

# EMI – TEST REPORT

- FCC Part 15.247, RSS247 -

**Type / Model Name** : MS32018

**Product Description** : Draeger WCM9113 802.11ABGN VG2

**Applicant** : Draeger Medical Systems Inc.

**Address** : 6 Tech drive

ANDOVER, MA 01810

**Manufacturer** : Draeger Medical Systems Inc.

**Address** : 3135 Quarry Road

TELFORD, PA 18969-1042

**Licence holder** : Draeger Medical Systems Inc.

**Address** : 3135 Quarry Road

TELFORD, PA 18969-1042

**Test Result** according to the standards  
listed in clause 1 test standards:

**POSITIVE**

**Test Report No. :** **T40046-05-05HS**

20. January 2016  
Date of issue



Deutsche  
Akkreditierungsstelle  
D-PL-12030-01-01  
D-PL-12030-01-02

The test report merely corresponds to the test sample.  
It is not permitted to copy extracts of these test results  
without the written permission of the test laboratory.

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ATTACHMENT A and C as separate supplement

## 1 TEST STANDARDS

The tests were performed according to following standards:

### **FCC Rules and Regulations Part 15, Subpart A - General (September, 2015)**

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

### **FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2015)**

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

ANSI C63.4: 2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
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ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
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ETSI TR 100 028 V1.3.1: 2001-03	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2
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KDB 558074 D01 v03r03	Guidance for performing compliance measurements on DTS operating under §15.247, June 9, 2015.
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## 2 EQUIPMENT UNDER TEST

### 2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT C

### 2.2 Equipment type

WLAN - Client

### 2.3 Short description of the equipment under test (EUT)

The EUT is a WLAN-module. The EUT is compatible with 802.11b, 802.11g Standard in the 2.4 GHz frequency band. The firmware does not support ad-hoc modes and gives the user no possibility to choose the channel for data transmission or power setting. It supports no beam forming. The transmissions according to the 802.11a, n Standard are disabled by firmware.

Number of tested samples: 1

Serial number: The module is labelled by bar code only. A serial number is reserved for end-device.

Firmware version, M540: 1.2.5

#### **EUT configuration:**

(The CDF filled by the applicant can be viewed at the test laboratory.)

### 2.4 Variants of the EUT

There is no variant.

### 2.5 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan WLAN Standard 802.11b, g:

Channel	Frequency (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

Note: the marked frequencies are determined for final testing.

## 2.6 Transmit operating modes

The EUT use DSSS or OFDM modulation and may operate under operating mode 2 and provide following data rates with auto-fall-back:

- 802.11b mode                      11, 5.5, 2, 1 Mbps                      (Mbps = *megabits per second*)
- 802.11g mode                    54, 48, 36, 24, 18, 12, 9, 6 Mbps                      (Mbps = *megabits per second*)

## 2.7 Antennas

The following antennas shall be used with the EUT:

Number	Characteristic	Model number	Plug	Frequency range (GHz)	Gain (dBi)	Cable loss (dB)	Effective gain (dBi)
1	Omni	CU5006-2, Antenova	Ufl	2.4	2.4	0	2.4

## 2.8 Power supply system utilised

M540:

- Power supply voltage,  $V_{nom}$                       : 7.2 VDC battery
- Power supply voltage (alternative)           : Input: 100-240 V, 47-63 Hz, 1 $\phi$  power supply,  
Output: +24 VDC.

## 2.9 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_

## 2.10 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.

The tests are carried out in the following frequency band:

**2400 MHz – 2483.5 MHz**

Preliminary tests are performed to find the worst case mode from all possible combinations between available modulations and data rates. The maximum output power depends on used data rate. The output power can be set by application software from 1 dBm to 18 dBm (P1 to P18) in 1 dB steps.

For the final test the following channels and test modes are selected:

WLAN	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
802.11b	1 to 11	1, 6, 11	P18	DSSS	DBPSK	1 Mbps
802.11g	1 to 11	1, 6, 11	P15	OFDM	BPSK	6 Mbps

- TX continuous mode, 802.11 b
- TX continuous mode, 802.11 g

### 2.10.1 Test jig

The EUT has been integrated in "Infinity M540" to provide power supply and control signals in order to generate the test pattern. The M540 is a final product. The "Infinity M300" device has inside an identical structure of the WLAN-module, but printed on motherboard. The values of the devices and the arrangement are identical, too. The radiated and conducted measurements have been performed under the support of a test jig (M300 and M540). Only for the special prepared test jigs, the needed test software is available.

### 2.10.2 Test software

The test software for the EUT provides free power setting, the special test mode TX continuous, modulated. The EUT is set with test modulation to transmit data during the tests with a duty cycle (X) of assumed  $X = 1$ .

### **3 TEST RESULT SUMMERY**

WLAN device using digital modulation:

Operating in the 2400 MHz – 2483.5 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	passed
15.247(a)(2)	RSS247, 5.2(1)	-6 dB EBW	passed
15.247(b)(3)	RSS247, 5.4	Peak power	passed
15.247(d)	RSS247, 5.5	Unwanted emission, radiated	passed
15.247(d)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.247(e)	RSS247, 5.2(2)	PSD	passed
15.35(c)	RSS-Gen, 6.10	Pulsed operation	passed
15.247(b)(4)	-	Antenna requirement	passed
	RSS-Gen, 6.11	Transmitter frequency stability	passed
	RSS-Gen, 6.6	99 % Bandwidth	passed

The mentioned RSS Rule Parts in the above table are related to:

RSS Gen, Issue 4, November 2014

RSS 247, Issue 1, May 2015

#### **3.1 Final assessment**

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 28 September 2015

Testing concluded on : 06 October 2015

Checked by:

Tested by:

\_\_\_\_\_  
Klaus Gegenfurtner  
Teamleader Radio

\_\_\_\_\_  
Hermann Smetana  
Radio Team

## **4 TEST ENVIRONMENT**

### **4.1 Address of the test laboratory**

**CSA Group Bayern GmbH  
Ohmstrasse 1-4  
94342 STRASSKIRCHEN  
GERMANY**

### **4.2 Environmental conditions**

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

### **4.3 Statement of the measurement uncertainty**

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor  $k = 2$ . The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.



## 4.4 Measurement protocol for FCC and IC

### 4.4.1 General information

#### 4.4.1.1 Test methodology

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

### IC 3009A-1

In compliance with RSS 247 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

#### 4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

#### 4.4.1.3 General Standard information

In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

### 1.1.1 Radiated emission (electrical field 30 MHz - 1 GHz)

#### Description of measurement

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.

The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:

30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency	Level	+	Factor	=	Level	-	CISPR Limit	=
Delta								
(MHz)	(dBµV)		(dB)		(dBµV/m)		(dBµV/m)	(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	= -2.4

**1.1.2 Radiated emission (electrical field 1 GHz - 40 GHz)**Description of measurement

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.4. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak and 10 Hz for average measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

## 5 TEST CONDITIONS AND RESULTS

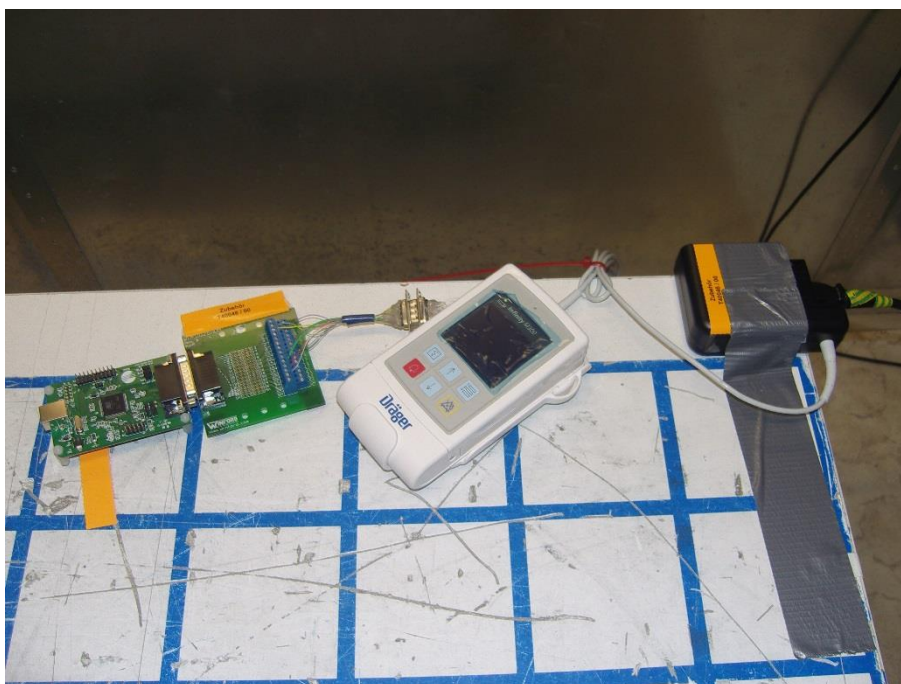
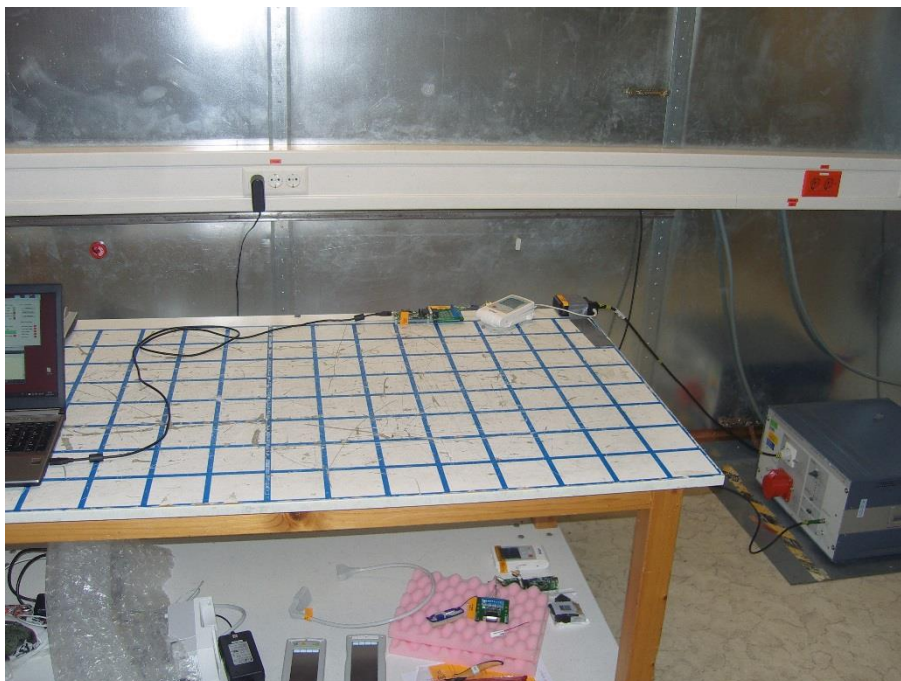
### 5.1 AC power line conducted emissions

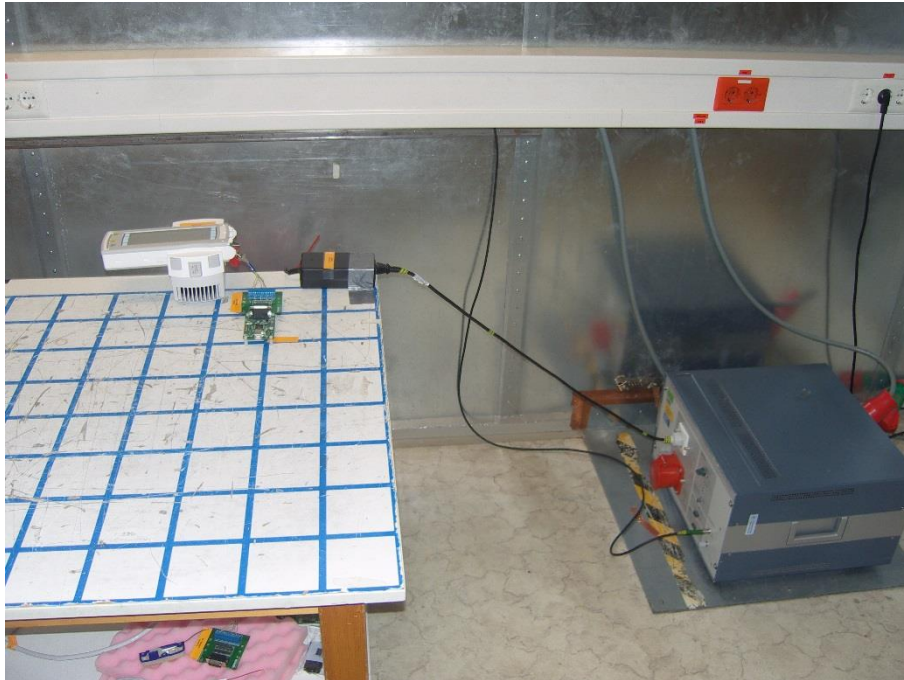
For test instruments and accessories used see section 6 Part A 4.

#### 5.1.1 Description of the test location

Test location:                    Shielded Room S2

#### 5.1.2 Photo documentation of the test set-up





Note: In the charger WLAN is not available.

### 5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

### 5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

### 5.1.5 Test result

Frequency range:	0.15 MHz - 30 MHz
Min. limit margin	23.5 dB at 25.050 MHz

Limit according to FCC Part 15, Section 15.207(a):

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency

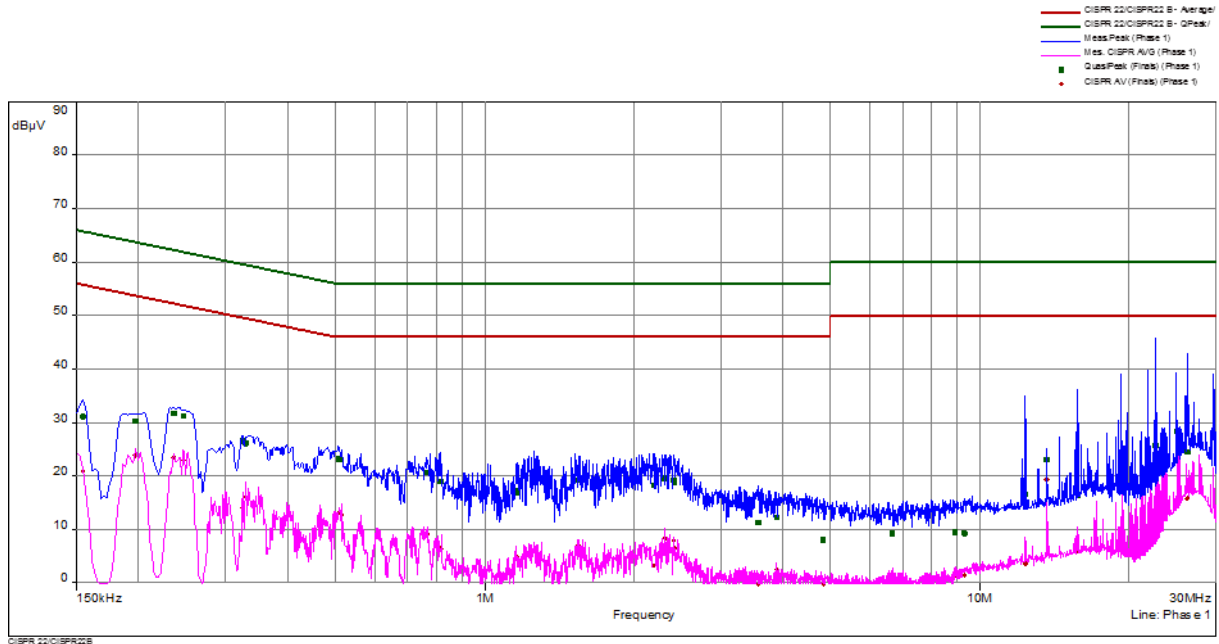
The requirements are **FULFILLED**.

