InterLab®

FCC Measurement/Technical Report on

Bluetooth transceiver
in
Car Head Unit
NBT EVO HU

FCC ID: T8GB140
IC: 6434A-B140

Report Reference: MDE_HARMAN_1404_FCCd

Test Laboratory:
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Germany
7Layers AG
40880 Ratingen

DAkkS Deutsche Akkreditierungsstelle D-PL-12140-01-01

Table of Contents

0 Applied Standards and Test Summary

0.1 Technical Report Summary

Type of Authorization
Certification for an Intentional Radiator (Frequency Hopping 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 and 15. 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

Note:
The tests were selected and performed with reference to the FCC Public Notice DA 00-705, released March 30, 2000. 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 0.3 Measurement Summary.

0.2 FCC and IC Correlation Table

Correlation of measurement requirements for FHSS (e.g. Bluetooth®) equipment from FCC and IC

FHSS equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 3: 7.2.4
Occupied bandwidth	§ 15.247 (a) (1)	RSS-210 Issue 8: A8.1 (b)
Peak conducted output power	§ 15.247 (b) (1), (4)	RSS-210 Issue 8: A8.4 (2)
Transmitter spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 3: 4.9; RSS-210 Issue 8: A8.5
Transmitter spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 3: 7.2.5; RSS-210 Issue 8: A8.5
Band edge compliance	§ 15.247 (d)	RSS-210 Issue 8: A8.5
Dwell time	§ 15.247 (a) (1) (iii)	RSS-210 Issue 8: A8.1 (d)
Channel separation	§ 15.247 (a) (1)	RSS-210 Issue 8: A8.1 (b)
No. of hopping frequencies	§ 15.247 (a) (1) (iii)	RSS-210 Issue 8: A8.1 (d)
Hybrid systems (only)	§ 15.247 (f); § 15.247 (e)	RSS-210 Issue 8: A8.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 3: 7.1.2
Receiver spurious emissions	–	RSS-210 Issue 8: 2.3; RSS Gen Issue 3: 6 *)

*) Receivers which are part of Transceivers are exempted with respect to Notice 2012-DRS0126.

Information Technology Equipment (ITE)

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.107	ICES-003 Issue 5: 6.1
Spurious Radiated Emissions	§ 15.109	ICES-003 Issue 5: 6.2

0.3 Measurement Summary

FCC Part 15, Subpart C	§ 15.207	
Conducted emissions (AC power line)		
The measurement was performed according to ANSI C63.4		2009
Setup	**Port**	**Final Result**
-	AC port	N/A

FCC Part 15, Subpart C	§ 15.247 (a) (1)	
Occupied bandwidth		
The measurement was performed according to FCC § 15.31		10-1-13 Edition
Setup	**Port**	**Final Result**
Setup_01	Antenna connector	Passed

FCC Part 15, Subpart C	§ 15.247 (b) (1)	
Peak power output		
The measurement was performed according to FCC § 15.31		10-1-13 Edition
Setup	**Port**	**Final Result**
Setup_01	Antenna connector	Passed

FCC Part 15, Subpart C	§ 15.247 (d), § 15.35 (b), § 15.207	
Spurious conducted emissions		
The measurement was performed according to ANSI C63.4		2009
Setup	**Port**	**Final Result**
Setup_01	Antenna connector	Passed

FCC Part 15, Subpart C	§ 15.247 (d), § 15.35 (b), § 15.209	
Spurious radiated emissions		
The measurement was performed according to ANSI C63.4		2009
OP-Mode	**Setup**	**Port**	**Final Result**
	Setup_01	Enclosure	passed

FCC Part 15, Subpart C	§ 15.247 (d)	
Band edge compliance		
The measurement was performed according to FCC § 15.31 / ANSI C63.4		10-1-13 Edition / 2009
Setup	**Port**	**Final Result**
Setup_01	Antenna connector	passed
Setup_01	Enclosure	passed

FCC Part 15, Subpart C	§ 15.247 (a)	
Dwell Time		
The measurement was performed according to FCC § 15.31		10-1-13 Edition
Setup	**Port**	**Final Result**
Setup_01	Antenna connector	Passed

FCC Part 15, Subpart C	§ 15.247 (a)	
Channel Separation		
The measurement was performed according to FCC § 15.31		10-1-13 Edition
Setup	**Port**	**Final Result**
Setup_01	Antenna connector	Passed

FCC Part 15, Subpart C	§ 15.247 (a)	
Number of hopping frequencies		
The measurement was performed according to FCC § 15.31		10-1-13 Edition
Setup	**Port**	**Final Result**
Setup_01	Antenna connector	Passed

N/A not applicable (the EUT is powered by DC)

Responsible for Accreditation Scope: _____ Responsible for Test Report: _____

0.4 Revision History

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2014-10-22	--	valid

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:

Laboratory accreditation no.:	DAkkS D-PL-12140-01-01
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Thomas Hoell Dipl.-Ing. Andreas Petz Dipl.-Ing. Marco Kullik
Report Template Version:	2014-08-26

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Daniel Gall
Date of Test(s):	2014-08-19 to 2014-10-05
Date of Report:	2014-10-22

1.3 Applicant Data

Company Name:	Harman Becker Automotive Systems GmbH
Address:	Becker-Göring-Str. 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:	IEEE 802.11b/g WLAN & BT transceiver
Type Designation:	NBT EVO HU
Kind of Device:	Car Head Unit
(optional)	
Voltage Type:	DC
Voltage Level:	12.0 V
Tested Modulation Type:	BT: GFSK, π/4-DQPSK, 8-DPSK

General product description:

The EUT is a Bluetooth Transceiver which is incorporated in a multimedia Car Head Unit. Besides Bluetooth the Car Head Unit also supports further wireless technologies like WLAN and GPS.

This test report focuses on the Bluetooth transceiver, working in the 2.4 GHz band during testing.

Specific product description for the EUT:

None

The EUT provides the following ports:

Ports
Enclosure
Display Port
USB Port
BT Antenna Port
WLAN Antenna Port
GPS Antenna Port
FM Antenna Port
SDARS Antenna Port
BroadReach Interface Port
Cable Harness (incl. DC, Microphone, Loudspeaker)

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
EUT A (Code: DE1009002bb01)	WLAN & BT transceiver	NBT EVO HU	B143BR0E750 4802	05	-

Remark: EUT A is equipped with two external antenna connectors, one for Bluetooth, one for WLAN. The external Antenna is not provided by the applicant. A representative antenna was used with a gain of -3dBi and a cable loss of about -2.8dB.

NOTE: The short description 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	Serial No.	HW Status	SW Status
ANC1	BT Antenna	–	–	–	–
ANC2	WLAN Antenna	–	–	–	–
ANC3	GPS Antenna	–	–	–	–

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
AUX1 (DE1009002 _ae04)	uMost-Board	– (device used for BUS simulation)	–	UMOST II–30GW-LS 2014.785-273	–

2.5 EUT Setups

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup	Combination of EUTs	Description and Rationale
Setup_01	EUT A + ANC1-3 + AUX1	setup for radiated radio measurements

2.6 Operating Modes

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

2.6.1 Test Channels

Band:		
BT 2.4 GHz ISM 2400 - 2483.5 MHz		
Bottom	Middle	Top
0	39	78
2402	2441	2480

2.6.2 Datarates

SISO:

BT 1-DH1; 1 Mbit/s
BT 2-DH1; 2 Mbit/s
BT 3-DH1; 3 Mbit/s

BT:

Data rate / frequency	2402	2441	2480
BT 1-DH1; 1 Mbit/s	BT1-BDR	BT2-BDR	BT3-BDR
BT 2-DH1; 2 Mbit/s	BT1-ED1	BT2-ED1	BT3-ED1
BT 3-DH1; 3 Mbit/s	BT1-ED2	BT2-ED2	BT3-ED2

2.7 Special software used for testing

The special Windows program by the manufacturer was used to control the BT/WLAN module.

