FCC ID: NI4TMLF-3

TTI - P-G 089 / 94-11
DAT - P-011 / 91-02

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

Test Report No. :	**T25911-00-02AA**	28. April 2005 Date of issue

Type / Model Name : TMLF-3

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

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

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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Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15 Subpart C- Intentional Radiators (October 01, 2003)

Part 15, Subpart C, Section 15.209(a) Radiated emissions, general requirements

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2 SUMMARY

GENERAL REMARKS:

The test of the EuT TMLF-3 has been carried out with CAN terminal included.

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 of MBPS

Testing commenced on : 25. April 2005

Testing concluded on : 27. April 2005

Checked by:

Harald Buchwald
Ich bestätige die Richtigkeit und Integrität dieses Dokuments
2005.04.29 14:04:52 +02'00'

Harald Buchwald
Dipl. Ing.(FH)

Tested by:

Anton Altmann
Ich bin der Verfasser dieses Dokuments
2005.04.29 13:36:51 +02'00'

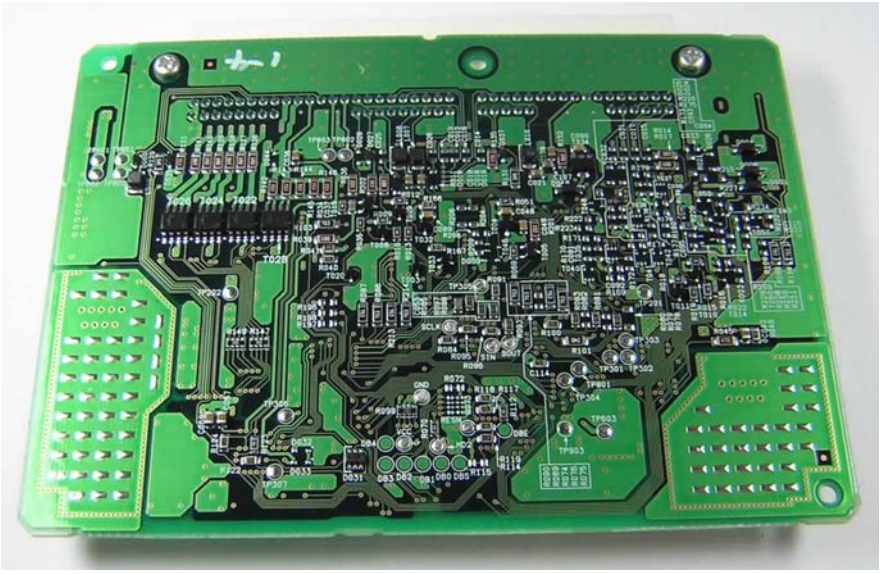
Anton Altmann
Dipl. Ing.(FH)

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EuT

ECU

ECU



Door Antenna

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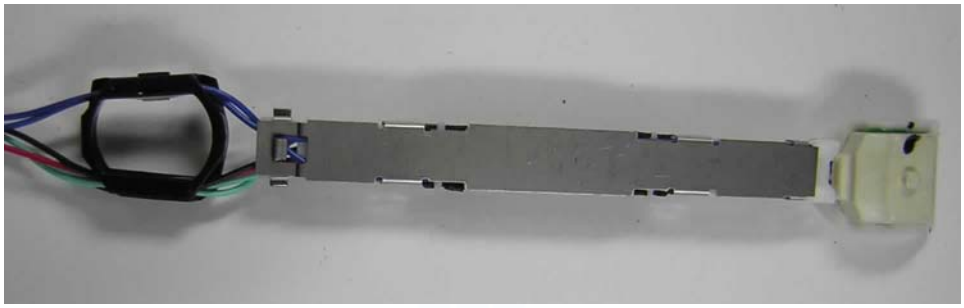
Door Antenna