**Remarks:** For detailed test result please see to following test protocols.

### 5.1.6 Test protocol

Test point L1  
Operation mode: M300: TX continuous  
Remarks:

Result: passed

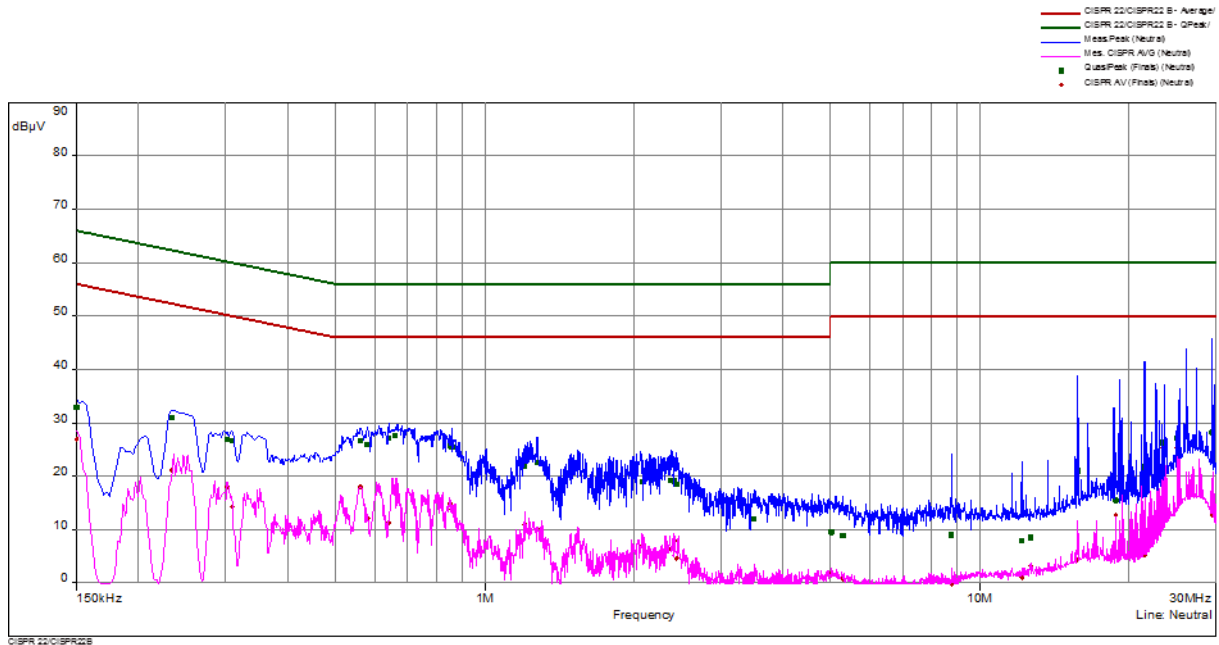


freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.155	1	31.1	34.6	65.8	20.9	34.9	55.8	Phase 1	9.8
0.197	1	30.3	33.4	63.7	23.9	29.9	53.7	Phase 1	9.8
0.236	1	31.7	30.6	62.3	23.4	28.8	52.3	Phase 1	9.8
0.247	1	31.2	30.7	61.9	23.0	28.9	51.9	Phase 1	9.8
0.325	2	26.5	33.0	59.6	14.1	35.5	49.6	Phase 1	9.8
0.329	2	26.1	33.4	59.5	16.1	33.4	49.5	Phase 1	9.8
0.507	2	23.2	32.8	56.0	13.0	33.0	46.0	Phase 1	9.8
0.514	2	23.1	32.9	56.0	12.7	33.3	46.0	Phase 1	9.8
0.767	3	20.7	35.3	56.0	9.2	36.8	46.0	Phase 1	9.8
0.816	3	19.0	37.0	56.0	6.4	39.6	46.0	Phase 1	9.8
1.160	3	16.7	39.3	56.0	4.8	41.2	46.0	Phase 1	9.8
1.167	3	17.2	38.8	56.0	4.5	41.5	46.0	Phase 1	9.8
1.261	4	18.8	37.2	56.0	5.9	40.2	46.0	Phase 1	9.8
1.544	4	19.1	36.9	56.0	7.1	38.9	46.0	Phase 1	9.8
2.197	4	18.2	37.8	56.0	3.3	42.7	46.0	Phase 1	9.8
2.316	4	19.5	36.5	56.0	8.3	37.7	46.0	Phase 1	9.8
2.411	5	19.2	36.8	56.0	8.0	38.0	46.0	Phase 1	9.8
2.416	5	18.7	37.3	56.0	6.4	39.6	46.0	Phase 1	9.8
3.577	5	11.3	44.7	56.0	-0.8	46.8	46.0	Phase 1	9.8
3.890	5	12.2	43.8	56.0	2.5	43.5	46.0	Phase 1	9.8
4.832	6	8.0	48.0	56.0	-1.2	47.2	46.0	Phase 1	9.8
6.659	6	9.2	50.8	60.0	1.6	48.4	50.0	Phase 1	9.8
8.927	6	9.4	50.6	60.0	1.4	48.6	50.0	Phase 1	9.9
9.325	6	9.3	50.7	60.0	1.5	48.6	50.0	Phase 1	9.9
12.381	7	16.6	43.4	60.0	3.6	46.4	50.0	Phase 1	10.0
13.666	7	23.1	37.0	60.0	19.3	30.7	50.0	Phase 1	10.1
15.792	7	16.3	43.8	60.0	5.9	44.1	50.0	Phase 1	10.2
22.676	8	25.7	34.3	60.0	8.8	41.3	50.0	Phase 1	10.3
23.405	8	27.2	32.8	60.0	26.1	23.9	50.0	Phase 1	10.3
25.050	8	28.3	31.7	60.0	26.5	23.5	50.0	Phase 1	10.4
26.270	8	24.4	35.6	60.0	15.8	34.2	50.0	Phase 1	10.3



Test point N  
Operation mode: M300: TX continuous  
Remarks:

Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.150	9	32.9	33.1	66.0	26.9	29.1	56.0	Neutral	9.8
0.233	9	31.0	31.4	62.3	21.1	31.2	52.3	Neutral	9.8
0.302	10	26.9	33.3	60.2	18.0	32.2	50.2	Neutral	9.8
0.309	10	26.7	33.3	60.0	14.2	35.8	50.0	Neutral	9.8
0.561	10	26.6	29.4	56.0	18.0	28.0	46.0	Neutral	9.8
0.581	10	25.9	30.1	56.0	12.2	33.8	46.0	Neutral	9.8
0.641	11	27.1	28.9	56.0	11.3	34.8	46.0	Neutral	9.8
0.661	11	27.6	28.4	56.0	17.9	28.1	46.0	Neutral	9.8
0.852	11	25.8	30.2	56.0	14.9	31.1	46.0	Neutral	9.8
0.859	11	25.5	30.5	56.0	13.8	32.2	46.0	Neutral	9.8
1.207	12	22.0	34.0	56.0	10.9	35.1	46.0	Neutral	9.8
1.279	12	22.6	33.4	56.0	10.1	35.9	46.0	Neutral	9.8
2.084	12	19.0	37.0	56.0	7.0	39.0	46.0	Neutral	9.8
2.384	12	19.2	36.8	56.0	6.3	39.7	46.0	Neutral	9.8
2.416	13	19.1	36.9	56.0	7.9	38.1	46.0	Neutral	9.8
2.443	13	18.5	37.5	56.0	4.6	41.4	46.0	Neutral	9.8
3.498	13	11.9	44.1	56.0	1.5	44.5	46.0	Neutral	9.8
5.018	14	9.5	50.5	60.0	1.7	48.3	50.0	Neutral	9.8
5.297	14	8.9	51.2	60.0	0.8	49.2	50.0	Neutral	9.8
8.767	14	9.0	51.0	60.0	-0.1	50.1	50.0	Neutral	9.8
12.170	15	7.9	52.1	60.0	1.0	49.0	50.0	Neutral	9.9
12.671	15	8.5	51.5	60.0	3.2	46.8	50.0	Neutral	9.9
15.803	15	21.0	39.0	60.0	4.3	45.7	50.0	Neutral	10.0
18.834	15	15.5	44.5	60.0	12.7	37.4	50.0	Neutral	10.1
21.522	16	21.7	38.3	60.0	5.3	44.7	50.0	Neutral	10.1
23.405	16	26.4	33.6	60.0	25.3	24.7	50.0	Neutral	10.0
25.050	16	27.2	32.8	60.0	25.3	24.7	50.0	Neutral	9.9
29.519	16	28.2	31.8	60.0	12.7	37.3	50.0	Neutral	9.7

Test point	L1	Result: -
Operation mode:	M540: TX continuous	
Remarks:	Not applicable, the EUT is battery powered.	

Test point	N	Result: -
Operation mode:	M540: TX continuous	
Remarks:	Not applicable, the EUT is battery powered.	



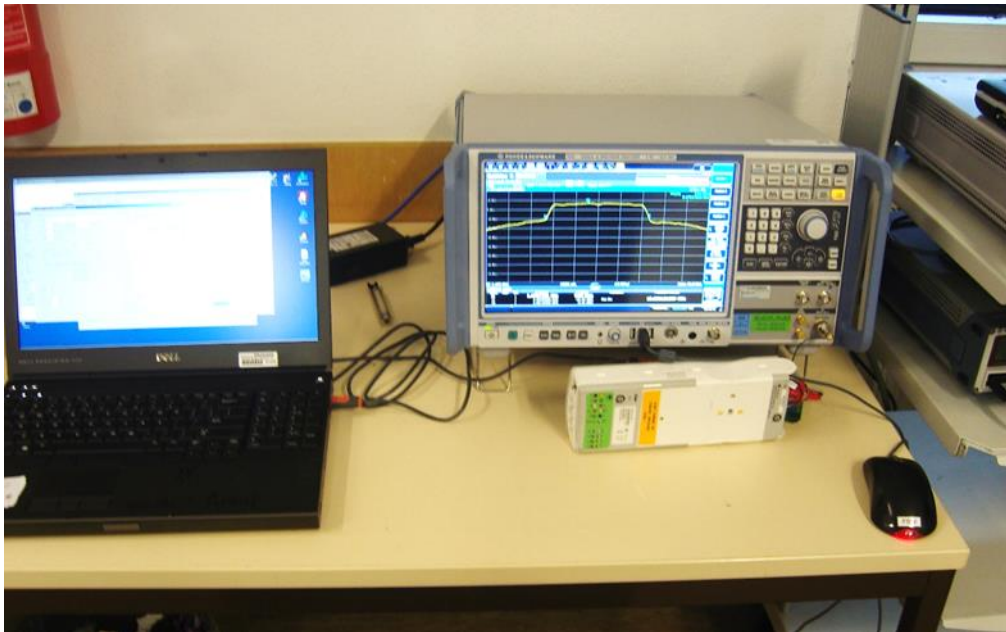
## 5.2 EBW and OBW

For test instruments and accessories used see section 6 Part **MB**.

### 5.2.1 Description of the test location

Test location: AREA4

### 5.2.2 Photo documentation of the test set-up



### 5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings for EBW:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Sweep time: 5 s, Span: 2 EBW;

Spectrum analyser settings for OBW:

RBW: 1-5% OBW, VBW: 3 RBW, Detector: Max peak, Sweep time: 5 s, Span: 2 OBW;

**5.2.5 Test result**

WLAN Standard 802.11b

Channel	Centre frequency	6 dB bandwidth	99% OBW	Minimum limit
	(MHz)	(MHz)	(MHz)	(MHz)
1	2412	10.001	12.256	0.5
6	2432	10.033	12.266	0.5
11	2462	10.033	12.336	0.5

WLAN Standard 802.11g

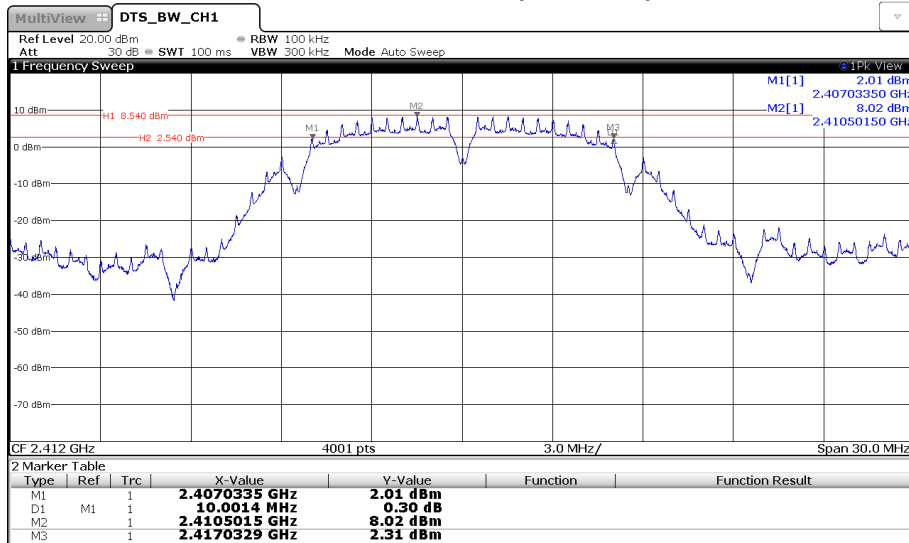
Channel	Centre frequency	6 dB bandwidth	99% OBW	Minimum limit
	(MHz)	(MHz)	(MHz)	(MHz)
1	2412	16.332	24.573	0.5
6	2432	16.562	24.438	0.5
11	2462	16.294	25.023	0.5

The requirements are **FULFILLED**.

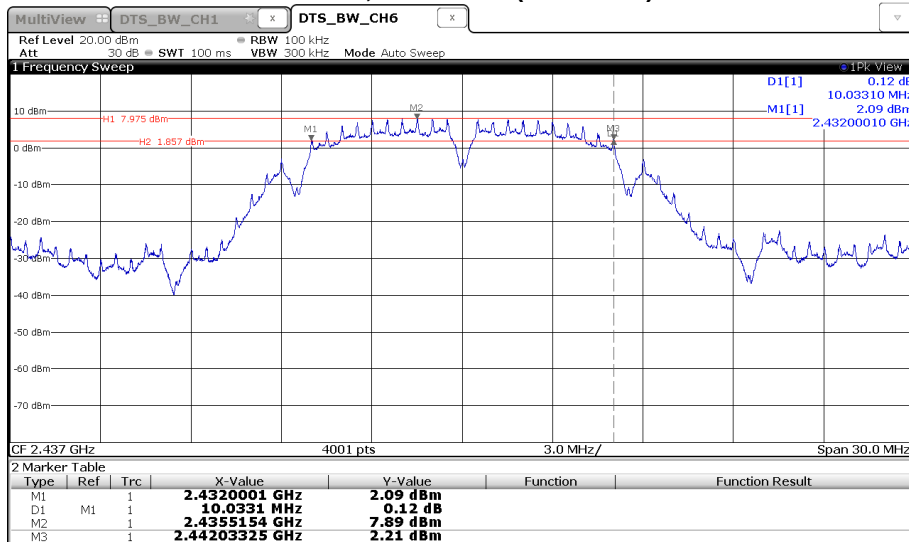
**Remarks:** For detailed test results please refer to following test protocols. The RSS Gen defines no limit for the occupied bandwidth.