2.8 Product labelling

2.8.1 FCC ID label

Please refer to the documentation of the applicant.

2.8.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

3 Test Results

3.1 Occupied bandwidth

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.1.1 Test Description

The Equipment Under Test (EUT) was setup to perform the occupied bandwidth measurements.
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.
The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth. The resolution bandwidth for measuring the reference level and the occupied bandwidth was 30 kHz.
The EUT was connected to the spectrum analyzer via a short coax cable.

3.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (1)
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Implication by the test laboratory:
Since the Bluetooth technology defines a fixed channel separation of 1 MHz this design parameter defines the maximum allowed occupied bandwidth depending on the EUT's output power:
1. Under the provision that the system operates with an output power not greater than 125 mW (21.0 dBm): Implicit Limit: Max. 20 dB BW = 1.0 MHz / 2/3 = 1.5 MHz
2. If the system output power exceeds 125 mW (21.0 dBm): Implicit Limit: Max. 20 dB BW = 1.0 MHz

Used conversion factor: Output power (dBm) = 10 log (Output power (W) / 1mW)

3.1.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 45 %

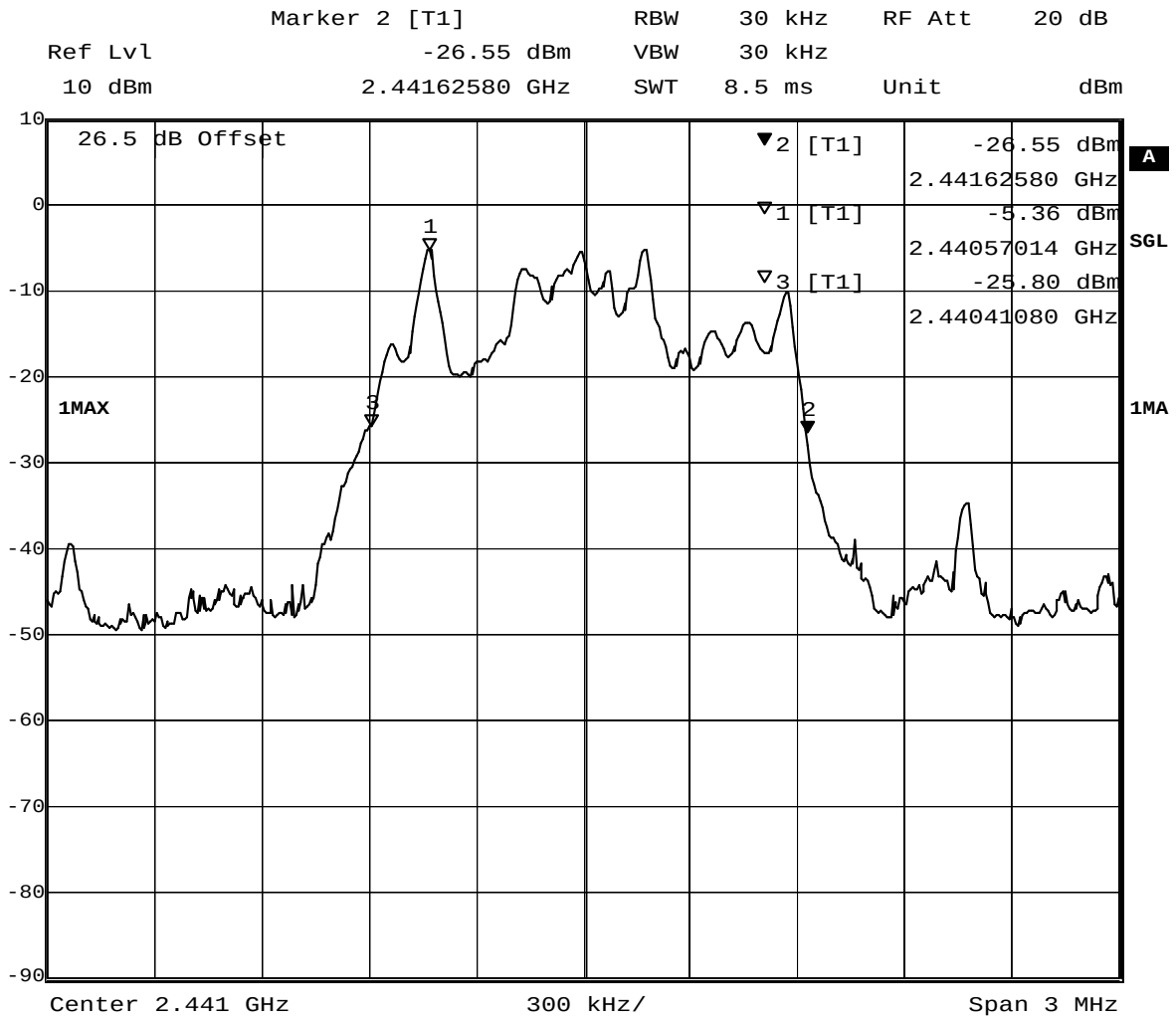
3.1.3.1 20 dB bandwidth

BT 1 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**20 dB Bandwidth [MHz]**
2.4 GHz ISM	0	2402	1.040
	39	2441	1.046
	78	2480	1.046

BT 2 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**20 dB Bandwidth [MHz]**
2.4 GHz ISM	0	2402	1.112
	39	2441	1.112
	78	2480	1.112

BT 3 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**20 dB Bandwidth [MHz]**
2.4 GHz ISM	0	2402	1.215
	39	2441	1.215
	78	2480	1.215

3.1.4 Measurement Plot (showing the highest value, “worst case”)



Title: 20dB Bandwidth
Comment A: CH M: 2441 MHz; 20dB bandwidth (kHz):1215
Date: 11.SEP.2014 07:49:11

BT 3Mbit mid channel

3.2 Peak power output

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.2.1 Test Description

The Equipment Under Test (EUT) was set up to perform the output power measurements. The resolution bandwidth for measuring the output power was set to 3 MHz. The reference level of the spectrum analyzer was set higher than the output power of the EUT. The EUT was connected to the spectrum analyzer via a short coax cable with a known loss.

3.2.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (b) (1)
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

==> Maximum conducted peak output power: 30 dBm (excluding antenna gain, if antennas with directional gains that do not exceed 6 dBi are used).

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW)

