

# InterLab®

## FCC Measurement/Technical Report on

### Multi-spectral camera SEQUOIA

FCC ID 2AG6ISICILIA  
IC: 21053-SICILIA

**Test Report Reference:** MDE\_PARRO\_1522\_FCCa\_REV1

**Test Laboratory:**

7layers GmbH  
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.

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## 1. Applied Standards and Test Summary

### 1. Applied Standards

#### Type of Authorization

Certification for an Intentional Radiator.

#### Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15 (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

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

#### Note:

The tests were selected and performed with reference to the FCC Public Notice "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, 558074 D01 DTS Meas Guidance v03r04, 2016-01-07". ANSI C63.10-2013 is applied.

#### Summary Test Results:

**The EUT complied with all performed tests as listed in chapter 1.3 Measurement Summary / Signatures.**

## 2. FCC-IC Correlation Table

### **Correlation of measurement requirements for DTS (e.g. WLAN 2.4 GHz) equipment from FCC and IC**

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Occupied bandwidth	§ 15.247 (a) (2)	RSS-247 Issue 1: 5.2 (1)
Peak conducted output power	§ 15.247 (b) (3), (4)	RSS-247 Issue 1: 5.4 (4)
Transmitter spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-247 Issue 1: 5.5
Transmitter spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-247 Issue 1: 5.5
Band edge compliance	§ 15.247 (d)	RSS-247 Issue 1: 5.5
Power density	§ 15.247 (e)	RSS-247 Issue 1: 5.2 (2)
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	-	-

### 3. Measurement Summary / Signatures

#### 47 CFR CHAPTER I FCC PART 15 Subpart C

#### § 15.207

##### **§15.247**

Conducted Emissions at AC Mains

The measurement was performed according to ANSI C63.10

**Final Result**

##### **OP-Mode**

Operating mode

worst case (WLAN b, channel 6; GPS active)

**Setup**

**FCC**

**IC**

A03

Passed

Passed

#### 47 CFR CHAPTER I FCC PART 15 Subpart C

#### § 15.247 (a) (2)

##### **§15.247**

Occupied Bandwidth (6 dB)

The measurement was performed according to ANSI C63.10

**Final Result**

##### **OP-Mode**

Operating Frequency, Radio Technology

mid, WLAN g

**Setup**

**FCC**

**IC**

A02

Passed

Passed

mid, WLAN b

A02

Passed

Passed

high, WLAN b

A02

Passed

Passed

high, WLAN g

A02

Passed

Passed

mid, WLAN n 20 MHz

A02

Passed

Passed

low, WLAN b

A02

Passed

Passed

low, WLAN n 20 MHz

A02

Passed

Passed

low, WLAN g

A02

Passed

Passed

high, WLAN n 20 MHz

A02

Passed

Passed

-  
Occupied Bandwidth (99%)

The measurement was performed according to ANSI C63.10

**Final Result**

##### **OP-Mode**

Operating Frequency, Radio Technology

low, WLAN n 20 MHz

**Setup**

**FCC**

**IC**

A02

N/A

-

mid, WLAN b

A02

N/A

-

mid, WLAN g

A02

N/A

-

low, WLAN b

A02

N/A

-

high, WLAN n 20 MHz

A02

N/A

-

<b>OP-Mode</b>		<b>Setup</b>	<b>FCC</b>	<b>IC</b>
Operating Frequency, Radio Technology				
high, WLAN g	A02	N/A	-	
low, WLAN g	A02	N/A	-	
high, WLAN b	A02	N/A	-	
mid, WLAN n 20 MHz	A02	N/A	-	

**47 CFR CHAPTER I FCC PART 15 Subpart C**  
**§15.247**

**§ 15.247 (b) (3)**

Peak Power Output

The measurement was performed according to ANSI C63.10

**Final Result**

<b>OP-Mode</b>		<b>Setup</b>	<b>FCC</b>	<b>IC</b>
Measurement method, Operating Frequency, Radio Technology				
conducted, mid, WLAN g	A02	Passed	Passed	
conducted, mid, WLAN b	A02	Passed	Passed	
conducted, low, WLAN b	A02	Passed	Passed	
conducted, mid, WLAN n 20 MHz	A02	Passed	Passed	
conducted, high, WLAN g	A02	Passed	Passed	
conducted, low, WLAN n 20 MHz	A02	Passed	Passed	
conducted, high, WLAN b	A02	Passed	Passed	
conducted, high, WLAN n 20 MHz	A02	Passed	Passed	
conducted, low, WLAN g	A02	Passed	Passed	

**47 CFR CHAPTER I FCC PART 15 Subpart C**  
**§15.247**

**§ 15.247 (d)**

Spurious RF Conducted Emissions

The measurement was performed according to ANSI C63.10

**Final Result**

<b>OP-Mode</b>		<b>Setup</b>	<b>FCC</b>	<b>IC</b>
Operating Frequency, Radio Technology				
mid, WLAN n 20 MHz	A02	Passed	Passed	
low, WLAN n 20 MHz	A02	Passed	Passed	
mid, WLAN b	A02	Passed	Passed	
low, WLAN g	A02	Passed	Passed	
mid, WLAN g	A02	Passed	Passed	
high, WLAN n 20 MHz	A02	Passed	Passed	
high, WLAN g	A02	Passed	Passed	

<b>OP-Mode</b>		<b>Setup</b>	<b>FCC</b>	<b>IC</b>
Operating Frequency, Radio Technology				
low, WLAN b	A02	Passed	Passed	
high, WLAN b	A02	Passed	Passed	

**47 CFR CHAPTER I FCC PART 15 Subpart C**  
**§15.247**

**§ 15.247 (d)**

Transmitter Spurious Radiated Emissions

The measurement was performed according to ANSI C63.10

**Final Result**

<b>OP-Mode</b>		<b>Setup</b>	<b>FCC</b>	<b>IC</b>
Measurement range, Operating Frequency, Radio Technology				
30 MHz - 1 GHz, high, WLAN b	A03	Passed	Passed	
30 MHz - 1 GHz, mid, WLAN b	A03	Passed	Passed	
1 GHz - 26 GHz, low, WLAN b	A03	Passed	Passed	
9 kHz - 30 MHz, mid, WLAN b	A03	Passed	Passed	
1 GHz - 26 GHz, low, WLAN g (measurement performed up to 8 GHz)	A01	Passed	Passed	
1 GHz - 26 GHz, low, WLAN n 20 MHz (measurement performed up to 8 GHz)	A01	Passed	Passed	
30 MHz - 1 GHz, low, WLAN b	A01	Passed	Passed	
1 GHz - 26 GHz, mid, WLAN g (measurement performed up to 8 GHz)	A01	Passed	Passed	
1 GHz - 26 GHz, high, WLAN b	A03	Passed	Passed	
1 GHz - 26 GHz, high, WLAN g (measurement performed up to 8 GHz)	A01	Passed	Passed	
1 GHz - 26 GHz, mid, WLAN b	A01	Passed	Passed	
1 GHz - 26 GHz, high, WLAN n 20 MHz (measurement performed up to 8 GHz)	A01	Passed	Passed	
1 GHz - 26 GHz, mid, WLAN n 20 MHz (measurement performed up to 8 GHz)	A01	Passed	Passed	

**47 CFR CHAPTER I FCC PART 15 Subpart C**  
**§15.247**
**§ 15.247 (d)**

Band Edge Compliance Conducted

The measurement was performed according to ANSI C63.10

**Final Result**

<b>OP-Mode</b>	<b>Setup</b>	<b>FCC</b>	<b>IC</b>
<u>Band Edge, Operating Frequency, Radio Technology</u>			
high, high, WLAN g	A02	Passed	Passed
high, high, WLAN b	A02	Passed	Passed
high, high, WLAN n 20 MHz	A02	Passed	Passed
low, low, WLAN n 20 MHz	A02	Passed	Passed
low, low, WLAN b	A02	Passed	Passed
low, low, WLAN g	A02	Passed	Passed

**47 CFR CHAPTER I FCC PART 15 Subpart C**  
**§15.247**
**§ 15.247 (d)**

Band Edge Compliance Radiated

The measurement was performed according to ANSI C63.10

**Final Result**

<b>OP-Mode</b>	<b>Setup</b>	<b>FCC</b>	<b>IC</b>
<u>Band Edge, Operating Frequency, Radio Technology</u>			
high, high, WLAN g	A01	Passed	Passed
high, high, WLAN n 20 MHz	A01	Passed	Passed
high, high, WLAN b	A01	Passed	Passed

**47 CFR CHAPTER I FCC PART 15 Subpart C**  
**§15.247**
**§ 15.247 (e)**
**Power Density**

The measurement was performed according to ANSI C63.10

**Final Result**

<b>OP-Mode</b> Operating Frequency, Radio Technology	<b>Setup</b>	<b>FCC</b>	<b>IC</b>
low, WLAN n 20 MHz	A02	Passed	Passed
low, WLAN g	A02	Passed	Passed
mid, WLAN b	A02	Passed	Passed
mid, WLAN n 20 MHz	A02	Passed	Passed
low, WLAN b	A02	Passed	Passed
high, WLAN g	A02	Passed	Passed
mid, WLAN g	A02	Passed	Passed
high, WLAN b	A02	Passed	Passed
high, WLAN n 20 MHz	A02	Passed	Passed

N/A Not applicable

N/P Not performed

**Revision History**

<b>Report version control</b>			
<b>Version</b>	<b>Release date</b>	<b>Change Description</b>	<b>Version validity</b>
initial	2014-02-03	--	invalid
REV1	2016-02-15	Revision number of FCC KDB 558074 updated from v03r03 to v03r04 (2016-01-07) Clarification of measurement description for radiated measurements	valid

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 (responsible for accreditation scope)  
 Dipl.-Ing. Marco Kullik

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 (responsible for testing and report)  
 Dipl.-Ing. Daniel Gall

## 2. Administrative Data

### 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. Marco Kullik

Report Template Version: 2015-11-30

### 2. Project Data

Responsible for testing and report: Dipl.-Ing. Daniel Gall

Employees who performed the tests: documented internally at 7Layers

Date of Report: 2016-02-15

Testing Period: 2015-11-29 to 2015-12-21

### 3. Applicant Data

Company Name: PARROT DRONE SAS

Address: 174 Quai de Jemmapes  
75010 Paris  
France

Contact Person: Mr. Pierre Alain Marchand

### 4. Manufacturer Data

Company Name: Please see at applicant data

Address:

Contact Person:

