

InterLab®

FCC Measurement/Technical Report on

WLAN transceiver
in
Parrot BEBOP DRONE

FCC: RKXMYKONOS3
IC: 5119A-MYKONOS3

Report Reference: MDE_PARRO_1430_FCCe

Test Laboratory:

7Layers AG
Borsigstrasse 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.

7 layers AG
Borsigstrasse 11
40880 Ratingen, Germany
Phone: +49 (0) 2102 749 0
Fax: +49 (0) 2102 749 350
www.7Layers.com

Aufsichtsratsvorsitzender •
Chairman of the Supervisory Board:
Peter Mertel
Vorstand • Board:
Dr. H. Ansorge

Registergericht • registered in:
Düsseldorf, HRB 44096
USt-IdNr • VAT No.:
DE 203159652
TAX No. 147/5869/0385
A Bureau Veritas Group Company

Table of Contents

0	Applied Standards and Test Summary	3
0.1	Applied Standards	3
0.2	FCC-IC Correlation Table	4
0.3	Measurement Summary / Signatures	5
0.4	Revision History	7
1	Administrative Data	8
1.1	Testing Laboratory	8
1.2	Project Data	8
1.3	Applicant Data	8
1.4	Manufacturer Data	8
2	Test object Data	9
2.1	General EUT Description	9
2.2	EUT Main components	10
2.3	Ancillary Equipment	10
2.4	Auxiliary Equipment	10
2.5	EUT Setups	11
2.6	Operating Modes	11
2.7	Special software used for testing	11
2.8	Product labelling	12
3	Test Results	13
3.1	26 / 6 dB Emission bandwidth / 99 % occupied bandwidth	13
3.2	Maximum conducted output power	19
3.3	Undesirable Emissions / General Field Strength Limits; Restricted Band and Radiated Emission Limits, Band Edge	24
4	Test Equipment	31
5	Photo Report	40
6	Setup Drawings	40

0 Applied Standards and Test Summary

0.1 Applied Standards

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 (10-1-13 Edition) and 15 (10-1-13 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

Part 15, Subpart E – Unlicensed National Information Infrastructure Devices

§ 15.403 Definitions

§ 15.407 General technical requirements

Note:

The tests were selected and performed with reference to the FCC Public Notice “Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D02 General U-NII Test Procedures v01, 2014-06-06”

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

FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 (“new rules”) is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.3 Measurement Summary / Signatures.

0.2 FCC-IC Correlation Table

Correlation of measurement requirements for UNII / LE-LAN (e.g. WLAN 5 GHz) equipment

UNII equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Occupied bandwidth	§ 15.403 (i) (26 dB) / § 15.407 (e) (6 dB)	RSS-210 Issue 8: A9.2, 9.4 (99%)
Maximum conducted output power	§ 15.407 (a) (1),(2),(3),(4)	RSS-210 Issue 8: A9.2, 9.4
Maximum power spectral density	§ 15.407 (a) (1),(2),(3),(5)	RSS-210 Issue 8: A9.2, 9.4
Transmitter undesirable emissions; General Field Strength Limits, Restricted Bands	15.407 (b) § 15.209 (a)	RSS-Gen Issue 4: 6.13/8.9/8.10; RSS-210 Issue 8: A9.2, 9.4
Frequency stability	§ 15.407 (g)	RSS-Gen Issue 4: 6.11/8.11
Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS)	§ 15.407 (h)	RSS-210 Issue 8: A9.2, 9.4
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	–	RSS-210 Issue 8: 2.3; RSS Gen Issue 4: 5/7 *)

*) Receivers are exempted from certification besides if operating in stand-alone mode in the frequency range 30–960 MHz or if these are scanner receivers.

0.3 Measurement Summary / Signatures

FCC Part 15, Subpart C § 15.207

Conducted emissions (AC power line)

The measurement was performed according to ANSI C63.4

OP-Mode	Setup	Port	Final Result
–	–	–	N/A ¹⁾

FCC Part 15, Subpart E § 15.403 (i), 15.407 (e)

26 / 6 dB Emission bandwidth / 99% occupied bandwidth

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result
a-Mode, CH 36	Setup_01	Temp.ant.connector	passed
a-Mode, CH 44	Setup_01	Temp.ant.connector	passed
a-Mode, CH 48	Setup_01	Temp.ant.connector	passed
a-Mode, CH 149	Setup_01	Temp.ant.connector	passed
a-Mode, CH 157	Setup_01	Temp.ant.connector	passed
a-Mode, CH 165	Setup_01	Temp.ant.connector	passed
n-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed
n-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed

FCC Part 15, Subpart E § 15.407 (a)(1,2,3,4)

Maximum Conducted Output Power

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result	
			FCC	IC
a-Mode, CH 36	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 44	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 48	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 149	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 157	Setup_01	Temp.ant.connector	passed	passed
a-Mode, CH 165	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
n-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	passed

FCC Part 15, Subpart E

§ 15.407 (a)(1,2,3,5)

Maximum Power Spectral Density

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result	
			FCC	IC
a-Mode, CH 36	Setup_01	Temp.ant.connector	N/P	N/P
a-Mode, CH 44	Setup_01	Temp.ant.connector	N/P	N/P
a-Mode, CH 48	Setup_01	Temp.ant.connector	N/P	N/P
a-Mode, CH 149	Setup_01	Temp.ant.connector	N/P	N/P
a-Mode, CH 157	Setup_01	Temp.ant.connector	N/P	N/P
a-Mode, CH 165	Setup_01	Temp.ant.connector	N/P	N/P
n-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	N/P	N/P
n-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	N/P	N/P
n-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	N/P	N/P
n-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	N/P	N/P
n-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	N/P	N/P
n-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	N/P	N/P

FCC Part 15, Subpart E

§ 15.407 (g)

Frequency Stability

The measurement was performed according to FCC § 15.31

OP-Mode	Setup	Port	Final Result
–	Setup_01	Temp.ant.connector	N/P

FCC Part 15, Subpart C & E

§ 15.205, § 15.209

§ 15.407 (b) (1,2,3,4,5,6)

