



# InterLab<sup>®</sup>

## Final Report on

### MFD - Car Radio with Bluetooth

**Report Reference:** MDE\_FAKT\_1106\_FCCa  
acc. Title 47 CFR chapter I part 15 subpart C

**Date:** November 24, 2011

**Test Laboratory:**

7Layers AG  
Borsigstr. 11  
40880 Ratingen  
Germany



**Note:**

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

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## 1 Administrative Data

### 1.1 Project Data

*Project Responsible:* Carsten Steinröder  
*Date Of Test Report:* 2011/11/24  
*Date of first test:* 2011/08/03  
*Date of last test:* 2011/08/03

### 1.2 Applicant Data

*Company Name:* FAKT S.r.l.  
*Street:* Via Lithos, 53  
*PO Box:* 20086  
*City:* Rezzato (BS)  
*Country:* Italy  
  
*Contact Person:* Mr. Nicola Scartapacchio  
*Fax:* +39 030 2590395  
*E-Mail:* nscartapacchio@fakt.it

### 1.3 Test Laboratory Data

The following list shows all places and laboratories involved for test result generation:

#### 7 layers DE

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*Company Name :* 7 layers AG  
*Street :* Borsigstrasse 11  
*City :* 40880 Ratingen  
*Country :* Germany  
*Contact Person :* Mr. Michael Albert  
*Phone :* +49 2102 749 201  
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*E Mail :* michael.albert@7Layers.de

#### Laboratory Details

<i>Lab ID</i>	<i>Identification</i>	<i>Responsible</i>	<i>Accreditation Info</i>
Lab 1	Radiated Emissions	Mr. Robert Machulec Mr. Andreas Petz	DAkKS-Registration no. D-PL-12140-01-01

### 1.4 Signature of the Testing Responsible



Carsten Steinröder  
responsible for tests performed in: Lab 1



7 layers AG, Borsigstr. 11  
40880 Ratingen, Germany  
Phone +49 (0)2102 749 0

## 1.5 Signature of the Accreditation Responsible



*B. Retka* [B. RETKA]

7 layers AG, Borlestr. 11  
40080 Nettmen, Germany  
Phone: +49 (0)2127 219 0

Accreditation scope responsible person  
responsible for Lab 1

## 2 Test Object Data

### 2.1 General OUT Description

The following section lists all OUTs (Object's Under Test) involved during testing.

#### OUT: MFD - Car Radio with Bluetooth

**Manufacturer:**

*Company Name:* MAGNETI MARELLI S.p.A  
*Street:* Via A. Borletti, 61/63  
*PO Box:* 20011  
*City:* Corbetta (MI)  
*Contact Person:* Mr. Franco Schinco

**Parameter List:**

Parameter name	Value
DC Power Supply	12 (V)
highest channel (BT)	2480 (MHz)
lowest channel (BT)	2402 (MHz)
mid channel (BT)	2441 (MHz)

### 2.2 Detailed Description of OUT Samples

**Sample : z03**

<i>OUT Identifier</i>	MFD - Car Radio with Bluetooth
<i>Sample Description</i>	MFD Radiated sample
<i>HW Status</i>	01
<i>SW Status</i>	00
<i>Nominal Voltage</i>	12 V
<i>Normal Temp.</i>	20 °C

**Parameter List:**

Parameter Description	Value
<b>Parameter for Scope FCC_v2</b>	
Frequency_high	2480 (MHz)
Frequency_low	2402 (MHz)
Frequency_mid	2441 (MHz)

## 2.3 OUT Features

### Features for OUT: MFD - Car Radio with Bluetooth

<i>Designation</i>	<i>Description</i>	<i>Allowed Values</i>	<i>Supported Value(s)</i>
<b>Features for scope: FCC_v2</b>			
BT	EUT supports Bluetooth data rate of 1 Mbps with GFSK modulation in the band 2400 MHz - 2483.5 MHz		
DC	The OUT is powered by or connected to DC Mains		
EDR2	EUT supports Bluetooth using data rate of 2 Mbps with PI/4 DQPSK modulation in the band 2400 MHz - 2483.5 MHz		
EDR3	EUT supports Bluetooth using data rate of 3 Mbps with 8DPSK modulation in the band 2400 MHz - 2483.5 MHz		
Iant	Integral Antenna: permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment		

## 2.4 Setups used for Testing

For each setup a relation is given to determine if and which samples and auxiliary equipment is used. The left side list all OUT samples and the right side lists all auxiliary equipment for the given setup.

