



Inter**Lab**[®]

FCC Measurement/Technical Report on

Bluetooth – WLAN transceiver
BMW NBT (Headunit)

Report Reference: MDE_HARMAN_1013_FCCc

Test Laboratory:

Borsigstr. 11
Germany
7Layers AG
40880 Ratingen



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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0 Summary

0.1 Technical Report Summary

Type of Authorization

Certification for an Intentional Radiator (Digital Device / Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 (10-1-11 Edition) and 15 (10-1-11 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

Note:

The tests were selected and performed with reference to the FCC measurement guide line "Measurement of Digital Transmission Systems Operating under Section 15.247 March 23, 2005"

Instead of applying ANSI C63.4–1992 which is referenced in the FCC Public Note, the newer ANSI C63.4–2009 is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.



0.2 Measurement Summary

FCC Part 15, Subpart C and E **§15.35, §15.205, §15.209, §15.407**

Spurious radiated emissions

The measurement was performed according to ANSI C63.4

2009

OP-Mode	Setup	Port	Final Result
op-mode 1-co	Setup_01	Enclosure	passed
op-mode 2-co	Setup_01	Enclosure	passed
op-mode 3-co	Setup_01	Enclosure	passed
op-mode 4-co	Setup_01	Enclosure	passed
op-mode 5-co	Setup_01	Enclosure	passed
op-mode 6-co	Setup_01	Enclosure	passed
op-mode 7-co	Setup_01	Enclosure	passed
op-mode 8-co	Setup_01	Enclosure	passed
op-mode 9-co	Setup_01	Enclosure	passed

The purpose of this test report is to evaluate simultaneous transmission effects. Therefore especially the measured frequency range of radiated emissions tests and limits may deviate from the FCC requirements, if tested stand-alone.

Responsible for
Accreditation Scope:

Responsible
for Test Report:



1 Administrative Data

1.1 Testing Laboratory

Company Name: 7 Layers AG
Address Borsigstr. 11
40880 Ratingen
Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716 .

The test facility is also accredited by the following accreditation organisation:
- Deutscher Akkreditierungs Rat DAR-Registration no. DGA-PL-192/99-02

Responsible for Accreditation Scope: Dipl.-Ing. Bernhard Retka
Dipl.-Ing. Robert Machulec
Dipl.-Ing. Thomas Hoell
Dipl.-Ing. Andreas Petz

Report Template Version: 2012-03-14

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Carsten Steinröder
Date of Test(s): 2012-03-30 to 2012-04-02
Date of Report: 2012-04-19

1.3 Applicant Data

Company Name: Harman Becker Automotive Systems GmbH
Address: Becker-Görling-Straße 16
76307 Karlsbad
Germany
Contact Person: Mr. Stefan Blaschek

1.4 Manufacturer Data

Company Name: please see applicant data
Address:
Contact Person:



2 Test object Data

2.1 General EUT Description

Equipment under Test	Bluetooth / WLAN transceiver
Type Designation:	NBT
Kind of Device:	Car Radio
(optional)	
Voltage Type:	DC
Voltage level:	12 V
Modulation Type:	Bluetooth: GFSK, 8DPSK, $\pi/4$ DQPSK WLAN: BPSK, DQPSK, QPSK, 16-QAM, 64-QAM, CCK

General product description:

Bluetooth is a short-range radio link intended to be a cable replacement between portable and/or fixed electronic devices.

Bluetooth operates in the unlicensed ISM Band at 2.4 GHz. In the US a band of 83.5 MHz width is available. In this band, the Bluetooth technology defines 79 RF channels spaced 1 MHz (2402 - 2480 MHz). The actual RF channel is chosen from a pseudo-random hopping sequence through the 79 channels. A channel is occupied for a defined amount of time slots, with a nominal slot length of 625 μ s. The maximum time slot length on one channel is defined by the packet type and is 0.625 ms for DH1 packets, 1.875 ms for DH3 and 3.125 ms for DH5. The nominal hop rate is 1600 hops/s for DH1, 1600/3 for DH3 and 1600/5 for DH5. All frequencies are equally used. The maximum nominal average time of occupancy is 0.4 s within a period of 79*0.4 seconds. The basic data rate of 1 Mbps uses GFSK modulation and the enhanced data rate uses PSK modulation. For the enhanced data rate of 3 Mbps 8DPSK modulation and of 2 Mbps $\pi/4$ DQPSK modulation is used.