Undesirable Emissions / General Field Strength Limits; Restricted

Band and Radiated Emission Limits, Band Edge

The measurement was performed according to ANSI C63.4

OP-Mode	Setup	Port	Final Result	
			FCC	IC
a-Mode, CH 36	Setup_02	Temp.ant.connector	passed	passed
a-Mode, CH 44	Setup_02	Temp.ant.connector	passed	passed
a-Mode, CH 48	Setup_02	Temp.ant.connector	passed	passed
a-Mode, CH 149	Setup_02	Temp.ant.connector	passed	passed
a-Mode, CH 157	Setup_02	Temp.ant.connector	passed	passed
a-Mode, CH 161	Setup_02	Temp.ant.connector	N/P	passed
a-Mode, CH 165	Setup_02	Temp.ant.connector	passed	N/P
n-Mode, CH 36, 20 MHz	Setup_02	Temp.ant.connector	N/P	N/P
n-Mode, CH 44, 20 MHz	Setup_02	Temp.ant.connector	N/P	N/P
n-Mode, CH 48, 20 MHz	Setup_02	Temp.ant.connector	N/P	N/P
n-Mode, CH 149, 20 MHz	Setup_02	Temp.ant.connector	N/P	N/P
n-Mode, CH 157, 20 MHz	Setup_02	Temp.ant.connector	N/P	N/P
n-Mode, CH 161, 20 MHz	Setup_02	Temp.ant.connector	N/P	N/P
n-Mode, CH 165, 20 MHz	Setup_02	Temp.ant.connector	N/P	N/P

FCC Part 15, Subpart E

§ 15.407 (h)

Dynamic Frequency selection

The measurement was performed according to FCC § 15.31

OP-Mode

Setup

Port

Final Result

FCC

IC

–

–

–

N/A ²⁾

N/A ²⁾

N/A Not applicable:

1) the EUT is powered by DC, transmitter is automatically switched off when connected to USB

2) the EUT operates only in bands where DFS is not required.

N/P Not performed

Not all tests which are applicable to the EUT have been performed.

The scope of this test report is to demonstrate that the hardware modifications will not affect the EUT's behaviour in a negative way.

It is intended to be used in conjunction with the test report referenced by "MDE_PARRO_1430_FCCb", dated on 2014-10-05, for the purpose of conducting a class-2 permissive change.

Responsible for
Accreditation Scope:

M. Kullik
[M. Kullik]

Responsible
for Test Report:

A. Pelt

7layers

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

0.4 Revision History

Report version control			
Version	Release date	Change Description	Version validity
initial	2015-01-16	--	valid

1 Administrative Data

1.1 Testing Laboratory

Company Name: 7Layers 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: 2014-11-24

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Andreas Petz
Employees who performed the tests: documented internally at 7Layers
Date of Test(s): 2014-12-08 to 2015-01-15
Date of Report: 2015-01-16

1.3 Applicant Data

Company Name: Parrot S.A.
Address: 174 quai de jemmaes
75010 Paris
France
Contact Person: Mr. Imad Benyacoub

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 802.11 g/n WLAN transceiver
Type Designation:	Parrot BEBOP DRONE
Kind of Device: (optional)	Quadricopter wifi controlled by smartphones
Voltage Type:	DC (Li-Po rechargeable battery)
Voltage Level:	12.0 V
Tested Modulation Type:	OFDM:BPSK; OFDM:64-QAM

General product description:

The EUT is a RC toy (quadcopter drone) that includes a video camera and a WLAN access point as well as four electric motors and a speaker. It can fly and is remotely controlled by the user via a Wi-Fi link, by the ways of a smartphone or a tablet.

Specific product description for the EUT:

The EUT is a dual band WLAN (802.11 2.4 GHz b/g/n and 5 GHz a/n) access point. In IEEE 802.11n mode it supports 20 MHz bandwidth channels providing up to 65.0 Mbit/s transfer data rates (MCS7).

The WLAN (Wireless Local Area Network) transceiver is operating in the 5 GHz band in the range 5.15 – 5.25 GHz and 5.725 – 5.850 GHz.

The object of this test report is the WLAN transceiver.

The EUT provides the following ports:

Ports

Enclosure
USB/DC Port

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: DE1018005aa03)	WLAN transceiver	Parrot BEBOP DRONE	PI040339P14I 000087	HW10	1.32.0
Remark: EUT A is equipped with a temporary antenna connector and a temporary power supply cable.					
EUT B (Code: DE1018005ac03)	WLAN transceiver	Parrot BEBOP DRONE	PI040306P14I 000356	HW10	1.32.0
Remark: EUT B is equipped with two dual-band integral antennas with different antenna gain: Antenna1: 3.3 dBi; Antenna2: 2.6 dBi (5 GHz band).					

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	Serial No.	HW Status	SW Status
ANC1	USB cable	–	–	–	–

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	Lithium-ion polymer rechargeable battery	PI020572	–	–	–
AUX2	Cable adapter USB / RJ45	–	–	–	–

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 B + ANC1 + AUX1	setup for radiated measurements
Setup_02	EUT A + AUX2	setup for conducted radio measurements

2.6 Operating Modes

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

2.6.1 Test Channels

Nom. BW	UNII-Subband 1 5150 - 5250 MHz			UNII-Subband 2A 5250 - 5350 MHz			UNII-Subband 2C 5470 - 5725 MHz			UNII-Subband 3 5725 - 5850 MHz		
20 MHz	Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top	Bottom	Middle	Top
Ch.-No.	36	44	48	-	-	-	-	-	-	149	157	165
MHz	5180	5220	5240	-	-	-	-	-	-	5745	5785	5825

Note: 1) Top Frequency for IC is Ch.-No. 161 at 5805 MHz.

2.6.2 Datarates

SISO:

WLAN a-Mode; 20 MHz; 6 Mbit/s
WLAN n-Mode; 20 MHz; 65.0 Mbit/s, MCS7
WLAN n-Mode; 40 MHz; N/A

MIMO:

WLAN n-Mode; 20 MHz; N/A
WLAN n-Mode; 40 MHz; N/A

2.7 Special software used for testing

In the engineering mode provided for the tests, the EUT can be controlled by an external computer where a terminal program runs. Using the terminal emulation, remote control of the EUT is possible when running script files that i.e. will command the EUT to transmit at the desired data rate, antenna port, RF power level and duty cycle. Nominal power is set to the setting "US", which is pre-defined by the applicant.

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 26 / 6 dB Emission bandwidth / 99 % occupied bandwidth

Standard FCC Part 15, Subpart E

The test was performed according to: FCC §15.31

3.1.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room 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 produce the worst-case (widest) emission bandwidth (26 / 6 dB and 99%).

The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

1) 26 bandwidth, sub-bands 1, 2A and 2C:

- Resolution Bandwidth (RBW): initially approx. 1 % of nominal emission bandwidth
- Video Bandwidth (VBW): > RBW
- readjust RBW close to 1 % of measured bandwidth and repeat the measurement

2) 6 dB bandwidth, sub-band 3:

- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): ≥ RBW
- Detector: Peak
- Trace: Maxhold
- Sweeps: ≥ 200

- Sweptime: at least coupled

3) 99% occupied bandwidth:

- Span: 1.5 to 5 times the occupied bandwidth
- Resolution Bandwidth (RBW): approx. ≥ 1 % of the span, but not below
- Video Bandwidth (VBW): ≥ 3 times the RBW
- Detector: Sample
- Trace: Maxhold
- Sweeps: ≥ 200
- Sweptime: at least coupled

3.1.2 Test Requirements / Limits

FCC Part 15, Subpart E, §15.403 (i)

There exist no applicable limits for the U-NII subbands 1, 2A and 2C. The test was performed to determine the limits for the "Maximum Conducted Output Power" test case. Therefore no result was applied.