<i>Setup No.</i>	<i>List of OUT samples</i>	<i>List of auxiliary equipment</i>
<i>Sample No.</i>	<i>Sample Description</i>	<i>AE No. AE Description</i>

### Z03 (FCC Radiated Test Setup)

<i>Sample: z03</i>	MFD Radiated sample
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## 3 Results

### 3.1 General

**Documentation of tested devices:**

Available at the test laboratory.

**Interpretation of the test results:**

The results of the inspection are described on the following pages, where 'Conformity' or 'Passed' means that the certification criteria were verified and that the tested device is conform to the applied standard.

In cases where 'Declaration' is printed, the required documents are available in the manufacturers product documentation.

In cases where 'not applicable' is printed, the test case requirements are not relevant to the specific equipment implementation.

**Note:**

1) This test report is a partial test report. The purpose of this test report is the investigation of a FCC Class 1/2 permissive change.

2) Special software used for testing:  
The OUT was connected to a PC (via RS232) to set the specific test modes. On the PC the Software "BlueTool" by Infineon Technologies AG was used to set the OUT into Bluetooth Test Mode.

### 3.2 List of the Applicable Body

(Body for Scope: FCC\_v2)

<i>Designation</i>	<i>Description</i>
FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES	Subpart C - Intentional Radiators; 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

### 3.3 List of Test Specification

<i>Test Specification:</i>	<b>FCC part 2 and 15</b>
<i>Version</i>	10-1-10 Edition
<i>Title:</i>	PART 2 - GENERAL RULES AND REGULATIONS PART 15 - RADIO FREQUENCY DEVICES



### 3.4 Summary

<i>Test Case Identifier / Name</i> <i>Test (condition)</i>	<i>Result</i>	<i>Date of Test</i>	<i>Lab</i> <i>Ref.</i>	<i>Setup</i>
<b>15c.2 Spurious radiated emissions §15.247 (d), §15.35 (b), §15.209</b> 15c.2; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation, Channel = mid	Passed	2011/08/03	Lab 1	Z03



### 3.5 Detailed Results

#### 3.5.1 15c.2 Spurious radiated emissions §15.247 (d), §15.35 (b), §15.209

**Test: 15c.2; Frequency = 2441, Mode = BT transmit using 1 Mbps with GFSK modulation, Channel = mid**

<i>Result:</i>	Passed
<i>Setup No.:</i>	Z03
<i>Date of Test:</i>	2011/08/03 11:43
<i>Body:</i>	FCC47CFRChIPART15c247RADIO FREQUENCY DEVICES
<i>Test Specification:</i>	FCC part 2 and 15

