

EMI – TEST REPORT

- FCC Part 15.247, RSS247 -

Type / Model Name : Morin

Product Description : WLAN-Modul 2.4 GHz

Applicant : Embedded Wireless GmbH

Address : Soeflinger Str. 200

89077 ULM, GERMANY

Manufacturer : Embedded Wireless GmbH

Address : Soeflinger Str. 200

89077 ULM, GERMANY

Licence holder : Embedded Wireless GmbH

Address : Soeflinger Str. 200

89077 ULM, GERMANY

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

POSITIVE

Test Report No. : **T41447-02-00HS**

09. February 2017

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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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2016)

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 2016)

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 C63.10: 2013 Testing Unlicensed Wireless Devices

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

KDB 558074 D01 v03r05 Guidance for performing compliance measurements on DTS
operating under §15.247, April 8, 2016.

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.2 Equipment type

WLAN - AP

2.3 Short description of the equipment under test (EUT)

The EUT is a WLAN-module and may be configured as access point or client. The firmware does not support ad-hoc modes and gives the user no possibility to choose the channel for data transmission or power setting. The AP is compatible with 802.11b, g, n Standard. It supports the 2.4 GHz frequency band and supports no beam forming.

Number of tested samples: 1
Serial number: 133
Firmware version: 1.0

EUT configuration:

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

2.4 Variants of the EUT

There are no variants.

2.5 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan WLAN Standard 802.11b/g/n, HT20:

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.

Channel plan WLAN Standard 802.11n, HT40:

Channel, HT40 up	Channel, HT40 down	Frequency (MHz)
1 up	5 down	2422
2 up	6 down	2427
3 up	7 down	2432
4 up	8 down	2437
5 up	9 down	2442
6 up	10 down	2447
7 up	11 down	2452

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)
- 802.11n HT20, MCS 0 - 15
- 802.11n HT40, MCS 0 - 15

2.7 Antenna

The following antenna shall be used with the EUT:

Number	Characteristic	Certification name	Plug	f-range (GHz)	Gain (dBi)	Cable loss (dB)	Effective gain (dBi)
1	Omni	PCB-inverted F	-	2.4	2.1	0	2.1

2.8 Power supply system utilised

Power supply voltage, V_{nom} : 5 VDC (USB-power supply of the test jig)

2.9 Extreme test conditions

The extreme temperature range for the EUT is defined by the manufacturer:

-5 °C to +65 °C, $T_{nom} = 20$ °C;

2.10 Peripheral devices and interface cables

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

- USB-cable, 1 m Model : Common type
- - Model : -
- Model : -

2.11 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 20 dBm (P1 to P20) in 1 dB steps.

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

WLAN	Available channel	Tested channels	Modulation	Modulation type	Data rate
802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1 Mbps
802.11n HT20	1 to 11	1, 6, 11	OFDM	BPSK	MCS0
802.11n HT40	1up to 7up	1up, 4up, 7up	OFDM	BPSK	MCS0

- TX continuous mode, 802.11 b
- TX continuous mode, 802.11n

Table of power setting			
WLAN	Lower channel	Middle channel	Upper channel
802.11b	P11	P14	P14
802.11g	P5	P14	P8
802.11n HT20	P4	P14	P8
802.11n HT40	P3	P9	P8

Due to the modulation 802.11g is nearly the same as 802.11n HT20 except the header, the 802.11n HT20 is listed as worst case only.

2.11.1 Test jig

The measurements are performed under the support of a test jig. The test jig provides a USB-Jack for control signals and power supply. The host is already at the WLAN module on-board.

2.11.2 Test software

The test software (OpenWRT) for the EUT provides free power setting, the special test mode RX and the TX continuous mode (TX99), modulated. The tests are performed using the country setting DE, packet sending. The EUT is set with test modulation to transmit data during the tests with a duty cycle (X) of assumed X = 99.

1 TEST RESULT SUMMERY

WLAN device using digital modulation:

Operating in the 2400 MHz – 2483.5 MHz:

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(4)	Maximum conducted output power	passed
15.247(b)(4)	RSS247, 5.4(4)	Defacto limit	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

2.12 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 : 29 September 2016

Testing concluded on : 20 January 2017

Checked by:

Tested by:

 Klaus Gegenfurtner
 Teamleader Radio

 Hermann Smetana
 Radio Team

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

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

3.2 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

3.3 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.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 3000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Maximum peak conducted output power	2400 MHz to 3000 MHz	95%	± 0.62 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB
Conducted Spurious Emissions	10000 MHz to 40000 MHz	95%	± 3.47 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Field strength of the fundamental	100 kHz to 100 MHz	95%	± 3.53 dB

3.4 Measurement protocol for FCC and ISCED

3.4.1 General information

3.4.1.1 Test methodology

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

IC 3009A-1

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:

IC 3009A-2

In compliance with RSS 247 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

3.4.1.2 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.

3.4.1.3 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 C63.10 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 C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center 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 center 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 setting of EMC-Receiver:

30 MHz – 1000 MHz: RBW: 120 kHz, Detector: QP;

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 1.5 metre 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 C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center 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 analyzer set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak 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.

4 TEST CONDITIONS AND RESULTS

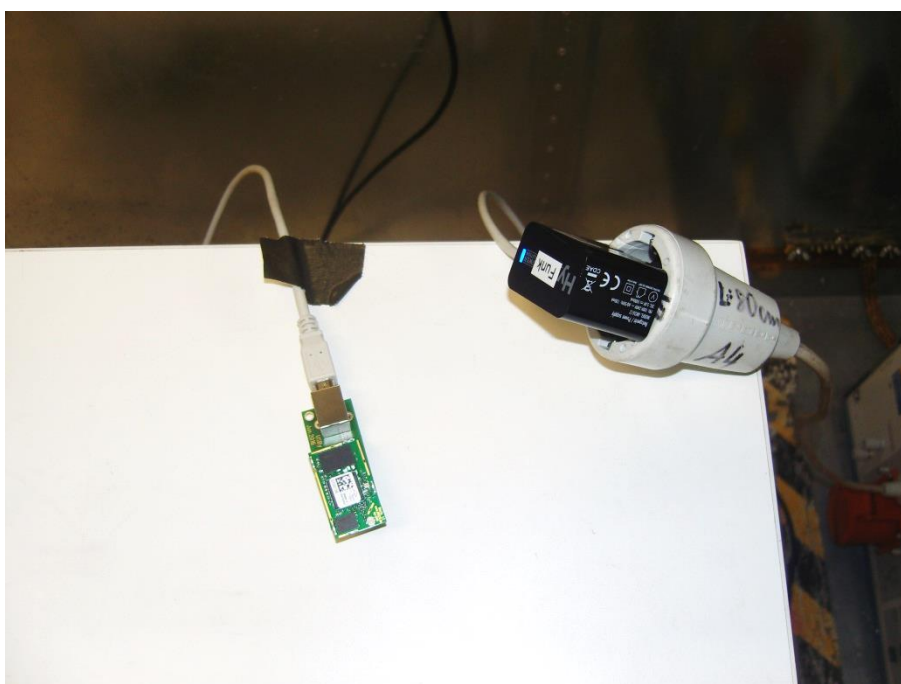
4.1 AC power line conducted emissions

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

4.1.1 Description of the test location

Test location: Shielded Room S2

4.1.2 Photo documentation of the test set-up



4.1.3 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.

4.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 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.

4.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 11.1 dB at 0.372 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

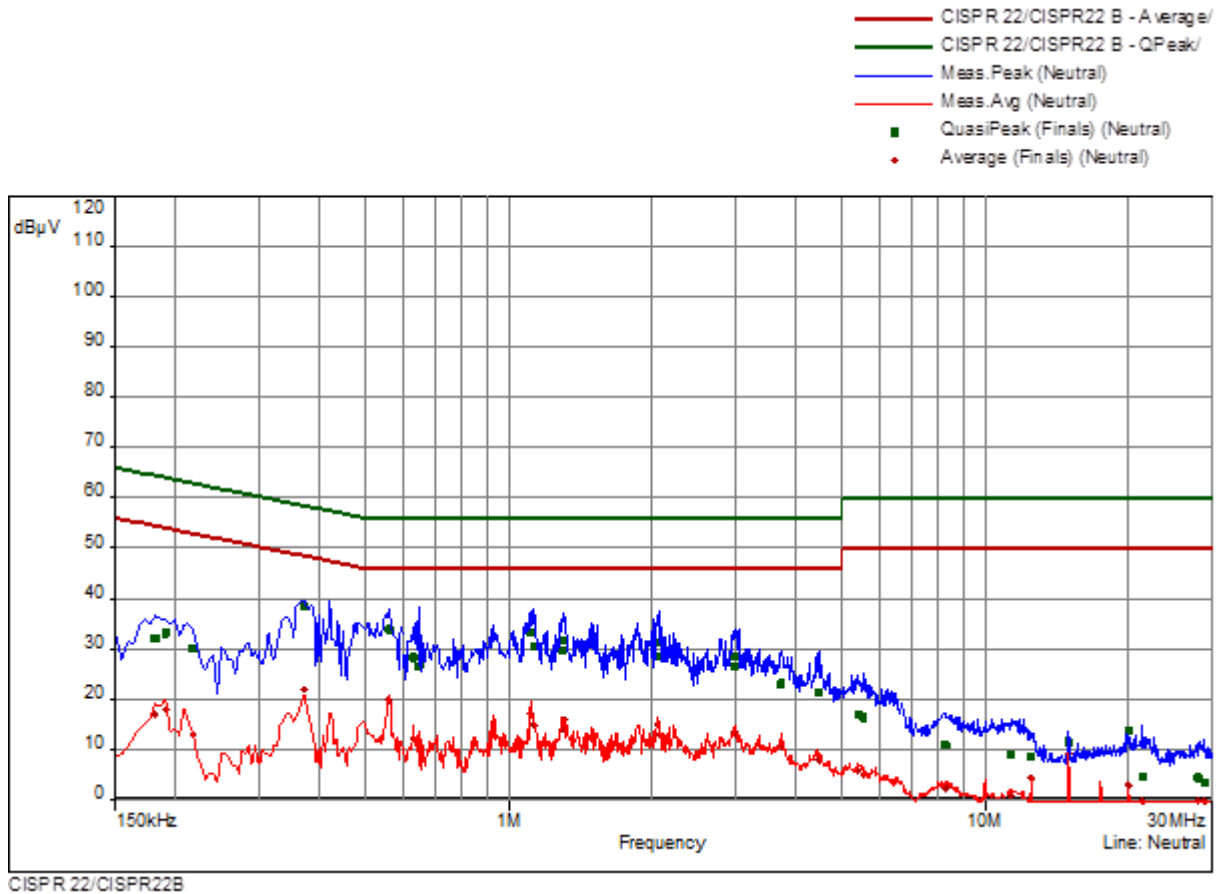
The requirements are **FULFILLED**.

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

4.1.6 Test protocol

Test point: L1
Operation mode: TX 2.4 GHz
Remarks:

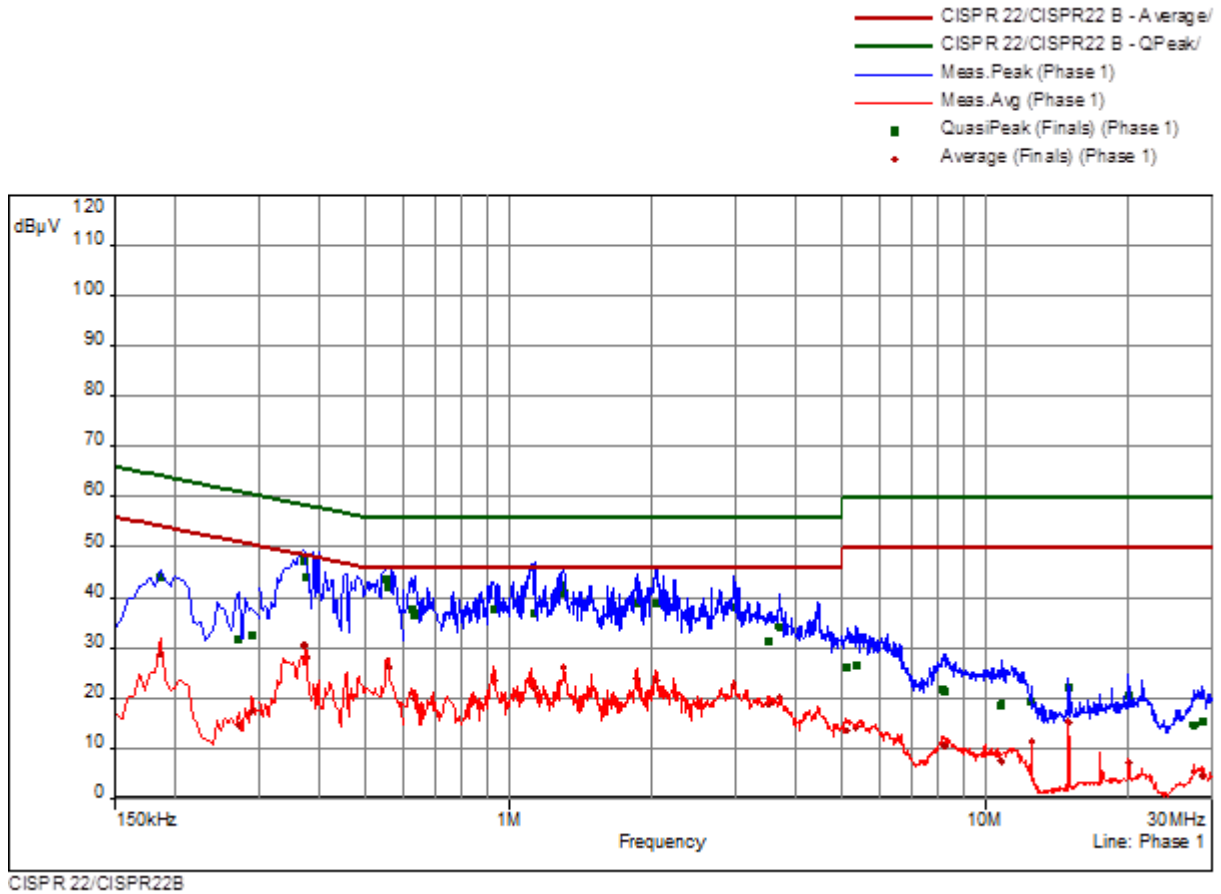
Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.182	9	32.1	32.4	64.4	16.8	37.6	54.4	Neutral	9.9
0.191	9	33.1	30.9	64.0	17.8	36.2	54.0	Neutral	9.9
0.218	9	30.0	32.9	62.9	13.1	39.8	52.9	Neutral	9.9
0.372	10	38.3	20.1	58.5	21.7	26.8	48.5	Neutral	9.8
0.561	10	33.9	22.1	56.0	19.8	26.2	46.0	Neutral	9.8
0.632	11	28.2	27.8	56.0	11.9	34.1	46.0	Neutral	9.8
0.650	11	26.5	29.5	56.0	9.8	36.2	46.0	Neutral	9.8
1.113	11	33.2	22.8	56.0	17.0	29.0	46.0	Neutral	9.8
1.131	11	30.3	25.7	56.0	14.8	31.2	46.0	Neutral	9.8
1.295	12	29.6	26.4	56.0	14.0	32.0	46.0	Neutral	9.8
1.308	12	31.6	24.4	56.0	15.9	30.1	46.0	Neutral	9.8
2.055	12	31.2	24.8	56.0	14.8	31.2	46.0	Neutral	9.8
2.073	12	28.5	27.5	56.0	12.8	33.2	46.0	Neutral	9.8
2.981	13	28.6	27.4	56.0	13.6	32.5	46.0	Neutral	9.8
2.994	13	26.5	29.5	56.0	13.0	33.0	46.0	Neutral	9.8
3.737	13	23.1	32.9	56.0	10.6	35.4	46.0	Neutral	9.8
4.488	13	21.3	34.8	56.0	7.8	38.2	46.0	Neutral	9.8
5.426	14	16.9	43.1	60.0	5.7	44.3	50.0	Neutral	9.8
5.556	14	16.3	43.7	60.0	4.9	45.1	50.0	Neutral	9.8
8.234	14	10.8	49.2	60.0	2.4	47.6	50.0	Neutral	9.8
8.261	14	10.8	49.2	60.0	2.3	47.7	50.0	Neutral	9.8
11.328	15	9.1	51.0	60.0	0.7	49.3	50.0	Neutral	9.8
12.503	15	8.6	51.4	60.0	4.2	45.8	50.0	Neutral	9.9
15.000	15	11.5	48.5	60.0	9.0	41.1	50.0	Neutral	9.9
20.001	16	13.7	46.3	60.0	2.9	47.1	50.0	Neutral	10.1
21.383	16	4.5	55.5	60.0	-2.2	52.2	50.0	Neutral	10.1
28.011	16	4.3	55.7	60.0	-0.8	50.8	50.0	Neutral	9.8
28.848	16	3.3	56.7	60.0	-2.3	52.3	50.0	Neutral	9.8

Test point: N
Operation mode: TX 2.4 GHz
Remarks:

Result: passed



freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.186	1	44.0	20.2	64.2	28.7	25.5	54.2	Phase 1	9.8
0.272	1	31.5	29.6	61.1	14.5	36.6	51.1	Phase 1	9.8
0.290	1	32.6	27.9	60.5	17.3	33.2	50.5	Phase 1	9.8
0.372	2	47.3	11.1	58.5	30.5	18.0	48.5	Phase 1	9.8
0.377	2	44.1	14.2	58.4	28.0	20.3	48.4	Phase 1	9.8
0.557	2	43.6	12.4	56.0	27.3	18.7	46.0	Phase 1	9.8
0.561	2	42.0	14.0	56.0	26.2	19.8	46.0	Phase 1	9.8
0.627	3	37.7	18.3	56.0	21.1	24.9	46.0	Phase 1	9.8
0.636	3	36.6	19.4	56.0	19.8	26.2	46.0	Phase 1	9.8
0.933	3	37.6	18.4	56.0	23.4	22.6	46.0	Phase 1	9.8
1.136	3	36.7	19.3	56.0	22.0	24.0	46.0	Phase 1	9.8
1.299	4	42.3	13.7	56.0	26.1	19.9	46.0	Phase 1	9.8
1.304	4	41.0	15.0	56.0	26.0	20.0	46.0	Phase 1	9.8
1.862	4	38.7	17.3	56.0	23.9	22.1	46.0	Phase 1	9.8
2.051	4	38.9	17.1	56.0	23.4	22.6	46.0	Phase 1	9.8
2.972	5	38.0	18.0	56.0	22.6	23.4	46.0	Phase 1	9.8
2.976	5	38.2	17.8	56.0	22.6	23.4	46.0	Phase 1	9.8
3.521	5	31.2	24.8	56.0	18.9	27.1	46.0	Phase 1	9.8
3.714	5	34.1	22.0	56.0	20.2	25.8	46.0	Phase 1	9.8
5.120	6	25.9	34.1	60.0	13.4	36.6	50.0	Phase 1	9.8
5.367	6	26.5	33.5	60.0	14.2	35.9	50.0	Phase 1	9.8
8.175	6	21.7	38.3	60.0	10.5	39.5	50.0	Phase 1	9.9
8.247	6	21.3	38.8	60.0	10.5	39.6	50.0	Phase 1	9.9
10.815	7	18.6	41.4	60.0	7.4	42.6	50.0	Phase 1	9.9
12.498	7	19.2	40.8	60.0	11.3	38.7	50.0	Phase 1	10.0
15.000	7	22.0	38.1	60.0	15.3	34.8	50.0	Phase 1	10.1
19.997	8	20.6	39.4	60.0	7.2	42.8	50.0	Phase 1	10.3
27.498	8	14.5	45.5	60.0	5.2	44.8	50.0	Phase 1	10.3
28.578	8	15.3	44.7	60.0	4.4	45.6	50.0	Phase 1	10.3

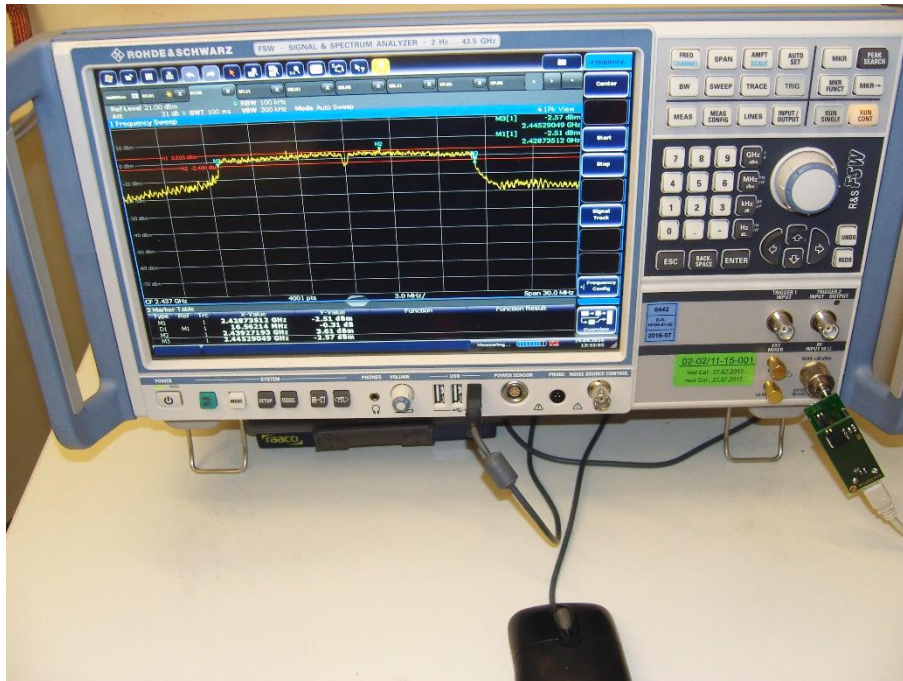
4.2 EBW and OBW

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

4.2.1 Description of the test location

Test location: AREA4

4.2.2 Photo documentation of the test set-up



4.2.3 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.

4.2.4 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;

4.2.5 Test result
WLAN Standard 802.11b

Channel	Centre frequency	6 dB bandwidth	99% OBW	Minimum limit
	(MHz)	(MHz)	(MHz)	(MHz)
1	2412	7.045	12.363	0.5
6	2437	7.336	12.183	0.5
11	2462	7.542	12.240	0.5

WLAN Standard 802.11n HT20

Channel	Centre frequency	6 dB bandwidth	99% OBW	Minimum limit
	(MHz)	(MHz)	(MHz)	(MHz)
1	2412	17.566	18.241	0.5
6	2437	17.540	18.029	0.5
11	2462	17.526	18.117	0.5

WLAN Standard 802.11n HT40

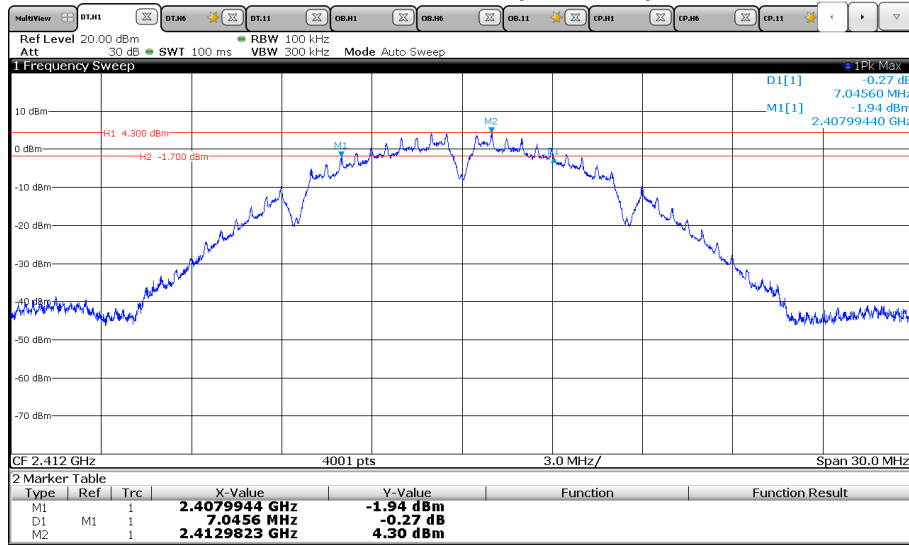
Channel	Centre frequency	6 dB bandwidth	99% OBW	Minimum limit
	(MHz)	(MHz)	(MHz)	(MHz)
1 up	2422	34.912	36.229	0.5
4 up	2437	35.107	36.103	0.5
7 up	2452	35.105	36.024	0.5

The requirements are **FULFILLED**.

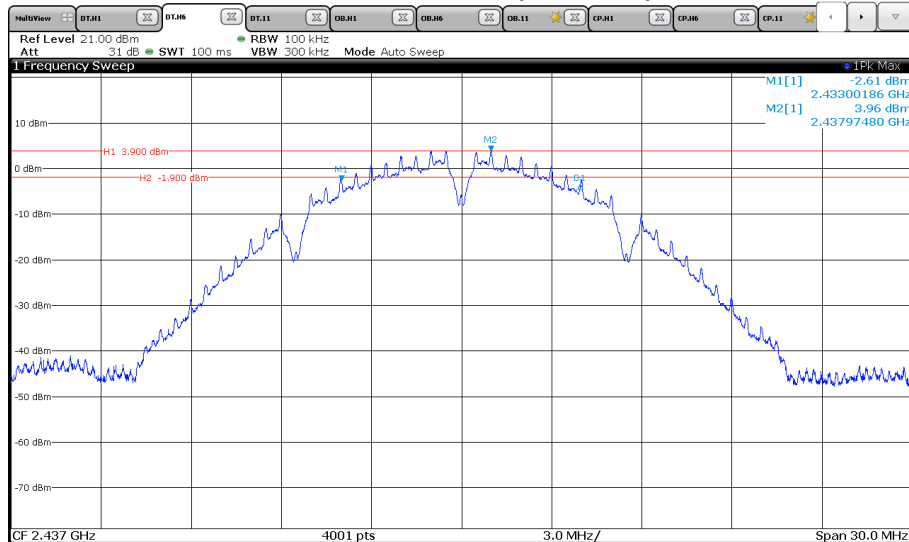
Remarks: For detailed test results please refer to following test protocols. The RSS Gen defines no limit for the occupied bandwidth!

