



Inter**Lab**<sup>®</sup>

FCC Measurement/Technical Report on

WLAN transceiver

in

Parrot BEBOP DRONE 2

FCC ID: RKXMYKONOS3

IC: 5119A-MYKONOS3

**Report Reference:** MDE\_PARRO\_1531\_FCCd

**Test Laboratory:**

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Germany



**Note:**

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

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## **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 (10-1-14 Edition) and 15 (10-1-14 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".

ANSI C63.10-2013 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 from FCC and IC

#### 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-247 Issue 1: 6.2.1 (1), 6.2.2 (1), 6.2.3 (1) (99%) RSS-247 Issue 1: 6.2.4 (1) (6 dB)
Maximum conducted output power	§ 15.407 (a) (1),(2),(3),(4)	RSS-247 Issue 1: : 6.2.1 (1), 6.2.2 (1), 6.2.3 (1), 6.2.4 (1)
Maximum power spectral density	§ 15.407 (a) (1),(2),(3),(5)	RSS-247 Issue 1: : 6.2.1 (1), 6.2.2 (1), 6.2.3 (1), 6.2.4 (1)
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-247 Issue 1: : 6.2.1 (2), 6.2.2 (2), 6.2.3 (2), 6.2.4 (2)
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-247 Issue 1: 6.2.2 (1), 6.2.3 (1), 6.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	-	-



### 0.3 Measurement Summary / Signatures

#### **FCC Part 15, Subpart C § 15.207**

Conducted emissions (AC power line)

The measurement was performed according to ANSI C63.10

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
-	-	AC Port (power line)	N/A <sup>1)</sup>

#### **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 ANSI C63.10

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
ac-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed
ac-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed
ac-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 ANSI C63.10

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>	
			<b>FCC</b>	<b>IC</b>
ac-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-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 ANSI C63.10

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>	
			<b>FCC</b>	<b>IC</b>
ac-Mode, CH 36, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 44, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 48, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 149, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 157, 20 MHz	Setup_01	Temp.ant.connector	passed	passed
ac-Mode, CH 165, 20 MHz	Setup_01	Temp.ant.connector	passed	passed

#### **FCC Part 15, Subpart E § 15.407 (g)**

Frequency Stability

The measurement was performed according to ANSI C63.10

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>
-	-	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 Bands and Radiated Emission Limits  
The measurement was performed according to ANSI C63.10

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>	
			<b>FCC</b>	<b>IC</b>
ac-Mode, CH 36, 20 MHz	Setup_02	Enclosure	passed	passed
ac-Mode, CH 44, 20 MHz	Setup_02	Enclosure	passed	passed
ac-Mode, CH 48, 20 MHz	Setup_02	Enclosure	passed	passed
ac-Mode, CH 149, 20 MHz	Setup_02	Enclosure	passed	passed
ac-Mode, CH 157, 20 MHz	Setup_02	Enclosure	passed	passed
ac-Mode, CH 165, 20 MHz	Setup_02	Enclosure	passed	passed

**FCC Part 15, Subpart E**

**§ 15.407 (h)**

Dynamic Frequency selection  
The measurement was performed according to FCC § 15.31

<b>OP-Mode</b>	<b>Setup</b>	<b>Port</b>	<b>Final Result</b>	
			<b>FCC</b>	<b>IC</b>
-	-	-	N/A <sup>2)</sup>	N/A <sup>2)</sup>

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

Another variant without activated AC mode of this EUT has already been tested. Due to this only AC mode was tested for this test report.

Test report reference old test report: MDE\_PARRO\_1430\_FCCb

Responsible for Accreditation Scope: \_\_\_\_\_

Responsible for Test Report: \_\_\_\_\_



## **1 Administrative Data**

### **1.1 Testing Laboratory**

Company Name: 7layers GmbH

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 .

This facility has been fully described in a report submitted to the IC and accepted under the registration number: Site# 3699A-1

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: 2015-09-28

### **1.2 Project Data**

Responsible for testing and report: Dipl.-Ing. Daniel Gall  
Employees who performed the tests: documented internally at 7Layers

Date of Test(s): 2015-10-08 to 2015-10-12  
Date of Report: 2015-11-06

### **1.3 Applicant Data**

Company Name: Parrot S.A.

Address: 174 quai de Jemmapes  
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

<b>Equipment under Test:</b>	IEEE 802.11a/n/ac WLAN transceiver
<b>Type Designation:</b>	Parrot BEBOP DRONE 2
<b>Kind of Device:</b>	Quadricopter wifi controlled
<b>(optional)</b>	
<b>Voltage Type:</b>	DC
<b>Voltage Level:</b>	DC 12.0 V
<b>Tested Modulation Type:</b>	OFDM:256-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. 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 g/n and 5 GHz a/n/ac) access point. In IEEE 802.11n and ac mode it supports 20 MHz bandwidth channels (SISO and MIMO), providing 72.2 / 86.7 Mbit/s, and 144.4 / 173.4 Mbit/s transfer data rates respectively.

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 – 5.825 GHz.  
(“new rules” 5.850 GHz)

The object of this test report is the now activated AC mode of the WLAN transceiver.