## 5.2.6 Test protocols EBW

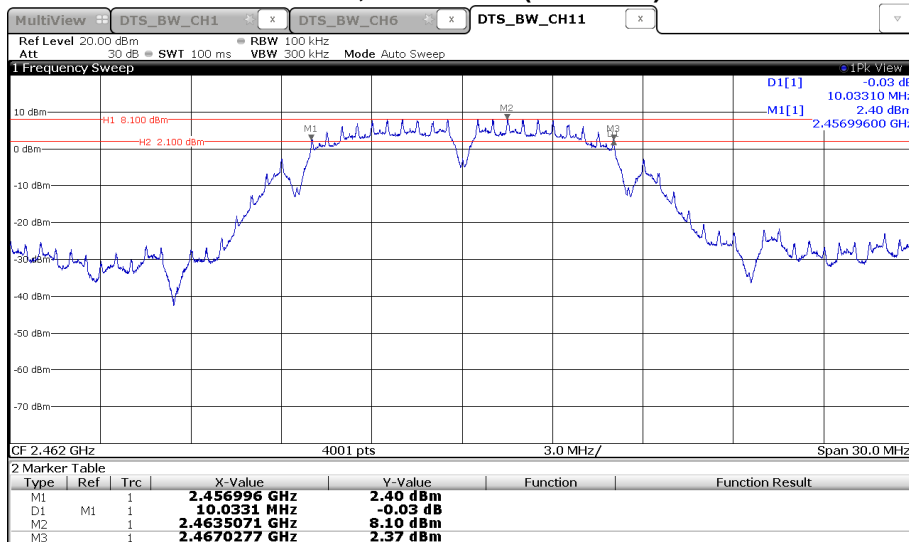
### 802.11b, Channel 1 (2412 MHz)



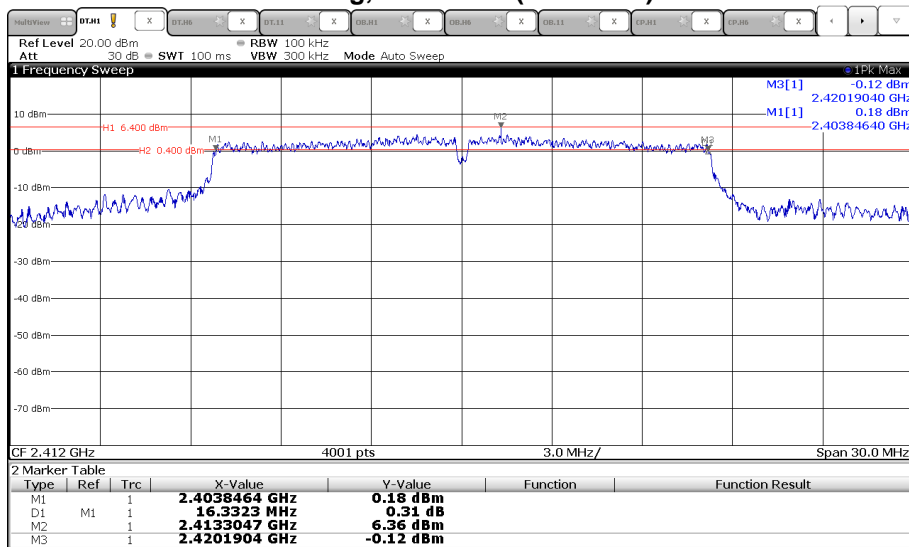
### 802.11b, Channel 6 (2437 MHz)



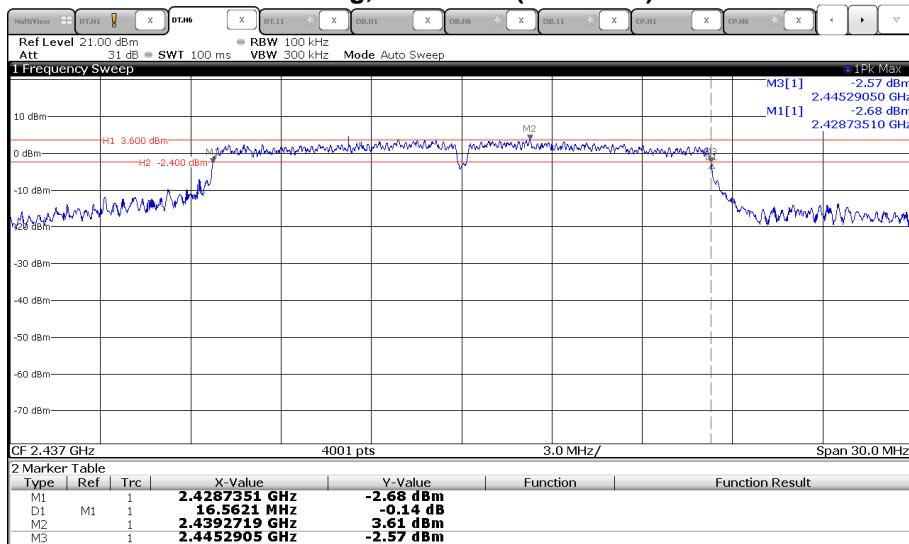
### 802.11b, Channel 11 (2462 MHz)



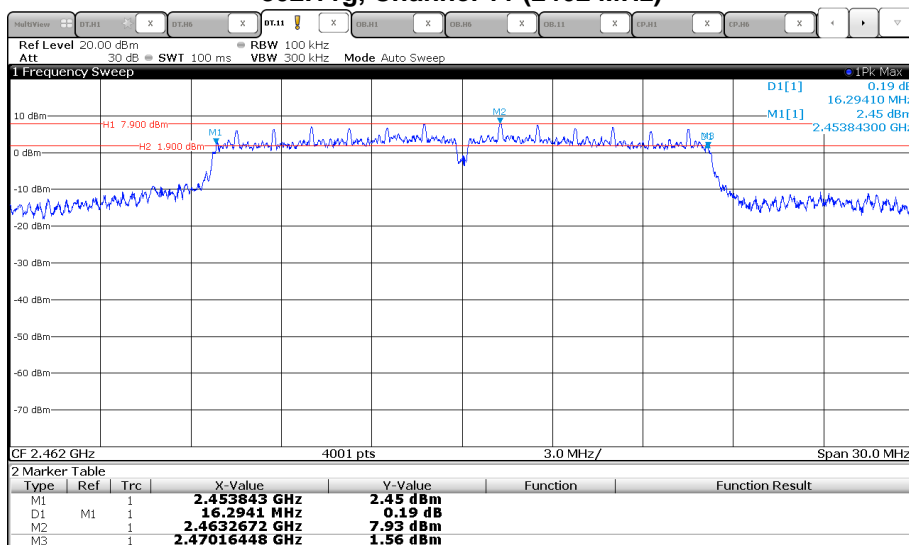
### 802.11g, Channel 1 (2412 MHz)



### 802.11g, Channel 6 (2437 MHz)

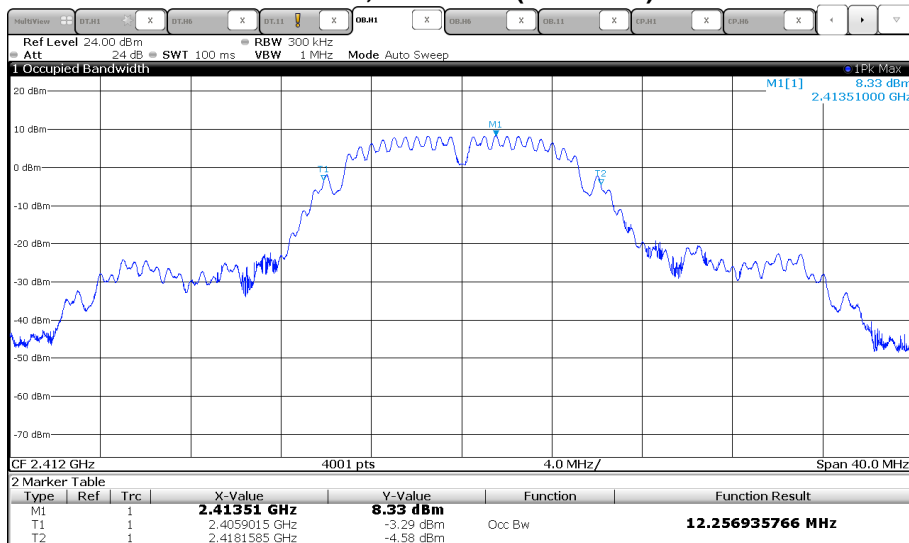


### 802.11g, Channel 11 (2462 MHz)

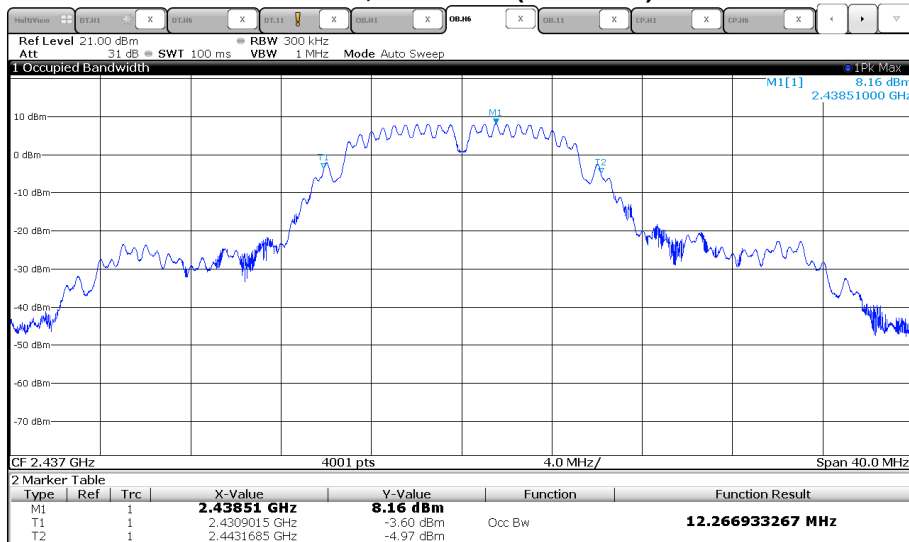


## 5.2.7 Test protocols OBW

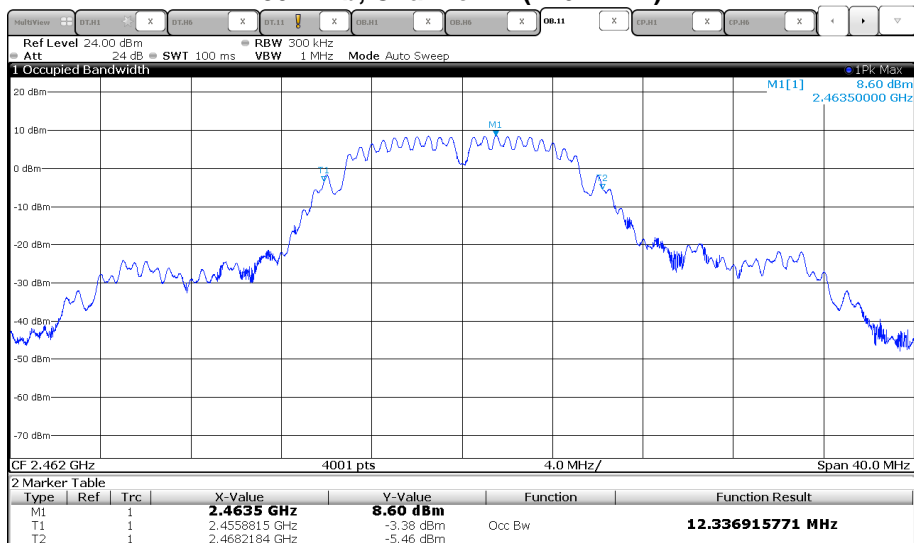
### 802.11b, Channel 1 (2412 MHz)



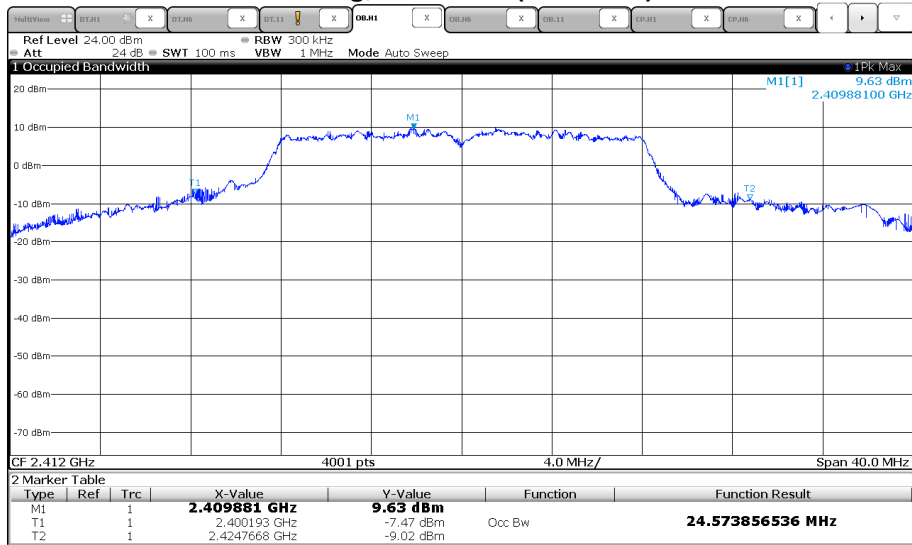
### 802.11b, Channel 6 (2437 MHz)



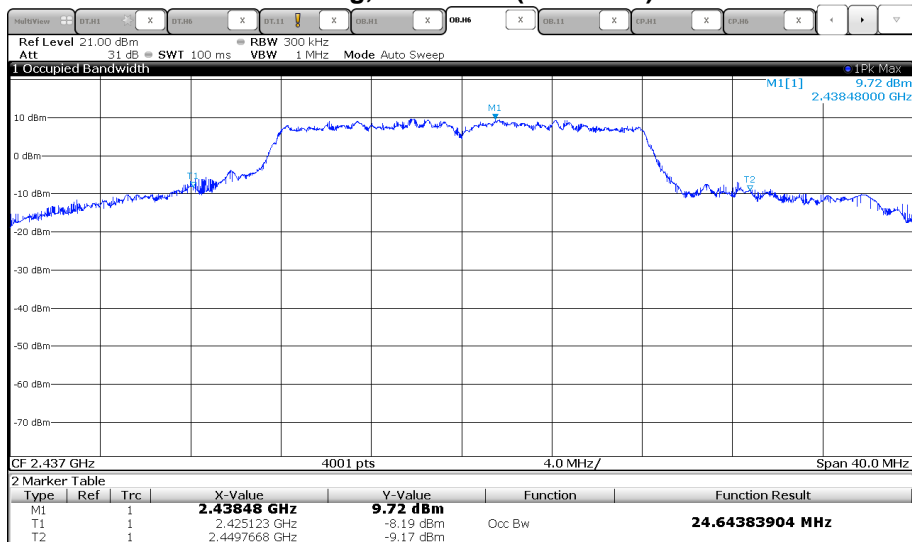
### 802.11b, Channel 11 (2462 MHz)



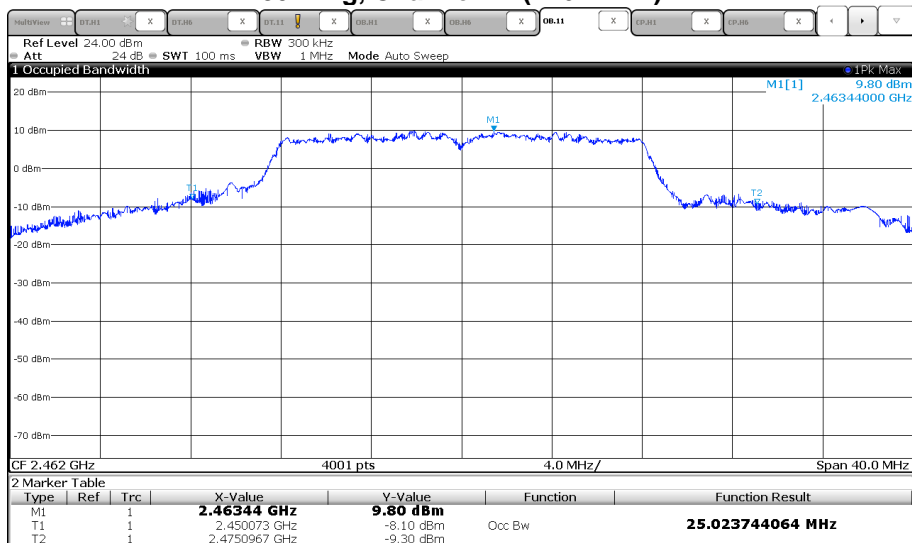
### 802.11g, Channel 1 (2412 MHz)



### 802.11g, Channel 6 (2437 MHz)



### 802.11g, Channel 11 (2462 MHz)



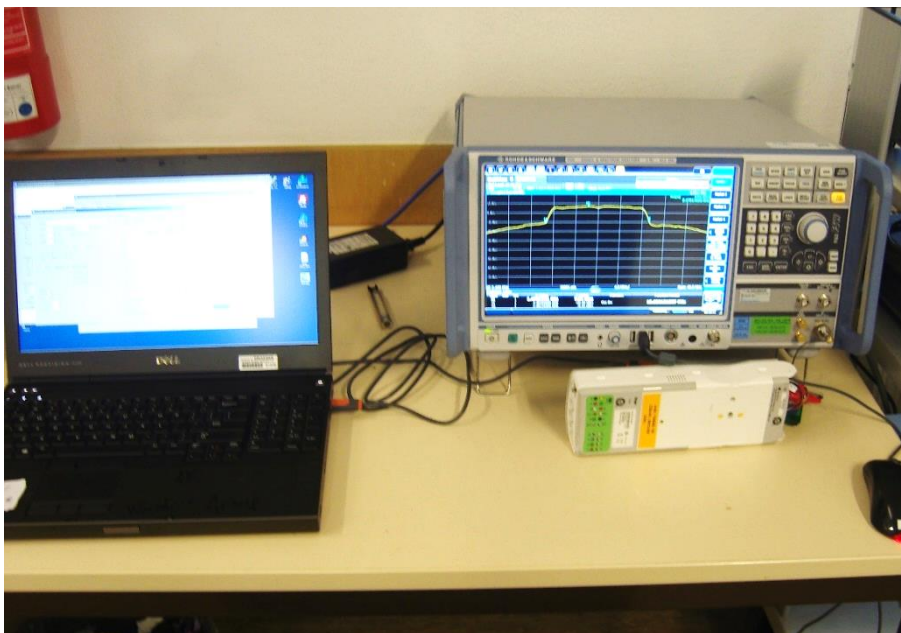
### 5.3 Maximum peak conducted output power

For test instruments and accessories used see section 6 Part **CPC 3**.

