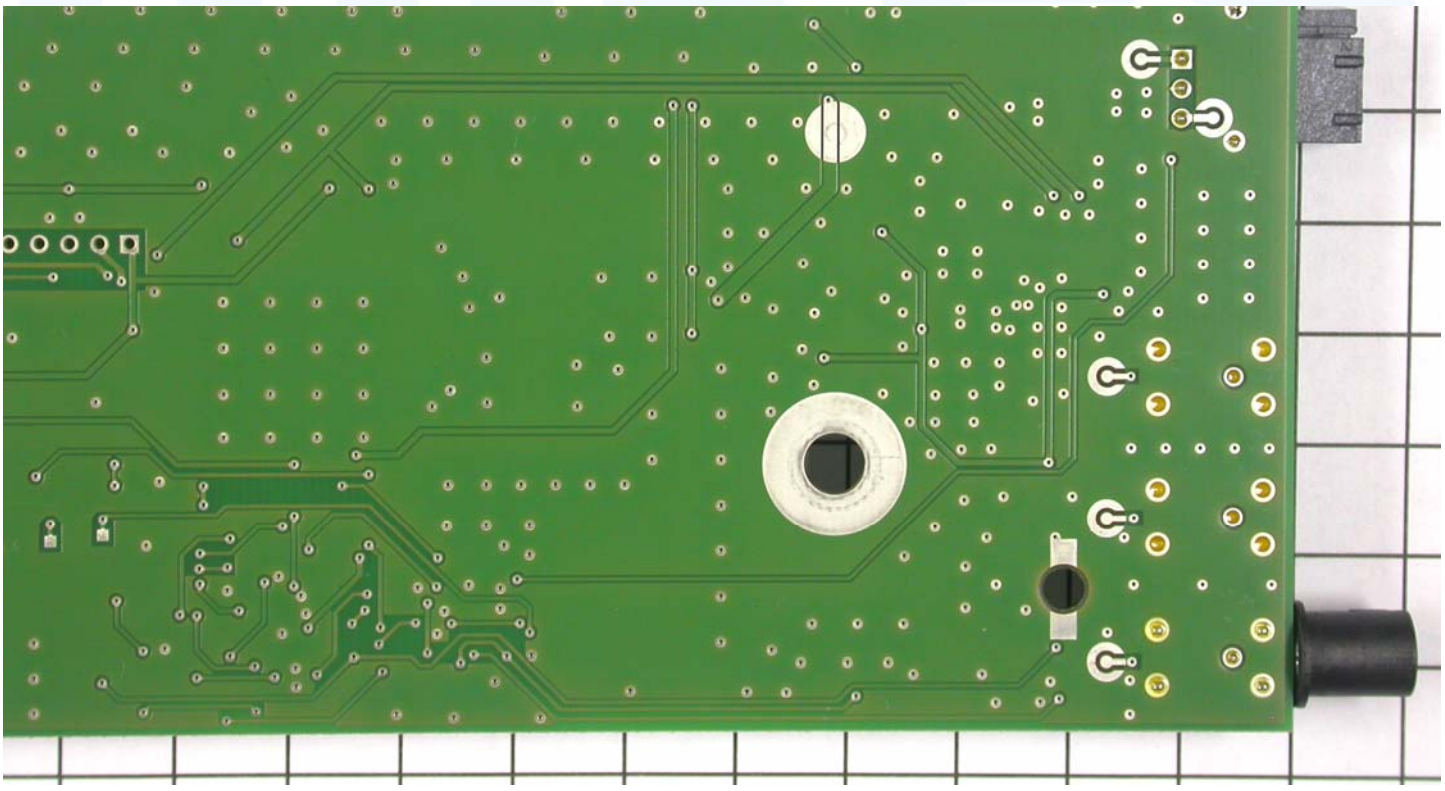

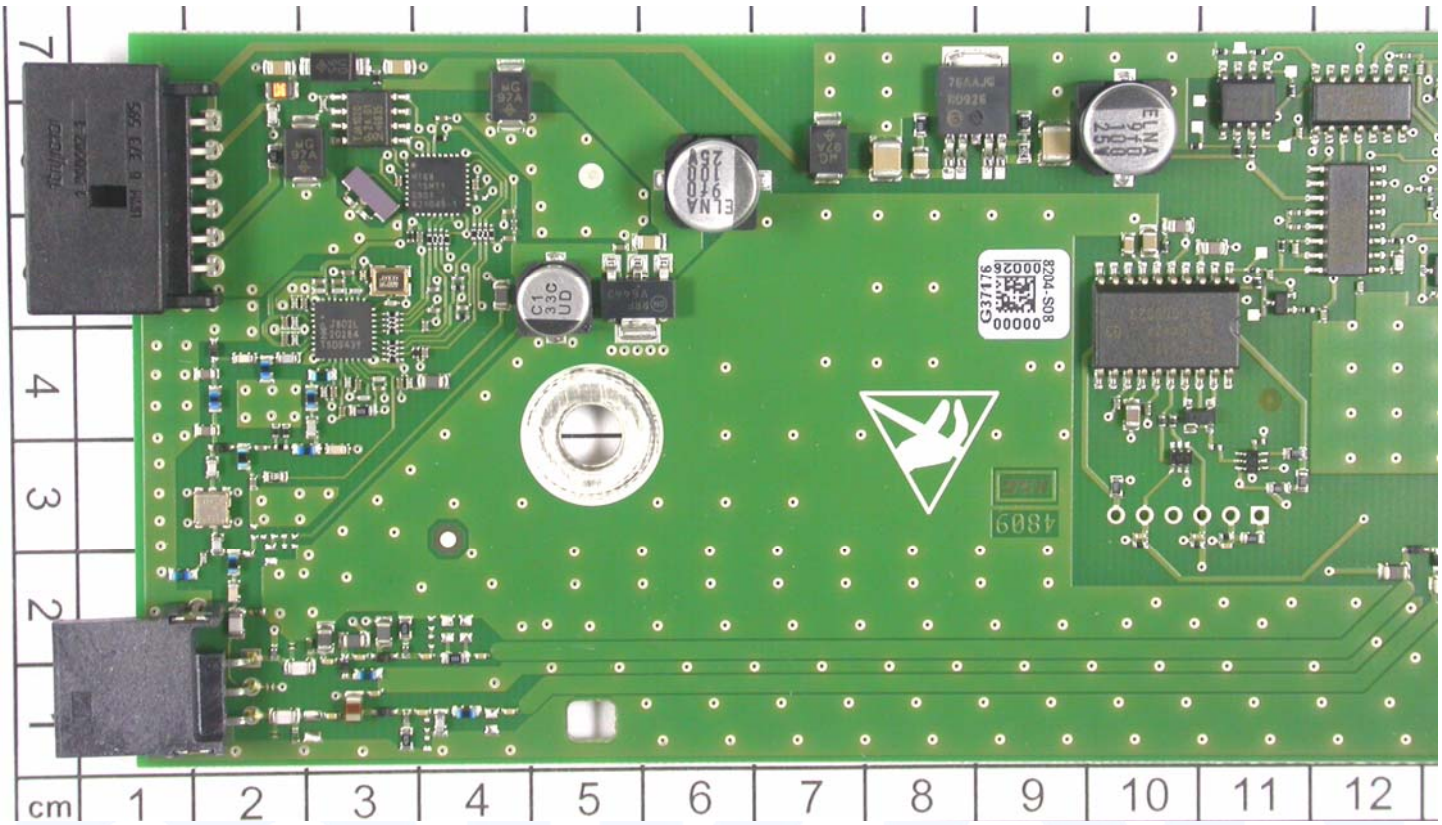
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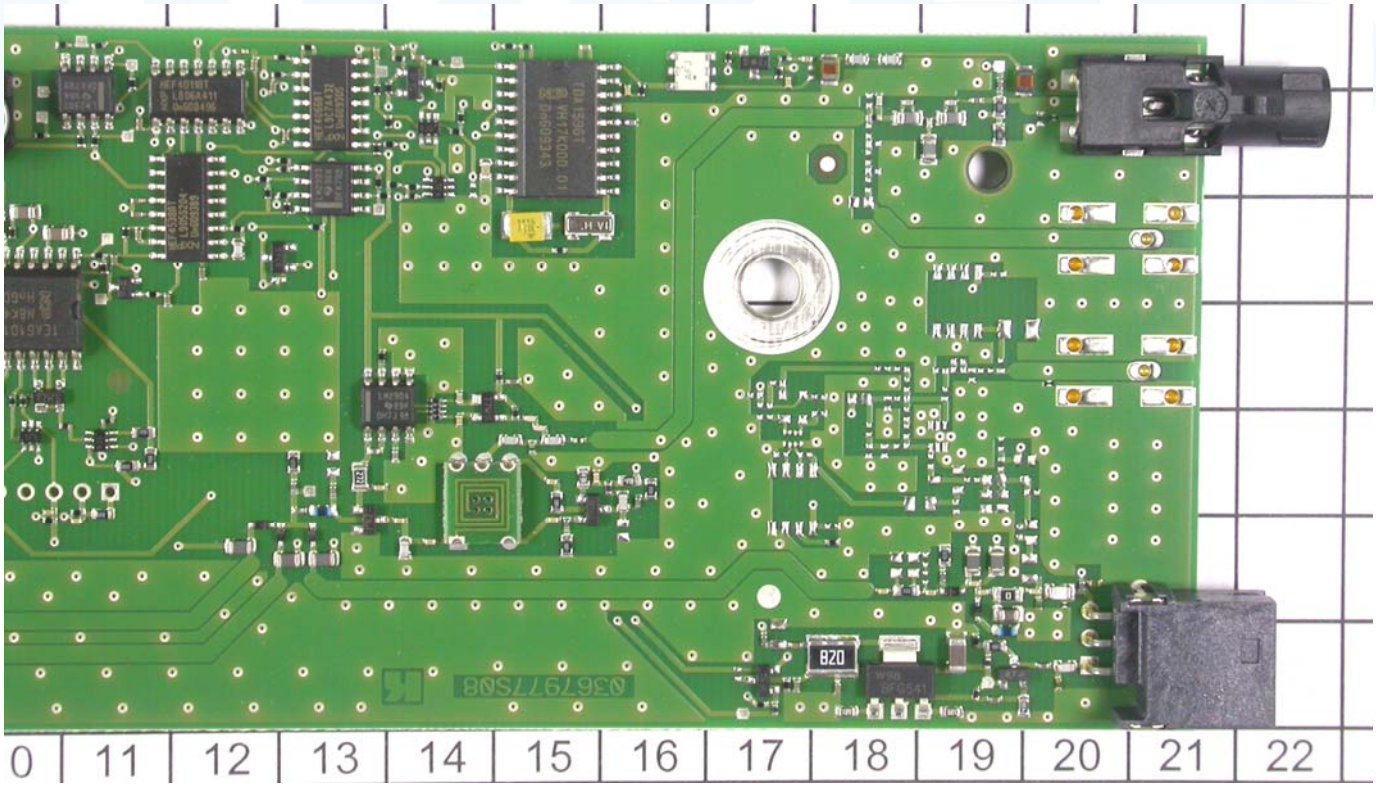
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3.2 Power supply system utilised

Power supply voltage: : 12 VDC (car application)

3.3 Short description of the equipment under test (EUT)

The EUT is a transceiver for car entry systems. As an option the EUT may have additionally an antenna preamplifier for AM/FM/Diversity. The EUT was equipped with all options. The EUT is a multi channel system using 2 RF channels and is controlled via LIN-Bus.