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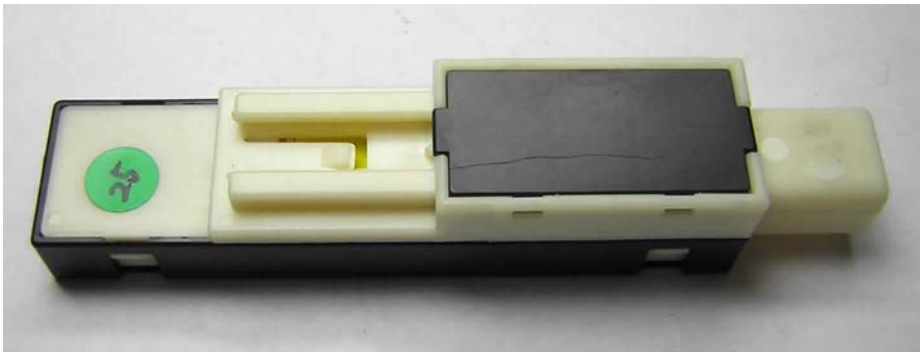
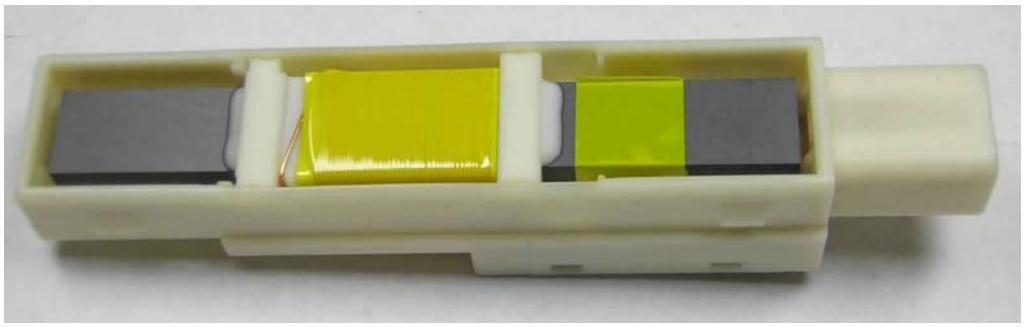
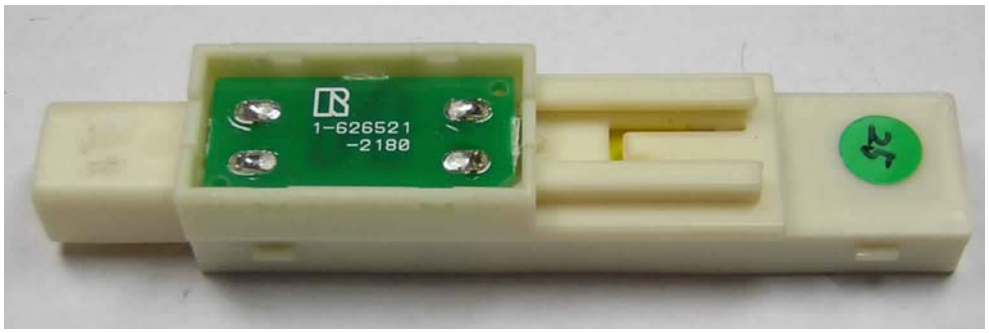
Door Oscillator