The WLAN transceiver operates in the 2.4 GHz ISM band using Direct Sequence Spread Spectrum (DSSS) Modulation. The EUT supports the modes 802.11b (maximum data rate 11 Mbps), 802.11g (maximum data rate 54 Mbps).

Specific product description for the EUT:

The EUT is a Car Radio which uses Bluetooth and WLAN technology to setup radio links to other devices.

The EUT provides the following ports:

Ports

- Permanent antenna connector WLAN
- Permanent antenna connector Bluetooth
- Permanent antenna connector GPS
- Car Connector
- APIX Display
- USB (3x)
- Ethernet
- FM1/AM
- FM2
- Enclosure
- Video in

The main components of the EUT are listed and described in Chapter 2.2.



2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status	Date of Receipt
EUT A (Code: 43080a01) Remark: None.	Bluetooth / WLAN transceiver	NBT	-	D3	Bios Control	-

NOTE: The short description is used to simplify the identification of the EUT in this test report.

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
AE 1	External Antenna	External BT/WLAN Antenna	-	-	-	-
AE 2	External Antenna	External GPS Antenna	-	-	-	-
AE 3	FM antenna	FM antenna	-	-	-	-
AE 4	Fakra / USB cables	Fakra / USB cables	-	-	-	-
AE 5	Fakra / Ethernet cable	Fakra / Ethernet cable	-	-	-	-
AE 6	Video IN cable	Video IN cable	-	-	-	-
AE 7	Cable Harness (incl. DC power line)	Cable Harness (Car Connector)	-	-	-	-
Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
-						

2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
AUX1	µMost Board	µMost Board	-	-	-	-



2.5 EUT Setups

This chapter describes the combination of EUTs and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
Setup_01	EUT A + all AEs + AUX1	setup for radiated measurements

2.6 Operating Modes

This chapter describes the operating modes of the EUTs used for testing.

Op. Mode	Description of Operating Modes	Remarks
op-mode 1-co	The EUT transmits on 2402 MHz (Bluetooth) + 2412 MHz (WLAN)	BT TX on 2402 MHz, Packettype: DH1 / Wlan b on 2412 MHz
op-mode 2-co	The EUT transmits on 2441 MHz (Bluetooth) + 2437MHz (WLAN)	BT TX on 2441 MHz, Packettype: DH1 / Wlan b on 2437 MHz
op-mode 3-co	The EUT transmits on 2480 MHz (Bluetooth) + 2462 MHz (WLAN)	BT TX on 2480 MHz, Packettype: DH1 / Wlan b on 2462 MHz
op-mode 4-co	The EUT transmits on 2402 MHz (Bluetooth) + 2412 MHz (WLAN)	BT TX on 2402 MHz, Packettype: 2-DH1 / Wlan g on 2412 MHz
op-mode 5-co	The EUT transmits on 2441 MHz (Bluetooth) + 2437MHz (WLAN)	BT TX on 2441 MHz, Packettype: 2-DH1 / Wlan g on 2437 MHz
op-mode 6-co	The EUT transmits on 2480 MHz (Bluetooth) + 2462 MHz (WLAN)	BT TX on 2480 MHz, Packettype: 2-DH1 / Wlan g on 2462 MHz
op-mode 7-co	The EUT transmits on 2402 MHz (Bluetooth) + 2412 MHz (WLAN)	BT TX on 2402 MHz, Packettype: 3-DH1 / Wlan g on 2412 MHz
op-mode 8-co	The EUT transmits on 2441 MHz (Bluetooth) + 2437MHz (WLAN)	BT TX on 2441 MHz, Packettype: 3-DH1 / Wlan g on 2437 MHz
op-mode 9-co	The EUT transmits on 2480 MHz (Bluetooth) + 2462 MHz (WLAN)	BT TX on 2480 MHz, Packettype: 3-DH1 / Wlan g on 2462 MHz

Remark: All modes are set locally at the EUT.