#### The EUT provides the following ports:

##### Ports

Enclosure  
USB Data 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: DE1018015aa01)	WLAN transceiver	Parrot BEBOP DRONE 2	PF726003P15I 000458	HW02	6.37.114.64
Remark: EUT A is equipped with a temporary antenna connector.					
EUT B (Code: DE1018015ab01)	WLAN transceiver	Parrot BEBOP DRONE 2	PF726003P15I 000480	HW02	6.37.114.64
Remark: EUT B is equipped with two dual-band integral antennae with different antenna gain: Antenna1: 2.7 dBi in 2.4 GHz and 3.3 dBi (SB1) / 2.6 dBi (SB3) in 5 GHz band, Antenna2: 2.7 dBi in 2.4 GHz and 3.9 dBi (SB1) / 2.1 dBi (SB3) in 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	-	-	-	-	-

## 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	USB cable	-	-	-	-

## 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	setup for conducted radio measurements
Setup_02	EUT B + AUX1	setup for radiated measurements

## 2.6 Operating Modes

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

### 2.6.1 Test Channels

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

### 2.6.2 Datarates

#### SISO:

WLAN ac-Mode; 20 MHz; 86.7 Mbit/s
-----------------------------------

#### MIMO:

WLAN ac-Mode; 20 MHz; 173.4 Mbit/s
------------------------------------

## 2.7 Special software used for testing

In the engineering mode provided for the tests, the EUT can be controlled by an external computer using a terminal program. With script files provided by the applicant, data rate, antenna port, RF power level and duty cycle can be set.

## 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:** ANSI C63.10

##### 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
- re-adjust 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):  $\geq 3$  times the RBW

1+2) 26 / 6 dB bandwidth:

- Detector: Peak
- Trace: Maxhold
- Sweeps:  $\geq 200$
- Sweptime: at least coupled

3) 99% occupied bandwidth:

- Span: 1.5 to 5 times the occupied bandwidth
- Resolution Bandwidth (RBW): approx.  $\geq 1$  % of the span, but not below
- Video Bandwidth (VBW):  $\geq 3$  times the RBW
- Detector: Sample
- Trace: Maxhold
- Sweeps:  $\geq 200$
- 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: 24 °C  
 Air Pressure: 1008 hPa  
 Humidity: 37 %

1) 26 dB bandwidth

WLAN ac-Mode; 20 MHz; MCS8			
UNII-Subband	Channel No.	Frequency [MHz]	26 dB Bandwidth [MHz]
1	36	5180	20.145
	44	5220	20.145
	48	5240	20.203
3	149	5745	20.087
	157	5785	20.260
	165	5825	20.203

2) 6 dB bandwidth (UNII-band 3 only)

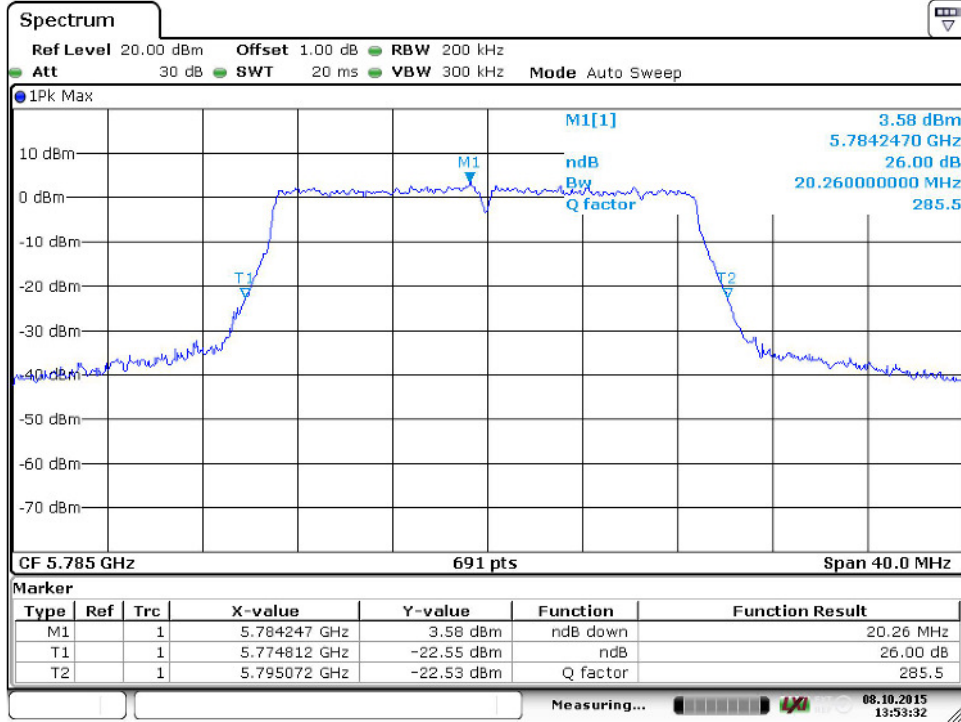
WLAN ac-Mode; 20 MHz; MCS8					
UNII-Subband	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin [MHz]
3	149	5745	17.800	0.500	17.300
	157	5785	17.800	0.500	17.300
	165	5825	17.800	0.500	17.300

3) 99% bandwidth

WLAN ac-Mode; 20 MHz; MCS8			
UNII-Subband	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
1	36	5180	18.017
	44	5220	18.017
	48	5240	18.162
3	149	5745	18.089
	157	5785	18.089
	165	5825	18.089

