

EMI - TEST REPORT

- FCC Part 15.209 -

Test Report No. : T36002-02-02KJ	27. February 2014
	Date of issue

Type / Model Name : JCI MQB IC / Kombiinstrument

Product Description : Vehicle Immobilizer / VW MQB Instrument Cluster

Applicant : Johnson Controls GmbH

Address : Mittelstr. 11-13

D-40789 Monheim

Manufacturer : Johnson Controls GmbH

Address : Mittelstr. 11-13

D-40789 Monheim

Licence holder : Johnson Controls GmbH

Address : Mittelstr. 11-13

D-40789 Monheim

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

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2013)

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, 2013)

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

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.

ANSI C95.1: 2005
IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

CISPR 16-4-2: 2003
Uncertainty in EMC measurement

CISPR 22: 2005
EN 55022: 2006
Information technology equipment

2 SUMMARY

GENERAL REMARKS:

The carrier frequency is 125.0 kHz.

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 : 21 January 2014

Testing concluded on : 31 January 2014

Checked by:

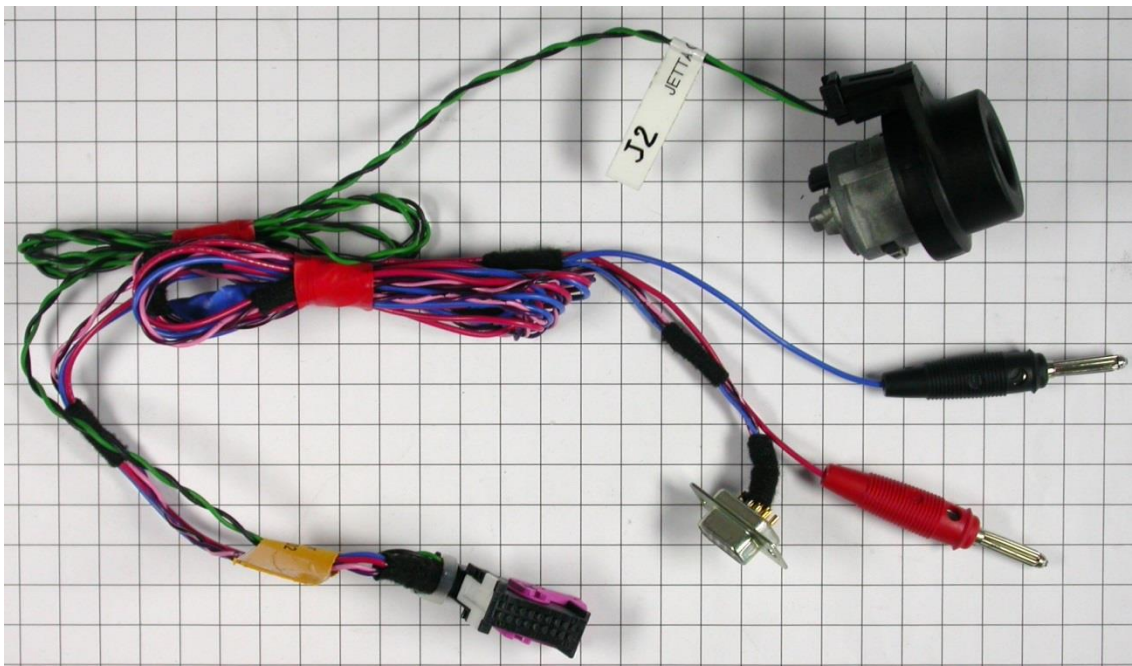
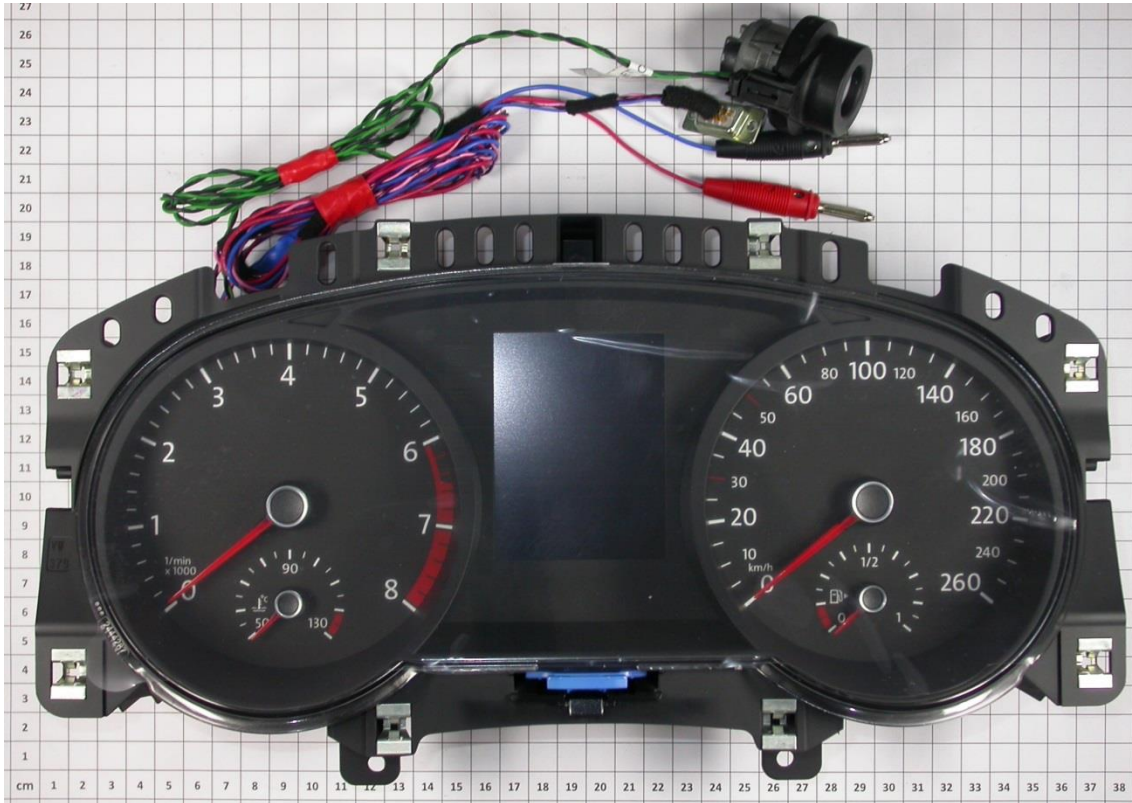
Tested by:

Klaus Gegenfurtner
Teamleader Radio

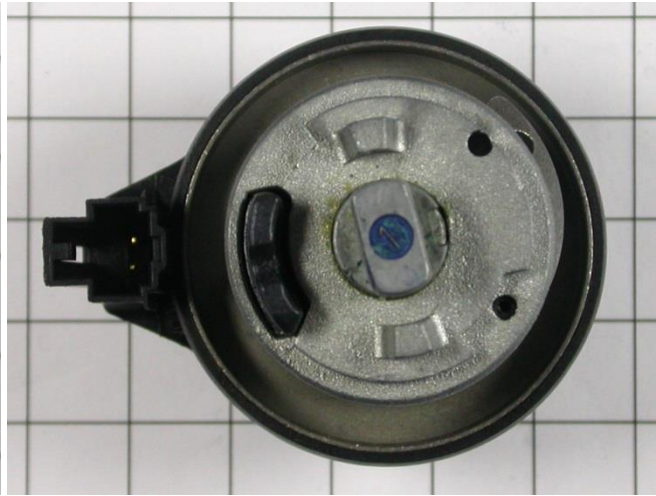
Josef Knab

3 EQUIPMENT UNDER TEST

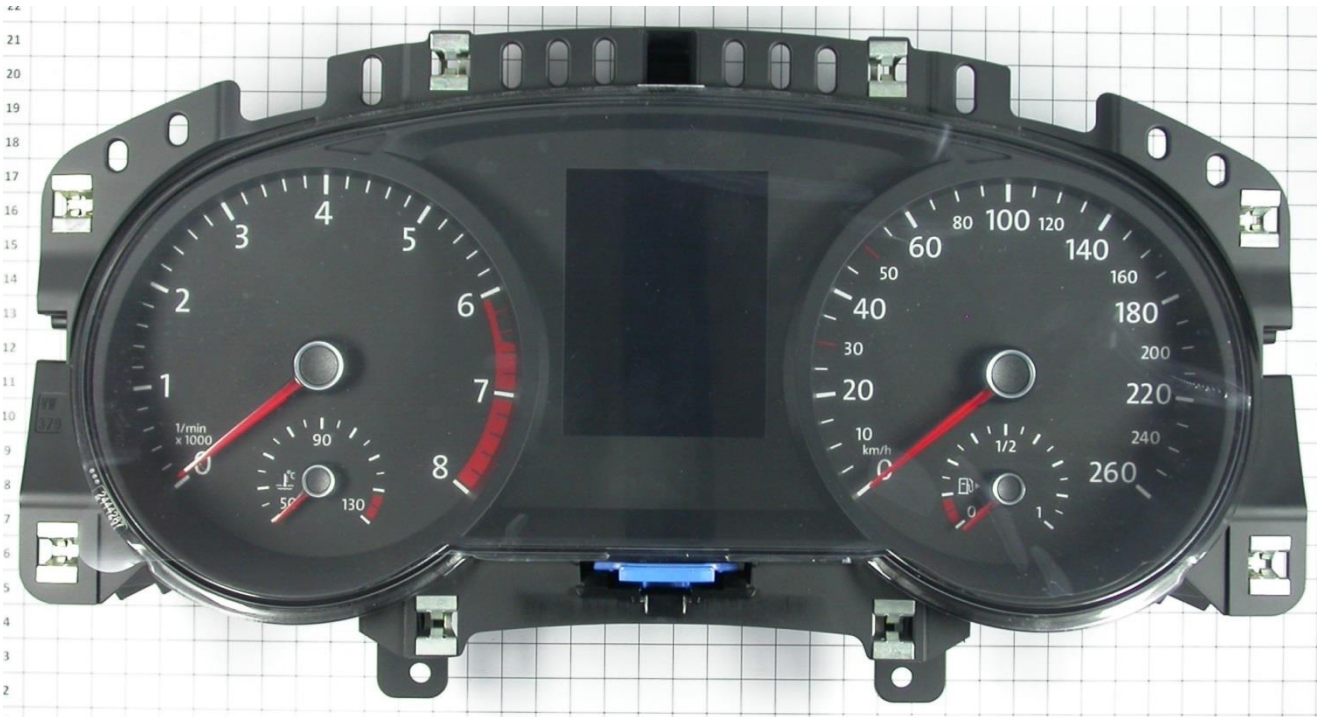
3.1 Photo documentation of the EUT



