

RADIO TEST REPORT

No. 2011036STO-301

RF Performance

EQUIPMENT UNDER TEST

Equipment: ID scanner
Type/Model: 365id Scanner
Manufacturer: 365id AB
Tested by request of: 365id AB

SUMMARY

Referring to the emission limits, and the operating mode during the tests specified in this report, the equipment complies with the selected requirements according to the following standards:

47 CFR Part 15: Subpart C: Intentional radiators. Section 15.247

RSS-GEN Issue 5 Amendment 1 (2019): General requirements of compliance of radio apparatus

RSS-247 Issue 2 (2017): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

For details, see clause 2 – 4.

Date of issue: November 20, 2020

Tested by: 
Robert Hietala

Approved by: 
Björn Utermöhl

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

Revision History

Test report number	Date	Description	Changes
2011036STO-301	October 20, 2020	First release	--

CONTENTS

	Page
1 Client Information	4
2 Equipment under test (EUT).....	4
2.1 Identification of the EUT	4
2.2 Companion device	5
2.3 Test signals and operating modes	5
3 Test Specifications	6
3.1 Standards	6
3.2 Additions, deviations and exclusions from standards and accreditation	6
3.3 Test site	6
4 Test Summary	7
5 Conducted continuous disturbances in the frequency-range 0.15 to 30 mhz.....	8
5.1 Test set-up and test procedure	8
5.2 Requirement.....	8
5.3 Test results.....	9
6 Radiated rf Emission in the frequency-range 30 MHz to 26 GHz	10
6.1 Test set-up and test procedure	10
6.2 Test conditions	10
6.3 Requirements	11
6.4 Test results 30 MHz – 1000 MHz, TX, 802.11b 1 Mbps	11
6.5 Test results 1 GHz – 26 GHz, TX, 802.11b 1 Mbps	14
6.6 Test results 1 GHz – 13 GHz, TX, 802.11g 6 Mbps	21
6.7 Test results 1 GHz – 13 GHz, TX, 802.11n MCS0	25
7 Conducted band edge measurement.....	29
7.1 Test set-up and test procedure.....	29
7.2 Test conditions	29
7.3 Requirement.....	29
7.4 Test results.....	30
8 Maximum average conducted output power	34
8.1 Test set-up and test procedure	34
8.2 Test conditions	34
8.3 Requirements	34
8.4 Test results.....	35
9 Occupied 6 dB bandwidth	40
9.1 Test set-up and test procedure.....	40
9.2 Test conditions	40
9.3 Requirements	40
9.4 Test results.....	41
10 99 % bandwidth	48
10.1 Test set-up and test procedure.....	48
10.2 Test conditions	48
10.3 Test results.....	48
11 Power spectral density	54
11.1 Test set-up and test procedure.....	54
11.2 Test conditions	54
11.3 Requirements	54
11.4 Test results.....	55
12 Test equipment.....	60
13 Measurement uncertainty	61
14 Test set up and EUT photos.....	61

1 CLIENT INFORMATION

The EUT has been tested by request of:

Company 365id AB
Slottsmöllan 10 B
302 31 Halmstad
Sweden

Name of contact Anders Nilsson

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT

Equipment: ID scanner

Type/Model: 365id Scanner

Brand name: 365id

Serial number: 0000 0081 9030 2296

Manufacturer: 365id AB

Transmitter frequency range: 2412 - 2462 MHz

Receiver frequency range: 2412 - 2462 MHz

Number of channels: 11

Antenna: ☒ Internal antenna¹ ☐ External antenna

Antenna connector: ☒ None, internal antenna ☐ Yes

Antenna gain: +1.5 dBi (peak gain)

Rating RF output power: +24 dBm (eirp)

Type of modulation: 802.11 b/g/n

Nominal bandwidth: 20 MHz

Transmitter standby mode supported: ☒ Yes ☐ No

¹ AEL A2450M000000S007

2.2 Companion device

Equipment	Type / Model	Manufacturer	Serial no.
Communication tester	CMW 500	Rohde & Schwarz	1201.0002K50-168416-nU

2.3 Test signals and operating modes

The EUT employs a Wi-Fi 2.4 GHz radio module which have been tested previously in test report no. TRA-029073-45-00B.

It was determined, by the output power and power spectral density in the test report mentioned above, that the following data rate for each modulation family is worst-case:

Modulation family	Data rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n	MCS0

The EUT have been evaluated for conducted measurements for all above mentioned data rates.

The EUT have been evaluated for radiated measurements as described in the table below.

Frequency range	Modulation and data rate
30 MHz – 1000 MHz	802.11b 1 Mbps
1 GHz – 13 GHz	802.11g 6 Mbps
1 GHz – 13 GHz	802.11n MCS0
1 GHz – 26 GHz	802.11b 1 Mbps

The following channel frequencies have been used throughout the testing:

Channel	Frequency
Low	2412 MHz
Middle	2437 MHz
High	2462 MHz

3 TEST SPECIFICATIONS

3.1 Standards

Requirements:

47 CFR Part 15 (2015): Subpart C: Intentional radiators. Section 15.247

RSS-GEN Issue 5 Amendment 1 (2019): General requirements of compliance of radio apparatus.

RSS-247 Issue 2 (2017): Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test methods:

ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3.2 Additions, deviations and exclusions from standards and accreditation

No additions, deviations or exclusions have been made from standards and accreditation.

3.3 Test site

Measurements were performed at:

Intertek Semko AB
Torshamnsgatan 43
Box 1103
SE-164 22 Kista

Intertek Semko AB is a FCC listed test site with site registration number 90913
Intertek Semko AB is a FCC accredited conformity assessment body with designation number SE0002
Intertek Semko AB is an Industry Canada listed test facility with IC assigned code 2042G
Intertek Semko AB is an ISED recognized wireless testing laboratory with CAB identifier SE0003.

Measurement chambers

Measurement Chamber	Type of chamber	IC Site filing #
Radiohallen (3m FAR)	Fully anechoic 3 m	2042G-4
Björkhallen (3m SAC)	Semi anechoic 2 m	2042G-1

4 TEST SUMMARY

The results in this report apply only to sample tested:

Requirement	Description	Result
FCC §15.203 RSS-GEN 8.3 FCC §15.247 (b)(4) RSS-247 5.4(4), 5.4(5)	Antenna	PASS
	The EUT has integrated non detachable antenna which can't be remove without breaking the EUT. The antenna gain is less than 6 dBi	
FCC Part 15.205 RSS-GEN 8.10	Restricted bands of operations	PASS
	The transmit frequency, including fundamental components of modulation, of license-exempt radio apparatus shall not fall within the restricted frequency bands listed in CFR 47 §15.205 and in RSS-GEN section 8.10 EUT operates in unrestricted 2400 – 2483.5 MHz frequency band.	
FCC §15.207, 15.107 RSS-GEN 8.8 table 3	Conducted continuous emission in the frequency range 150 kHz to 30 MHz, AC Power input port	PASS
	The margin to the limit was at least 10 dB. See clause	
FCC §15.247 (d), 15.209(a) RSS-GEN 8.9 RSS-247 5.5	Radiated emission of electromagnetic fields in the frequency range 30 – 1000 MHz	PASS
	The margin to the limit was at least 7.2 dB.	
FCC §15.247(d), 15.209(a) RSS-GEN 8.9 RSS-247 5.5	Radiated emission of electromagnetic fields in the frequency range above 1 GHz	PASS
	The EUT complies with the limits. The margin to the limit was at least 10 dB. See clause 5.4.	
FCC §15.247(a)(2) RSS-GEN 6.7 RSS-247 5.2(1)	Occupied bandwidth	PASS
	The margin to the limit was at least 8.5 MHz.	
FCC §15.247(b) RSS-247 5.4(4)	Conducted output power	PASS
	The margin to the limit was at least 7.8 dB.	
FCC §15.247(e) RSS-247 5.2(2)	Power spectral density	PASS
	The margin to the limit was at least 10 dB.	
FCC §15.247(e) RSS-247 5.5	Conducted Band edge	PASS
	The margin to the limit was at least 10 dB.	

NT = Not tested

5 CONDUCTED CONTINUOUS DISTURBANCES IN THE FREQUENCY-RANGE 0.15 TO 30 MHz

Date of test:	2020-11-19	Test location:	Bur 1
EUT Serial:	0000 0081 9380 0244	Ambient temp:	22 °C
Tested by:	Robert Hietala	Relative humidity:	32 %
Test result:	Pass	Margin:	> 10 dB

5.1 Test set-up and test procedure

The test method is in accordance with ANSI C63.10-2013 section 6.2.

The EUT was connected to the power via Artificial Mains Networks AMN.

The EUT was placed on an insulating support 0.8 m above the floor, 0.4 m from the vertical reference ground plane (RGP) and 0.8 m from the AMN/ISN.

Overview sweeps were performed for each lead.

During the tests the EUT was operated according to the mode of operation mentioned in clause 2.3.

5.2 Requirement

Limits for conducted emission from AC mains

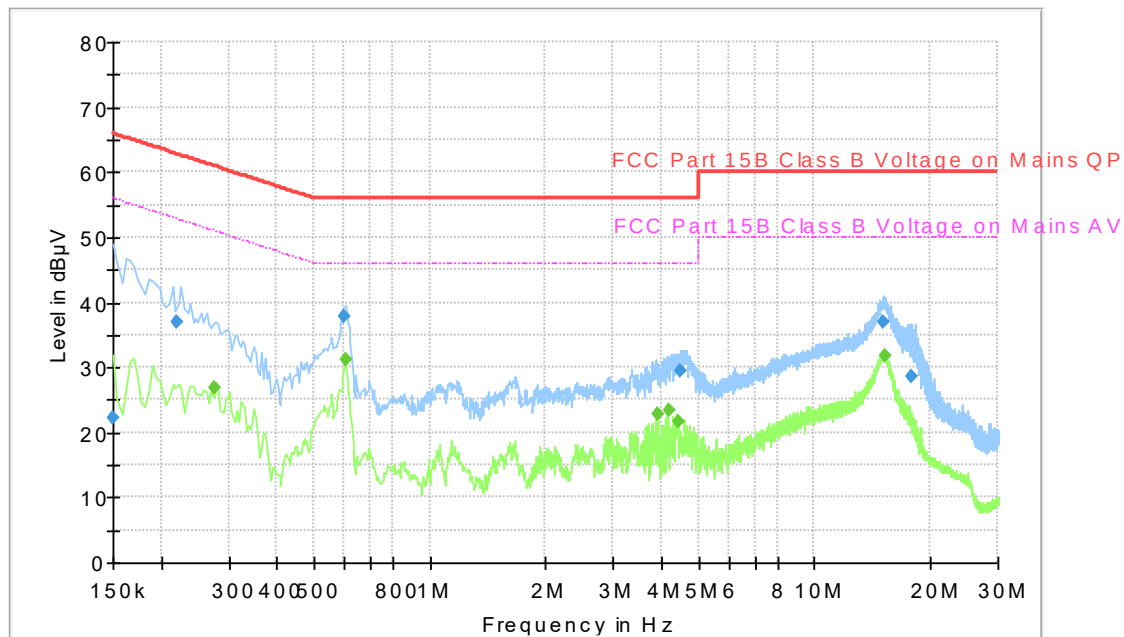
The EUT shall meet the limits for the standards.

Reference: 47 CFR §15.207

RSS-GEN, section 8.8 table 3

Frequency range [MHz]	Limits [dBμV]	
	Quasi-Peak	Average
0.15 – 0.50	66 – 56	56 – 46
0.50 – 5.00	56	46
5.00 – 30.0	60	50

5.3 Test results



Diagram, Peak and Average overview sweep, middle channel, 802.11b 1 Mbps

Measurement results, Quasi-peak

Frequency [MHz]	Level [dBµV]	Limit [dBµV]	Line L/N	Margin [dB]
0.150	22.2	66.0	N	43.8
0.220	36.9	62.8	N	25.9
0.599	37.9	56.0	L1	18.2
4.491	29.4	56.0	L1	26.6
15.154	37.0	60.0	N	23.0
17.867	28.5	60.0	N	31.5

Measurement results, Average

Frequency [MHz]	Level [dBµV]	Limit [dBµV]	Line L/N	Margin [dB]
0.276	26.9	50.9	N	24.0
0.602	31.3	46.0	N	14.7
3.902	22.9	46.0	L1	23.1
4.170	23.3	46.0	L1	22.7
4.424	21.5	46.0	L1	24.5
15.271	31.6	50.0	N	18.4

Result [dBµV] = Analyser reading [dBµV] + cable loss [dB] + LISN insertion loss [dB]

6 RADIATED RF EMISSION IN THE FREQUENCY-RANGE 30 MHZ TO 26 GHZ

Date of test:	2020-10-08 to 2020-10-19	Test location:	3m FAR and Björkhallen
EUT Serial:	0000 0081 9380 0244	Ambient temp:	20 °C
Tested by:	Robert Hietala	Relative humidity:	54 %
Test result:	Pass	Margin:	7.2 dB

6.1 Test set-up and test procedure

The test method is in accordance with ANSI C63.10-2013.

The EUT was set up in order to emit maximum disturbances.

The EUT was placed on an insulating support 1.5 m above the turntable which is part of the reference ground plane.

Overview sweeps were performed with the measurement receiver in max-hold mode and the peak and average detector activated.

6.2 Test conditions

Test set-up:

Test receiver set-up:

Preview test:

Final test:

EUT height above ground plane:

Measuring distance:

Measuring angle:

Antenna

Height above ground plane:

Polarisation:

Type:

30 MHz to 1000 MHz

Peak

RBW 120 kHz

VBW 1 MHz

Quasi-Peak

RBW 120 kHz

VBW 1 MHz

0.8 m

3 m

0 – 359°

1 – 4 m

Vertical and Horizontal

Bilog

Test set-up:

Test receiver set-up:

Preview test:

Final test:

EUT height above ground plane:

Measuring distance:

Measuring angle:

Antenna

Height above ground plane:

Polarisation:

Type:

Antenna tilt:

1 GHz – 26.5 GHz

Peak

RBW 1 MHz

VBW 3 MHz

Average

RBW 1 MHz

VBW 3 MHz

Peak

RBW 1 MHz

VBW 3 MHz

Average

RBW 1 MHz

VBW 3 MHz

1.5 m

3 m

0 – 359°

1.5 m

Vertical and Horizontal

Horn

The EUT is rotated around its axis as described in ANSI C63.10 (2013) clause 6.6.5.