### 3.1.4 Measurement Plot (showing the highest or lowest value, "worst case")

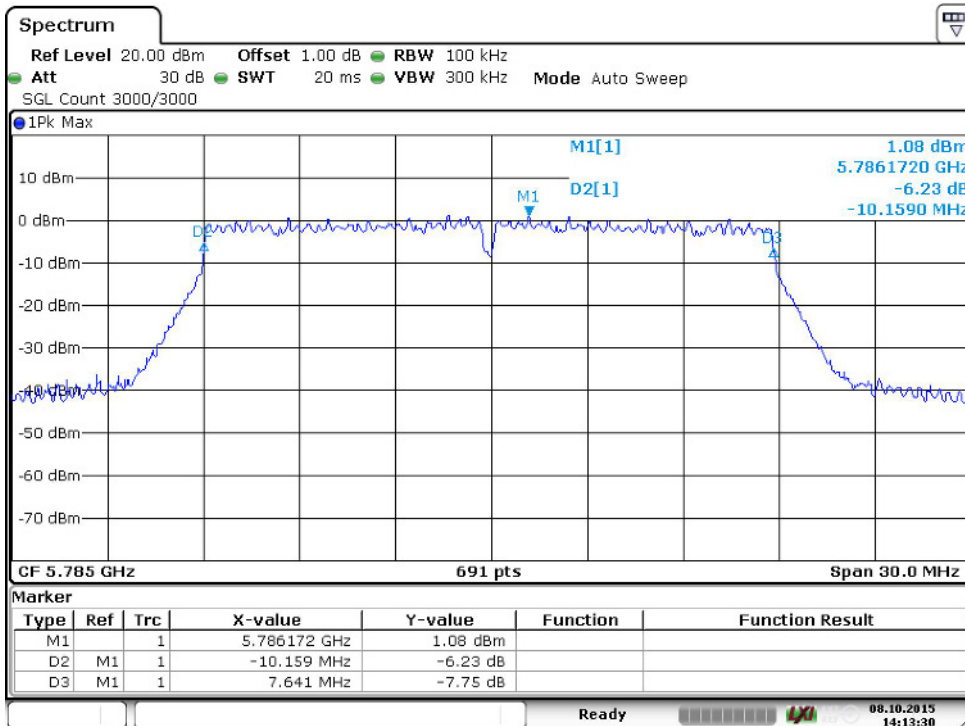
1) 26 dB bandwidth



Date: 8.OCT.2015 13:53:32

plot of highest 26 dB Bandwidth measurement

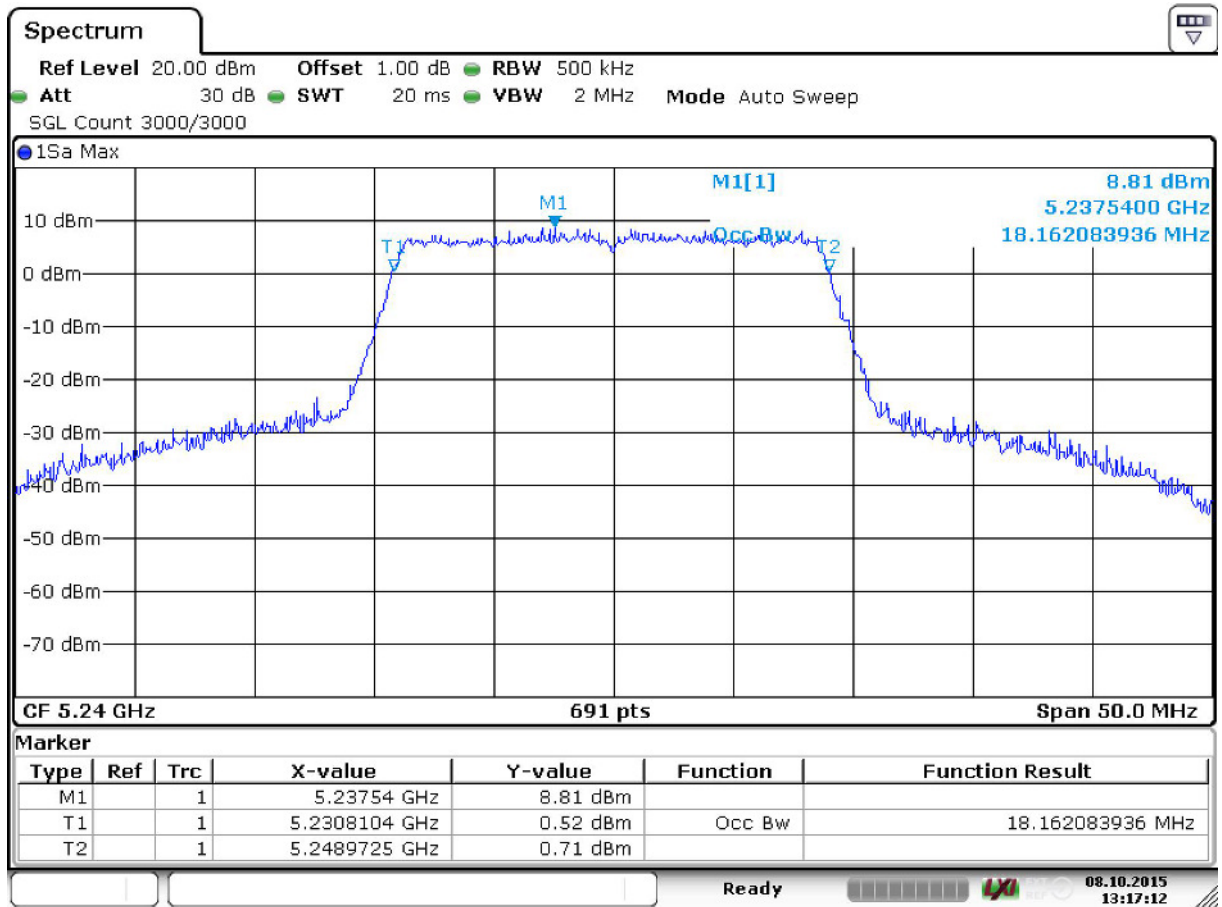
2) 6 dB bandwidth



Date: 8.OCT.2015 14:13:30

plot of smallest 6 dB Bandwidth measurement

3) 99% bandwidth



Date: 8.OCT.2015 13:17:12

plot of highest 99 % Bandwidth measurement



## 3.2 Maximum conducted output power

**Standard** FCC Part 15, Subpart E

**The test was performed according to:** ANSI C63.10

### 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
- Sweeptime: 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 D02", 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-247, 6.2 (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-247, 6.2 (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-247, 6.2 (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-247, 6.2 (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: 23 °C  
 Air Pressure: 1010 hPa  
 Humidity: 40 %

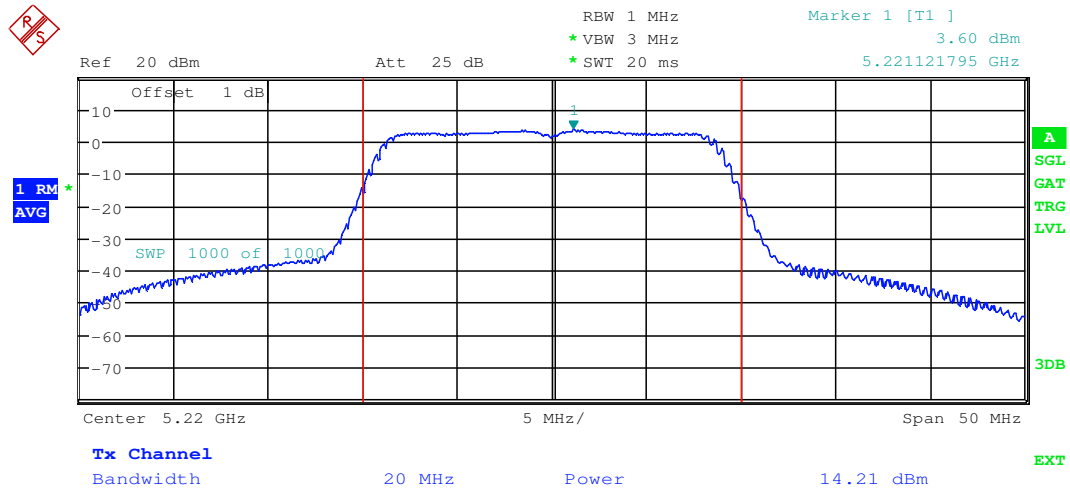
WLAN ac-Mode; 20 MHz; MCS8					FCC		IC				
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]	
1	36	5180	14.2	17.5	30.0	15.8	N/A	-	22.6	5.1	1)
	44	5220	14.2	17.5	30.0	15.8	N/A	-	22.6	5.1	1)
	48	5240	14.1	17.4	30.0	15.9	N/A	-	22.6	5.2	1)
3	149	5745	12.6	15.9	30.0	17.4	29.6	17.0	35.6	19.7	