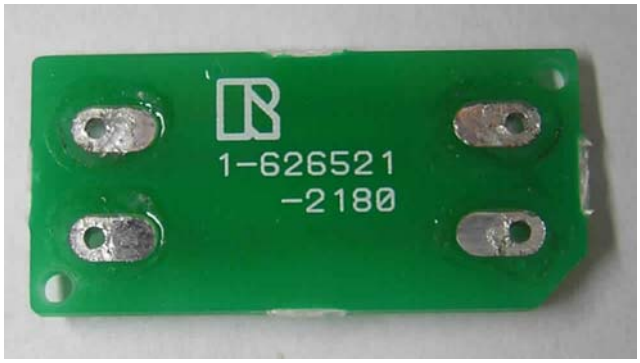
Door Oscillator

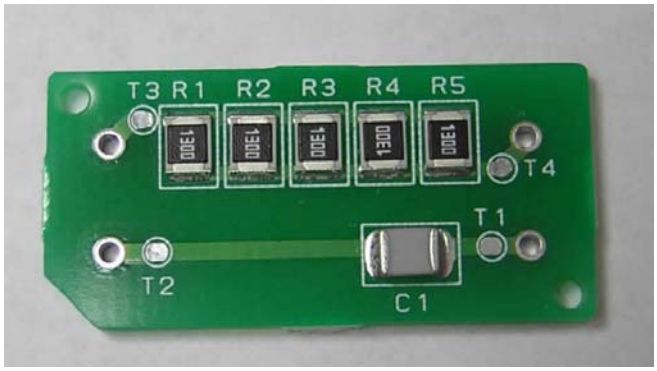
Room Antenna



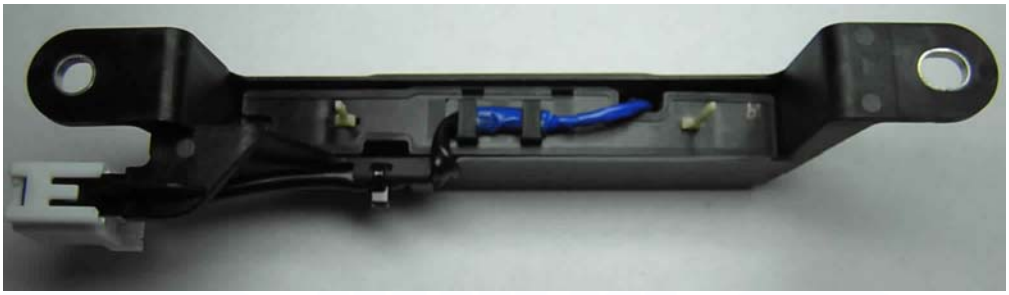




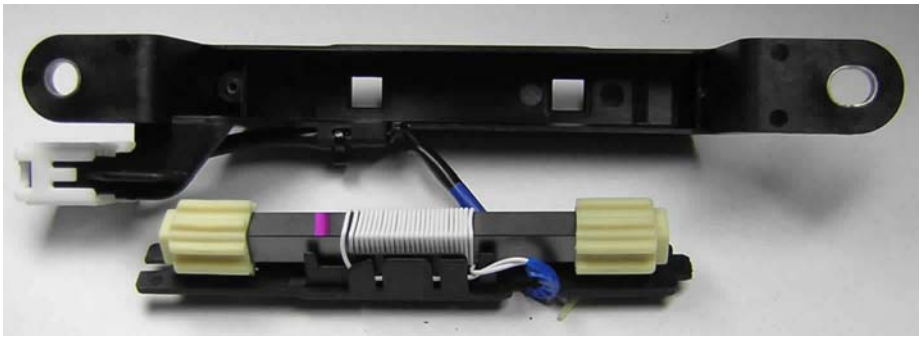




Trunk Antenna



Trunk Antenna



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3.2 Power supply system utilised

Power supply voltage : 12 V / DC

3.3 Short description of the Equipment under Test (EuT)

The Smart LF Oscillator Model TMLF-3 is a transmitter that is installed in a motor vehicle and is used as part of Smart Key System. In the system, the Smart LF Oscillator mainly functions as follows:

- Smart Door Unlocking
  4 door antennas transmit a low frequency of 134.2kHz intermittently. An electronic key, carried by the driver, will transmits 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 134.2kHz.
  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 134.2kHz. If the electronic key recognize the signal it transmits a high radio frequency back to trigger the engine start mechanism.

For the worst case three antennas have been tested in conjunction with the Computer assy (ECU):

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

Number of tested samples: 1
Serial number: Prototype

EuT operation mode:

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

- Continuous transmission (unmodulated)

- Continuous transmission (modulated)

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:

- Test box Model : Supplied by the manufacturer
- Door Antenna/Door oscillator Model :
- Trunk Antenna Model :
- Room Antenna Model :

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

MIKES BABT Product Service 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 MIKES BABT Product Service GmbH 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 (1997), European Standard EN 55022 and Australian Standard AS 3548 (which are based on CISPR 22).