3.2.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 45 %

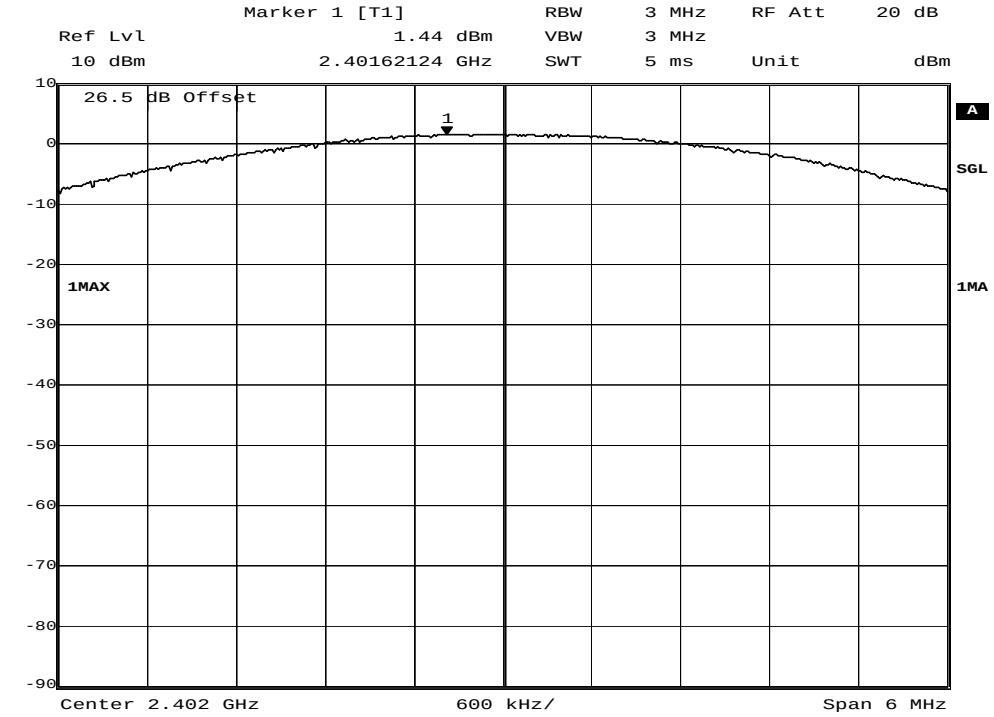
The antenna gain is excluded in the table.

Bluetooth BDR 1 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**Peak Power [dBm]**
2.4 GHz ISM	0	2402	-0.17
	39	2441	-1.58
	78	2480	-2.00

Bluetooth BDR 2 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**Peak Power [dBm]**
2.4 GHz ISM	0	2402	1.44
	39	2441	0.07
	78	2480	-0.40

Bluetooth BDR 3 Mbit/s			
Band	**Channel No.**	**Frequency [MHz]**	**Peak Power [dBm]**
2.4 GHz ISM	0	2402	0.31
	39	2441	-0.05
	78	2480	-0.28

3.2.4 Measurement Plot (showing the highest value, “worst case”)



BT 2Mbit lowest channel

3.3 Spurious RF conducted emissions

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.3.1 Test Description

The Equipment Under Test (EUT) was set up to perform the spurious emissions measurements.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:

- Detector: Peak-Maxhold
- Frequency range: 30 – 25000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: 330 s

The reference value for the measurement of the spurious RF conducted emissions is determined during the test "band edge compliance" (cf. chapter 3.5). This value is used to calculate the 20 dBc limit.

3.3.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

3.3.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 45 %

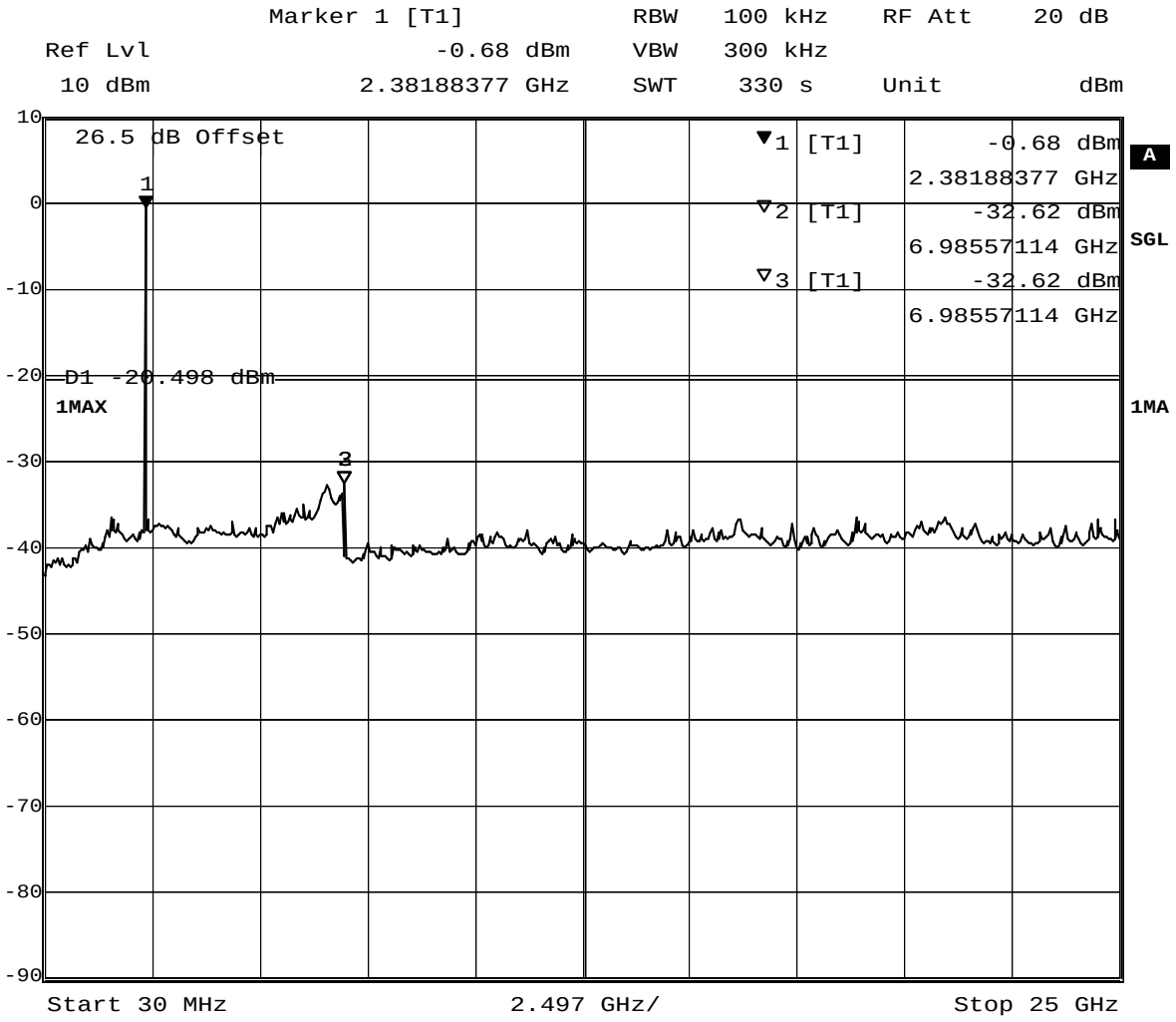
BT BDR ; 1 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402			PEAK	100	-0.7	-20.7	- - -
39	2441			PEAK	100	-1.6	-21.6	- - -
78	2480			PEAK	100	-2.6	-22.6	- - -

BT EDR 2 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402			PEAK	100	-0.8	-20.8	- - -
39	2441			PEAK	100	-1.7	-21.7	- - -
78	2480			PEAK	100	-2.3	-22.3	- - -

BT EDR 3 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402			PEAK	100	-2.3	-22.3	- - -
39	2441			PEAK	100	-2.3	-22.3	- - -
78	2480			PEAK	100	-2.4	-22.4	- - -

Note: No spurious emissions in the range 20 dB below the limit found.

3.3.4 Measurement Plot (showing the highest value, “worst case”)



Title: spurious emissions
Comment A: CH B: 2402 MHz
Date: 10.SEP.2014 14:52:00

BT BDR Lowest Channel

3.4 Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.4

3.4.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4 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 measurement procedure is implemented into the EMI test software ES-K1 from R&S. 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 performed while the EUT is powered from a DC power sourse.

1. Measurement up to 30 MHz
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 MHz 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: 0.2 - 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan

This is a 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 µs
- 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 slowly vary by ± 22.5° 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 will also slowly vary 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 ° around the determined value
- Height variation range: ± 25 cm 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

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.

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

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.