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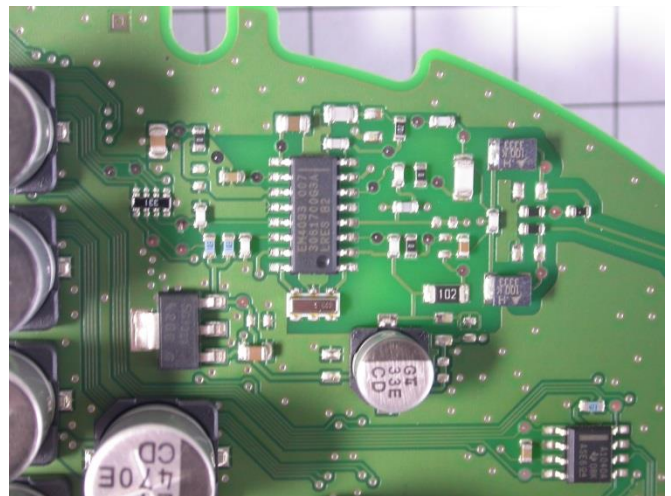
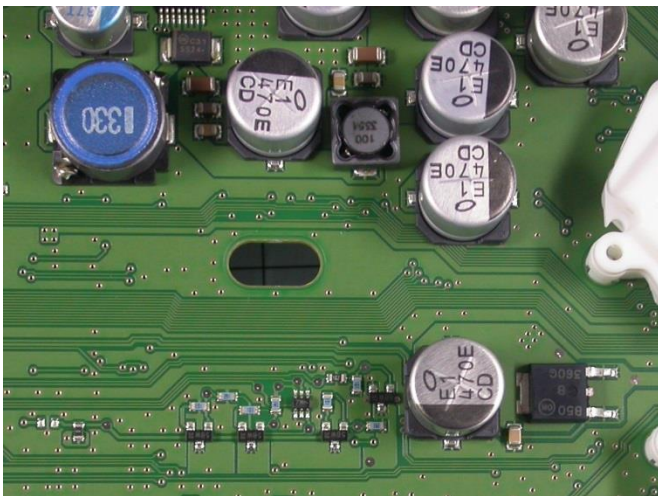
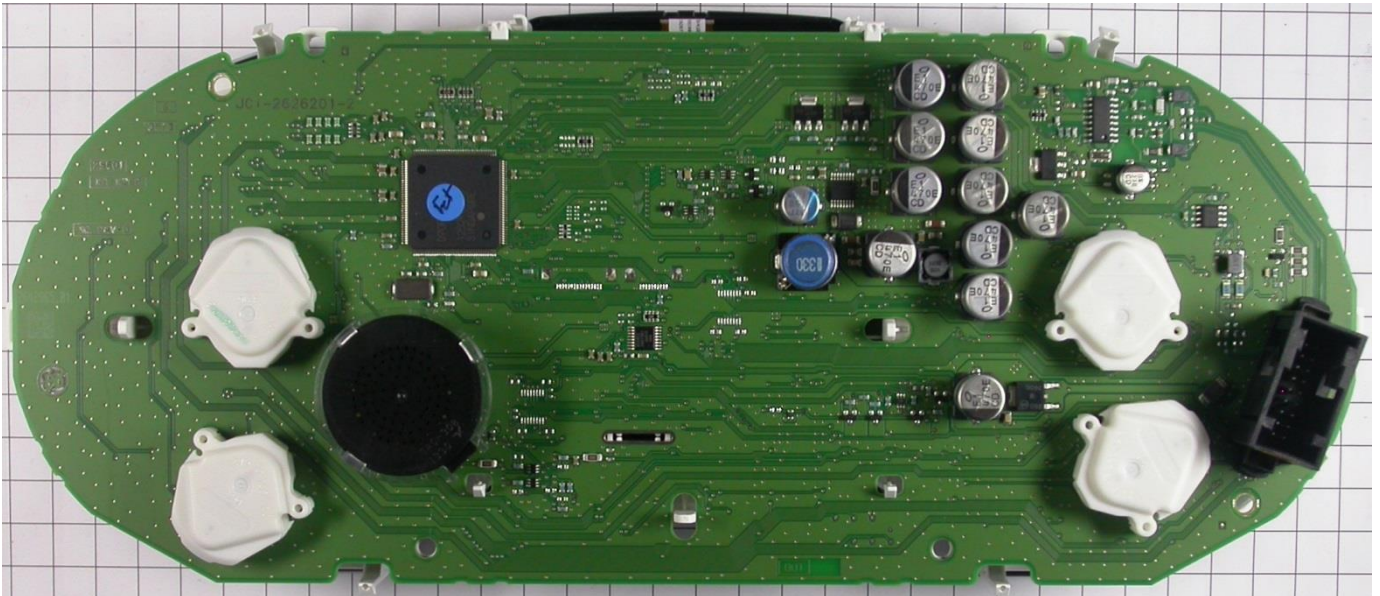