	157	5785	12.4	15.6	30.0	17.7	29.6	17.2	35.6	20.0	
	165	5825	12.7	16.0	30.0	17.3	29.6	16.9	35.6	19.6	

WLAN ac-Mode; 20 MHz; MCS8 MIMO					FCC		TX1		TX2
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Power [dBm]	EIRP [dBm]	Cond. Limit [dBm]	Margin [dB]	ANT1	ANT2	
1	36	5180	15.6	19.2	30.0	14.4	12.8	12.3	1)
	44	5220	15.6	19.2	30.0	14.4	12.8	12.3	1)
	48	5240	15.3	18.9	30.0	14.7	12.5	12.1	1)
3	149	5745	15.8	19.4	30.0	14.2	12.5	13.0	
	157	5785	15.7	19.3	30.0	14.3	12.4	12.9	
	165	5825	15.9	19.6	30.0	14.1	12.7	13.1	

table continued			IC			
UNII-Sub-band	Ch. No.	Freq. [MHz]	Cond. Limit [dBm]	Margin [dB]	EIRP Limit [dBm]	Margin [dB]
1	36	5180	N/A		22.6	3.4
	44	5220	N/A		22.6	3.4
	48	5240	N/A		22.6	3.7
3	149	5745	29.6	13.8	35.6	16.2
	157	5785	29.6	13.9	35.6	16.3
	165	5825	29.6	13.7	35.6	16.0

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

### 3.2.4 Measurement Plot (showing the highest value, "worst case")



Date: 9.OCT.2015 09:30:23

### 3.3 Maximum Power Spectral Density

**Standard** FCC Part 15, Subpart E

**The test was performed according to:** ANSI C63.10

#### 3.3.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the Maximum Power Spectral Density 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
- Sweeptime: coupled
- Marker: Peak
- 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 D02", method **SA-1**.