Number of tested samples: 1
Serial number: 27043

EUT operation mode:

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

- TX continuos mode

EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

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

- DC power supply and control bus cable — Model : Self-made, unscreened
- USB to CAN interface for controlling — Model : Vector, CANcaseXL
- DC power supply — Model : Voltcraft VLP 1602

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

mikes-testingpartners gmbh
Ohmstrasse 2-4
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. The reader may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement“ and documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners 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 diversity and modifications in production process of devices may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for the specific test. The manufacturer has the sole responsibility of continued compliance of the EUT.

4.4 Measurement protocol for FCC

4.4.1 GENERAL INFORMATION

4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under Section 1 of this report.
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.

4.4.1.2 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.

4.4.2 Conducted emission

4.4.2.1 Description of measurement

The final level, expressed in dBµV, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC Limit or to the CISPR limit.

To convert between dBµV and 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 50 Ω/50 µH (CISPR 16) characteristics. Table top 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 appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured 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)

4.4.3.1 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 polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top 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 set-up of the equipment under test is established in accordance with ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center 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 center of the table and to a screened room located outside the test area. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres, measurement scans are made with both horizontal and vertical antenna polarization planes and the EUT is rotated 360 degrees.

The final field strength level (dBµV/m) is calculated to add the correction factor and cable loss factor (dB) on the reading from the EMI receiver (dBµV). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

Instrument setting: 30 MHz – 1000 MHz: RBW: 120 kHz

Example:

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

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

4.4.4.1 Description of measurement

Radiated emissions from the EUT are measured in the frequency range of 1 GHz to the maximum frequency as specified in 47 CFR Part 15 Subpart A, Section 15.33, using a tuned receiver (Spectrum Analyser) and appropriate linearly polarized antennas. Table top 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 set-up of the equipment under test is established in accordance with ANSI C63.4.
The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center 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 center of the table and to a screened room located outside the test area. The antenna is positioned 3 metres horizontally from the EUT.
Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyzer set to a peak detector function and a resolution and video bandwidth of 1 MHz.
All tests are performed at a test-distance of 3 metres. Hand-held or body-worn devices are rotated around three orthogonal axes in order to determine the position, angle and configuration having the maximum emission. The cables and equipment are placed and moved within the range of their likely positioning to find the maximum emissions. These conditions will then be used for the final measurements. When the EUT is larger than the bandwidth 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 demonstrate that emissions are under the limits at the specified test distance.

4.5 Determination of worst case measurement conditions

Measurements have been made in all three orthogonal axes and the settings of the EUT were changed to locate at which position and at what setting the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position and by software set on the output power “17” in a range from 0 to 31.

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

Remarks: The measurement is not applicable. The EUT has no AC mains connection.

5.2 Field strength of the fundamental wave

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

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

Position of the EUT:

5.2.1 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.

5.2.2 Description of Measurement

The radiated power of the fundamental wave from the EUT is measured as described under item 4.4.3. The set up of the EUT is in accordance to ANSI C63.4. The measurement has been performed in unmodulated TX mode at normal conditions.

5.2.3 Test result

Frequency (MHz)	Level Pk (dBµV)	Duty cycle corr. (dB)	Correct. factor (dB/m)	Corrected level dB(µV/m)	Limit dB(µV/m)	Delta (dB)
314.6	73.8	-17.0	17.3	74.1	75.6	-1.5
315.0	73.7	-17.0	17.3	74.0	75.6	-1.6

Limit according to FCC Section 15.231(b):

Frequency (MHz)	Field strength of fundamental @ 3m		Effective limit for 315 MHz	
	(µV/m)	dB(µV/m)	(µV/m)	dB(µV/m)
260 - 470	3750 to 12500)*	71.4 to 81.9)*	6042	75.6

*Linear interpolation

The requirements are **FULFILLED.**

Remarks:

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

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 magnetic field strength from the EUT will be measured in an open area test site in the frequency range of 9 kHz to 30 MHz using a tuned receiver and a shielded loop antenna. The set up of the Equipment under test will be in accordance to ANSI C63.4. In the case where larger measuring distances are required the results will extrapolated based on the values measured on the closer distances according to Section 15.31(f)(2)(2). The final measurement will be performed with an EMI Receiver set to 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)(2).
Instrument setting:
9 kHz – 150 kHz: RBW: 200 Hz
150 kHz – 30 MHz: RBW: 9 kHz

5.3.5 Test result

Frequency (MHz)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB/m)	Corrected level dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
-						

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

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(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: All unwanted emissions in the frequency range from 9 kHz to 30 MHz are below 10 dB(µV/m) at a test distance of 3 metres.

5.4 Spurious emissions radiated (electric field)

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

5.4.1 Description of the test location

Test location: OATS1
Test location: Anechoic Chamber A2

Test distance: 3 metres

5.4.2 Photo documentation of the test set-up

5.4.3 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.

