

## EMI -- TEST REPORT

<b>Test Report No. :</b> T32027-00-01AA	11. October 2007
	Date of issue

**Type / Model Name** : TMLF8-4

**Product Description** : Smart LF Oscillator System

**Applicant** : Toyota Motor Corporation

**Address** : 1, Toyota-Cho

Toyota, Aichi, 471-8572 Japan

**Manufacturer** : Toyota Motor Corporation

**Address** : 1, Toyota-Cho

Toyota, Aichi, 471-8572 Japan

**Licence holder** : Toyota Motor Corporation

**Address** : 1, Toyota-Cho

Toyota, Aichi, 471-8572 Japan

<b>Test Result</b> according to the standards listed in clause 1 test standards:	<b>POSITIVE</b>
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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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PHOTO DOCUMENTATION OF THE EUT

ATTACHMENT A

## 1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart C- Intentional Radiators (May 04, 2007)

Part 15, Subpart C, Section 15.209

Radiated emissions, general requirements

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## 2 SUMMARY

### GENERAL REMARKS:

None

### 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 : 08. October 2007

Testing concluded on : 09. October 2007

Checked by:

Tested by:

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

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Anton Altmann  
Dipl.-Ing.(FH)

### **3 EQUIPMENT UNDER TEST**

#### **3.1 Power supply system utilised**

Power supply voltage : 12 V / DC

#### **3.2 Short description of the Equipment under Test (EuT)**

Smart LF Oscillator Model TMLF8-3 is a transmitter installed in a motor vehicle and is used as a part of the Smart System. In the system, the Smart LF Oscillator has mainly following functions:

- Smart Door Unlocking  
Door antennas transmit a low frequency of 134.2 kHz intermittently. An electronic key, carried by driver, will transmit a high radio wave when recognized the signal.
- Smart Trunk Unlocking  
The trunk antenna provides the signal for the electronic key to open the trunk.
- Detection of Electronic Key inside Trunk  
If the driver tries to close the trunk, the inside trunk antenna transmits a radio wave of 134.2 kHz. The electronic key left inside the trunk will recognize the signal and transmits a high radio frequency back to alarm the driver.
- Smart Engine Start  
When the driver is inside the car the inside Room Antenna transmits a radio wave of 134.2 kHz. If the electronic key recognizes the signal it transmits a high radio frequency back to trigger the engine start mechanism.

The tests were performed on three antenna types in conjunction with the Computer assy (ECU):

1. Door antenna
2. Trunk antenna
3. Room antenna / Luggage Antenna

Number of tested samples: 1

#### **EuT operation mode:**

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

- Transmit mode CW (unmodulated)

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- Transmit mode modulated

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#### **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:**

- |                        |   |
|------------------------|---|
| - <u>Test box</u>      | Model : <u>Supplied by the manufacturer</u> |
| - <u>Door antenna</u>  | Model : _____                               |
| - <u>Room antenna</u>  | Model : _____                               |
| - <u>Trunk antenna</u> | Model : _____                               |
| - _____                | Model : _____                               |

## **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 is cautioned that there may be errors within the calibration limits of the equipment and facilities. 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. 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, VCCI and AUSTEL**

#### **4.4.1 GENERAL INFORMATION**

##### **4.4.1.1 Test Methodology**

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

In compliance with 47 CFR Part 15 Subpart A Section 15.38 testing for FCC compliance may be done following the ANSI C63.4-2003 procedures and using 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 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 C63.4-2003 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

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## **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:

#### **5.1.2 Photo documentation of the test set-up**

#### **5.1.3 Description of Measurement**

The final level, expressed in dB $\mu$ 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 $\mu$ V and  $\mu$ V, the following conversions apply:

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

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

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 $\Omega$ /50  $\mu$ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters 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.