#### 5.3.1 Description of the test location

Test location: AREA4

#### 5.3.2 Photo documentation of the test set-up



#### 5.3.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):

For systems using digital modulation in the 2400 – 2483.5 MHz band, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

#### 5.3.4 Description of Measurement

The maximum peak conducted output power is measured using a peak spectrum analyser following the procedure set out in KDB 558074, item 9.1.1. The EUT is set in TX continuous mode while measuring.

#### 5.3.5 Test result

WLAN Standard 802.11b

802.11b, 1 Mbps, 1 TX, P18		Test results conducted		
Duty cycle: 100%		A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH1				
$T_{nom}$	$V_{nom}$	20.7	30.0	-9.3
Middle frequency: CH6				
$T_{nom}$	$V_{nom}$	20.5	30.0	-9.5
Highest frequency: CH11				
$T_{nom}$	$V_{nom}$	20.7	30.0	-9.3

WLAN Standard 802.11g

<b>802.11g, 6 Mbps, 1 TX, P15</b>		Test results conducted		
Duty cycle: 100%				
		A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH1				
$T_{nom}$	$V_{nom}$	23.1	30.0	-6.9
Middle frequency: CH6				
$T_{nom}$	$V_{nom}$	23.0	30.0	-7.0
Highest frequency: CH11				
$T_{nom}$	$V_{nom}$	22.9	30.0	-7.1

(The following test values are maximum average output power for verification to the original measurement.  
The measurement method is AVGSA-1.

<b>802.11b, 1 Mbps, 1 TX</b>		Test results conducted		
Duty cycle: 100%				
<b>Average values</b>		A [P18] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH1				
$T_{nom}$	$V_{nom}$	18.2	30.0	-11.8
Middle frequency: CH6				
$T_{nom}$	$V_{nom}$	17.6	30.0	-12.4
Highest frequency: CH11				
$T_{nom}$	$V_{nom}$	17.7	30.0	-12.3

<b>802.11g, 6 Mbps, 1 TX</b>		Test results conducted		
Duty cycle: 100%				
<b>Average values</b>		A [P15] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH1				
$T_{nom}$	$V_{nom}$	16.5	30.0	-13.5
Middle frequency: CH6				
$T_{nom}$	$V_{nom}$	16.6	30.0	-13.4
Highest frequency: CH11				
$T_{nom}$	$V_{nom}$	16.9	30.0	-13.1

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency (MHz)	Peak Power Limit	
	(dBm)	(Watt)
902-928	30	1.0
<b>2400-2483.5</b>	<b>30</b>	<b>1.0</b>
5725-5850	30	1.0

The requirements are **FULFILLED**.

Remarks:



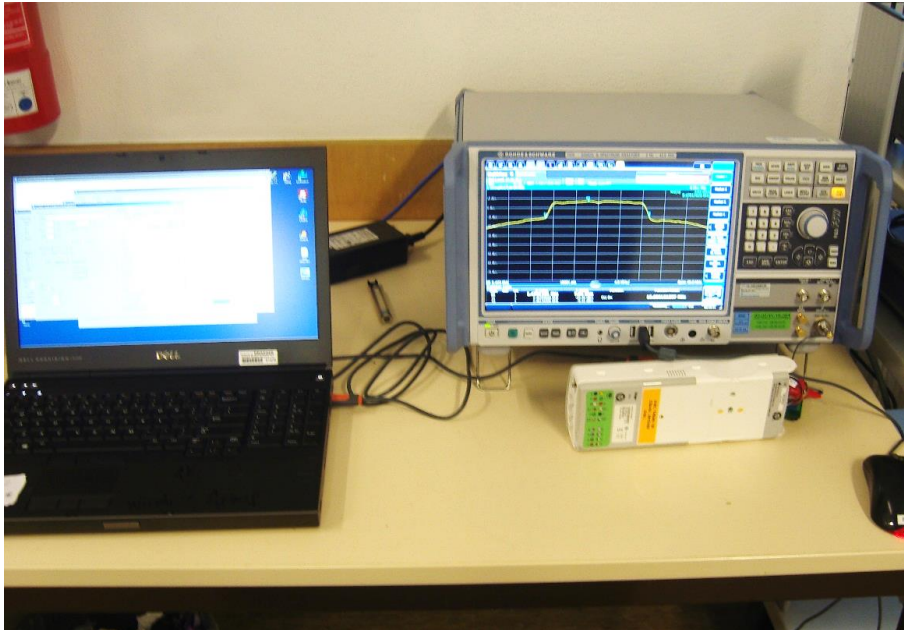
## 5.4 Power spectral density

For test instruments and accessories used see section 6 Part **CPC 3**.

### 5.4.1 Description of the test location

Test location: AREA4

### 5.4.2 Photo documentation of the test set-up



### 5.4.3 Applicable standard

According to FCC Part 15, Section 15.247(e):

For digitally modulated systems, the 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

### 5.4.4 Description of Measurement

The measurement is performed using the procedure 10.2 set out in KDB-558074. The power measurement was done as peak power measurement. Therefore the PKPSD is measured. The max peak was located and with the spectrum analyser and a marker set to peak.

Spectrum analyser settings:

RBW: 3 kHz, VBW: 10 kHz, Detector: Peak, Sweep time: 10 s,

**5.4.5 Test result**

WLAN Standard 802.11b

<b>802.11b, 1 Mbps, 1 TX, P18</b>		Test results conducted		
Duty cycle: 100%				
		PD [Pmax] (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Lowest frequency: CH1				
$T_{nom}$	$V_{nom}$	-1.3	8.0	-9.3
Middle frequency: CH6				
$T_{nom}$	$V_{nom}$	-1.4	8.0	-9.4
Highest frequency: CH11				
$T_{nom}$	$V_{nom}$	-5.9	8.0	-13.9

WLAN Standard 802.11g

<b>802.11g, 6 Mbps, 1 TX, P15</b>		Test results conducted		
Duty cycle: 100%				
		PD [Pmax] (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Lowest frequency: CH1				
$T_{nom}$	$V_{nom}$	-7.9	8.0	-15.9
Middle frequency: CH6				
$T_{nom}$	$V_{nom}$	-7.8	8.0	-15.8
Highest frequency: CH11				
$T_{nom}$	$V_{nom}$	-5.9	8.0	-13.9

Power spectral density limit according to FCC Part 15, Section 15.247(e):

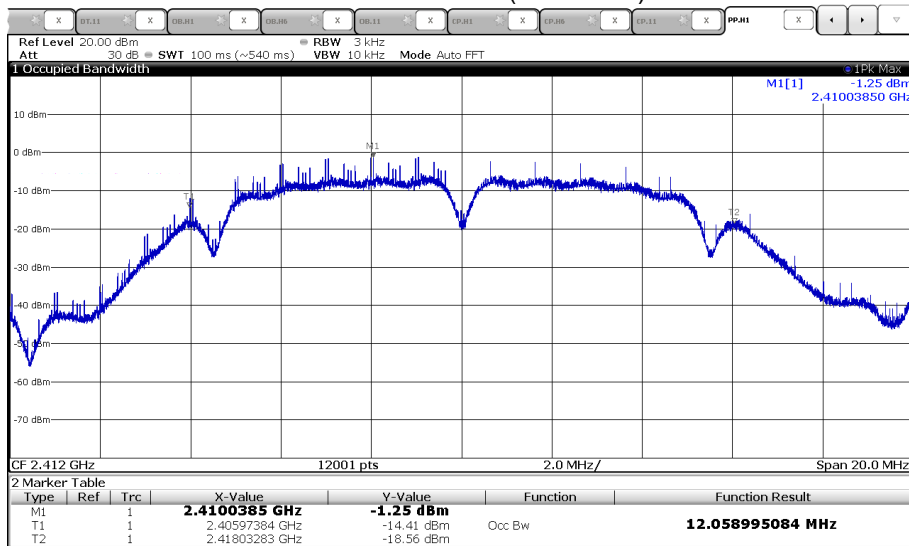
Frequency (MHz)	Power spectral density limit
	(dBm/3 kHz)
2400 - 2483.5	8

The requirements are **FULFILLED**.

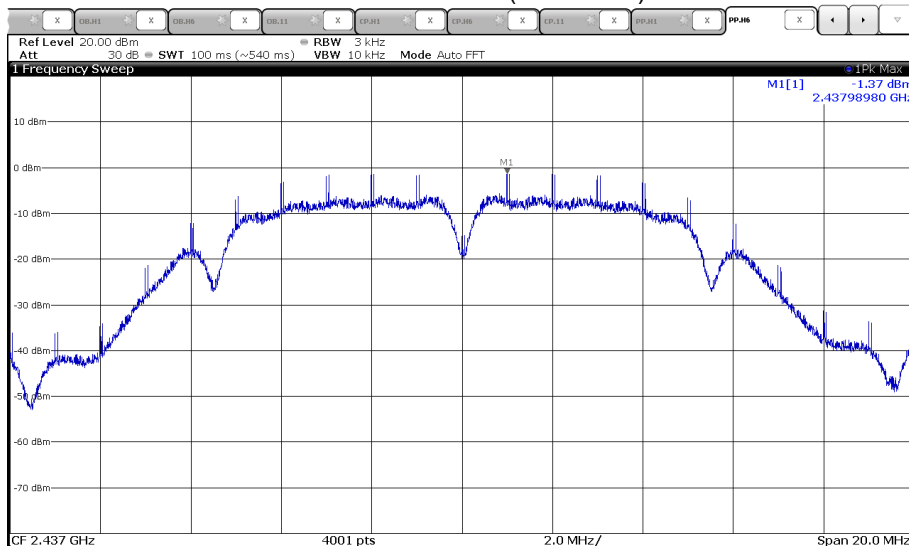
**Remarks:** For detailed test results please refer to following test protocols.

#### 5.4.6 Power spectral density plots

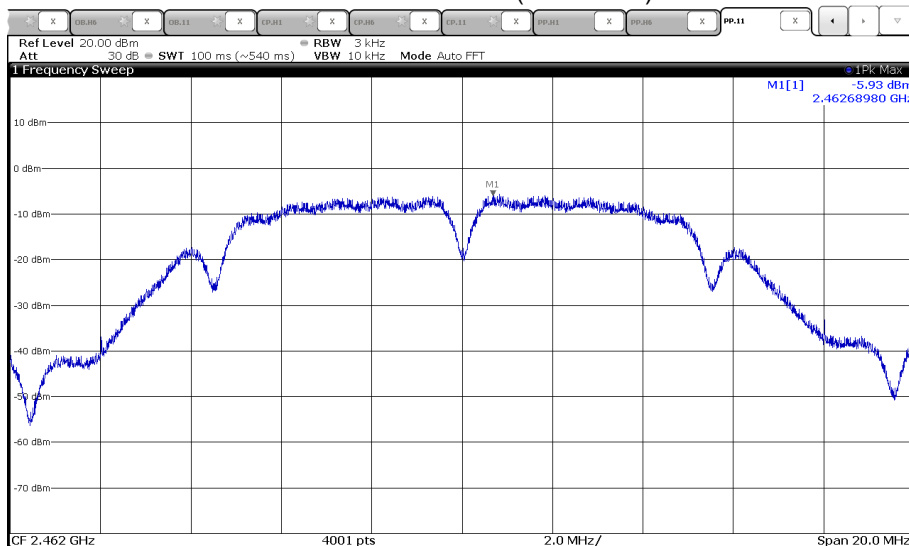
802.11b Channel 1 (2412 MHz)



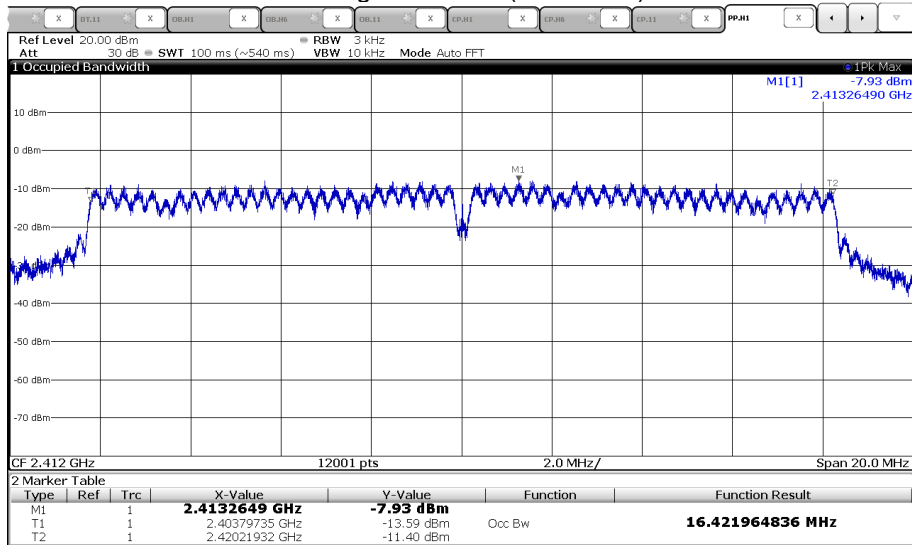
802.11b Channel 6 (2437 MHz)



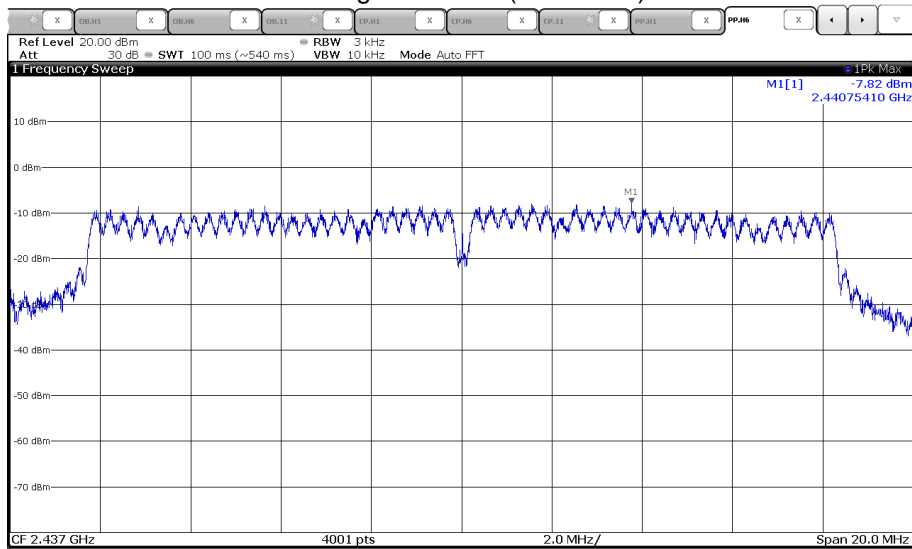
802.11b Channel 11 (2462 MHz)



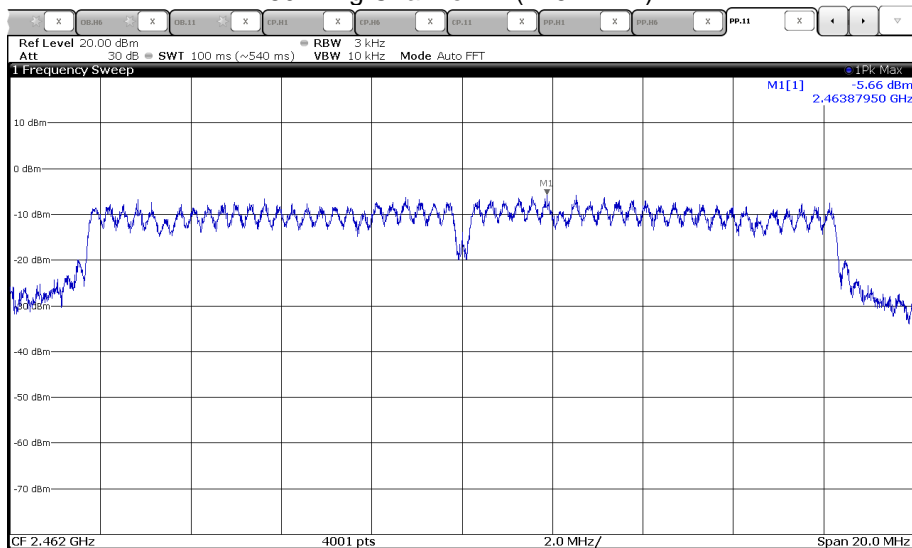
### 802.11g Channel 1 (2412 MHz)



### 802.11g Channel 6 (2437 MHz)



### 802.11g Channel 11 (2462 MHz)



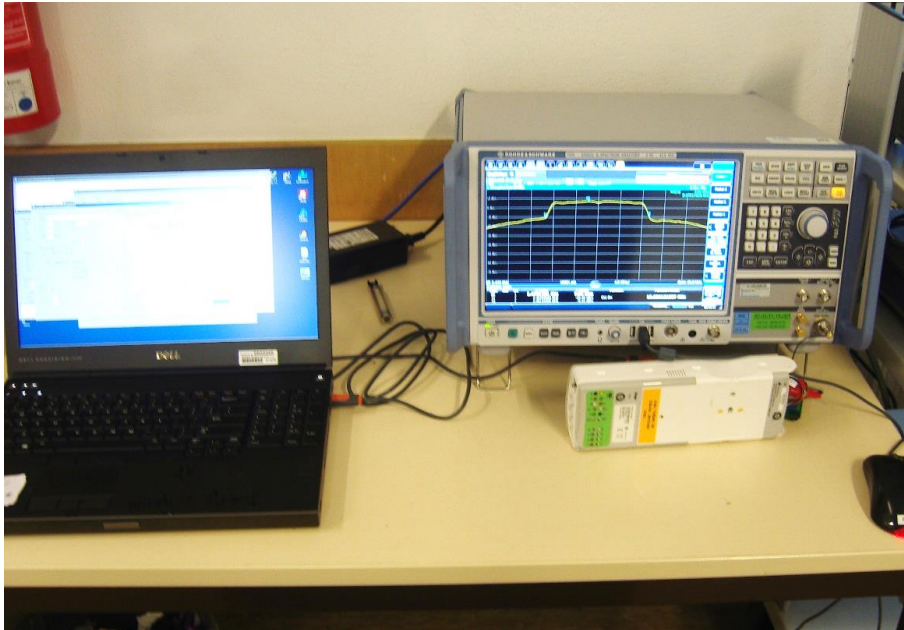
## 5.5 Unwanted emissions, conducted

For test instruments and accessories used see section 6 Part **SEC 2** and **SEC 3**.