5.4.4 Description of Measurement

The radiated power of the spurious emission from the EUT is measured as described under item 4.4.3 and 4.4.4. The set up of the EUT is in accordance to ANSI C63.4. For testing above 1 GHz, if the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, 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. The measurement has been performed in unmodulated TX mode at normal conditions.

Instrument settings:
30 MHz – 1000 MHz: RBW: 120 kHz
1000 MHz – 4000 MHz RBW: 1 MHz

5.4.5 Test result f < 1 GHz

Ch1:

Frequency (MHz)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB/m)	Corrected level dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
629.16	12.4	120	24.4	36.8	55.6	-18.8
943.74	11.3	120	29.1	40.4	55.6	-15.2

CH2:

Frequency (MHz)	Level QP (dBµV)	Bandwidth (kHz)	Correct. factor (dB/m)	Corrected level dB(µV/m)	Effective limit dB(µV/m)	Delta (dB)
629.96	10.2	120	24.4	34.6	55.6	-21.0
944.93	8.0	120	29.1	37.1	55.6	-18.5

5.4.6 Test result f > 1 GHz

Ch1:

f (MHz)	L: PK (dBµV)	L: AV (dBµV)	Bandwidth (kHz)	Cor. factor (dB/m)	L_c: PK dB(µV/m)	L_c: AV dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
1210	54.2		1000	-12.9	41.3		54.0	-12.7
1624	56.3		1000	-14.5	41.8		54.0	-12.2
1918	55.1		1000	-10.1	45.0		55.6	-14.9
1990	50.2		1000	-10.4	35.6		55.6	-18.4

CH2:

f (MHz)	L: PK (dBµV)	L: AV (dBµV)	Bandwidth (kHz)	Cor. factor (dB/m)	L_c: PK dB(µV/m)	L_c: AV dB(µV/m)	Limit AV dB(µV/m)	Delta (dB)
1012	59.2		1000	-13.8	45.4		54.0	-8.6
1324	57.4		1000	-12.5	44.9		54.0	-9.1
1372	55.4		1000	-12.9	42.5		54.0	-11.5
1726	56.9		1000	-13.2	43.7		55.6	-11.9

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

Fundamental frequency (MHz)	Field strength of spurious emissions @ 3m	
	(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*
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. All emissions not recorded are more than 20 dB below the specified limit.

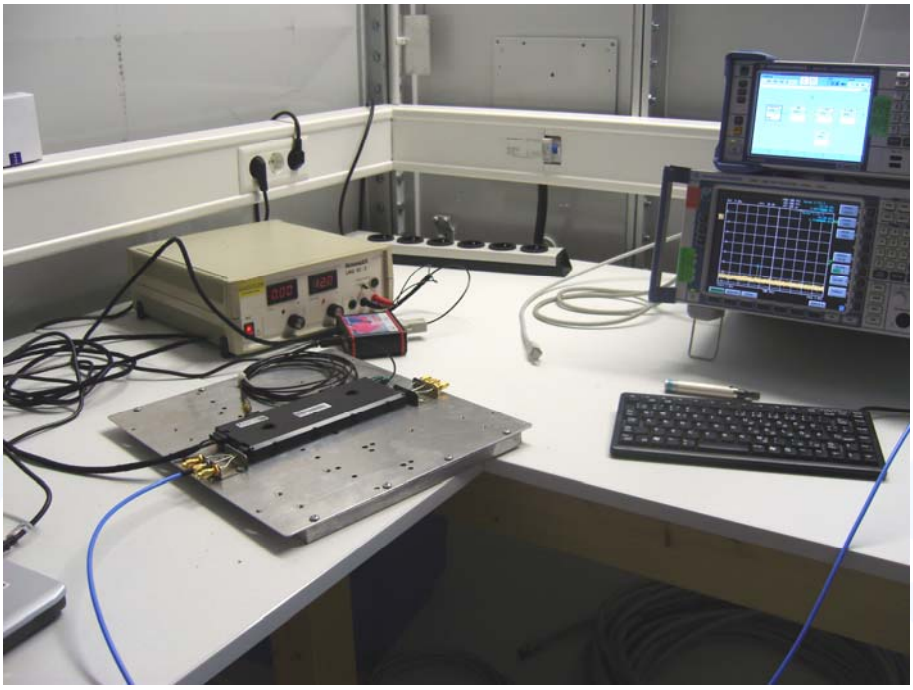
5.5 Correction for pulse operation (duty cycle)

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

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

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

5.5.4 Description of Measurement

The duty cycle measurement is performed using an arbitrary waveform generator and an RF-Generator as stimulus for the receiver. The spectrum analyser displays the puls train in cero span mode. The EUT is only able to send the right puls train in normal mode. The stimulus shall provide with the shortest reaction possible for this programmed puls train. The puls train have two main pulses, a “button pressed acknowledge puls” and a “button released acknowledge puls”. The puls train is programmed for CH1 and CH2 as “button pressed puls” (9 ms) + min blank time (45 ms) + “button released telegram” (37 ms) + blank time (4 ms) + “button released acknowledge puls” (9 ms). The puls train is recorded. Other usable remote controller show the same behaviour as below described, the difference between the remote controllers is the Byte “Mode only”.

5.5.5 Test result

5.5.5.1 The communication between IDG and FBDII

The FBDII checks a received telegram (is WUP FBDII=WUP IDG) and decides whether the telegram is valid or not. An ACK signal is sent by the FBDII if a valid telegram is received from the remote controller. The ACK signal consists of 2 pulses, the first pulse acknowledge the “button-pressed” telegram and the second pulse acknowledge the “button-released” telegram. Between the first pulse and the second pulse is a forced space. The space depends on the user and his intention to control the several functions which are implemented as interpretation on how long the button is pressed.