#### **5.1.4 Test result**

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin

**Remarks:** This test is not applicable because the EuT is battery powered.

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## 5.2 Field strength of the fundamental wave

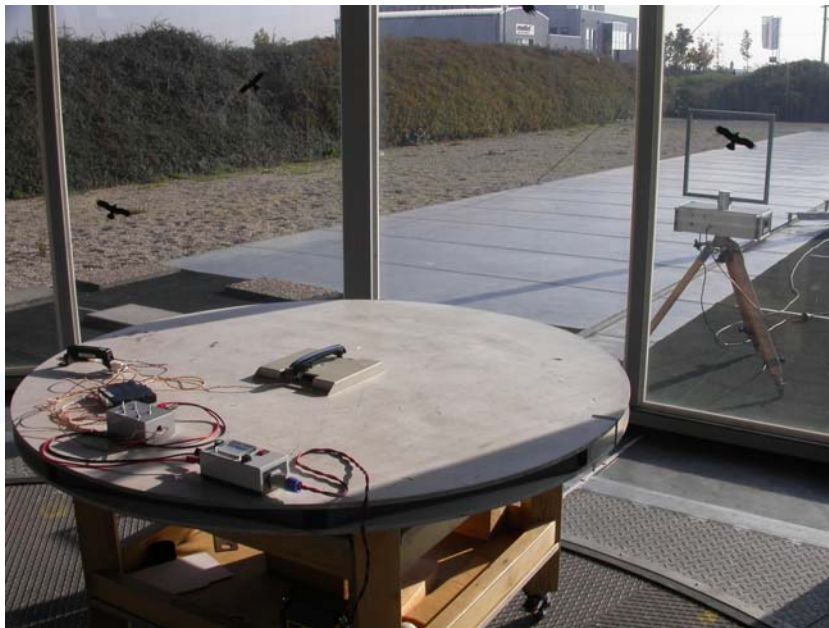
For test instruments and accessories used see section 6 Part CPR 1.

### 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



### 5.2.3 Description of Measurement

The magnetic field strength from the EuT will be measured on 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 C63.4-2003. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. 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].

The final level, expressed in dB $\mu$ V/m, is arrived at by taking the reading from the EMI receiver (Level dB $\mu$ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit.

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: ResBW: 200 Hz

150 kHz – 30 MHz: ResBW: 9 kHz

Example:

Frequency (MHz)	Level (dB $\mu$ V)	+	Factor (dB)	=	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	=	Delta (dB)
1.705	5	+	20	=	25	30	=	5

### 5.2.4 Test result

#### a) Door antenna

Measurement distance: 3 m

Frequency [kHz]	L: PK [dB $\mu$ V]	L: AV [dB $\mu$ V]	L: QP [dB $\mu$ V]	Correct. [dB]	L: PK [dB $\mu$ V/m]	L: AV [dB $\mu$ V/m]	L: QP [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Delta [dB]
134.2	74.6	74.6	74.4	20.0	94.6	94.6	94.4	105.0	-10.4

Calculated value at distance: 30 m

Frequency [kHz]	L: PK [dB $\mu$ V]	L: AV [dB $\mu$ V]	L: QP [dB $\mu$ V]	Correct. [dB]	L: PK [dB $\mu$ V/m]	L: AV [dB $\mu$ V/m]	L: QP [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Delta [dB]
134.2	34.6	34.6	34.4	20.0	54.6	54.6	54.4	65.0	-10.4

Calculated value at distance: 300 m

Frequency [kHz]	L: PK [dB $\mu$ V]	L: AV [dB $\mu$ V]	L: QP [dB $\mu$ V]	Correct. [dB]	L: PK [dB $\mu$ V/m]	L: AV [dB $\mu$ V/m]	L: QP [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Delta [dB]
134.2	-5.4	-5.4	-5.6	20.0	14.6	14.6	14.4	25.0	-10.4

b) Trunk antenna

Measurement distance: 3 m

Frequency [kHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
134.2	75.8	75.8	75.7	20.0	95.8	95.8	95.7	105.0	-9.2

Calculated value at distance: 30 m

Frequency [kHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
134.2	35.8	35.8	35.7	20.0	55.8	55.8	55.7	65.0	-9.2

Calculated value at distance: 300 m

Frequency [kHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
134.2	-4.2	-4.2	-4.3	20.0	15.8	15.8	15.7	25.0	-9.2

c) Room antenna

Measurement distance: 3 m

Frequency [kHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
134.2	75.1	75.1	75.0	20.0	95.1	95.1	95.0	105.0	-9.9