2.7 Product labelling

2.7.1 FCC ID label

Please refer to the documentation of the applicant.

2.7.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Spurious radiated emissions

Standard FCC Part 15, 10-1-11 Subpart C

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

3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4–2009 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² 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 C 63.4-2009. 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:

- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 μ s
- Turntable angle range: -180° to 180°
- Turntable step size: 90°
- 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°
- Turntable step size: 45°
- 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°
- 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 ± 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° to $+ 22.5^\circ$ around the determined value
- Height variation range: -0.25m 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 data rate in mode n the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at modes b and g. Typically, the measurement is performed in the frequency range 1 to 8 GHz but it depends on the emissions found during the test for the modes b and g. Please refer to the results for the used frequency range.

3.1.2 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) + 30 dB
0.49 – 1.705	24000/F(kHz)	30	Limit (dBµV/m) + 10 dB
1.705 – 30	30	30	Limit (dBµV/m) + 10 dB

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)

For co-location scenarios the limit which permits the higher emission applies for simultaneous operation.

3.1.3 Test Protocol

Temperature: 24 °C
 Air Pressure: 1014 hPa
 Humidity: 33 %

Op. Mode **Setup** **Port**
 op-mode 1-co Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 25 GHz.

Op. Mode **Setup** **Port**
 op-mode 2-co Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 25 GHz.

Op. Mode **Setup** **Port**
 op-mode 3-co Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 25 GHz.

Op. Mode **Setup** **Port**
 op-mode 4-co Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 18 GHz, because pre-measurements have shown that no other spurious emissions were found outside this frequency range.



Op. Mode **Setup** **Port**
 op-mode 1-co Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 18 GHz, because pre-measurements have shown that no other spurious emissions were found outside this frequency range.

Op. Mode **Setup** **Port**
 op-mode 1-co Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 18 GHz, because pre-measurements have shown that no other spurious emissions were found outside this frequency range.

Op. Mode **Setup** **Port**
 op-mode 1-co Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 18 GHz, because pre-measurements have shown that no other spurious emissions were found outside this frequency range.

Op. Mode **Setup** **Port**
 op-mode 1-co Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 18 GHz, because pre-measurements have shown that no other spurious emissions were found outside this frequency range.



Op. Mode	Setup	Port
op-mode 1-co	Setup_01	Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Delta to limit dB	Delta to limit dB
		QP	Peak	AV	QP	Peak	AV	QP/Peak	AV
Horizontal / Vertical	-	-	-	-	-	74.0	54.0	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found. The measurement was performed not only within the restricted bands. The measurement was performed from 1 GHz up to 18 GHz, because pre-measurements have shown that no other spurious emissions were found outside this frequency range.

3.1.4 Test result: Spurious radiated emissions

FCC Part 15, Subpart C	Op. Mode	Result
	op-mode 1-co	passed
	op-mode 2-co	passed
	op-mode 3-co	passed
	op-mode 4-co	passed
	op-mode 5-co	passed
	op-mode 6-co	passed
	op-mode 7-co	passed
	op-mode 8-co	passed
	op-mode 9-co	passed



4 Test Equipment

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

Test Equipment Anechoic Chamber

Lab ID:	Lab 3
Manufacturer:	Frankonia
Description:	Anechoic Chamber for radiated testing
Type:	10.58x6.38x6.00 m ³

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 ³ FCC listing 96716 3m Part15/18 IC listing 3699A-1 3m	none	Frankonia 2011/01/11 2014/01/10 2011/02/07 2014/02/06
Controller Innco 2000	CO 2000	CO2000/328/12470 406/L	Innco innovative constructions GmbH
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

Lab ID:	Lab 3
Description:	Equipment for emission measurements
Serial Number:	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 Standard Calibration Standard Calibration	9117-108	Schwarzbeck 2008/10/27 2013/10/26 2012/01/18 2015/01/17
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01- 2	Kabel Kusch
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02- 2	Rosenberger Micro-Coax
Double-ridged horn	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i>		<i>Last Execution</i> <i>Next Exec.</i>
	Standard Calibration		2009/04/16 2012/04/15