### 5.5.1 Description of the test location

Test location: AREA4

### 5.5.2 Photo documentation of the test set-up



### 5.5.3 Applicable standard

According to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated 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 an radiated measurement. 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 limit specified in Section 15.209(a) (see Section 15.205(c)).

### 5.5.4 Description of measurement

The spurious emissions are measured conducted using a spectrum analyser in a test setup following the procedures set out in KDB 558074 for DTS. The transmitter is set to the lowest operating frequency (CH1), the middle (CH6) and to the highest operating frequency (CH11). The frequency spectrum outside from the operating frequency range (2400 - 2483.5 MHz) is scanned for emissions that exceed the limit. The measurement is performed at normal test conditions in modulated TX continuous mode.

Spectrum analyser search setting:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Trace Mode: Max hold, Sweep time: 1 s

**5.5.5 Test result**
**802.11b**

Lowest frequency: CH1						
Test conditions: 1 TX , P18, 1 Mbps						
Reference power level:					8.2 dBm	
			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	1000	472	-56.9	-12.8	-44.1
1000	2400	1000	2400	-23.7	-12.8	-10.9
2483.5	5000	1000	4824	-45.5	-12.8	-32.7
5000	15000	1000	7235	-51.7	-12.8	-38.9
15000	25000	1000	24840	-53.2	-12.8	-40.4
Measurement uncertainty				±3 dB		

Middle frequency: CH6						
Test conditions: 1 TX , P18, 1 Mbps						
Reference power level:					8.2 dBm	
			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	1000	552	-56.4	-12.8	-43.6
1000	2400	1000	2400	-48.6	-12.8	-35.8
2483.5	5000	1000	3249	-46.2	-12.8	-33.4
5000	15000	1000	7309	-51.2	-12.8	-38.4
15000	25000	1000	24893	-53.8	-12.8	-41.0
Measurement uncertainty				±3 dB		

Highest frequency: CH11						
Test conditions: 1 TX , P18, 1 Mbps						
Reference power level:					8.2 dBm	
			Test results			
Start $f$	Stop $f$	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	1000	548	-56.9	-12.8	-44.1
1000	2400	1000	2400	-51.1	-12.8	-38.3
2483.5	5000	1000	3282	-45.7	-12.8	-32.9
5000	15000	1000	7382	-50.3	-12.8	-37.5
15000	25000	1000	24846	-52.4	-12.8	-39.6
Measurement uncertainty				±3 dB		

**802.11g**

Lowest frequency: CH1						
Test conditions: 1 TX , P15, 6 Mbps						
Reference power level:					8.2 dBm	
			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	1000	809	-53.9	-12.8	-41.1
1000	2400	1000	2400	-14.9	-12.8	-2.1
2483.5	5000	1000	3215	-45.5	-12.8	-32.7
5000	15000	1000	7236	-52.6	-12.8	-39.8
15000	25000	1000	24886	-52.4	-12.8	-39.6
Measurement uncertainty				±3 dB		

Middle frequency: CH6						
Test conditions: 1 TX , P15, 6 Mbps						
Reference power level:					8.2 dBm	
			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	1000	814	-53.0	-12.8	-40.2
1000	2400	1000	2400	-38.4	-12.8	-25.6
2483.5	5000	1000	3249	-44.8	-12.8	-32.0
5000	15000	1000	7304	-48.3	-12.8	-35.5
15000	25000	1000	16773	-53.1	-12.8	-40.3
Measurement uncertainty				±3 dB		

Highest frequency: CH11						
Test conditions: 1 TX , P15, 6 Mbps						
Reference power level:					8.2 dBm	
			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	1000	822	-53.0	-12.8	-40.2
1000	2400	1000	2400	-49.7	-12.8	-36.9
2483.5	5000	1000	3283	-44.3	-12.8	-31.5
5000	15000	1000	7387	-52.4	-12.8	-39.6
15000	25000	1000	24959	-52.5	-12.8	-39.7
Measurement uncertainty				±3 dB		

Note: The average limit in restricted bands are 54 dBμV/m. The formula  $FS = EIRP - 20\log + 104.8$  is used to determine the level in dBm for emission in restricted bands will be exceed the AV-Limit and has to be re-measured. The level is -40.8 dBm. No emission is higher than -40.8 dBm, therefore no emission has to be re-measured in restricted bands.

Limit according to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated 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 an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Frequency (MHz)	Spurious emission limit
Below 960	20 dB below the highest level of the desired power
Above 960	20 dB below the highest level of the desired power

The requirements are **FULFILLED**.

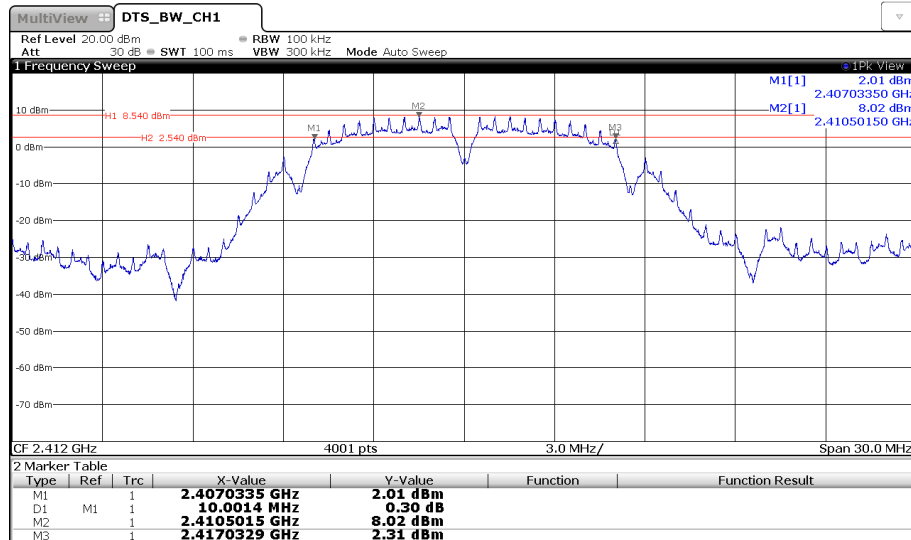
**Remarks:** For detailed test results please refer to following test protocols.

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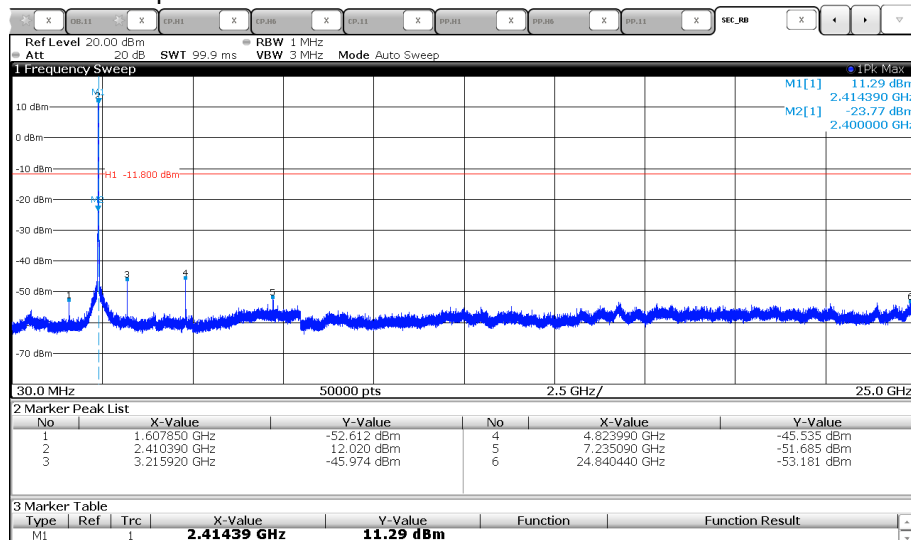
## 5.5.6 Test protocols

### Determination of the reference level and limit



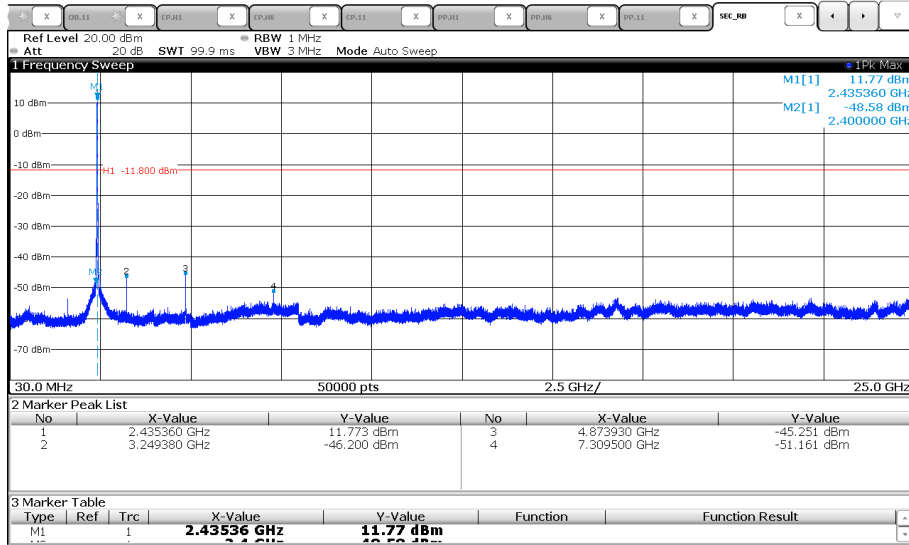
Plots of spurious emissions conducted out of operating frequency bands (-20 dBc)  
802.11b, Ch1