Calculated value at distance: 30 m

Frequency [kHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
134.2	35.1	35.1	35.0	20.0	55.1	55.1	55.0	65.0	-9.9

Calculated value at distance: 300 m

Frequency [kHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
134.2	-4.9	-4.9	-5.0	20.0	15.1	15.1	15.0	25.0	-9.9

Limit according to FCC Part 15 Subpart 15.209(a)

Frequency (MHz)	Field strength of fundamental wave		Measurement distance (meters)
	(µV/m)	dB (µV/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

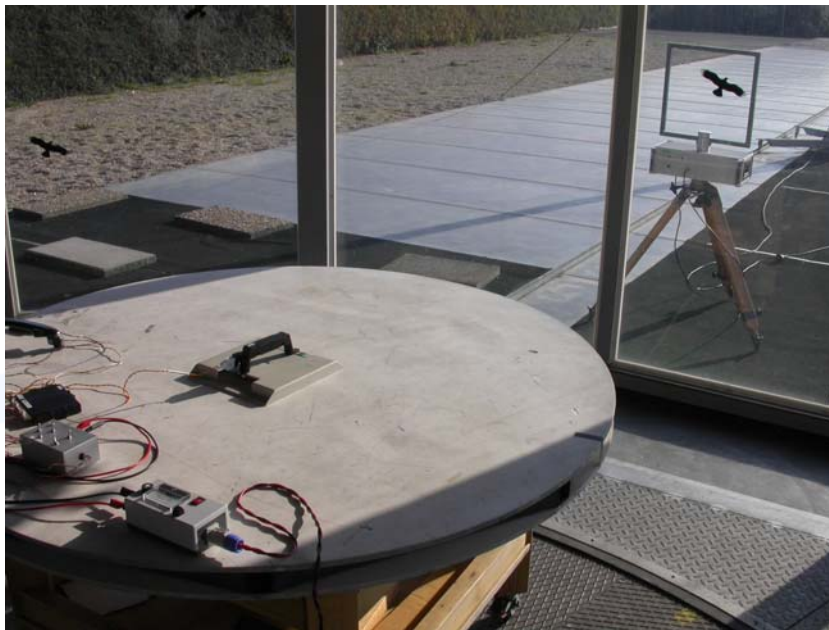
For test instruments and accessories used see section 6 Part SER 1.

#### 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 Description of Measurement

The spurious emissions from the EuT will be measured on 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 antenna was positioned 3, 10 or 30 meters horizontally from the EuT. Measurements have been made in all three orthogonal axes and the shielded loop antenna was rotated to locate the maximum of the emissions. 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].

The final level, expressed in dB $\mu$ V/m, is arrived at by taking the reading from the EMI receiver (Level dB $\mu$ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has to be compared with the relevant FCC limit.

The resolution bandwidth during the measurement is as follows:

9 kHz – 150 kHz: ResBW: 200 Hz

150 kHz – 30 MHz: ResBW: 9 kHz

Example:

Frequency (MHz)	Level (dB $\mu$ V)	+	Factor (dB)	=	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	=	Delta (dB)
1.705	5	+	20	=	25	30	=	5

### 5.3.4 Test result

#### a) Door antenna

Measurement distance: 3 m

Frequency [kHz]	L: PK [dB $\mu$ V]	L: AV [dB $\mu$ V]	L: QP [dB $\mu$ V]	Correct. [dB]	L: PK [dB $\mu$ V/m]	L: AV [dB $\mu$ V/m]	L: QP [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Delta [dB]
402.6	49.2	48.5	37.2	20.0	69.2	68.5	57.2	95.5	-27.0

Calculated value at distance: 300 m

Frequency [kHz]	L: PK [dB $\mu$ V]	L: AV [dB $\mu$ V]	L: QP [dB $\mu$ V]	Correct. [dB]	L: PK [dB $\mu$ V/m]	L: AV [dB $\mu$ V/m]	L: QP [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Delta [dB]
402.6	-30.8	-31.5	-42.8	20.0	-10.8	-11.5	-22.8	15.5	-27.0