FCC Part 15, Subpart E, §15.407 (e)

Within the 5.725-5.850 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

3.1.3 Test Protocol

Temperature: 22–24 °C
Air Pressure: 1008–1014 hPa
Humidity: 37–45 %

1) 26 dB bandwidth

WLAN a-Mode; 20 MHz; 6 Mbit/s			
UNII-Subband	Channel No.	Frequency [MHz]	26 dB Bandwidth [MHz]
1	36	5180	20.203
	44	5220	20.260
	48	5240	20.203
3	149	5745	31.869
	157	5785	29.233
	165	5825	30.217

WLAN n-Mode; 20 MHz; 65.0 Mbit/s			
UNII-Subband	Channel No.	Frequency [MHz]	26 dB Bandwidth [MHz]
1	36	5180	20.434
	44	5220	20.492
	48	5240	20.492
3	149	5745	29.118
	157	5785	30.912
	165	5825	30.680

Maximum [MHz]:		31.869
Minimum [MHz]:		20.203

2) 6 dB bandwidth

WLAN a-Mode; 20 MHz; 6 Mbit/s					
UNII-Subband	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin [MHz]
3	149	5745	16.411	0.500	15.911
	157	5785	16.411	0.500	15.911
	165	5825	16.411	0.500	15.911

WLAN n-Mode; 20 MHz; 65.0 Mbit/s					
UNII-Subband	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin [MHz]
3	149	5745	17.844	0.500	17.344
	157	5785	17.844	0.500	17.344
	165	5825	17.800	0.500	17.300

3) 99 % bandwidth

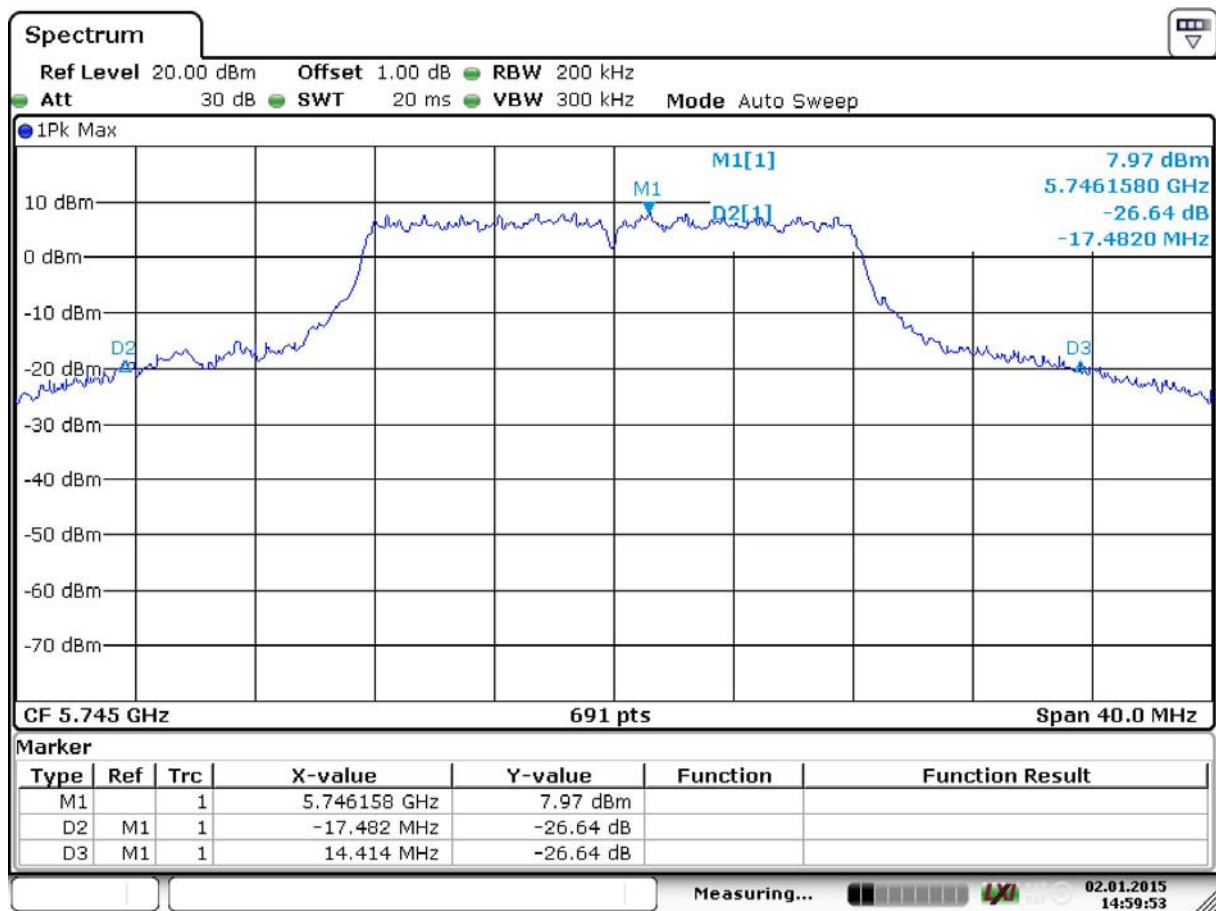
WLAN a-Mode; 20 MHz; 6 Mbit/s			
UNII-Subband	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
1	36	5180	17.511
	44	5220	17.511
	48	5240	17.511
3	149	5745	18.379
	157	5785	18.379
	165	5825	18.524

WLAN n-Mode; 20 MHz; 65.0 Mbit/s			
UNII-Subband	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
1	36	5180	18.162
	44	5220	18.162
	48	5240	18.234
3	149	5745	18.452
	157	5785	18.524
	165	5825	18.452