### 3. Test object Data

#### 1. General EUT Description

Kind of Device product description	Multi-spectral Camera with integrated WLAN & GPS Receiver
Product name	Multi-spectral camera
Type	SEQUOIA
<b>Declared EUT data by the supplier</b>	
Voltage Type	DC
Voltage Level	5.0 V
Tested Modulation Type	DBPSK; OFDM:BPSK; OFDM:64-QAM
General product description	Sequoia is a multi-spectral sensor with integrated GPS/GNSS and WLAN, specifically for farming. The Sequoia sensor is designed to be suitable for all types of drones. It can be used to get images of agricultural fields in several spectral bands which measure the state of the vegetation: Green (550nm wavelength, 40nm bandwidth), Red (660nm wavelength, 40nm bandwidth), Red Edge (735nm wavelength, 10nm bandwidth) and Near Infrared (790nm wavelength, 40nm bandwidth).
Specific product description for the EUT	<p>The EUT is a single band WLAN (802.11 2.4 GHz b/g/n device with one antenna connector for WLAN. In IEEE 802.11n mode it supports 20 MHz bandwidth channels (up to MCS7), providing max. 72.2 Mbit/s transfer data rate.</p> <p>The object of this test report is the WLAN transceiver, consequently switched on the IEEE 802.11 b/g/n modes, working in the 2.4 GHz band. In IEEE 802.11n mode, it was tested with 20 MHz channel bandwidth (only SISO).</p>
The EUT provides the following ports:	<ul style="list-style-type: none"> <li>- Enclosure</li> <li>- Micro-B USB port (power supply &amp; data transfer)</li> <li>- Micro-A USB port (connection to the Irradiance module)</li> </ul>

**The main components of the EUT are listed and described in chapter 3.2 EUT Main components.**

## 2. EUT Main components

<b>Sample Name</b>	<b>Sample Code</b>	<b>Description</b>
Irradiance Module	DE1018016ba01	GPS Receiver, SD Card slot
<b>Sample Parameter</b>	<b>Value</b>	
Serial No.	PI040379D159000001	
HW Version	DV	
SW Version	0.4.1	
Comment		

<b>Sample Name</b>	<b>Sample Code</b>	<b>Description</b>
WLAN Camera	DE1018016aa01	Radiated Sample
<b>Sample Parameter</b>	<b>Value</b>	
Serial No.	PI040378D159000006	
HW Version	DV	
SW Version	0.4.1	
Comment		

<b>Sample Name</b>	<b>Sample Code</b>	<b>Description</b>
WLAN Camera	DE1018016ab01	Conducted Sample
<b>Sample Parameter</b>	<b>Value</b>	
Serial No.	PI040378D159000012	
HW Version	DV	
SW Version	0.4.1	
Comment		

<b>Sample Name</b>	<b>Sample Code</b>	<b>Description</b>
WLAN Camera	DE1018016ac01	Radiated Sample
<b>Sample Parameter</b>	<b>Value</b>	
Serial No.	PI040378D159000011	
HW Version	DV	
SW Version	0.4.1	
Comment		

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

## 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.

<b>Device</b>	<b>Details (Manufacturer, Type Model, OUT Code)</b>	<b>Reason for using</b>
-	-	-

#### 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.

Device	Details (Manufacturer, HW, SW, S/N)	Reason for using
Power Bank (DE1018016AKKU1)	Qualcomm, -, -, -	Power supply during conducted tests
Power Bank (DE1018016AKKU2)	Qualcomm, -, -, -	Power supply during conducted tests
TC E250 (AC adapter)	HTC, -, -, 2RSA119F022294	Power supply during radiated tests

#### 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
A01	WLAN Camera [aa01], Irradiance module [ba01], AC Charger [TC E250]	Setup for Radiated Measurements
A02	WLAN Camera [ab01], Power Bank,	Setup for Conducted Measurements
A03	WLAN Camera [ac01], Irradiance module [ba01], AC Charger [TC E250]	Setup for Radiated Measurements

## 6. Operating Modes

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

### 1. Test Channels

	Band:					
	900 MHz			2.4 GHz ISM		
	902 - 928 MHz			2400 - 2483.5 MHz		
<b>20 MHz Test Channels:</b>	low	mid	high	low	mid	high
<b>Channel:</b>	-	-	-	1	6	11
<b>Frequency [MHz]</b>	-	-	-	2412	2437	2462
<b>40 MHz Test Channels:</b>	low	mid	high	low	mid	high
<b>Channel:</b>	-	-	-	-	-	-
<b>Frequency [MHz]</b>	-	-	-	-	-	-

### 2. Test Data Rates

#### SISO:

WLAN b-Mode; 20 MHz; 1 Mbit/s
WLAN g-Mode; 20 MHz; 6 Mbit/s
WLAN n-Mode; 20 MHz; 7.2 Mbit/s

These data rates are the worst case data rates for each WLAN mode.

## 7. Product labelling

### 1. FCC ID label

Please refer to the documentation of the applicant.

### 2. Location of the label on the EUT

Please refer to the documentation of the applicant.

## 4. Test Results

### 1. Conducted Emissions at AC Mains

Standard      **47 CFR CHAPTER I FCC PART 15 Subpart C §15.247**

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

#### 1. Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.10. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 $\mu$ H || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.

The measurement procedure consists of two steps. It is implemented into the EMI test software EMC-32 from R&S.

##### **Step 1: Preliminary scan**

Intention of this step is, to determine the conducted EMI-profile of the EUT.

EMI receiver settings:

- Detector: Peak – Maxhold & Average
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)
- Measurement on phase + neutral lines of the power cords

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

##### **Step 2: Final measurement**

Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.

EMI receiver settings:

- Detector: Quasi-Peak
- IF Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:

- 1) Neutral lead - reference ground (PE grounded)
- 2) Phase lead - reference ground (PE grounded)
- 3) Neutral lead - reference ground (PE floating)
- 4) Phase lead - reference ground (PE floating)

The highest value is reported.

## 2. Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

Frequency Range (MHz)	QP Limit (dB $\mu$ V)	AV Limit (dB $\mu$ V)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

Used conversion factor: Limit (dB $\mu$ V) = 20 log (Limit ( $\mu$ V)/1 $\mu$ V).

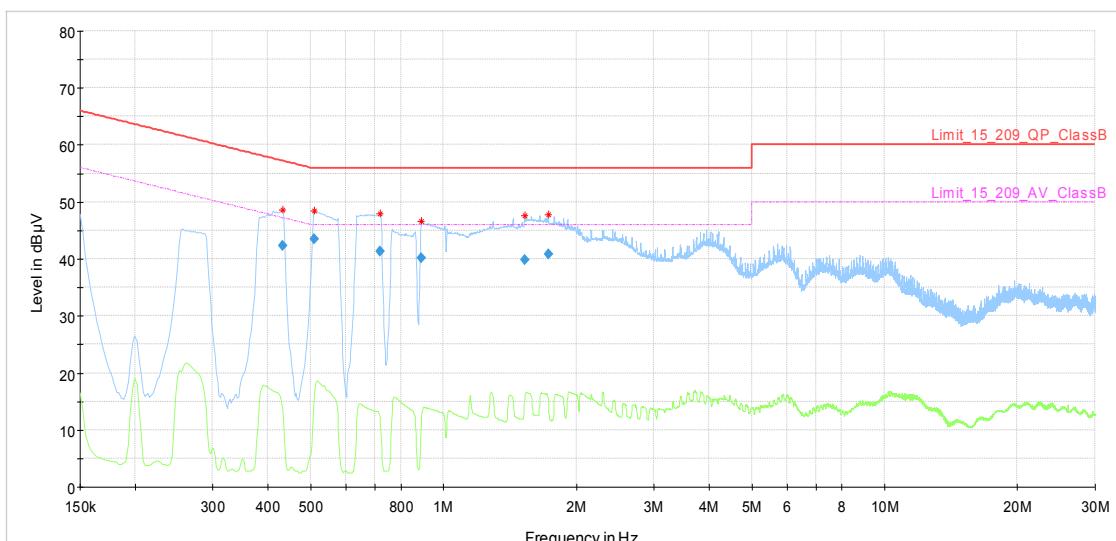
## 3. Test Protocol

**Temperature:** 23 °C  
**Air Pressure:** 1018 hPa  
**Humidity:** 43 %

Power line	Frequency [MHz]	Measured value QP [dB $\mu$ V]	Measured value AV [dB $\mu$ V]	QP Limit [dB $\mu$ V]	AV Limit [dB $\mu$ V]	Margin QP [dB]	Margin AV [dB]
N	0.5	43.5	--	56.0	46.0	12.5	--
N	0.7	41.3	--	56.0	46.0	14.7	--
N	0.9	40.2	--	56.0	46.0	15.8	--
L	0.4	42.6	--	57.2	47.2	14.9	--
L	1.5	39.8	--	56.0	46.0	16.2	--
L	1.7	40.9	--	56.0	46.0	15.1	--

Remark: Please see next sub-clause for the measurement plot.

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



## 5. Test Equipment used

Conducted Emissions

## 2. Occupied Bandwidth (6 dB)

Standard     **47 CFR CHAPTER I FCC PART 15 Subpart C §15.247**

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

### 1. Test Description

The Equipment Under Test (EUT) was set up 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 EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Span: 30 / 50 MHz (for 20 / 40 MHz nominal bandwidth)
- Detector: Peak

### 2. Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (a) (2)

Systems using digital modulation techniques may operate in the 902-928 MHz and 2400-2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 3. Test Protocol

**Ambient temperature:** 23 °C

**Air Pressure:** 1008 hPa

**Humidity:** 36 %

#### WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	1	2412.0	10.1	0.5	9.6
	6	2437.0	10.1	0.5	9.6
	11	2462.0	10.1	0.5	9.6

#### WLAN g-Mode; 20 MHz; 6 Mbit/s

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	1	2412.0	15.5	0.5	15.0
	6	2437.0	15.2	0.5	14.7
	11	2462.0	15.5	0.5	15.0

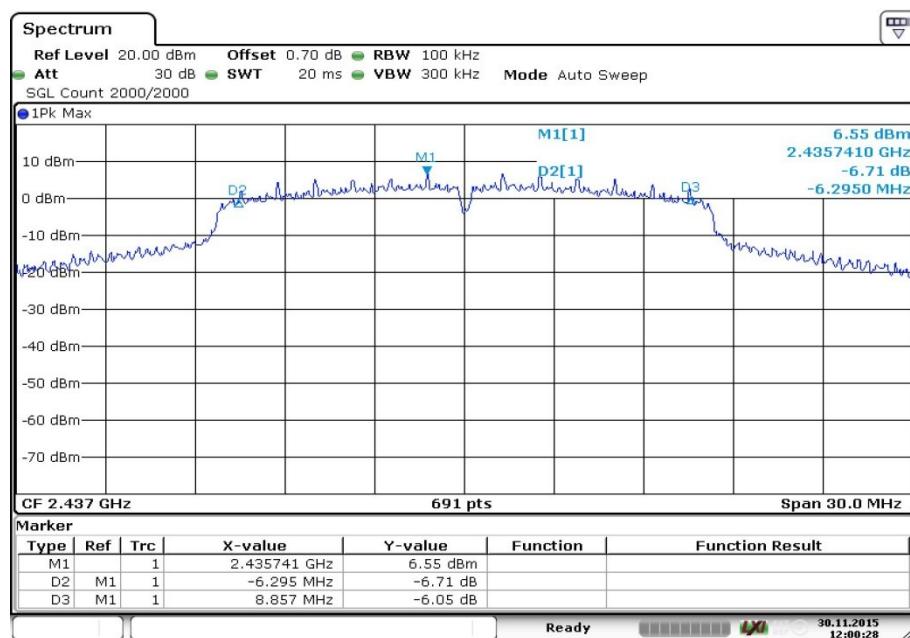
**WLAN n-Mode; 20 MHz; 7.2 Mbit/s**

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	1	2412.0	15.2	0.5	14.7
	6	2437.0	15.3	0.5	14.8
	11	2462.0	15.2	0.5	14.7

Remark: Please see next sub-clause for the measurement plot.