3.4.2 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)	Calculated Limits(dBµV/m @10m)	Limits(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300 59.1 dB	(48.5 – 13.8) + 30 dB	78.5 – 43.8
0.49 – 1.705	24000/F(kHz)	30 19.1 dB	(48.9 – 23.0) + 10 dB	58.9 – 33.0
1.705 – 30	30	30 19.1 dB	29.5 + 10 dB	39.5

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)

3.4.3 Test Protocol

Temperature: 23–27 °C
Air Pressure: 997-1011 hPa
Humidity: 33–50 %

WLAN b-Mode; 20 MHz; 1 Mbit/s BT BDR 1Mbps							
Ch. No.	Channel Center Frequency [MHz]	Frequency [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]
1/78	2412/2480	2387.0	57.9	Peak	1000	74.0	16.1

Note: No (further) spurious emissions in the range 20 dB below the limit found.
The measurement was performed from 1 GHz up to 8 GHz because at pre-measurements no significant spurious emissions have been found outside this frequency range.

WLAN g-Mode; 20 MHz; 6 Mbit/s BT EDR 2Mbps							
Ch. No.	Channel Center Frequency [MHz]	Frequency [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]
1/78	2412/2480	2389.0	57.8	Peak	1000	74.0	16.2
1/78	2412/2480	2389.0	38.5	AV	1000	54.0	15.5
11/39	2472/2441	2483.5	56.7	Peak	1000	74.0	17.3
11/39	2472/2441	2483.5	40.5	AV	1000	54.0	13.5

Note: No (further) spurious emissions in the range 20 dB below the limit found.

3.5 Band edge compliance

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.4–2009, FCC §15.31

3.5.1 Test Description

The procedure to show compliance with the band edge requirement is divided into two measurements: 1. Show compliance of the lower band edge by a conducted measurement and 2. show compliance of the higher band edge by a radiated and conducted measurement.

For the first measurement the EUT is set to transmit on the lowest channel (2402 MHz). The lower band edge is 2400 MHz.
Analyzer settings:
- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz

For the second measurement the EUT is set to transmit on the highest channel (2480 MHz). The higher band edge is 2483.5 MHz.
Analyzer settings for conducted measurement:
- Detector: Peak
- RBW= 100 kHz
- VBW= 300 kHz

EMI receiver settings:
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

3.5.2 Test Requirements / Limits

FCC Part 15.247 (d)
"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
...
Attenuation below the general limits specified in Section 15.209(a) is not required. 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))."

For the measurement of the lower band edge the RF power at the band edge shall be "at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power..."

For the measurement of the higher band edge the limit is "specified in Section 15.209(a)".

3.5.3 Test Protocol

3.5.3.1 Conducted measurement, lower and higher band edge

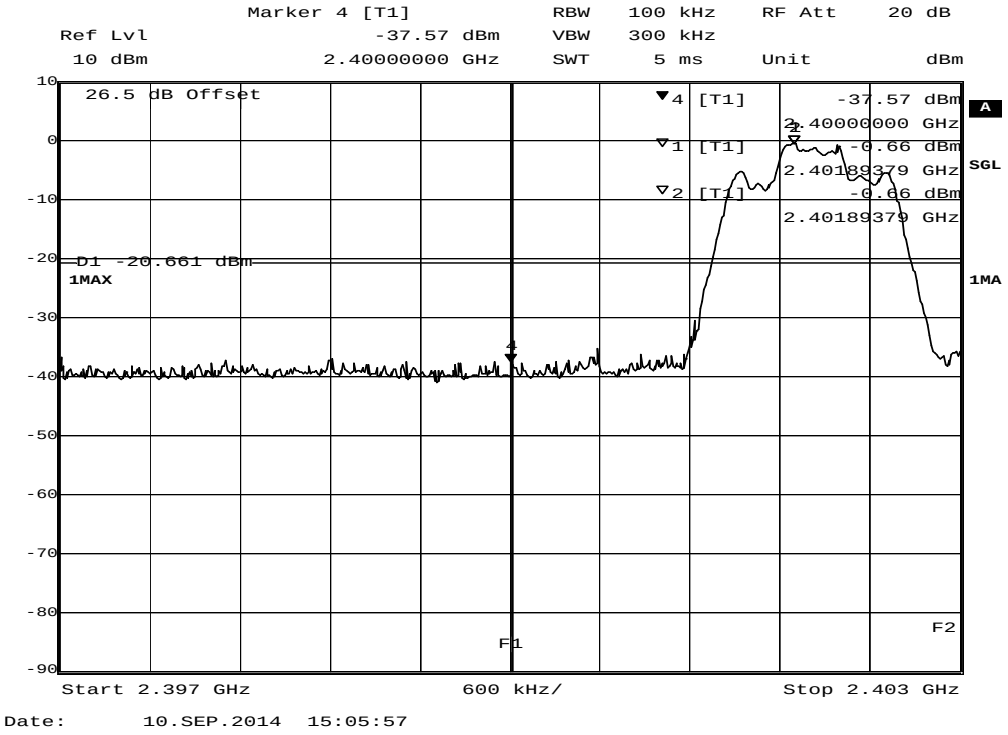
Temperature: 23 °C
Air Pressure: 1009 hPa
Humidity: 38 %

BT BDR; 1 Mbit/s								
Channel No	Channel Center Frequency [MHz]	Frequency [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBµV/m]	Margin to Limit [dB]
0	2402	2400.0	-40.4	PEAK	100	-0.5	-20.5	19.9
78	2480	2483.5	-41.8	PEAK	100	-2.3	-22.3	19.5

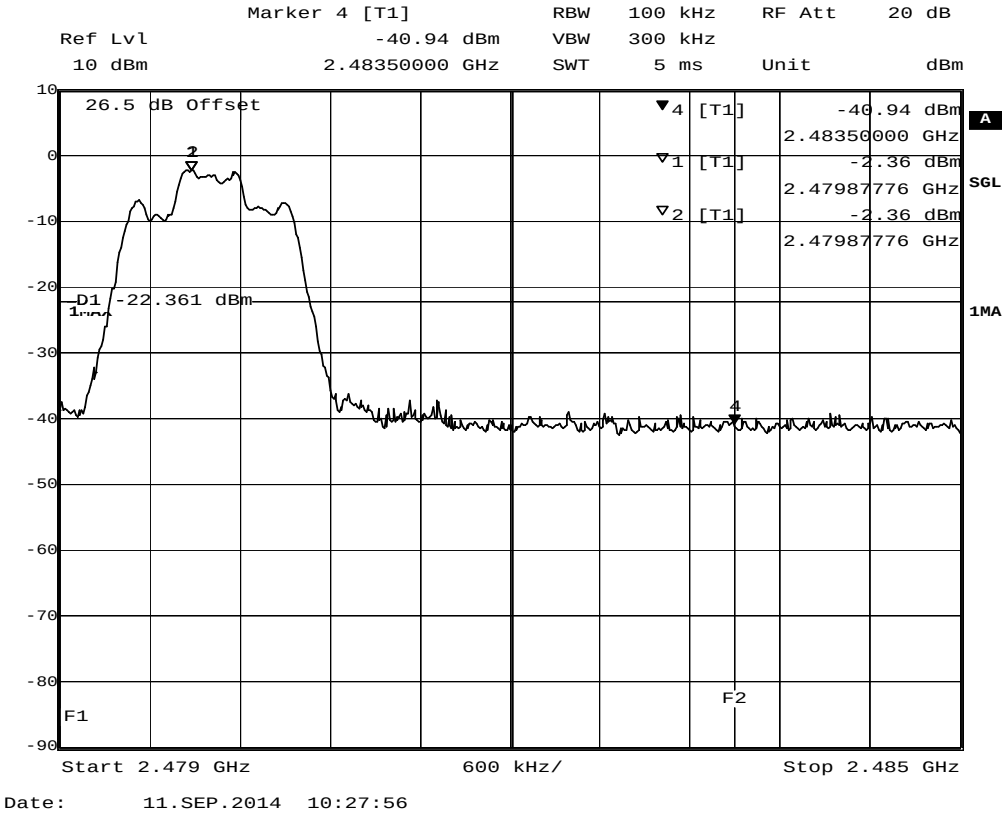
BT EDR; 2 Mbit/s								
Channel No	Channel Center Frequency [MHz]	Frequency [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	2400.0	-37.6	PEAK	100	-0.7	-20.7	16.9
78	2480	2483.5	-40.9	PEAK	100	-2.4	-22.4	18.5