6.3 Requirements

Within restricted bands:

Reference: CFR 47 §15.209, RSS-Gen section 8.9

Field strength of emissions must comply with limits shown in table below

Frequency range [MHz]	Field strength at 3 m (dB μ V/m)	Field strength at 10 m (dB μ V/m)	Detector (dB μ V/m)
30 – 88	40.0	29.5	Quasi Peak
88 – 216	43.5	33.0	Quasi Peak
216 – 960	46.0	35.5	Quasi Peak
960 – 1000	54.0	43.5	Quasi Peak
Above 1000	54.0 / 74.0	43.5 / 63.5	Average / Peak

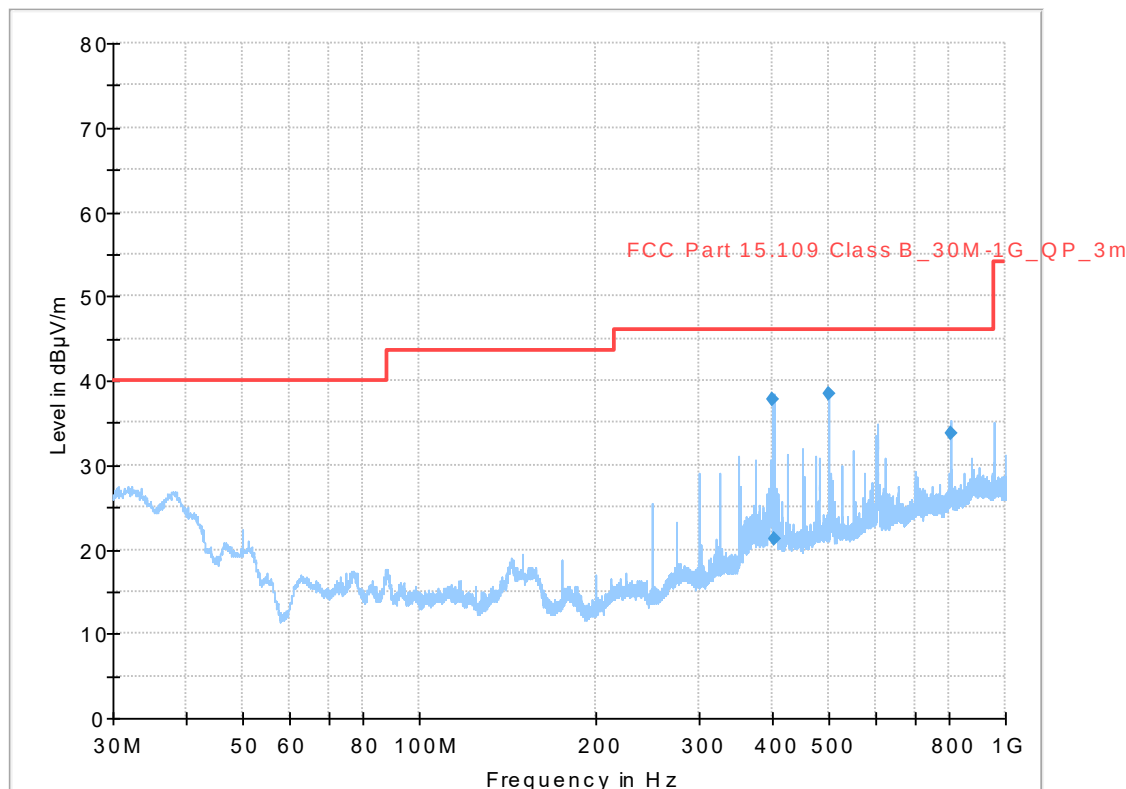
The values for 10 m measuring distance are calculated by subtracting 10.5 dB from the 3 m limit. (i.e. an extrapolation factor of 20 dB/decade according to CFR 47 §15.31(f)(1))

Outside the restricted bands:

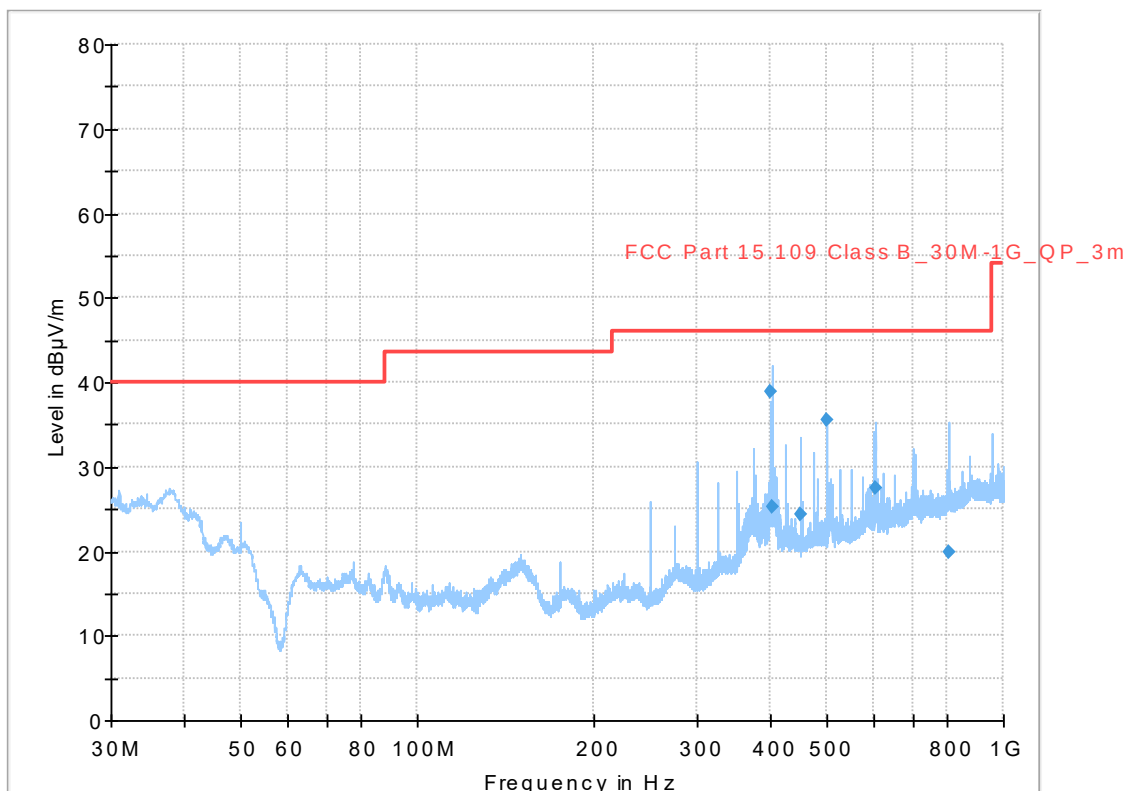
Reference: CFR 47 §15.247(d), RSS-247 5.5

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

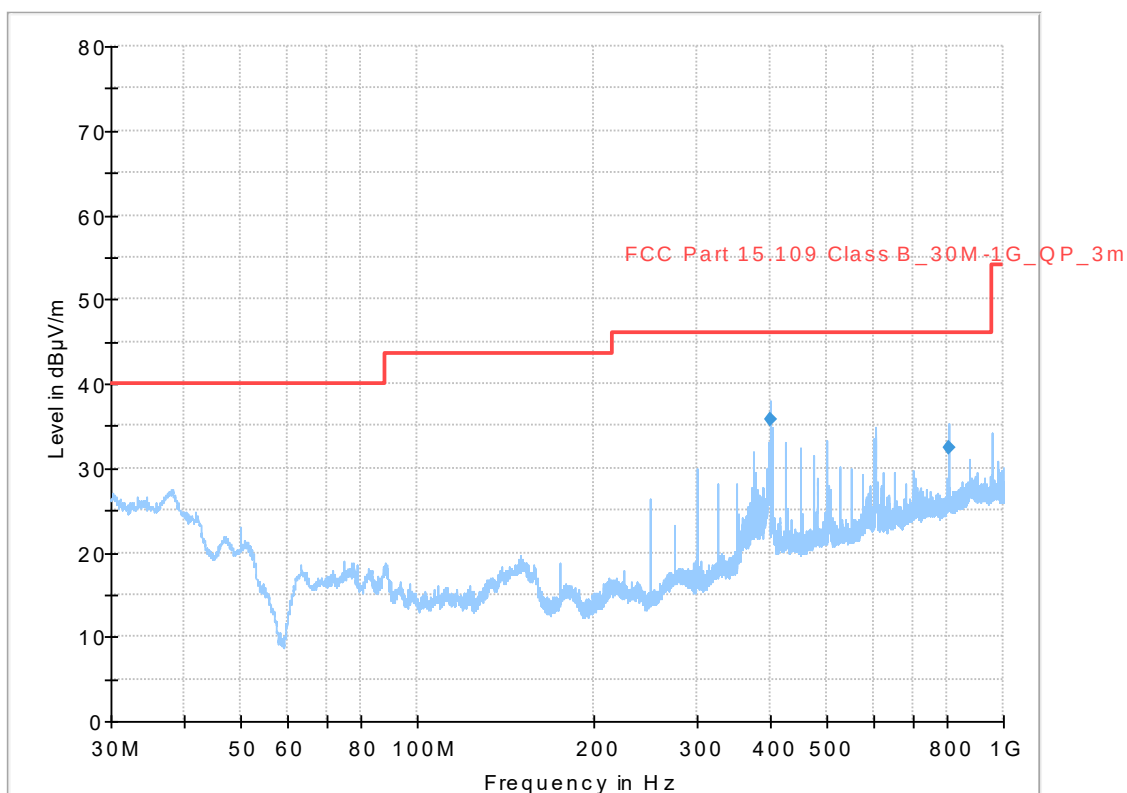
6.4 Test results 30 MHz – 1000 MHz, TX, 802.11b 1 Mbps



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX low channel.



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX mid channel.



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. TX high channel.

Measurement results, Quasi Peak, low channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
400.000	37.8	46.0	H	8.3
403.210	21.3	46.0	V	24.7
500.020	38.4	46.0	H	7.6
806.410	33.7	46.0	H	12.3

Measurement results, Quasi Peak, mid channel

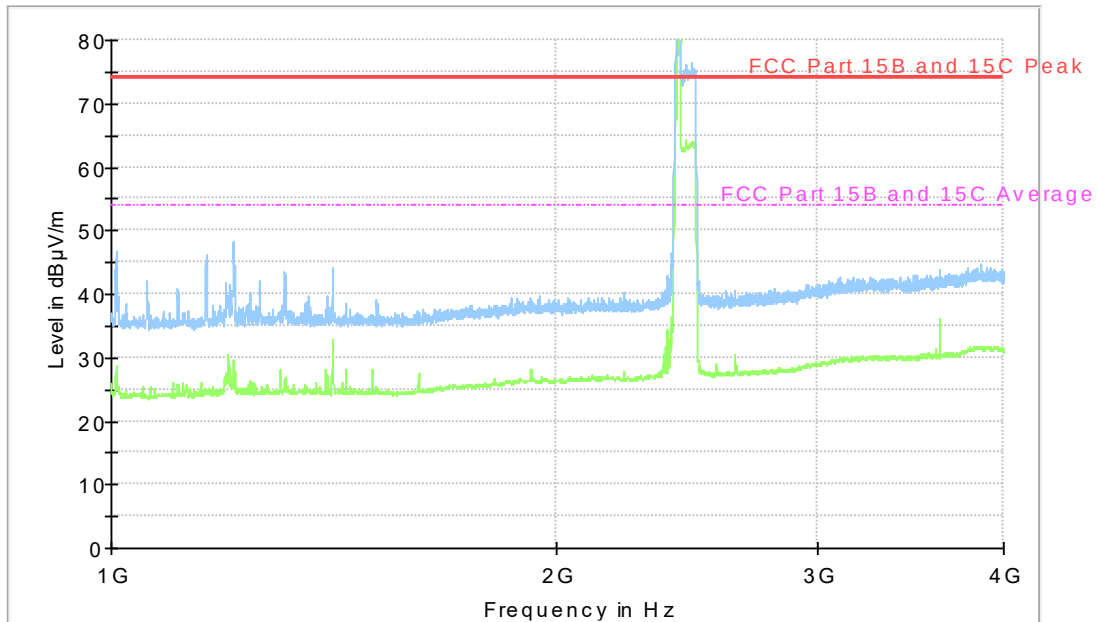
Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
400.000	38.8	46.0	V	7.2
403.210	25.2	46.0	V	20.8
450.010	24.4	46.0	V	21.6
500.020	35.6	46.0	H	10.4
604.810	27.5	46.0	H	18.5
805.810	20.0	46.0	V	26.0

Measurement results, Quasi Peak, high channel

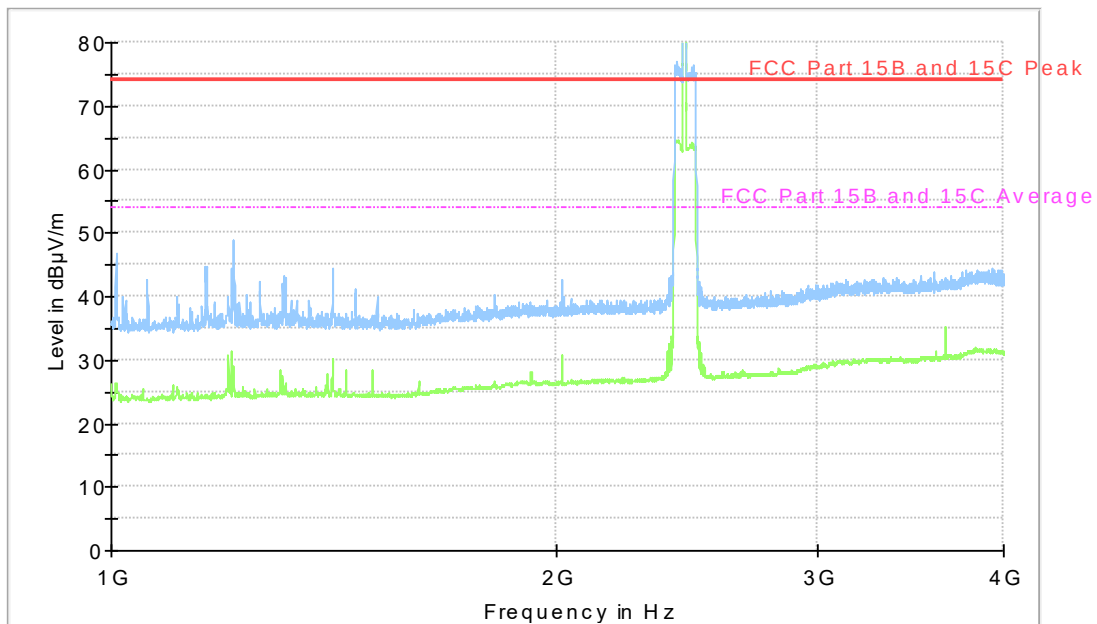
Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
400.000	35.8	46.0	V	10.2
806.410	32.5	46.0	V	13.5

Result [dBμV/m] = Analyser reading [dBμV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

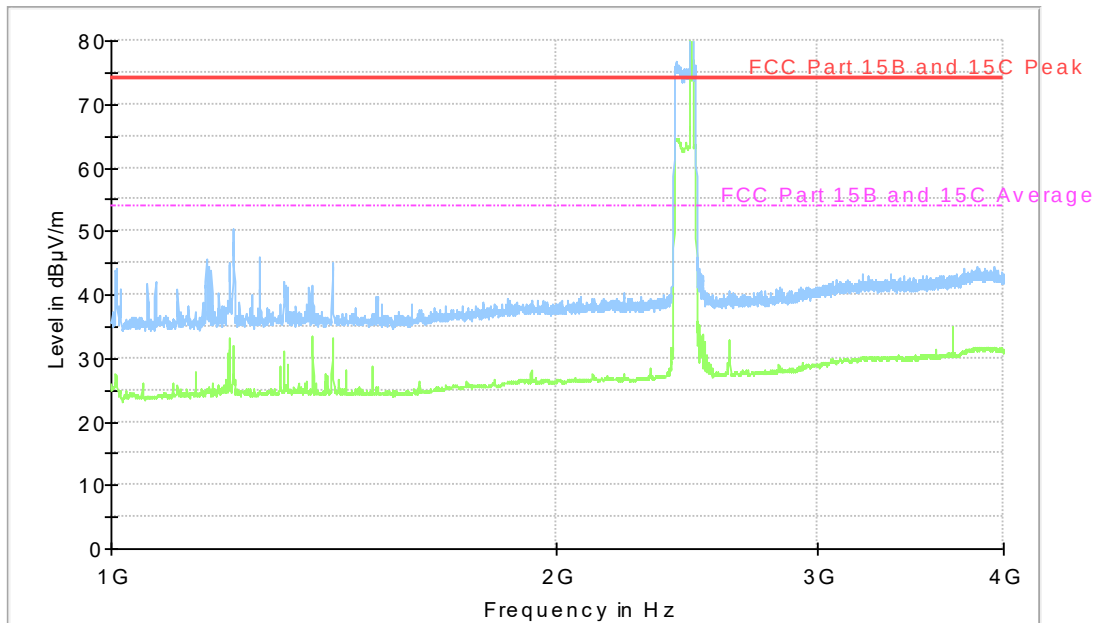
6.5 Test results 1 GHz – 26 GHz, TX, 802.11b 1 Mbps