4.2.6 Test protocols EBW

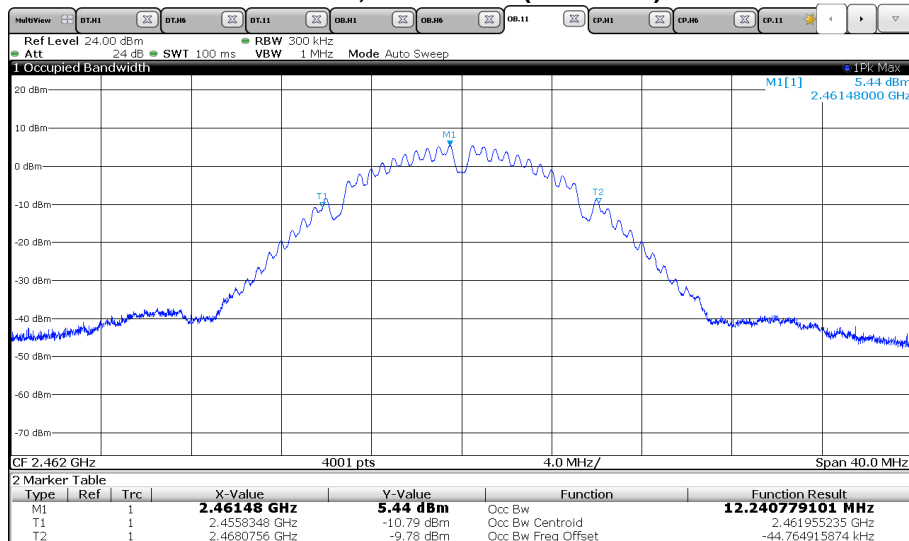
802.11b, Channel 1 (2412 MHz)



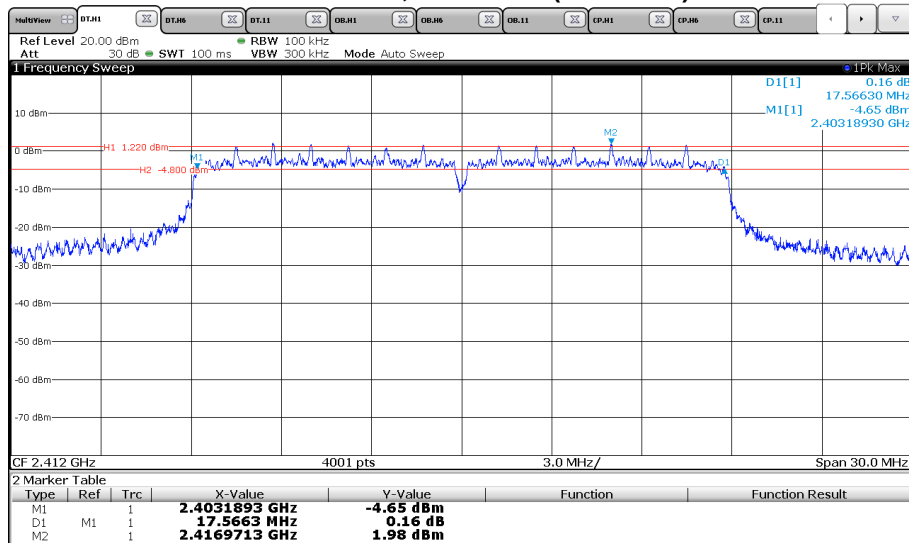
802.11b, Channel 6 (2437 MHz)



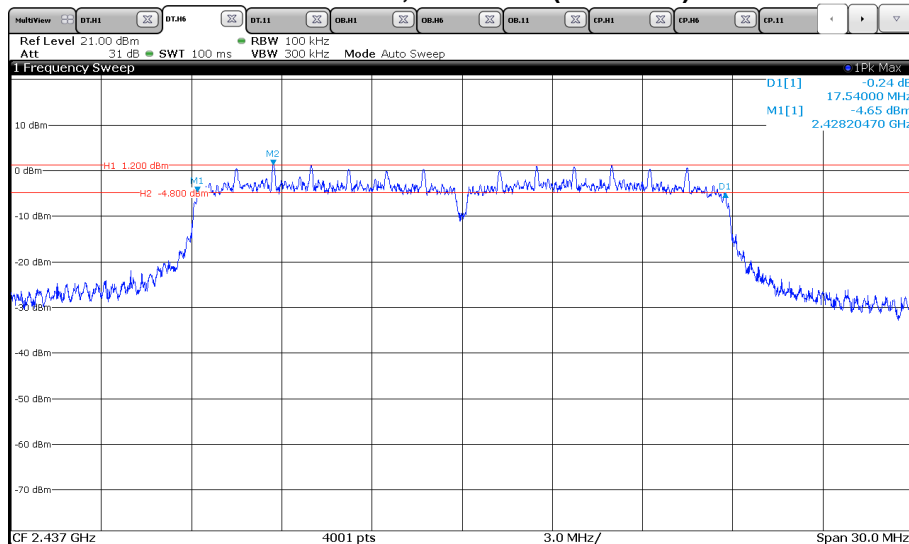
802.11b, Channel 11 (2462 MHz)



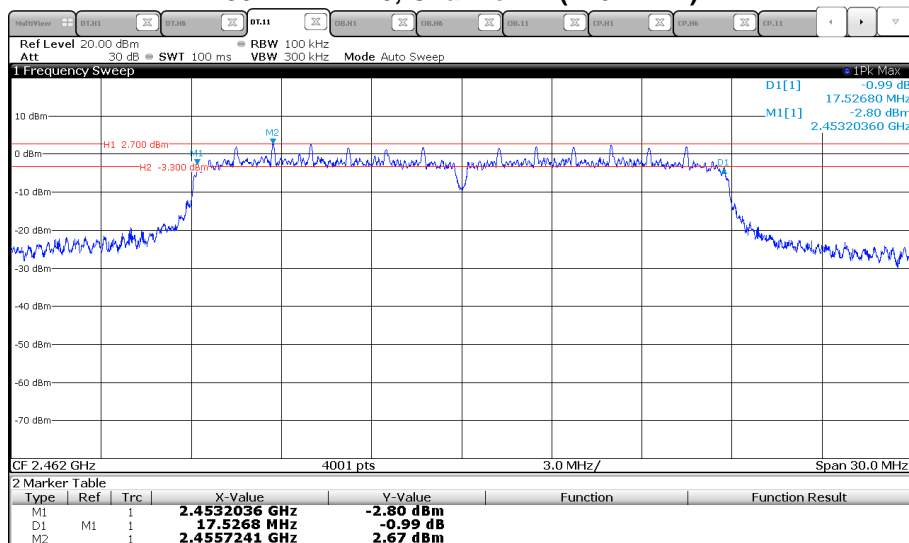
802.11n HT20, Channel 1 (2412 MHz)



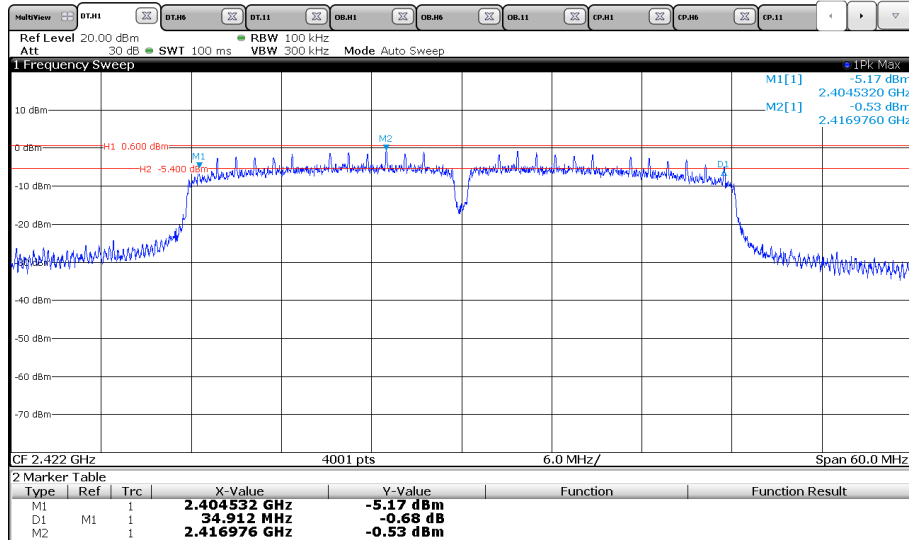
802.11n HT20, Channel 6 (2437 MHz)



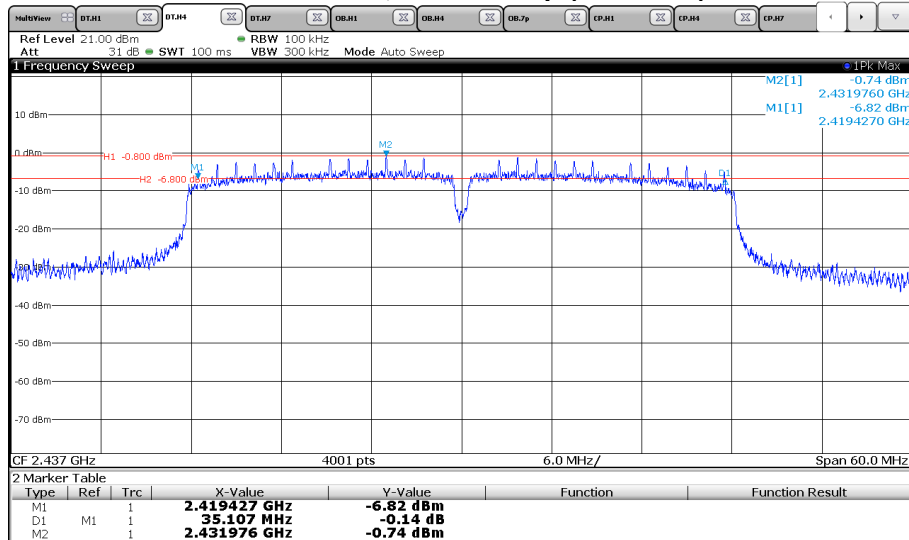
802.11n HT20, Channel 11 (2462 MHz)



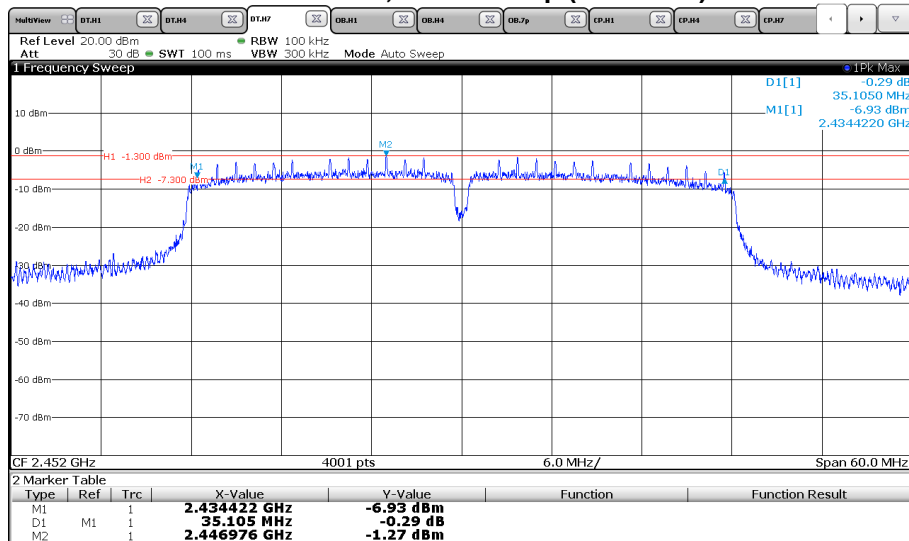
802.11n HT40, Channel 1up (2422 MHz)



802.11n HT40, Channel 4up (2437 MHz)

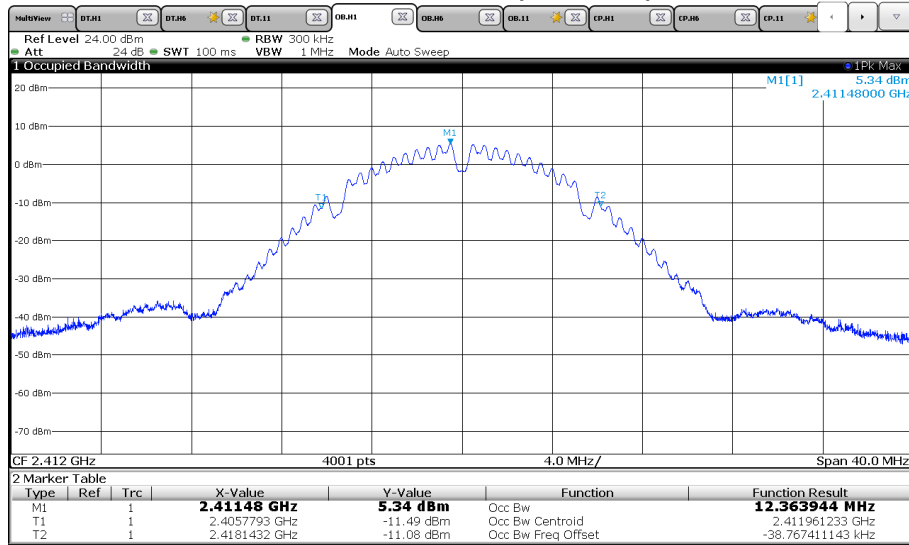


802.11n HT40, Channel 7up (2452 MHz)

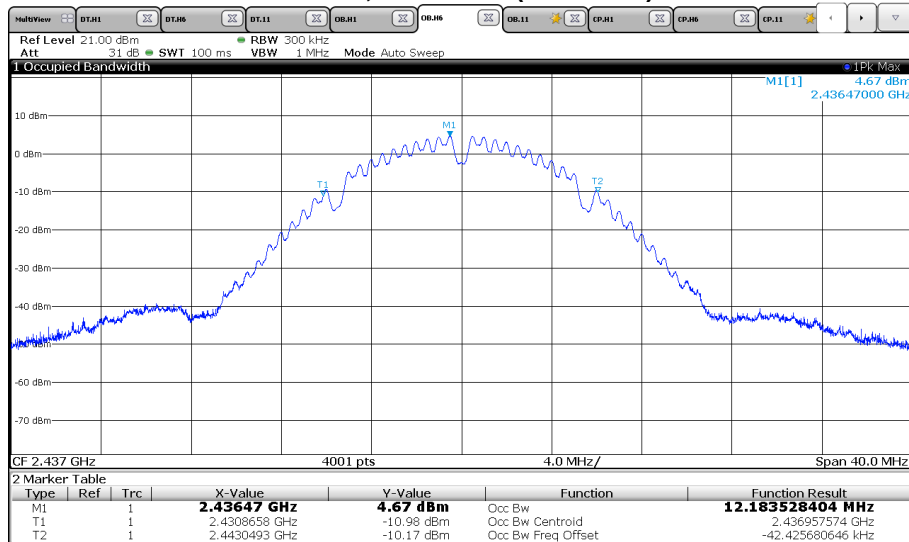


4.2.7 Test protocols OBW

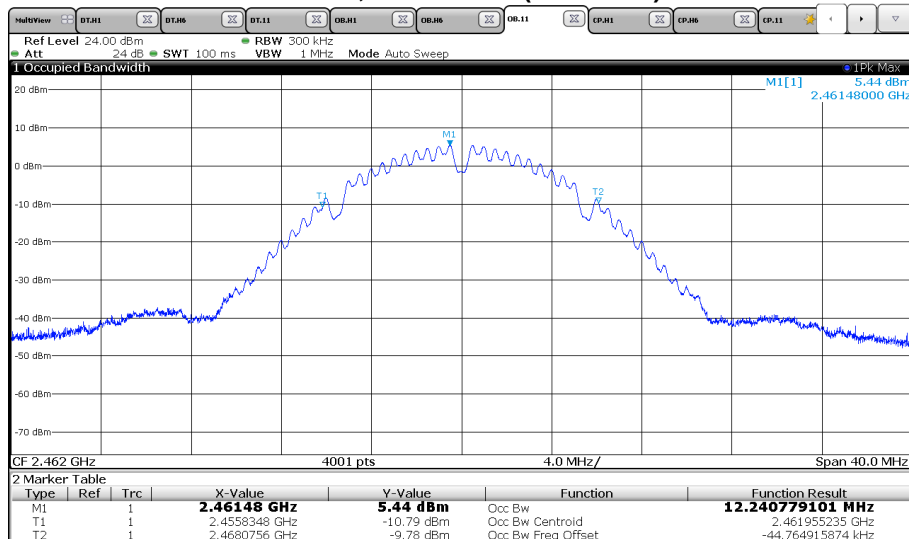
802.11b, Channel 1 (2412 MHz)



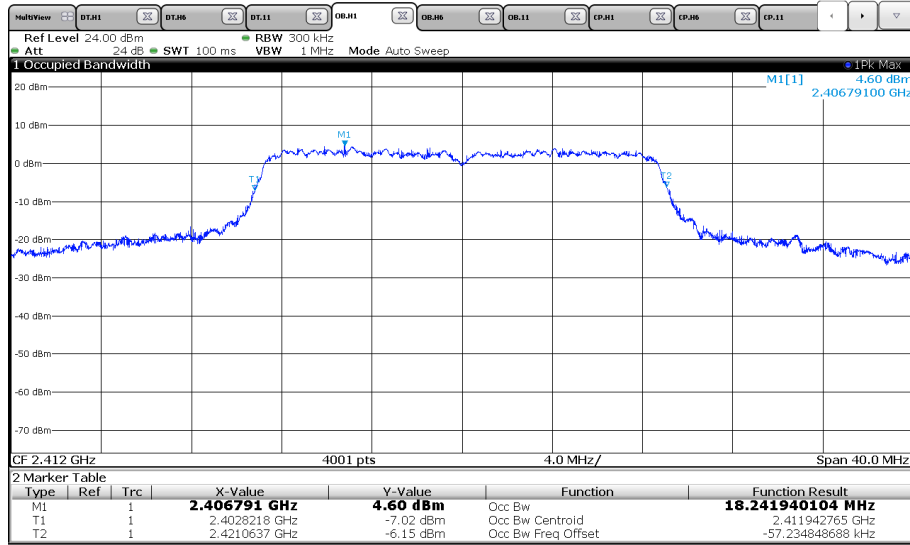
802.11b, Channel 6 (2437 MHz)



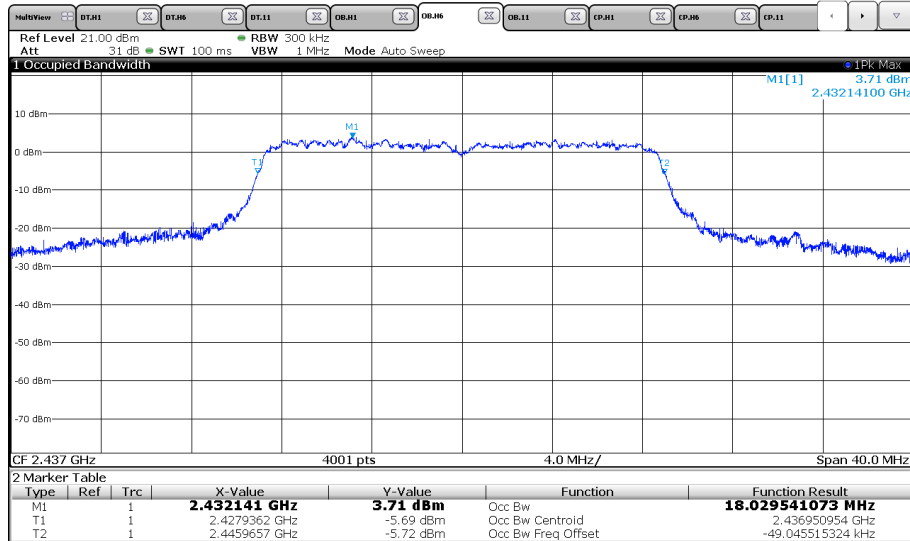
802.11b, Channel 11 (2462 MHz)



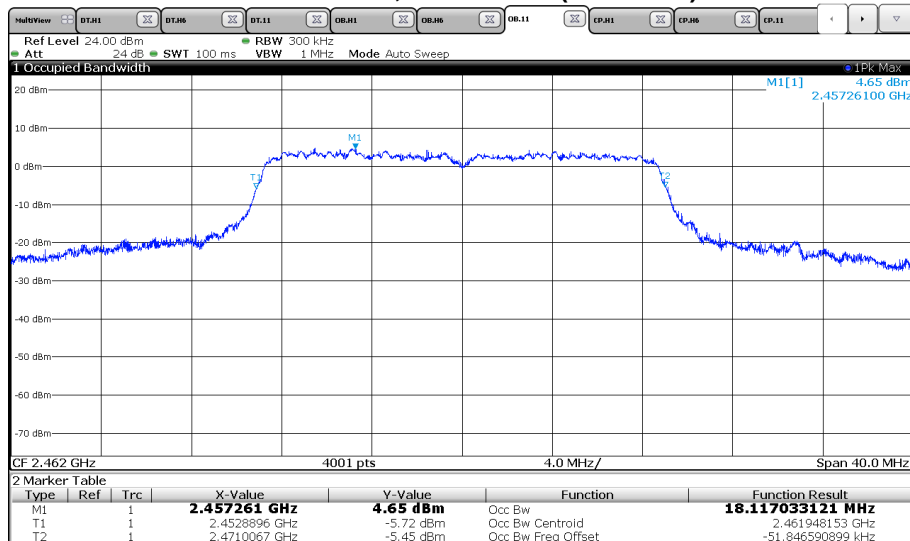
802.11n HT20, Channel 1 (2412 MHz)



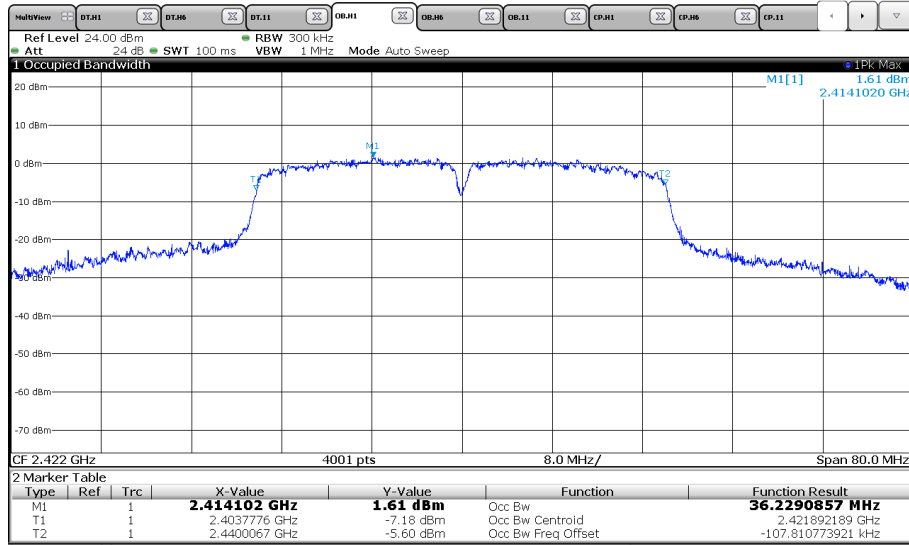
802.11n HT20, Channel 6 (2437 MHz)



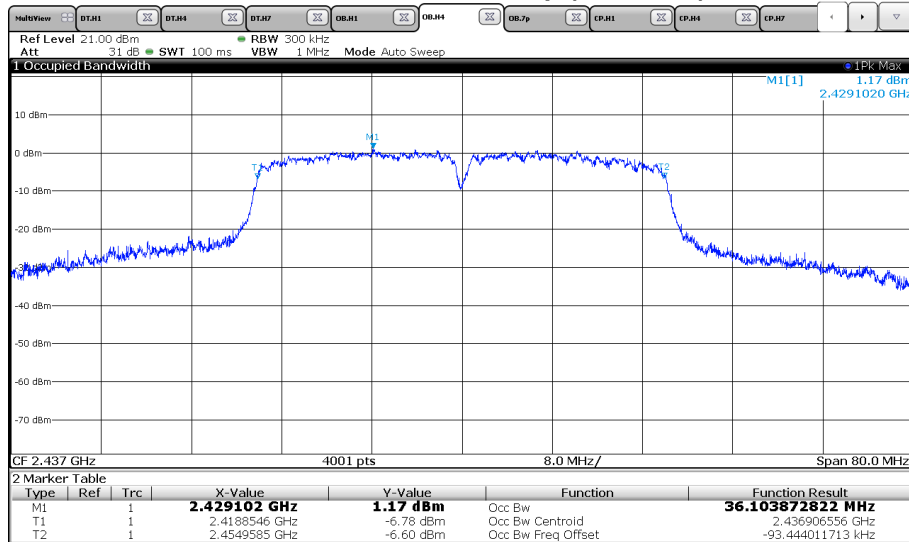
802.11n HT20, Channel 11 (2462 MHz)