5.5.5.2 Function “lock, unlock”

The function is achieved by pressing the button of the remote controller (Door, Trunk) a short time. Thereby the shortest follow up time of the 2 acknowledge pulses is set.

5.5.5.3 Additional function

If the button “lock/unlock Door” is still pressed after the door is locked/unlocked the additional function “window close/open” controls dependent on the time how long the button is pressed how wide the windows are closed/opened. The limit hereby is 60 s. After this time the second ACK is sent autonomously and stops the further transmission of the remote controller whether the button is still pressed or not. The max forced space time between the first ACK pulse and the second ACK pulse is therefore limited to 60 s.

5.5.5.4 No ACK

In case that the WUP of the FBDII is not the same as sent by the IDG or the remote controller is out of the detecting area the FBDII doesn’t send any ACK. The IDG repeats the code-telegram on the second cannel. Is than no ACK received, after 500 ms the event starts again on the first channel, if the button is still pressed and no ACK is received by IDG. This sequence starts two times after additionally 500 ms.

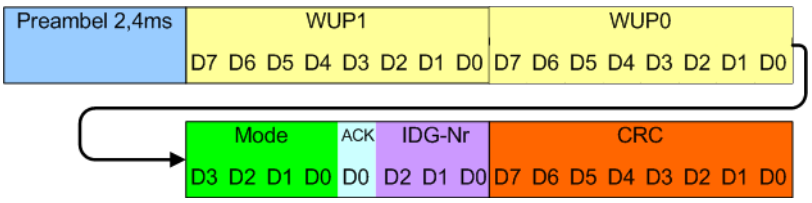
5.5.5.5 Other remote controllers

FBDII is able to communicate with other approved remote controllers (THS, IDG, FFB, DVM). The communication is based on the same routines and protocols as described before. The difference between the remote controller signals is the byte “mode” of the code-telegram.

5.5.5.6 The acknowledge telegram includes the follow data:

- First part is the preamble that only consists bits changes there state from zero to one for 2.4 ms.
- WUP1 and WUP0 stands for Wake Up-Pattern. WUP is unique for every car and is the ID for this entry system.
- The four byte in the mode section gives the type of the telegram, here “acknowledge”.
- The ACK bit indicates a successful receive of a valuable telegram.
- The IDG-Nr. indicates the key from which the communication has started. Up to 8 keys are possible.
- CRC is Cyclic Redundancy Check

Data content of every part of the acknowledge puls



Abbreviation	Description
WUP	Wake Up Pattern
Mode	diff. state
ACK	Ok or Not Ok
IDG-Nr.	Key 0-8

Calculation of the correction factor:

The shortest possible puls train:

t_{iw} = 9 ms + 45 ms + 37 ms + 4 ms + 9 ms = 104 ms

Tolerances of the devices may cause an uncertainty of the puls length up to 9 ms. Therefore in the following calculation a puls length of 9 ms is assumed as worst case for both channels. The duration within 100 ms is nearly one and a half pulse (9 ms + 5 ms = 14 ms), because one half of the puls is out of the 100 ms.

The duty cycle factor (dB) is calculated applying the following formula:

$K_E = 20 \log ((tiB*p)/Tw)$ =20 log ((14*1)/100)) = -17.0 dB

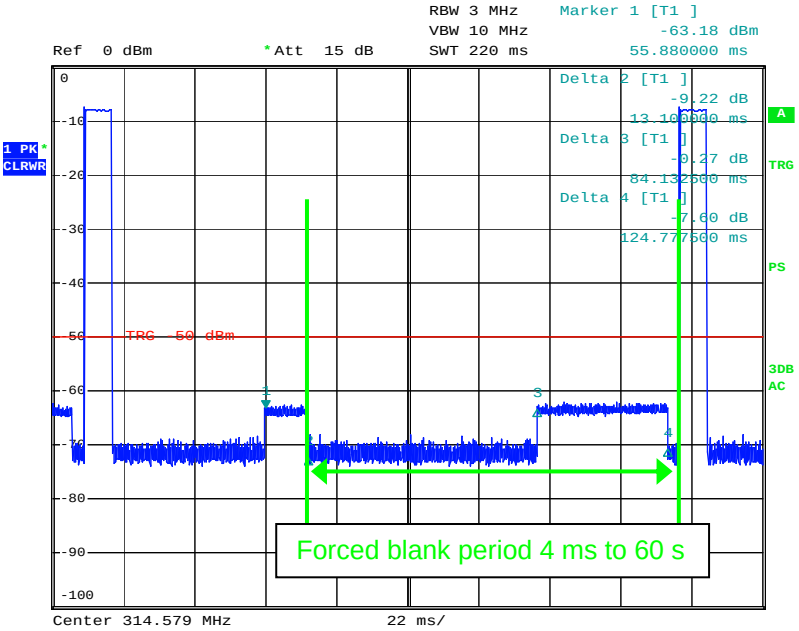
K_E	pulse operation correction factor	(dB)
t_{iw}	pulse duration for one complete pulse track	(ms)
t_{iB}	pulse duration within 100 ms	(ms)
T_w	a period of the pulse track	(ms)
p	number of pulses in one train	

Duty cycle	t_{iW} (ms)	T_W (ms)	t_{iB} (ms)	p	K_E (dB)
Within 100 ms	104	100	14	1	-17.0

Remarks: The pulse train (Tw) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulses over the 100 ms time window with the highest average values. For detailed results, please see the following test protocol.