The Japanese standard, "Voluntary Control Council for Interference (VCCI) by Data Processing Equipment and Electronic Office Machines, Technical Requirements" is technically equivalent to CISPR 22 (1997). For official compliance, a conformance report must be sent to and accepted by the VCCI.

In compliance with FCC Docket 92-152, "Harmonization of Rules for Digital Devices Incorporate International Standards", testing for FCC compliance may be done following the ANSI C63.4-2003 procedures and using the CISPR 22 Limits.

4.4.1.2 Measurement Error

The data and results referenced in this document are true and accurate. The reader is cautioned that there is some measurement variability due to the tolerances of the test equipment that can contribute to a nominal product measurement uncertainty. The measurement uncertainty was calculated for all measurements listed in this test report according to NIS 81/5.1994 “The treatment of uncertainty in EMC measurements” and is documented in the MIKES BABT Product Service GmbH quality system according to DIN EN ISO/IEC 17025. Furthermore, component differences and manufacturing process variability of production units similar to that tested may result in additional product uncertainty. If necessary, refer to the test lab for the actual measurement uncertainty for specific tests. The manufacturer has the sole responsibility of continued compliance of the device.

4.4.1.3 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 into it’s characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum disturbances from the unit.

4.4.2 DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with CISPR Publication 22 (1997), EN 55022 (2001) and AS 3548 (1992) - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment" 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.

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 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, which is equivalent to the Australian AS 3548 limit.

To convert between dBμV and μV, the following conversions apply:

dBμV = 20(log μV)

μV = Inverse log(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 50Ω/50 μH (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeter's above the floor and is positioned 40 centimeter's from the vertical ground plane (wall) of the screen room. If the minimum passing 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:

Min. limit margin

Remarks: The measurement is not applicable.

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

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5.2.3 Description of Measurement

The magnetic field strength from the EuT is measured 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.

The final level, expressed in dBµV/m, is arrived at by taking the reading from the EMI receiver (Level dBµV) 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 (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	Limit (dBµV/m)	=	Delta (dB)
1.705	5	+	20	=	25	30	=	5

5.2.4 Test result

a) Door Antenna/Oscillator

Measurement distance: 3m

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]
0.134	76.6	75.7	76.0	20.0	96.6	95.7	96.0	105.0	-9.3

Calculated value at distance: 30 m

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]
0.134	36.6	35.7	36.0	20.0	56.6	55.7	56.0	65.0	-9.3

Calculated value at distance: 300 m

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]
0.134	-3.4	-4.3	-4.0	20	16.6	15.7	16.0	25.0	-9.3

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b) Room Antenna

Measurement distance: 3m

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]
0.134	76.0	75.8	76.0	20.0	96.0	95.8	96.0	105.0	-9.2

Calculated value at distance: 30 m

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]
0.134	36.0	35.8	36.0	20.0	56.0	55.8	56.0	65.0	-9.2

Calculated value at distance: 300 m

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]
0.134	-4.0	-4.2	-4.0	20	16.0	15.8	16.0	25.0	-9.2

c) Trunk Antenna

Measurement distance: 3m

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]
0.134	77.3	76.3	76.6	20.0	97.3	96.3	96.6	105.0	-8.7

Calculated value at distance: 30 m

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]
0.134	37.3	36.3	36.6	20.0	57.3	56.3	56.6	65.0	-8.7

Calculated value at distance: 300 m

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]
0.134	-2.7	-3.7	-3.4	20	17.3	16.3	16.6	25.0	-8.7

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 (Magnectic field) 9 kHz – 30 MHz