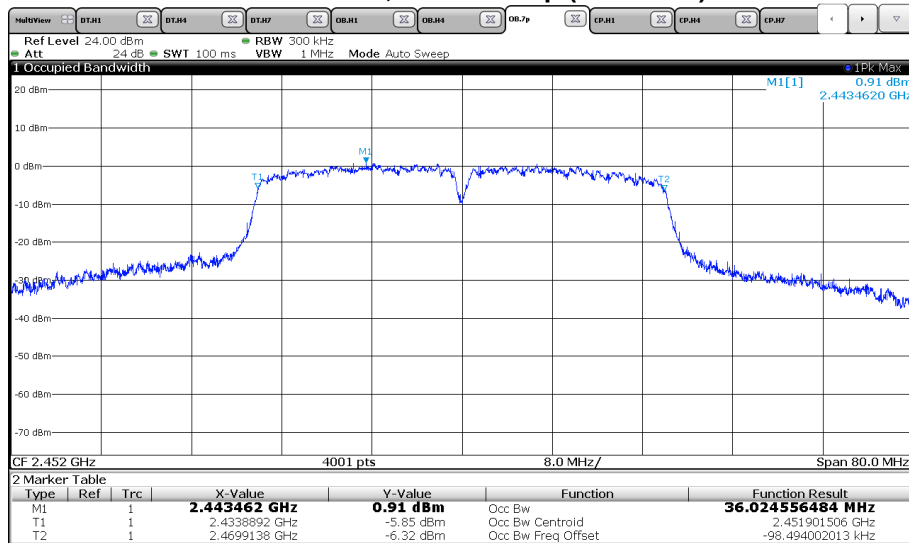
802.11n HT40, Channel 1up (2422 MHz)



802.11n HT40, Channel 4up (2437 MHz)



802.11n HT40, Channel 7up (2452 MHz)



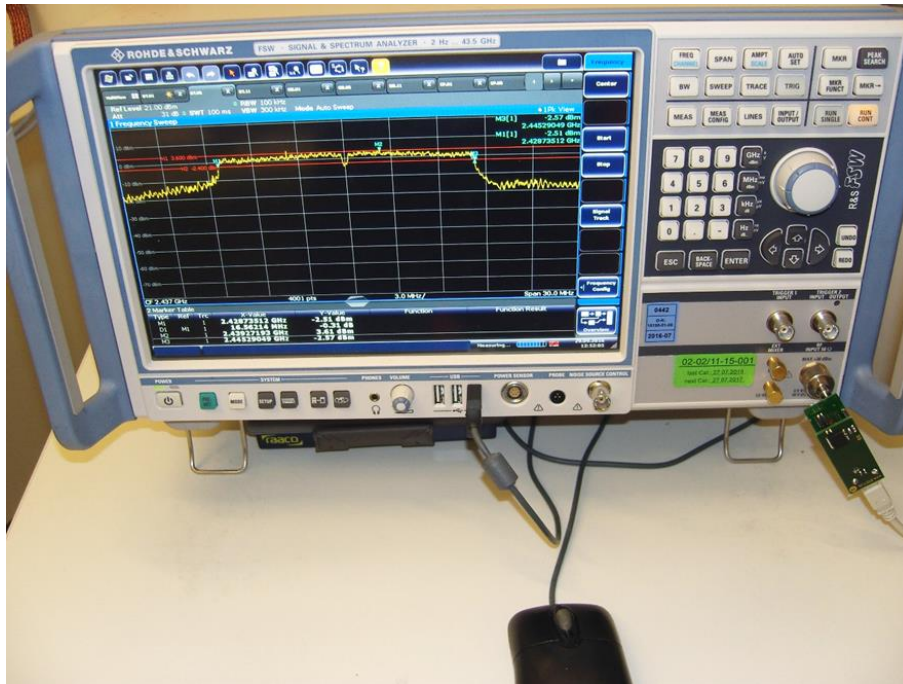
4.3 Maximum peak conducted output power

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

4.3.1 Description of the test location

Test location: AREA4

4.3.2 Photo documentation of the test set-up



4.3.3 Applicable standard

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

For systems using digital modulation in the 2400 – 2483.5 MHz and 5725 – 5850 MHz bands, 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.

4.3.4 Description of Measurement

The maximum peak conducted output power is measured using a gated average power meter following the procedure set out in KDB 558074, item 9.2.3.2. The EUT is set in TX continuous mode while measuring. For the power settings see item 2.11.

4.3.5 Test result

WLAN Standard 802.11b

802.11b, 1 Mbps, 1 TX		Test results		
Duty cycle: 98%				
Chain 1		A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH1				
T_{nom}	V_{nom}	15.7	30.0	-14.3
Middle frequency: CH6				
T_{nom}	V_{nom}	17.6	30.0	-12.4
Highest frequency: CH11				
T_{nom}	V_{nom}	17.9	30.0	-12.1

WLAN Standard 802.11n HT20

802.11n HT20, MCS0, 1 TX		Test results		
Duty cycle: 98%				
Chain 1		A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH1				
T_{nom}	V_{nom}	15.1	30.0	-14.9
Middle frequency: CH6				
T_{nom}	V_{nom}	20.2	30.0	-9.8
Highest frequency:CH11				
T_{nom}	V_{nom}	18.0	30.0	-12.0

WLAN Standard 802.11n HT40

802.11n HT40, MCS0, 1 TX		Test results		
Duty cycle: 98%				
Chain 1		A [Pmax] (dBm)	Limit (dBm)	Margin (dB)
Lowest frequency: CH1up				
T_{nom}	V_{nom}	14.6	30.0	-15.4
Middle frequency: CH4up				
T_{nom}	V_{nom}	17.7	30.0	-12.3
Highest frequency: CH7up				
T_{nom}	V_{nom}	17.3	30.0	-12.7

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
2400-2483.5	30	1.0
5725-5850	30	1.0

The requirements are **FULFILLED**.

Remarks:

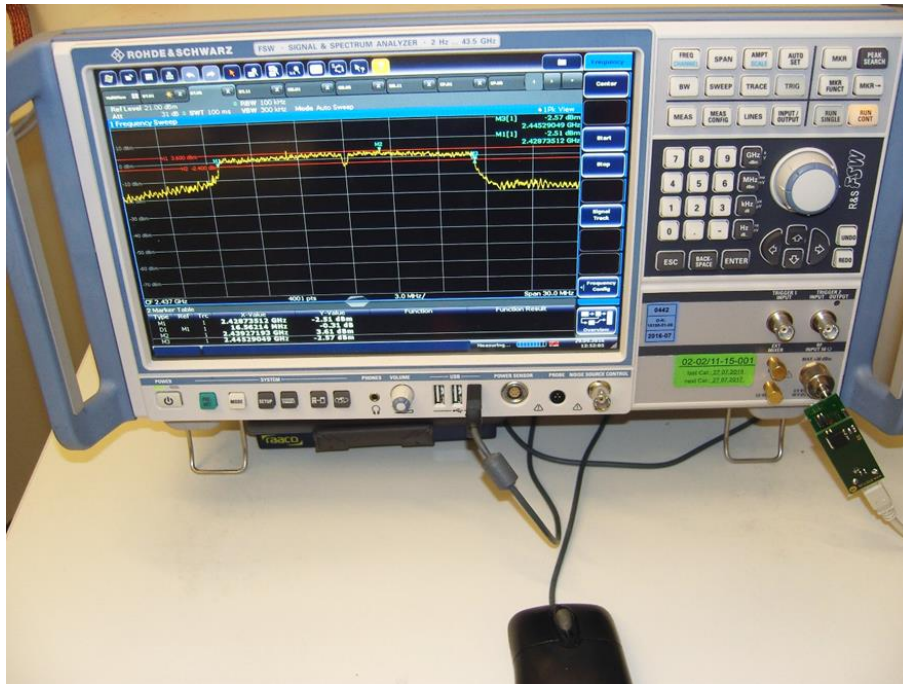
4.4 Power spectral density

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

4.4.1 Description of the test location

Test location: AREA4

4.4.2 Photo documentation of the test set-up



4.4.3 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.

4.4.4 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. For the power settings see item 2.11.

Spectrum analyser settings:

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

4.4.5 Test result

WLAN Standard 802.11b

802.11b, 1 Mbps, 1 TX		Test results conducted		
Duty cycle: 98%				
Chain 1		PD [Pmax] (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Lowest frequency: CH1				
T_{nom}	V_{nom}	-9.1	8.0	-17.1
Middle frequency: CH6				
T_{nom}	V_{nom}	-7.4	8.0	-15.4
Highest frequency: CH11				
T_{nom}	V_{nom}	-7.0	8.0	-15.0

WLAN Standard 802.11n HT20

802.11n HT20, MCS0, 1 TX		Test results conducted		
Duty cycle: 98%				
Chain 1		PD [Pmax]	Limit	Margin
		(dBm/3kHz)	(dBm/3kHz)	(dB)
Lowest frequency: CH1				
T_{nom}	V_{nom}	-18.2	8.0	-26.2
Middle frequency: CH6				
T_{nom}	V_{nom}	-9.1	8.0	-17.1
Highest frequency: CH11				
T_{nom}	V_{nom}	-14.5	8.0	-22.5

WLAN Standard 802.11n HT40

802.11n HT20, MCS0, 1 TX		Test results conducted		
Duty cycle: 98%				
Chain 1		PD [Pmax]	Limit	Margin
		(dBm/3kHz)	(dBm/3kHz)	(dB)
Lowest frequency: CH1				
T_{nom}	V_{nom}	-23.2	8.0	-31.2
Middle frequency: CH6				
T_{nom}	V_{nom}	-17.6	8.0	-25.6
Highest frequency: CH11				
T_{nom}	V_{nom}	-17.8	8.0	-25.8

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

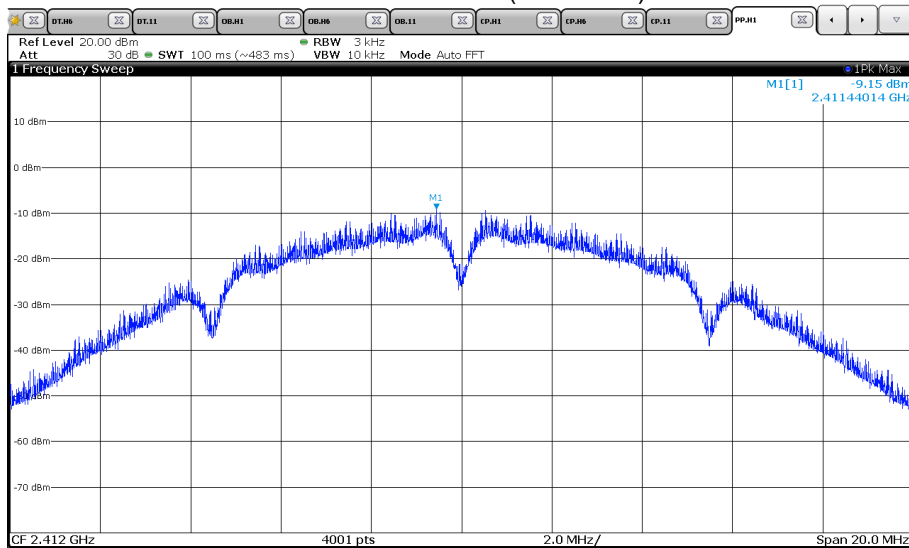
Frequency (MHz)	Power spectral density limit
	(dBm/3 kHz)
2400 - 2483.5	8

The requirements are **FULFILLED**.

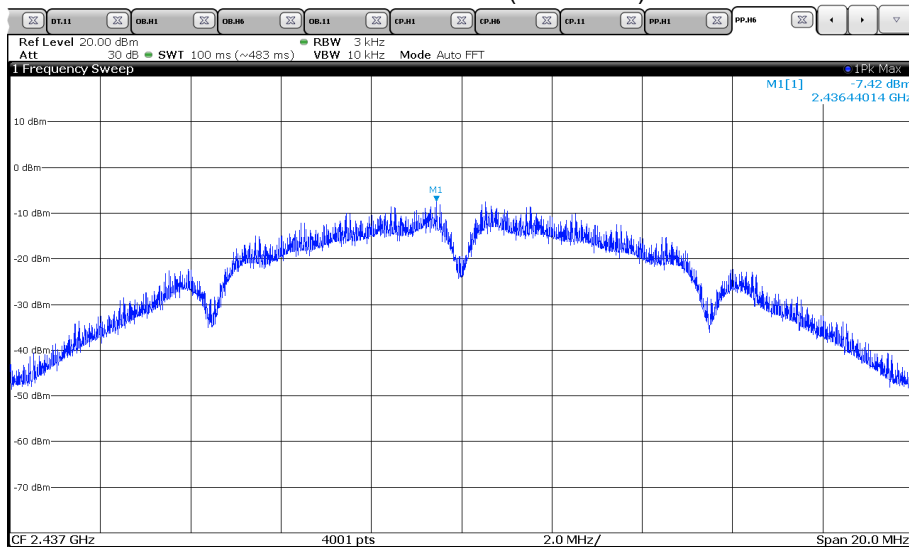
Remarks: For detailed test results please refer to following test protocols.

4.4.6 Power spectral density plots

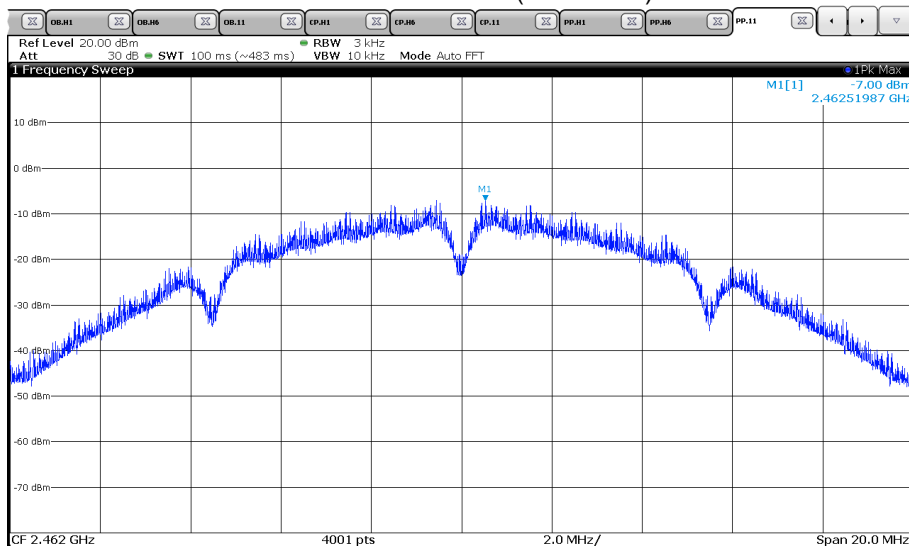
802.11b Channel 1 (2412 MHz)



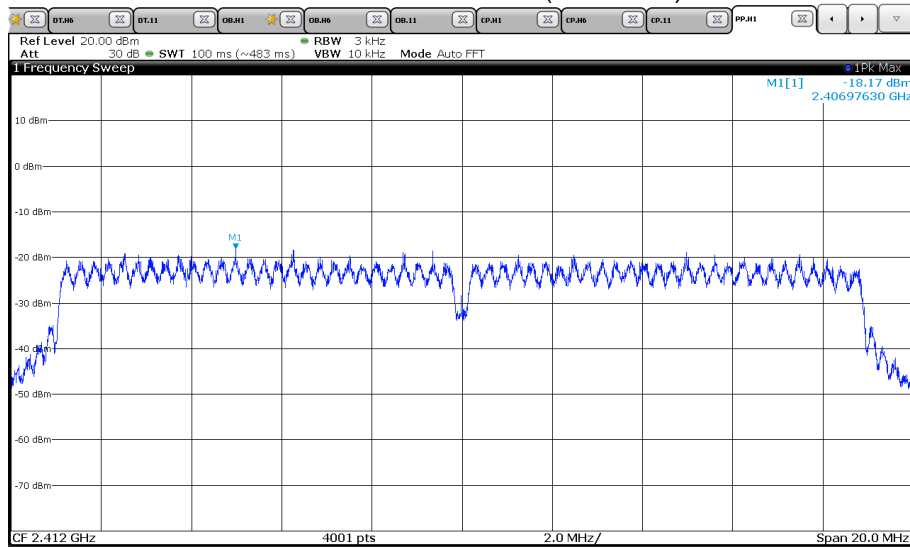
802.11b Channel 6 (2437 MHz)



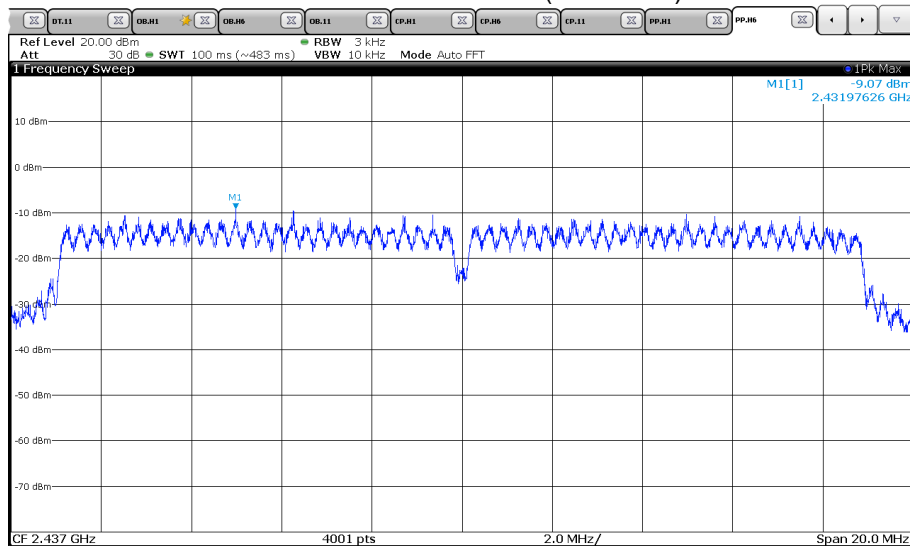
802.11b Channel 11 (2462 MHz)



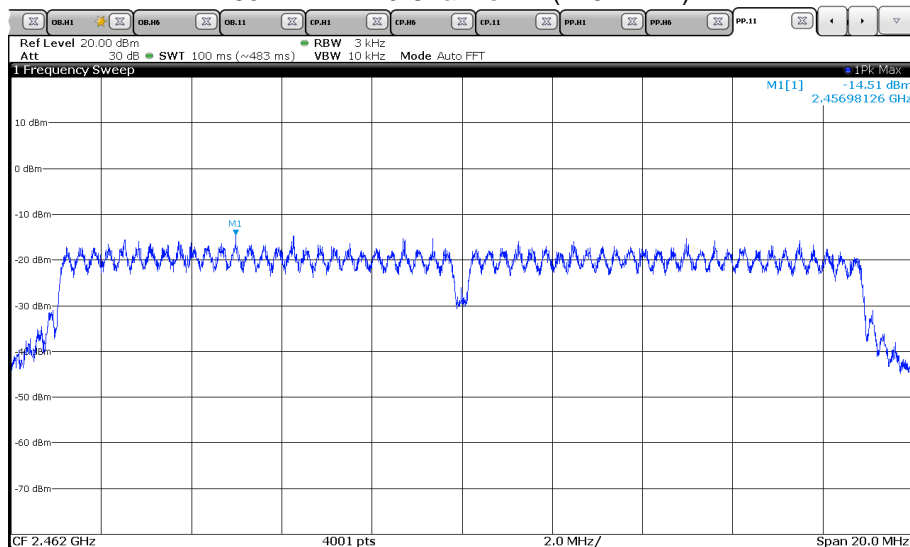
802.11n HT20 Channel 1 (2412 MHz)



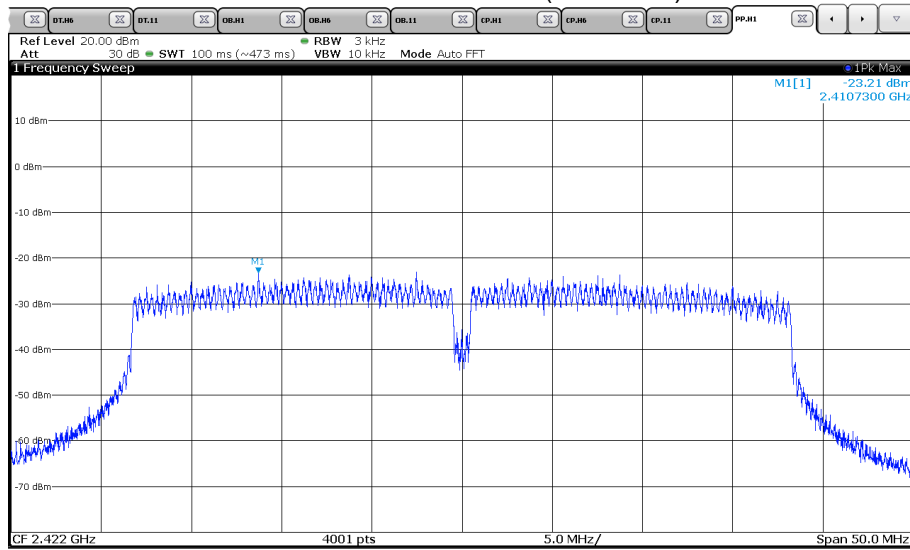
802.11n HT20 Channel 6 (2437 MHz)



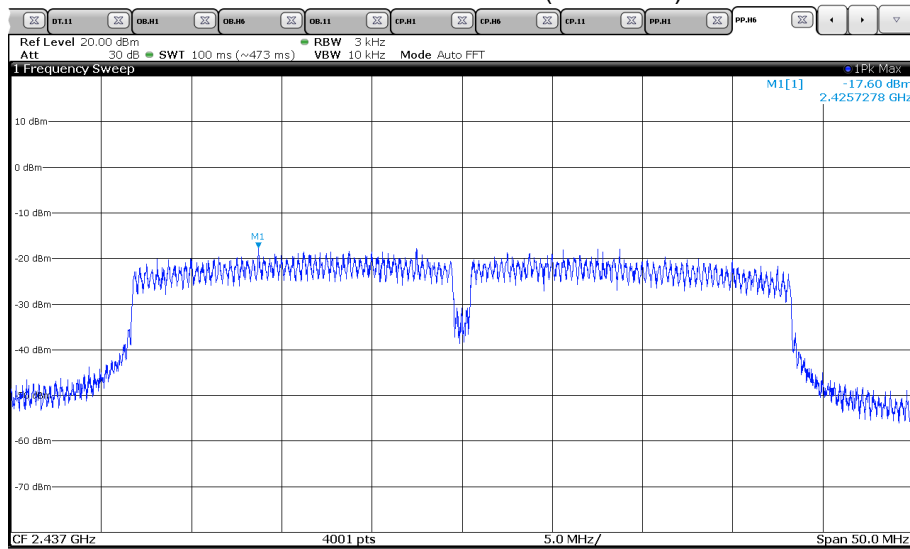
802.11n HT20 Channel 11 (2462 MHz)



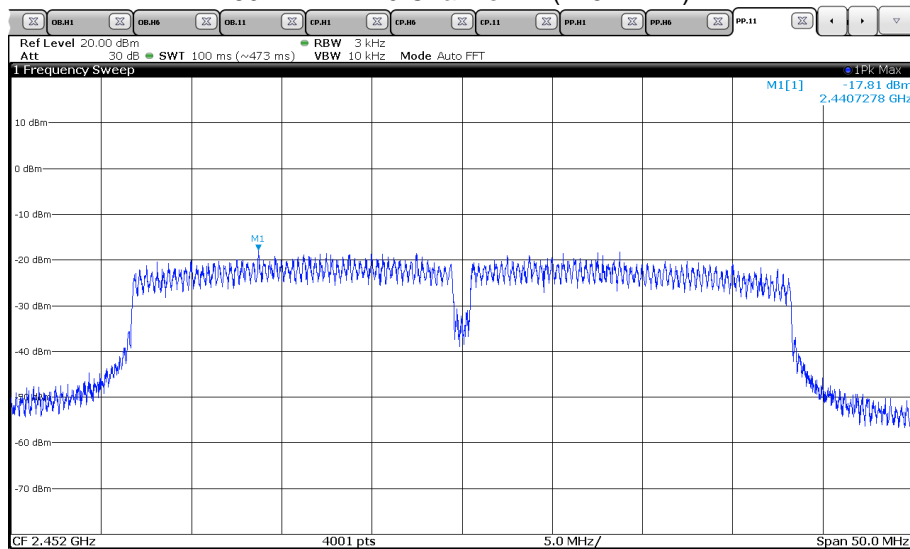
802.11n HT40 Channel 1 (2422 MHz)



802.11n HT40 Channel 6 (2437 MHz)



802.11n HT40 Channel 11 (2452 MHz)



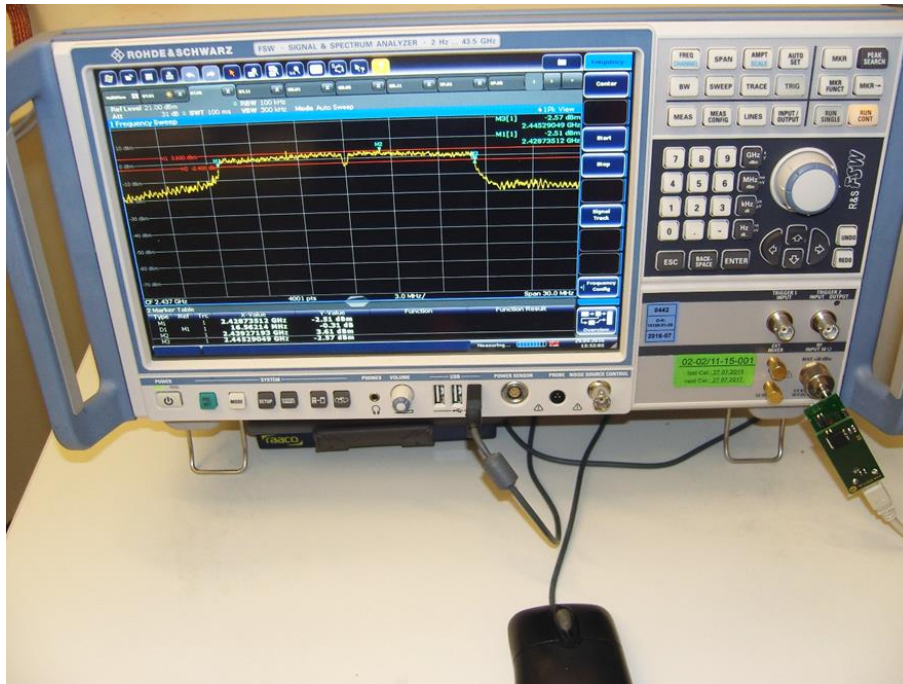
4.5 Emissions in non-restricted frequency bands, conducted

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

4.5.1 Description of the test location

Test location: AREA4

4.5.2 Photo documentation of the test set-up



4.5.3 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)).