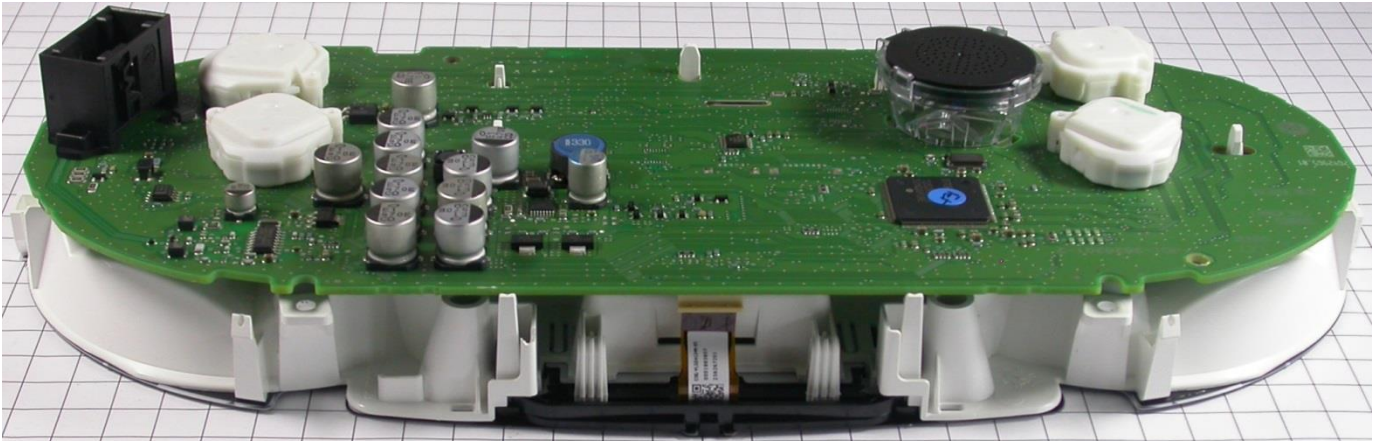
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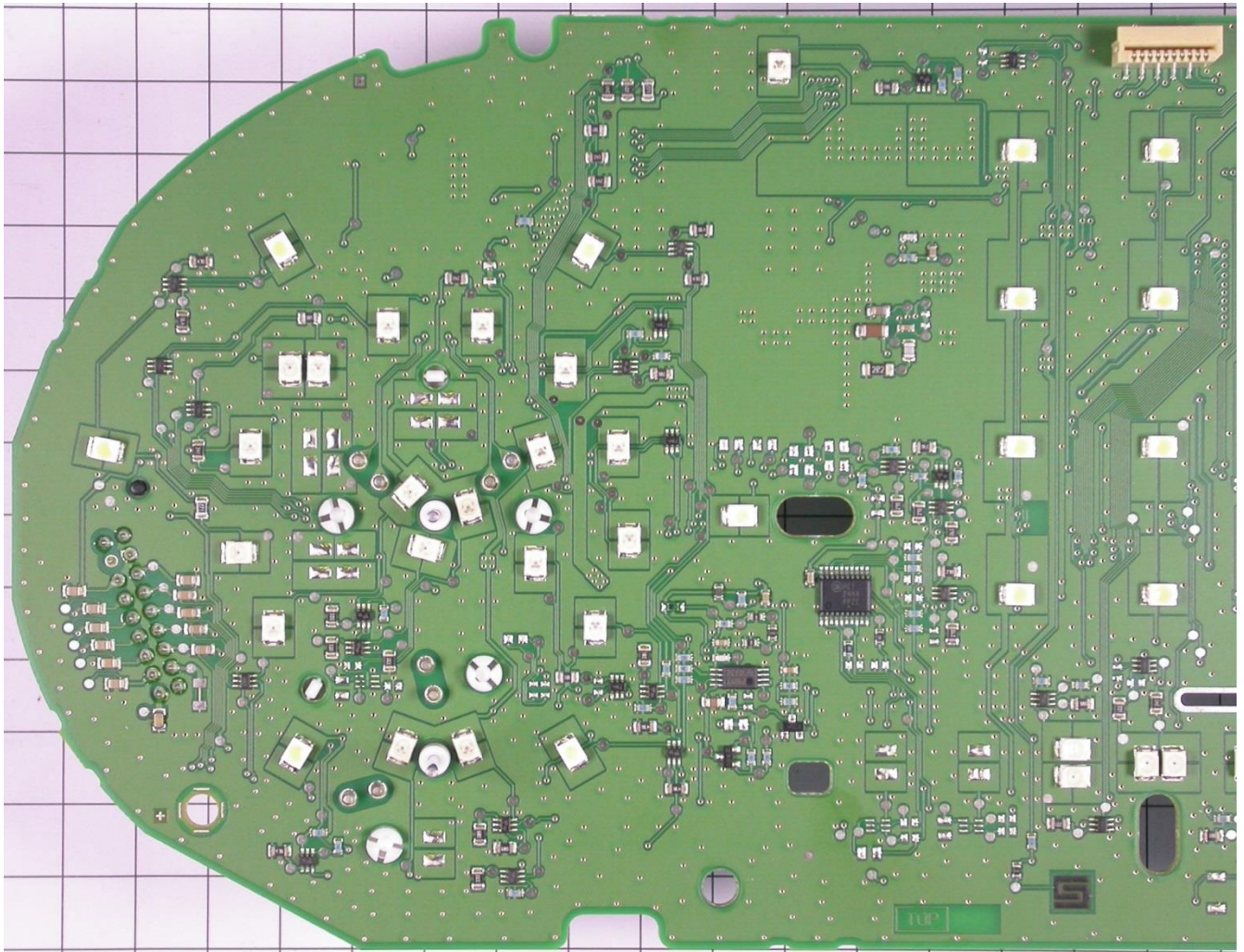
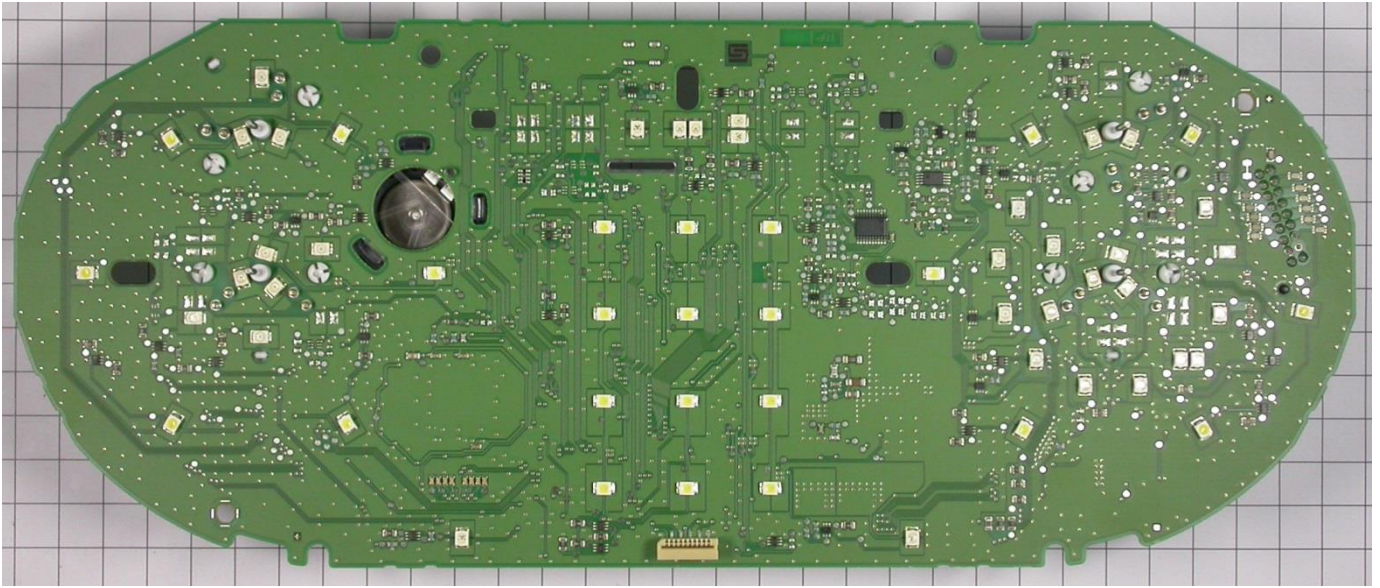