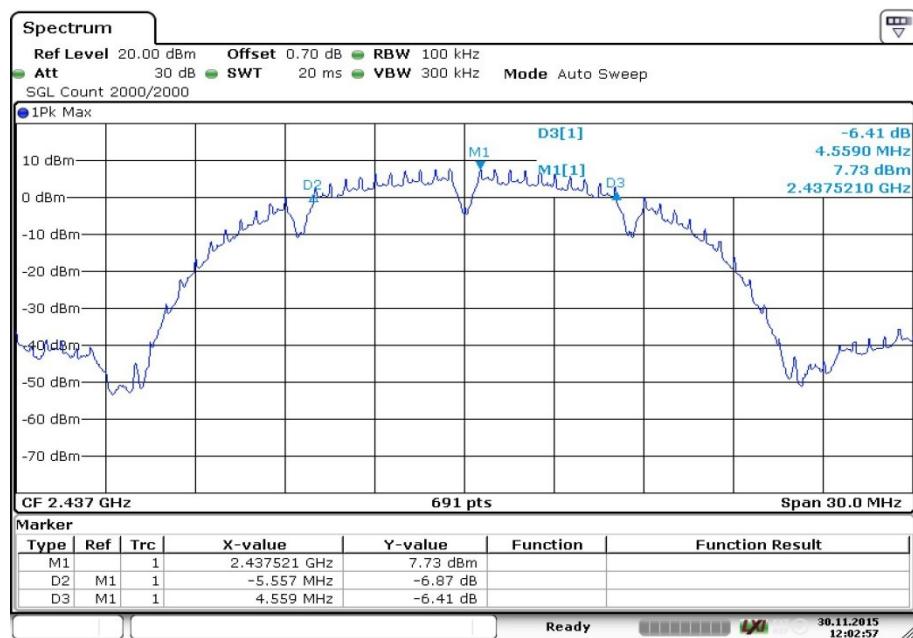
**4. Measurement Plots (showing the lowest value, "worst case")**

g-mode, channel 6



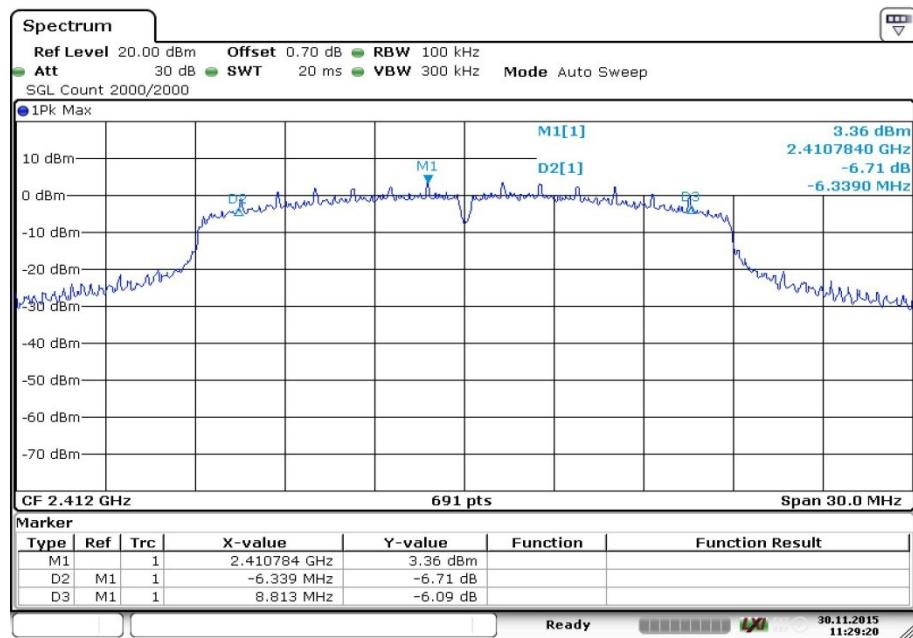
Date: 30.NOV.2015 12:00:28

### b-mode, channel 6



Date: 30 NOV 2015 12:02:57

### n-mode, channel 1



Date: 30.NOV.2015 11:29:20

## 5. Test Equipment used

Radio Laboratory

### 3. Occupied Bandwidth (99%)

Standard -

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

#### 1. Test Description

The Equipment Under Test (EUT) was set up 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 EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Resolution Bandwidth (RBW): 500 kHz
- Video Bandwidth (VBW): 2000 kHz
- Span: 30 / 50 MHz (for 20 / 40 MHz nominal bandwidth)
- Detector: Sample
- Trace: Maxhold

The 99% OBW function of the analyser is used.

#### 2. Test Requirements / Limits

No applicable limit:

#### 3. Test Protocol

**Ambient temperature:** 23 °C

**Air Pressure:** 1008 hPa

**Humidity:** 36 %

#### WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412.0	14.5
	6	2437.0	14.8
	11	2462.0	14.8

#### WLAN g-Mode; 20 MHz; 6 Mbit/s

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412.0	16.9
	6	2437.0	21.6
	11	2462.0	17.0

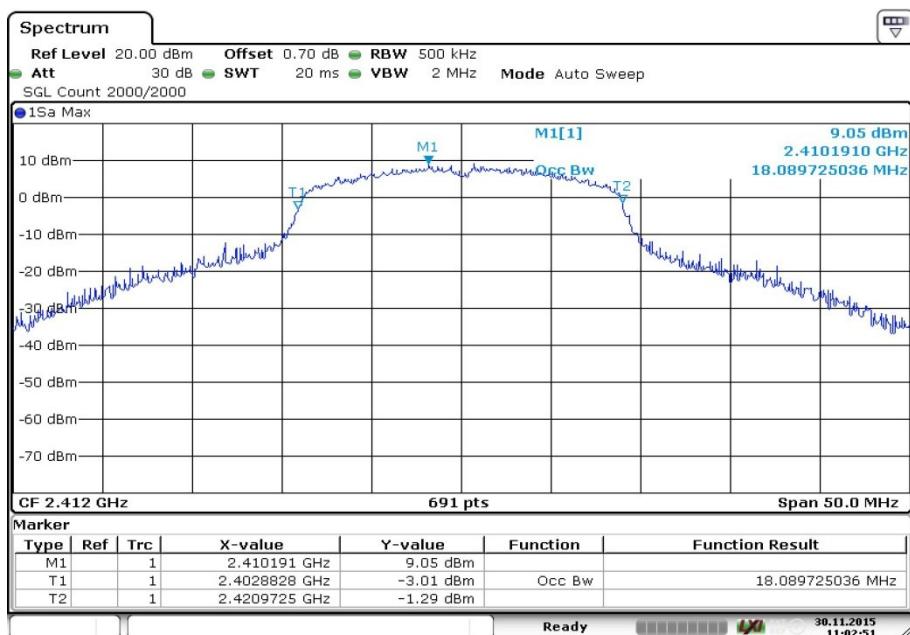
#### WLAN n-Mode; 20 MHz; 7.2 Mbit/s

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412.0	18.1
	6	2437.0	20.8
	11	2462.0	18.1

Remark: Please see next sub-clause for the measurement plot.

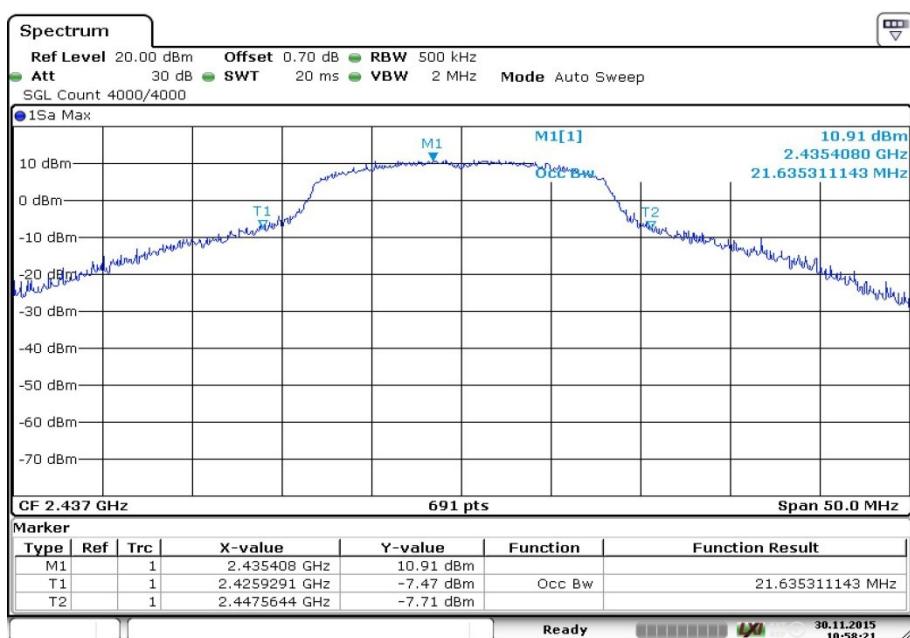
## 4. Measurement Plots (showing the lowest value, "worst case")

n-mode, channel 1



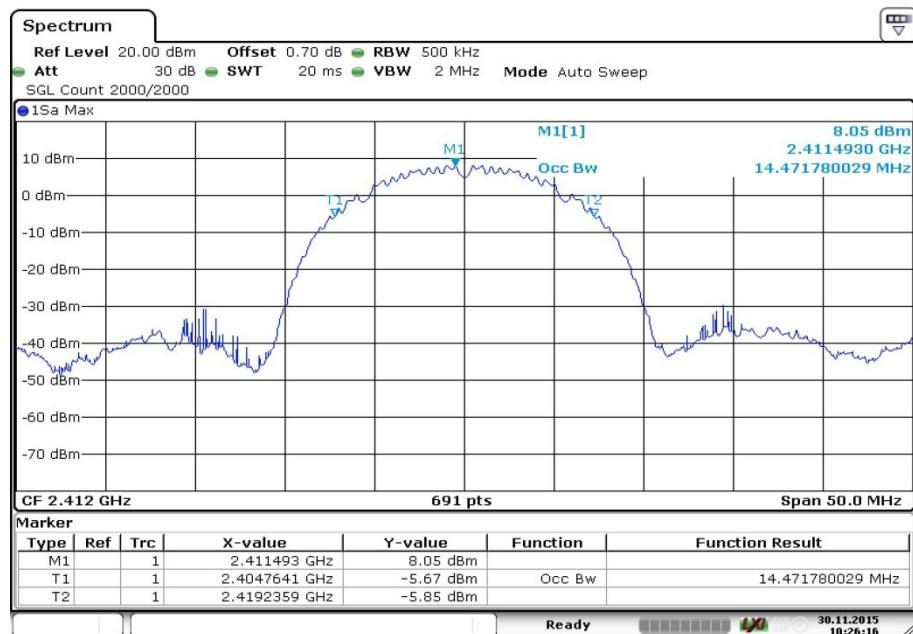
Date: 30.NOV.2015 11:02:52

g-mode, channel 6



Date: 30.NOV.2015 10:58:21

### b-mode, channel 1



Date: 30 NOV 2015 10:26:16

## 5. Test Equipment used

Radio Laboratory

#### **4. Peak Power Output**

Standard     **47 CFR CHAPTER I FCC PART 15 Subpart C §15.247**

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

##### **1. Test Description**

The Equipment Under Test (EUT) was set up to perform the output power measurements. The results recorded were measured with the modulation which produces the worst-case (highest) output power. The reference level of the spectrum analyzer was set higher than the output power of the EUT. The EUT was connected to the spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Detector: Peak
- RBW: 1 MHz
- VBW: 3 MHz
- Trace: Maxhold

The channel power function of the spectrum analyser was used (Used channel bandwidth = DTS bandwidth)

##### **2. Test Requirements / Limits**

FCC Part 15, Subpart C, §15.247 (b) (3)

For systems using digital modulation techniques in the 902-928 MHz and 2400-2483.5 MHz bands: 1 watt.