Maximum [MHz]:	20 MHz:	18.524
Minimum [MHz]:		17.511

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

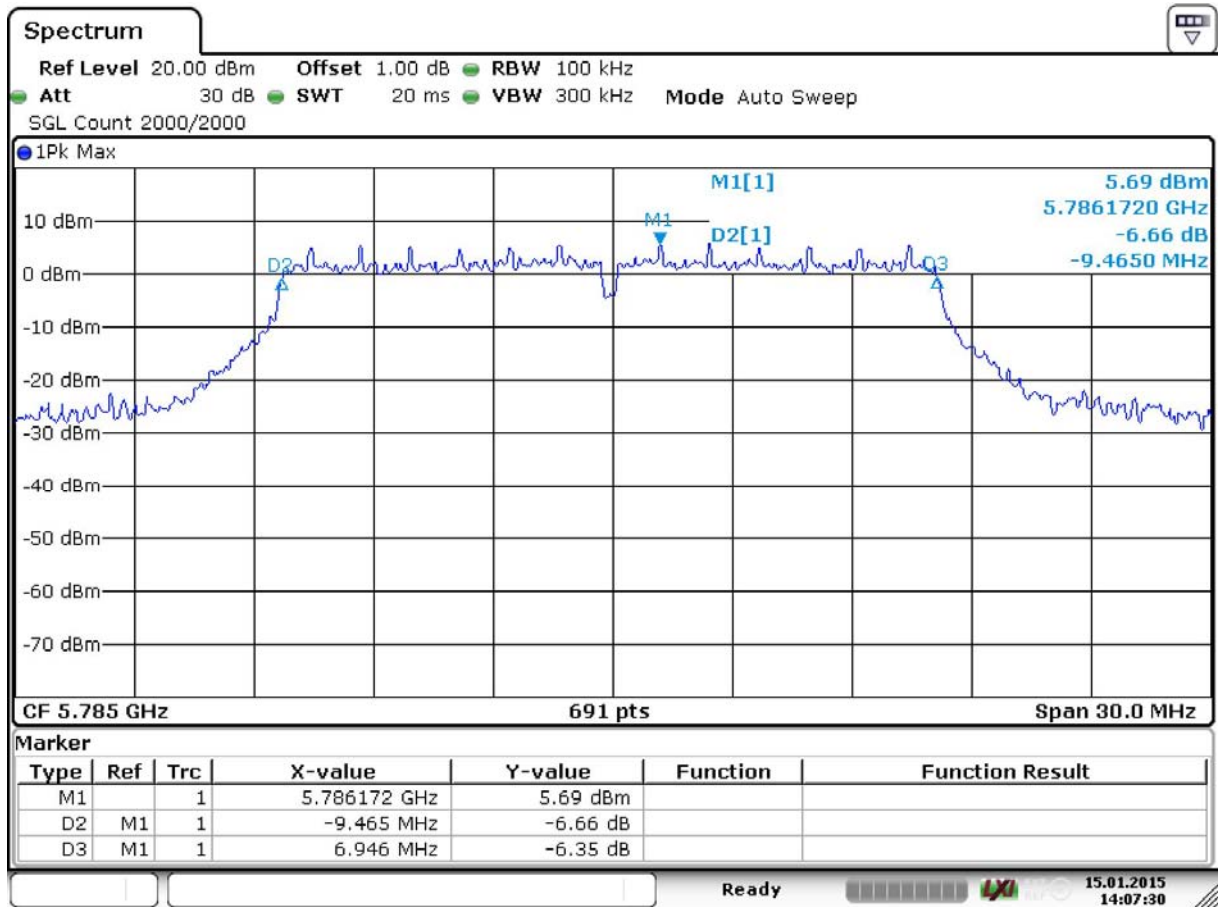
1) 26 dB bandwidth



Date: 2.JAN.2015 14:59:54

a-mode, 5745 MHz

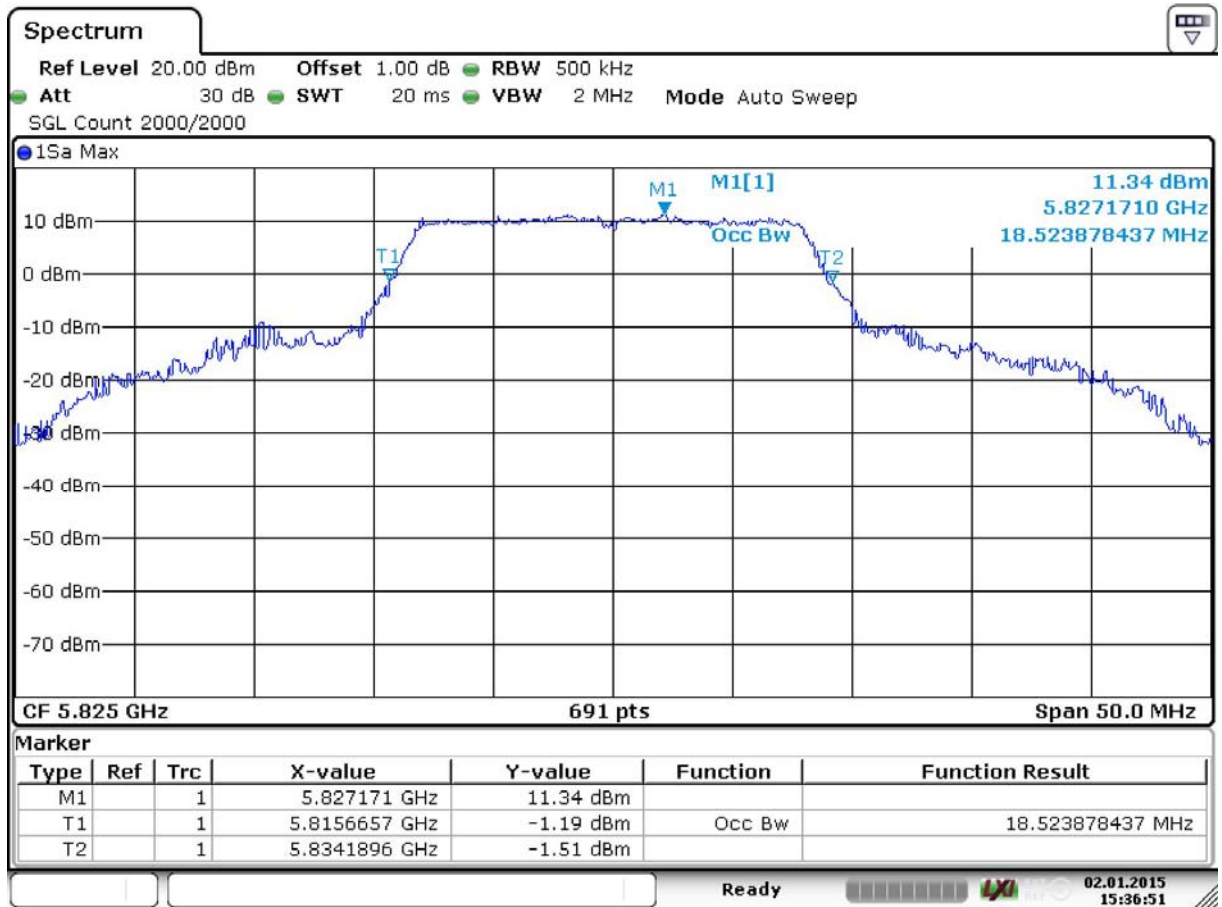
2) 6 dB bandwidth



Date: 15.JAN.2015 14:07:29

a-mode, 5785 MHz

3) 99% bandwidth



Date: 2.JAN.2015 15:36:51

a-mode, 5825 MHz

3.2 Maximum conducted output power

Standard FCC Part 15, Subpart E

The test was performed according to: FCC §15.31

3.2.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the output power measurements. The results recorded were measured with the modulation which produces the worst-case (highest) output power. The EUT was connected to spectrum analyser via a short coax cable with a known loss.