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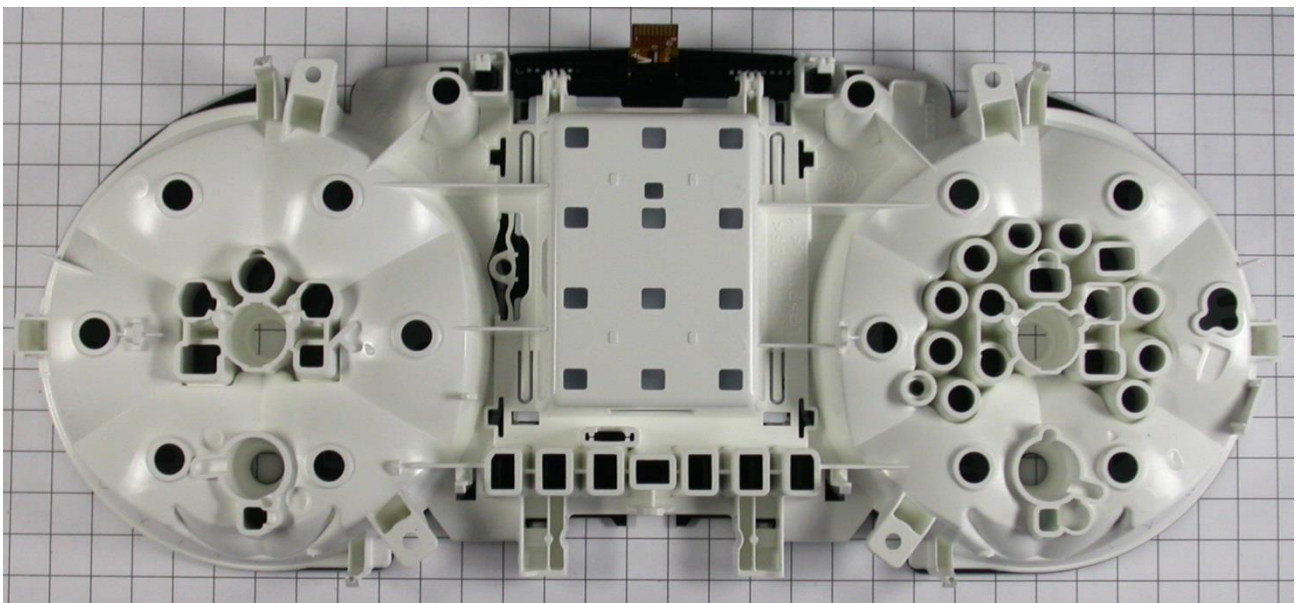
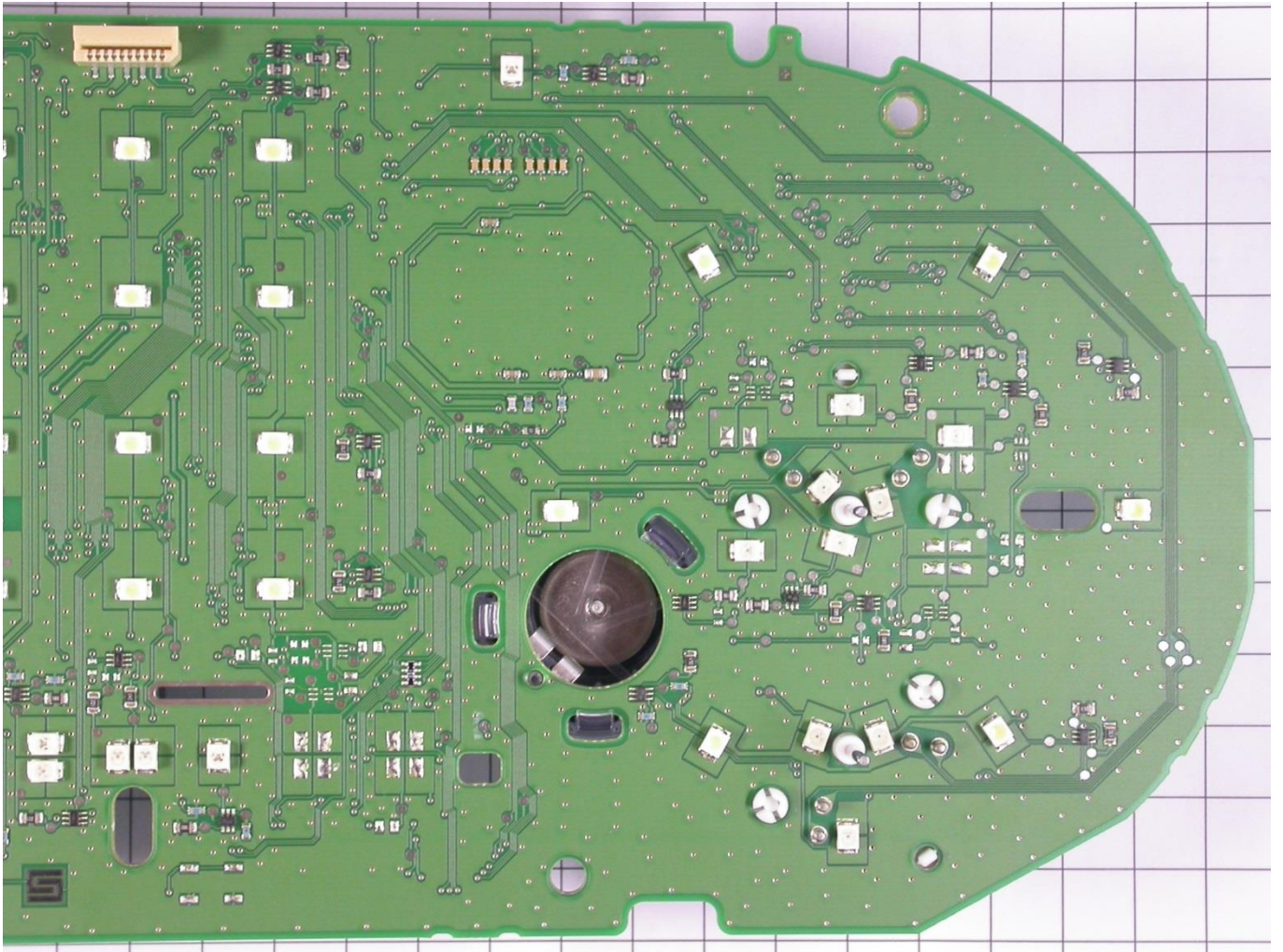
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4 TEST ENVIRONMENT