#### 3.3.2 Test Requirements / Limits

##### A) FCC

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

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

(i) and (ii), outdoor and indoor access points: Limit: 17 dBm/MHz.

(iv), mobile and portable client devices: Limit: 11 dBm/MHz.

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

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

Limit: 11 dBm/MHz.

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

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

Limit: 30 dBm/500 kHz.

Note: The limit will be also fulfilled when measuring at any bandwidth greater than 500 kHz. This applies to signals where the maximum conducted output power was measured at a bandwidth exceeding 500 kHz and which fulfil that limit of 30 dBm.



**B) IC**

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

RSS-247, 6.2 (1), Band 5150-5250 MHz, indoor operation only:  
Limit (e.i.r.p.): 10 dBm/MHz.

RSS-247, 6.2 (2), Band 5250-5350 MHz:  
Limit: 11 dBm/MHz.

RSS-247, 6.2 (3), Bands 5470-5600 MHz and 5650-5725 MHz:  
Limit: 11 dBm/MHz.

RSS-247, 6.2 (4), Band 5725-5825 MHz:  
Limit: 17 dBm/MHz.

### 3.3.3 Test Protocol

Temperature: 23 °C  
 Air Pressure: 1010 hPa  
 Humidity: 40 %

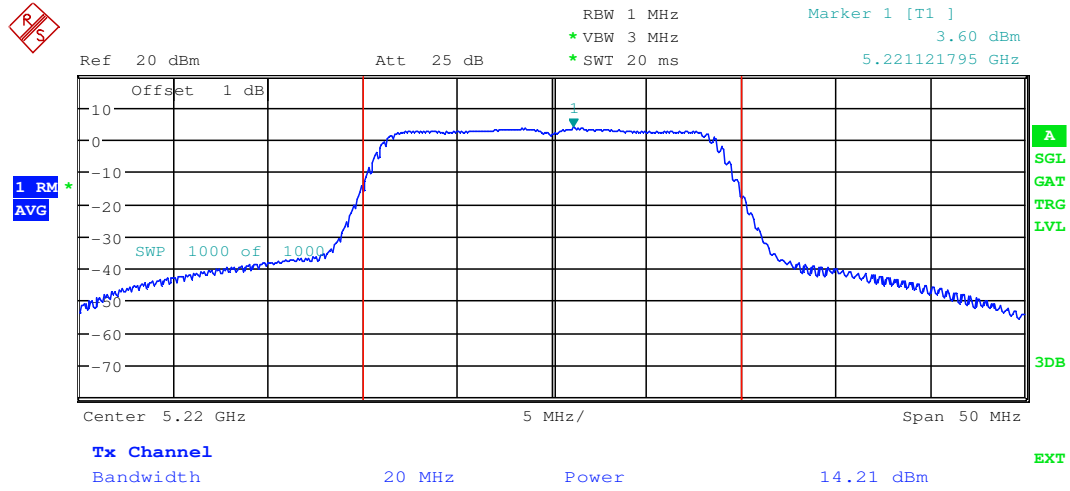
WLAN ac-Mode; 20 MHz; MCS8								
UNII-Sub-band	Ch. No.	Freq. [MHz]	MPSD [dBm/MHz]	FCC Limit [dBm]	Margin [dB]	IC Limit [dBm]	Margin [dB]	IC EIRP MPSD
1	36	5180	3.4	17.0	13.6	10.0	3.3	6.7
	44	5220	3.6	17.0	13.4	10.0	3.1	6.9
	48	5240	3.0	17.0	14.0	10.0	3.7	6.3
3	149	5745	1.7	30.0	28.3	17.0	15.3	
	157	5785	1.4	30.0	28.6	17.0	15.6	
	165	5825	1.6	30.0	28.4	17.0	15.4	

WLAN ac-Mode; 20 MHz; MCS8 MIMO						TX1	TX2
UNII-Sub-band	Ch. No.	Freq. [MHz]	MPSD [dBm/MHz]	FCC Limit [dBm]	Margin [dB]	ANT1	ANT2
1	36	5180	4.8	17.0	12.2	1.9	1.6
	44	5220	4.7	17.0	12.3	1.8	1.5
	48	5240	4.6	17.0	12.4	1.6	1.7
3	149	5745	5.1	30.0	24.9	1.9	2.2
	157	5785	5.1	30.0	24.9	1.9	2.3
	165	5825	5.1	30.0	24.9	1.8	2.3

table continued					
UNII-Sub-band	Ch. No.	Freq. [MHz]	IC EIRP MPSD	IC Limit [dBm]	Margin [dB]
1	36	5180	8.4	10.0	1.6
	44	5220	8.3	10.0	1.7
	48	5240	8.3	10.0	1.7
3	149	5745		17.0	11.9
	157	5785		17.0	11.9
	165	5825		17.0	11.9

Note: MPSD for subband 3 is measured at 1 MHz bandwidth.

### 3.3.4 Measurement Plot (showing the highest value, "worst case")



Date: 9.OCT.2015 09:30:23

### **3.4 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 C63.10

#### **3.4.1 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  $\mu$ s
- Turntable angle range:  $-180$  to  $180^\circ$
- Turntable step size:  $90^\circ$
- Height variation range: 1 – 3 m
- Height variation step size: 2 m

- Polarisation: Horizontal + Vertical

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

**Step 2:** second measurement

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

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: -180 to 180°
- 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  $\pm 25$  cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

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

**Step 4:** final measurement with QP detector

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

EMI receiver settings for step 4:

- Detector: Quasi-Peak
- 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.