Analyser settings:

- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Detector: RMS
- Trace: Average, RMS power averaging mode
- Sweeps: 100
- Sweep time: coupled
- Trigger: gated mode

Note:

The analyser settings are according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D01 General UNII Test Procedures v01r03, 2013-4-08", method **SA-1**.

3.2.2 Test Requirements / Limits

A) FCC

For systems using digital modulation techniques in the 5.15 – 5.25 GHz bands:

§15.407 (a) (1)

Limit: 50 mW (17 dBm) or 4 dBm + 10 log (26 dB bandwidth/MHz) whatever is the lesser.

FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 ("new rules"):

§15.407 (a) (1) (i): Outdoor access point:

Limit: 1 W (30 dBm) provided the maximum antenna gain does not exceed 6 dBi.

The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

§15.407 (a) (1) (ii): Indoor access point:

Limit: 1 W (30 dBm) provided the maximum antenna gain does not exceed 6 dBi.

§15.407 (a) (1) (iv): Mobile and portable client devices:

Limit: 250 mW (24 dBm) provided the maximum antenna gain does not exceed 6 dBi.

For systems using digital modulation techniques in the 5.25 – 5.35 GHz and 5.47 – 5.725 GHz bands:

§15.407 (a) (2)

Limit: 250 mW (24 dBm) or 11 dBm + 10 log (26 dB bandwidth/MHz) whatever is the lesser.

For systems using digital modulation techniques in the 5.725 – 5.850 GHz bands:

§15.407 (a) (3)

Limit: 1 W (30 dBm) or 17 dBm + 10 log (26 dB bandwidth/MHz) whatever is the lesser.

FCC ET Docket No. 13-49, FIRST REPORT AND ORDER, April 1, 2014 (“new rules”):
§15.407 (a) (3):
Limit: 1 W (30 dBm).

§15.407 (a) (4):
The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

B) IC

Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-210, A9.2 (1), Band 5150-5250 MHz, indoor operation only:
Limit (e.i.r.p.): 200 mW (23 dBm) or $10 + 10 \log_{10} B$ [dBm], whichever power is less.
B is the 99% emission bandwidth in MHz.

RSS-210, A9.2 (2), Band 5250-5350 MHz:
Limits:
Maximum conducted Power: 250 mW (24 dBm) or $11 + 10 \log_{10} B$ [dBm], whichever power is less.
e.i.r.p.: 1.0 W (30 dBm) or $17 + 10 \log_{10} B$ [dBm], whichever power is less.

Note: For EUTs operating at a higher e.i.r.p. than 200 mW (23 dBm), compliance with the e.i.r.p. elevation mask is required.

RSS-210, A9.2 (3), Bands 5470-5600 MHz and 5650-5725 MHz:
Limits:
Maximum conducted Power: 250 mW (24 dBm) or $11 + 10 \log_{10} B$ [dBm], whichever power is less.
e.i.r.p.: 1.0 W (30 dBm) or $17 + 10 \log_{10} B$ [dBm], whichever power is less.

RSS-210, A9.2 (4), Band 5725-5825 MHz:
Limits:
Maximum conducted Power: 1W (30 dBm) or $17 + 10 \log_{10} B$ [dBm], whichever power is less.
e.i.r.p.: 4.0 W (36 dBm) or $23 + 10 \log_{10} B$ [dBm], whichever power is less.

All frequency bands: B is the 99% emission bandwidth in MHz.

3.2.3 Test Protocol

Temperature: 22–24 °C
 Air Pressure: 1008–1014 hPa
 Humidity: 37–45 %

1) SISO-mode, measured at antenna 1

WLAN a-Mode; 20 MHz; 6 Mbit/s					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	36	5180	14.5	17.8	30.0	15.5	N/A	-	22.4	4.6	1)
	44	5220	14.5	17.8	30.0	15.5	N/A	-	22.4	4.6	1)
	48	5240	14.6	17.9	30.0	15.4	N/A	-	22.4	4.5	1)
3	149	5745	18.6	21.9	30.0	11.4	29.6	11.0	35.6	13.7	
	157	5785	18.6	21.9	30.0	11.4	29.6	11.0	35.6	13.7	
	165	5825	18.4	21.7	30.0	11.6	29.7	11.3	35.7	14.0	

WLAN n-Mode; 20 MHz; 65.0 Mbit/s					FCC		IC			
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]
1	36	5180	14.8	18.1	30.0	15.2	N/A	-	22.6	4.5
	44	5220	14.4	17.7	30.0	15.6	N/A	-	22.6	4.9
	48	5240	14.6	17.9	30.0	15.4	N/A	-	22.6	4.7
3	149	5745	18.6	21.9	30.0	11.4	29.7	11.1	35.7	13.8
	157	5785	18.6	21.9	30.0	11.4	29.7	11.1	35.7	13.8
	165	5825	18.4	21.7	30.0	11.6	29.7	11.3	35.7	14.0

2) SISO-mode, measured at antenna 2

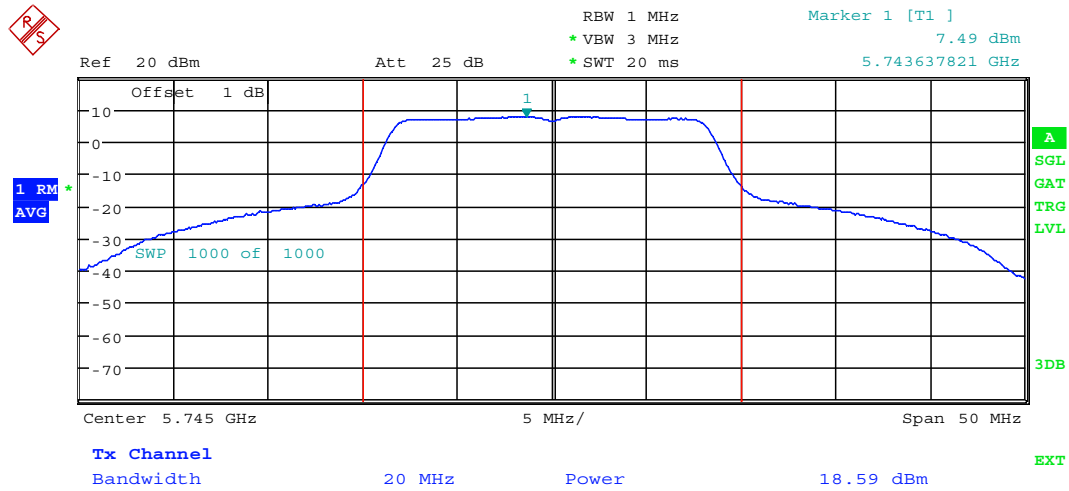
WLAN a-Mode; 20 MHz; 6 Mbit/s					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	36	5180	13.8	16.4	30.0	16.2	N/A	-	22.4	6.0	1)
	44	5220	13.6	16.2	30.0	16.4	N/A	-	22.4	6.2	1)
	48	5240	13.8	16.4	30.0	16.2	N/A	-	22.4	6.0	1)
3	149	5745	17.7	20.3	30.0	12.3	29.6	11.9	35.6	15.3	
	157	5785	18.0	20.6	30.0	12.0	29.6	11.6	35.6	15.0	
	165	5825	17.7	20.3	30.0	12.3	29.7	12.0	35.7	15.4	