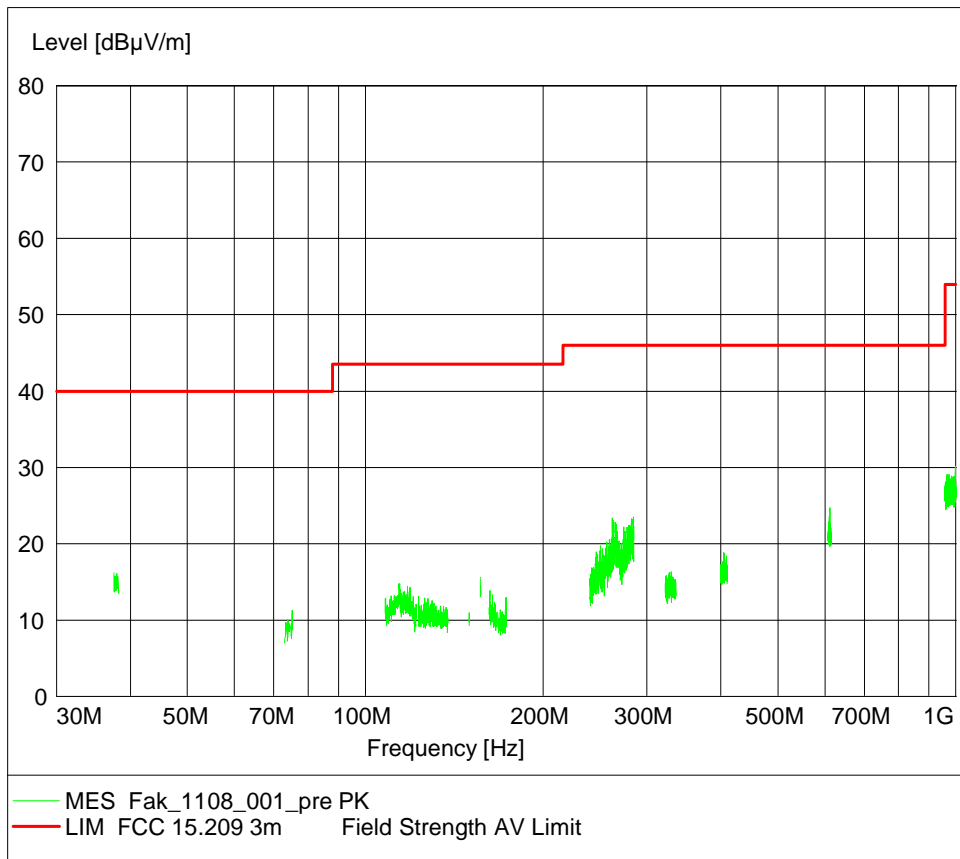
**Detailed Results:**

**SPURIOUS EMISSION RADIATED**

EUT: (DA110z03) / 03.08.2011  
 Manufacturer: Fakt  
 Operating Condition: BT TX on 2441 MHz 1-DH1, loopback mode  
 Test Site: 7 layers, Ratingen  
 Operator: Doe  
 Test Specification: FCC 15.247 (15.35b, 15.209)  
 Comment: vertical + horizontal antenna polarisation  
 Start of Test: 03.08.2011 / 16:43:27