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

Used conversion factor: Limit (dBm) =  $10 \log (\text{Limit (W)}/1\text{mW})$

### 3. Test Protocol

#### WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]
2.4 GHz ISM	1	2412.0	19.8	30.0	10.2
	6	2437.0	19.5	30.0	10.5
	11	2462.0	19.0	30.0	11.0

#### WLAN g-Mode; 20 MHz; 6 Mbit/s

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]
2.4 GHz ISM	1	2412.0	22.8	30.0	7.2
	6	2437.0	24.9	30.0	5.1
	11	2462.0	22.7	30.0	7.3

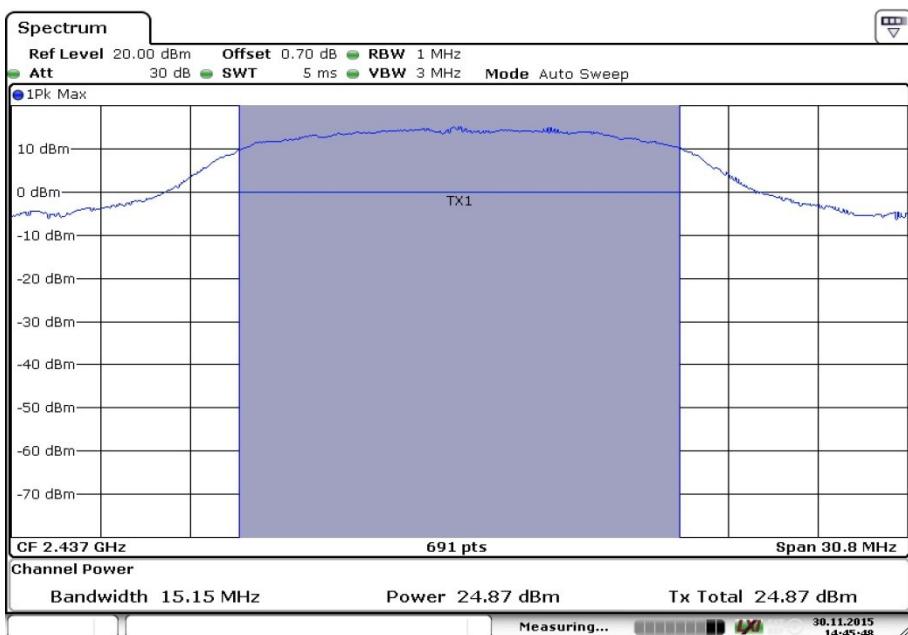
#### WLAN n-Mode; 20 MHz; 7.2 Mbit/s

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]
2.4 GHz ISM	1.0	2412.0	23.1	30.0	6.9
	6.0	2437.0	24.1	30.0	5.9
	11.0	2462.0	22.7	30.0	7.3

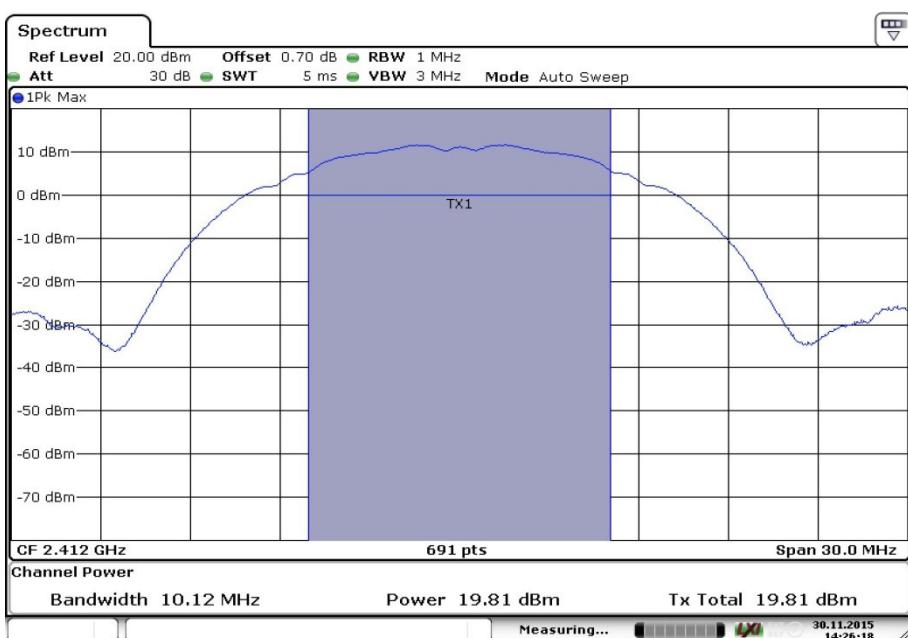
Remark: Please see next sub-clause for the measurement plot.

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

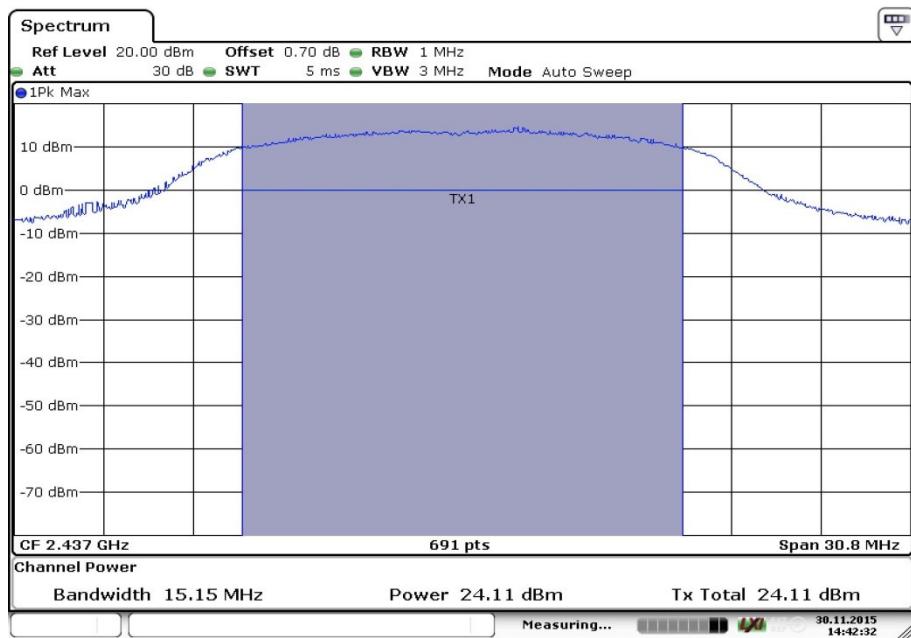
g-mode, channel 6



b-mode, channel 1



n-mode, channel 6



## 5. Test Equipment used

Radio Laboratory

## 5. Spurious RF Conducted Emissions

Standard      **47 CFR CHAPTER I FCC PART 15 Subpart C §15.247**

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

### 1. Test Description

The Equipment Under Test (EUT) was set up to perform the spurious emissions measurements.

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

Analyzer settings:

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

The reference value for the measurement of the spurious RF conducted emissions is determined during the test "band edge compliance conducted" (cf. chapter 7.3). This value is used to calculate the 20 dBc limit.

### 2. Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (c)

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

### 3. Test Protocol

**Ambient temperature:** 23 °C

**Air Pressure:** 1008 hPa

**Humidity:** 36%

#### WLAN b-Mode; 20 MHz; 1 Mbit/s

Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412.0	-	-	PEAK	100.0	7.9	-12.1	---
6	2437.0	-	-	PEAK	100.0	6.6	-13.4	---
11	2462.0	-	-	PEAK	100.0	7.9	-12.1	---

**WLAN g-Mode; 20 MHz; 6 Mbit/s**

Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412.0	-	-	PEAK	100.0	3.2	-16.8	---
6	2437.0	-	-	PEAK	100.0	5.9	-14.1	---
11	2462.0	-	-	PEAK	100.0	2.2	-17.8	---

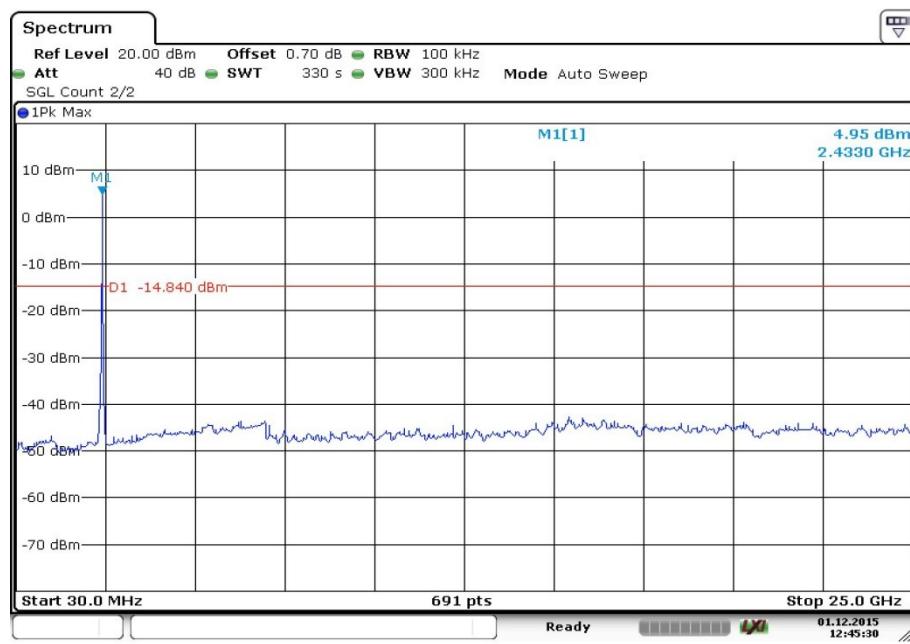
**WLAN n-Mode; 20 MHz; 7.2 Mbit/s**

Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412.0	-	-	PEAK	100.0	3.5	-16.5	---
6	2437.0	-	-	PEAK	100.0	5.2	-14.8	---
11	2462.0	-	-	PEAK	100.0	3.7	-16.3	---

Remark: Please see next sub-clause for the measurement plot.