### **3.4.2 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-247, 6.2 (1), Emissions outside the band 5150-5250 MHz, indoor operation only:  
Limit: -27 dBm/MHz EIRP outside of the band 5150-5250 MHz.

RSS-247, 6.2 (2), Emissions outside the band 5250-5350 MHz:  
Limit: -27 dBm/MHz EIRP outside of the band 5250-5350 MHz.

RSS-247, 6.2 (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-247, 6.2 (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)	Specified distance (m)	Measurement distance (m)	Calculated Limit (dBµV/m @10m)	Limit (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	(33.8 – 23.0) + 19.1 dB	52.9 – 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:      Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)  
    Limit (dBµV/m) = EIRP [dBm] – 20 log (d [m]) + 104.8  
    where d is the measurement distance

### 3.4.3 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-UE – Band Edge Limit basing on “Undesirable Emission Limit”

\*) Below 1 GHz the limits of §15.209 are applied for all frequencies.

Temperature: 22 °C  
 Air Pressure: 1012 hPa  
 Humidity: 38 %

#### 3.4.3.1 Radiated spurious and undesired emissions

WLAN ac-Mode; 20 MHz; MCS8 MIMO					Applied duty cycle correction (AV) [dB]: 2.9			
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin [dB]	Limit Type
36	5180	4966.5	58.0	PEAK	1000	74.0	16.0	RB
36	5180	4962.8	48.1	AV	1000	54.0	5.9	RB
36	5180	5098.0	59.9	PEAK	1000	74.0	14.1	RB
36	5180	5098.8	49.4	AV	1000	54.0	4.6	RB
36	5180	5394.0	58.1	PEAK	1000	74.0	15.9	RB
36	5180	5394.0	48.7	AV	1000	54.0	5.3	RB
44	5220	5005.4	58.5	PEAK	1000	74.0	15.5	RB
44	5220	5001.3	47.1	AV	1000	54.0	6.9	RB
44	5220	5142.2	60.2	PEAK	1000	74.0	13.8	RB
44	5220	5141.2	47.9	AV	1000	54.0	6.1	RB
48	5240	5024.6	57.7	PEAK	1000	74.0	16.3	RB
48	5240	5024.1	46.9	AV	1000	54.0	7.1	RB
48	5240	5460.6	57.2	PEAK	1000	68.0	10.8	UE
48	5240	5459.3	47.3	AV	1000	54.0	6.7	RB
149	5745	5507.7	58.1	PEAK	1000	68.0	9.9	UE
149	5745	5590.9	56.0	PEAK	1000	68.0	12.0	UE
149	5745	5667.3	60.0	PEAK	1000	68.0	8.0	UE
149	5745	5725.0	60.5	PEAK	1000	78.0	17.5	BE
157	5785	5705.2	58.9	PEAK	1000	68.0	9.2	UE
157	5785	5871.4	59.1	PEAK	1000	68.0	8.9	UE
165	5825	5907.0	59.3	PEAK	1000	68.0	8.7	UE

Note: No (further) spurious emissions in the range 20 dB below the limit found.  
 The measurement was performed from 1 GHz up to 26 GHz because at pre-measurements no significant spurious emissions have been found outside this frequency range.