**SCAN TABLE: "FCC 15.209 Field <1G"**

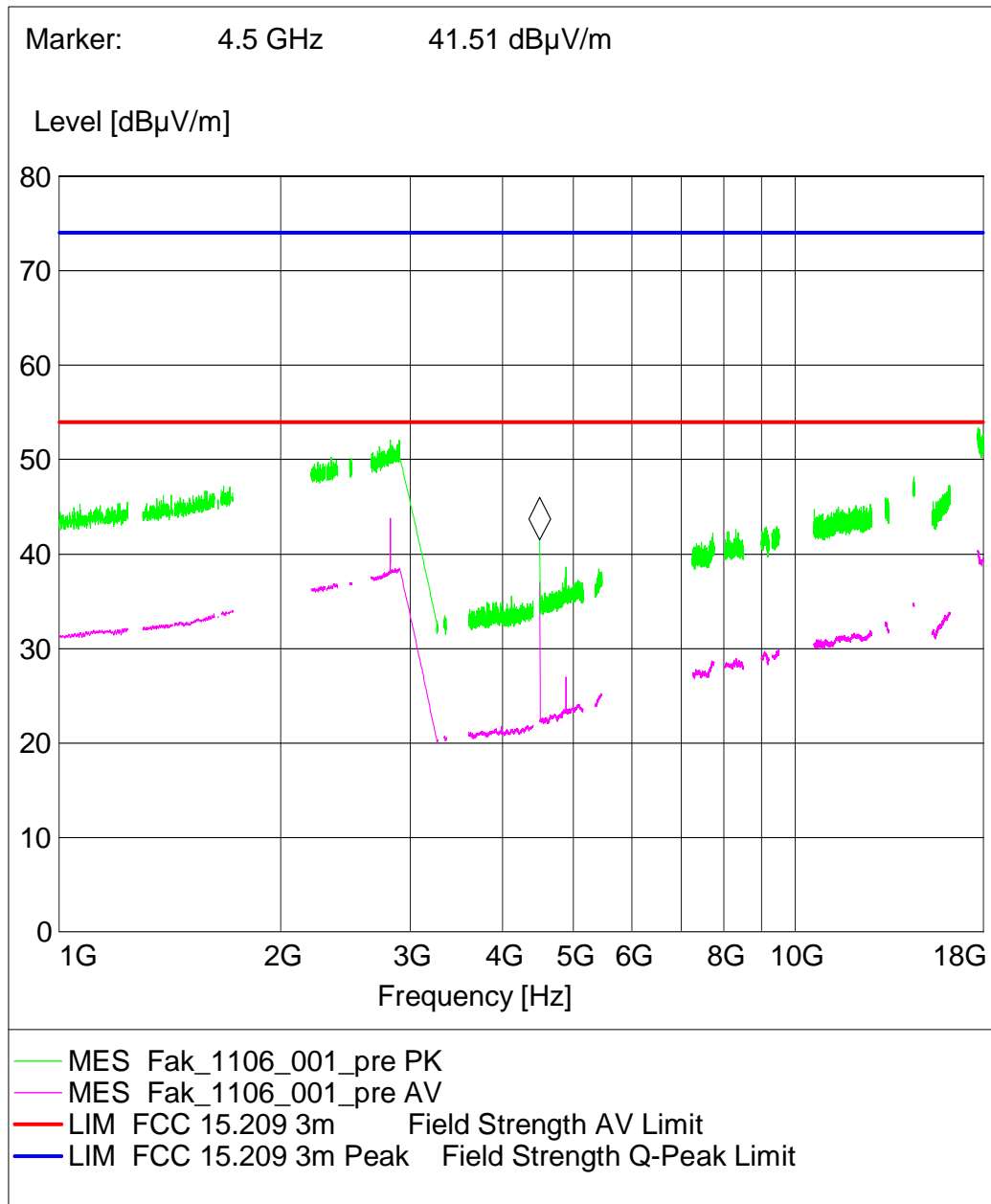
Short Description:		FCC				
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
37.5 MHz	38.3 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
73.0 MHz	74.6 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
74.8 MHz	75.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
108.0 MHz	121.9 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
123.0 MHz	138.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
149.9 MHz	150.1 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
156.5 MHz	156.5 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
156.7 MHz	156.9 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
162.0 MHz	167.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
167.7 MHz	173.2 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
240.0 MHz	285.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
322.0 MHz	335.4 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
399.9 MHz	410.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
608.0 MHz	614.0 MHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562
960.0 MHz	1.0 GHz	60.0 kHz	MaxPeak	100.0 µs	120 kHz	HL562





**SPURIOUS EMISSION RADIATED**

EUT: MFD (DA110z03) / 21.07.2011  
 Manufacturer:  
 Operating Condition: TX on 2441 MHz, loopback mode, 1-DH1  
 Test Site: 7 layers Ratingen  
 Operator: Gal  
 Test Specification: FCC 15.247 (15.35b, 15.209)  
 Comment: vertical + horizontal antenna polarisation  
 horizontal EUT position