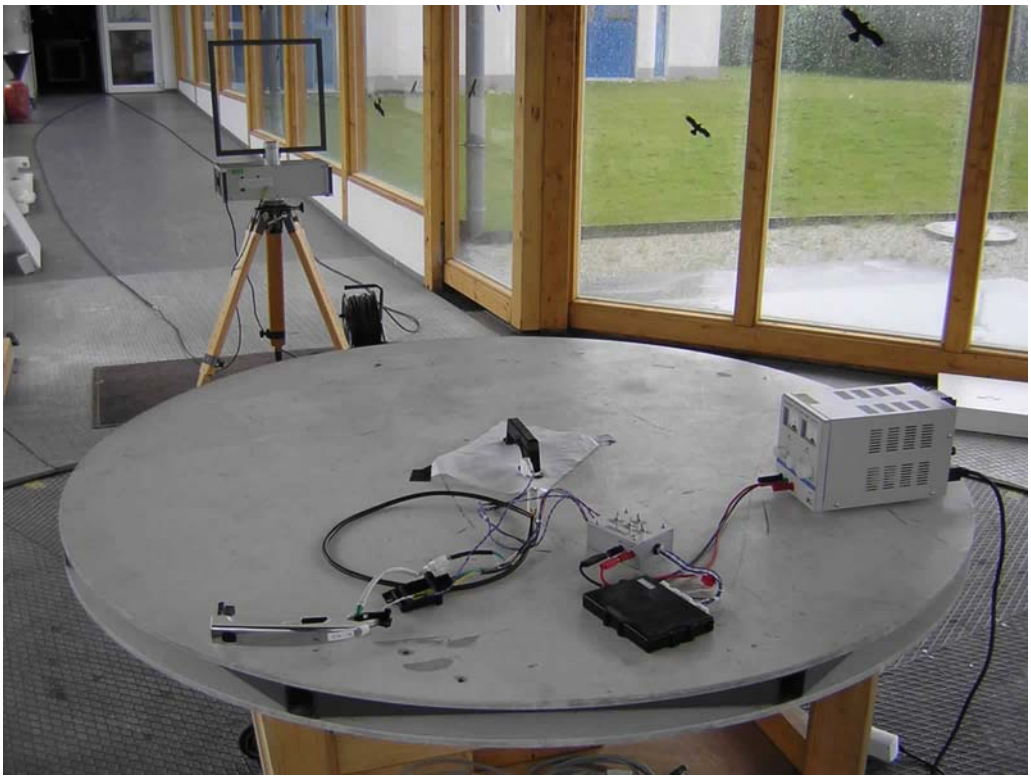
For test instruments and accessories used see section 6 Part **SER 1**.

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

Spurious emissions from the EuT are measured 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.

The final level, expressed in dBµV/m, is arrived at by taking the reading from the EMI receiver (Level dBµV) 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 (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	Limit (dBµV/m)	=	Delta (dB)
1.705	5	+	20	=	25	30	=	5

5.3.4 Test result

a) Door Antenna/Door Oscillator

Measurement distance: 3m

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]
0.402	34.2	33.7	34.0	20.0	54.2	53.7	54.0	95.5	-41.8

Calculated value at distance: 300 m

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]
0.402	-45.8	-46.3	-46.0	20.0	-25.8	-26.3	-26.0	15.5	-41.5

b) Room Antenna

Measurement distance: 3m

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]
0.402	45.2	45.1	45.3	20.0	65.2	65.1	65.3	95.5	-30.2

Calculated value at distance: 300 m

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]
0.402	-34.8	-34.9	-34.7	20.0	-14.8	-14.9	-14.7	15.5	-30.2

c) Trunk Antenna

Measurement distance: 3m

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]
0.402	52.8	53.0	53.0	20.0	72.8	73.0	73.0	95.5	-22.5

Calculated value at distance: 300 m

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]
0.402	-27.2	-27.0	-27.0	20.0	-7.2	-7.0	-7.0	15.5	-22.5