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

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.

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 DETAILS OF TEST PROCEDURES

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.

4.4.3 Conducted emission

The final level, expressed in dB μ V, 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 dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20 \cdot \log(\mu\text{V});$$

$$\mu\text{V} = 10^{(\text{dB}\mu\text{V}/20)};$$

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 μ H (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 of a peak mode measurement appears to be less than 20 dB, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

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

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. 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 setup 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. The antenna is

positioned 3, 10 or 30 meters 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 meters and the EUT is rotated 360 degrees. The final level in dB μ V/m is calculated by taking the reading from the EMI receiver (Level dB μ V) 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)	(dB μ V)		(dB)		(dB μ V/m)		(dB μ V/m)	(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	= -2.4

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

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. 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 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 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. 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.

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 of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position with the following settings:

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 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 (dB μ V)	
	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

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

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



5.2.1 Applicable standard

According to FCC Part 15C, Section 15.209:

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

5.2.2 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 set up 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

Example:

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

5.2.3 Test result

Variant **Basic**

Measurement distance: 3 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.125	55.9	49.3	54.5	0.2	20	75.9	69.3	74.5	105.0	-35.7

Calculated value at distance: 300 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.125	-24.1	-30.7	-25.5	0.2	20	-4.1	-10.7	-5.5	25.0	-35.7

Variant **Medium**

Measurement distance: 3 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.125	55.9	49.3	54.5	0.2	20	75.9	69.3	74.5	105.0	-35.7

Calculated value at distance: 300 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.125	-24.1	-30.7	-25.5	0.2	20	-4.1	-10.7	-5.5	25.0	-35.7

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Variant **Colour**

Measurement distance: 3 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.125	55.9	49.4	54.5	0.2	20	75.9	69.4	74.5	105.0	-35.6

Calculated value at distance: 300 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.125	-24.1	-30.6	-25.5	0.2	20	-4.1	-10.6	-5.5	25.0	-35.6