4.5.4 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

4.5.5 Test result
802.11b

Lowest frequency: CH1b						
Test conditions: 1 TX, P11, 1 Mbps						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-45.8	-15.8	-30.0
1000	2400	100	2399	-38.6	-15.8	-22.8
2483.5	5000	100	4824	-41.7	-15.8	-25.9
5000	15000	100	9874	-58.3	-15.8	-42.5
15000	25000	100	16778	-54.1	-15.8	-38.3
Measurement uncertainty				±3 dB		

Middle frequency: CH6b						
Test conditions: 1 TX, P14, 1 Mbps						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-44.5	-15.8	-28.7
1000	2400	100	2288	-42.0	-15.8	-26.2
2483.5	5000	100	4873	-43.0	-15.8	-27.2
5000	15000	100	13850	-56.9	-15.8	-41.1
15000	25000	100	20586	-51.7	-15.8	-35.9
Measurement uncertainty				±3 dB		

Highest frequency: CH11b						
Test conditions: 1 TX, P14, 1 Mbps						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-44.4	-15.8	-28.6
1000	2400	100	2288	-45.9	-15.8	-30.1
2483.5	5000	100	4923	-41.3	-15.8	-25.5
5000	15000	100	13742	-56.8	-15.8	-41.0
15000	25000	100	24866	-54.1	-15.8	-38.3
Measurement uncertainty				±3 dB		

802.11n HT20

Highest level of the desired power:

4.2 dBm

Lowest frequency: CH1n HT20						
Test conditions: 1 TX, P2, MCS0						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-46.1	-15.8	-30.3
1000	2400	100	2328	-48.5	-15.8	-32.7
2483.5	5000	100	4824	-38.3	-15.8	-22.5
5000	15000	100	14472	-53.2	-15.8	-37.4
15000	25000	100	24841	-54.2	-15.8	-38.4
Measurement uncertainty				±3 dB		

Middle frequency: CH6n HT20						
Test conditions: 1 TX, P11, MCS0						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start f	Stop f	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-44.9	-15.8	-29.1
1000	2400	100	2288	-49.1	-15.8	-33.3
2483.5	5000	100	4875	-52.0	-15.8	-36.2
5000	15000	100	13879	-56.3	-15.8	-40.5
15000	25000	100	24890	-54.4	-15.8	-38.6
Measurement uncertainty				.		

Highest frequency: CH11n HT20						
Test conditions: 1 TX, P2, MCS0						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-45.7	-15.8	-29.9
1000	2400	100	2288	-49.5	-15.8	-33.7
2483.5	5000	100	4922	-51.1	-15.8	-35.3
5000	15000	100	13989	-56.1	-15.8	-40.3
15000	25000	100	24884	-54.4	-15.8	-38.6
Measurement uncertainty				±3 dB		

802.11n HT40

Highest level of the desired power:

4.2 dBm

Lowest frequency: CH1up HT40						
Test conditions: 1 TX, P1, MCS0						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-45.3	-15.8	-29.5
1000	2400	100	2288	-49.6	-15.8	-33.8
2483.5	5000	100	4844	-49.5	-15.8	-33.7
5000	15000	100	13876	-56.7	-15.8	-40.9
15000	25000	100	24838	-54.7	-15.8	-38.9
Measurement uncertainty				±3 dB		

Middle frequency: CH4up HT40						
Test conditions: 1 TX, P3, MCS0						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-45.3	-15.8	-29.5
1000	2400	100	2288	-50.1	-15.8	-34.3
2483.5	5000	100	4873	-53.4	-15.8	-37.6
5000	15000	100	13586	-55.3	-15.8	-39.5
15000	25000	100	24868	-54.4	-15.8	-38.6
Measurement uncertainty				±3 dB		

Highest frequency: CH7up HT40						
Test conditions: 1 TX, P2, MCS0						
Reference power level:					4.2 dBm	
Chain1			Test results			
Start <i>f</i>	Stop <i>f</i>	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBm)	(dBm)	(dB)
30	1000	100	399.8	-45.1	-15.8	-29.3
1000	2400	100	2288	-50.1	-15.8	-34.3
2483.5	5000	100	4902	-53.1	-15.8	-37.3
5000	15000	100	12048	-56.3	-15.8	-40.5
15000	25000	100	24817	-54.6	-15.8	-38.8
Measurement uncertainty				±3 dB		

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.

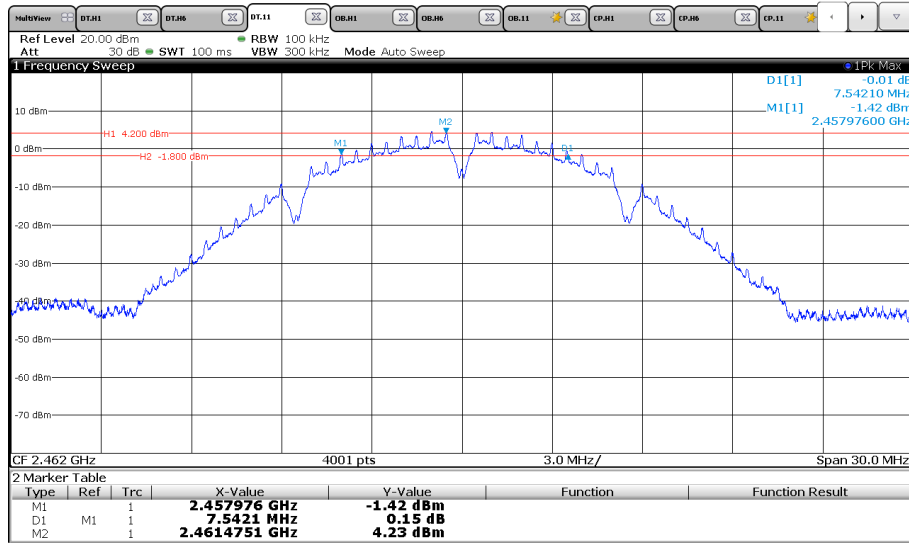
Frequency (MHz)	Spurious emission limit
Below 960	20 dB below the highest level of the desired power
Above 960	20 dB below the highest level of the desired power

The requirements are **FULFILLED**.

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

4.5.7 Test protocols

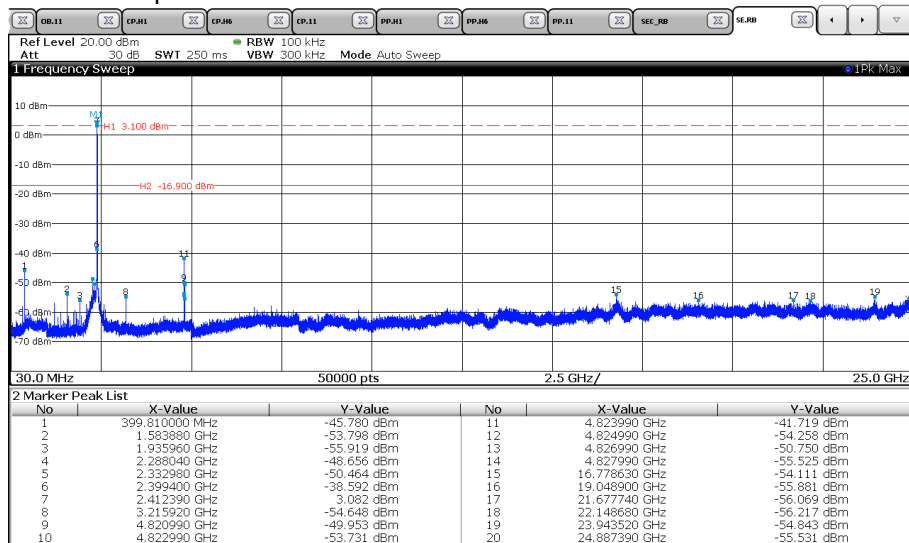
Determination of the reference level and limit



Plots of spurious emissions conducted out of operating frequency bands (-20 dBc)

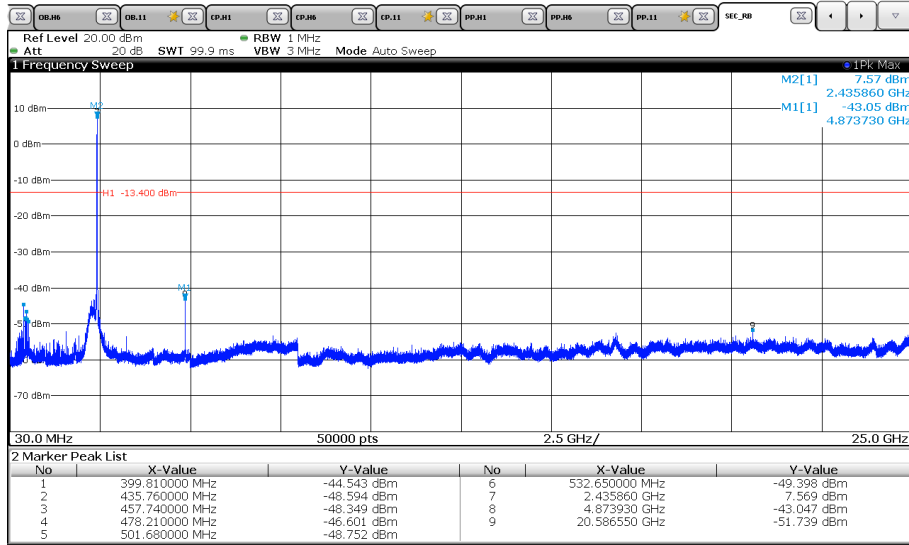
802.11b, Ch1

Spurious emissions conducted from 30 MHz to 25 GHz



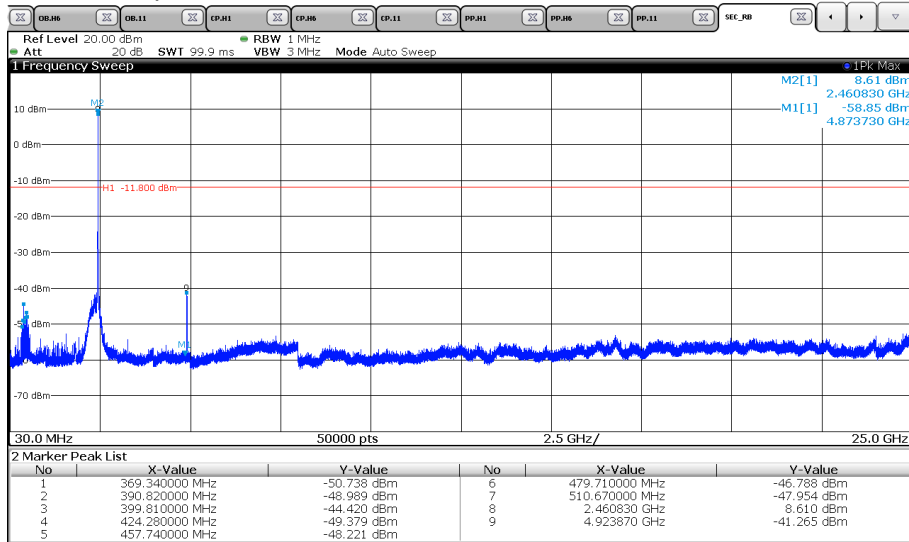
802.11b, Ch6

Spurious emissions conducted from 30 MHz to 25 GHz



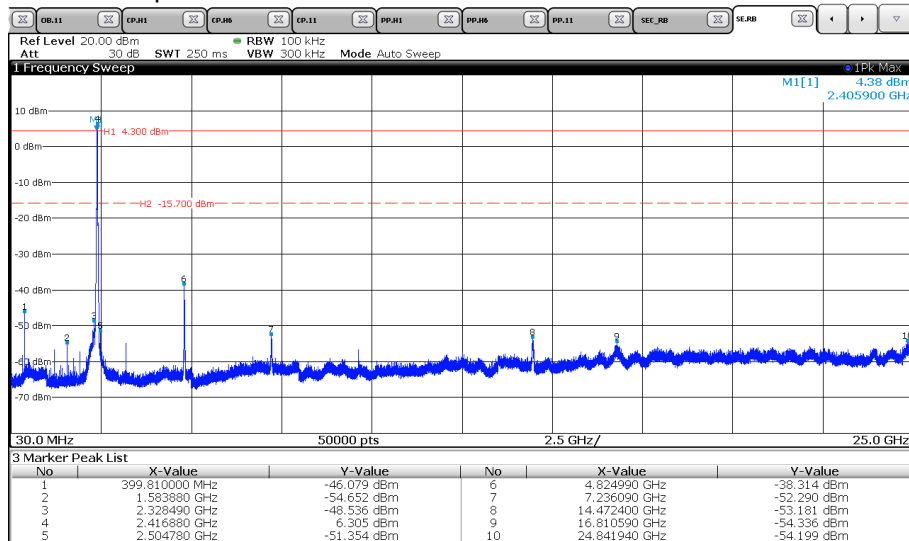
802.11b, Ch11

Spurious emissions conducted from 30 MHz to 25 GHz



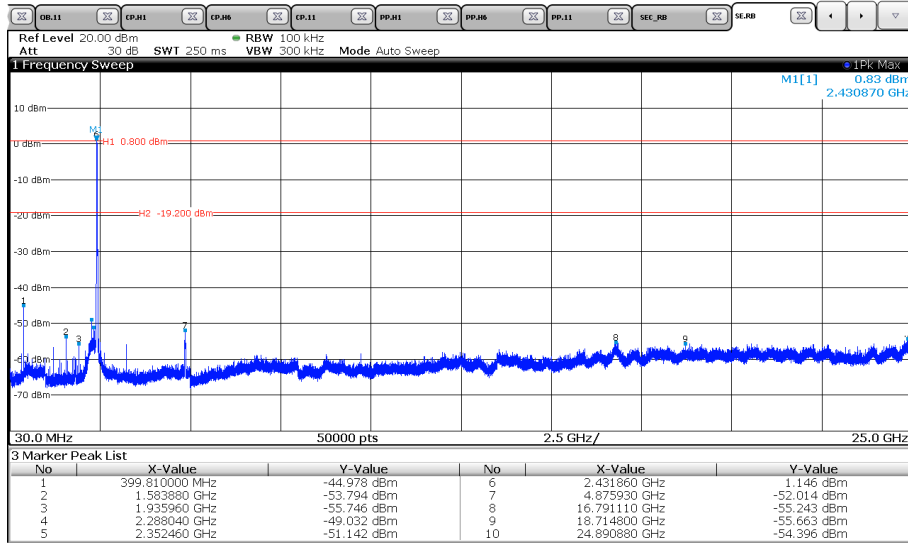
802.11 n HT20, Ch1

Spurious emissions conducted from 30 MHz to 25 GHz



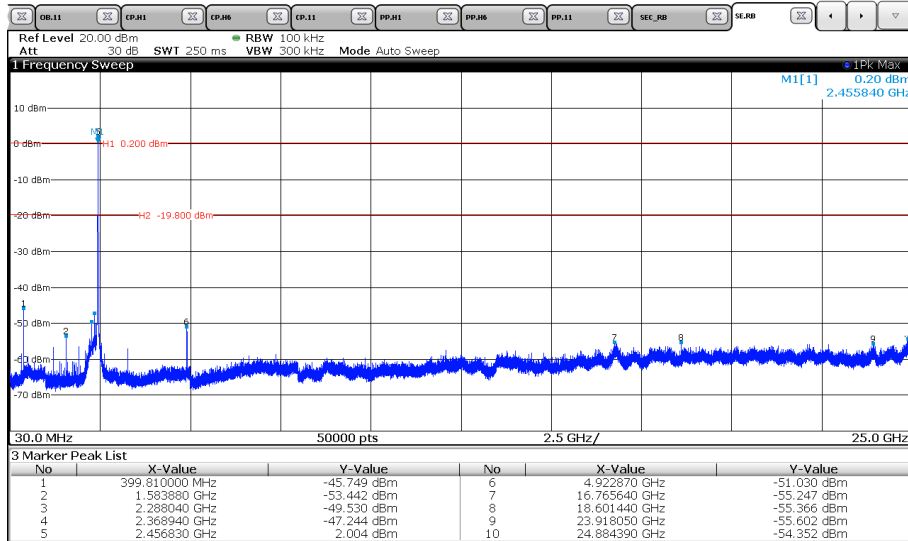
802.11 n HT20, Ch6

Spurious emissions conducted from 30 MHz to 25 GHz



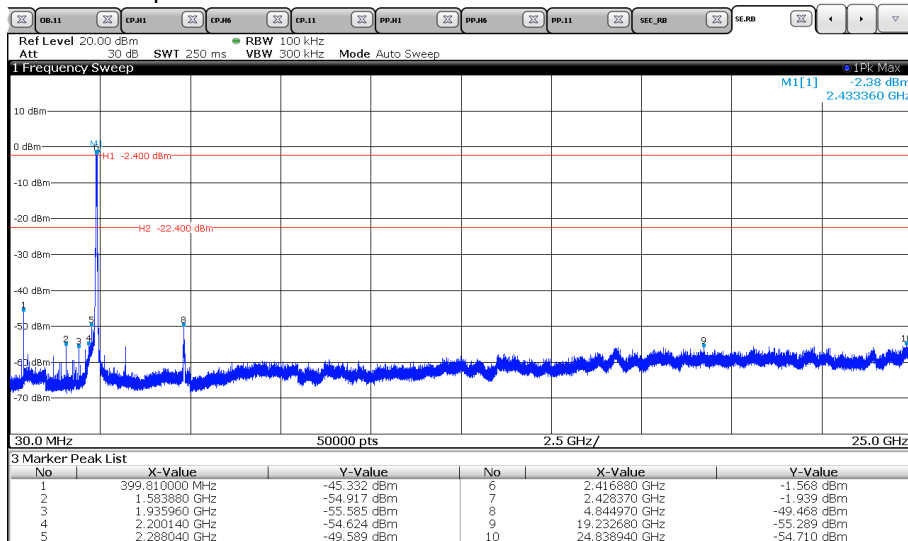
802.11n HT20, Ch11

Spurious emissions conducted from 30 MHz to 25 GHz



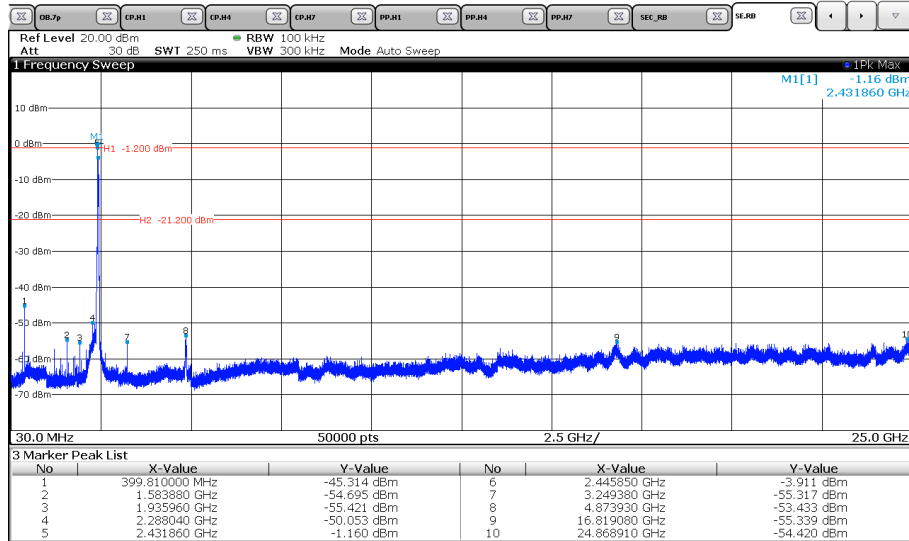
802.11 n HT40, Ch1up

Spurious emissions conducted from 30 MHz to 25 GHz



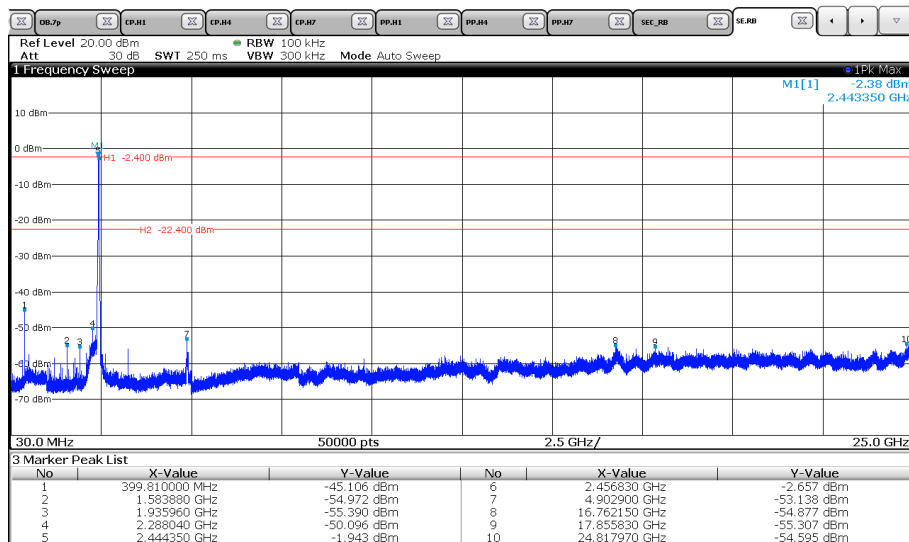
802.11 n HT40, Ch4up

Spurious emissions conducted from 30 MHz to 25 GHz



802.11n HT40, Ch7up

Spurious emissions conducted from 30 MHz to 25 GHz



4.7 Unwanted emissions in restricted bands, radiated

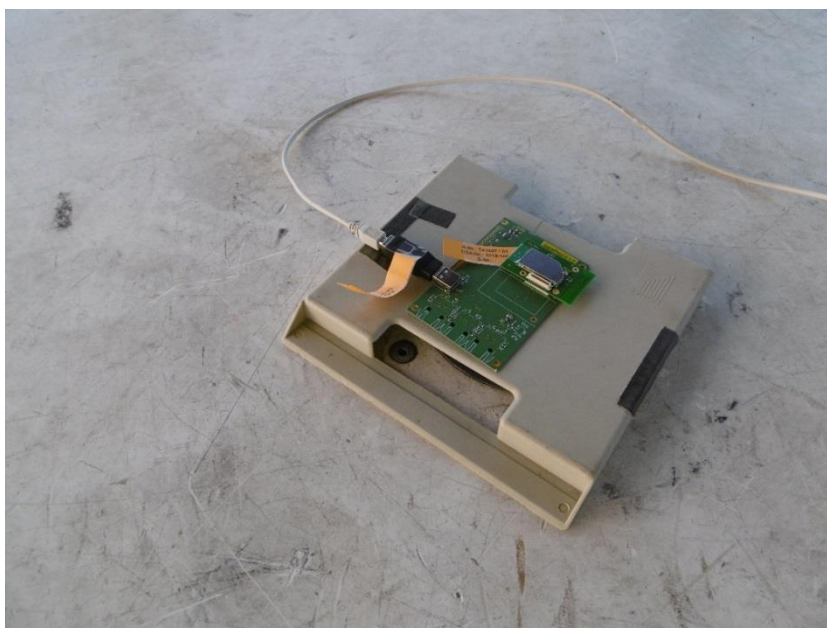
For test instruments and accessories used see section 6 Part **SER 2**, **SER 3**.