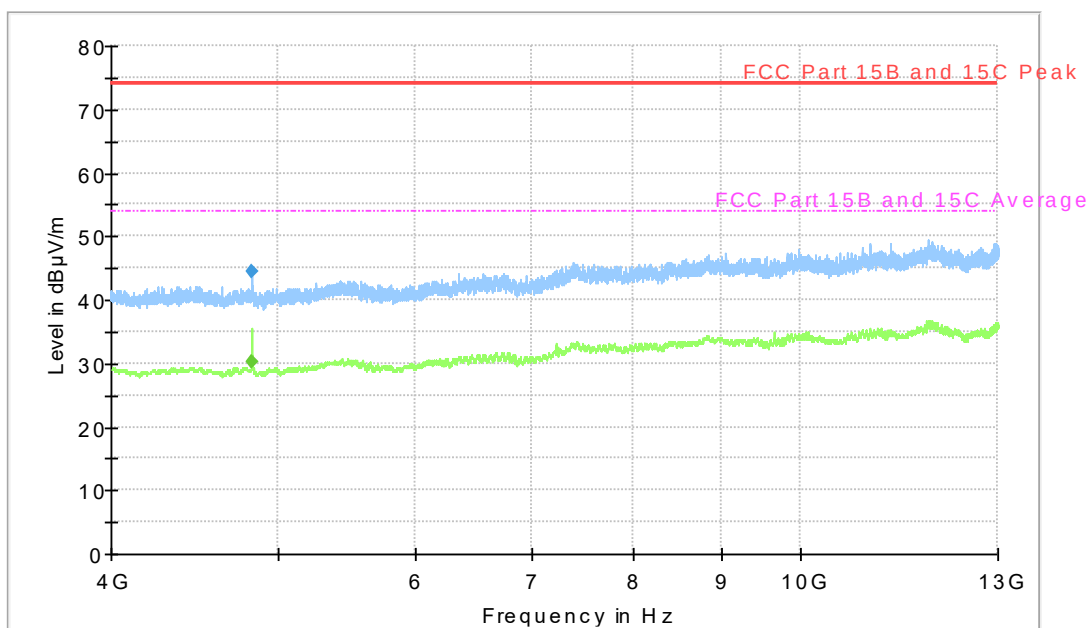
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel. Carrier is attenuated by a band rejection filter.



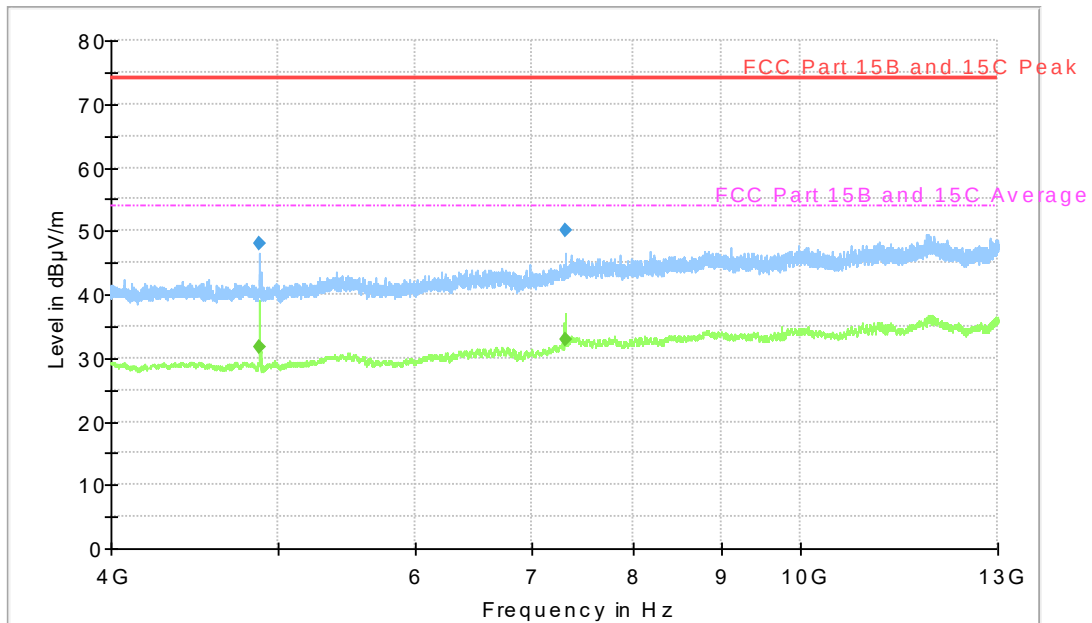
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX mid channel. Carrier is attenuated by a band rejection filter.



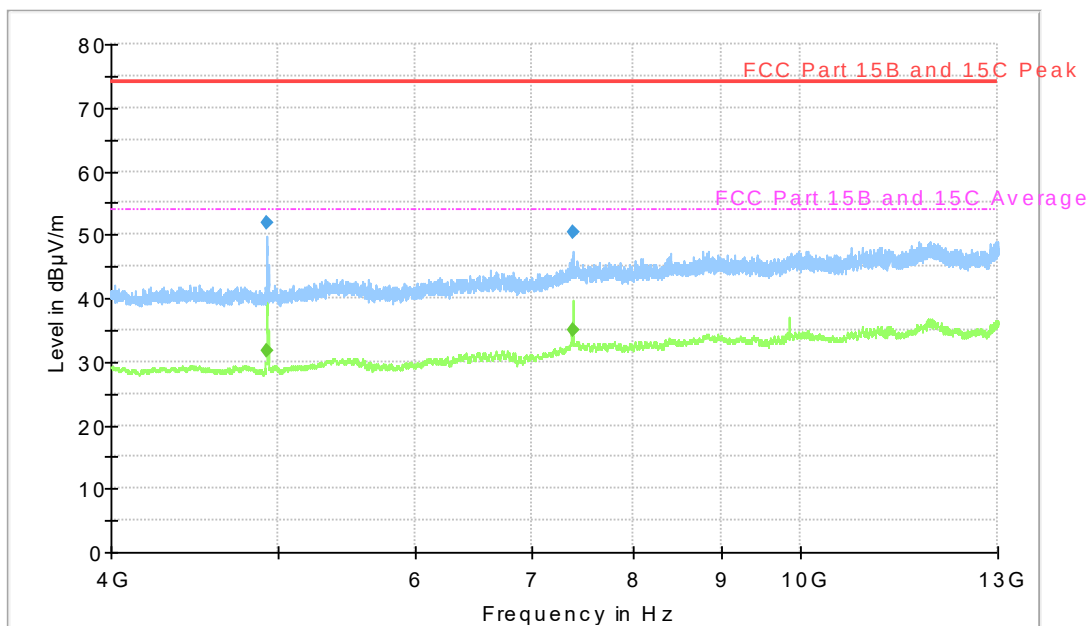
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX high channel. Carrier is attenuated by a band rejection filter.



Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX low channel. Emissions below 4000 MHz are attenuated by a high-pass filter.

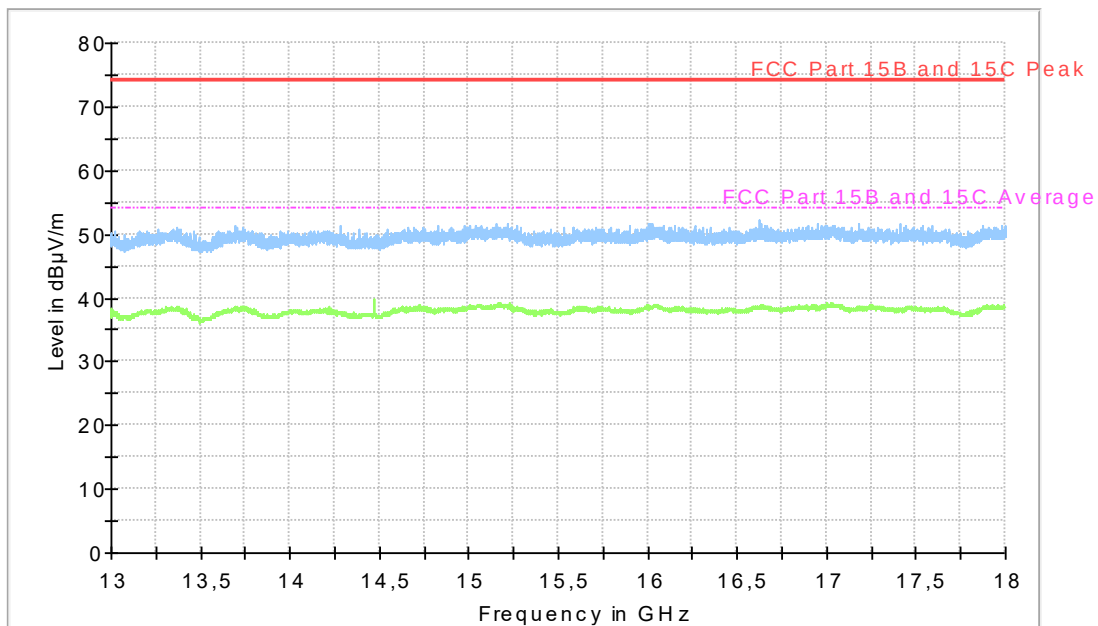


Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX middle channel. Emissions below 4000 MHz are attenuated by a high-pass filter.



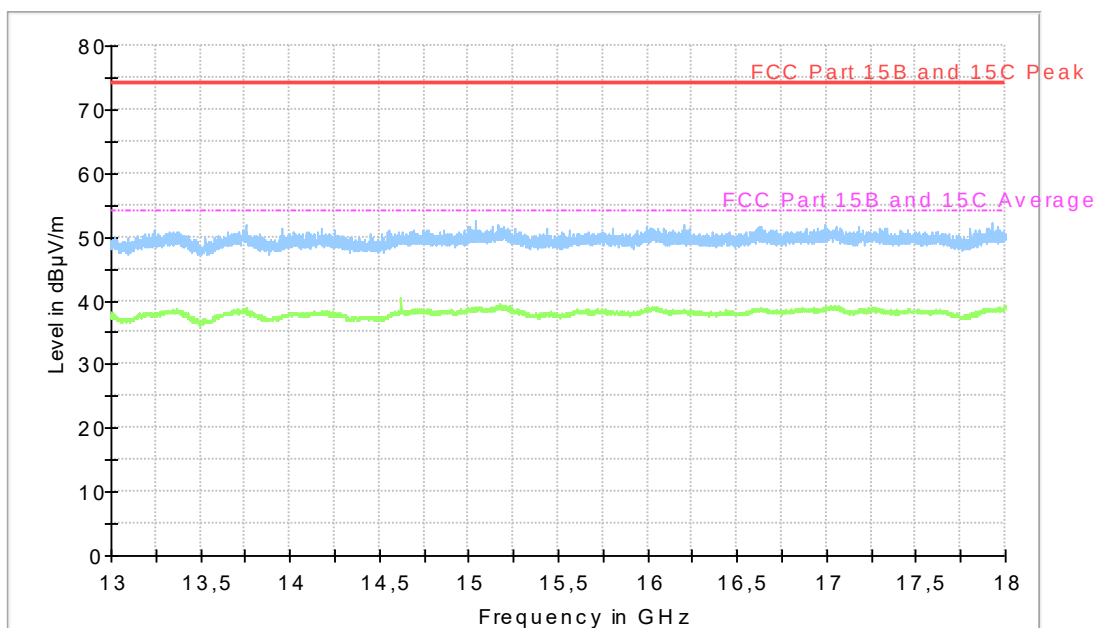
Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX high channel. Emissions below 4000 MHz are attenuated by a high-pass filter.

Full Spectrum



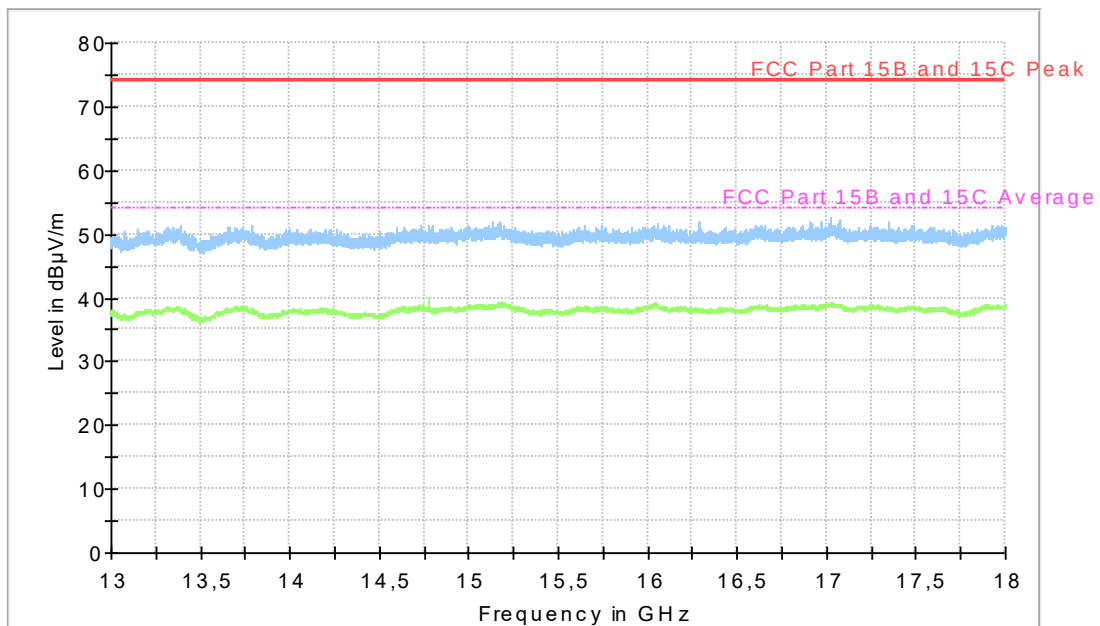
Diagram, Peak overview sweep, 13 – 18 GHz at 3 m distance. TX low channel.