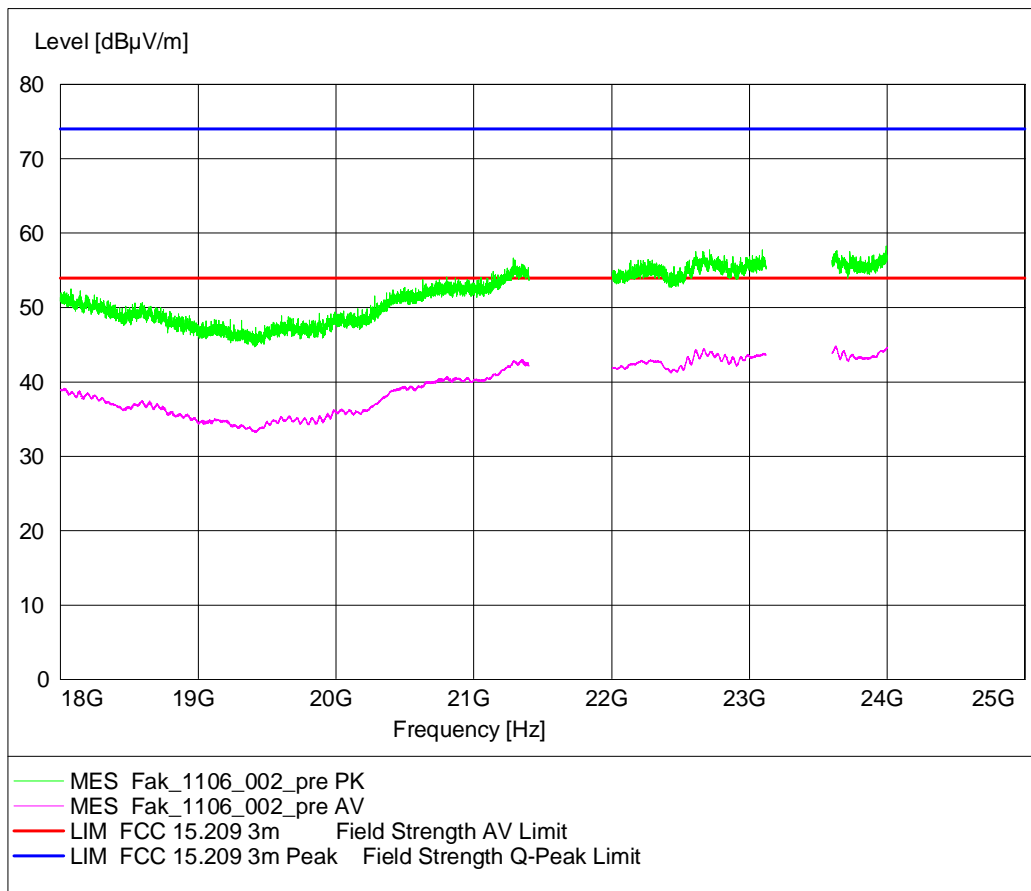


**SPURIOUS EMISSION RADIATE**

EUT: MFD (DA110z03) / 21.07.2011  
 Manufacturer:  
 Operating Condition: TX on 2441 MHz, loopback mode, 1-DH1  
 Test Site: 7 Layers Ratingen  
 Operator: Gal  
 Test Specification: FCC 15.247 (15.35b, 15.209)  
 Comment: vertical + horizontal antenna polarisation  
 horizontal EUT position

**SCAN TABLE: "FCC 15.209 C Field m"**

Short Description:			FCC ClassA Field Strength			
Start	Stop	Step	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1000.0 MHz	60.0 kHz	MaxPeak	100.0 ms	120 kHz	HL562
1.0 GHz	2.4 GHz	500.0 kHz	MaxPeak	100.0 ms	1 MHz	HF 906 / 001
			Average			
2.5 GHz	7.0 GHz	500.0 kHz	MaxPeak	100.0 ms	1 MHz	HF 906 / 001
			Average			
7.0 GHz	18.0 GHz	500.0 kHz	MaxPeak	100.0 µs	1 MHz	HF 906 / 001
			Average			
18.0 GHz	25.0 GHz	500.0 kHz	MaxPeak	100.0 ms	1 MHz	EMCO 3160-09
			Average			



## 4 Test Equipment Details

### 4.1 List of Used Test Equipment

The calibration, hardware and software states are shown for the testing period.