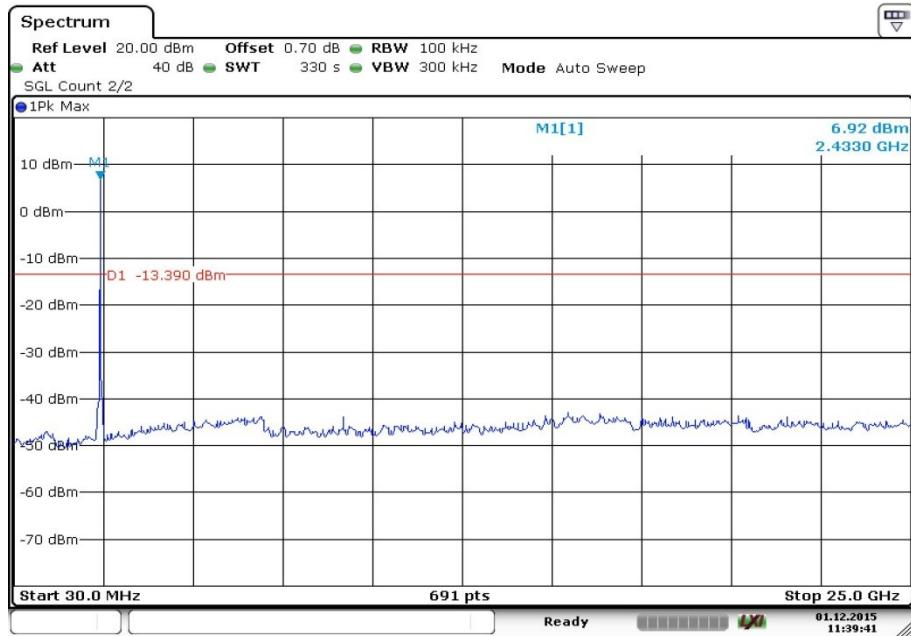
**4. Measurement Plot (showing the highest value, "worst case")**

n-mode, channel 6



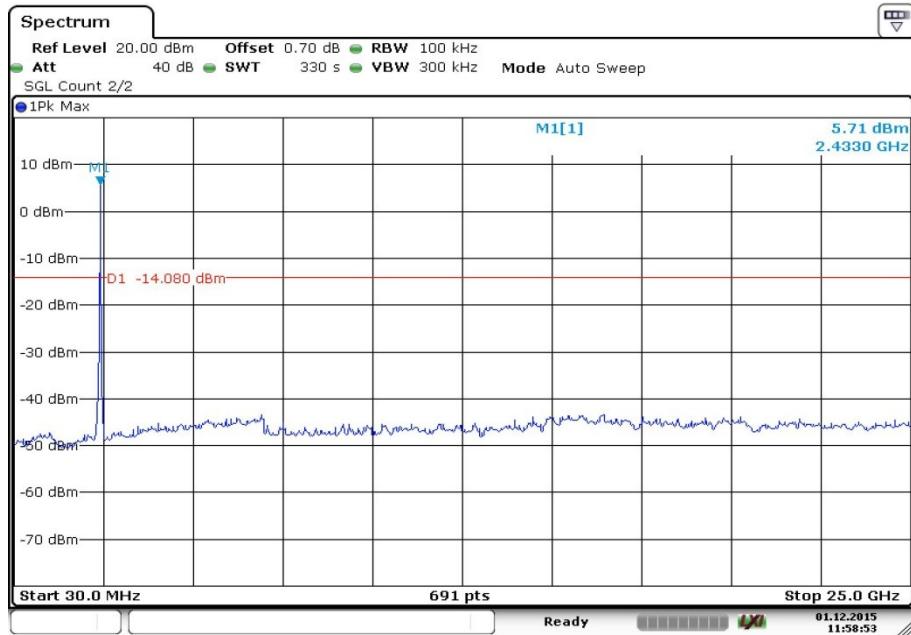
Date: 1.DEC.2015 12:45:30

### b-mode, channel 6



Date: 1.DEC.2015 11:39:42

### g-mode, channel 6



Date: 1.DEC.2015 11:58:53

## 5. Test Equipment used

Radio Laboratory

## 6. Spurious Radiated Emissions

Standard     **47 CFR CHAPTER I FCC PART 15 Subpart C §15.247**

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

### 1. Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m<sup>2</sup> in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is performed while the EUT is powered from a DC power source.

#### 1. Measurement up to 30 MHz

The Loop antenna HFH2-Z2 is used.

##### Step 1: pre measurement

- Anechoic chamber
- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 MHz and 0.15 – 30 MHz
- Frequency steps: 0.05 kHz and 2.25 kHz
- IF-Bandwidth: 0.2 kHz and 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)

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 site
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF-Bandwidth: 0.2 - 10 kHz
- Measuring time / Frequency step: 1 s

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

##### Step 1: Preliminary scan

This is a preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: -180° to 90°
- Turntable step size: 90°

- Height variation range: 1 – 3 m
- Height variation step size: 1.5 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:** Adjustment measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by  $\pm 45^\circ$  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 will also slowly vary by  $\pm 150$  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:  $\pm 45^\circ$  around the determined value
- Height variation range:  $\pm 150$  cm around the determined value

#### **Step 3:** Final measurement with QP detector

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

EMI receiver settings for step 4:

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

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

### **3. Measurement above 1 GHz**

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

- The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.
- Due to the fact, that in this frequency range the test is performed in a fully anechoic room, step 2 is omitted.
- All steps were performed with one height (1.5m) of the receiving antenna only.
- The EUT is turned during the preliminary measurement across the elevation axis, with a step size of  $90^\circ$ .
- The turn table step size (azimuth angle) for the preliminary measurement is  $45^\circ$ .
- The turn table azimuth will slowly vary by  $\pm 22.5^\circ$ .
- The elevation angle will slowly vary by  $\pm 45^\circ$

EMI receiver settings:

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

For the data rate in mode n the test is performed as worst-case-check in order to verify that emissions have a comparable level as found at modes b and g. Typically, the measurement is performed in the frequency range 1 to 8 GHz but it depends on the emissions found during the test for the modes b and g. Please refer to the measurement overview for the used frequency range.

## 2. Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)

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

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

Frequency in MHz	Limit ( $\mu\text{V}/\text{m}$ )	Measurement distance (m)	Limits ( $\text{dB}\mu\text{V}/\text{m}$ )
0.009 – 0.49	2400/F(kHz)	300@3	48.5 – 13.8
0.49 – 1.705	24000/F(kHz)	30@3	33.8 – 23.0
1.705 – 30	30	30@3	29.5

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

Frequency in MHz	Limit ( $\mu\text{V}/\text{m}$ )	Measurement distance (m)	Limit ( $\text{dB}\mu\text{V}/\text{m}$ )
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
above 960	500	3	54.0

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§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 ( $\text{dB}\mu\text{V}/\text{m}$ ) =  $20 \log (\text{Limit} (\mu\text{V}/\text{m})/1\mu\text{V}/\text{m})$

### 3. Test Protocol

Ambient temperature: 23-24 °C

Air Pressure: 1003-1013 hPa

Humidity: 34-35 %

WLAN b-Mode; 20 MHz; 1 Mbit/s				Applied duty cycle correction (AV) [dB]:					0.1
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dB $\mu$ V/m]	Detector	RBW [kHz]	Limit [dB $\mu$ V/m]	Margin to Limit [dB]	Limit Type	
1	2412	2361.4	61.0	PEAK	1000	74.0	13.0	RB	
1	2412	4824.4	57.0	PEAK	1000	74.0	16.3	RB	
1	2412	2361.1	52.7	AV	1000	54.0	1.3	RB	
1	2412	4824.0	53.9	AV	1000	54.0	0.1	RB	
6	2437	2386.4	60.3	PEAK	1000	74.0	13.7	RB	
6	2437	2500.0	58.1	PEAK	1000	74.0	16.3	RB	
6	2437	4874.1	55.5	PEAK	1000	74.0	16.3	RB	
6	2437	2385.8	49.0	AV	1000	54.0	5.0	RB	
6	2437	2500.0	46.1	AV	1000	54.0	7.9	RB	
6	2437	4874.1	52.8	AV	1000	54.0	1.2	RB	
11	2462	2389.4	59.0	PEAK	1000	74.0	15.0	RB	
11	2462	2488.0	59.7	PEAK	1000	74.0	14.3	RB	
11	2462	4924.1	57.0	PEAK	1000	74.0	17.0	RB	
11	2462	2389.9	48.1	AV	1000	54.0	5.9	RB	
11	2462	2487.6	50.2	AV	1000	54.0	3.8	RB	
11	2462	4924.1	53.9	AV	1000	54.0	0.1	RB	

WLAN g-Mode; 20 MHz; 6 Mbit/s				Applied duty cycle correction (AV) [dB]: 0.6				
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
1	2412	2388.6	67.9	PEAK	1000	74.0	6.1	RB
1	2412	2499.3	54.3	PEAK	1000	74.0	19.7	RB
1	2412	4822.6	55.9	PEAK	1000	74.0	18.1	RB
1	2412	2390.0	45.9	AV	1000	54.0	8.1	RB
1	2412	2499.3	39.0	AV	1000	54.0	15.0	RB
1	2412	4822.4	42.6	AV	1000	54.0	11.4	RB
6	2437	2387.6	64.6	PEAK	1000	74.0	9.4	RB
6	2437	2499.9	61.3	PEAK	1000	74.0	12.7	RB
6	2437	2386.9	50.4	AV	1000	54.0	3.6	RB
6	2437	2499.4	47.2	AV	1000	54.0	6.8	RB
11	2462	2389.5	60.1	PEAK	1000	74.0	13.9	RB
11	2462	2492.2	60.1	PEAK	1000	74.0	13.9	RB
11	2462	2389.4	43.6	AV	1000	54.0	10.4	RB
11	2462	2499.5	42.6	AV	1000	54.0	11.4	RB