#### b) Trunk antenna

Measurement distance: 3 m

Frequency [kHz]	L: PK [dB $\mu$ V]	L: AV [dB $\mu$ V]	L: QP [dB $\mu$ V]	Correct. [dB]	L: PK [dB $\mu$ V/m]	L: AV [dB $\mu$ V/m]	L: QP [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Delta [dB]
402.6	52.5	52.0	40.4	20.0	72.5	72.0	60.4	95.5	-23.5

Calculated value at distance: 300 m

Frequency [kHz]	L: PK [dB $\mu$ V]	L: AV [dB $\mu$ V]	L: QP [dB $\mu$ V]	Correct. [dB]	L: PK [dB $\mu$ V/m]	L: AV [dB $\mu$ V/m]	L: QP [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Delta [dB]
402.6	-27.5	-28.0	-39.6	20.0	-7.5	-8.0	-19.6	15.5	-23.5

c) Room antenna

Measurement distance: 3 m

Frequency [kHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
402.6	45.4	44.5	33.1	20.0	65.4	64.5	53.1	95.5	-31.0

Calculated value at distance: 300 m

Frequency [kHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
402.6	-34.6	-35.5	-46.9	20.0	-14.6	-15.5	-26.9	15.5	-31.0

Limit according to FCC Part 15 Subpart 15.209(a)

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (meters)
	(µV/m)	dB (µV/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: All other unwanted emissions are below -15 dBµV/m (at 300 m).

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## 5.4 Radiated emissions (electric field) 30 MHz – 1 GHz

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

### 5.4.1 Description of the test location

Test location: OATS1

Test distance: 3 metres

### 5.4.2 Photo documentation of the test set-up



### 5.4.3 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 meter 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 will be in accordance to ANSI C63.4-2003. 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 screen room located outside the test area. The antenna was positioned 3, 10 or 30 meters horizontally from the EuT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarization`s and the EuT are rotated 360 degrees.

The final level, expressed in dBµV/m, is arrived by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (Factor dB) to it. This is done automatically in the EMI receiver, where the correction factors are stored. This result then has the FCC or CISPR limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets at page.

The resolution bandwidth during the measurement is as follows:  
 30 MHz – 1000 MHz: ResBW: 120 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	Limit (dBµV/m)	=	Delta (dB)
719	75	+	32.6	=	107.6	110	=	-2.4

### 5.4.4 Test result

Door antenna, Trunk antenna, Room antenna

Frequency [MHz]	L: PK [dBµV]	L: AV [dBµV]	L: QP [dBµV]	Correct. [dB]	L: PK [dBµV/m]	L: AV [dBµV/m]	L: QP [dBµV/m]	Limit [dBµV/m]	Delta [dB]
30-1000	---	---	---	20	---	---	---		

No spurious emissions could be detected!

Limit according to FCC Part 15 Subpart 15.209(a)

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (meters)
	(µV/m)	dB (µV/m)	
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

The requirements are **FULFILLED**.

Remarks: The measurement has been performed up to 1 GHz.



## 5.5 Emission Bandwidth

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

### 5.5.1 Description of the test location

Test location: AREA4

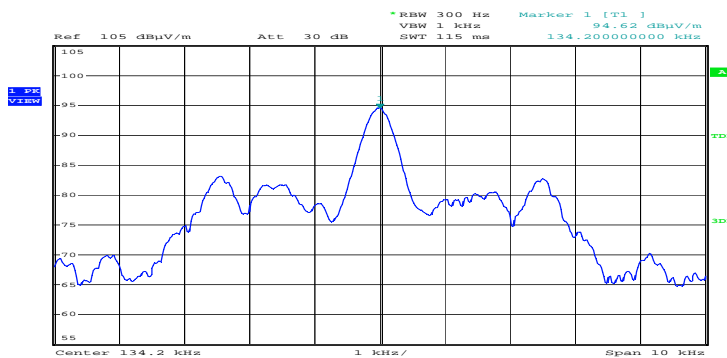
### 5.5.2 Photo documentation of the test set-up