WLAN n-Mode; 20 MHz; 65.0 Mbit/s					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	36	5180	13.4	16.0	30.0	16.6	N/A	-	22.6	6.6	1)
	44	5220	13.3	15.9	30.0	16.7	N/A	-	22.6	6.7	1)
	48	5240	13.4	16.0	30.0	16.6	N/A	-	22.6	6.6	1)
3	149	5745	17.6	20.2	30.0	12.4	29.7	12.1	35.7	15.5	
	157	5785	17.6	20.2	30.0	12.4	29.7	12.1	35.7	15.5	
	165	5825	17.7	20.3	30.0	12.3	29.7	12.0	35.7	15.4	

Maximum [dBm]:	20 MHz:	18.6	(conducted)
Maximum [dBm]:	20 MHz:	21.9	(EIRP)

1) = no additional limit applies related to the elevation.

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



Date: 5.JAN.2015 11:46:36

a-mode, 5745 MHz (worst case for single antenna)

3.3 Undesirable Emissions / General Field Strength Limits; Restricted Band and Radiated Emission Limits, Band Edge

Standard FCC Part 15, Subpart C & E

The test was performed according to: ANSI C 63.4

3.3.1 Test Description

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.

1. Measurement up to 30 MHz

The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber.

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: -0.25 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
- 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.

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 15 GHz) and a horn antenna (15-26 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 15 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.

In the frequency range 26 – 40 GHz the measurement was performed conducted.

3.3.2 Test Requirements / Limits

A) FCC

FCC Part 15 Subpart E , §15.407 (b)(1)

For transmitters operating in the 5150–5250 MHz band:

Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E , §15.407 (b)(2)

For transmitters operating in the 5250–5350 MHz band:

Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E , §15.407 (b)(3)

For transmitters operating in the 5470–5725 MHz band:

Limit: –27 dBm/MHz EIRP outside of the band 5470–5725 MHz.

FCC Part 15 Subpart E , §15.407 (b)(4)

For transmitters operating in the 5725–5850 MHz band:

Limit: –27 dBm/MHz EIRP outside of the band 5715–5860 MHz and additionally

Limit: –17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5850–5860 MHz.

B) IC

Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-210, A9.2 (1), Emissions outside the band 5150-5250 MHz, indoor operation only:
Limit: -27 dBm/MHz EIRP outside of the band 5150–5250 MHz.

RSS-210, A9.2 (2), Emissions outside the band 5250-5350 MHz:
Limit: -27 dBm/MHz EIRP outside of the band 5250–5350 MHz.

RSS-210, A9.2 (3), Emissions outside the bands 5470-5600 MHz and 5650-5725 MHz:
Limit: -27 dBm/MHz EIRP outside of the band 5470–5725 MHz.
Note: No operation is permitted for the frequency range 5600–5650 MHz.

RSS-210, A9.2 (4), Emissions outside the band 5725-5825 MHz:
Limit: -27 dBm/MHz EIRP outside of the band 5715–5835 MHz and additionally
Limit: -17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5825–5835 MHz.

C) FCC & IC

FCC Part 15 Subpart E , §15.405 and §15.407 (b)(6,7)
Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. The provisions of §§ 15.203 and 15.205 are included.

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 10	(48.5 – 13.8) + 59.1 dB	107.6 – 72.9
0.49 – 1.705	24000/F(kHz)	30 10	(48.9 – 23.0) + 19.1 dB	60.0 – 42.1
1.705 – 30	30	30 10	29.5 + 19.1 dB	48.6

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: $\text{Limit (dBµV/m)} = 20 \log (\text{Limit (µV/m)}/1\mu\text{V/m})$
 $\text{Limit (dBµV/m)} = \text{EIRP [dBm]} - 20 \log (d [\text{m}]) + 104.8$
 where d is the measurement distance

3.3.3 Test Protocol

Limit types:

RB – Emissions falls into a “Restricted Band” according FCC §§15.205 and 15.209

UE – “Undesirable Emission Limit” according FCC §15.407

BE-RB – Band Edge Limit basing on “Restricted Band Limits”

BE-RB – Band Edge Limit basing on “Undesirable Emission Limit”

Temperature: 21–25 °C

Air Pressure: 1004–1020 hPa

Humidity: 36–39 %

3.3.3.1 Radiated spurious and undesired emissions

WLAN a-Mode; 20 MHz; 6 Mbit/s				Applied duty cycle correction (AV) [dB]: 0.3				
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detec-tor	RBW [kHz]	Limit [dBμV/m]	Margin [dB]	Limit Type
36	5180	5107.0	55.2	PEAK	1000	68.0	12.8	UE
36	5180	5102.0	45.4	AV	1000	68.0	22.6	UE
36	5180	5262.5	56.9	PEAK	1000	68.0	11.1	UE
36	5180	10362.5	49.3	PEAK	1000	68.0	18.7	UE
44	5220	5138.0	55.9	PEAK	1000	68.0	12.1	UE
44	5220	5142.0	45.7	AV	1000	68.0	22.3	UE
44	5220	5299.0	57.4	PEAK	1000	68.0	10.6	UE
44	5220	6960.0	51.7	PEAK	1000	68.0	16.3	UE
44	5220	10445.0	48.2	PEAK	1000	68.0	19.8	UE
48	5240	5020.0	48.1	PEAK	1000	68.0	19.9	UE
48	5240	5020.0	37.3	AV	1000	54.0	16.7	UE
48	5240	10477.5	50.5	PEAK	1000	68.0	17.5	UE
149	5745	5663.0	57.4	PEAK	1000	68.0	10.6	UE
149	5745	5725.0	71.8	PEAK	1000	78.0	6.2	UE
149	5745	11489.0	49.3	PEAK	1000	74.0	24.7	UE
149	5745	11489.0	36.3	AV	1000	68.0	31.7	UE
157	5785	5706.5	59.7	PEAK	1000	68.0	8.3	UE
157	5785	5863.0	59.6	PEAK	1000	68.0	8.4	UE
161	5805	5825.0	75.3	PEAK	1000	78.0	2.7	UE
165	5825	5903.0	58.4	PEAK	1000	68.0	9.6	UE