### Spurious emissions conducted from 30 MHz to 25 GHz



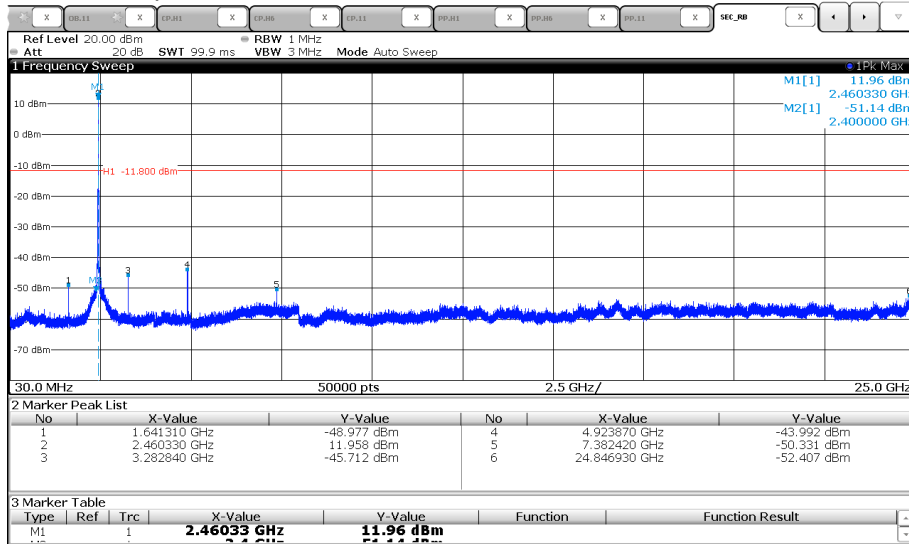
802.11b, Ch6

Spurious emissions conducted from 30 MHz to 25 GHz



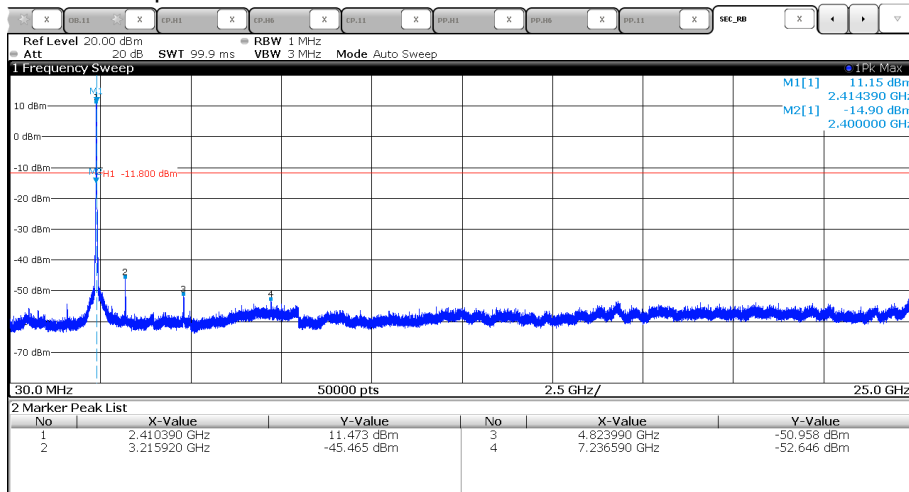
802.11b, Ch11

Spurious emissions conducted from 30 MHz to 25 GHz



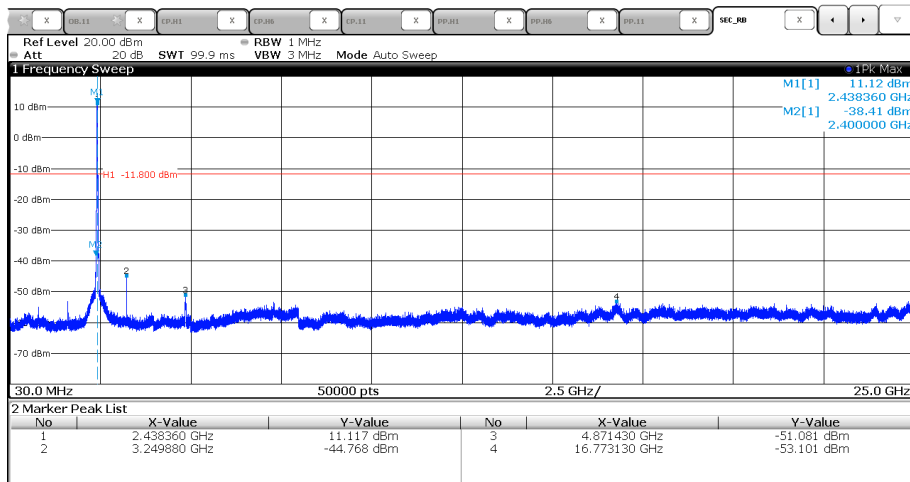
802.11g, Ch1

Spurious emissions conducted from 30 MHz to 25 GHz



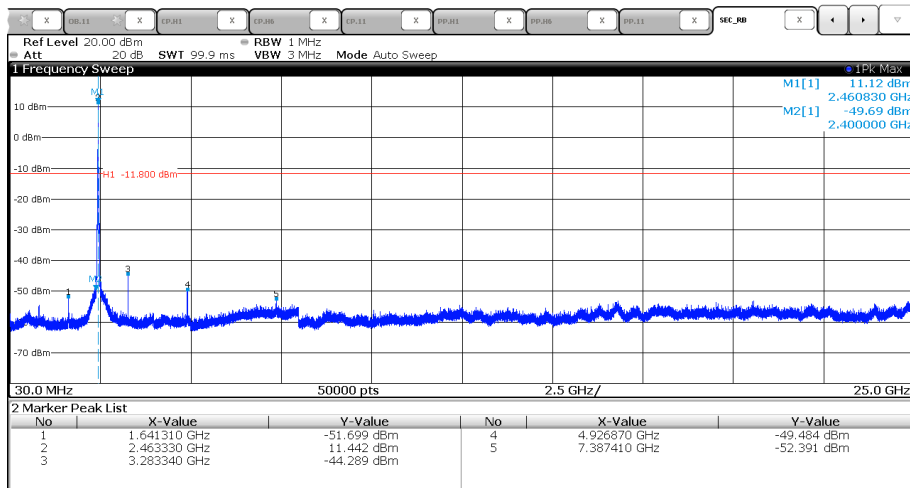
802.11g, Ch6

Spurious emissions conducted from 30 MHz to 25 GHz



802.11g, Ch11

Spurious emissions conducted from 30 MHz to 25 GHz



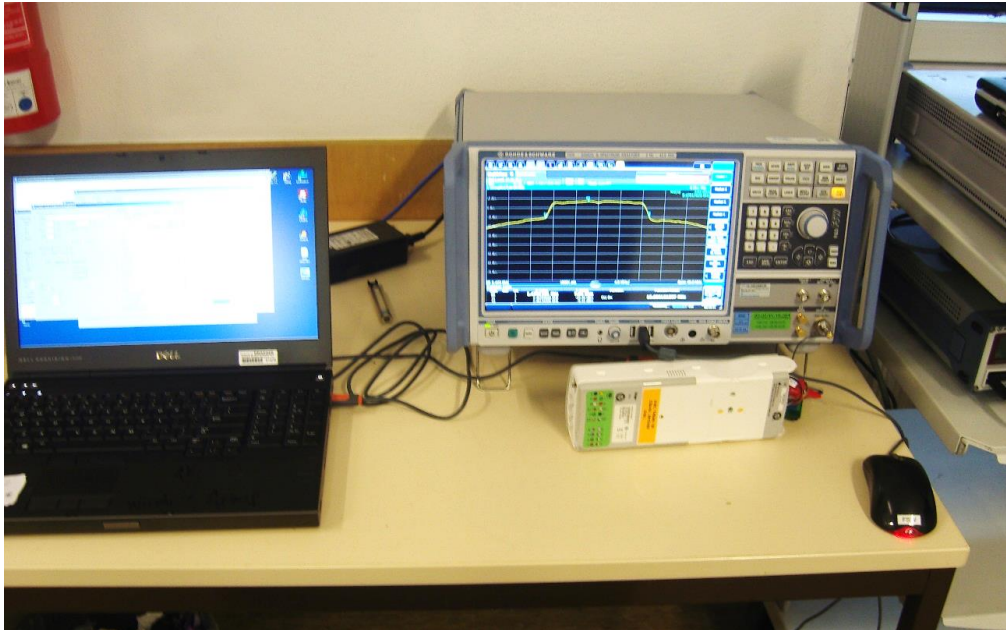
## 5.6 Band edge compliance

For test instruments and accessories used see section 6 Part **SEC3**.

### 5.6.1 Description of the test location

Test location: AREA4

### 5.6.2 Photo documentation of the test set-up



### 5.6.3 Applicable standard

According to FCC Part 15C, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.5 MHz and 5725 – 5850 MHz, the digitally modulated 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 an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

### 5.6.4 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode at the assigned frequency according OET 558074, 05/6/2014, Item 13.3.1.

Spectrum analyser settings:

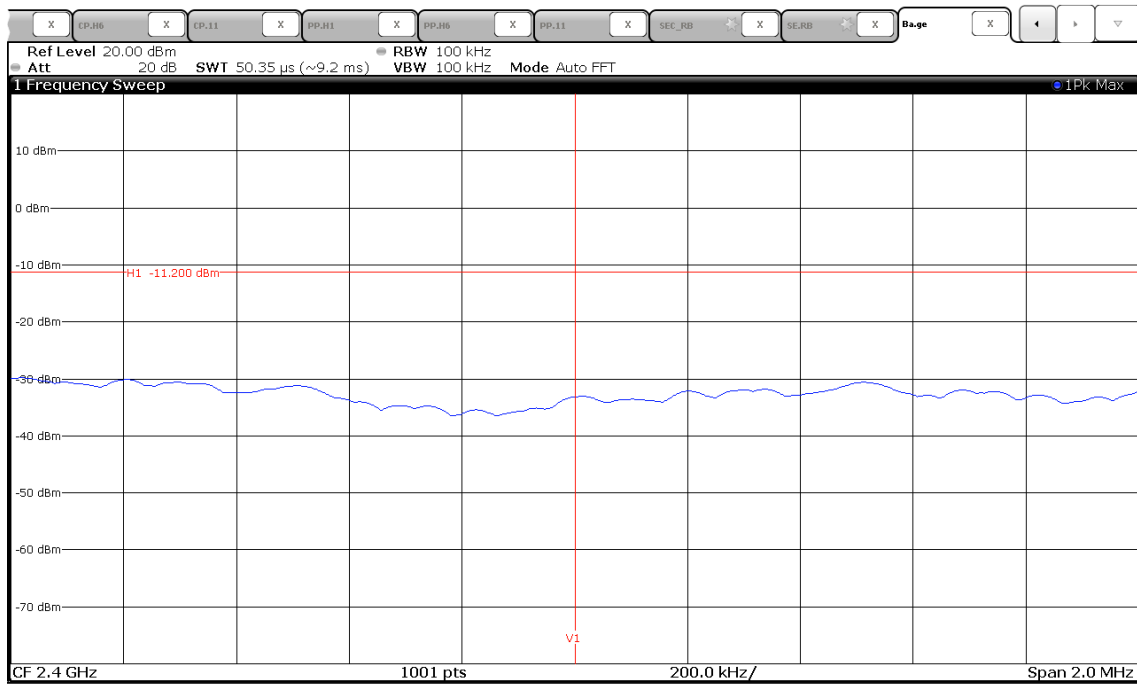
RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Trace: Max hold, Sweep: auto

### 5.6.5 Test result

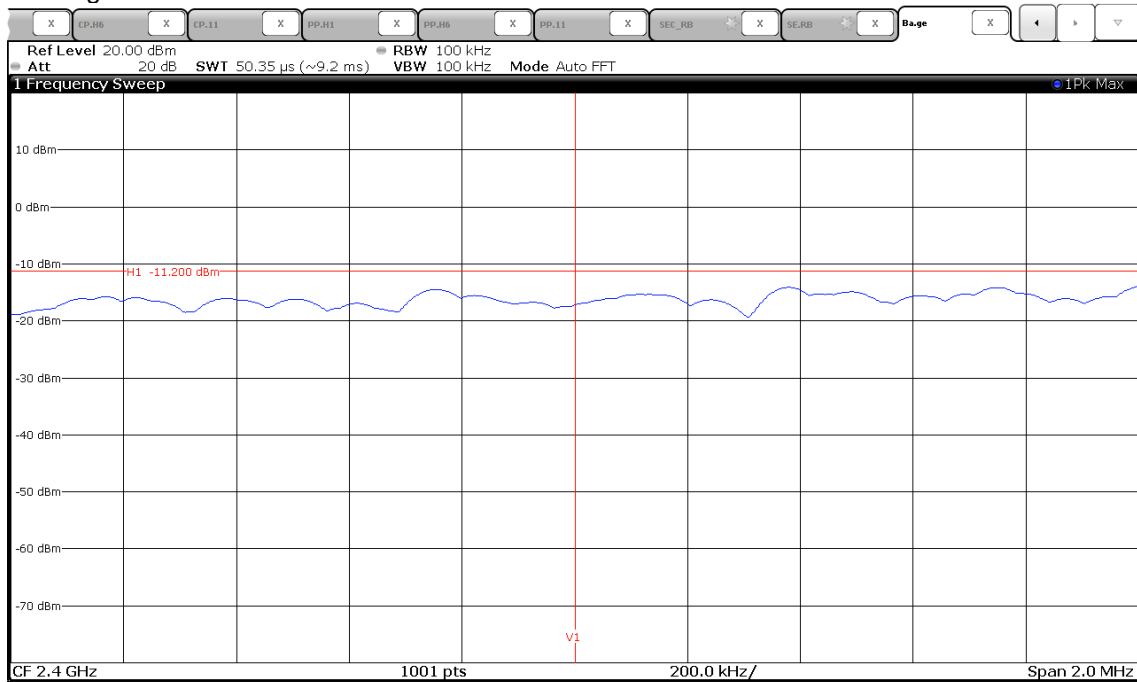
The lower operating frequency is test against the 20 dB down limit.

Lower frequency:

Standard 802.11b

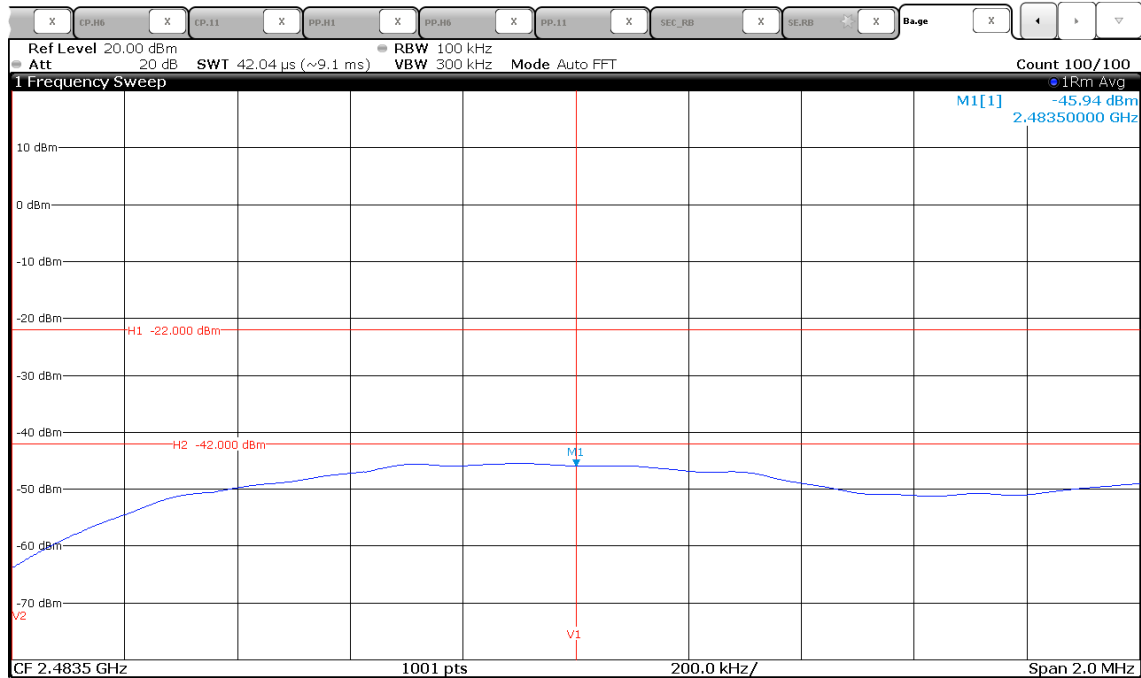


Standard 802.11g



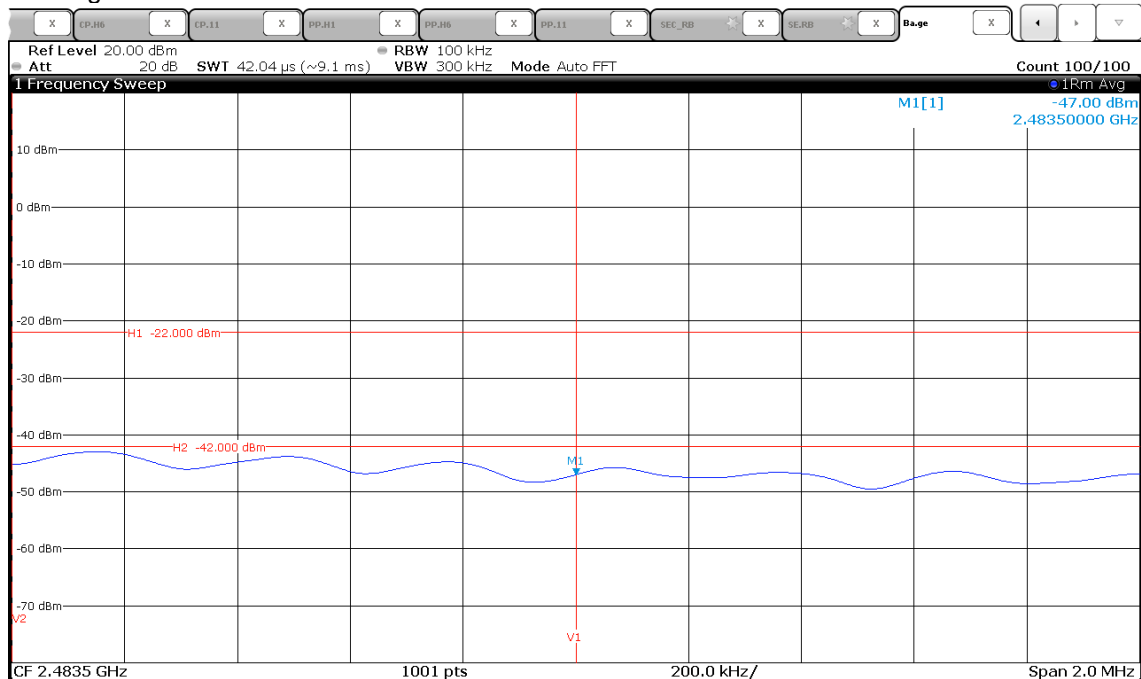
The upper frequency against the restricted band limit. The limit is calculated using the formula  
 $EIRP = E + 20 \log D - 104.8$   
 $EIRP \text{ limit} = 54 \text{ dB}\mu\text{V/m} + 9.5 - 104.8 = -41.2 \text{ dBm}$   
 $FS = EIRP - 20 \log D + 104.8$ ;

Upper frequency:  
 Standard 802.11b



Note:  $EIRP = A + G$ ;  $EIRP = -45.9 + 2.4 \text{ dBi} = -43.5 \text{ dBm}$ ;  $FS = -45.9 - 9.5 + 104.8 = 49.4 \text{ dB}\mu\text{V/m}$ ;

Standard 802.11g



Note:  $EIRP = A + G$ ;  $EIRP = -47 + 2.4 \text{ dBi} = -44.6 \text{ dBm}$ ;  $FS = -44.6 - 9.5 + 104.8 = 50.7 \text{ dB}\mu\text{V/m}$ ;

Peak-Limit according to FCC Subpart 15.247(d):

In any 100 kHz bandwidth outside the frequency band 2400 – 2483.5 MHz, 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. Attenuation below the general limits specified in §15.209(a) is not required.

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

The requirements are **FULFILLED**.

**Remarks:**

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## 5.7 Unwanted emissions in restricted bands, cabinet radiation

For test instruments and accessories used see section 6 Part **SER 2**, **SER 3**.