Full Spectrum



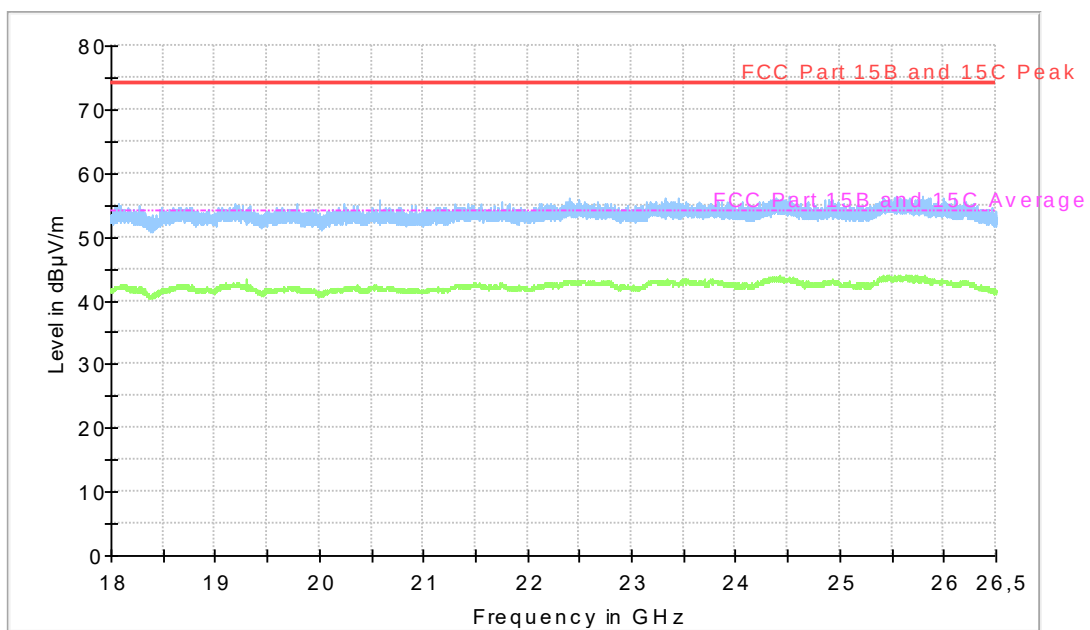
Diagram, Peak overview sweep, 13 – 18 GHz at 3 m distance. TX middle channel.

Full Spectrum



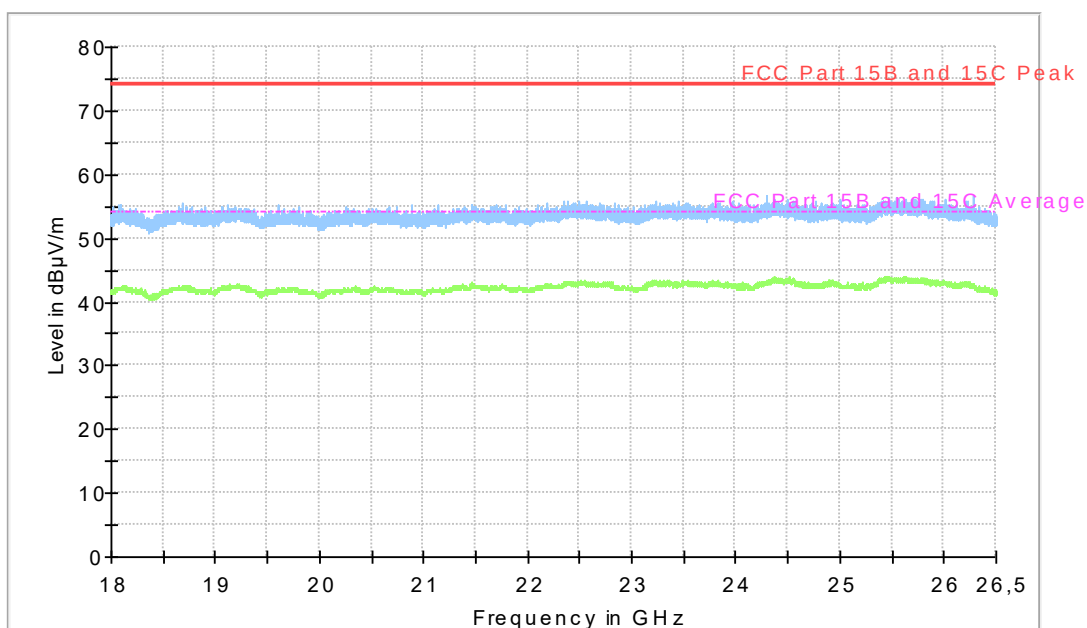
Diagram, Peak overview sweep, 13 – 18 GHz at 3 m distance. TX high channel.

Full Spectrum



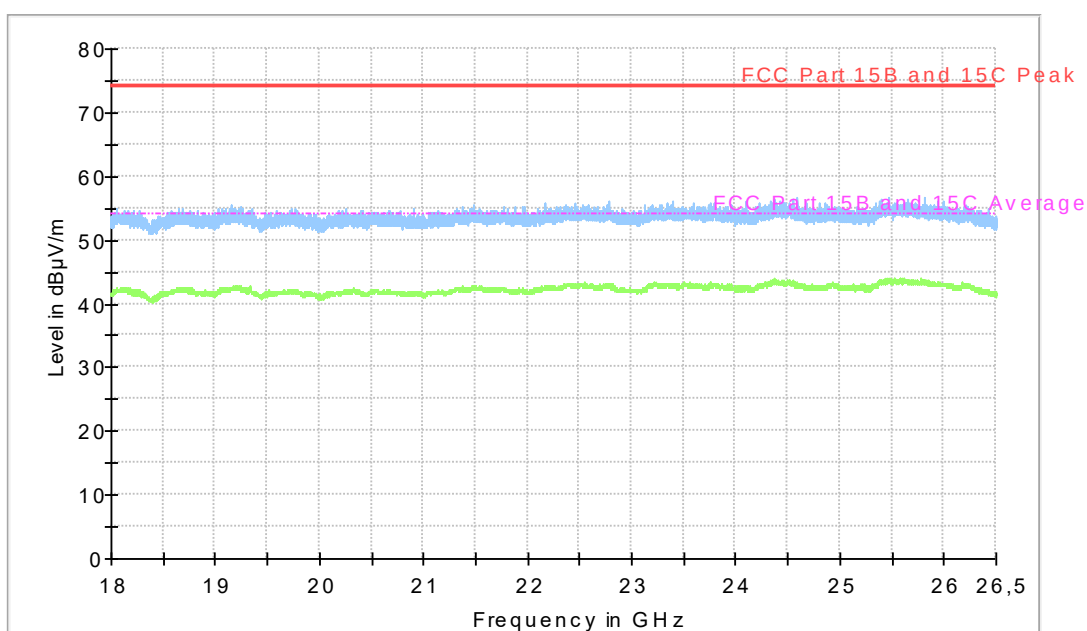
Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. TX low channel.

Full Spectrum



Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. TX middle channel.

Full Spectrum



Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. TX high channel.

Measurement results, Peak, TX low channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4823.5	44.3	74.0	V	29.7	--

Measurement results, Average, TX low channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4824.0	30.1	54.0	V	23.9	--

Measurement results, Peak, TX middle channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4873.5	48.0	74.0	V	26.0	--
7312.0	49.9	74.0	H	24.1	--

Measurement results, Average, TX middle channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4874.0	31.7	54.0	V	22.3	--
7312.0	33.0	54.0	V	21.0	--

Measurement results, Peak, TX high channel

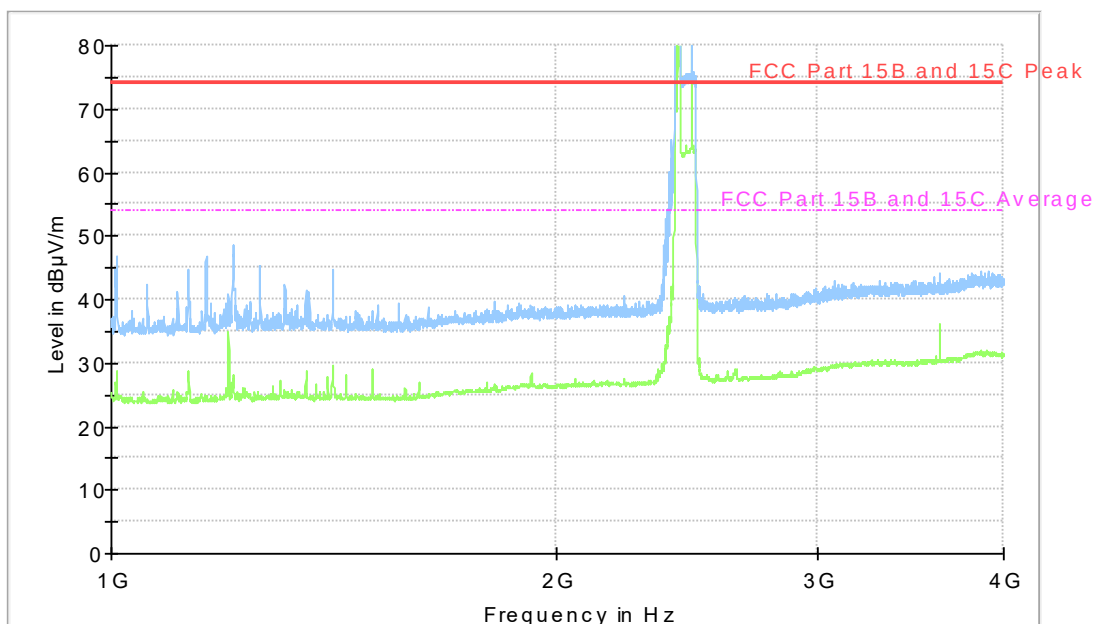
Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
2484.0	58.1	74.0	V	15.9	--
4923.0	51.8	74.0	V	22.2	--
7388.0	50.4	74.0	H	23.6	--

Measurement results, Average, TX high channel

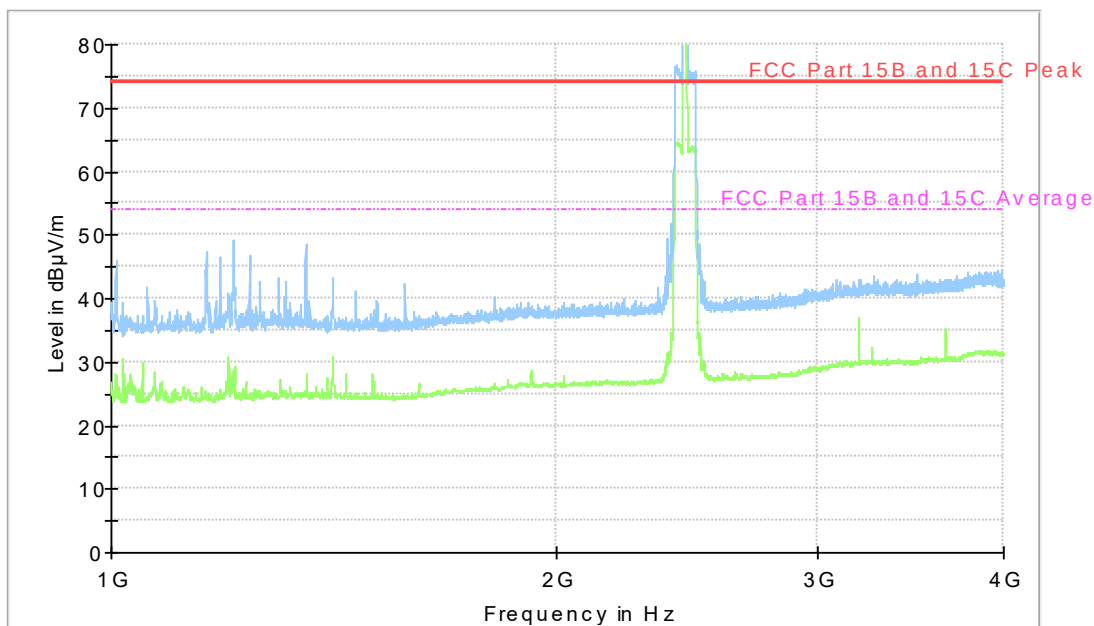
Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
2484.0	38.6	54.0	V	15.4	--
4923.0	31.6	54.0	H	22.4	--
7388.0	35.0	54.0	H	19.0	--

Result [dBμV/m] = Analyser reading [dBμV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

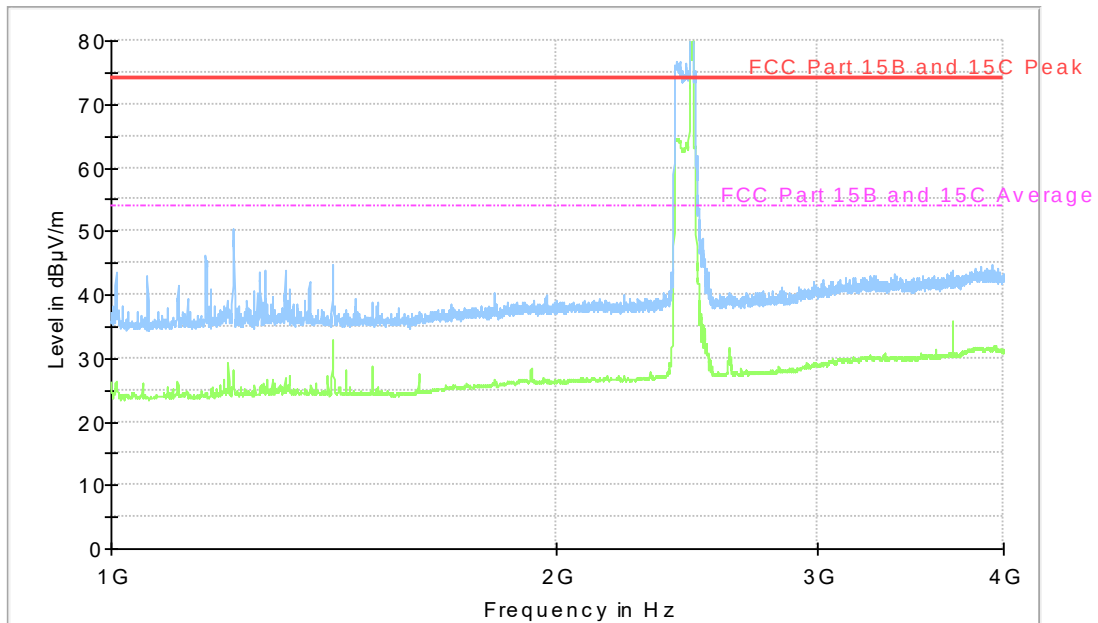
6.6 Test results 1 GHz – 13 GHz, TX, 802.11g 6 Mbps



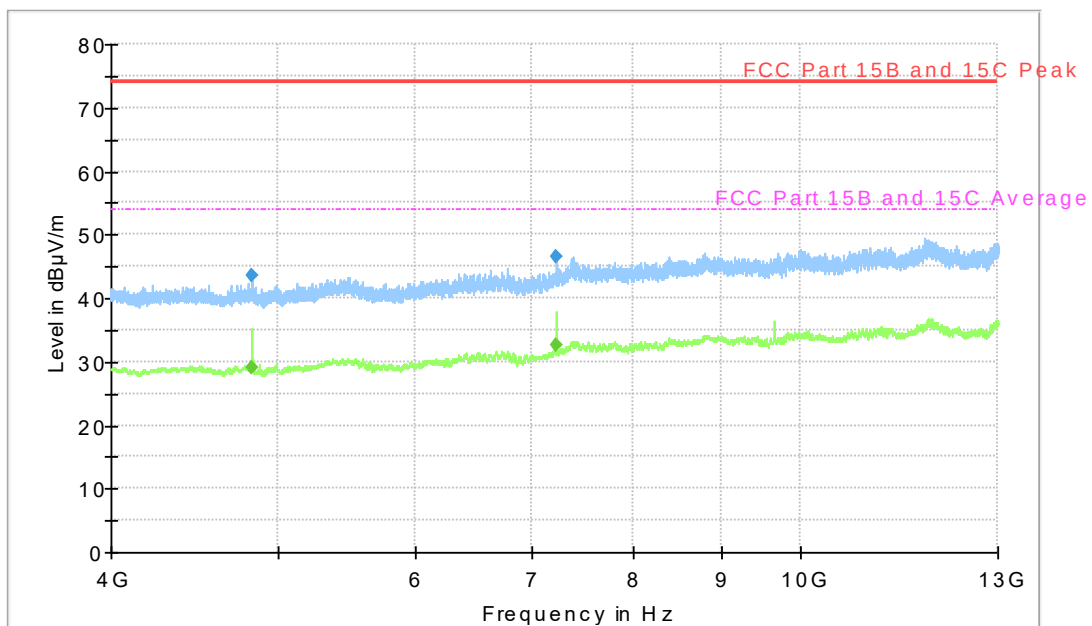
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel. Carrier is attenuated by a band rejection filter.