#### Test Equipment Anechoic Chamber

<b>Lab ID:</b>	<b>Lab 1</b>
<b>Manufacturer:</b>	Frankonia
<b>Description:</b>	Anechoic Chamber for radiated testing
<b>Type:</b>	10.58x6.38x6 m <sup>3</sup>

#### Single Devices for Anechoic Chamber

Single Device Name	Type	Serial Number	Manufacturer
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m <sup>3</sup>	none	Frankonia
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	FCC listing 96716 3m Part15/18		2011/01/11 2014/01/10
	IC listing 3699A-1 3m		2011/02/07 2014/02/06
Controller Maturo	MCU	961208	Maturo GmbH
EMC camera	CE-CAM/1	-	CE-SYS
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1	-	Siemens&Matsushita
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita

#### Test Equipment Auxiliary Equipment for Radiated emissions

<b>Lab ID:</b>	<b>Lab 1</b>
<b>Description:</b>	Equipment for emission measurements
<b>Serial Number:</b>	see single devices

#### Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	Type	Serial Number	Manufacturer
Antenna mast	AS 620 P	620/37	HD GmbH
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Standard Calibration		2008/10/27 2013/10/26
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Path Calibration		2011/05/11 2011/11/10
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Path Calibration		2011/05/11 2011/11/10
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Path Calibration		2011/05/11 2011/11/10
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01- 2+W38.01-2	Kabel Kusch
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>

**Single Devices for Auxiliary Equipment for Radiated emissions (continued)**

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
	Path Calibration		2011/05/11 2011/11/10
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02-2	Rosenberger Micro-Coax
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Path Calibration		2011/05/11 2011/11/10
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Standard Calibration		2009/04/16 2012/04/15
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Standard Calibration		2009/04/28 2012/04/27
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Path Calibration		2011/05/11 2011/11/10
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Path Calibration		2011/05/11 2011/11/10
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Path Calibration		2011/05/11 2011/11/10
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Path Calibration		2011/05/11 2011/11/10
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Standard Calibration		2009/05/27 2012/05/26
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	DKD calibration		2008/10/07 2011/10/06
Network Analyzer	E5071B	MY42200813	Agilent
	<i>Calibration Details</i>		<i>Last Execution Next Exec.</i>
	Standard Calibration		2010/11/09 2011/11/09
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH

**Test Equipment Auxiliary Test Equipment**

**Lab ID:** **Lab 1**  
**Manufacturer:** see single devices  
**Description:** Single Devices for various Test Equipment  
**Type:** various  
**Serial Number:** none

**Single Devices for Auxiliary Test Equipment**

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2009/10/07 2011/10/06
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

**Test Equipment Digital Signalling Devices**

**Lab ID:** Lab 1  
**Description:** Signalling equipment for various wireless technologies.

**Single Devices for Digital Signalling Devices**

Single Device Name	Type	Serial Number	Manufacturer
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2008/08/14 2011/08/13
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG
	<i>HW/SW Status</i>		<i>Date of Start</i> <i>Date of End</i>
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard calibration		2008/12/01 2011/11/30
	<i>HW/SW Status</i>		<i>Date of Start</i> <i>Date of End</i>
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02
	SW: K62, K69		2008/11/03

**Test Equipment Emission measurement devices**

**Lab ID:** **Lab 1**  
**Description:** Equipment for emission measurements  
**Serial Number:** see single devices

**Single Devices for Emission measurement devices**

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Personal Computer	Dell	30304832059	Dell
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard Calibration			2009/10/20 2011/10/19
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard calibration			2009/10/15 2011/10/14
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard Calibration			2009/12/03 2011/12/02

**4.2 Laboratory Environmental Conditions**

<i>Laboratory</i>	<i>Date</i>	<i>Temperature</i>	<i>Humidity</i>	<i>Air Pressure</i>
Lab 1	2011/08/03	24 °C	39 %	1005 hPa

## 5 Annex

### 5.1 Additional Information for Report

#### Spurious radiated emissions

**Standard** FCC Part 15, 10-1-10 Edition Subpart C

**The test was performed according to:** ANSI C63.4–2009

#### Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

The test was performed at the distance of 3 m between the EUT and the receiving antenna. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The radiated emissions measurements were made in a typical installation configuration. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is also performed while the EUT is powered from both AC and DC (battery) power in order to find the worst-case operating condition.