### 5.7.1 Description of the test location

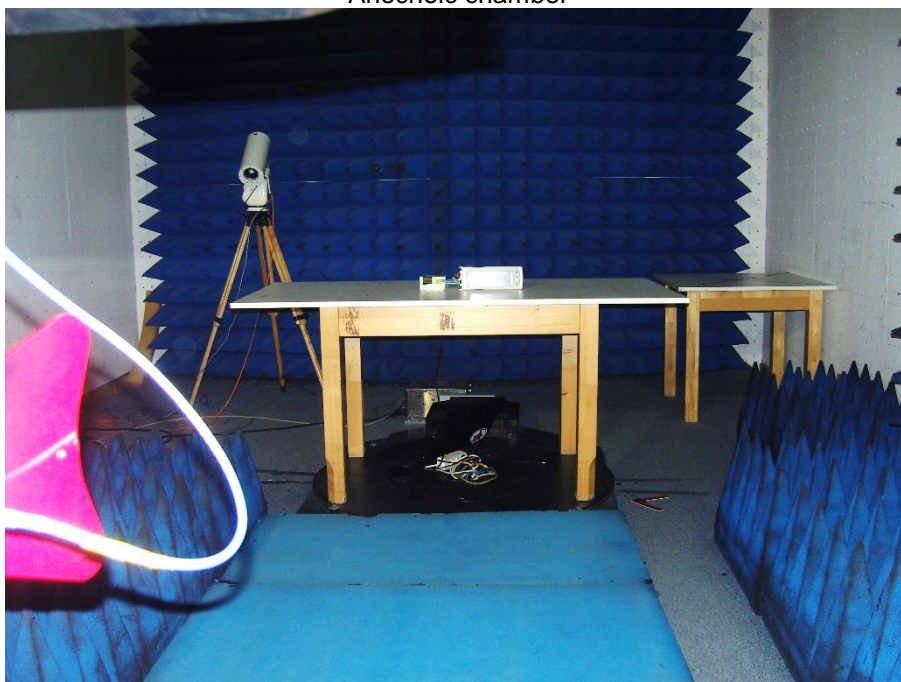
Test location:	OATS 1
Test distance:	3 m
Test location:	Anechoic chamber 2
Test distance:	3 m

### 5.7.2 Photo documentation of the test set-up

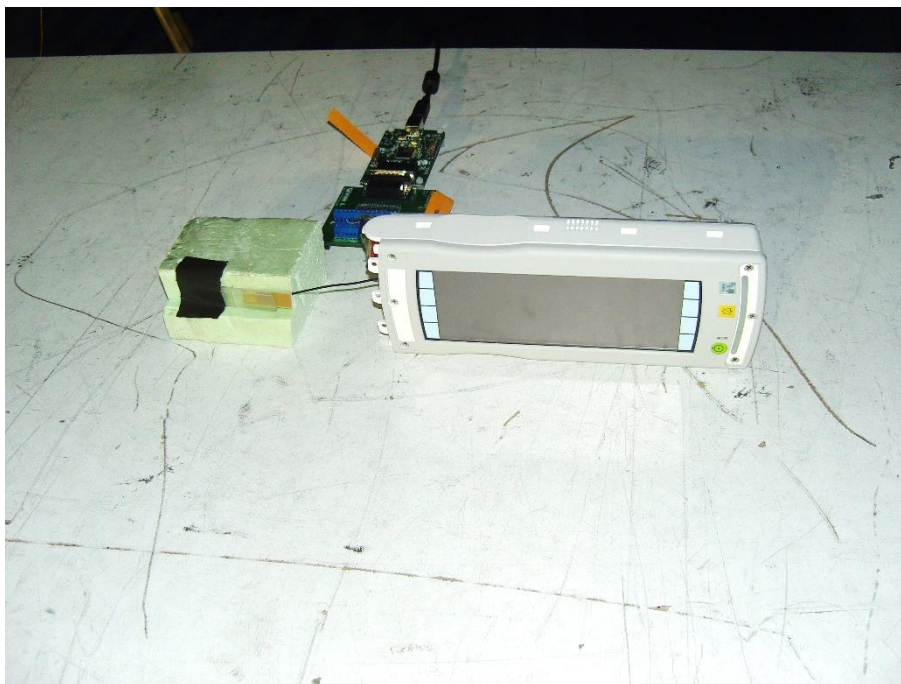
OATS1



Anechoic chamber







According to FCC Part 15, Section 15.205(a):

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

### 5.7.3 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

Spectrum analyser settings:

9 kHz – 150 kHz	RBW: 200 Hz
150 kHz - 30 MHz	RBW: 9 kHz
30 MHz – 1000 MHz:	RBW: 120 kHz
1000 MHz – 25 GHz:	RBW: 1 MHz, VBW: 3 MHz, Sweep: Auto, Detector function: Peak

### 5.7.1 Test result

#### WLAN Standard 802.11b

9 kHz < f < 30 MHz

In this frequency range only noise floor could be measured.

30 MHz < f < 1 GHz

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
383.95	17.7	25.0	19.1	18.7	36.8	43.7	46.0	-2.3
479.97	2.0	7.2	21.7	21.5	23.7	28.7	46.0	-17.3
576.00	8.6	6.9	24.6	24.1	33.2	31.0	46.0	-12.8
661.44	1.2	0.6	26.4	25.8	27.6	26.4	46.0	-18.4

1 GHz < f

Lower Channel

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
1596.00	68.3	61.3	-21.3	-21.3	47.0	40.0	74.0	-27.0
2089.00	60.5	56.8	-16.4	-16.4	44.1	40.4	74.0	-29.9
2140.00	61.2	56.9	-16.7	-16.7	44.5	40.2	74.0	-29.5
2197.00	63.1	51.4	-16.6	-16.6	46.5	34.8	74.0	-27.5
2242.00	60.6	52.0	-16.3	-16.3	44.3	35.7	74.0	-29.7
3192.00	59.7	51.7	-13.1	-13.1	46.6	38.6	74.0	-27.4
3990.00	56.8	50.1	-11.5	-11.5	45.3	38.6	74.0	-28.7
4824.00	45.4	41.3	2.8	2.8	48.2	44.1	74.0	-25.8
11983.00	42.7	36.8	11.5	11.5	54.2	48.3	74.0	-19.8

In the frequency range 12 GHz to 25 GHz only noise floor could be measured.

Mid Channel

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
1596.00	66.0	62.1	-20.9	-20.9	45.1	41.2	74.0	-28.9
2390.00	66.4	58.6	-14.6	-14.6	51.8	44.0	74.0	-22.2
3186.00	59.0	51.4	-13.0	-13.0	46.0	38.4	74.0	-28.0
4924.00	42.3	36.9	2.5	2.5	44.8	39.4	74.0	-29.2
11923.00	42.5	37.5	11.5	11.5	54.0	49.0	74.0	-20.0

In the frequency range 12 GHz to 25 GHz only noise floor could be measured.

Higher Channel

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
1594.00	71.6	62.5	-21.2	-21.2	50.4	41.3	74.0	-23.6
2189.00	62.7	56.3	-16.6	-16.6	46.1	39.7	74.0	-27.9
2390.00	62.1	57.4	-14.8	-14.8	47.3	42.6	74.0	-26.7
2493.00	59.9	51.6	-14.3	-14.3	45.6	37.3	74.0	-28.4
3188.00	58.7	49.3	-13.1	-13.1	45.6	36.2	74.0	-28.4
3192.00	61.9	53.8	-13.1	-13.1	48.8	40.7	74.0	-25.2
3990.00	57.5	50.6	-11.5	-11.5	46.0	39.1	74.0	-28.0
8927.00	44.2	39.6	8.0	8.0	52.2	47.6	74.0	-21.8
11985.00	43.2	33.4	11.5	11.5	54.7	44.9	74.0	-19.3

In the frequency range 12 GHz to 25 GHz only noise floor could be measured.

**WLAN Standard 802.11g**

9 kHz < f < 30 MHz

In this frequency range only noise floor could be measured.

30 MHz < f < 1 GHz

Frequency (MHz)	Reading Vert. (dBμV)	Reading Hor. (dBμV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBμV/m)	Level Hor. (dBμV/m)	Limit (dBμV/m)	Dlimit (dB)
383.95	17.5	24.6	19.1	18.7	36.6	43.3	46.0	-2.7
479.97	3.6	8.1	21.7	21.5	25.3	29.6	46.0	-16.4
576.00	9.5	7.5	24.6	24.1	34.1	31.6	46.0	-11.9
661.44	2.3	7.3	26.4	25.8	28.7	33.1	46.0	-12.9

1 GHz < f

Lower Channel

Frequency (MHz)	Reading Vert. (dBμV)	Reading Hor. (dBμV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBμV/m)	Level Hor. (dBμV/m)	Limit (dBμV/m)	Dlimit (dB)
1595.00	73.4	61.3	-21.2	-21.2	52.2	40.1	74.0	-21.8
2192.00	63.8	53.6	-16.6	-16.6	47.2	37.0	74.0	-26.8
2200.00	63.6	54.2	-16.6	-16.6	47.0	37.6	74.0	-27.0
2489.00	60.6	53.2	-14.3	-14.3	46.3	38.9	74.0	-27.7
3186.00	60.6	52.3	-13.1	-13.1	47.5	39.2	74.0	-26.5
3192.00	60.8	51.9	-13.1	-13.1	47.7	38.8	74.0	-26.3
3991.00	58.2	49.6	-11.5	-11.5	46.7	38.1	74.0	-27.3
11994.00	43.1	37.4	11.5	11.5	54.6	48.9	74.0	-19.4

Mid Channel

Frequency (MHz)	Reading Vert. (dBμV)	Reading Hor. (dBμV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBμV/m)	Level Hor. (dBμV/m)	Limit (dBμV/m)	Dlimit (dB)
1595.00	60.1	56.3	-20.9	-20.9	39.2	35.4	74.0	-34.8
2389.00	66.9	58.9	-14.6	-14.6	52.3	44.3	74.0	-21.7
3249.00	57.6	49.0	-12.8	-12.8	44.8	36.2	74.0	-29.2
4874.00	41.8	37.8	2.3	2.3	44.1	40.1	74.0	-29.9
11855.00	37.7	36.4	11.0	11.0	48.7	47.4	74.0	-25.3

In the frequency range 12 GHz to 25 GHz only noise floor could be measured.

**Higher Channel**

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
1595.00	71.5	59.9	-21.2	-21.2	50.3	38.7	74.0	-23.7
2197.00	62.6	51.4	-16.6	-16.6	46.0	34.8	74.0	-28.0
2339.00	61.0	49.6	-15.5	-15.5	45.5	34.1	74.0	-28.5
2492.00	64.8	51.7	-14.3	-14.3	50.5	37.4	74.0	-23.5
3188.00	61.9	53.6	-13.1	-13.1	48.8	40.5	74.0	-25.2
3990.00	59.3	50.9	-11.5	-11.5	47.8	39.4	74.0	-26.2
8927.00	44.2	39.5	8.0	8.0	52.2	47.5	74.0	-21.8
11985.00	43.2	38.6	11.5	11.5	54.7	50.1	74.0	-19.3

In the frequency range 12 GHz to 25 GHz only noise floor could be measured.

**Average re-measurement**

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
CH1b								
11989.00	41.8	40.3	11.5	11.5	53.3	51.8	54.0	-0.7
CH11b								
11974.00	42.1	40.1	11.5	11.5	53.6	51.6	54.0	-0.4
CH1g								
11994.00	42.1	40.2	11.5	11.5	53.6	51.7	54.0	-0.4
CH11g								
11974.00	42.1	39.6	11.5	11.5	53.6	51.1	54.0	-0.4

Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance
	(µV/m)	dB(µV/m)	(metres)
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

**Restricted bands of operation:**

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

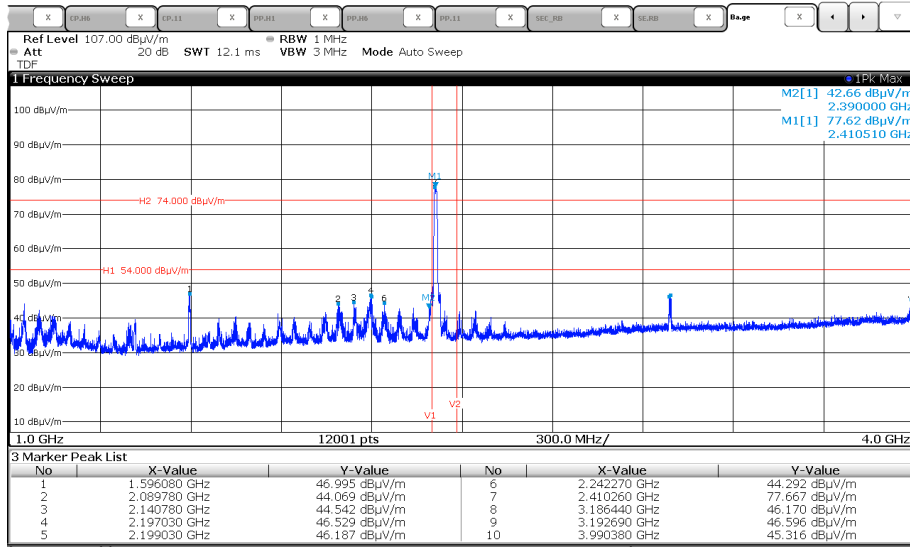
The requirements are **FULFILLED**.

**Remarks:** The measurement was performed up to the 10<sup>th</sup> harmonic. For detailed test results please see to following test protocols.

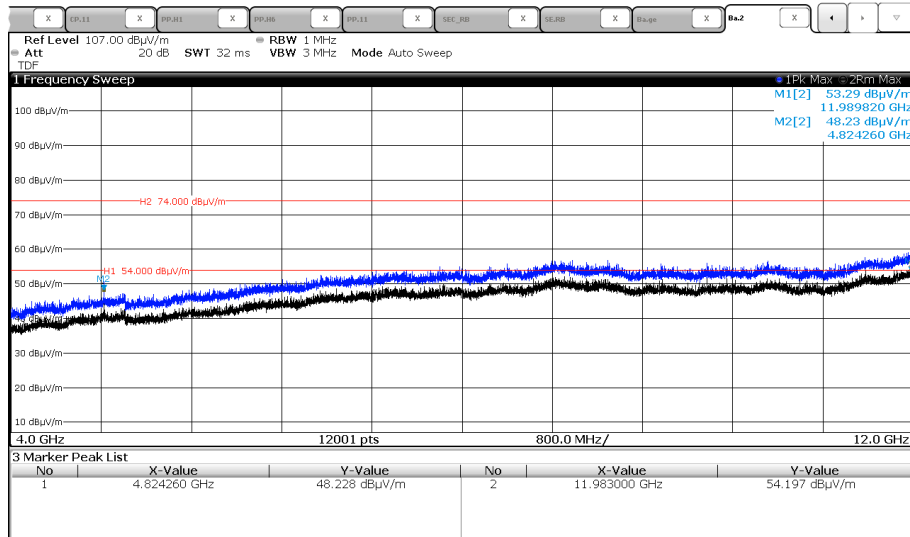
## 5.7.2 Test protocols of restricted band emissions