5.5.3 Test protocol

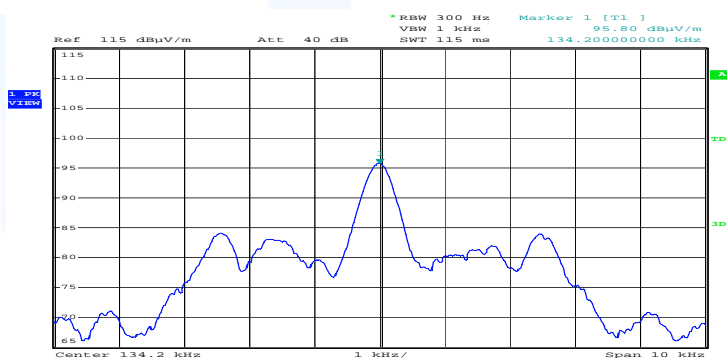
Emission Bandwidth plots

Door antenna



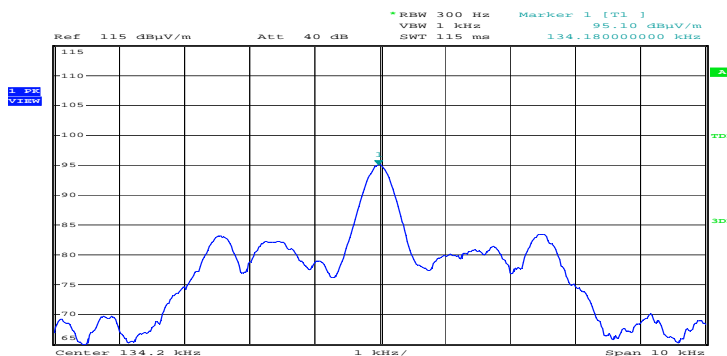
Date: 9.OCT.2007 15:48:05

Trunk antenna



Date: 9.OCT.2007 15:53:00

Room antenna



Date: 9.OCT.2007 15:50:53

## 6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used, in addition to the test accessories, are calibrated and verified regularly.

Test ID	Model / Type	Kind of Equipment	Manufacturer	Equipment No.
CPR 1	FMZB 1516 ESCI	Magnetic Field Antenna EMI Test Receiver	Schwarzbeck Mess-Elektronik Rohde & Schwarz München	01-02/24-01-018 02-02/03-05-004
MB	ESCI THS730A HZ-10 WK-340/40 6543A	EMI Test Receiver Handheld Scope Magnetic Field Antenna Climatic Chamber Power Supply	Rohde & Schwarz München Tektronix GmbH Rohde & Schwarz München Weiss Umwelttechnik GmbH HP Hewlett-Packard	02-02/03-05-004 02-02/13-05-001 02-02/24-05-012 02-02/45-05-001 02-02/50-05-157
SER 1	FMZB 1516 ESCI	Magnetic Field Antenna EMI Test Receiver	Schwarzbeck Mess-Elektronik Rohde & Schwarz München	01-02/24-01-018 02-02/03-05-004
SER 2	ESVS 30 VULB 9168 S10162-B/+11N-50-10-5 KK-EF393-21N-16 NW-2000-NB	EMI Test Receiver Trilog-Broadband Antenna RF Cable 33m RF Cable 20m RF Cable	Rohde & Schwarz München Schwarzbeck Mess-Elektronik Huber + Suhner Huber + Suhner Huber + Suhner	02-02/03-05-006 02-02/24-05-005 02-02/50-05-031 02-02/50-05-033 02-02/50-05-113

Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
01-02/24-01-018 02-02/03-05-004	11/30/2007	11/30/2006	12/04/2007	12/04/2006
02-02/03-05-004 02-02/13-05-001 02-02/24-05-012 02-02/45-05-001 02-02/50-05-157	11/30/2007 09/03/2008 09/01/2008	11/30/2006 09/03/2007 09/01/2005	12/06/2007	06/06/2007
01-02/24-01-018 02-02/03-05-004	11/30/2007	11/30/2006	12/04/2007	12/04/2006
02-02/03-05-006 02-02/24-05-005 02-02/50-05-031 02-02/50-05-033 02-02/50-05-113	07/24/2008 04/15/2008	07/24/2007 04/15/2005	09/21/2007	05/09/2006