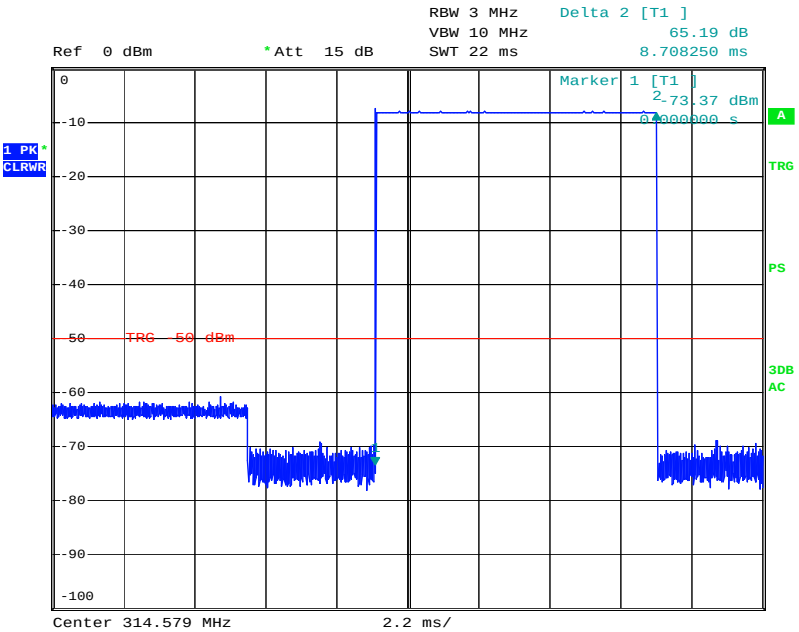
5.5.6 Test protocol

Complete pulse train



The first puls marked by marker 1 means the first part of the acknowledge puls “button pressed” by the EUT. The second puls means the telegram sent by the external key “button released” after a forced blank period. The fourth puls is the second part of the acknowledge puls “button released” by the EUT. The forced blank period can be enlarged, 4 ms up to 60 s (green marks), by the user hold the button pressed. After this period the IDG sends autonomously the signal “button released” and stops after receiving the acknowledge puls further activities, this means saving of battery power of the IDG.

Determination of the pulse length



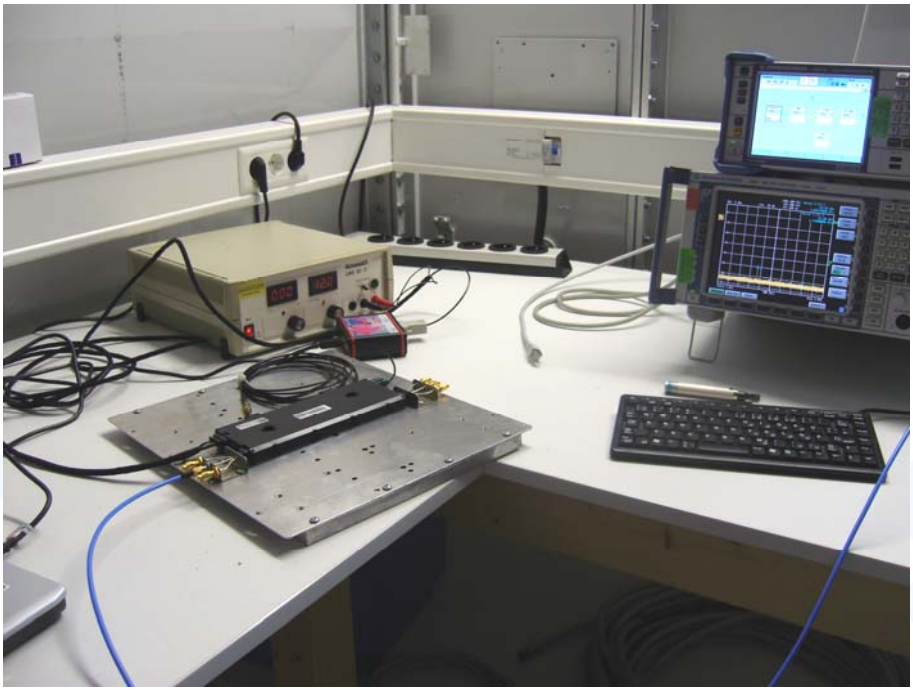
5.6 Emission bandwidth

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

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(c):
The bandwidth of the emission shall not exceed the effective limits.

5.6.4 Description of Measurement

The measurement was performed conducted with intentional modulation using a spectrum analyser. The analyser span was set wide enough to capture the most of the power envelope of the signal. The function “20-dB-down” is used to determine the BW. For an overview on the adjacent restricted bands the span was set as wide as needed to show that the restricted bands are not affected.

5.6.5 Test result

Centre frequency (MHz)	20dB bandwidth *f1*	20dB bandwidth *f2*	Measured bandwidth (kHz)	Limit fundamental *f* * 0.0025 (kHz)	Limit fundamental *f* * 0.005 (kHz)
314.6	314.548125	314.650875	102.7	786.5	-
315.0	314.947250	315.052000	105.7	787.5	-

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

Frequency (MHz)	20 dB BW limit dependent of the carrier (%)
70 – 900	0.25
above 900	0.50