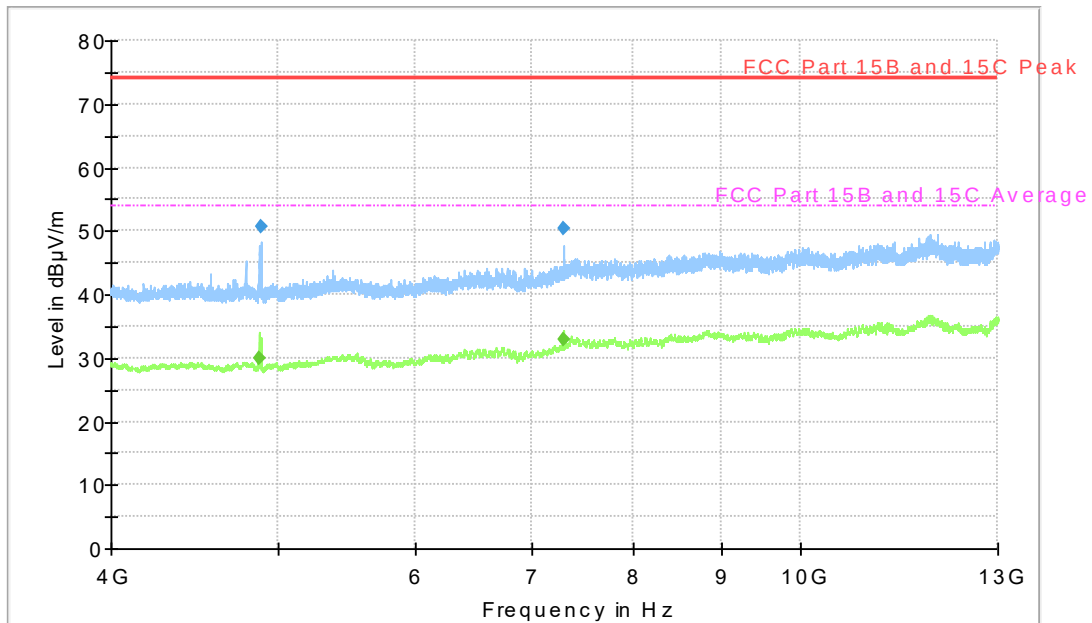
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX middle channel. Carrier is attenuated by a band rejection filter.



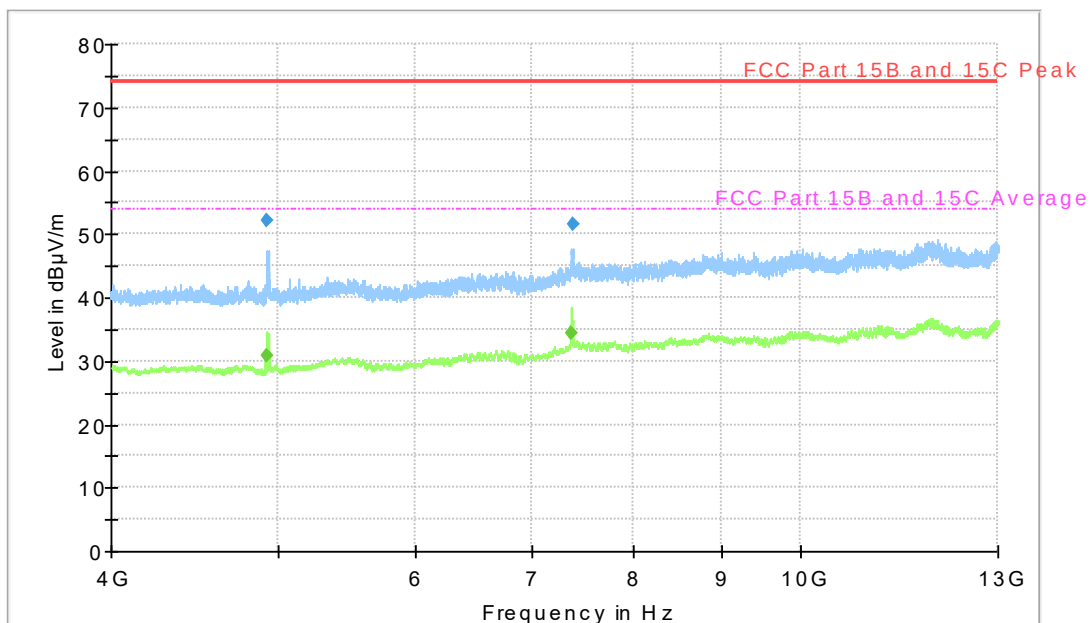
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX high channel. Carrier is attenuated by a band rejection filter.



Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX low channel. Emissions below 4000 MHz are attenuated by a high-pass filter.



Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX middle channel. Emissions below 4000 MHz are attenuated by a high-pass filter.



Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX high channel. Emissions below 4000 MHz are attenuated by a high-pass filter.

Measurement results, Peak, TX low channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4824.5	43.6	74.0	H	30.4	--
7234.0	46.5	74.0	H	27.5	--

Measurement results, Average, TX low channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4824.5	29.2	54.0	H	24.8	--
7234.0	32.5	54.0	H	21.5	--

Measurement results, Peak, TX middle channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4879.5	50.7	74.0	V	23.3	--
7304.5	50.5	74.0	H	23.5	--

Measurement results, Average, TX middle channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4874.0	29.8	54.0	H	24.2	--
7305.5	33.0	54.0	H	21.0	--

Measurement results, Peak, TX high channel

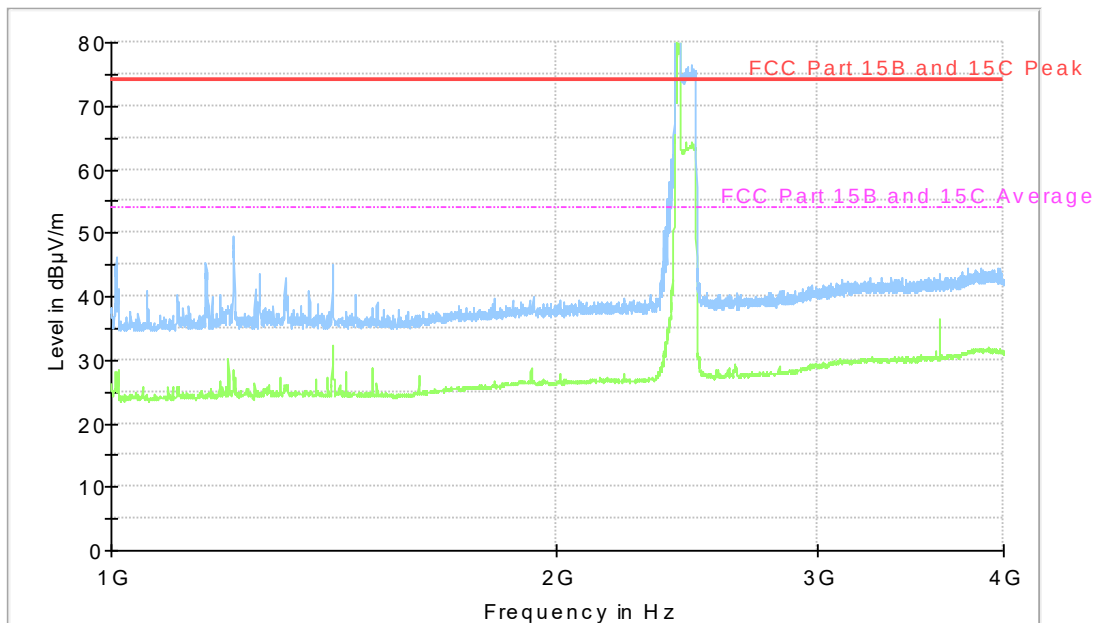
Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
2484.0	58.8	74.0	H	15.2	--
4921.0	52.2	74.0	H	21.8	--
7386.5	51.6	74.0	H	22.4	--

Measurement results, Average, TX high channel

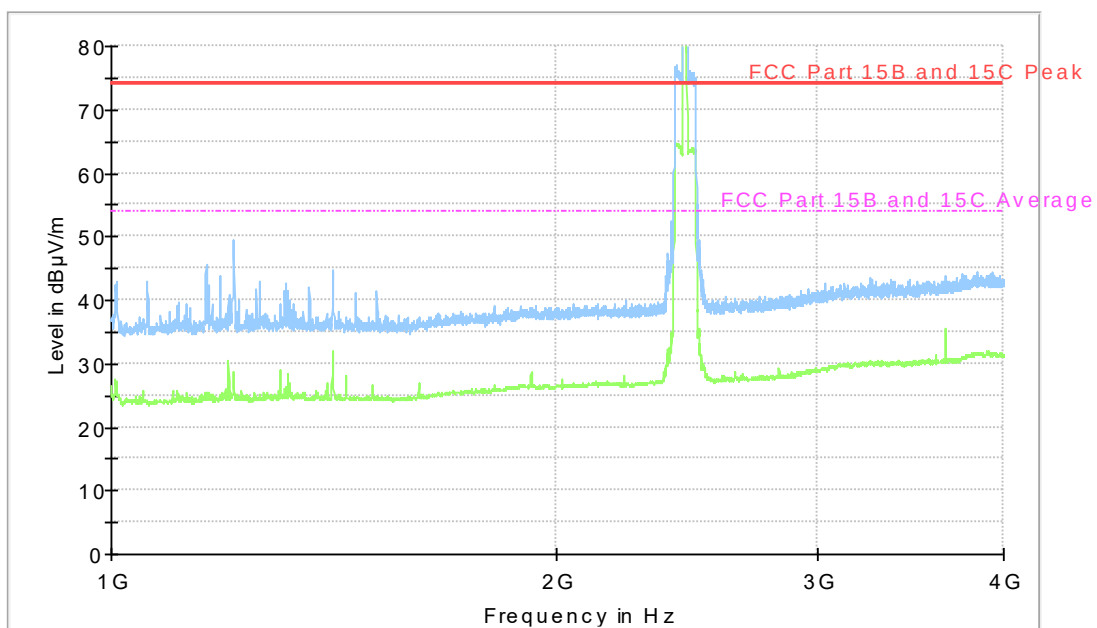
Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
2484.0	38.8	54.0	H	15.2	--
4921.5	30.9	54.0	H	23.1	--
7379.5	34.3	54.0	H	19.7	--

Result [dBμV/m] = Analyser reading [dBμV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

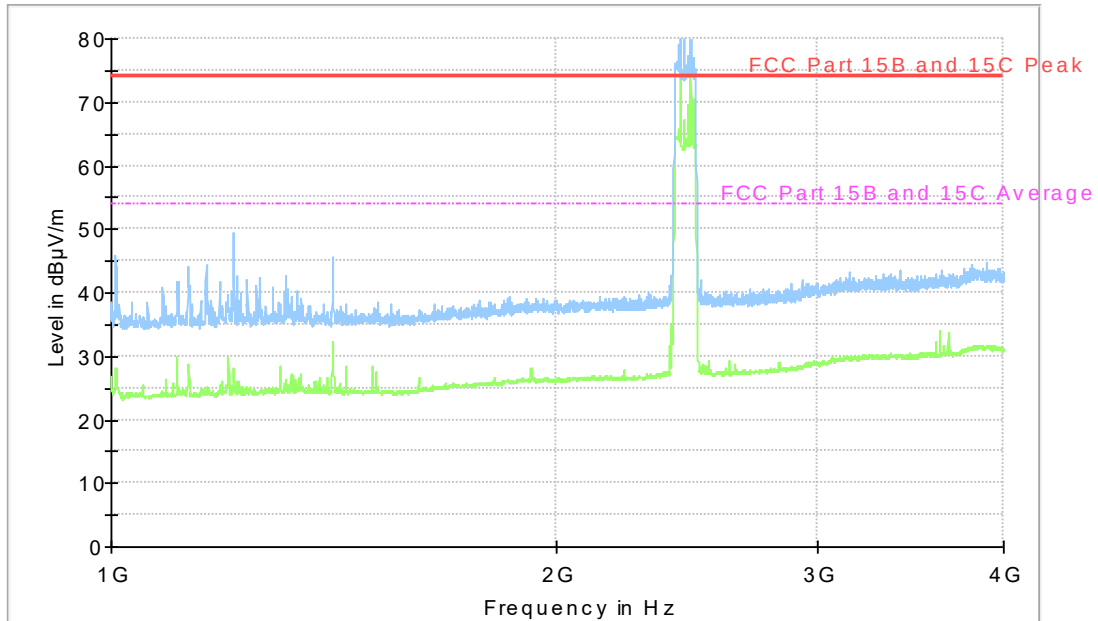
6.7 Test results 1 GHz – 13 GHz, TX, 802.11n MCS0



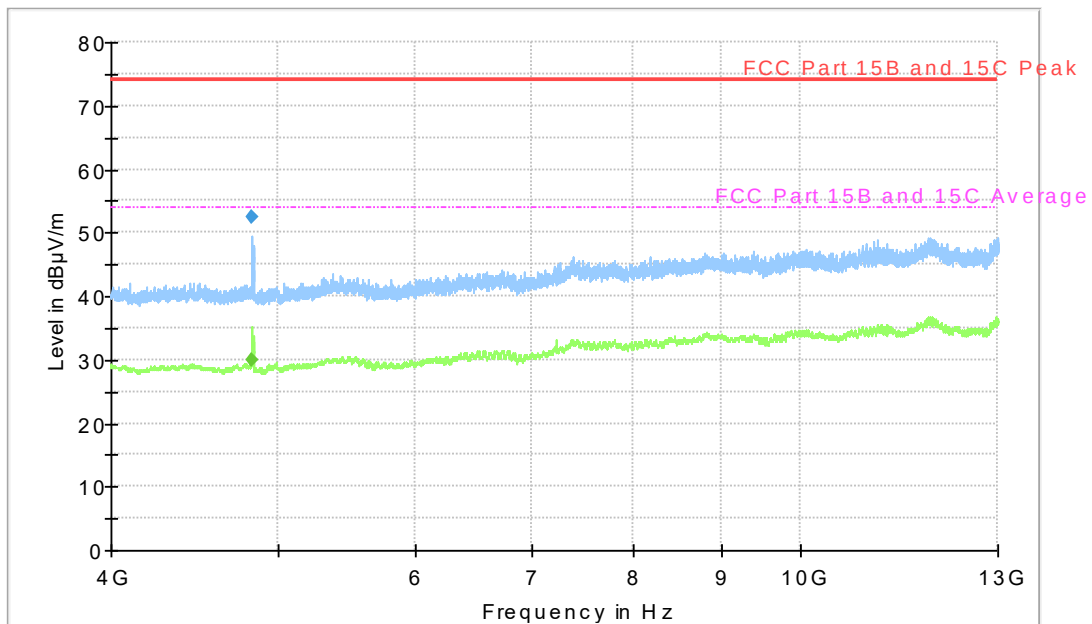
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel. Carrier is attenuated by a band rejection filter.