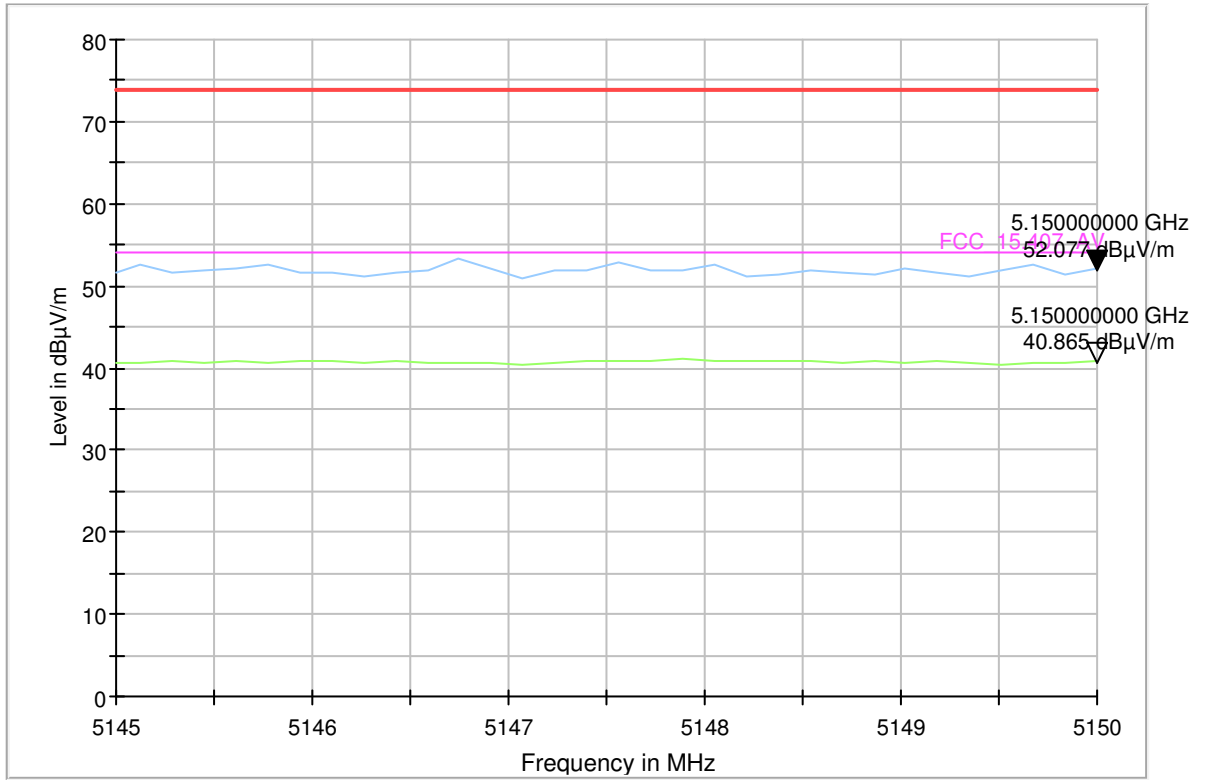
### 3.4.3.2 Band Edge

WLAN ac-Mode; 20 MHz; MCS8 MIMO					Applied duty cycle correction (AV) [dB]: 2.9					
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	52.1	PEAK	1000	74.0	21.9	BE-RB	FCC&IC
	36	5180	5150.0	43.8	AV	1000	54.0	10.2	BE-RB	FCC&IC
3	149	5745	5725.0	60.5	PEAK	1000	78.0	17.5	BE-UE	FCC&IC
	165	5825	5850.0	54.0	PEAK	1000	78.0	24.0	BE-UE	FCC&IC

Note: 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.

### 3.4.4 Measurement Plot Band Edge (showing the highest value, "worst case")

a) at restricted band



## 4 Measurement Uncertainty

Test Case	Parameter	Uncertainty
AC Power Line	Power	$\pm 3.4$ dB
Field Strength of spurious radiation	Power	$\pm 5.5$ dB
6 dB / 26 dB / 99% Bandwidth	Power Frequency	$\pm 2.9$ dB $\pm 11.2$ kHz
Conducted Output Power	Power	$\pm 2.2$ dB
Band Edge Compliance	Power Frequency	$\pm 2.2$ dB $\pm 11.2$ kHz
Frequency Stability	Frequency	$\pm 25$ Hz
Power Spectral Density	Power	$\pm 2.2$ dB

## 5 Test Equipment

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

### Test Equipment Anechoic Chamber

<b>Lab ID:</b>	<b>Lab 1</b>		
<i>Manufacturer:</i>	Frankonia		
<i>Description:</i>	Anechoic Chamber for radiated testing		
<i>Type:</i>	10.58x6.38x6.00 m <sup>3</sup>		
	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 <sup>3</sup> FCC listing 96716 3m Part15/18	none	Frankonia 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

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

### Single Devices for Auxiliary Equipment for Radiated emissions

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Antenna mast	AM 4.0	AM4.0/180/119205 13	Maturo GmbH
Antenna mast	AS 620 P	620/37	HD GmbH
Biconical Broadband Antenna	SBA 9119	9119-005	Schwarzbeck Mess-Elektronik OHG
Biconical dipole	VUBA 9117	9117-108	Schwarzbeck Mess-Elektronik OHG
Broadband Amplifier 1 GHz - 4 GHz	AFS4-01000400-1Q-10P-4	-	Miteq
Broadband Amplifier 18 GHz - 26 GHz	JS4-18002600-32-5P	849785	Miteq
Broadband Amplifier 30 MHz - 18 GHz	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"	SucoFlex	W18.02-2+W38.02- 2	HUBER+SUHNER
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02- 2	Rosenberger Micro-Coax
Double-ridged horn	HF 906	357357/002	Rohde & Schwarz GmbH & Co. KG



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

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>	
	Standard Calibration		2015/06/23	2018/06/22
Double-ridged horn	HF 907	102444	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration		2015/05/11	2018/05/10
Double-ridged horn-duplicated 2015-07-15 10:47:55	HF 906	357357/001	Rohde & Schwarz GmbH & Co. KG	
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic	
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic	
High Pass Filter	5HC3500/18000-1.2-KK	200035008	Trilithic	
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright	
Horn Antenna Schwarzbeck 15-26.5 GHz BBHA 9170	BBHA 9170	BBHA9170262	Schwarzbeck Mess-Elektronik OHG	
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 (upgraded)	HL 562 Ultralog new biconicals	830547/003	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard Calibration		2015/06/30	2018/06/29
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
Standard Gain / Pyramidal Horn Antenna 26.5 GHz	3160-09	00083069	EMCO Elektronik GmbH	
Standard Gain / 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
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
Digital Multimeter 13 (Clamp Meter)	Fluke 325	31270091WS	FLUKE
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	FSU26	200418	Rohde & Schwarz GmbH & Co.KG
Spectrum Analyzer	FSP3	836722/011	Rohde & Schwarz GmbH & Co. KG
	DKD calibration		2015/06/23 2018/06/22
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	
	Standart calibration		2015/01/21	2018/01/19
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2014/01/27	2016/01/26
Digital Radio Communication Tester	CMD 55	831050/020	Rohde & Schwarz GmbH & Co. KG	
	DKD calibration		2014/12/02	2017/12/01
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	
	DKD calibration		2014/12/03	2017/12/02
	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 1  
**Description:** Equipment for emission measurements  
**Serial Number:** see single devices