Single Devices for Auxiliary Equipment for Radiated emissions (continued)

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG
	Standard Calibration		2009/04/28 2012/04/27
Dreheinheit	DE 325		HD GmbH
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG
	Standard Calibration		2009/05/27 2012/05/26
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG
	Standard calibration		2011/10/27 2014/10/26
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH
Pyramidal Horn Antenna 26,5 GHz	3160-09	9910-1184	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 3
Manufacturer: see single devices
Description: Single Devices for various Test Equipment
Type: various
Serial Number: none

Single Devices for Auxiliary Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
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
Broadband Power Divider SMA (Aux)	1515 / 93459	LN673	Weinschel Associates
Digital Multimeter 01 (Multimeter)	Voltcraft M-3860M	IJ096055	Conrad Electronics
Digital Multimeter 03 (Multimeter)	Fluke 177 Customized calibration	86670383	Fluke Europe B.V. 2011/10/19 2013/10/18
Digital Oscilloscope [SA2] (Aux)	TDS 784C	B021311	Tektronix GmbH
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
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
ThermoHygro_01 (Aux)	430202	none	Fischer Feingerätebau K. Fischer GmbH
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG



Test Equipment Digital Signalling Devices

Lab ID: Lab 3
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	Standard calibration	100589	Rohde & Schwarz GmbH & Co. KG 2011/11/24 2014/11/23
Digital Radio Communication Tester	CMD 55 Standard calibration	831050/020	Rohde & Schwarz GmbH & Co. KG 2011/11/28 2014/11/27
Digital Radio Test Set	6103E	2359	Racal Instruments, Ltd.
Universal Radio Communication Tester	CMU 200 Standard calibration <i>HW/SW Status</i>	102366	Rohde & Schwarz GmbH & Co. KG 2011/05/26 2013/05/25 <i>Date of Start 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 Standard calibration <i>HW/SW Status</i>	837983/052	Rohde & Schwarz GmbH & Co. KG 2011/12/07 2014/12/06 <i>Date of Start 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
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG



Test Equipment Emission measurement devices

Lab ID: Lab 3
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Emission measurement devices

Single Device Name	Type	Serial Number	Manufacturer
Personal Computer	Dell	30304832059	Dell
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG
Signal Generator	SMR 20 standard calibration	846834/008	Rohde & Schwarz GmbH & Co. KG 2011/05/12 2014/05/11
Spectrum Analyzer	ESIB 26 Standard Calibration HW/SW Status Firmware-Update 4.34.4 from 3.45 during calibration	830482/004	Rohde & Schwarz GmbH & Co. KG 2011/12/05 2013/12/04 Date of Start Date of End 2009/12/03

Test Equipment Multimeter 12

Lab ID: Lab 6
Description: Ex-Tech 520
Serial Number: 05157876

Single Devices for Multimeter 12

Single Device Name	Type	Serial Number	Manufacturer
Digital Multimeter 12 (Multimeter)	EX520 Customized calibration	05157876	Extech Instruments Corp. 2011/10/18 2013/10/17

Test Equipment Shielded Room 07

Lab ID: Lab 6
Description: Shielded Room 4m x 6m

Test Equipment T/H Logger 04

Lab ID: Lab 6
Description: Lufft Opus10
Serial Number: 7481

Single Devices for T/H Logger 04

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 04 (Environ)		7481	Lufft Mess- und Regeltechnik GmbH



Test Equipment Temperature Chamber 01

Lab ID: Lab 6
Manufacturer: see single devices
Description: Temperature Chamber KWP 120/70
Type: Weiss
Serial Number: see single devices

Single Devices for Temperature Chamber 01

Single Device Name	Type	Serial Number	Manufacturer
Temperature Chamber Weiss 01	KWP 120/70	59226012190010	Weiss Umwelttechnik GmbH
	Specific calibration		2010/03/16 2012/03/15