#### 1. Measurement up to 30 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009. The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.

The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software ES-K1 from R&S. The Loop antenna HFH2-Z2 is used.

##### Step 1: pre-measurement

- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 – 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF-Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

##### Step 2: final measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.

- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF-Bandwidth: 200 Hz – 10 kHz
- Measuring time / Frequency step: 100 ms



## 2. Measurement above 30 MHz and up to 1 GHz

### Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100  $\mu$ s (BT Timing 1.25 ms)
- Turntable angle range:  $-180$  to  $+180^\circ$
- Turntable step size:  $90^\circ$
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

### Step 2: second measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range:  $-180$  to  $+180^\circ$
- Turntable step size:  $45^\circ$
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable):  $45^\circ$
- Antenna height: 0.5 m

### Step 3: final measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved.

This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by  $\pm 22.5^\circ$  around this value.

During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by  $\pm 25$  cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range:  $-22.5^\circ$  to  $+22.5^\circ$  around the determined value
- Height variation range:  $-0.25$  m to  $+0.25$  m around the determined value

### Step 4: final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak ( $< 1$  GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

**3. Measurement above 1 GHz**

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

The Equipment Under Test (EUT) was set up on a non-conductive support at 1.4 m height in the fully-anechoic chamber. The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18–25 GHz) are used, the steps 2–4 are omitted. Step 1 was performed with one height of the receiving antenna only.

EMI receiver settings:

- Detector: Peak, Average
- IF Bandwidth = 1 MHz

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

For the enhanced data rate packets the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at basic data rate. Typically, the measurement for these packets is performed in the frequency range 1 to 8 GHz but it depends on the emissions found during the test for the basic data rate. Please refer to the results for the used frequency range.

**Test Requirements / Limits**

FCC Part 15, Subpart C, §15.247 (d)

... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300	Limit (dBµV/m)+30dB
0.49 – 1.705	24000/F(kHz)	30	Limit (dBµV/m)+10dB
1.705 - 30	30	30	Limit (dBµV/m)+10dB

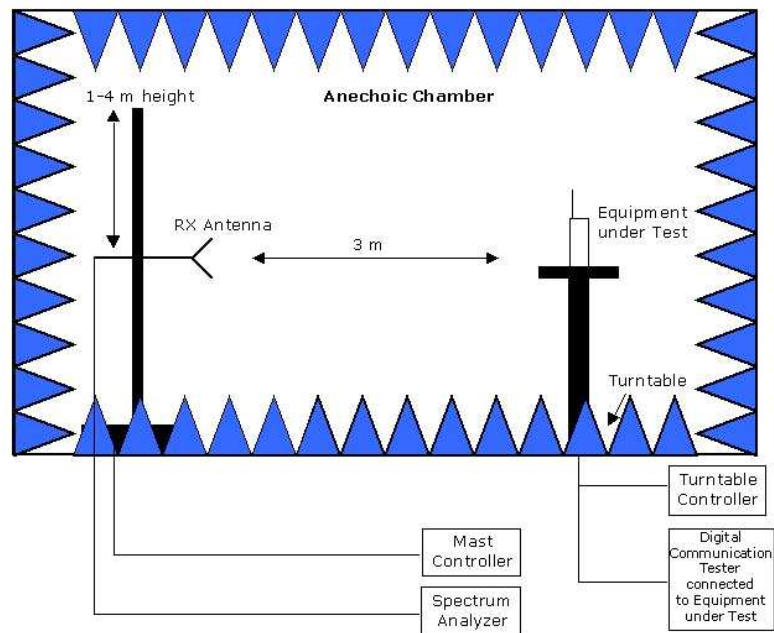
Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 - 88	100	3	40.0
88 - 216	150	3	43.5
216 - 960	200	3	46.0
above 960	500	3	54.0

§15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

## Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

**Drawing 1:** Setup in the Anechoic chamber:  
Measurements below 1 GHz: Semi-anechoic, conducting ground plane.  
Measurements above 1 GHz: Fully-anechoic, absorbers on all surfaces

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