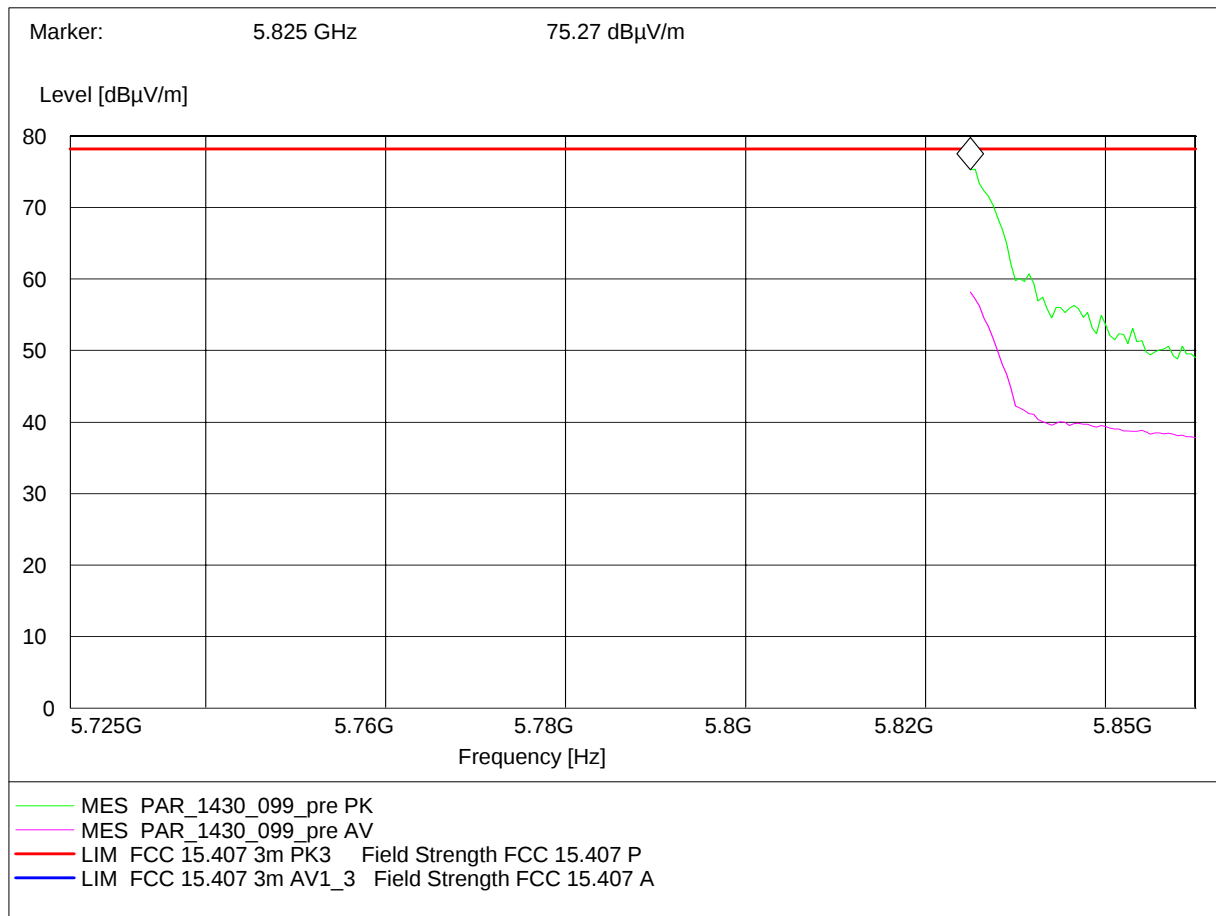
Note: No (further) spurious emissions in the range 20 dB below the limit found.
The results of the pre-test with peak detector have been similar for all three transmit frequencies in the frequency range 30–1000 MHz and independent from the transmit frequency. Therefore the final test applying the QP-(quasi-peak-)detector was performed only for one transmit frequency.

3.3.3.2 Band Edge

WLAN a-Mode; 20 MHz; 6 Mbit/s					Applied duty cycle correction (AV) [dB]: 0.3					
UNII-Sub-band	Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin [dB]	Limit Type	FCC /IC?
1	36	5180	5150.0	49.3	PEAK	1000	74.0	24.7	BE-RB	FCC
	36	5180	5150.0	34.4	AV	1000	54.0	19.6	BE-RB	FCC
3	149	5745	5725.0	71.8	PEAK	1000	78.0	6.2	BE-UE	FCC&IC
	161	5805	5825.0	75.3	PEAK	1000	78.0	2.7	BE-UE	IC
	165	5825	5850.0	58.8	PEAK	1000	78.0	19.2	BE-UE	FCC

Notes: Tests at the Band Edges are implicitly performed together with the undesired emission tests, which are performed as radiated test. The measurements are performed up to the band edges using the bandwidth specified for the undesired emissions.
If this test is passed, no additional test especially at the band edges will be performed, e.g. applying a reduced bandwidth or carrying out tests using the marker-delta method. Otherwise, the results will be reported in this sub-clause.
Band Edge tests are always performed and reported when the band directly adjacent to a Restricted Band.
Spurious emissions in the range 20 dB below the limit need not to be reported.

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



a-mode, 5805 MHz

4 Test Equipment

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

Test Equipment Anechoic Chamber

Lab ID:	Lab 1		
Manufacturer:	Frankonia		
Description:	Anechoic Chamber for radiated testing		
Type:	10.58x6.38x6.00 m ³		
	<i>Calibration Details</i>	<i>Last Execution</i>	<i>Next Exec.</i>
	NSA (FCC)	2014/01/09	2017/01/09

Single Devices for Anechoic Chamber

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>	
Air compressor	none	-	Atlas Copco	
Anechoic Chamber	10.58 x 6.38 x 6.00 m ³	none	Frankonia	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	FCC listing 96716 3m Part15/18		2014/01/09	2017/01/08
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 1
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		
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck		
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Standard Calibration		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		2012/05/18	2015/05/17	
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Standard Calibration		2012/06/26	2015/06/25	
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		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	Standard Calibration		2012/12/18	2015/12/17	
Log.-per. Antenna	HL 562 Ultralog	830547/003	Rohde & Schwarz GmbH & Co. KG		
Loop Antenna	HFH2-Z2	829324/006	Rohde & Schwarz GmbH & Co. KG		
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>	
	DKD Calibration		2014/11/27	2017/11/27	
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH		