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

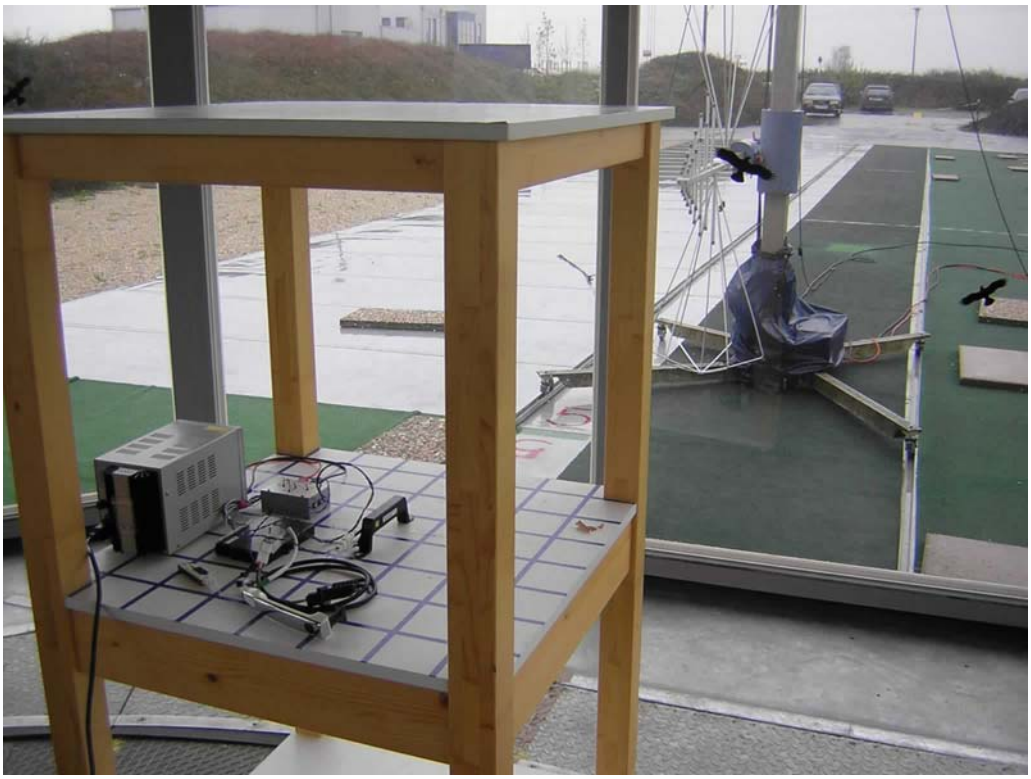
For test instruments and accessories used see section 6 Part **SER 2**.

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 10 times the highest used frequency 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. 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.

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

a) Door Antenna/Door Oscillator

Measurement distance: 3m

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]
50.7	-8.1	-3.9	-3.0	13.1	5.0	9.2	10.1	40.0	-29.9

b) Room Antenna

Measurement distance: 3m

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]
50.7	9.2	4.8	10.1	13.1	22.3	17.9	23.2	40.0	-16.8

c) Trunk Antenna

Measurement distance: 3m

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]
50.7	9.1	4.3	10.0	13.1	22.2	17.4	23.1	40.0	-16.9

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
960-1000	500	54	3

The requirements are **FULFILLED.**

Remarks: All other unwanted emissions are below 5 dBµV/m (at 3 m).