### 802.11b

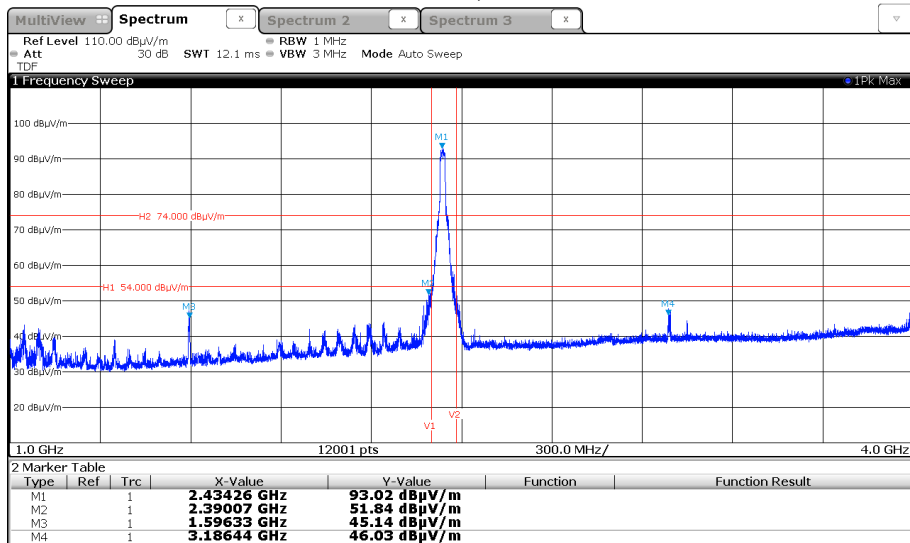
#### 1 GHz to 4 GHz, low channel



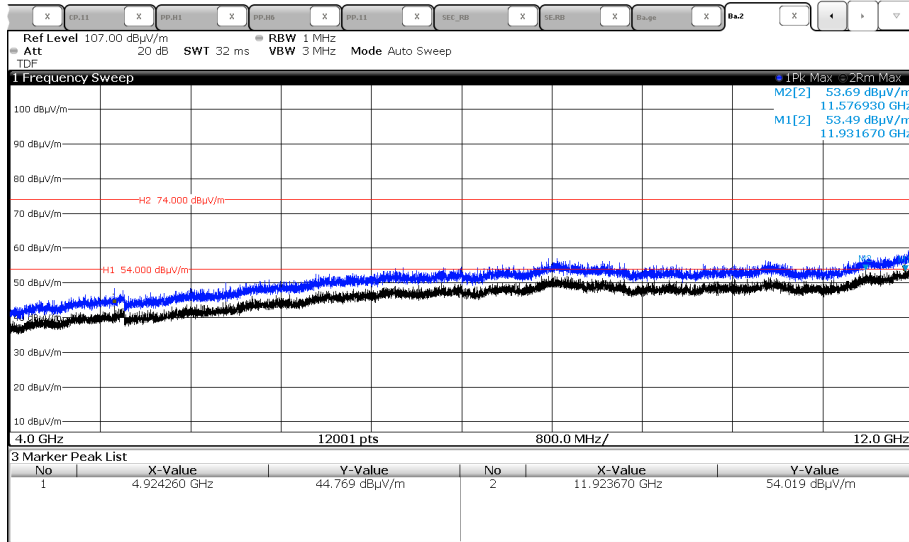
#### 4 GHz to 12 GHz, low channel



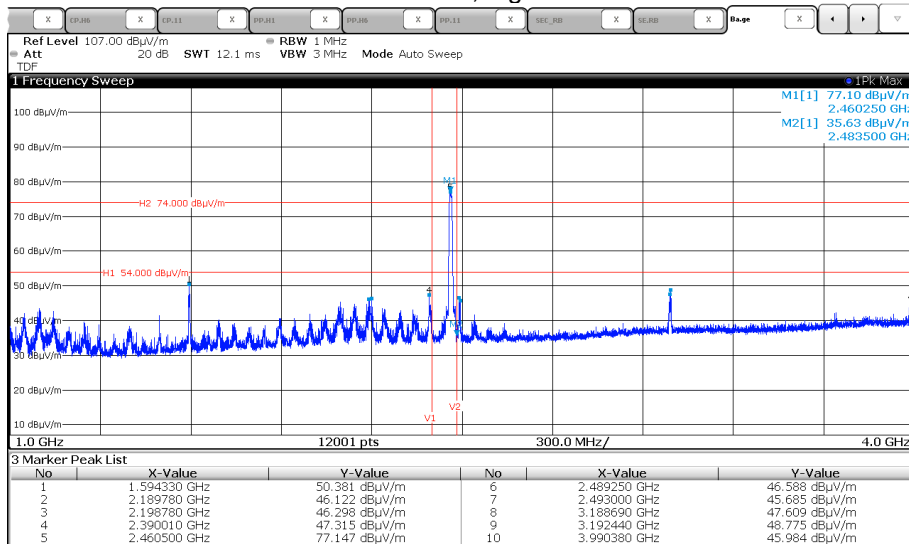
#### 1 GHz to 4 GHz, mid channel



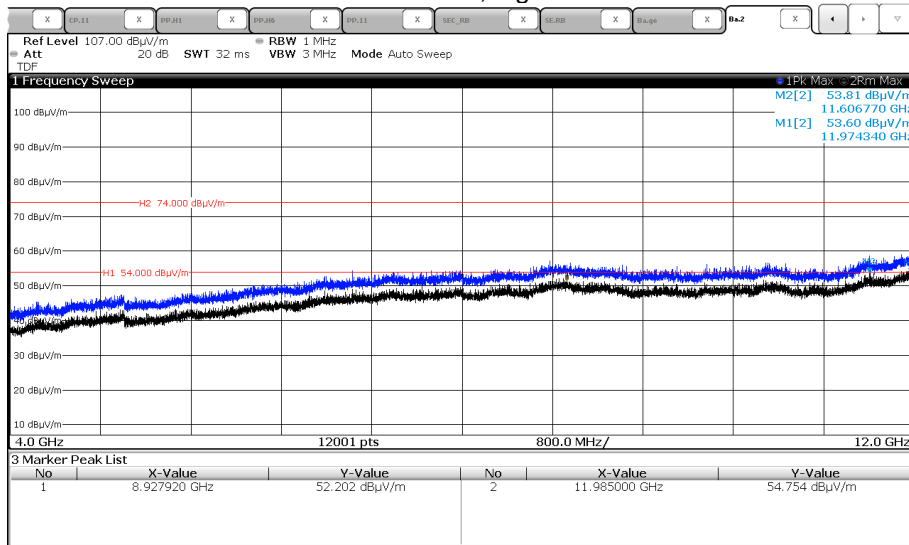
4 GHz to 12 GHz, mid channel



1 GHz to 4 GHz, high channel



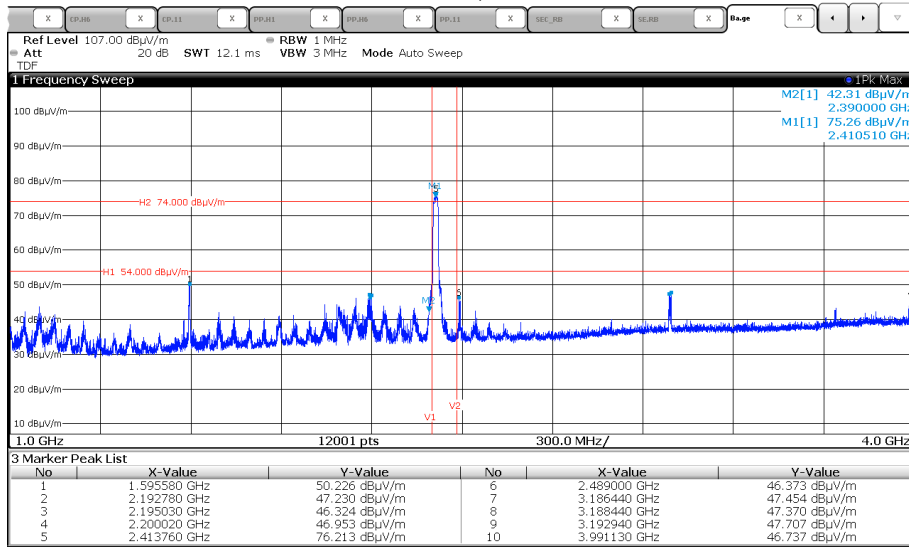
4 GHz to 12 GHz, high channel



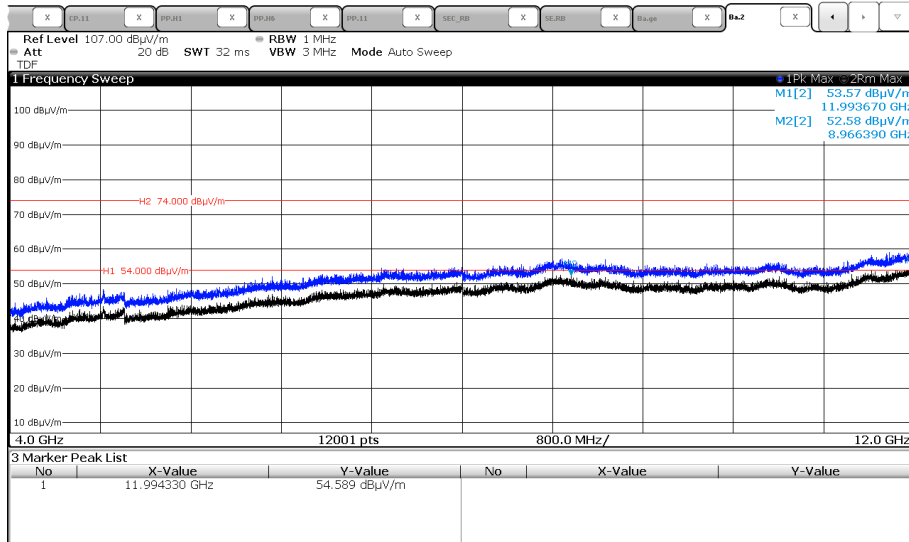
**Remark:** All peak emissions were below the limits of part 15.209.

802.11g

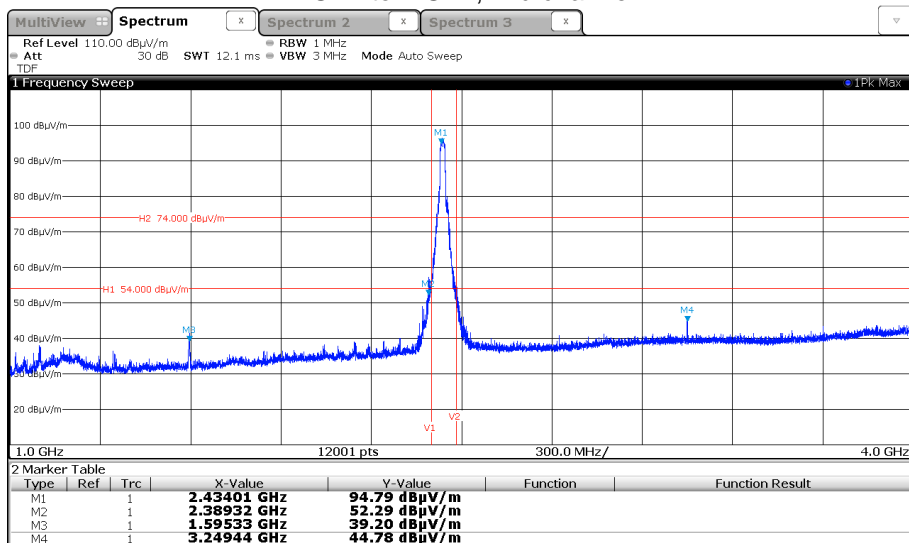
1 GHz to 4 GHz, low channel



4 GHz to 12 GHz, low channel

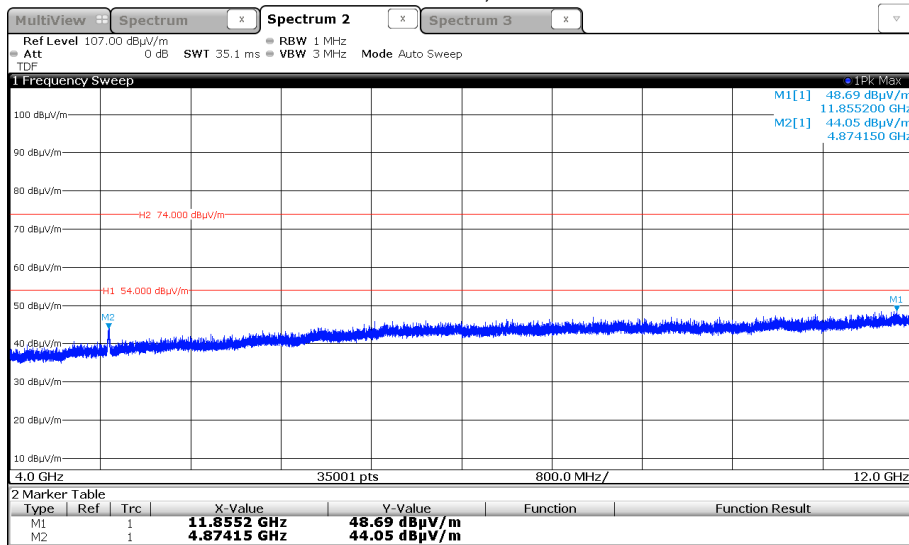


1 GHz to 4 GHz, mid channel

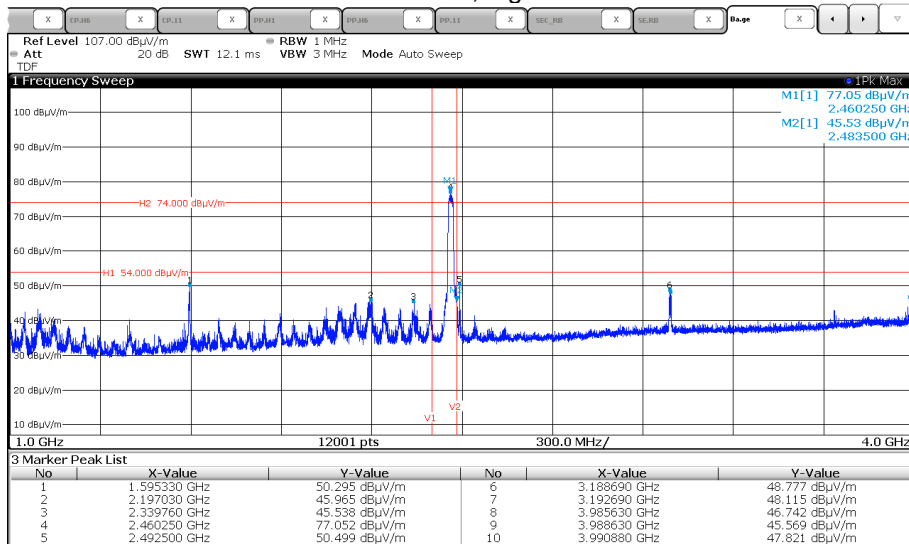




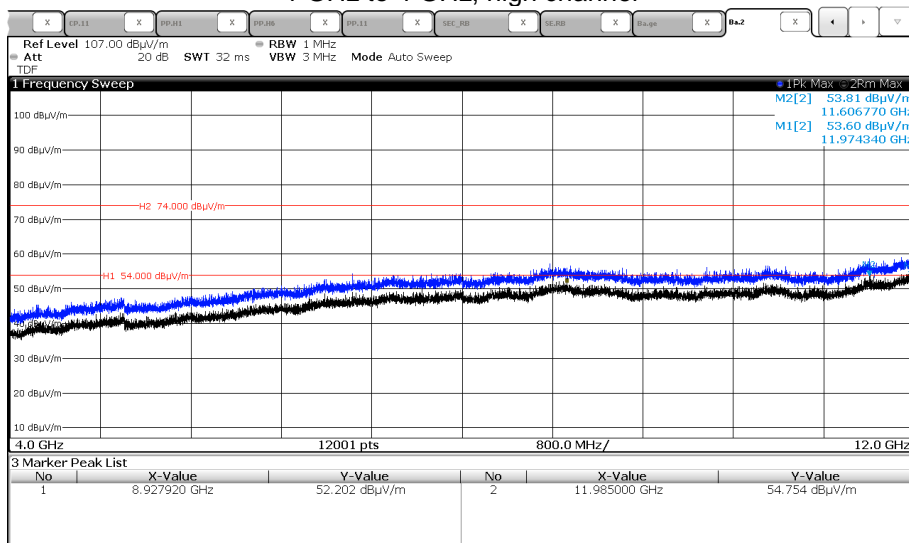
4 GHz to 12 GHz, mid channel



1 GHz to 4 GHz, high channel



1 GHz to 4 GHz, high channel



Remark: All peak emissions were below the limits of part 15.209.

## 5.9 Antenna application

### 5.9.1 Applicable standard

According to FCC Part 15C, Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated antenna. No other antenna can be used with the device.

All supplied antennas meet the requirements of part 15.203 and 15.204.

### 5.9.2 Antenna requirements

According to FCC Part 15C, Section 15.247(b)(4):

The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Defacto EIRP-Limit:**

$$P_{out} = 30 - (G_x - 6);$$

Antenna	G <sub>x</sub> (dBi)	Cond. limit (dBm)	max. G (dBi)	A [P15] (dBm)	Limit P <sub>out</sub> (dBm)	Reduction (dB)	P set 2.4 GHz
Fractus chip	2.4	30.0	6.0	23.1	33.6	-10.5	P15

**Remarks:** No power reduction results from the defacto limit.

## **6 USED TEST EQUIPMENT AND ACCESSORIES**

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

<b>Test ID</b>	<b>Model Type</b>	<b>Equipment No.</b>	<b>Next Calib.</b>	<b>Last Calib.</b>	<b>Next Verif.</b>	<b>Last Verif.</b>
A 4	ESCI	02-02/03-05-004	17/09/2016	17/09/2015		
	ESH 2 - Z 5	02-02/20-05-004	18/10/2015	18/10/2013	21/01/2016	21/07/2015
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	19/11/2015	19/11/2014	09/12/2015	09/06/2015
CPC 3	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
MB	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
SEC 1-3	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
SER 2	ESVS 30	02-02/03-05-003	09/07/2016	09/07/2015		
	VULB 9168	02-02/24-05-005	17/04/2016	17/04/2015	29/02/2016	31/08/2015
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSW43	02-02/11-15-001	05/08/2016	05/08/2015		
	JS4-18004000-30-5A	02-02/17-05-017				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	12/05/2016	12/05/2015		
	BBHA 9170	02-02/24-05-014	02/06/2018	02/06/2015	02/06/2016	02/06/2015
	Sucoflex N-2000-SMA	02-02/50-05-075				
	KMS102-0.2 m	02-02/50-11-020				
	SF104/11N/11N/1500MM	02-02/50-13-015				