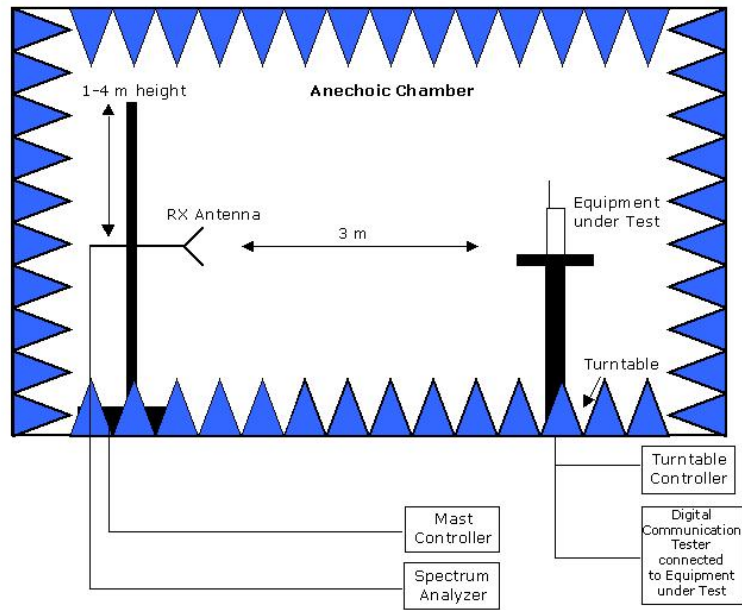
Test Equipment WLAN RF Test Solution

Lab ID: Lab 6
Manufacturer: 7 layers AG
Description: Regulatory WLAN RF Tests
Type: WLAN RF
Serial Number: 001

Single Devices for WLAN RF Test Solution

Single Device Name	Type	Serial Number	Manufacturer
Arbitrary Waveform Generator	TGA12101	284482	2010/06/23 2013/06
Power Meter NRVD	NRVD Standard Calibration	832025/059	2011/06/14 2012/06/13
Power Sensor NRV Z1 A	PROBE Standard Calibration	832279/013	2011/06/14 2012/06/13
Power Supply	NGSM 32/10 Standard Calibration	2725	2011/06/15 2013/06/14
Rubidium Frequency Normal MFS	Datum MFS Standard Calibration	002	Datum GmbH 2011/08/17 2012/08/16
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG
Signal Generator	SMP03 Standard Calibration	833680/003	Rohde & Schwarz GmbH & Co.KG 2009/06/23 2012/06/22
Spectrum Analyser	FSU26 Standard calibration FSU FW Update to v4.61 SP3, K5 v4.60 and K73 v4.61	100136	Rohde & Schwarz GmbH & Co.KG 2011/05/11 2012/05/10 2011/12/05
TOCT Switching Unit	Switching Unit	030106	7 layers, Inc.
TOCT Switching Unit (loan unit)	Switching Unit	030101	7 layers, Inc.
Vector Signal Generator SMIQ03B	SMIQ03B	832870/017	

5 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



6 FCC and IC Correlation of measurement requirements

The following tables show the correlation of measurement requirements for WLAN equipment and Digital Apparatus from FCC and IC standards.

WLAN equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC mains	§ 15.207	RSS-Gen: 7.2.4
Occupied bandwidth	§ 15.247 (a) (1)	RSS-210: A8.1
Peak power output	§ 15.247 (b) (1)	RSS-210: A8.4
Spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen: 6; RSS-210: A8.5
Spurious radiated emissions	§ 15.247 (d)	RSS-Gen: 6; RSS-210: A8.5
Band edge compliance	§ 15.247 (d)	RSS-210: A8.5
Power density	§ 15.247 (e)	RSS-210: A8.2 (b)
Antenna requirement	§ 15.203 / 15.204	RSS-Gen: 7.1.2

Digital Apparatus

Measurement	FCC reference	IC reference
Conducted Emissions (AC Power Line)	§ 15.107	ICES-003
Spurious Radiated Emissions	§ 15.109	ICES-003