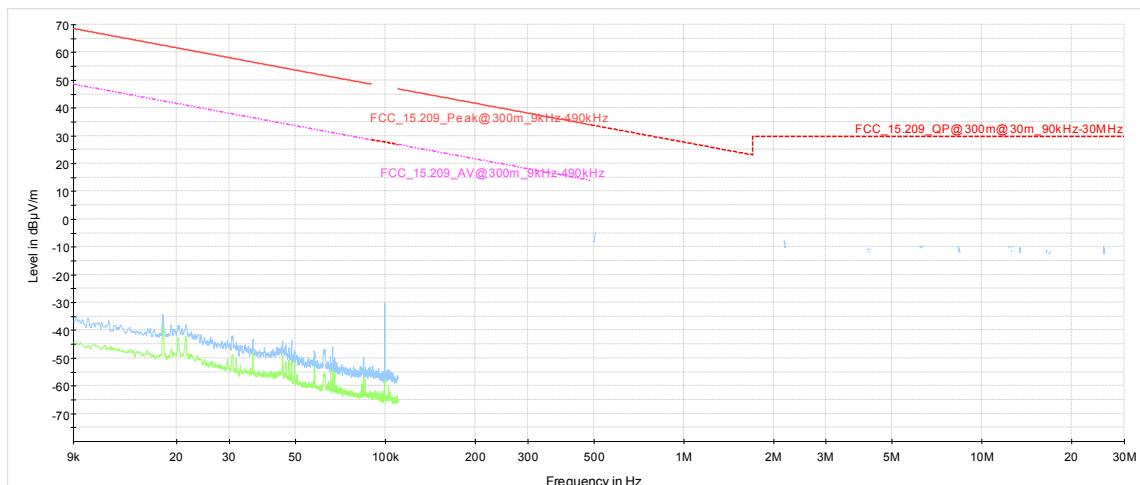
WLAN n-Mode; 20 MHz; 7.2 Mbit/s				Applied duty cycle correction (AV) [dB]: 0.7				
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
1	2412	2389.9	71.1	PEAK	1000	74.0	2.9	RB
1	2412	2497.8	57.6	PEAK	1000	74.0	16.4	RB
1	2412	4824.7	57.9	PEAK	1000	74.0	16.1	RB
1	2412	2389.9	51.3	AV	1000	54.0	2.7	RB
1	2412	2499.8	40.7	AV	1000	54.0	13.3	RB
1	2412	4822.2	44.4	AV	1000	54.0	9.6	RB
6	2437	2382.6	63.7	PEAK	1000	74.0	10.3	RB
6	2437	2487.9	64.2	PEAK	1000	74.0	9.8	RB
6	2437	2387.3	47.8	AV	1000	54.0	6.2	RB
6	2430	2491.9	47.9	AV	1000	54.0	6.1	RB
11	2462	2389.4	59.7	PEAK	1000	74.0	14.3	RB
11	2462	2499.7	62.1	PEAK	1000	74.0	11.9	RB
11	2462	2389.4	43.1	AV	1000	54.0	10.9	RB
11	2462	2499.6	42.4	AV	1000	54.0	11.6	RB

RB – Restricted Band

Remark: Please see next sub-clause for the measurement plot.

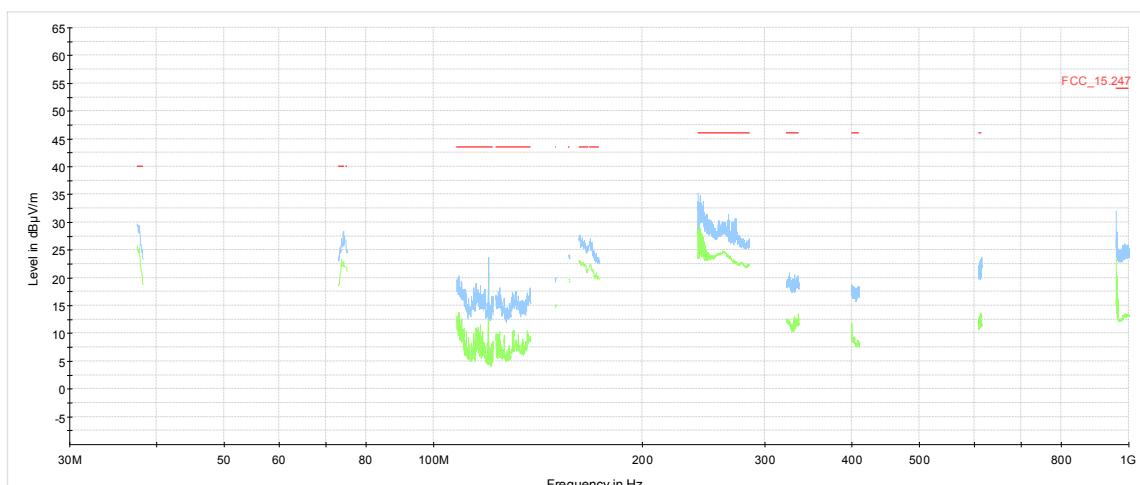
#### 4. Measurement Plot (showing the highest value, "worst case")

9 kHz – 30 MHz, b-mode, channel 6

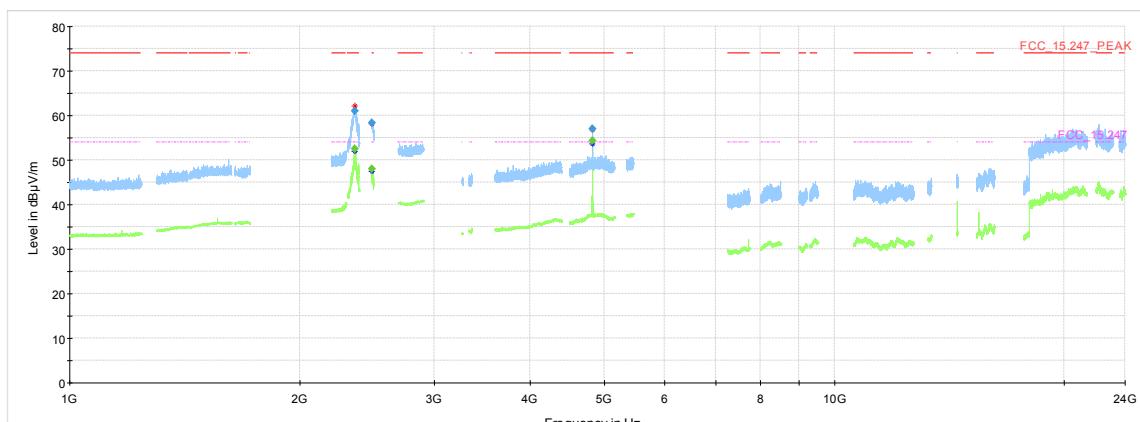


Peak at 98.8 kHz → Power supply of the loop antenna

30 MHz – 1 GHz, b-mode, channel 6



1 GHz – 26 GHz, b-mode, channel 1





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## **5. Test Equipment used**

Radiated Emissions

## 7. Band Edge Compliance Conducted

Standard     **47 CFR CHAPTER I FCC PART 15 Subpart C §15.247**

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

### 1. Test Description

The procedure to show compliance with the band edge requirement is divided into two measurements:

1. Show compliance of the lower and higher band edge by a conducted measurement.

For the conducted measurement, the Equipment Under Test (EUT) is placed in a shielded room.

For the lower band edge the EUT is set to transmit as follows:

For a WLAN transmitter working in the 2.4 GHz band on lowest channel:

CH1 = 2412 MHz / CH3 = 2422 MHz for a channel bandwidth of 20 / 40 MHz.

The lower band edge is 2400 MHz for 2.4 GHz band transmitter.

For the higher band edge the EUT is set to transmit as follows:

For a WLAN transmitter working in the 2.4 GHz band on highest channel:

CH11 = 2462 MHz or CH13 = 2472 MHz / CH11= 2462 MHz for a channel bandwidth of 20 / 40 MHz.

The higher band edge is 2483.5 MHz for a 2.4 GHz band transmitter.

Analyzer settings for conducted measurement:

- Detector: Peak

- RBW / VBW = 100 / 300 kHz

### 2. Test Requirements / Limits

FCC Part 15.247 (d)

"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. ..."

If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c))."

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

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

### 3. Test Protocol

**Ambient temperature:** 23 °C

**Air Pressure:** 1008 hPa

**Humidity:** 36%

WLAN b-Mode; 20 MHz; 1 Mbit/s				Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]					
1	2412	2400.0	-45.6	PEAK	100	7.9	-12.1	33.5
11	2462	2483.5	-45.3	PEAK	100	8.0	-12.0	33.3

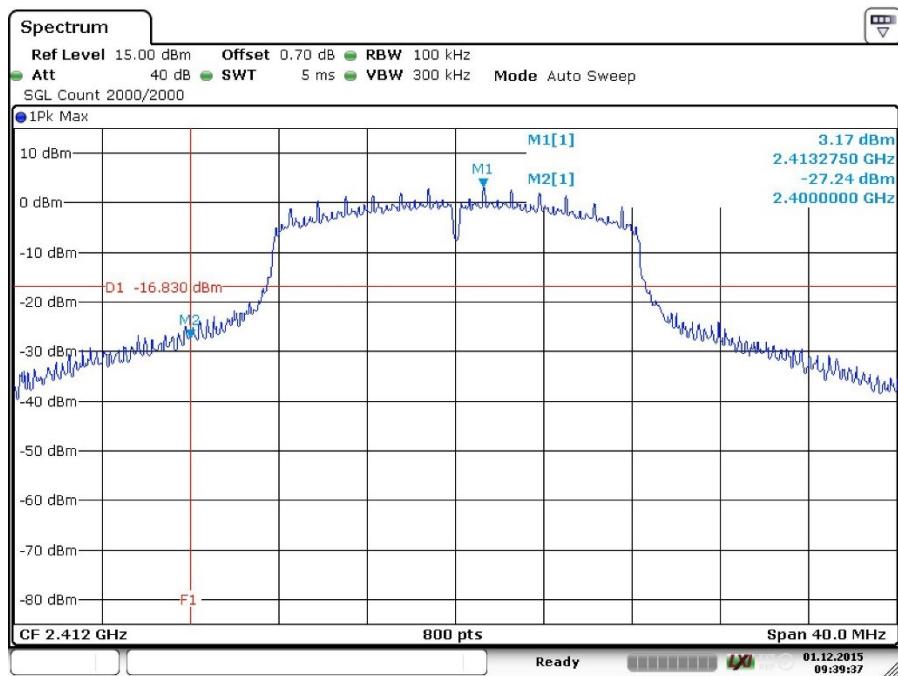
WLAN g-Mode; 20 MHz; 6 Mbit/s				Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]					
1	2412	2400.0	-27.2	PEAK	100	3.2	-16.8	10.4
11	2462	2483.5	-39.8	PEAK	100	2.2	-17.8	22.1

WLAN n-Mode; 20 MHz; 7.2 Mbit/s				Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]					
1	2412	2400.0	-27.9	PEAK	100	3.5	-16.5	11.3
11	2462	2483.5	-37.7	PEAK	100	3.7	-16.3	21.4

Remark: Please see next sub-clause for the measurement plot.