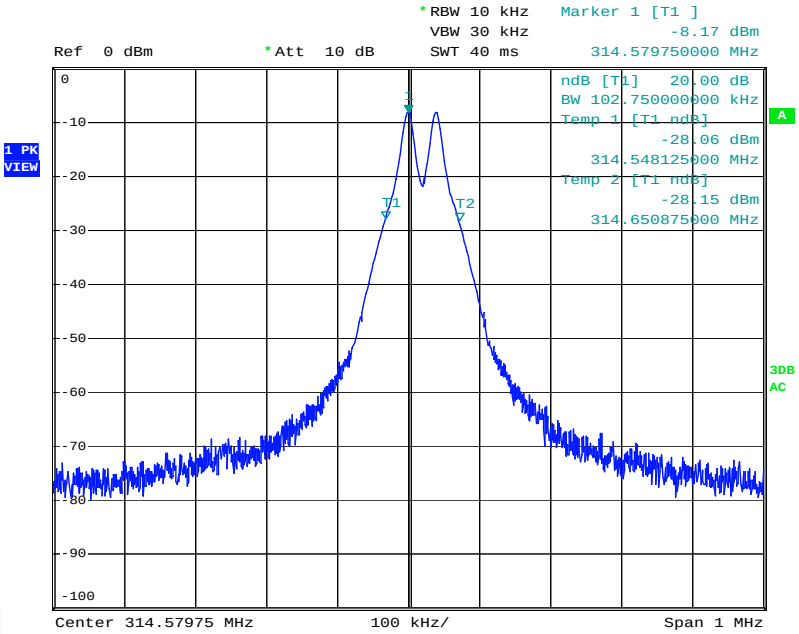
The bandwidth of the emission shall be no wider than 0.25% of the centre frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

The requirements are **FULFILLED.**

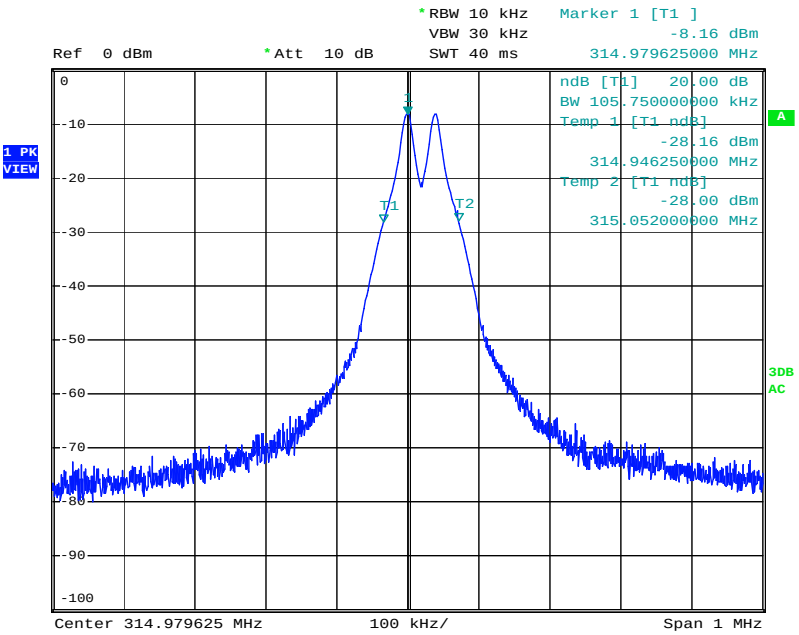
Remarks: For detailed results, please see the test protocol below.

5.6.6 Test protocol

Emission bandwidth Ch1



Emission bandwidth Ch2



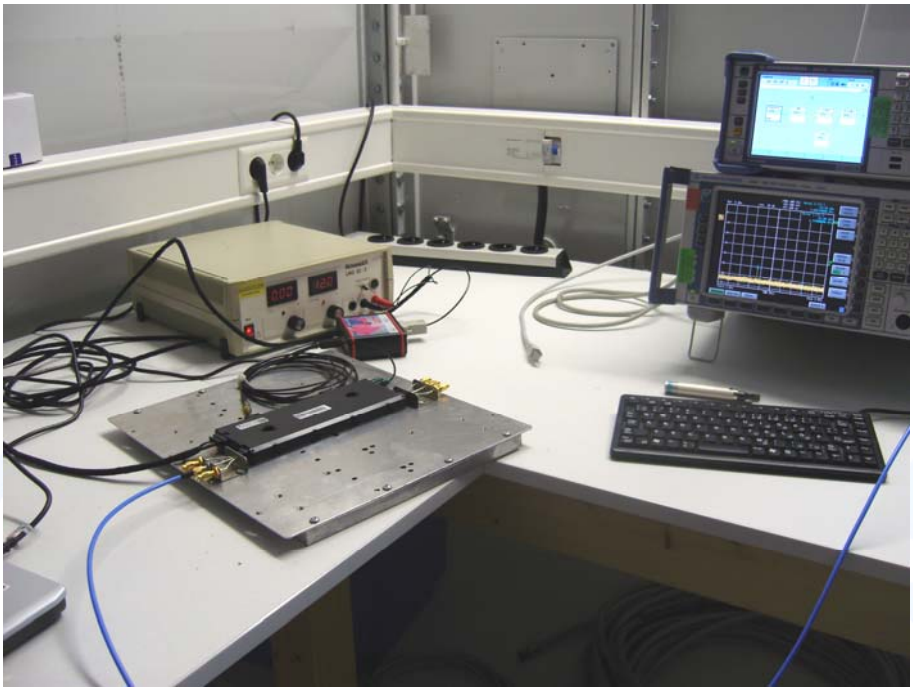
5.7 Signal deactivation

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



5.7.3 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.