5.5 Emission Bandwidth

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

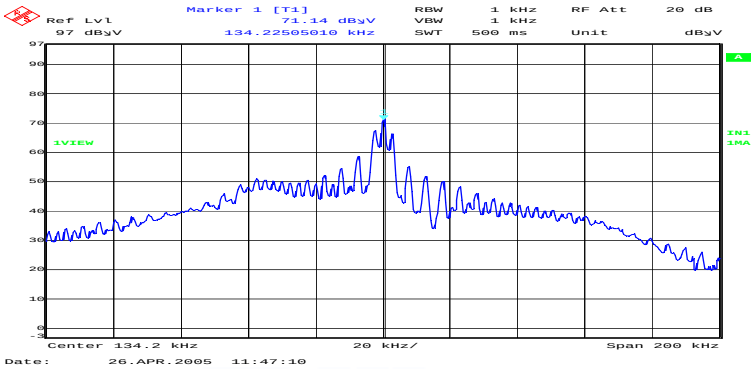
5.5.1 Description of the test location

Test location: AREA4

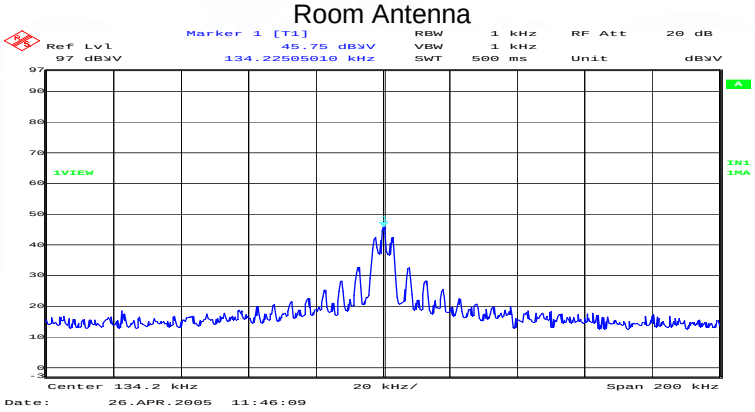
5.5.2 Test protocol

Emission Bandwidth plots

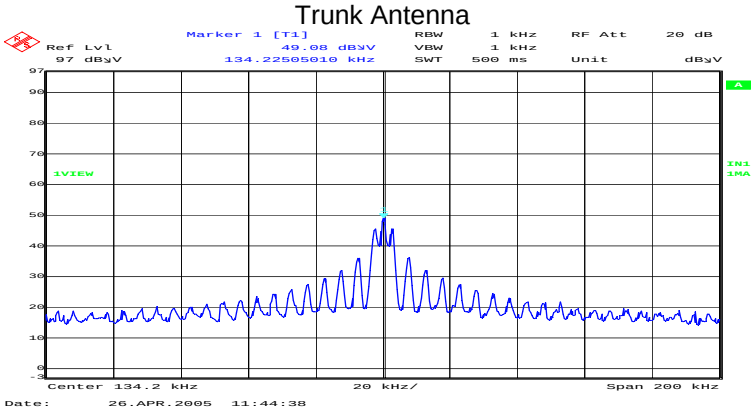
Door Antenna/Door Oscillator



Room Antenna



Trunk Antenna



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.
CPR1	Peaktech 6015 A	DC Power Supply	BÜRKLIN	04-07/49-03-003
	ESCS 30	Test Receiver	Rohde & Schwarz GmbH & Co	04-07/63-99-001
	FMZB 1516	Magnetic Field Antenna	Schwarzbeck Mess-Elektronik	99-07/62-03-004
MB	Peaktech 6015 A	DC Power Supply	BÜRKLIN	04-07/49-03-003
	HZ-10	Magnetic Field Antenna	Rohde & Schwarz GmbH & Co	04-07/62-95-320
	ESIB 40	Test Receiver	Rohde & Schwarz GmbH & Co	04-07/63-03-002
	VLK 04/300	Climatic Chamber	Heraeus -Vötsch GmbH	04-10/90-89-001
SER1	Peaktech 6015 A	DC Power Supply	BÜRKLIN	04-07/49-03-003
	ESCS 30	Test Receiver	Rohde & Schwarz GmbH & Co	04-07/63-99-001
	FMZB 1516	Magnetic Field Antenna	Schwarzbeck Mess-Elektronik	99-07/62-03-004
SER2	Peaktech 6015 A	DC Power Supply	BÜRKLIN	04-07/49-03-003
	Sucofeed 7/8	RF Cable	Huber + Suhner	04-07/60-04-089
	NW-2000-NB	RF Cable	MBPS GmbH	04-07/60-04-205
	EF393-21N-15m	RF Cable	Huber + Suhner	04-07/60-04-258
	VULB 9165	Super Broadband Antenn	Schwarzbeck Mess-Elektronik	04-07/62-00-001
	ESVS 30	Test Receiver	Rohde & Schwarz GmbH & Co	04-07/63-04-001
	Antenna Mast	Antenna Mast	Rohde & Schwarz GmbH & Co	04-07/92-97-002