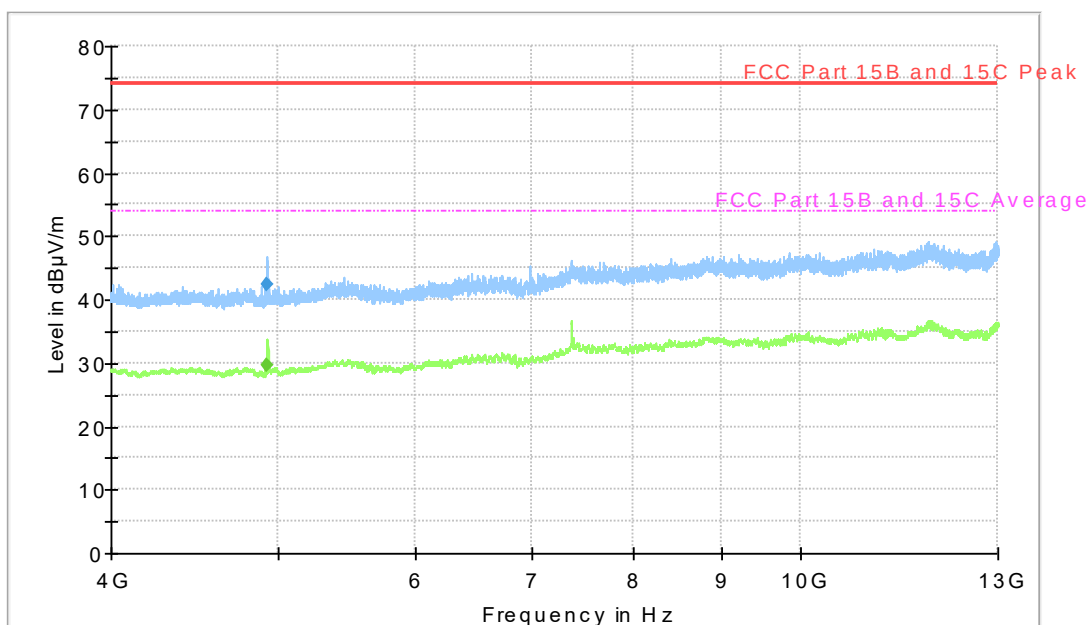
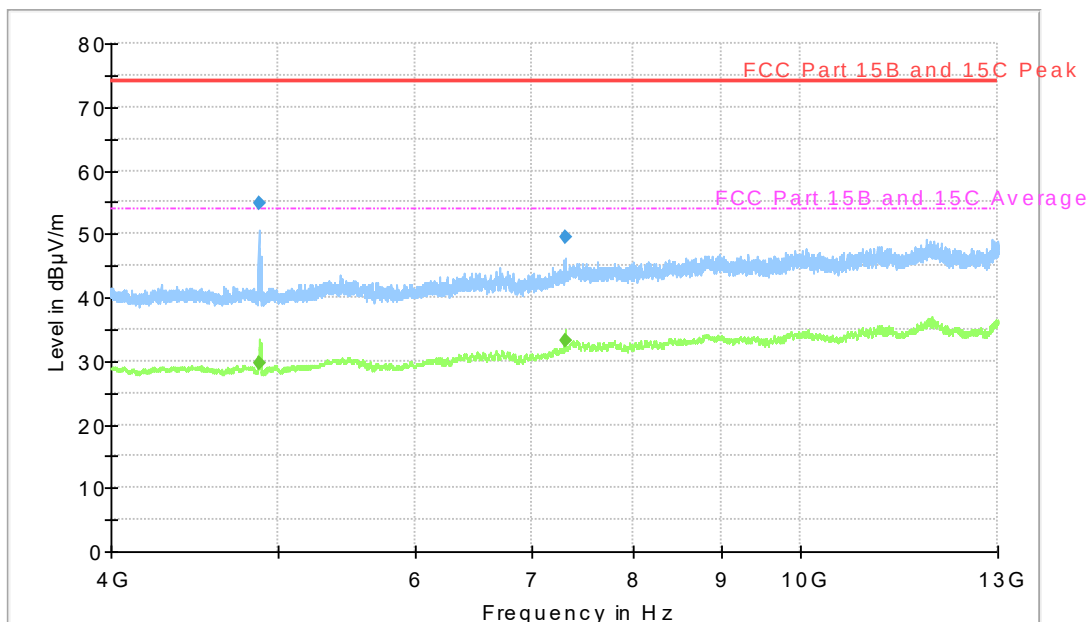
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX middle channel. Carrier is attenuated by a band rejection filter.



Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX high channel. Carrier is attenuated by a band rejection filter.



Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX low channel. Emissions below 4000 MHz are attenuated by a high-pass filter.



Measurement results, Peak, TX low channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4825.5	52.6	74.0	V	21.4	--

Measurement results, Average, TX low channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4825.5	29.8	54.0	V	24.2	--

Measurement results, Peak, TX middle channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4866.5	54.8	74.0	V	19.2	--
7316.0	49.6	74.0	H	24.4	--

Measurement results, Average, TX middle channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
4876.5	29.7	54.0	H	24.3	--
7316.0	33.1	54.0	H	20.9	--

Measurement results, Peak, TX high channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
2484.0	60.2	74.0	H	13.8	--
4920.0	42.3	74.0	H	31.7	--

Measurement results, Average, TX high channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]	Comment
2484.0	39.4	54.0	H	14.6	--
4925.5	29.5	54.0	H	24.5	--

Result [dBμV/m] = Analyser reading [dBμV] + Antenna factor [1/m] - Amplifier gain [dB] + Cable loss [dB]

7 CONDUCTED BAND EDGE MEASUREMENT

Date of test:	2020-11-19	Test location:	Radiolabbet
EUT Serial:	0000 0081 9380 0244	Ambient temp:	22 °C
Tested by:	Robert Hietala	Relative humidity:	32 %
Test result:	Pass	Margin:	8.9 dB

7.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 6.10.4.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

The EUT was set up in order to emit maximum disturbances.

7.2 Test conditions

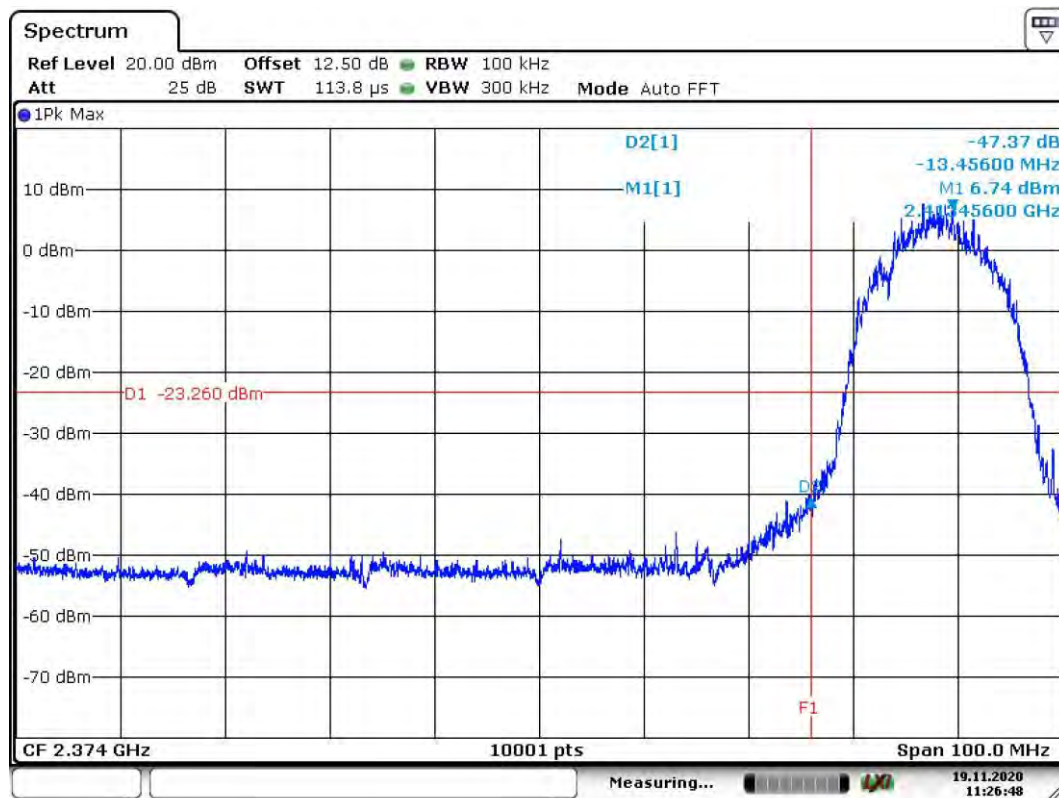
Detector: Peak
 RBW: 100 kHz
 VBW: 300 kHz
 Span: 100 MHz

7.3 Requirement

Reference: CFR 47 §15.247(d), RSS-247 5.5

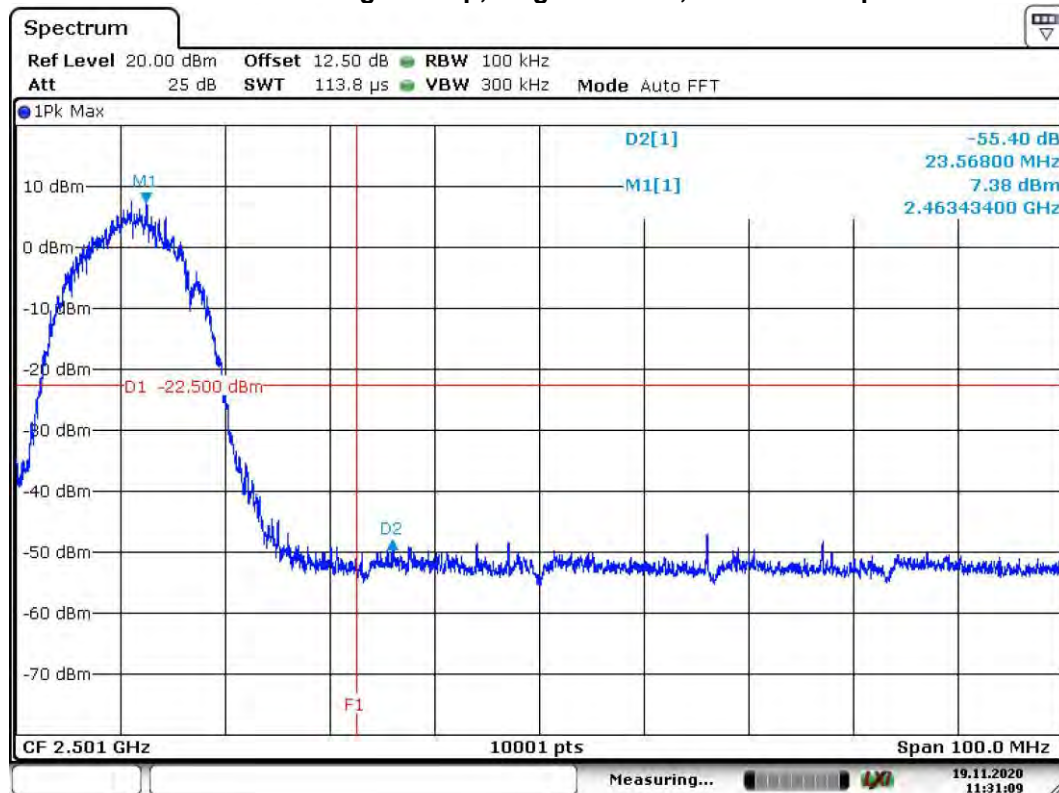
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval the attenuation required shall be 30 dB instead of 20 dB.