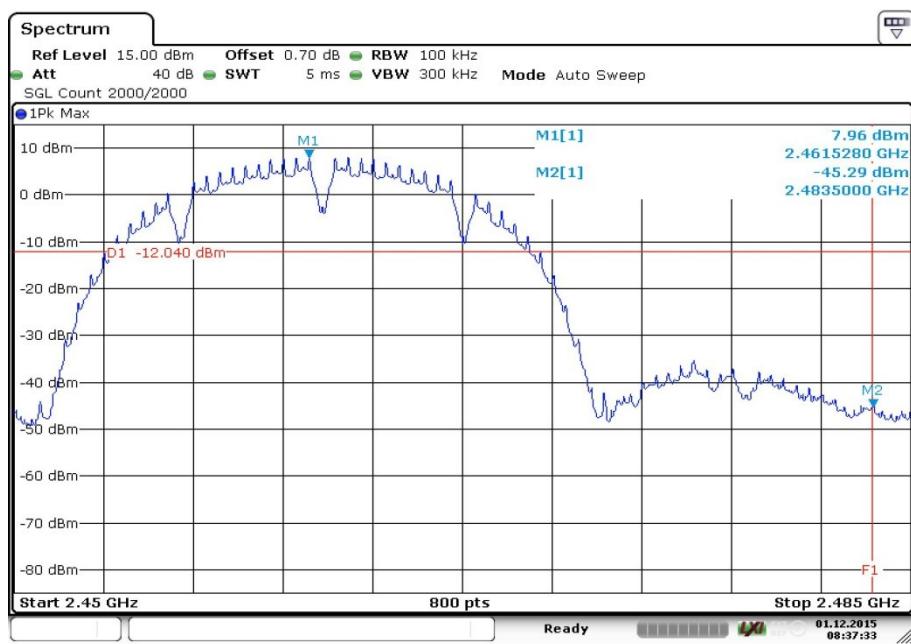
## 4. Measurement Plot (showing the highest value, "worst case")

g-mode, channel 1



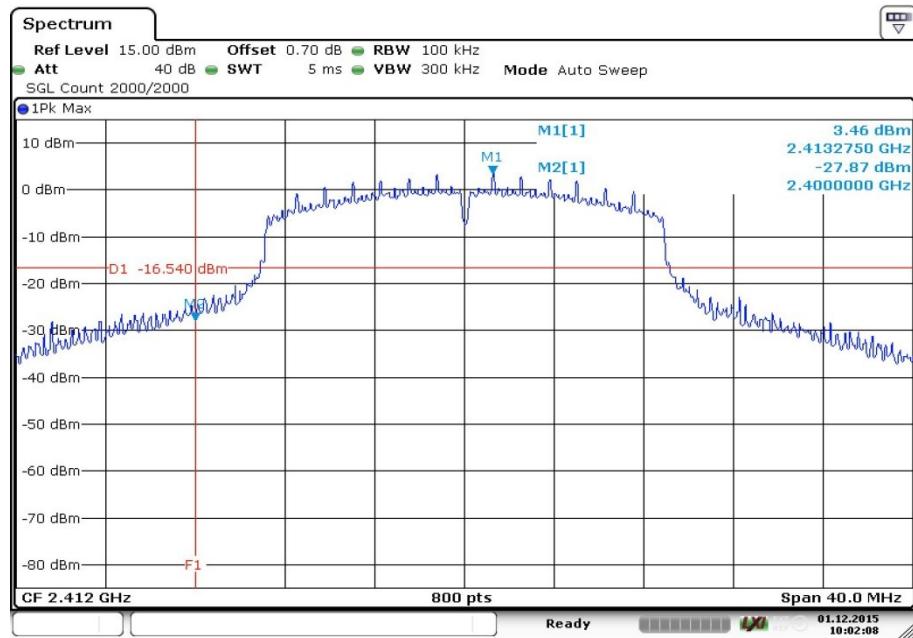
Date: 1.DEC.2015 09:39:36

b-mode, channel 11



Date: 1.DEC.2015 08:37:34

n-mode, channel 1



Date: 1.DEC.2015 10:02:08

## 5. Test Equipment used

Radio Laboratory

## 8. Band Edge Compliance Radiated

Standard **47 CFR CHAPTER I FCC PART 15 Subpart C §15.247**

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

### 1. Test Description

Please see chapter 6.1 (Radiated spurious Emissions)

Showing compliance of the higher band edge falls in to restricted bands by a radiated measurement.  
 The radiated emissions measurements are performed in a typical installation configuration inside the fully anechoic chamber using a horn antenna at 3 m distance.

EMI receiver settings for radiated measurement:

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

### 2. Test Requirements / Limits

Please see chapter 6.2 (Radiated spurious Emissions)

### 3. Test Protocol

Ambient temperature: 23 – 24 °C

Air Pressure: 1003 – 1 013 hPa

Humidity: 34 – 35 %

WLAN b-Mode; 20 MHz; 1 Mbit/s				Applied duty cycle correction (AV) [dB]: 0.1				
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dB $\mu$ V/m]	Detector	RBW [kHz]	Limit [dB $\mu$ V/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	52.6	PEAK	1000	74.0	21.4	BE
11	2462	2483.5	41.8	AV	1000	54.0	12.2	BE

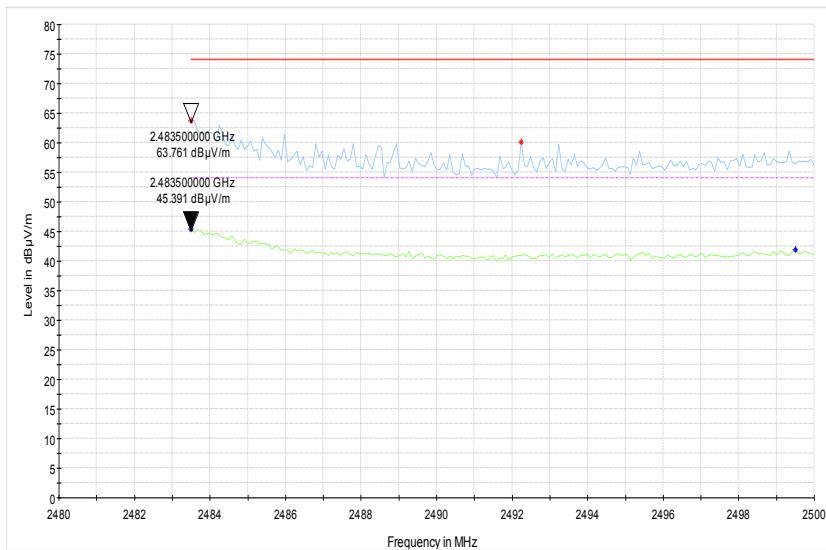
WLAN g-Mode; 20 MHz; 6 Mbit/s				Applied duty cycle correction (AV) [dB]: 0.6				
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dB $\mu$ V/m]	Detector	RBW [kHz]	Limit [dB $\mu$ V/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	63.8	PEAK	1000	74.0	10.2	BE
11	2462	2483.5	46.0	AV	1000	54.0	8.0	BE

WLAN n-Mode; 20 MHz; 7.2 Mbit/s				Applied duty cycle correction (AV) [dB]: 0.7				
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dB $\mu$ V/m]	Detector	RBW [kHz]	Limit [dB $\mu$ V/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	64.1	PEAK	1000	74.0	9.9	BE
11	2462	2483.5	47.6	AV	1000	54.0	6.4	BE

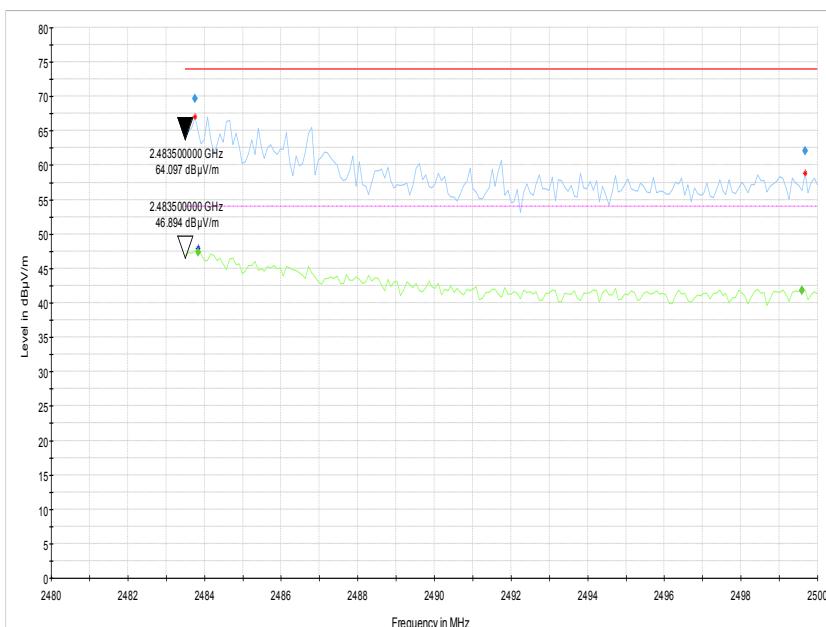
Remark: Please see next sub-clause for the measurement plot.

**4. Measurement Plot (showing the highest value, "worst case")**

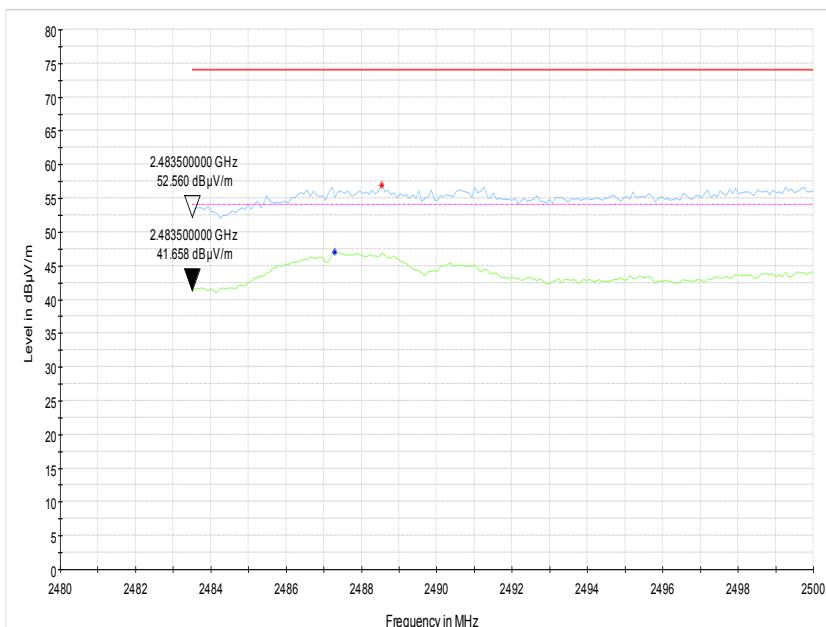
g-mode, channel 11



n-mode, channel 11



b-mode, channel 11



## 5. Test Equipment used

Radiated Emissions

## 9. Power Density

Standard **47 CFR CHAPTER I FCC PART 15 Subpart C §15.247**

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

### 1. Test Description

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

Analyzer settings:

- Detector: Peak-Maxhold
- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 10 kHz
- Sweep Time: Coupled

### 2. Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (e)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The same method of determining the conducted output power shall be used to determine the power spectral density.