4.7.1 Description of the test location

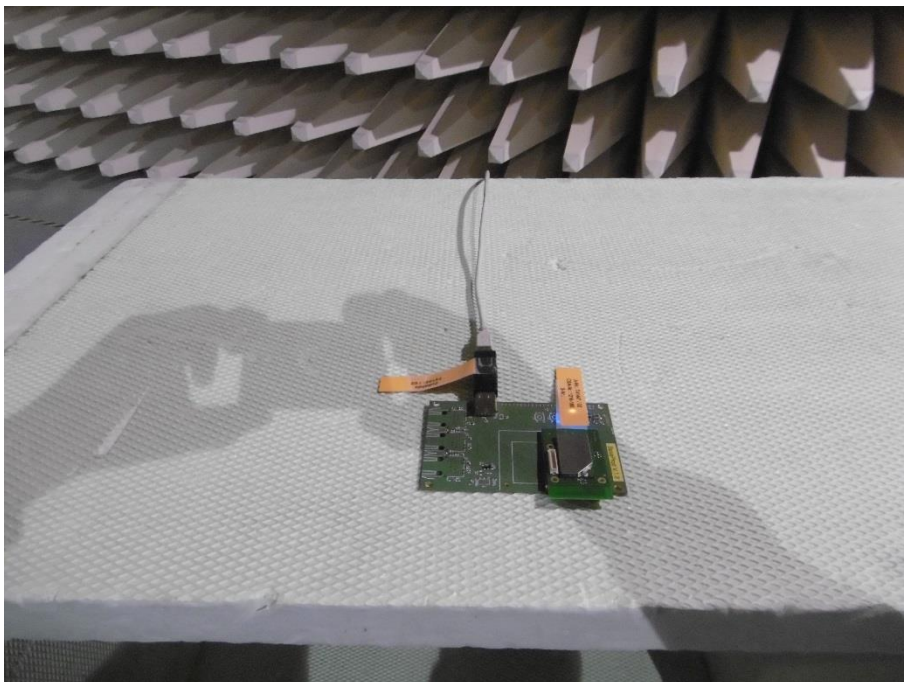
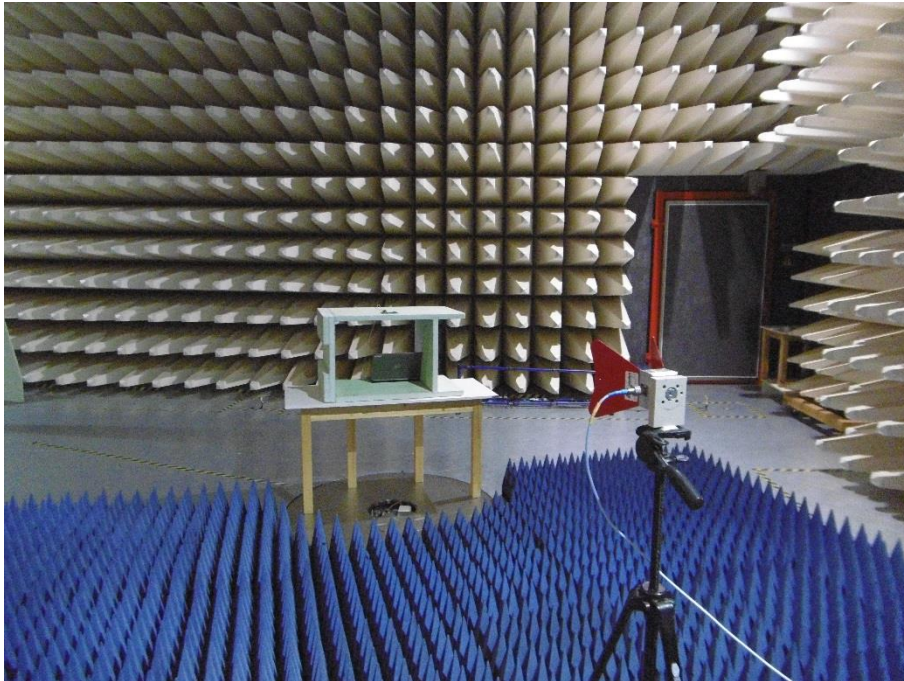
Test location: OATS 1
Test location: Anechoic chamber 1
Test distance: 3 m

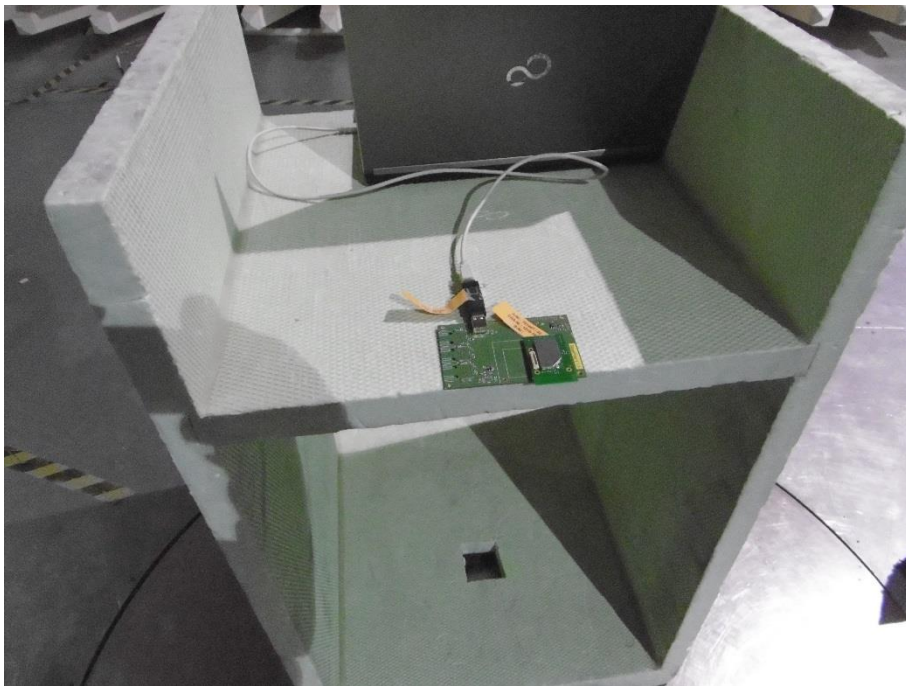
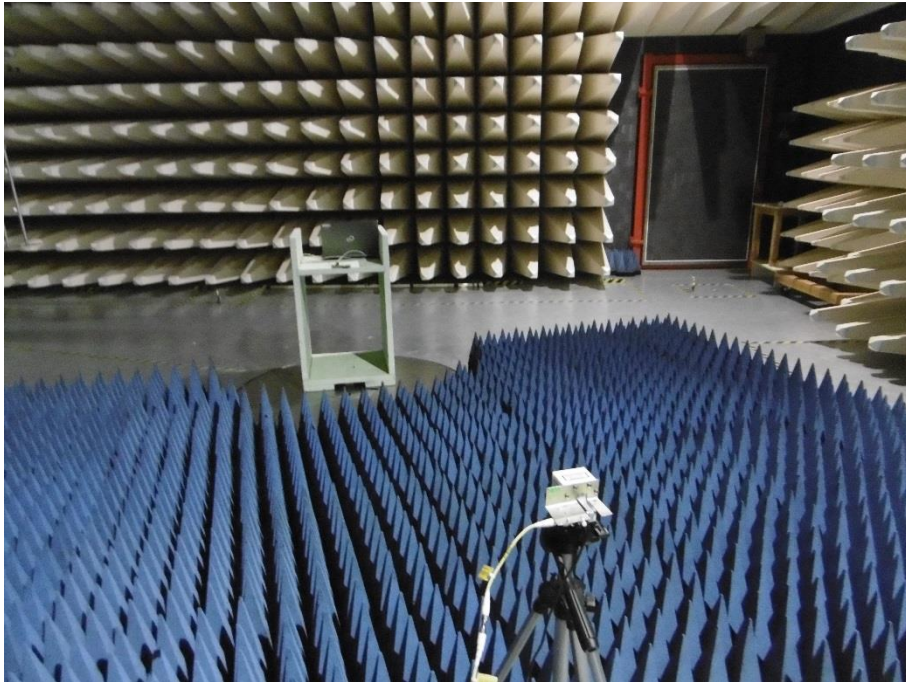
4.7.2 Photo documentation of the test set-up

Open area test site



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).

4.7.3 Description of Measurement

The frequency range 30 MHz to 25 GHz is measured radiated to identify the emissions. 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 identified emission are now re-measured and verified with the limits of the restricted bands. The span of the spectrum analyser is set wide enough to capture the complete emission.

EMC test receiver settings:

30 MHz – 1000 MHz: RBW: 120 kHz, Detector function: QP

Spectrum analyser search settings:

1000 MHz – 25 GHz: RBW: 1 MHz, VBW: 3 MHz, Sweep: Auto, Detector function: Peak

Spectrum analyser final settings:

1000 MHz – 25 GHz: RBW: 1 MHz, VBW: 3 MHz, Sweep: Auto, Detector function: RMS

4.7.1 Test result

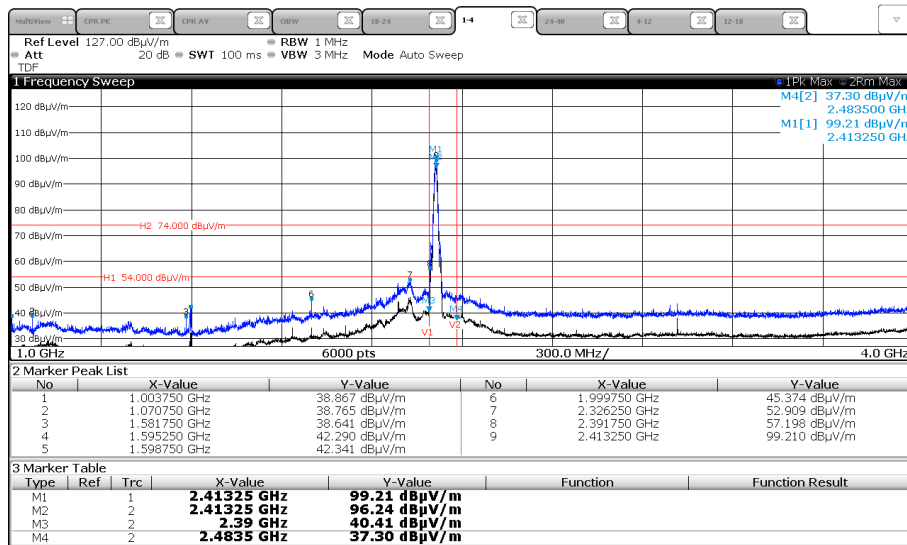
30 MHz < f < 1 GHz

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)
32.50	7.2	-2.1	14.0	12.6	21.2	10.5	40.0	-18.8
37.50	5.8	-1.4	14.3	13.1	20.1	11.7	40.0	-19.9
49.90	-1.3	-3.8	15.2	14.2	13.9	10.4	40.0	-26.1
400.00	11.8	13.0	19.8	19.6	31.6	32.6	46.0	-13.4
410.18	3.1	1.3	20.1	19.8	23.2	21.1	46.0	-22.8
800.00	2.6	6.3	29.5	29.0	32.1	35.3	46.0	-10.7

f > 1 GHz:

802.11b, CH1, P11

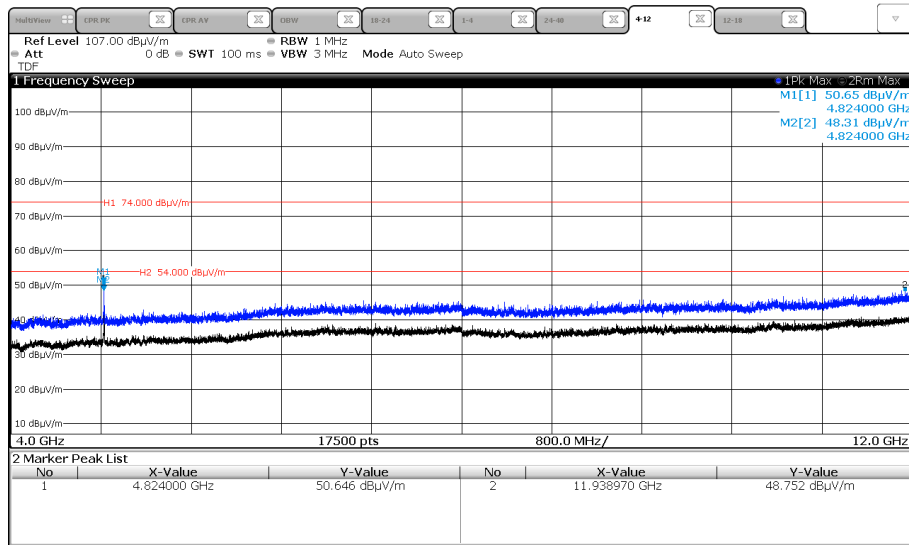
1 GHz to 4 GHz



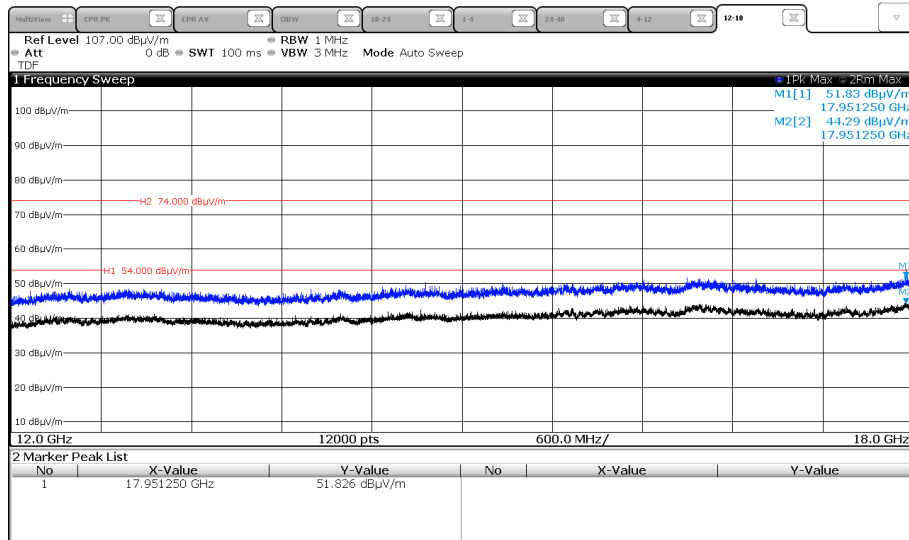
FCC ID: 2AJY6MORIN01

IC: 22172-MORIN01

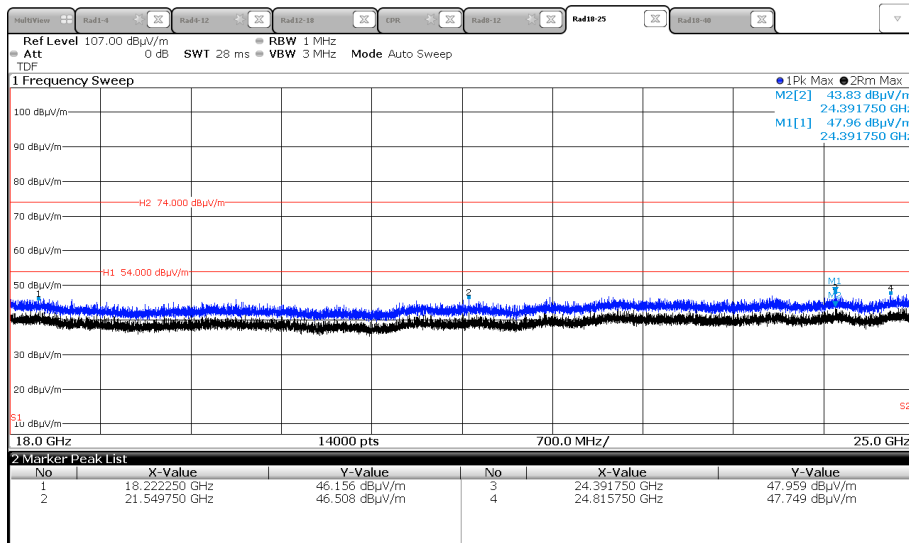
4 GHz to 12 GHz



12 GHz to 18 GHz

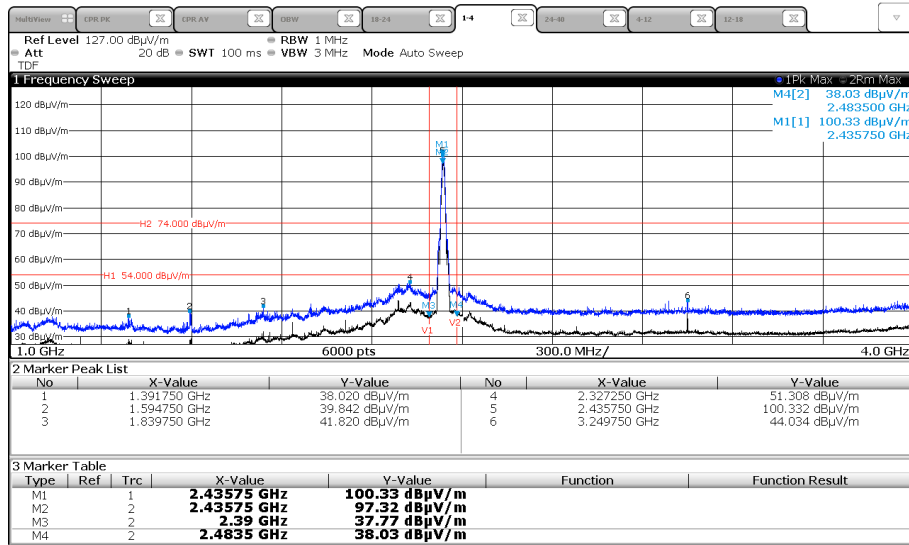


18 GHz to 25 GHz

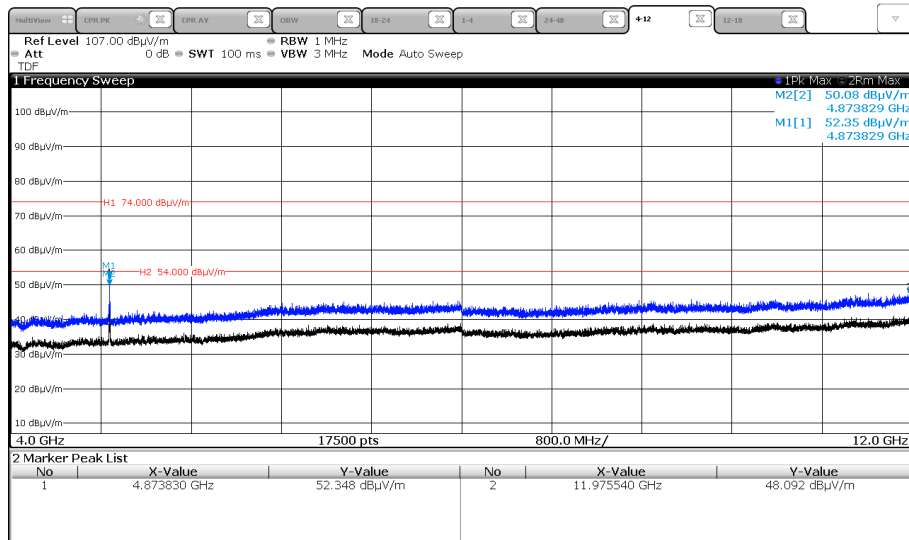


802.11b, CH6, P14

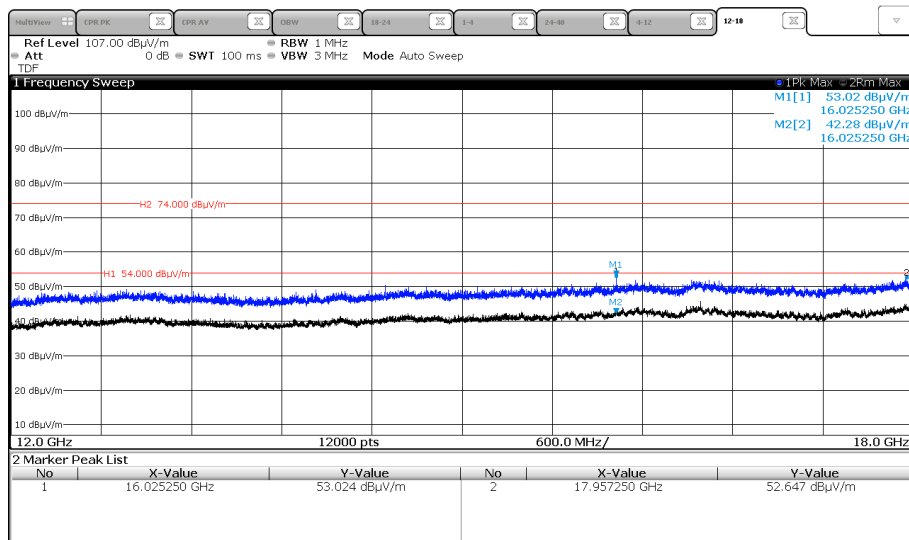
1 GHz to 4 GHz

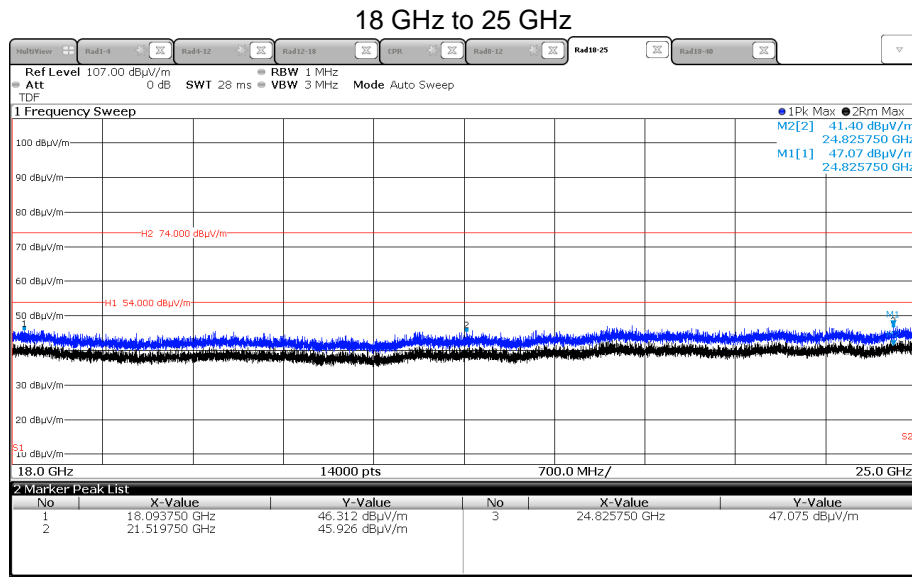


4 GHz to 12 GHz



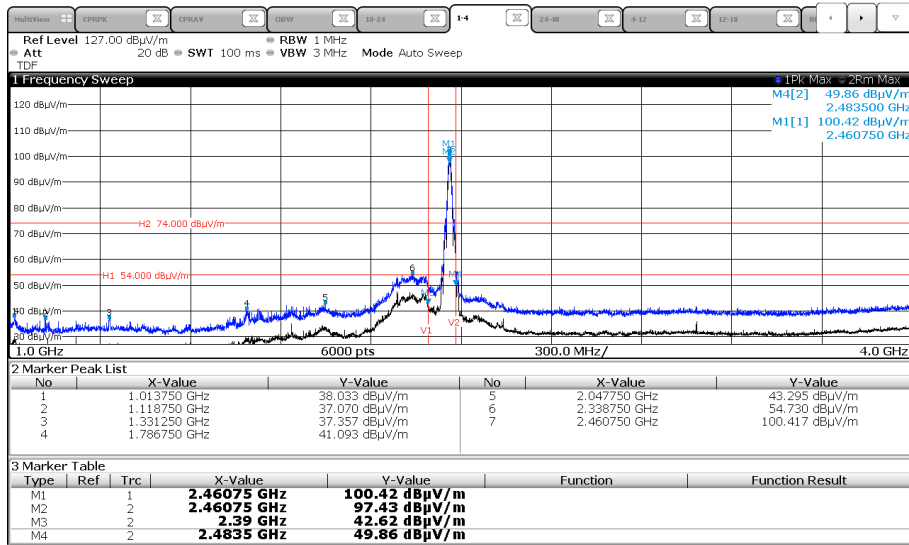
12 GHz to 18 GHz



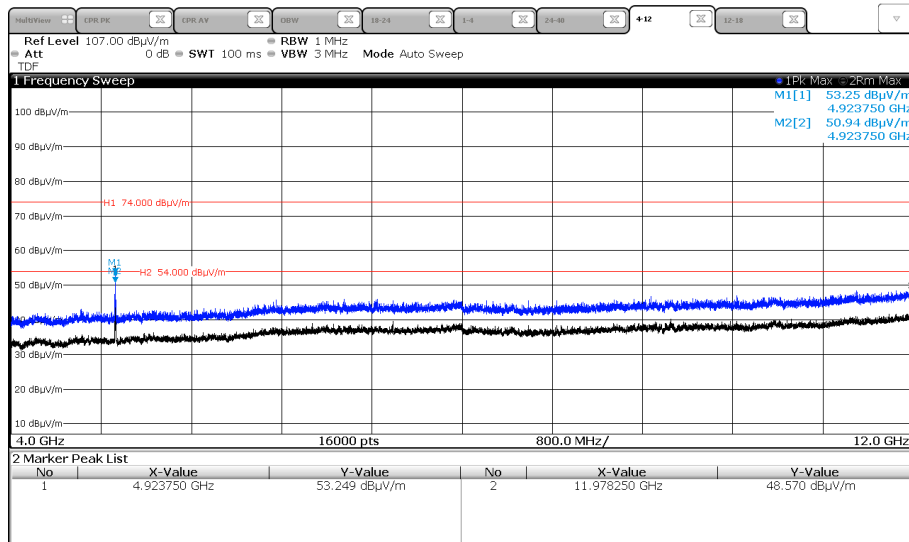


802.11b, CH11, P14

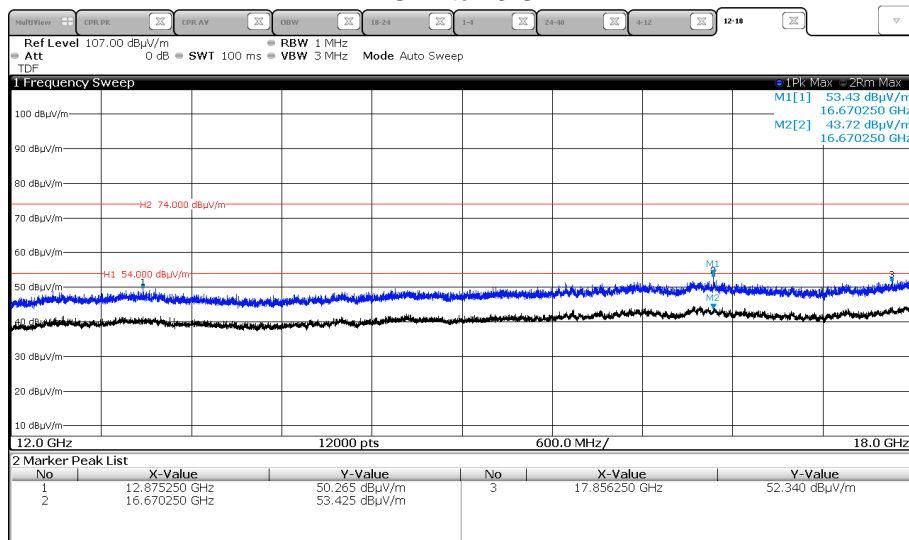
1 GHz to 4 GHz



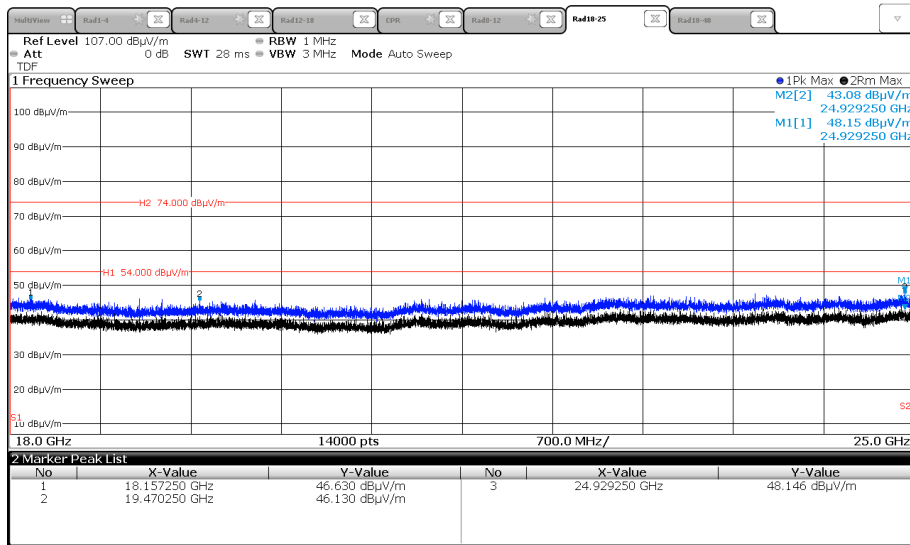
4 GHz to 12 GHz



12 GHz to 18 GHz

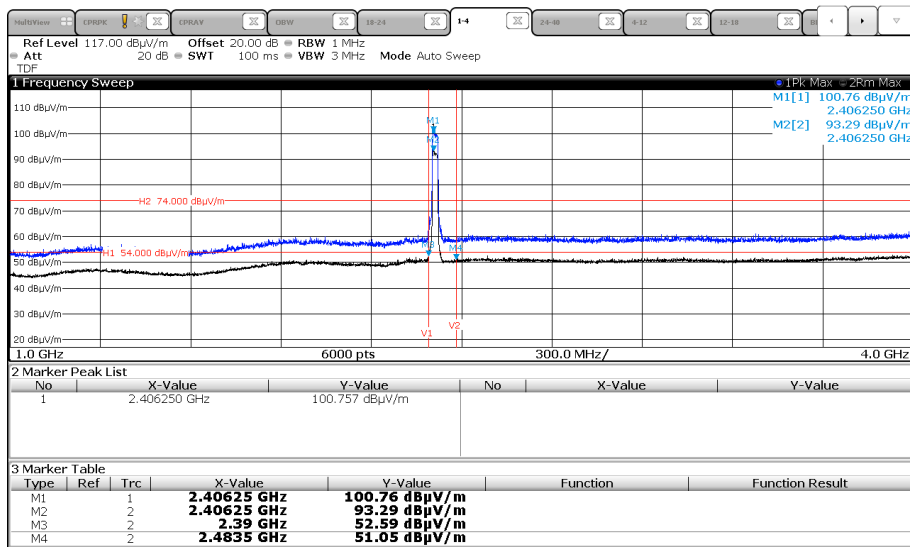


18 GHz to 25 GHz

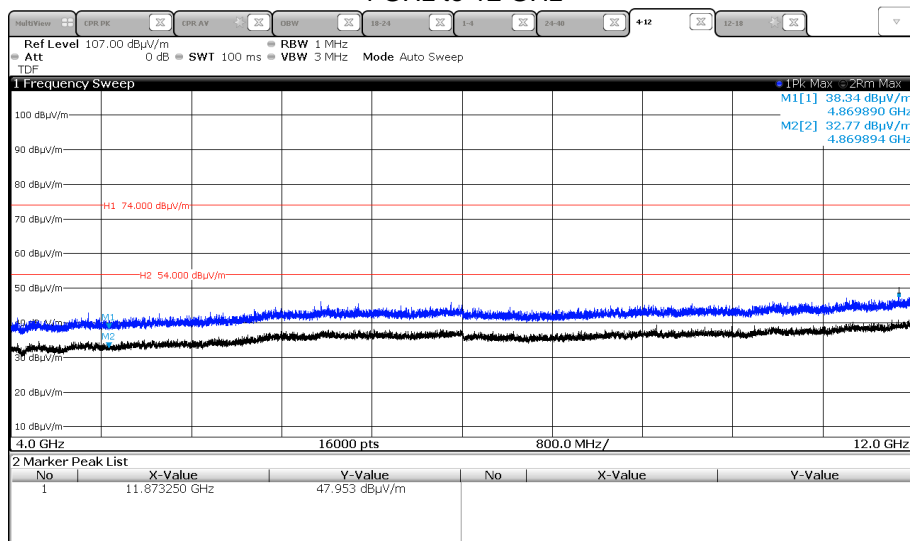


802.11n HT20, CH1, P4

1 GHz to 4 GHz



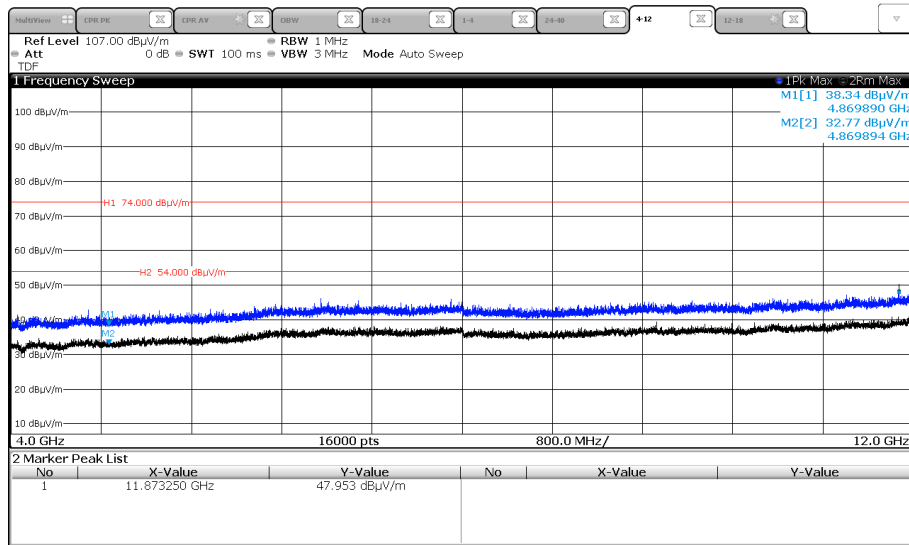
4 GHz to 12 GHz



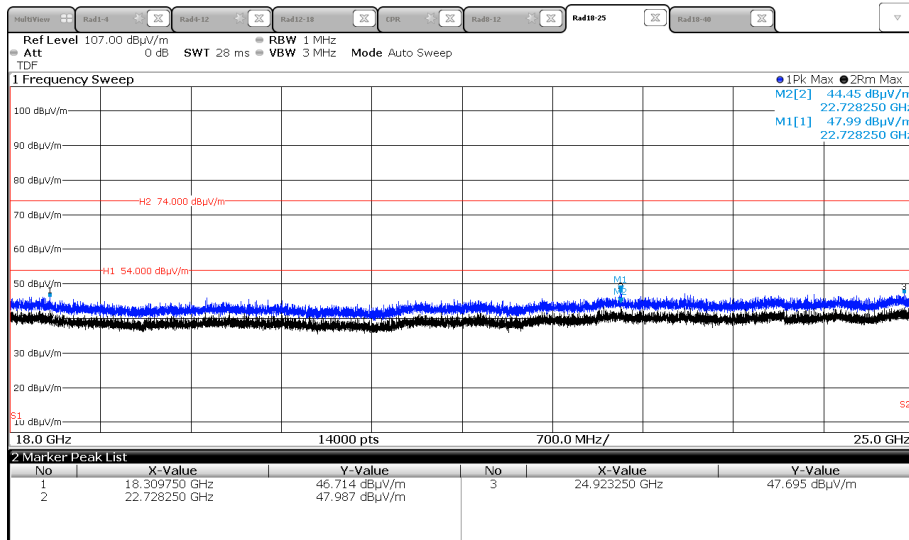
FCC ID: 2AJY6MORIN01

IC: 22172-MORIN01

12 GHz to 18 GHz

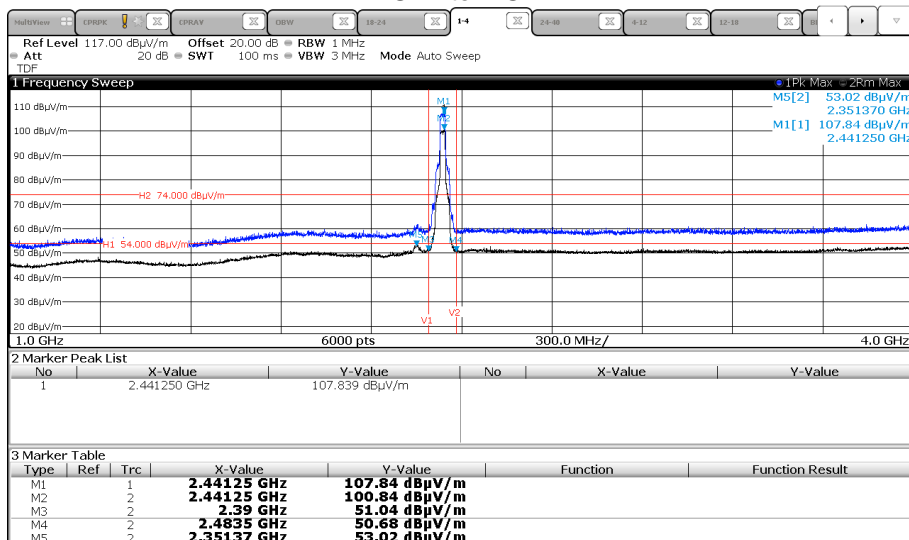


18 GHz to 25 GHz



802.11n HT20, CH6, P14

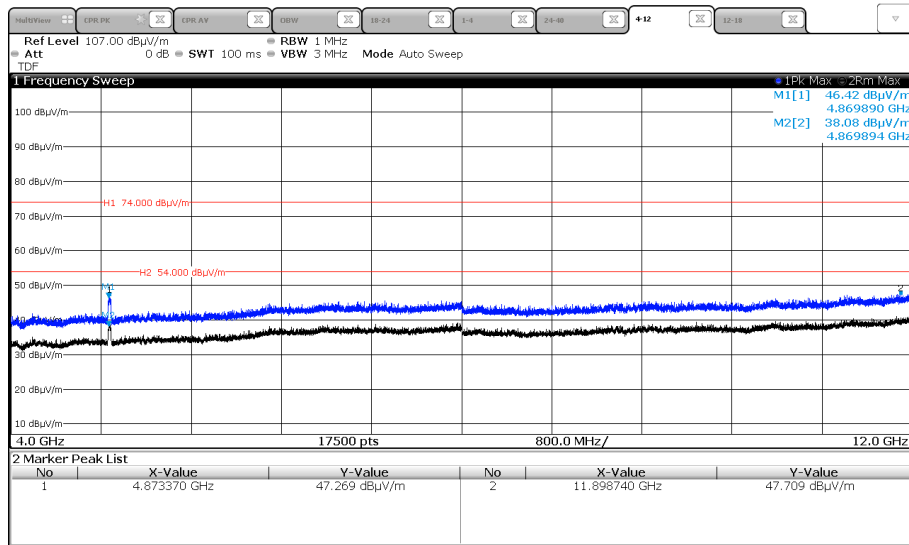
1 GHz to 4 GHz



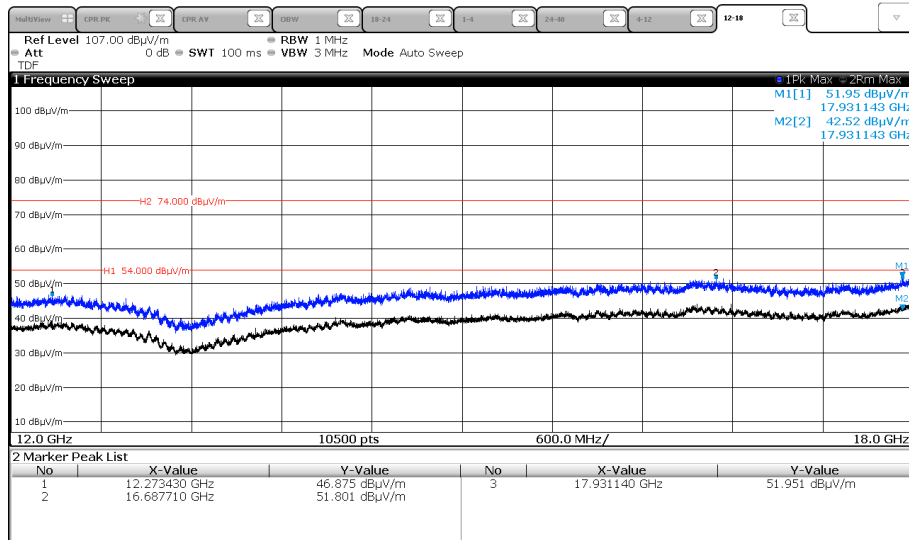
FCC ID: 2AJY6MORIN01

IC: 22172-MORIN01

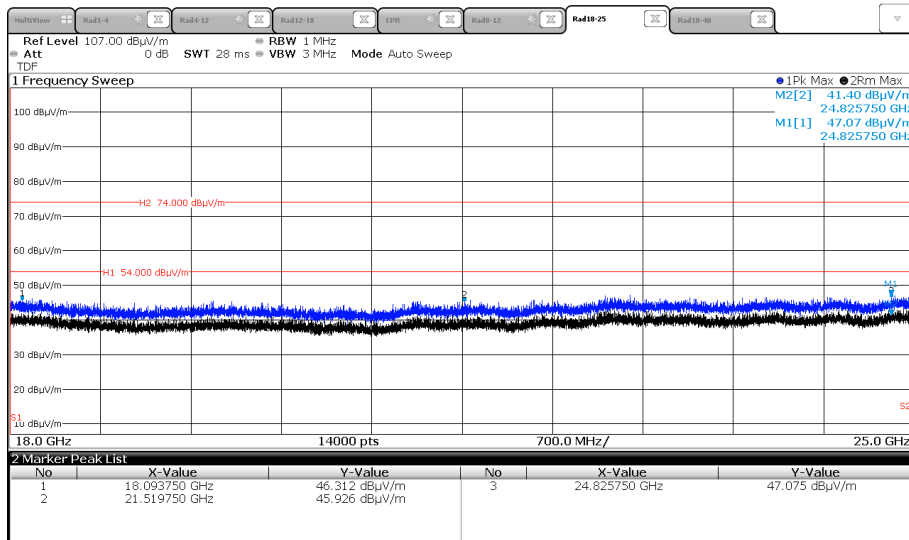
4 GHz to 12 GHz



12 GHz to 18 GHz

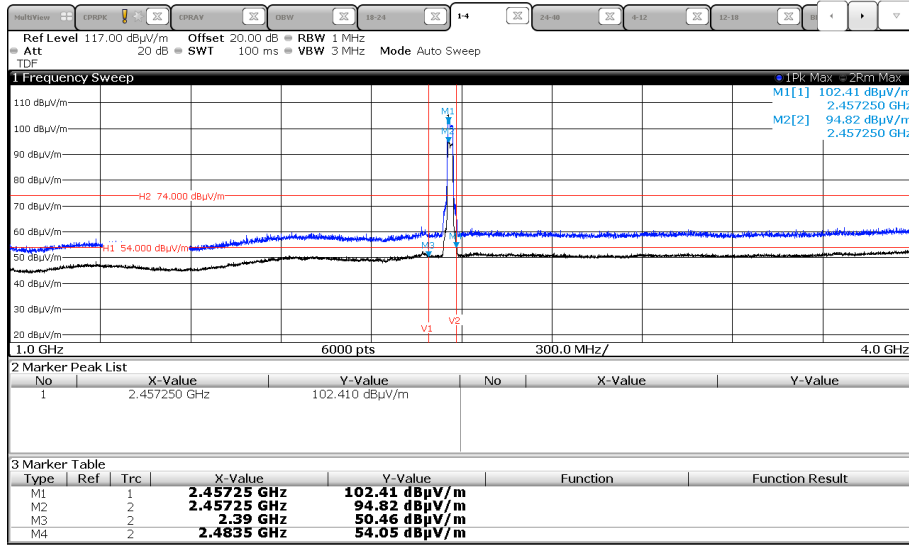


18 GHz to 25 GHz

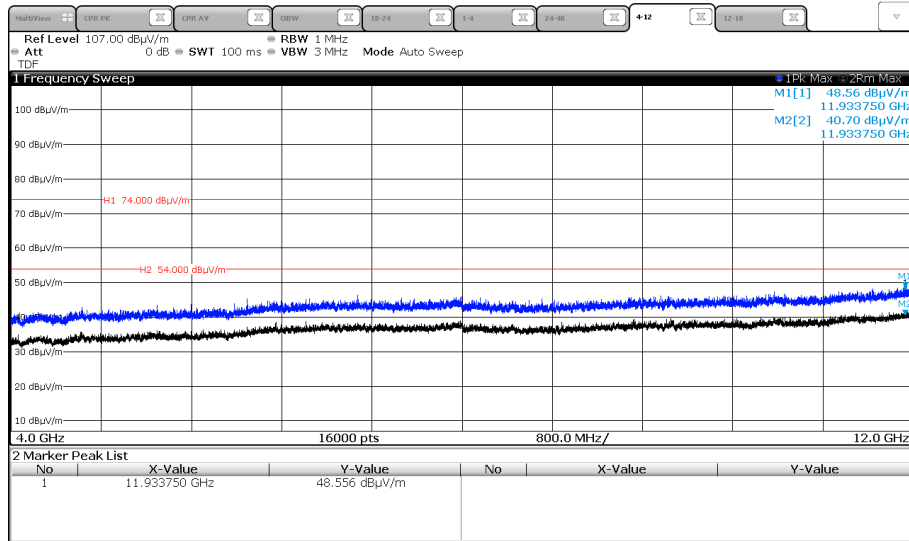


802.11n HT20, CH11, P8

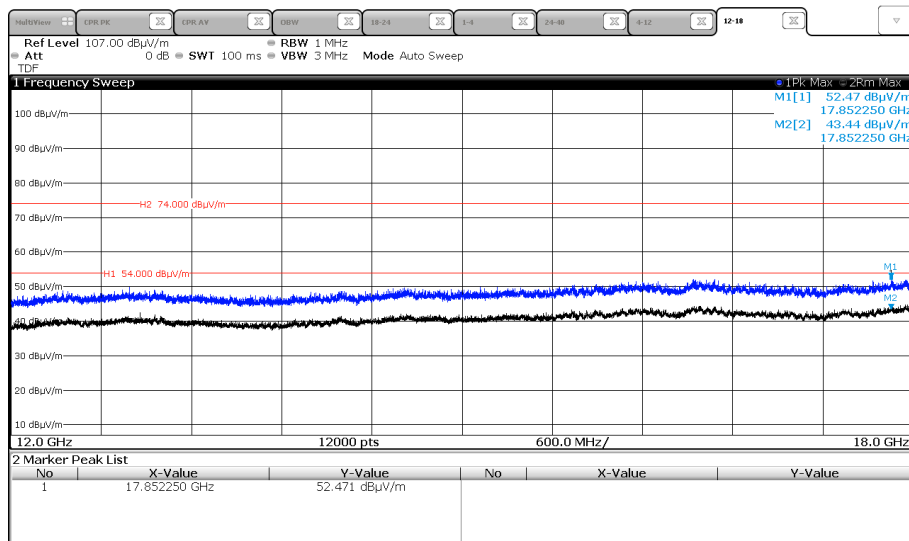
1 GHz to 4 GHz



4 GHz to 12 GHz



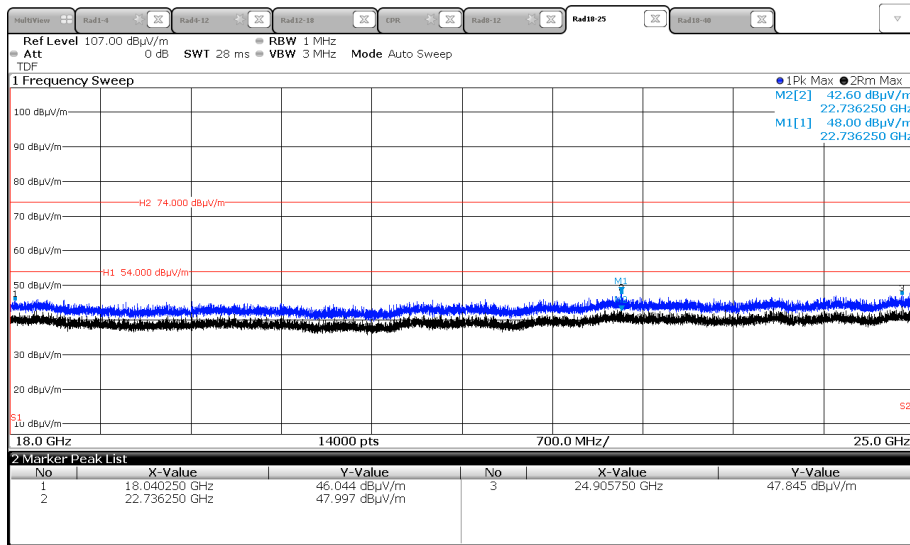
12 GHz to 18 GHz



FCC ID: 2AJY6MORIN01