#### Single Devices for Emission measurement devices

Single Device Name	Type	Serial Number	Manufacturer	
EMI Receiver / Spectrum Analyzer	ESR 7	101424	Rohde & Schwarz	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Initial Factory Calibration		2014/11/13	2016/11/12
Personal Computer	Dell	30304832059	Dell	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/05/11	2016/05/10
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	Standard calibration		2015/05/11	2016/05/10
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	Standard Calibration		2014/06/24	2017/06/23
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	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	
Spectrum Analyzer	FSW 43	103779	Rohde & Schwarz	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Initial Factory Calibration		2014/11/17	2016/11/16

### Test Equipment Multimeter 03

**Lab ID:** Lab 1, Lab 2  
**Description:** Fluke 177  
**Serial Number:** 86670383

#### Single Devices for Multimeter 03

Single Device Name	Type	Serial Number	Manufacturer	
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



**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 Standard calibration	828110/016	Rohde & Schwarz GmbH & Co.KG 2015/05/11 2016/05/10
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFS Standard calibration	5489/001	Datum-Beverly 2015/06/25 2016/06/24
Sensor Head A	NRV-Z1 Standard calibration	827753/005	Rohde & Schwarz GmbH & Co.KG 2015/05/11 2016/05/10
Signal Generator SME	SME03 <i>Calibration Details</i> Standard calibration	827460/016	Rohde & Schwarz GmbH & Co.KG <i>Last Execution</i> <i>Next Exec.</i> 2014/12/02 2017/12/01
Signal Generator SMP	SMP02 <i>Calibration Details</i> Standard calibration	836402/008	Rohde & Schwarz GmbH & Co. KG <i>Last Execution</i> <i>Next Exec.</i> 2013/05/06 2016/05/05
Spectrum Analyzer	FSIQ26 Calibration after reparation	840061/005	Rohde & Schwarz GmbH & Co. KG 2015/04/02 2017/04/01



### Test Equipment T/A Logger 13

**Lab ID:** Lab 1, Lab 2  
**Description:** Luft 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
	Customized calibration		2015/02/27 2017/02/26

### Test Equipment T/H Logger 03

**Lab ID:** Lab 2  
**Description:** Luft 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
	Customized calibration		2015/02/27 2017/02/26

### Test Equipment T/H Logger 12

**Lab ID:** Lab 1  
**Description:** Luft 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
	Customized calibration		2015/03/10 2017/03/09

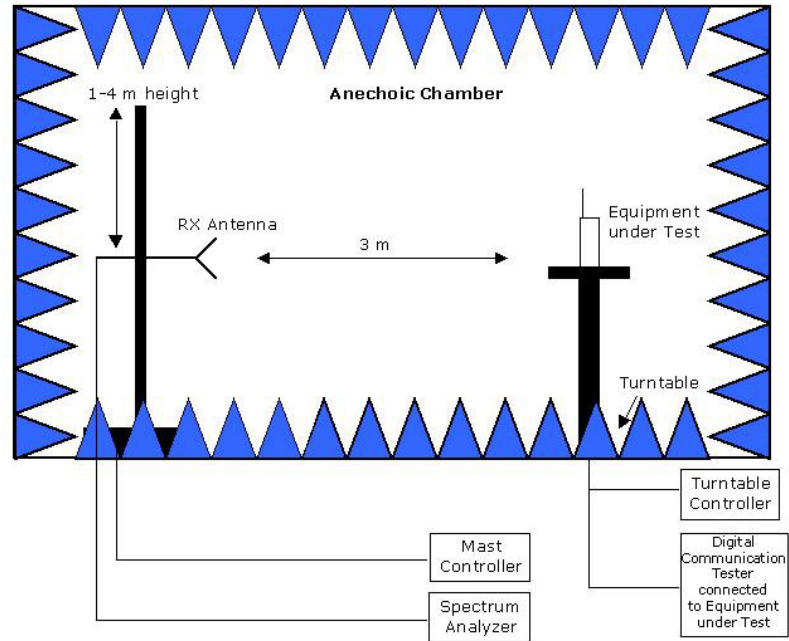
### Test Equipment Temperature Chamber 05

**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

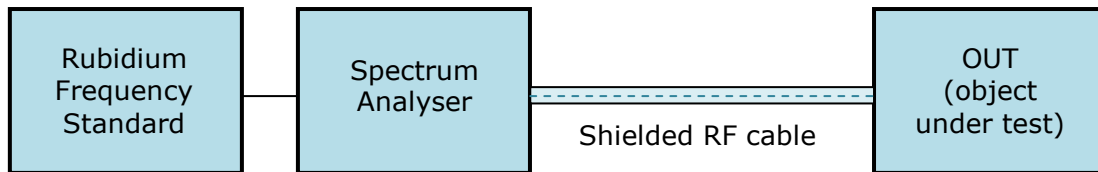
Single Device Name	Type	Serial Number	Manufacturer
Temperature Chamber Vötsch 05	VT 4002	58566080550010	Vötsch
	Customized calibration		2014/03/11 2016/03/10

## 6 Setup Drawings



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

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



**Drawing 2:** Setup for conducted radio tests.

## 7 Photo Report

Please refer to external report.