### 3. Test Protocol

**Ambient temperature:** 23 °C

**Air Pressure:** 1008 hPa

**Humidity:** 36%

#### WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	Power Density [dBm/3kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	1	2412.0	-4.8	8.0	12.8
	6	2437.0	-5.8	8.0	13.8
	11.0	2462.0	-5.7	8.0	13.7

#### WLAN g-Mode; 20 MHz; 6 Mbit/s

Band	Channel No.	Frequency [MHz]	Power Density [dBm/3kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	1	2412.0	-9.7	8.0	17.7
	6	2437.0	-7.2	8.0	15.2
	11	2462.0	-10.0	8.0	18.0

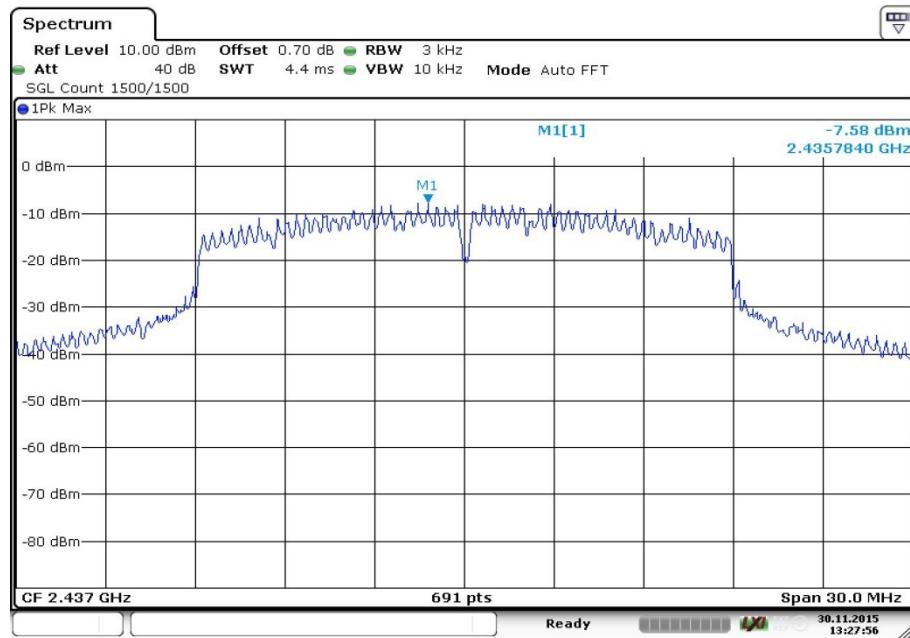
**WLAN n-Mode; 20 MHz; 7.2 Mbit/s**

Band	Channel No.	Frequency [MHz]	Power Density [dBm/3kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	1	2412.0	-9.5	8.0	17.5
	6	2437.0	-7.6	8.0	15.6
	11	2462.0	-9.1	8.0	17.1

Remark: Please see next sub-clause for the measurement plot.

**4. Measurement Plot (showing the highest value, "worst case")**

n-mode, channel 6



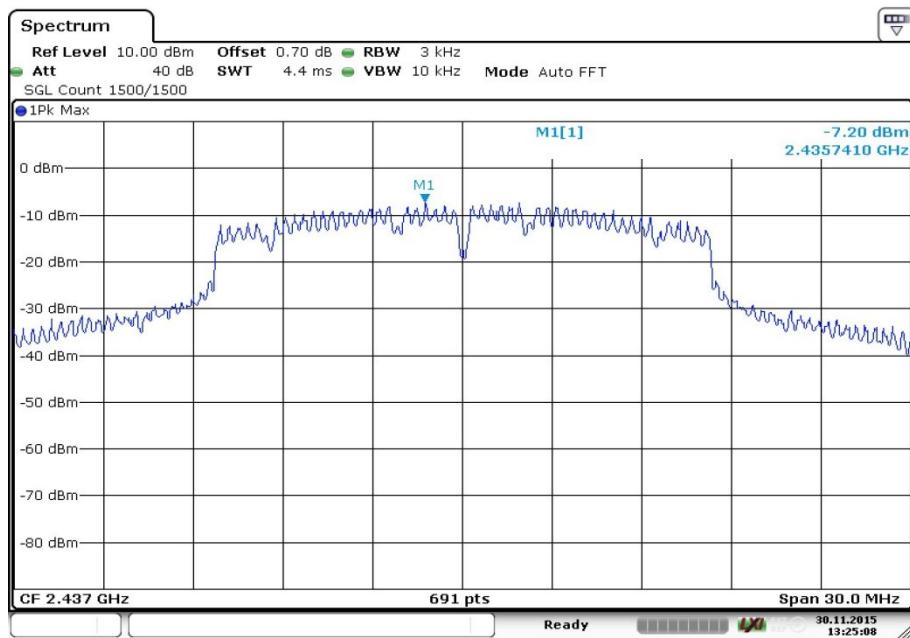
Date: 30.NOV.2015 13:27:56

## b-mode, channel 1



Date: 30.NOV.2015 13:03:51

## g-mode, channel 6



Date: 30.NOV.2015 13:25:08

## 5. Test Equipment used

Radio Laboratory

## 5. Test Equipment

### 1 Radiated Emissions

Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Calibration Due
1.1	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronik GmbH	00083069	-
1.2	Fully Anechoic Room	8.80 x 4.60 x 4.05 m <sup>3</sup> (l x w x h)	Albatross Projects	P26971-647-001-PRB	2018-06-28
1.3	FO RS232 Link	Fibre optic link Transceiver (Aux)	Pontis	182-018	-
1.4	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2016-11-13
1.5	Semi Anechoic Chamber	10.58 x 6.38 x 6.00 m <sup>3</sup>	Frankonia	none	2017-01-09
1.6	NRV-Z1	Sensor Head A	Rohde & Schwarz	827753/005	2016-05-11
1.7	FO RS232 Link	Fibre optic link Satellite (Aux)	Pontis	181-018	
1.8	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785	-
1.9	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037	-
1.10	HL 562	Ultralog new biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2018-06-30
1.11	Opus10 THI (8152.00)	ThermoHygro Datalogger 12 (Environ)	Lufft Mess- und Regeltechnik GmbH	12482	2017-03-10
1.12	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368	-
1.13	HFH2-Z2	Loop Antenna	Rohde & Schwarz GmbH & Co. KG	829324/006	2017-11-27
1.14	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2016-11-17
1.15	Opus10 TPR (8253.00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936	2017-02-27
1.16	SMR 20	Signal Generator	Rohde & Schwarz	846834/008	2017-06-24
1.17	Chroma 6404	AC Power Source	Chroma ATE INC.	64040001304	-

### 2 Radio Laboratory

FCC conducted Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Calibration Due
2.1	OSP120	Switching Unit with integrated power meter	Rohde & Schwarz GmbH & Co. KG	101158	2016-08-21
2.2	Opus10 THI (8152.00)	ThermoHygro Datalogger 03 (Environ)	Lufft Mess- und Regeltechnik GmbH	7482	2017-02-27
2.3	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz GmbH & Co. KG	107695	2017-06-06
2.4	VT 4002	Climatic Chamber	Vötsch	585660021500 10	2016-03-11
2.5	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2016-02-10
2.6	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz GmbH & Co. KG	259291	2016-08-23
2.7	Datum, Model: MFS	Rubidium Frequency Standard	Datum-Beverly	5489/001	2016-06-25

### 3 Conducted Emissions

Shielded Room 02

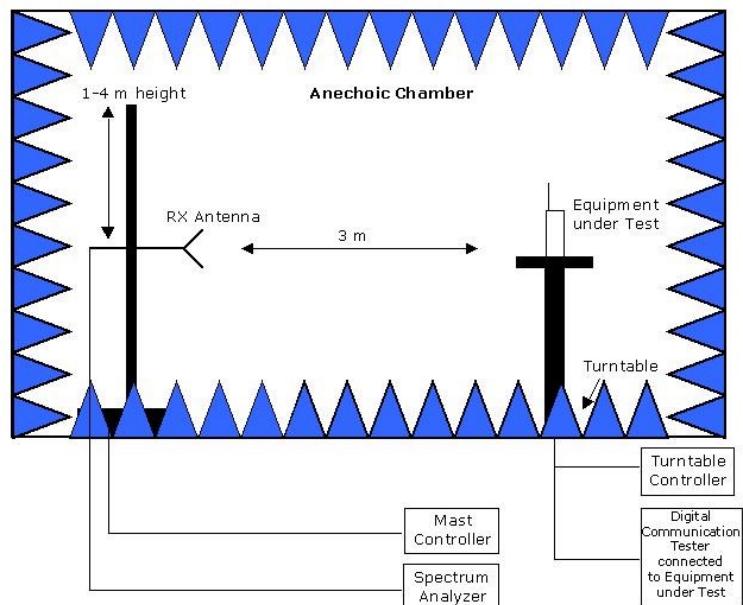
Ref.No.	Device Name	Description	Manufacturer	Serial Number	Calibration Due
3.1	ESH 3-Z5	Two-Line V-Network	Rohde & Schwarz	828304/029	2017-03-31
3.2	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2016-11-13
3.3	EP 1200/B, NA/B1	Amplifier with integrated variable Oscillator	Spitzenberger & Spieß	B6278	2018-07-23
3.4	Opus10 THI (8152.00)	ThermoHygro Datalogger 02 (Environ)	Lufft Mess- und Regeltechnik GmbH	7489	2017-02-27
3.5	ESH 3-Z5	Two-Line V-Network	Rohde & Schwarz	829996/002	2017-03-31
3.6	1-phase 16A	Line impedance simulation system	Spitzenberger & Spieß	B6279	2018-07-22
3.7	Opus10 TPR (8253.00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936	2017-02-27
3.8	Chroma 6404	AC Power Source	Chroma ATE INC.	64040001304	-



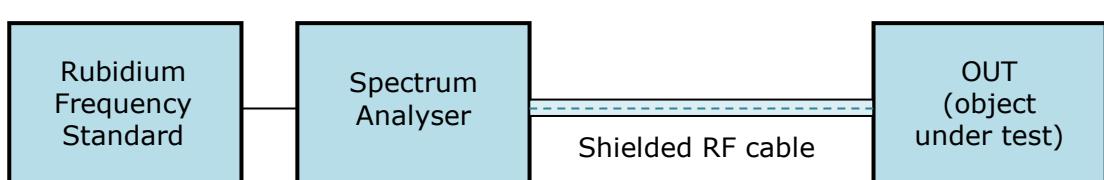
## **6. Photo Report**

Please see separate photo report.

## 7. Setup Drawings



**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.

## 8. Measurement Uncertainties

Test Case	Parameter	Uncertainty
Conducted Emissions at AC mains	Voltage	± 3.4 dB
Field Strength of spurious radiation / Band Edge Compliance Radiated	Field strength	± 5.5 dB
Occupied Bandwidth (6 dB / 26 dB / 99%) Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
Conducted Output Power	Power	± 2.2 dB
Spurious RF Conducted Emissions / Band Edge Compliance Conducted	Power	± 2.2 dB
Power Spectral Density	Power	± 2.2 dB