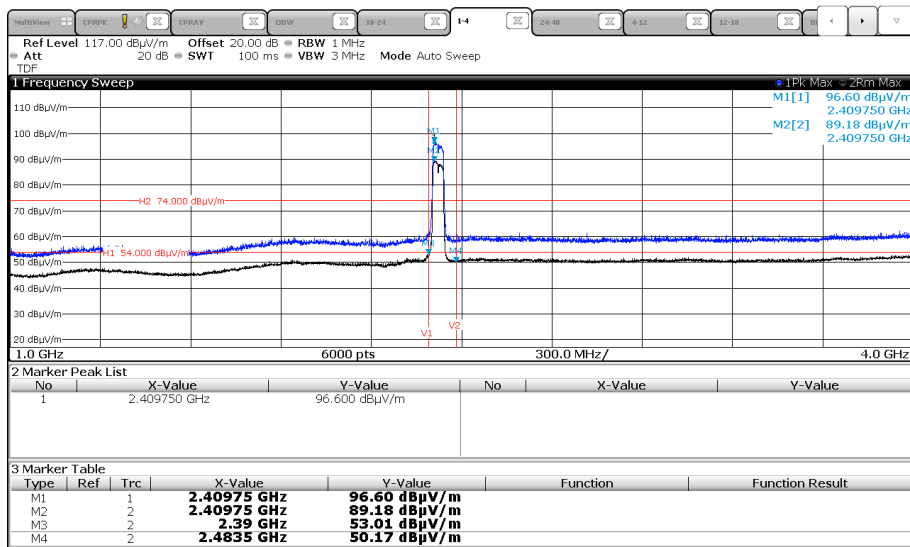
IC: 22172-MORIN01

18 GHz to 25 GHz

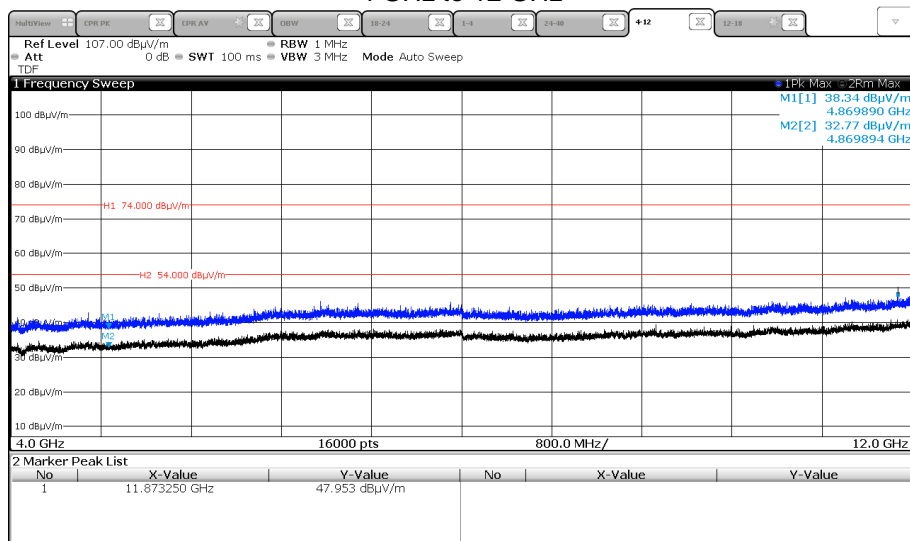


802.11n HT40, CH1up, P3

1 GHz to 4 GHz



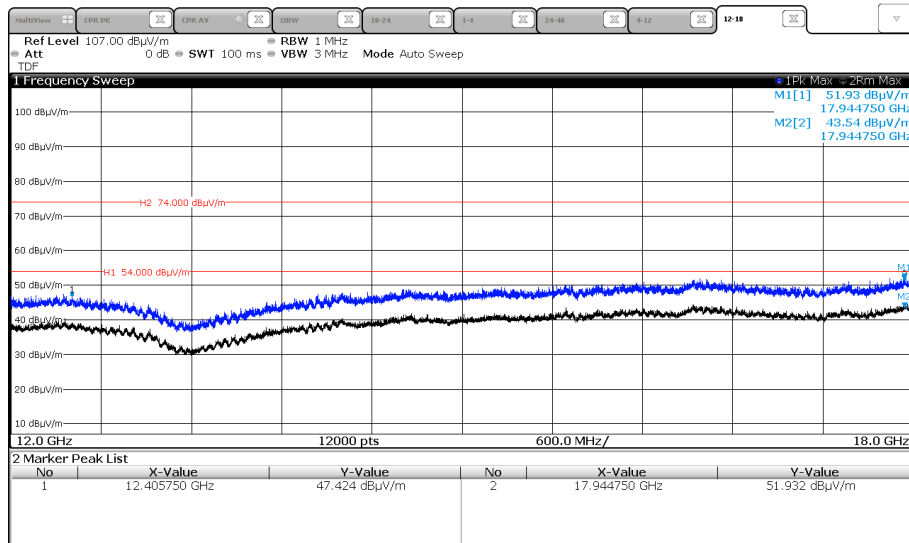
4 GHz to 12 GHz



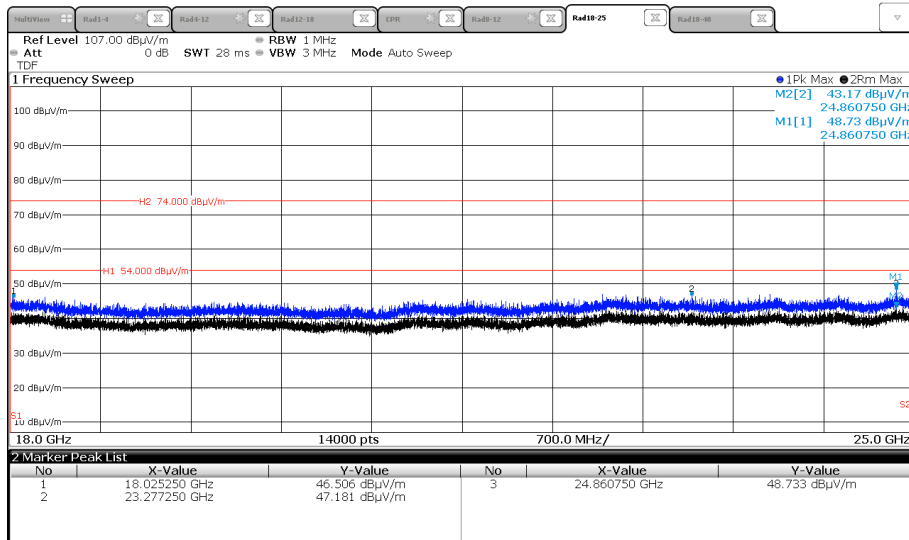
FCC ID: 2AJY6MORIN01

IC: 22172-MORIN01

12 GHz to 18 GHz

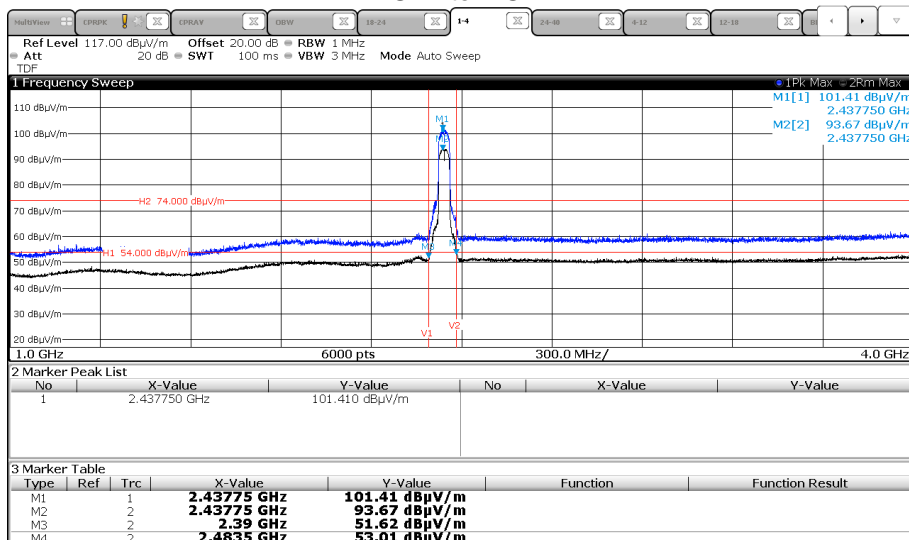


18 GHz to 25 GHz

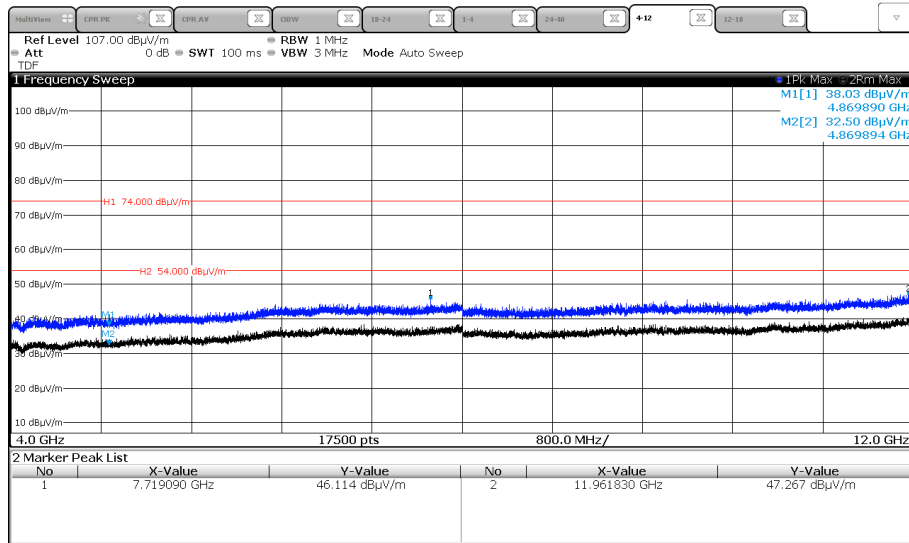


802.11n HT40, CH4up, P9

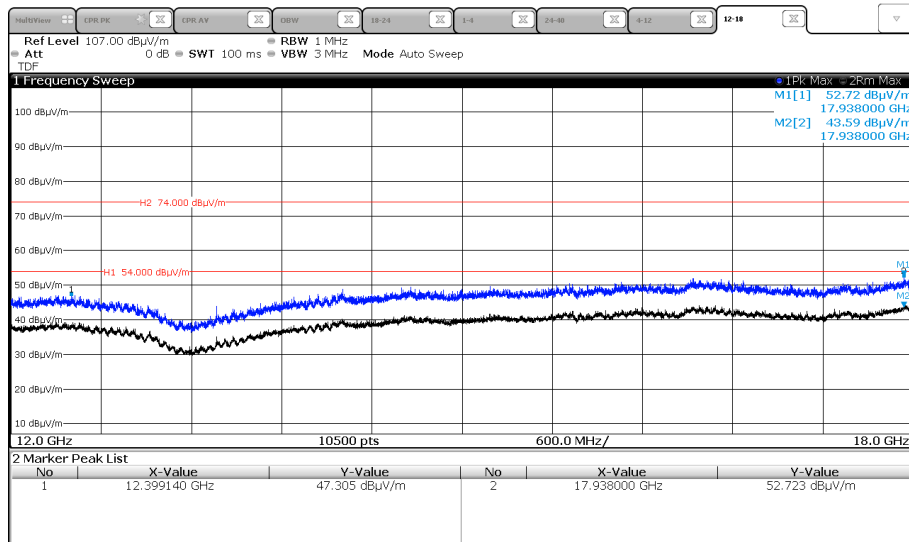
1 GHz to 4 GHz



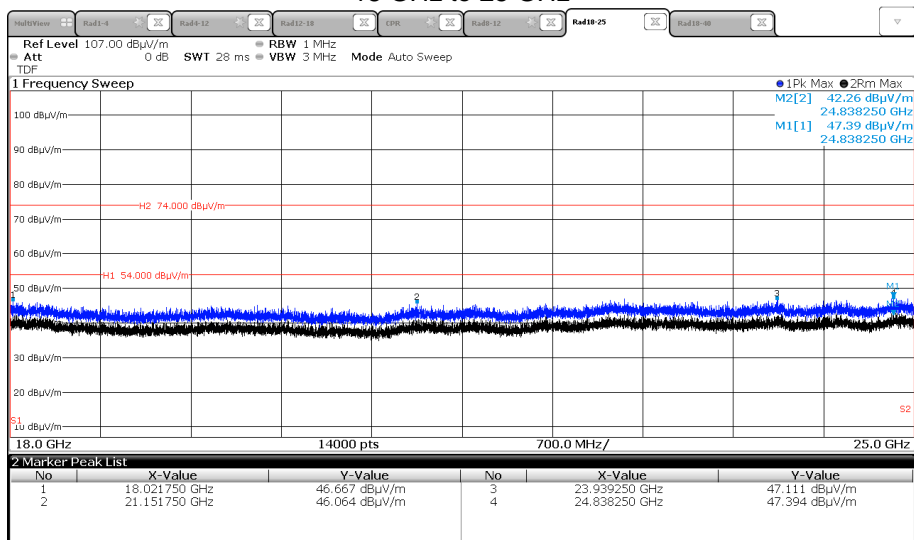
4 GHz to 12 GHz



12 GHz to 18 GHz

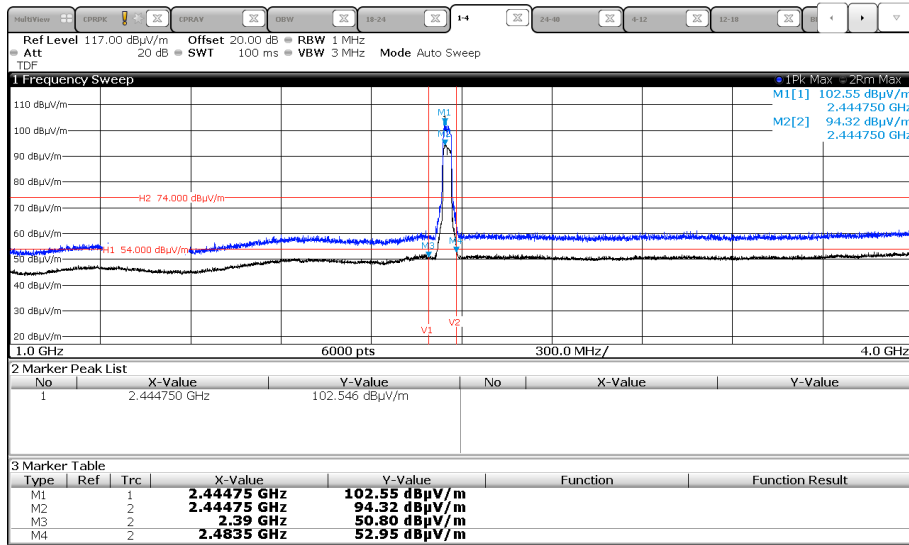


18 GHz to 25 GHz

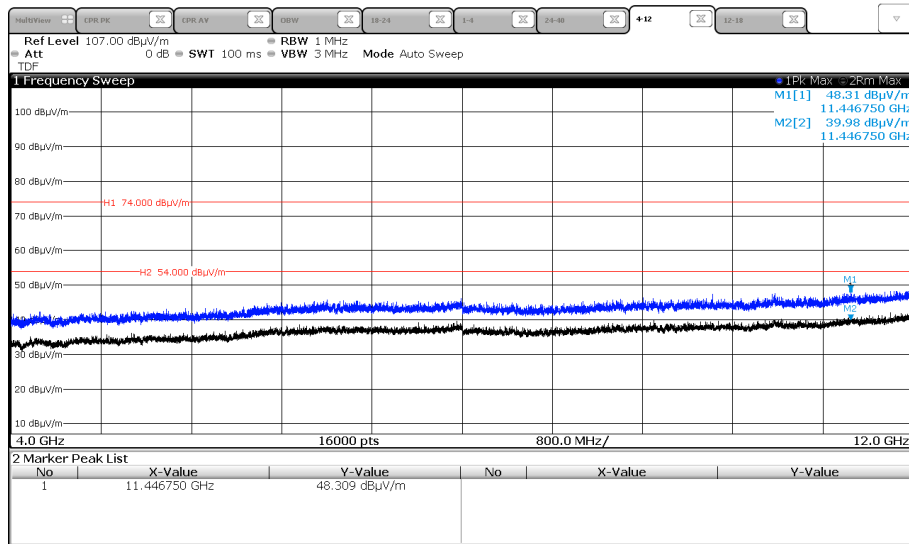


802.11n HT40, CH7up, P8

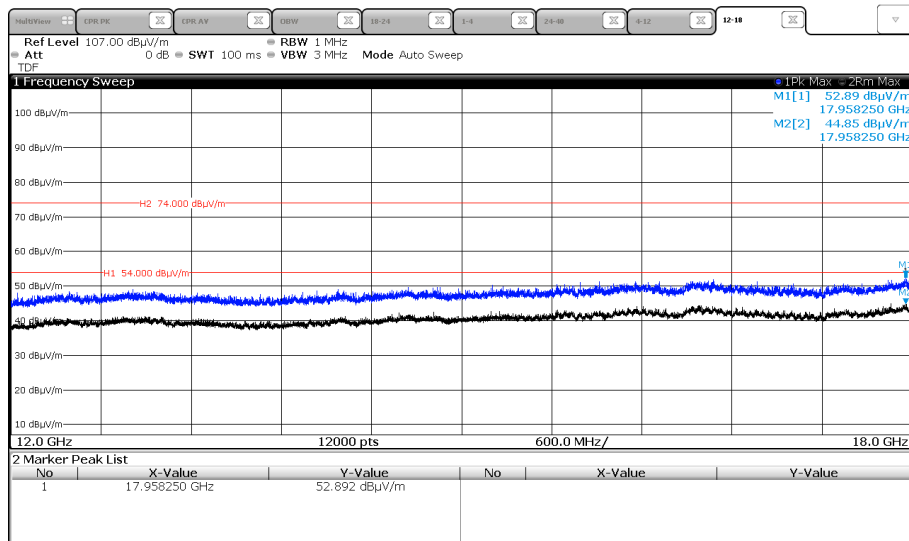
1 GHz to 4 GHz



4 GHz to 12 GHz

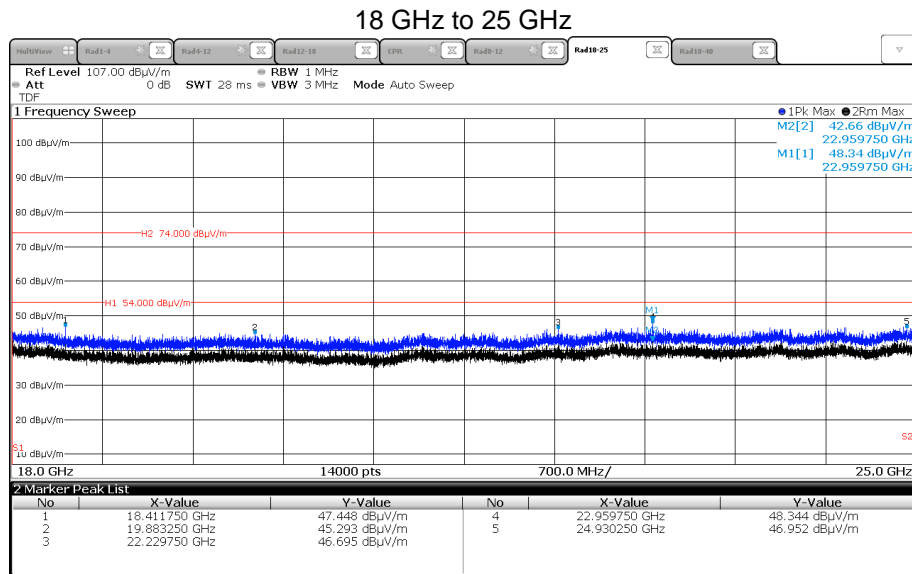


12 GHz to 18 GHz



FCC ID: 2AJY6MORIN01

IC: 22172-MORIN01



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 10th harmonic.

4.7.2 Test protocols of restricted band emissions

4.8 Band edge compliance

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

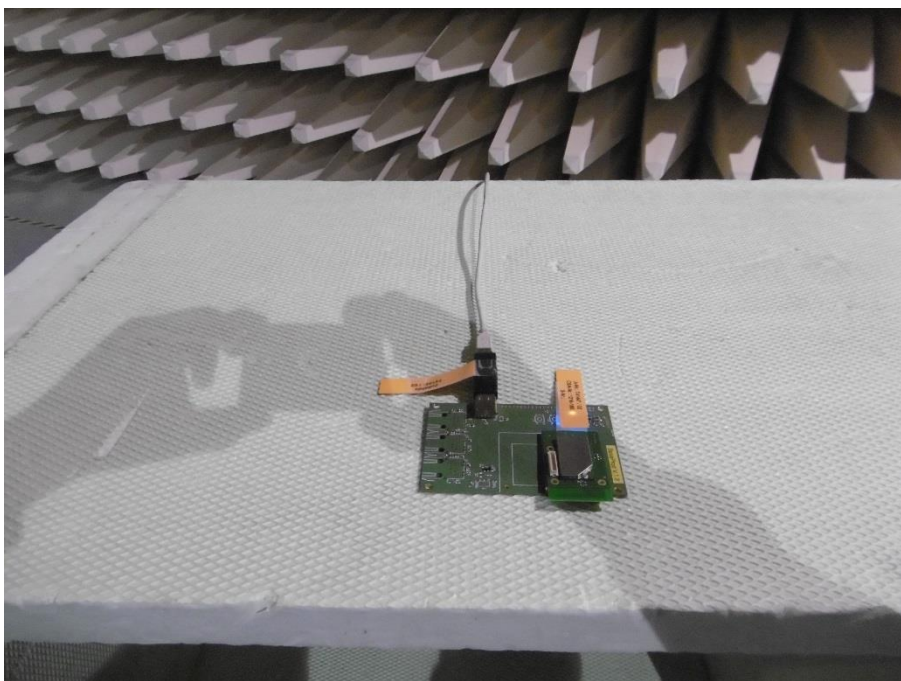
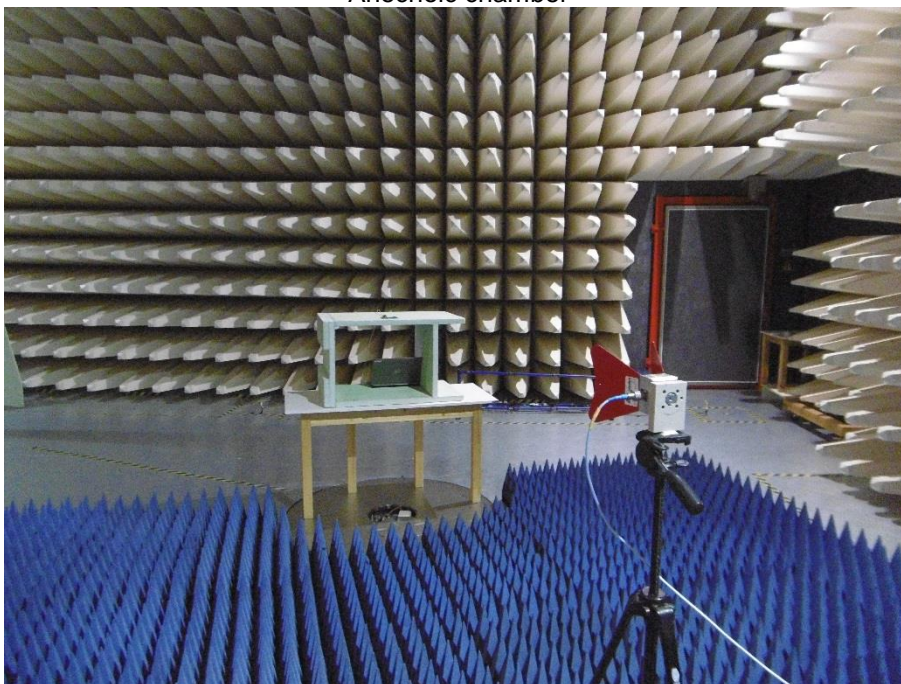
4.8.1 Description of the test location

Test location: Anechoic chamber 1

Test distance: 3 m

4.8.2 Photo documentation of the test set-up

Anechoic chamber



4.8.3 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.

4.8.4 Description of Measurement

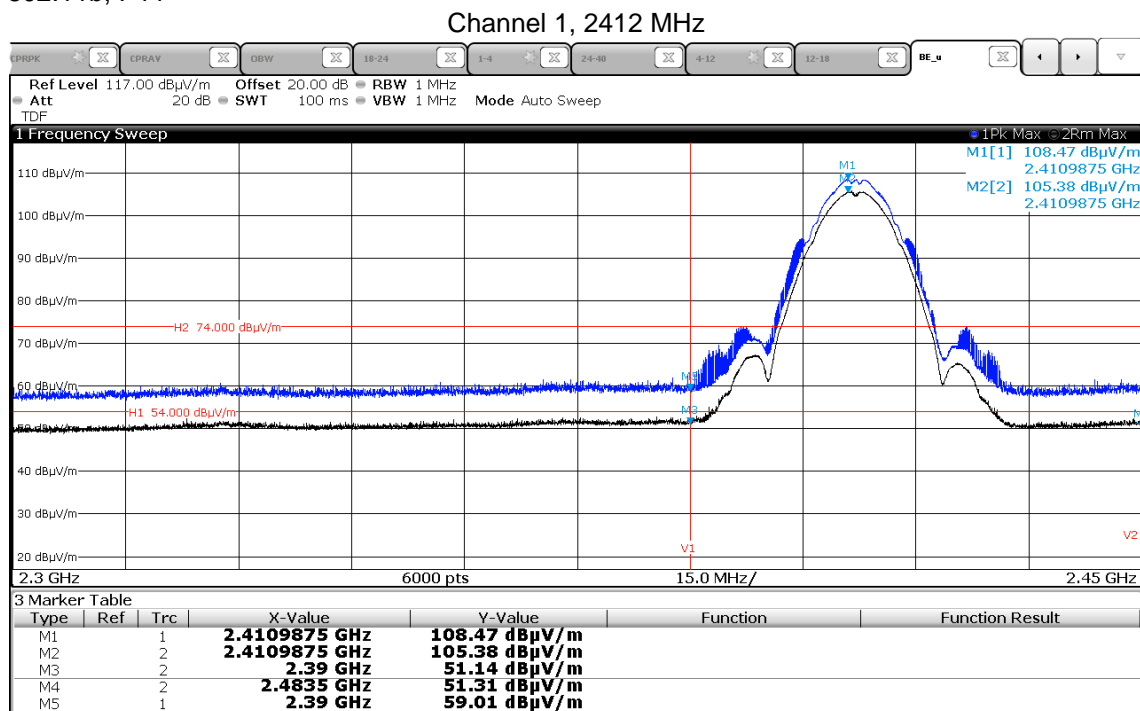
A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT was operating in transmit mode at the assigned frequency according Publication Number 913591, 03/26/2007.