7.4 Test results



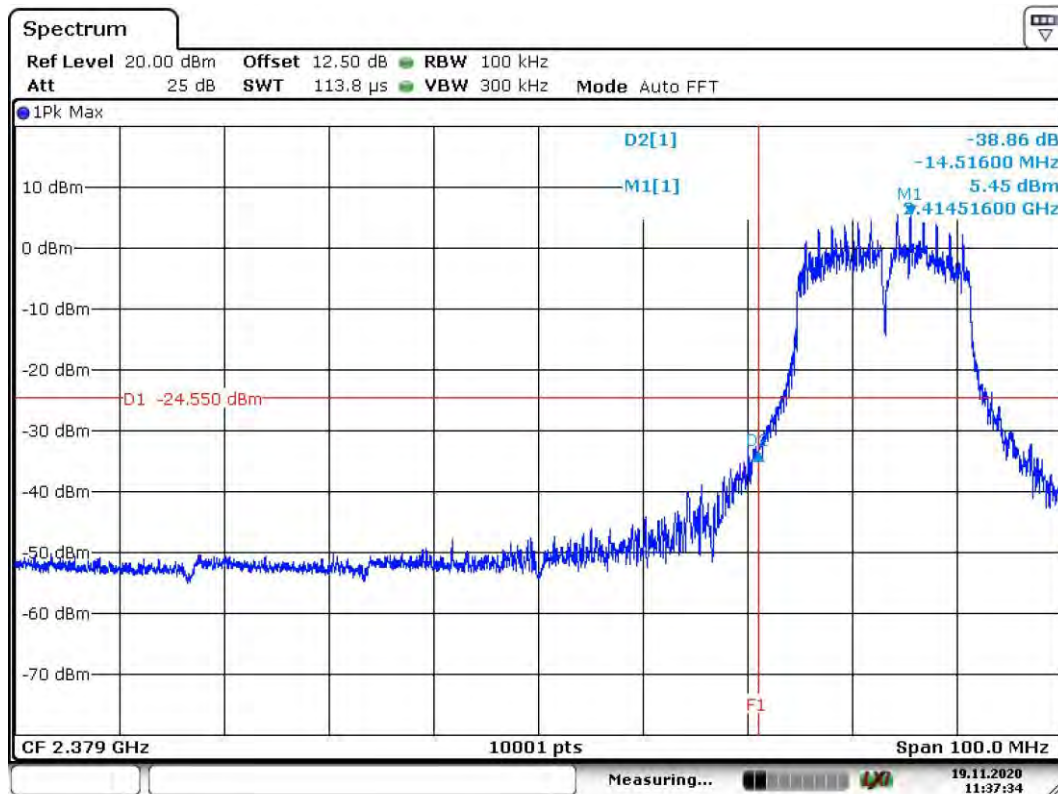
Date: 19.NOV.2020 11:26:48

Screenshot: Lower band edge sweep, single channel, 802.11b 1 Mbps



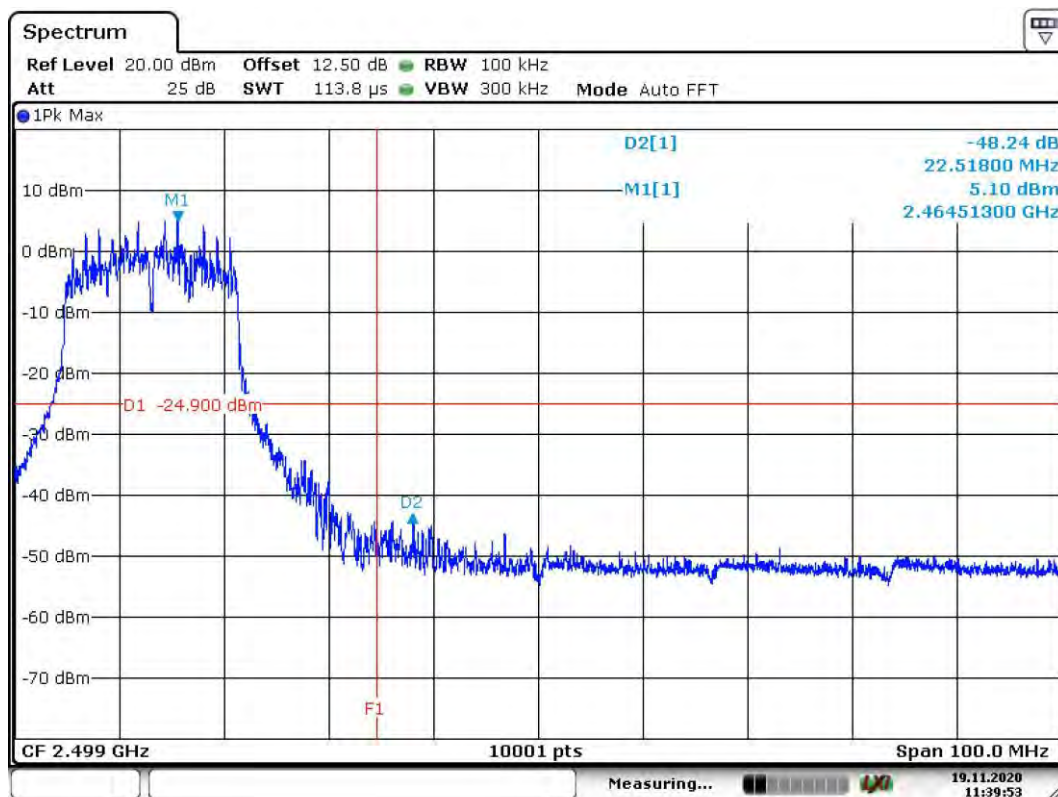
Date: 19.NOV.2020 11:31:10

Screenshot: Upper band edge sweep, single channel, 802.11b 1 Mbps



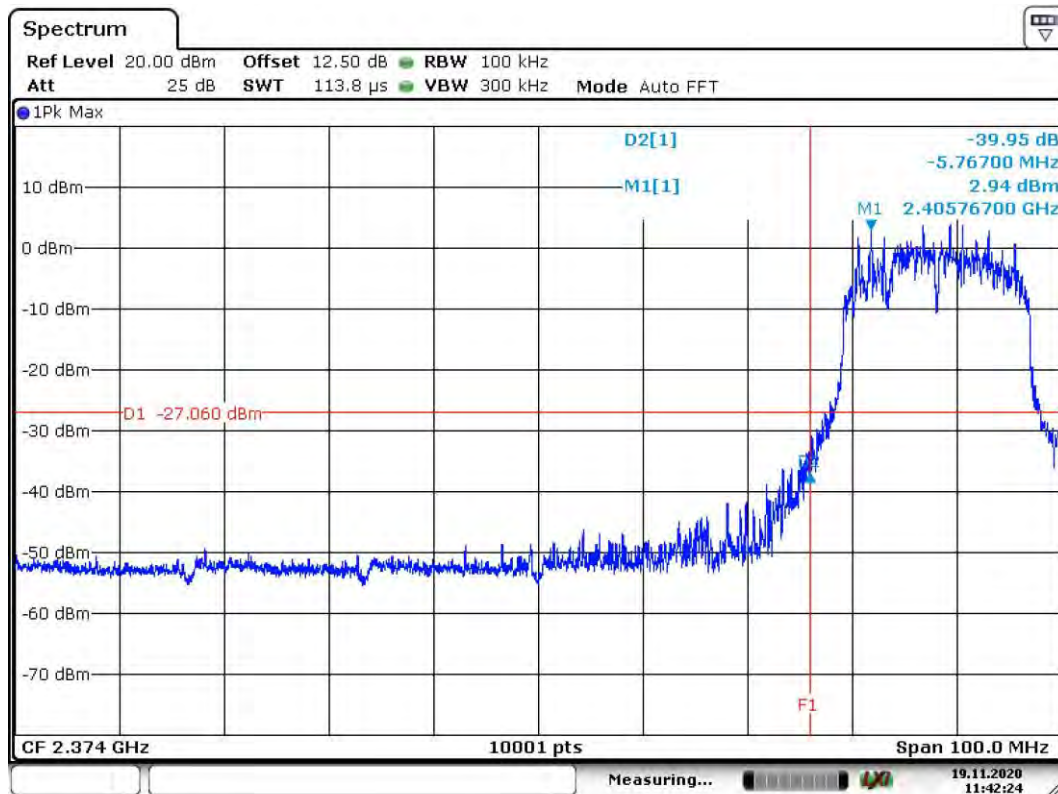
Date: 19.NOV.2020 11:37:34

Screenshot: Lower band edge sweep, single channel, 802.11g 6 Mbps



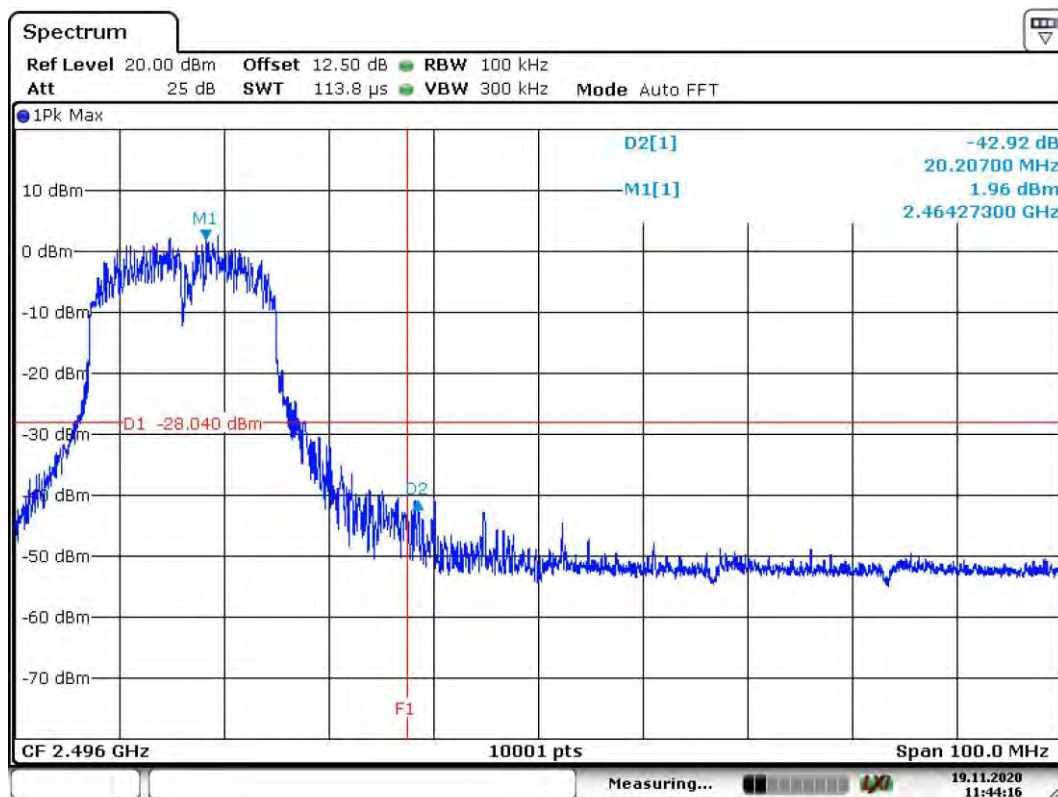
Date: 19.NOV.2020 11:39:53

Screenshot: Upper band edge sweep, single channel, 802.11g 6 Mbps



Date: 19.NOV.2020 11:42:25

Screenshot: Lower band edge sweep, single channel, 802.11n MCS0



Date: 19.NOV.2020 11:44:16

Screenshot: Upper band edge sweep, single channel, 802.11n MCS0

Test results

Modulation	Band edge	Delta [dBc]	Limit [dBc]	Margin [dB]
802.11b 1 Mbps	Lower	47.7	30	17.7
	Upper	55.4	30	25.4
802.11g 6 Mbps	Lower	38.9	30	8.9
	Upper	48.2	30	18.2
802.11n MCS0	Lower	40.0	30	10.0
	Upper	42.9	30	12.9

8 MAXIMUM AVERAGE CONDUCTED OUTPUT POWER

Date of test:	2020-11-18	Test location:	Radiolabbet
EUT Serial:	0000 0081 9380 0244	Ambient temp:	21 °C
Tested by:	Robert Hietala	Relative humidity:	48 %
Test result:	Pass	Margin:	7.8 dB

8.1 Test set-up and test procedure

The test method is in accordance with ANSI C63.10-2013 section 11.9.2.2.6 Method AVGSA-3.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

8.2 Test conditions

Detector: RMS
 RBW: 300 kHz
 VBW: 1 MHz
 Span: > 1.5 x OBW

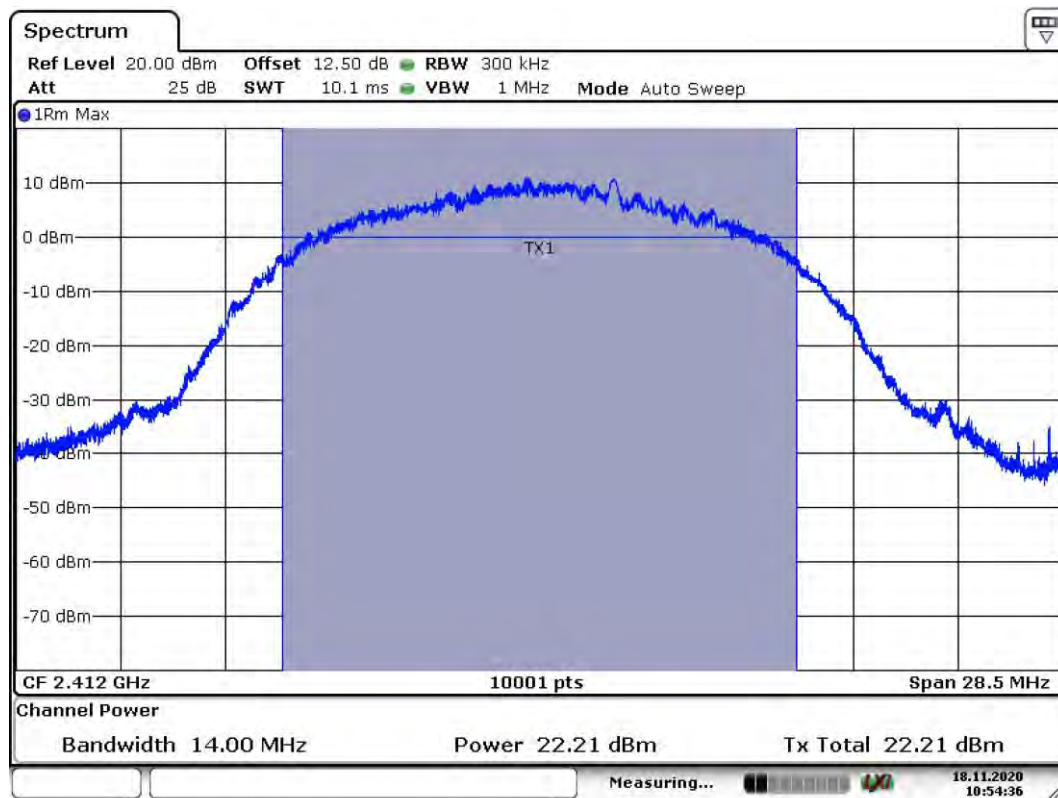
The EUT was set up in order to emit maximum disturbances.

8.3 Requirements

Reference: CFR 47§15.247(b)(3), RSS-247 5.4

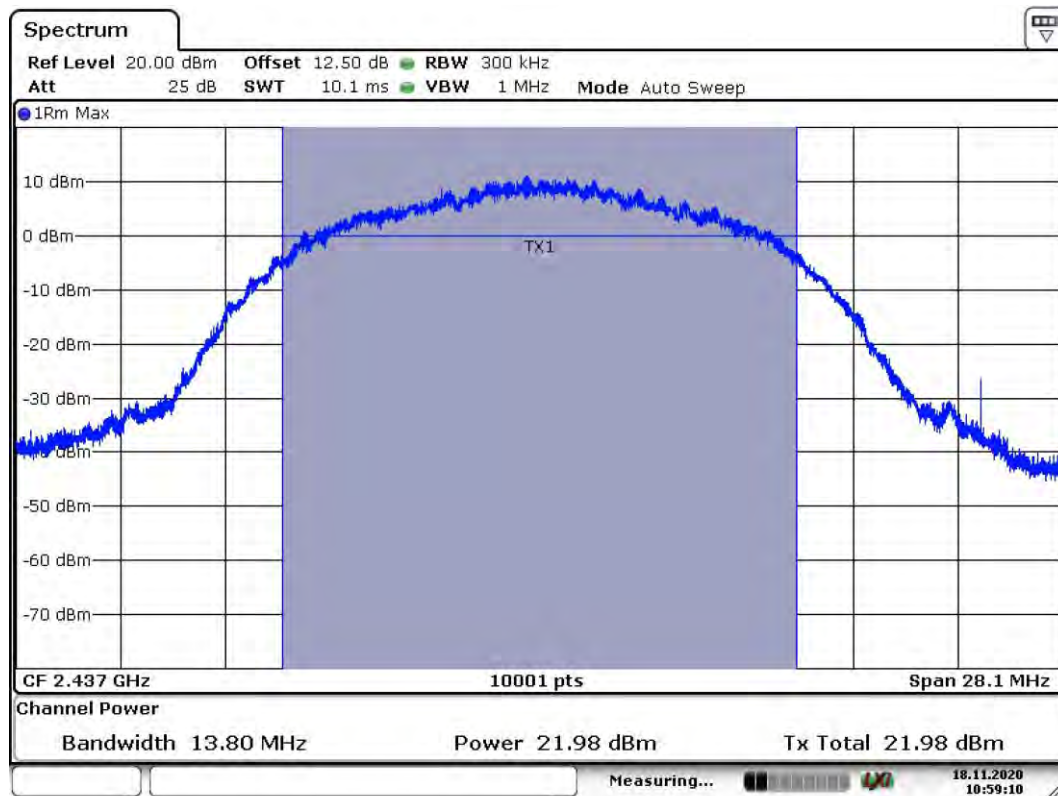
For DTSSs employing digital modulation techniques operating in the bands 902 – 128 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz, the maximum conducted output power shall not exceed 1W.