BT EDR; 3 Mbit/s								
Channel No	Channel Center Frequency [MHz]	Frequency [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	2400.0	-39.8	PEAK	100	-1.8	-21.8	18.0
78	2480	2483.5	-41.3	PEAK	100	-2.3	-22.3	19.0

3.5.3.2 Measurement Plot (showing the highest value, “worst case”)



BT EDR 2Mbit lower edge



BT EDR 2Mbit higher edge

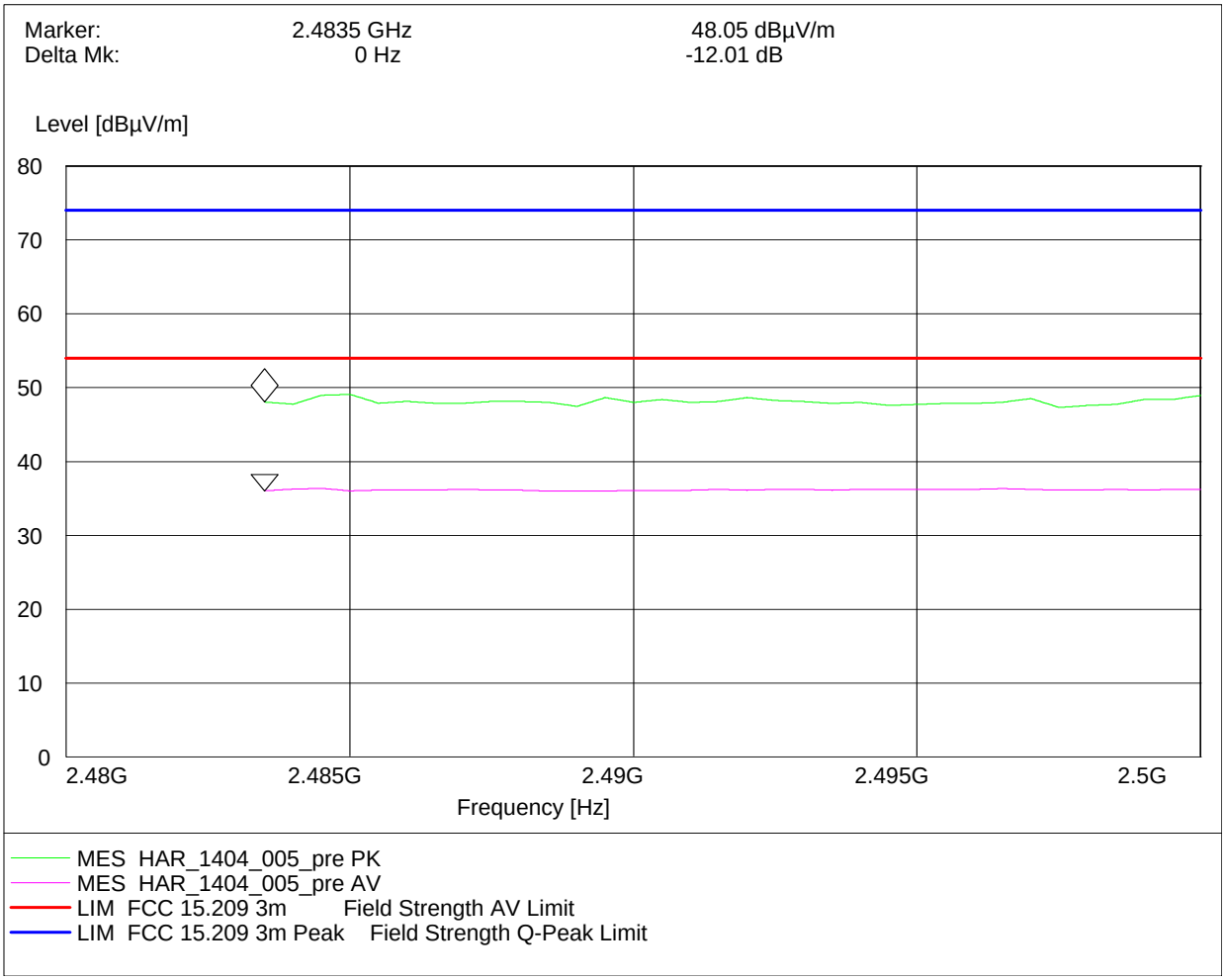
3.5.3.3 Radiated measurement, higher band edge

Temperature: 23–27 °C
Air Pressure: 997-1011 hPa
Humidity: 33–50 %

BT BDR 1 Mbit/s								
Ch. No.	Channel Center Frequency [MHz]	Frequency [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]	Limit Type
78	2480	2483.5	47.9	PEAK	1000	74.0	26.1	BE
78	2480	2483.5	35.8	AV	1000	54.0	18.2	BE

BT EDR 2 Mbit/s								
Ch. No.	Channel Center Frequency [MHz]	Frequency [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480	2483.5	48.1	PEAK	1000	74.0	25.9	BE
78	2480	2483.5	36.0	AV	1000	54.0	18.0	BE

3.5.3.4 Measurement Plot (showing the highest value, “worst case”)


Marker: 2.4835 GHz 48.05 dBµV/m
Delta Mk: 0 Hz -12.01 dB
Level [dBµV/m]
80
70
60
50
40
30
20
10
0
2.48G
2.485G
2.49G
2.495G
2.5G
Frequency [Hz]
MES HAR_1404_005_pre PK
MES HAR_1404_005_pre AV
LIM FCC 15.209 3m Field Strength AV Limit
LIM FCC 15.209 3m Peak Field Strength Q-Peak Limit

BT 2MBit

3.6 Dwell Time

Standard FCC Part 15, Subpart A

3.6.1 Test Description

The Equipment Under Test (EUT) was set up to perform the dwell time measurements. The EUT was connected to the spectrum analyzer via a short coax cable. The dwell time is calculated by:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6 s

with:
- hop rate = 1600 * 1/s for DH1 packets = 1600 s-1
- hop rate = 1600/3 * 1/s for DH3 packets = 533.33 s-1
- hop rate = 1600/5 * 1/s for DH5 packets = 320 s-1
- number of hopping channels = 79
- 31.6 s = 0.4 seconds multiplied by the number of hopping channels = 0.4 s * 79

The highest value of the dwell time is reported.