Spectrum analyser settings:

RBW: 1 MHz, VBW: 3 MHz, Detector: RMS, Trace: Max hold, Sweep: 100 ms

4.8.5 Test result

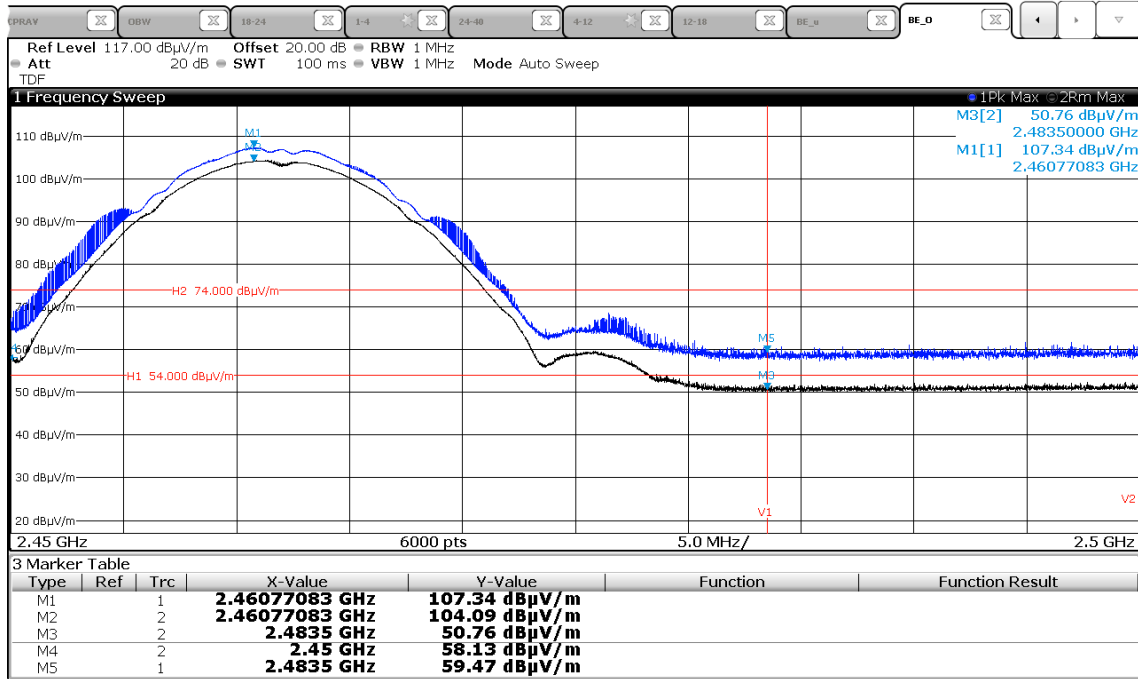
Standard 802.11b, P11



FCC ID: 2AJY6MORIN01

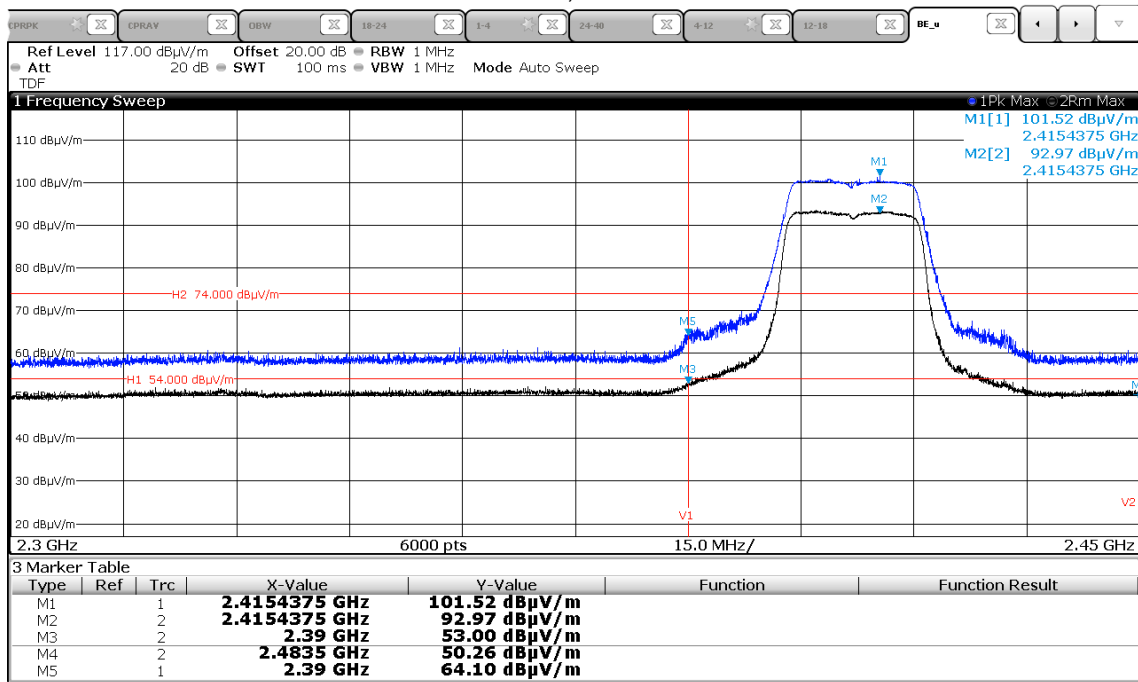
IC: 22172-MORIN01

Channel 11, 2462 MHz



Standard 802.11n HT20, P2

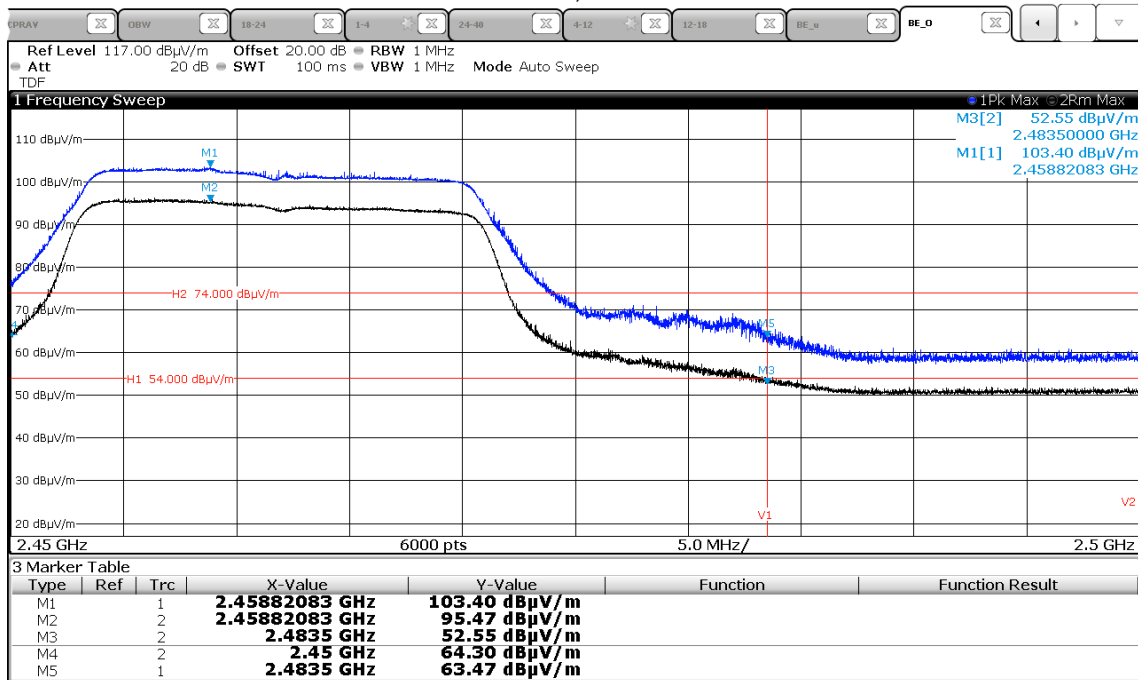
Channel 1, 2412 MHz



FCC ID: 2AJY6MORIN01

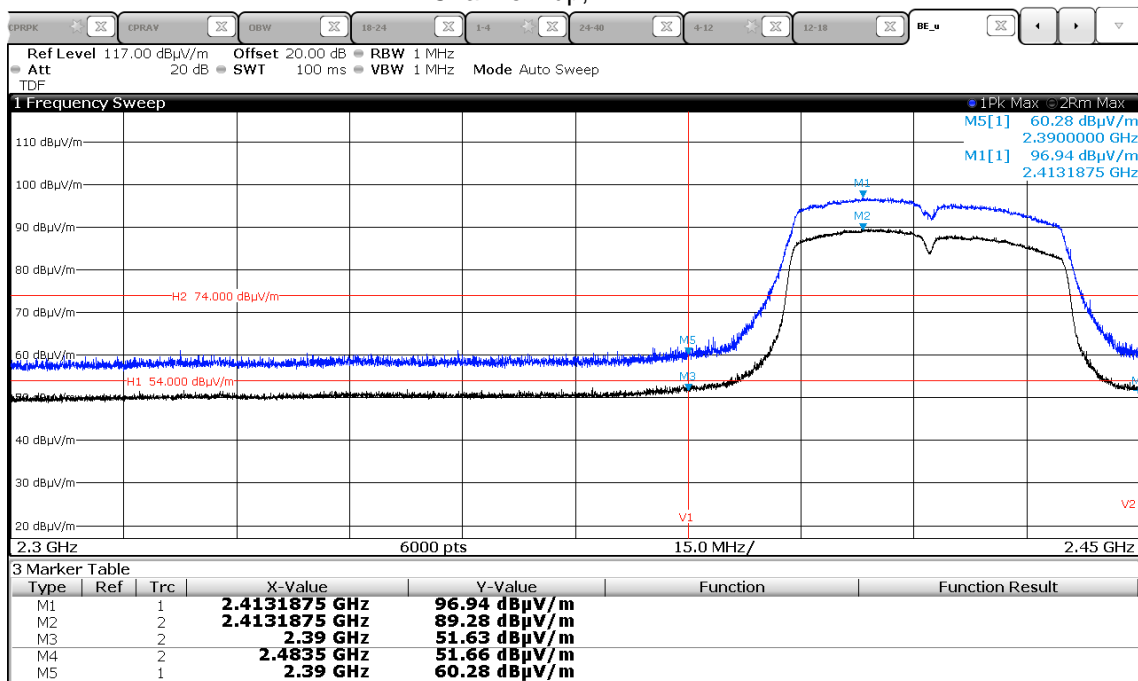
IC: 22172-MORIN01

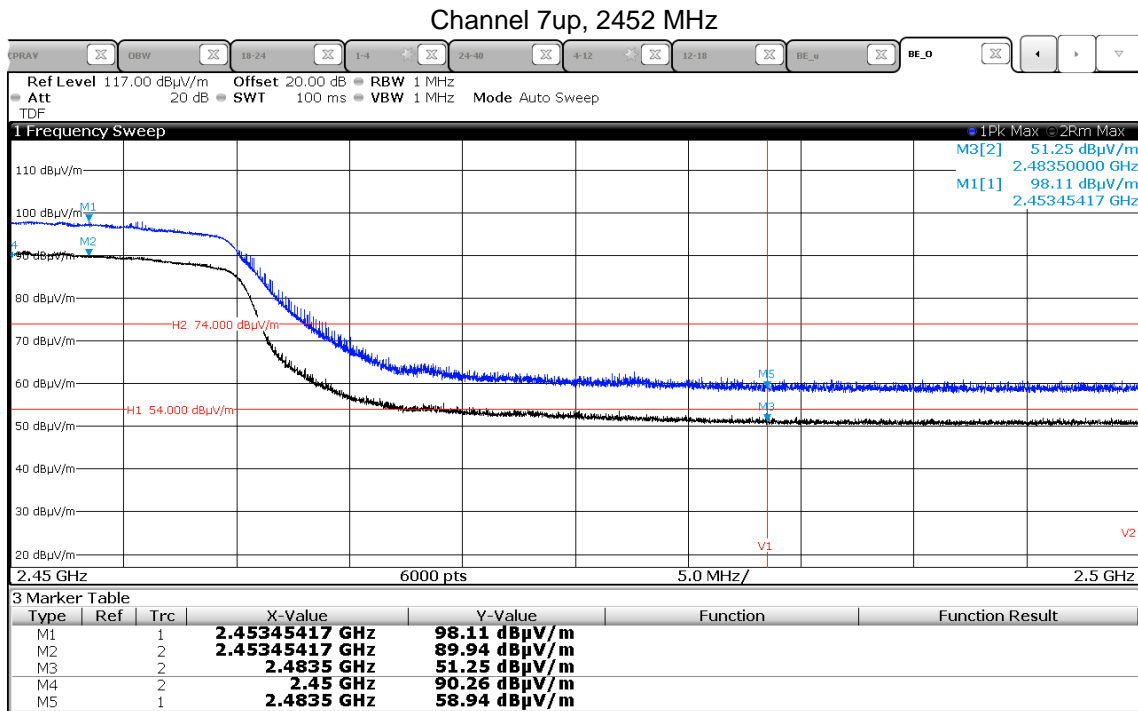
Channel 11, 2462 MHz



Standard 802.11n HT40, P1

Channel 1up, 2422 MHz





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:

4.9 Antenna application

4.9.1 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 R-SMA antenna port. This antenna port is a unique antenna port which allows only the installing of the furnished antenna.

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

4.9.2 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 _x (dBi)	Cond. limit (dBm)	max. G (dBi)	A _{max} (dBm)	Limit P _{out} (dBm)	Reduction (dB)	P set 2.4 GHz
PCB, Omni	2.1	30.0	6.0	20.2	33.9	-13.7	P11

Remarks: No power reduction results from the defacto limit.

5 USED TEST EQUIPMENT AND ACCESSORIES

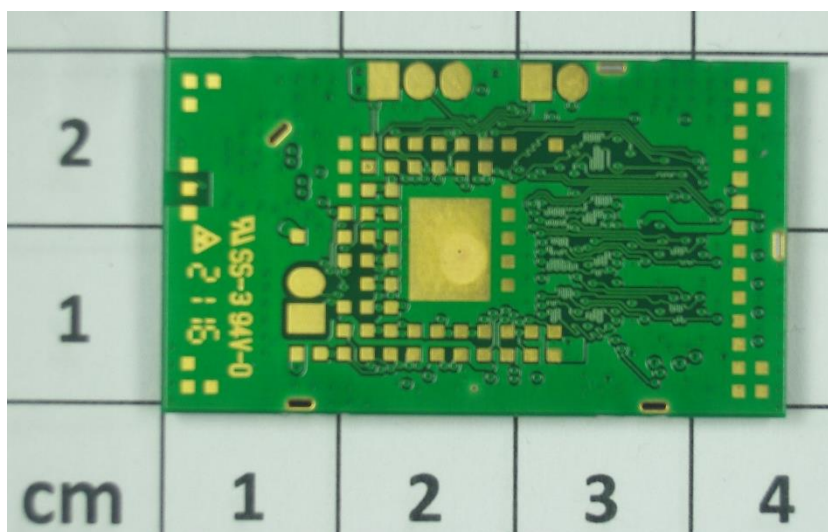
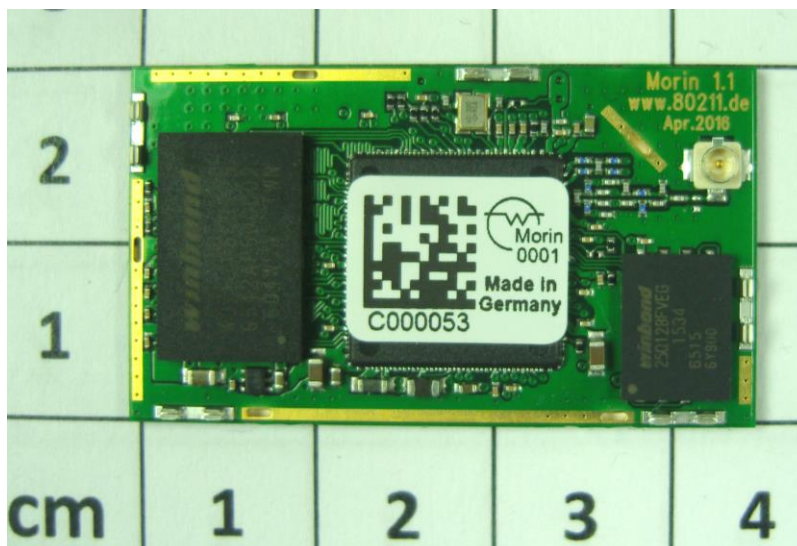
All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	ESCI	02-02/03-15-001	23/05/2017	23/05/2016		
	FSP 30	02-02/11-05-001	06/10/2017	06/10/2016		
	ESH 2 - Z 5	02-02/20-05-004	26/10/2017	26/10/2015	09/12/2016	09/06/2016
	EMV D 30000/PAS	02-02/30-05-006	14/01/2017	14/01/2016		
	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	06/11/2016	06/11/2015	04/02/2017	04/08/2016
CPC 3	FSW43	02-02/11-15-001	25/07/2017	25/07/2016		
MB	FSW43	02-02/11-15-001	25/07/2017	25/07/2016		
SEC 1-3	FSW43	02-02/11-15-001	25/07/2017	25/07/2016		
SER 2	ESVS 30	02-02/03-05-003	08/07/2017	08/07/2016		
	VULB 9168	02-02/24-05-005	20/04/2017	20/04/2016	01/03/2017	01/09/2016
	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	25/07/2017	25/07/2016		
	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	24/05/2017	24/05/2016		
	BBHA 9170	02-02/24-05-014	02/06/2018	02/06/2015	02/12/2016	02/12/2015
	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				

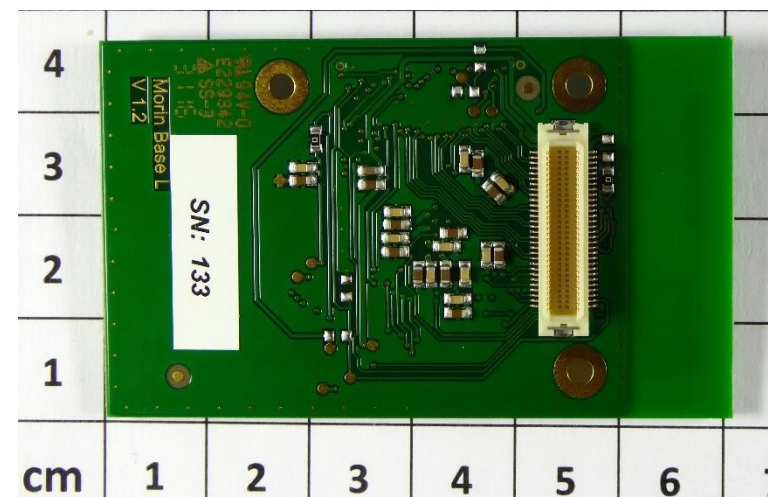
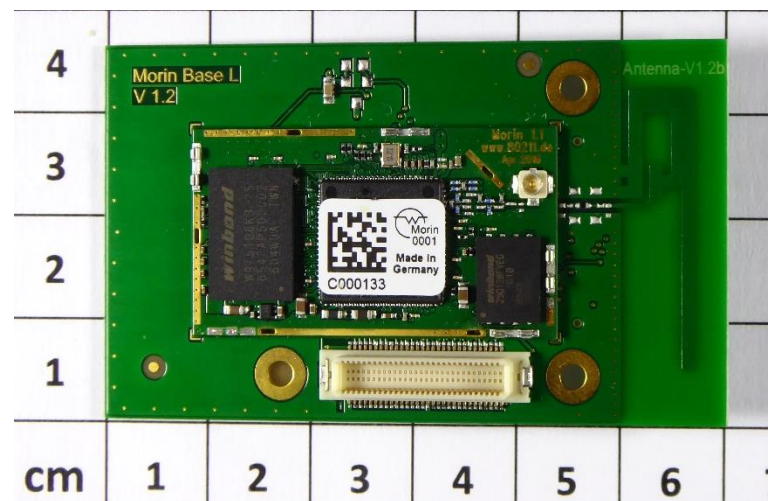
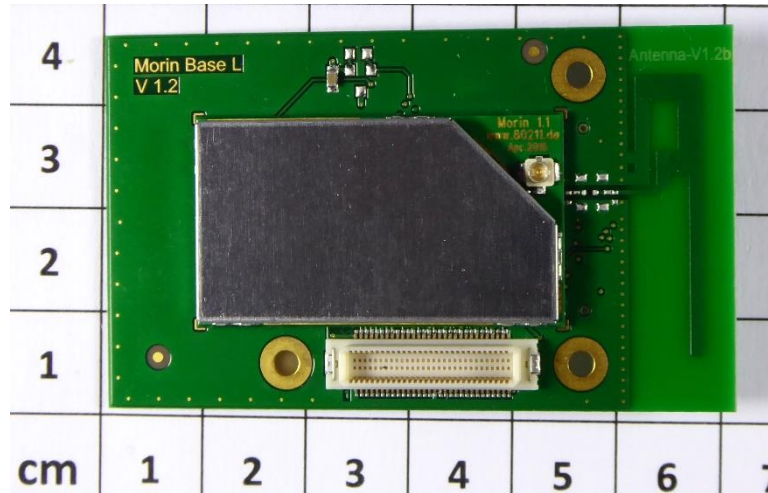
ATTACHMENT A

A1) Photo documentation of the EUT

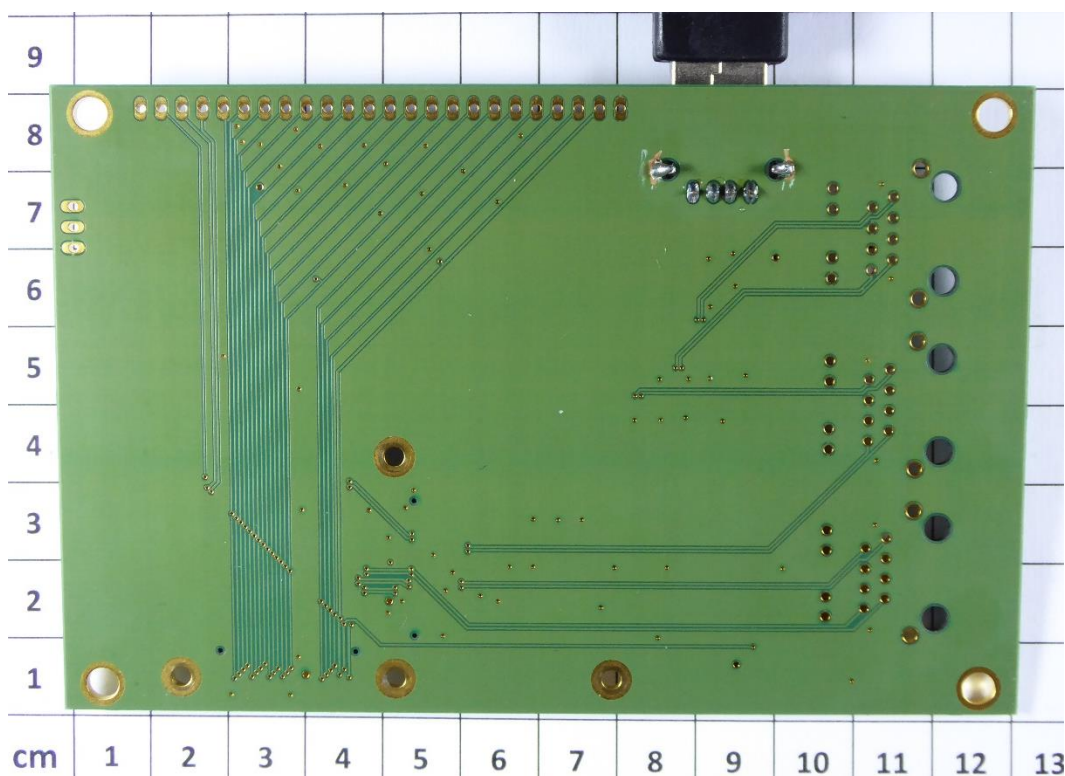
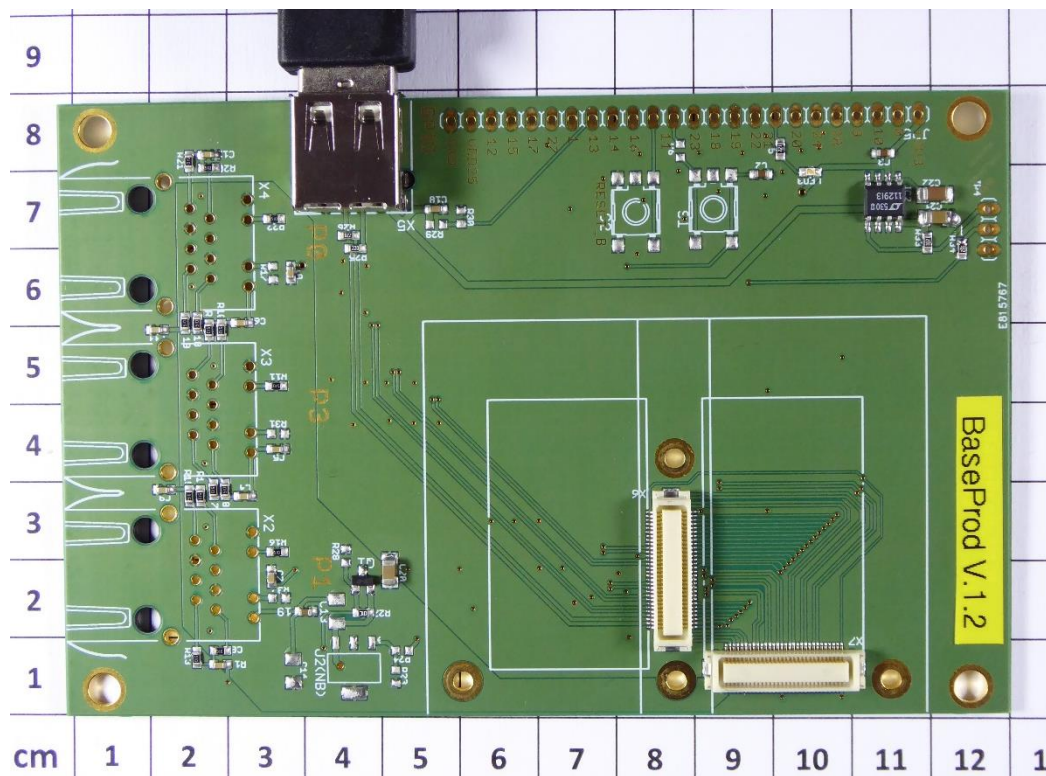
WLAN-Module:



WLAN-Module with antenna PCB:



Test jig:



- End of attachment A -