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

Single Device Name	Type	Serial Number	Manufacturer
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, Lab 2
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
Digital Multimeter 03 (Multimeter)	Fluke 177	86670383	Fluke Europe B.V.
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Customized calibration			2013/12/04 2015/12/03
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
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard			2014/02/10 2016/02/09
Spectrum Analyser	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard			2012/06/13 2015/06/12
DKD calibration			2014/11/24 2017/11/23
Spectrum Analyser	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
<i>Calibration Details</i>			<i>Last Execution</i> <i>Next Exec.</i>
Standard calibration			2014/07/29 2015/07/28
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

Test Equipment Digital Signalling Devices

Lab ID: Lab 1, Lab 2

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	
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard calibration		2014/01/27	2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	DKD calibration		2014/12/02	2017/12/01
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>
	DKD calibration		2014/12/03	2017/12/02
	<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	
Vector Signal Generator	SMU200A	100912	Rohde & Schwarz GmbH & Co. KG	

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

Single Device Name	Type	Serial Number	Manufacturer
Personal Computer	Dell	30304832059	Dell
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2014/05/13 2015/05/12
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2014/05/13 2015/05/12
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard Calibration	2014/06/24 2017/06/23
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	2014/01/07 2016/01/31
		<i>HW/SW Status</i>	<i>Date of Start</i> <i>Date of End</i>
		Firmware-Update 4.34.4 from 3.45 during calibration	2009/12/03

Test Equipment Multimeter 12

Lab ID: Lab 3
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.
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Customized calibration	2013/12/04 2015/12/03

Test Equipment Radio Lab Test Equipment

Lab ID: Lab 2
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power DividerWA1515 SMA		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
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2014/05/13 2015/05/12
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFS	5489/001	Datum-Beverly
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2014/07/03 2015/07/02
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2014/05/13 2015/05/12
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2014/12/02 2017/12/01
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard calibration	2013/05/06 2016/05/05
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG
		<i>Calibration Details</i>	<i>Last Execution</i> <i>Next Exec.</i>
		Standard Calibration	2013/02/12 2015/02/11

Test Equipment Shielded Room 07

Lab ID: Lab 3
Description: Shielded Room 4m x 6m

Test Equipment T/A Logger 13

Lab ID: Lab 1, Lab 2
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 Next Exec.
Customized calibration			2013/02/07 2015/02/06

Test Equipment T/H Logger 03

Lab ID: Lab 2
Description: Lufft Opus10
Serial Number: 7482

Single Devices for T/H Logger 03

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 03 (Environ)	Opus10 THI (8152.00)	7482	Lufft Mess- und Regeltechnik GmbH
Calibration Details			Last Execution Next Exec.
Customized calibration			2013/02/07 2015/02/06

Test Equipment T/H Logger 12

Lab ID: Lab 1
Description: Lufft Opus10
Serial Number: 12482

Single Devices for T/H Logger 12

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 12 (Environ)	Opus10 THI (8152.00)	12482	Lufft Mess- und Regeltechnik GmbH
Calibration Details			Last Execution Next Exec.
Customized calibration			2013/01/07 2015/01/06

Test Equipment T/H Logger 15

Lab ID: Lab 3
Description: Lufft Opus10
Serial Number: 13985

Single Devices for T/H Logger 15

Single Device Name	Type	Serial Number	Manufacturer
ThermoHygro DataloggerOpus10 THI (8152.00) 15 (Environ)	Opus10 THI (8152.00)	13985	Lufft Mess- und Regeltechnik GmbH
Calibration Details			Last Execution Next Exec.
Customized calibration			2013/01/07 2015/01/06

Test Equipment Temperature Chamber 01

Lab ID: Lab 3
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
<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
Customized calibration		2014/03/12	2016/03/11

Test Equipment Temperature Chamber 05

Lab ID: Lab 2
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
<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
Customized calibration		2014/03/11	2016/03/10

Test Equipment WLAN RF Test Solution

Lab ID: Lab 3
Manufacturer: 7 layers AG
Description: Regulatory WLAN RF Tests
Type: WLAN RF
Serial Number: 001

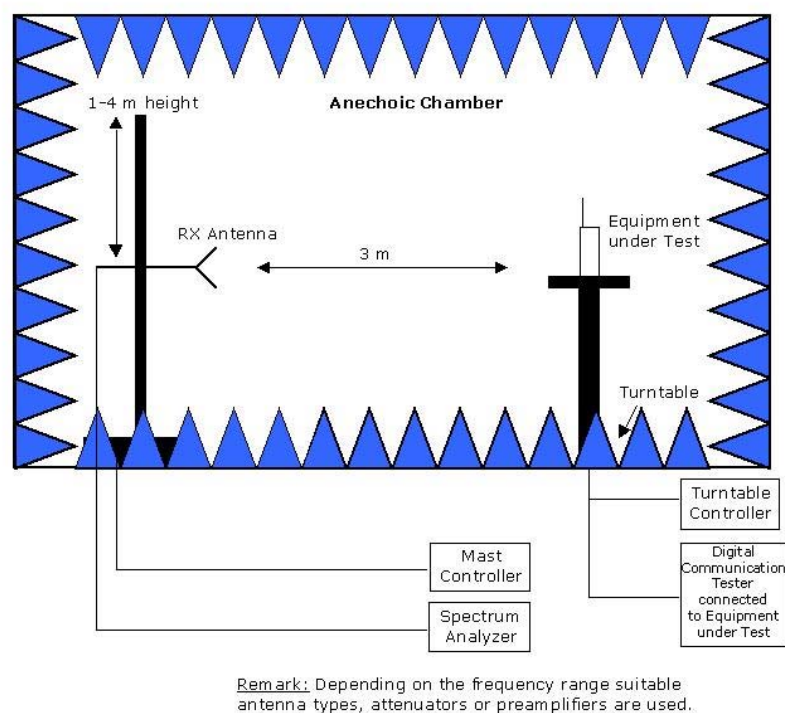
Single Devices for WLAN RF Test Solution

Single Device Name	Type	Serial Number	Manufacturer	
Arbitrary Waveform Generator	TGA12101	284482		
Power Meter NRVD	NRVD	832025/059		
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2014/08/29	2015/08/28
Power Sensor NRV Z1 A	PROBE	832279/013		
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2014/08/28	2015/08/27
Power Supply	NGSM 32/10	2725		
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2013/06/20	2015/06/19
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	
	Calibration Details		Last Execution	Next Exec.
	Standard Calibration		2014/01/06	2015/01/05
	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	
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2014/07/01	2015/06/30
	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		
	Calibration Details		Last Execution	Next Exec.
	Standard calibration		2013/06/21	2016/06/20

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.