3.6.2 Test Requirements / Limits

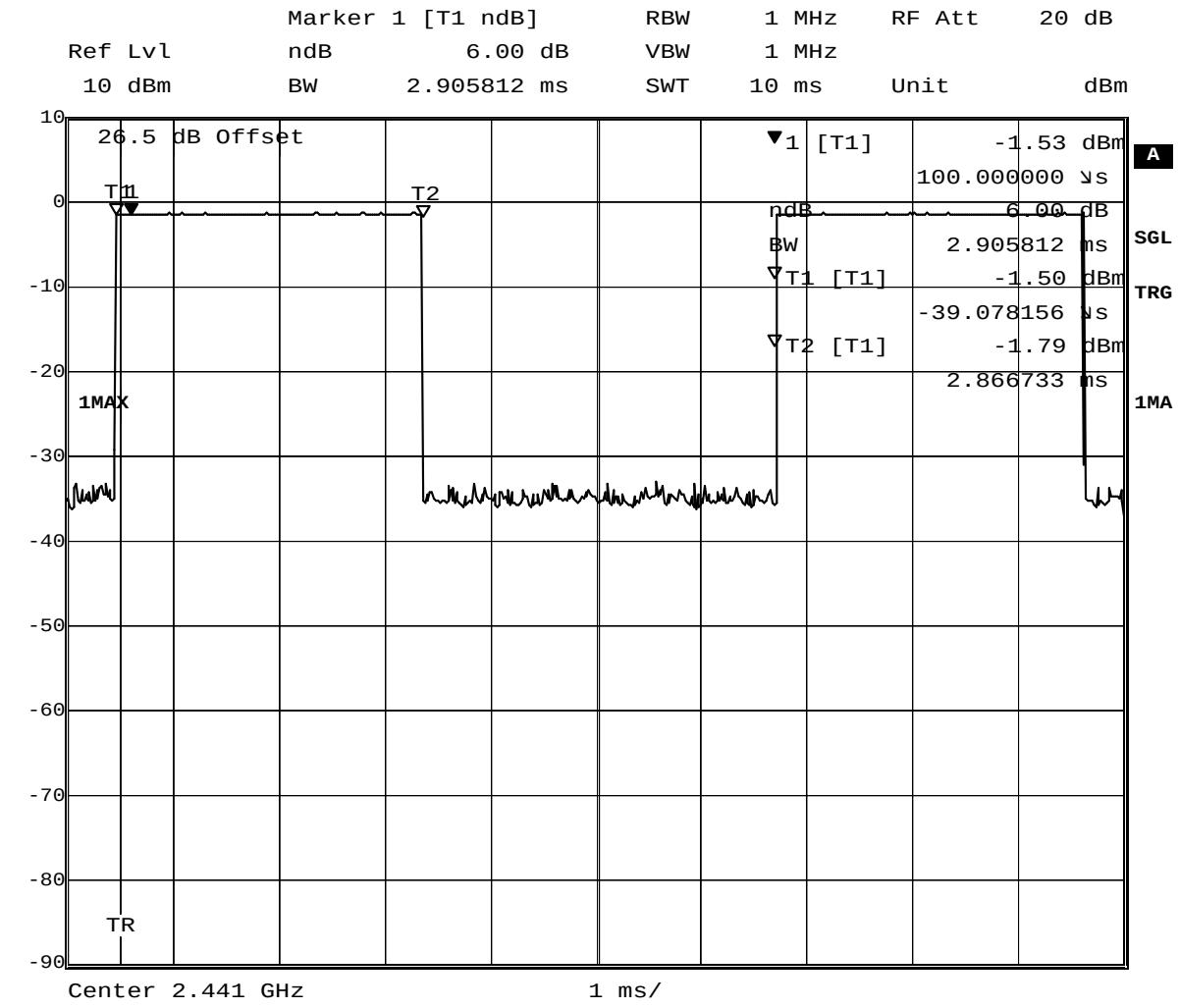
FCC Part 15, Subpart C, §15.247 (a) (1) (iii)
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Since the Bluetooth technology uses 79 channels this period is calculated to be 31.6 seconds.

3.6.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 45 %

Packet type	Time slot length	Dwell time	Dwell time ms
DH1	0.40	time slot length * 1600/5 /79 * 31.6	51.30
DH3	1.64	time slot length * 1600/5 /79 * 31.6	210.34
DH5	2.91	time slot length * 1600/5 /79 * 31.6	371.94
2-DH1	0.40	time slot length * 1600/5 /79 * 31.6	51.30
2-DH3	1.64	time slot length * 1600/5 /79 * 31.6	210.34
2-DH5	2.91	time slot length * 1600/5 /79 * 31.6	371.94
3-DH1	0.40	time slot length * 1600/5 /79 * 31.6	51.30
3-DH3	1.64	time slot length * 1600/5 /79 * 31.6	210.34
DH5	2.91	time slot length * 1600/5 /79 * 31.6	371.94

3.6.4 Measurement Plot (showing the highest value, “worst case”)



Title: Dwell time
Comment A: CH M: 2441 MHz
Date: 11.SEP.2014 11:29:52

3.7 Channel Separation

Standard FCC Part 15, Subpart A

3.7.1 Test Description

The Equipment Under Test (EUT) was set up to perform the channel separation measurements. The channel separation is independent from the modulation pattern. The EUT was connected to spectrum analyzer via a short coax cable.
Analyzer settings:
- Detector: Peak-Maxhold
- Span: 3 MHz
- Centre Frequency: a mid frequency of the 2.4 GHz ISM band
- Resolution Bandwidth (RBW): 30 kHz
- Video Bandwidth (VBW): 100 kHz
- Sweep Time: Coupled

3.7.2 Test Requirements / Limits

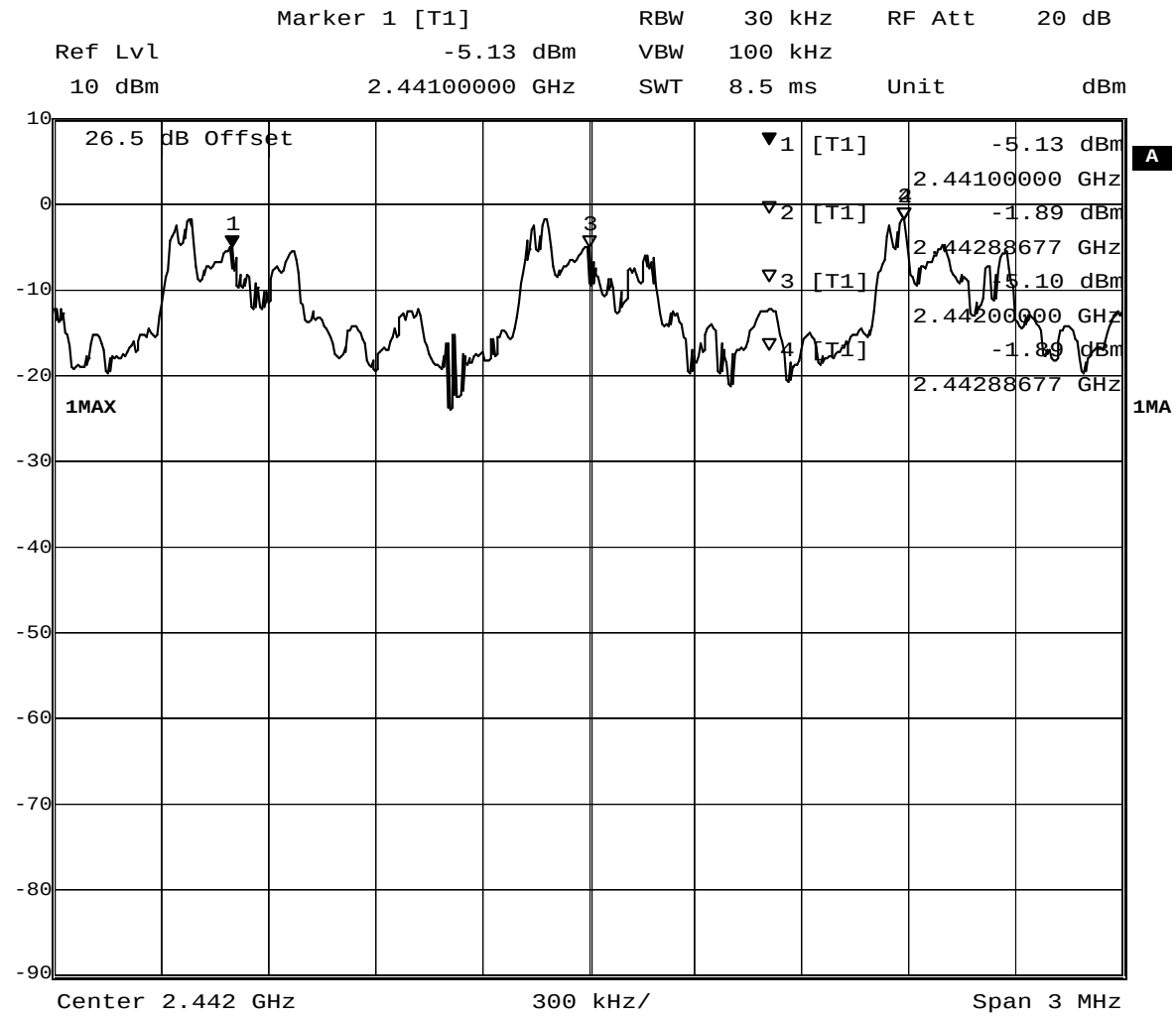
FCC Part 15, Subpart C, §15.247 (a) (1)
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