5.7.4 Description of Measurement

The duration of transmission is measured using an arbitrary waveform generator and an RF-Generator as stimulus for the receiver. The spectrum analyser displays the puls train in cero span mode. The EUT is only able to send the right puls train in normal mode. The stimulus shall provide with a usually reaction for this programmed puls train. The puls train exists from two pulses, a “button pressed acknowledge puls” and a “button released acknowledge puls”. The puls train is programmed for CH1 and CH2 as “button pressed puls” (9 ms) + min blank time (45 ms) + “button released telegram” (37 ms) + blank time (4 ms) + “button released acknowledge puls” (9 ms). The puls train is recorded.

5.7.5 Test result

The duration after releasing the button the following part of the puls train is summed:

t_{off} = 45 ms + 37 ms + 4 ms + 9 ms = 95 ms

Tolerances of the devices may enable an uncertainty of the puls duration up to 9 ms. Therefore in the following calculation puls duration of 9 ms is assumed as worst case for both channels.

Duration of transmission (ms)	Duration after releasing the button (s)
9	0.095

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.

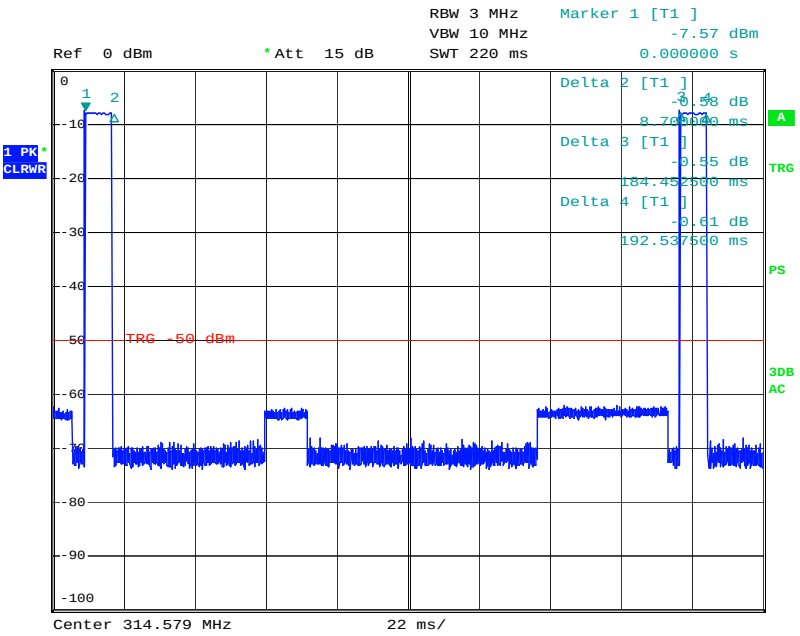
The requirements are **FULFILLED.**

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

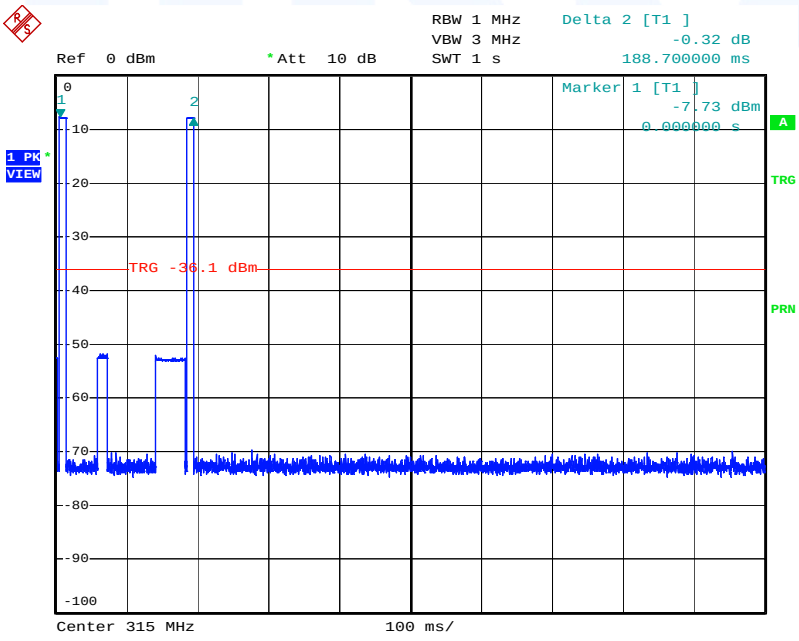
5.7.6 Test protocol

Signal deactivation

FCC Part 15C, Section 15.231(a)



Long term observation



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 2	ESVS 30	02-02/03-05-006	11/06/2011	11/06/2010		
	VULB 9168	02-02/24-05-005	06/05/2011	06/05/2008	01/10/2010	01/04/2010
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
DC	ESCI	02-02/03-05-005	10/11/2010	10/11/2009		
	LNG32-3	02-02/50-07-034				
MB	ESCI	02-02/03-05-005	10/11/2010	10/11/2009		
	LNG32-3	02-02/50-07-034				
SER 1	FMZB 1516	01-02/24-01-018			15/02/2011	15/02/2010
	ESCI	02-02/03-05-005	10/11/2010	10/11/2009		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
	VLP-1602 PRO	02-02/50-10-015				
SER 2	ESVS 30	02-02/03-05-006	11/06/2011	11/06/2010		
	VULB 9168	02-02/24-05-005	06/05/2011	06/05/2008	01/10/2010	01/04/2010
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
	VLP-1602 PRO	02-02/50-10-015				
SER 3	FSP 30	02-02/11-05-001	04/05/2011	04/05/2010		
	AFS4-01000400-10-10P-4	02-02/17-05-003				
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	3117	02-02/24-05-009	10/02/2011	10/02/2010		
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	VLP-1602 PRO	02-02/50-10-015				