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

Frequency (MHz)	Field strength of fundamental wave		Measurement distance (metres)
	(μ V/m)	dB(μ V/m)	
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:

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 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 set up 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

Example:

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

5.3.5 Test result

Variant **Basic**

Measurement distance: 3 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.375	28.2	20.9	25.7	9	20	48.2	40.9	45.7	95.5	-54.6

Calculated value at distance: 300m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.375	-51.8	-59.1	-54.3	9	20	-31.8	-39.1	-34.3	15.5	-54.6

Values at distance: 3m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit QP dB(μ V/m)	Delta (dB)
0.537*	-	19.5	24.0	9	20	-	39.5	44.0	73.0	29.0
2.11*	-	19.8	23.9	9	20	-	39.8	43.9	69.5	25.6
7.98*	-	21.0	24.7	9	20	-	41.0	44.7	69.5	24.8
16.04*	-	21.9	24.6	9	20	-	41.9	44.6	69.5	24.9
23.84*	-	19.8	23.7	9	20	-	39.8	43.7	69.5	25.8
29.82*	-	22.4	25.0	9	20	-	42.4	45.0	69.5	24.5

*ambient noise

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Variant *Medium*

Measurement distance: 3 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.375	30.3	17.3	22.6	9	20	50.3	37.3	42.6	95.5	-58.2

Calculated value at distance: 300m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.375	-49.7	-62.7	-57.4	9	20	-29.7	-42.7	-37.4	15.5	-58.2

Values at distance: 3m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit QP dB(μ V/m)	Delta (dB)
0.537*	-	19.5	24.0	9	20	-	39.5	44.0	73.0	29.0
2.11*	-	19.8	23.9	9	20	-	39.8	43.9	69.5	25.6
7.98*	-	21.0	24.7	9	20	-	41.0	44.7	69.5	24.8
16.04*	-	21.9	24.6	9	20	-	41.9	44.6	69.5	24.9
23.84*	-	19.8	23.7	9	20	-	39.8	43.7	69.5	25.8
29.82*	-	22.4	25.0	9	20	-	42.4	45.0	69.5	24.5

*ambient noise

Variant *Colour*

Measurement distance: 3 m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.375	30.2	17.4	22.8	9	20	50.2	37.4	42.8	95.5	-58.1

Calculated value at distance: 300m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit AV dB(μ V/m)	Delta (dB)
0.375	-49.8	-62.6	-57.2	9	20	-29.8	-42.6	-37.2	15.5	-58.1

Values at distance: 3m

Frequency (MHz)	Level PK (dB μ V)	Level AV (dB μ V)	Level QP (dB μ V)	Band- width (kHz)	Correct. factor (dB)	Corrected Level PK dB(μ V/m)	Corrected Level AV dB(μ V/m)	Corrected Level QP dB(μ V/m)	Limit QP dB(μ V/m)	Delta (dB)
0.537*	-	19.5	24.0	9	20	-	39.5	44.0	73.0	29.0
2.11*	-	19.8	23.9	9	20	-	39.8	43.9	69.5	25.6
7.98*	-	21.0	24.7	9	20	-	41.0	44.7	69.5	24.8
16.04*	-	21.9	24.6	9	20	-	41.9	44.6	69.5	24.9
23.84*	-	19.8	23.7	9	20	-	39.8	43.7	69.5	25.8
29.82*	-	22.4	25.0	9	20	-	42.4	45.0	69.5	24.5

*ambient noise

FCC ID: 2AA98A

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

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	(μ V/m)	dB(μ V/m)	
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:

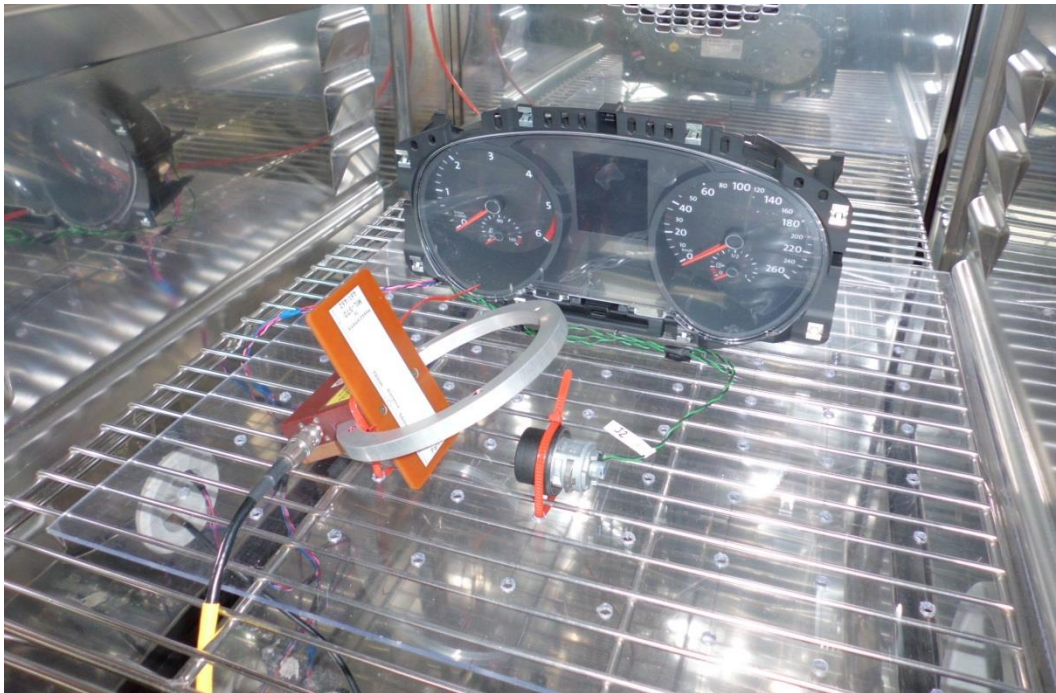
5.4 Emission Bandwidth

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

5.4.1 Description of the test location

Test location: AREA4

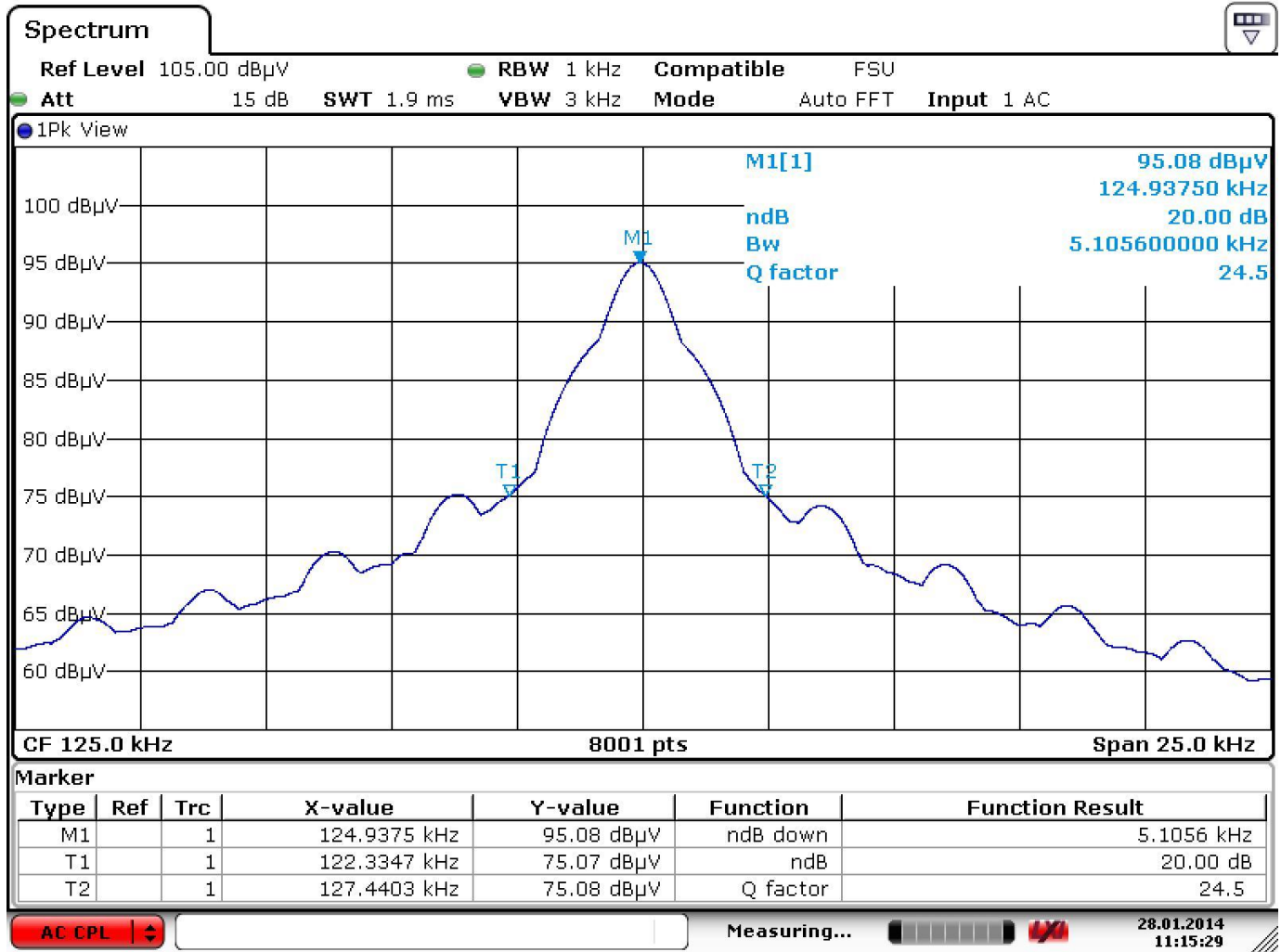
5.4.2 Photo documentation of the test set-up



Fundamental [kHz] See Plot 1	20dB Bandwidth F1	20dB Bandwidth F2	Measured Bandwidth [kHz]
124.94	122.33	127.44	5.11

5.4.3 Test protocol

Emission Bandwidth plots
 Variant **Basic**
 (no differences to variant medium and colour)



Date: 28.JAN.2014 11:15:29

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	FMZB 1516	01-02/24-01-018			14/02/2014	14/02/2013
	ESCI	02-02/03-05-005	12/12/2014	12/12/2013		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
MB	ESR7	02-02/03-13-001	21/05/2014	21/05/2013		
	HZ-10	02-02/24-05-012				
	6543A	02-02/50-05-157				
SER 1	FMZB 1516	01-02/24-01-018			14/02/2014	14/02/2013
	ESCI	02-02/03-05-005	12/12/2014	12/12/2013		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				