3.7.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 45 %

Modulation	Channel Separation
GFSK	1 MHz
PI/4 DQPSK	1 MHz
8DPSK	1 MHz

3.7.4 Measurement Plot (showing the highest value, “worst case”)



Title: Number of hopping frequencies
Comment A: CH H: Hopping
Date: 11.SEP.2014 12:19:03

BT EDR 2Mbit

3.8 Number of hopping frequencies

Standard FCC Part 15, Subpart C

3.8.1 Test Description

The Equipment Under Test (EUT) was set up to perform the number of hopping frequencies measurement. The number of hopping frequencies is independent from the modulation pattern.
The EUT was connected to spectrum analyzer via a short coax cable.
Analyzer settings:
- Detector: Peak-Maxhold
- Centre frequency: 2442 MHz
- Frequency span: 84 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep Time: Coupled

3.8.2 Test Requirements / Limits

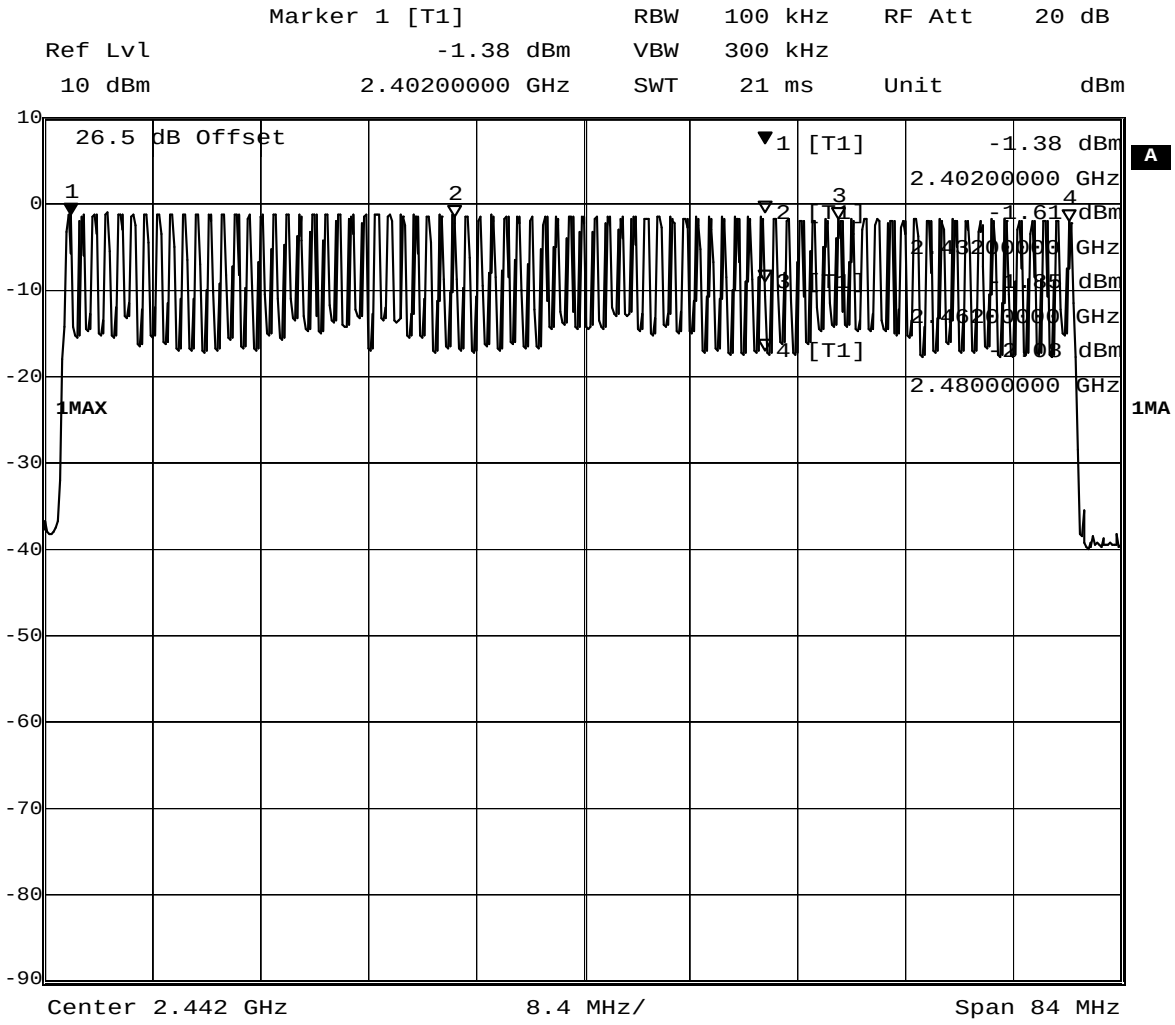
FCC Part 15, Subpart C, §15.247 (a) (iii)
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

3.8.3 Test Protocol

Temperature: 23 °C
Air Pressure: 1010 hPa
Humidity: 45 %

Modulation	Number of hopping channels
GFSK	79
PI/4 DQPSK	79
8DPSK	79

3.8.4 Measurement Plot



Title: Number of hopping frequencies
Comment A: CH H: Hopping
Date: 11.SEP.2014 12:08:11

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 m³	
	NSA (FCC)	2014/01/09

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 m³ FCC listing 96716 3m Part15/18	none	Frankonia 2014/01/09
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	AM 4.0	AM4.0/180/11920513	Maturo GmbH
Antenna mast	AS 620 P	620/37	HD GmbH
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck
	Calibration Details		*Last Execution*
	Standard Calibration		2012/01/18
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
	Calibration Details		*Last Execution*

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
	Standard Calibration		2012/05/18
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution*
	Standard Calibration		2012/06/26
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
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170		
Log.-per. Antenna	HL 562 Ultralog	100609	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution*
	Standard Calibration		2012/12/18
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution*
	Standard calibration		2011/10/27
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 3, Lab 4**
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*
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.
	Calibration Details		*Last Execution*
	Customized calibration		2013/12/04
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 Transformatorenwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Signal Analyzer	FSV30	103005	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution*
	Standard		2014/02/10
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution*
	Standard		2012/06/13
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/07/29
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

Test Equipment Digital Signalling Devices

Lab ID:	**Lab 3, Lab 4**
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
	Calibration Details		*Last Execution*
	Standard calibration		2011/11/24
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/01/27
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution*
	Standard calibration		2011/11/28
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG
	HW/SW Status		*Date of Start* *Date of End*
	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
	Calibration Details		*Last Execution*
	Standard calibration		2011/12/07
	HW/SW Status		*Date of Start* *Date of End*
	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 Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/05/13
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/05/13
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG
	Standard Calibration		2014/01/07
	HW/SW Status		*Date of Start* *Date of End*
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03

Test Equipment Multimeter 12

Lab ID:	**Lab 5, 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	05157876	Extech Instruments Corp.
	Calibration Details		*Last Execution*
	Customized calibration		2013/12/04

Test Equipment Radio Lab Test Equipment

Lab ID: **Lab 4**
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Broadband Power Divider SMA	WA1515	A856	Weinschel Associates
Coax Attenuator 10dB SMA 2W	4T-10	F9401	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3702	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3711	Weinschel Associates
Coax Cable Huber&Suhner	Sucotest 2,0m		Huber&Suhner
Coax Cable Rosenberger Micro Coax FA210A0010003030 SMA/SMA 1,0m	FA210A0010003030	54491-2	Rosenberger Micro-Coax
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/05/13
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly
	Standard calibration		2014/07/03
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/05/13
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG
	Calibration Details		*Last Execution*
	Standard calibration		2011/11/25
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution*
	Standard calibration		2013/05/06
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG
	Calibration Details		*Last Execution*
	Standard Calibration		2013/02/12

Test Equipment Regulatory Bluetooth RF Test Solution

Lab ID:	**Lab 5**
Description:	Regulatory Bluetooth RF Tests
Type:	Bluetooth RF
Serial Number:	001

Single Devices for Regulatory Bluetooth RF Test Solution

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ADU 200 Relay Box 7	Relay Box	A04380	Ontrak Control Systems Inc.
Bluetooth Signalling Unit CBT	CBT	100302	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/08/29
Power Meter NRVD	NRVD	832025/059	
	Standard calibration		2014/08/29
Power Sensor NRV Z1 A	PROBE	832279/013	
	Standard calibration		2014/08/28
Power Supply	NGSM 32/10	2725	
	Standard calibration		2013/06/20
Rubidium Frequency Normal MFS	Datum MFS	002	Datum GmbH
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG
Vector Signal Generator SMIQ03B	SMIQ03B	832870/017	
	Standard calibration		2013/06/21

Test Equipment Shielded Room 07

Lab ID:	**Lab 5, Lab 6**
Description:	Shielded Room 4m x 6m

Test Equipment T/A Logger 13

Lab ID:	**Lab 3, Lab 4**
Description:	Lufft Opus10 TPR
Type:	Opus10 TPR
Serial Number:	13936

Single Devices for T/A Logger 13

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoAirpressure Datalogger 13 (Environ)	Opus10 TPR (8253.00)	13936	Lufft Mess- und Regeltechnik GmbH
	Calibration Details		*Last Execution*
	Customized calibration		2013/02/07

Test Equipment T/H Logger 03

Lab ID:	**Lab 4**
Description:	Lufft Opus10
Serial Number:	7482

Single Devices for T/H Logger 03

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 03 (Environ)	Opus10 THI (8152.00)	7482	Lufft Mess- und Regeltechnik GmbH
	Calibration Details		*Last Execution*
	Customized calibration		2013/02/07

Test Equipment T/H Logger 12

Lab ID:	**Lab 3**
Description:	Lufft Opus10
Serial Number:	12482

Single Devices for T/H Logger 12

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 12 (Environ)	Opus10 THI (8152.00)	12482	Lufft Mess- und Regeltechnik GmbH
	Calibration Details		*Last Execution*
	Customized calibration		2013/01/07

Test Equipment T/H Logger 15

Lab ID:	**Lab 5, Lab 6**
Description:	Lufft Opus10
Serial Number:	13985

Single Devices for T/H Logger 15

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
ThermoHygro Datalogger 15 (Environ)	Opus10 THI (8152.00)	13985	Lufft Mess- und Regeltechnik GmbH
	Calibration Details		*Last Execution*
	Customized calibration		2013/01/07

Test Equipment Temperature Chamber 01

Lab ID:	**Lab 5, 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
	Customized calibration		2014/03/12

Test Equipment Temperature Chamber 05

Lab ID:	**Lab 4**
Manufacturer:	see single devices
Description:	Temperature Chamber VT4002
Type:	Vötsch
Serial Number:	see single devices

Single Devices for Temperature Chamber 05

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Temperature Chamber Vötsch 05	VT 4002	58566080550010	Vötsch
	Customized calibration		2014/03/11

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

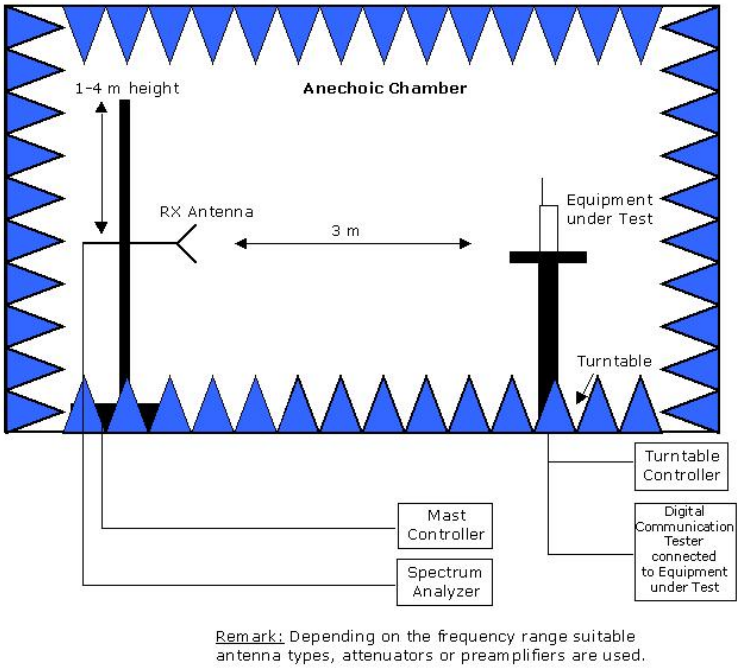
Single Devices for WLAN RF Test Solution

Single Device Name	*Type*	*Serial Number*	*Manufacturer*
Arbitrary Waveform Generator	TGA12101	284482	
Power Meter NRVD	NRVD	832025/059	
	Standard calibration		2014/08/29
Power Sensor NRV Z1 A	PROBE	832279/013	
	Standard calibration		2014/08/28
Power Supply	NGSM 32/10	2725	
	Standard calibration		2013/06/20
Rubidium Frequency Normal MFS	Datum MFS	002	Datum GmbH
Signal Analyser FSIQ26	1119.6001.26	832695/007	Rohde & Schwarz GmbH & Co.KG
Spectrum Analyser	FSU26	100136	Rohde & Schwarz GmbH & Co.KG
	Standard Calibration		2014/01/06
	HW/SW Status		*Date of Start* *Date of End*
	FSU FW Update to v4.61 SP3, K5 v4.60 and K73 v4.61		2011/12/05
Spectrum Analyser	FSU3	200046	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2014/07/01
	HW/SW Status		*Date of Start* *Date of End*
	Firmware Version 4.51 SP1 Option FS-K72 4.50 SP1 Option FS-K73 4.50 SP1		2011/12/07
TOCT Switching Unit	Switching Unit	040107	7 layers, Inc.
Vector Signal Generator SMIQ03B	SMIQ03B	832870/017	
	Standard calibration		2013/06/21

5 Photo Report

Please refer to external report.

6 Setup Drawings



Drawing 1: Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting groundplane.