8.4 Test results



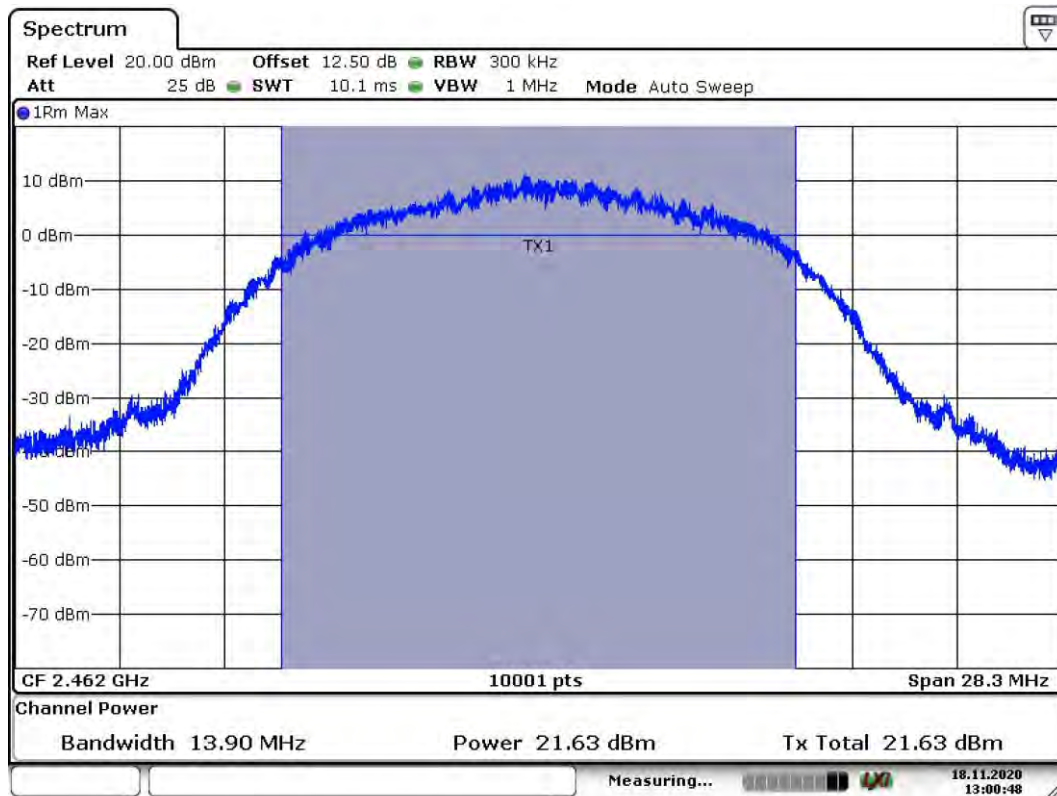
Date: 18.NOV.2020 10:54:36

Screenshot: Output power, low channel, 802.11b 1 Mbps



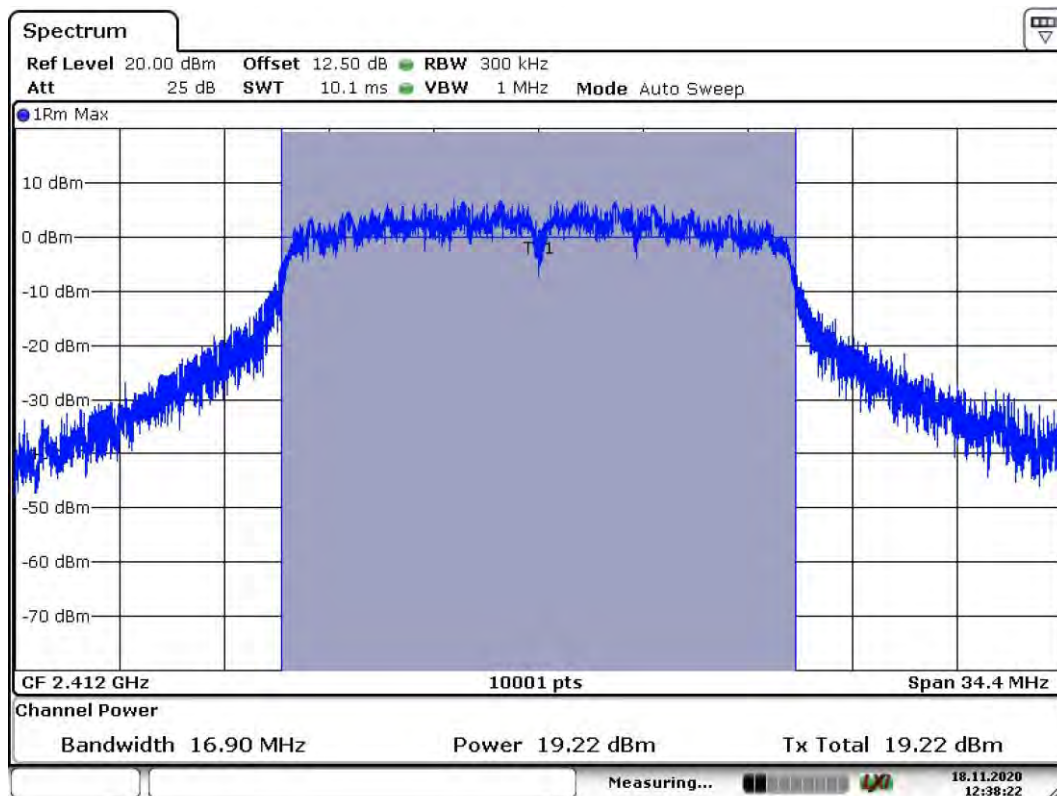
Date: 18.NOV.2020 10:59:10

Screenshot: Output power, middle channel, 802.11b 1 Mbps



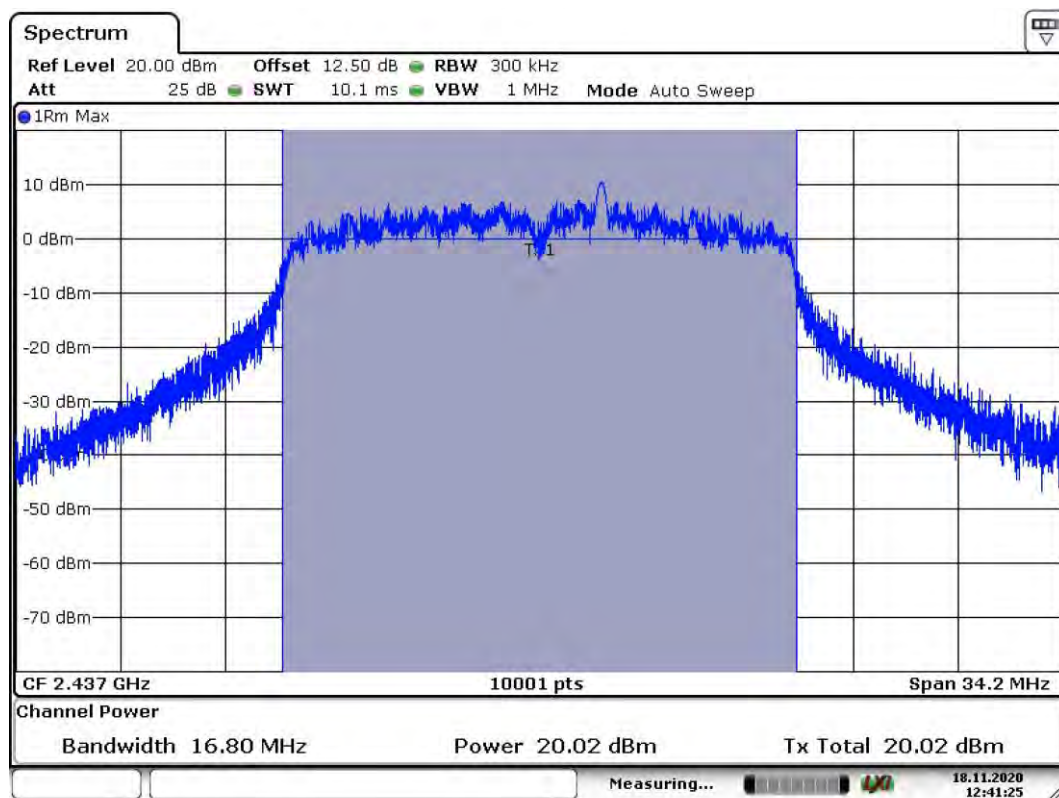
Date: 18.NOV.2020 13:00:48

Screenshot: Output power, high channel, 802.11b 1 Mbps



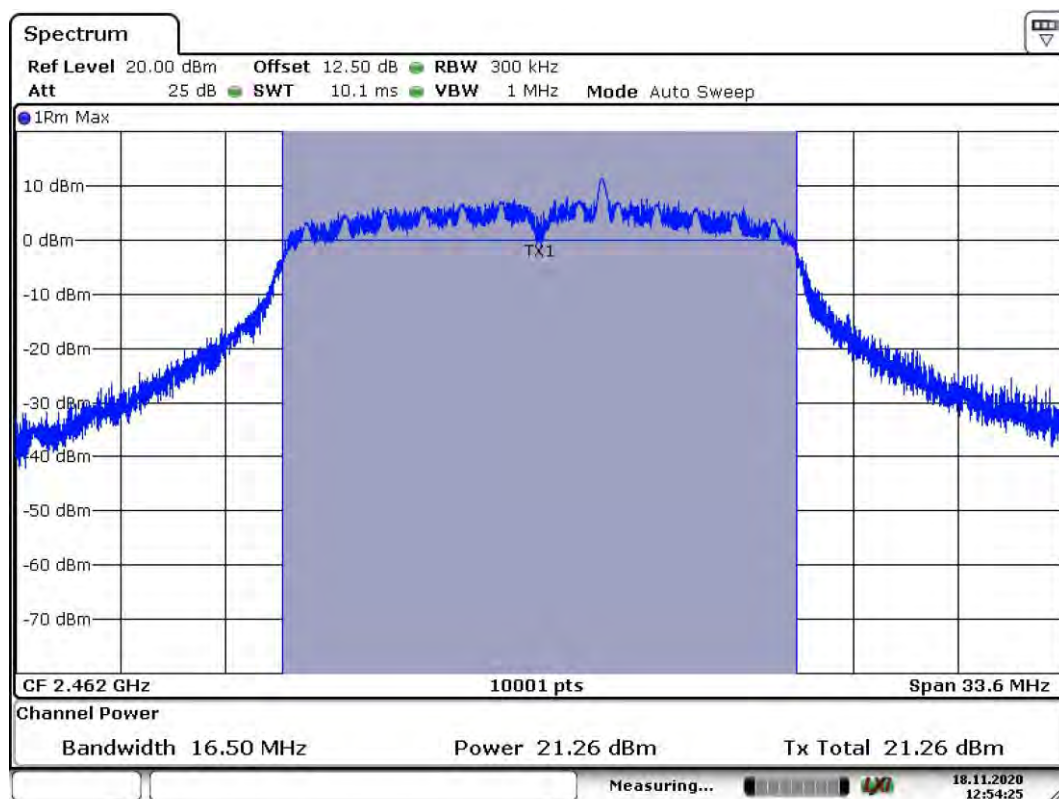
Date: 18.NOV.2020 12:38:22

Screenshot: Output power, low channel, 802.11g 6 Mbps



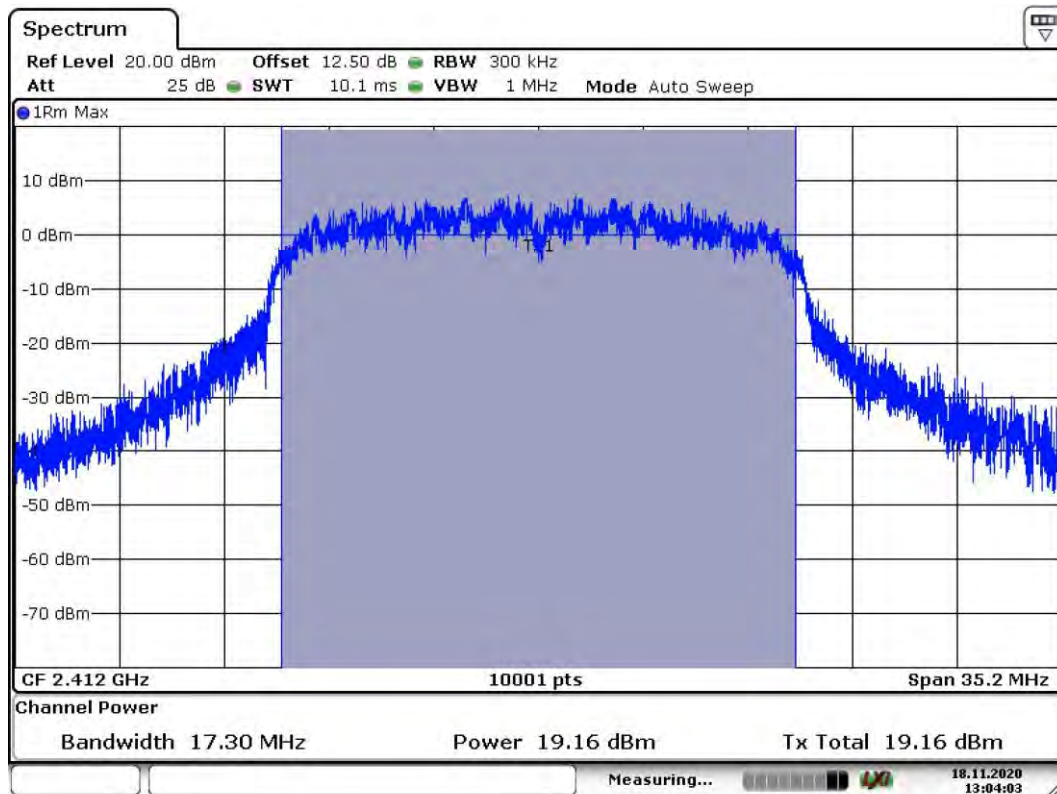
Date: 18.NOV.2020 12:41:26

Screenshot: Output power, middle channel, 802.11g 6 Mbps



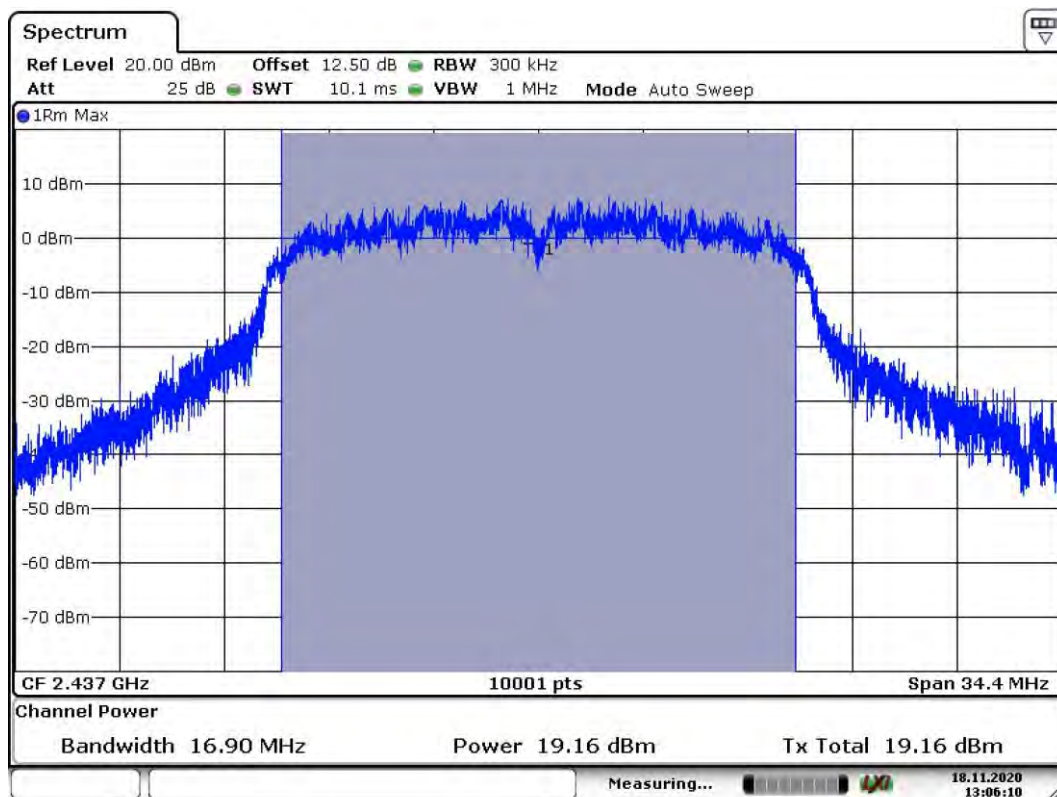
Date: 18.NOV.2020 12:54:26

Screenshot: Output power, high channel, 802.11g 6 Mbps



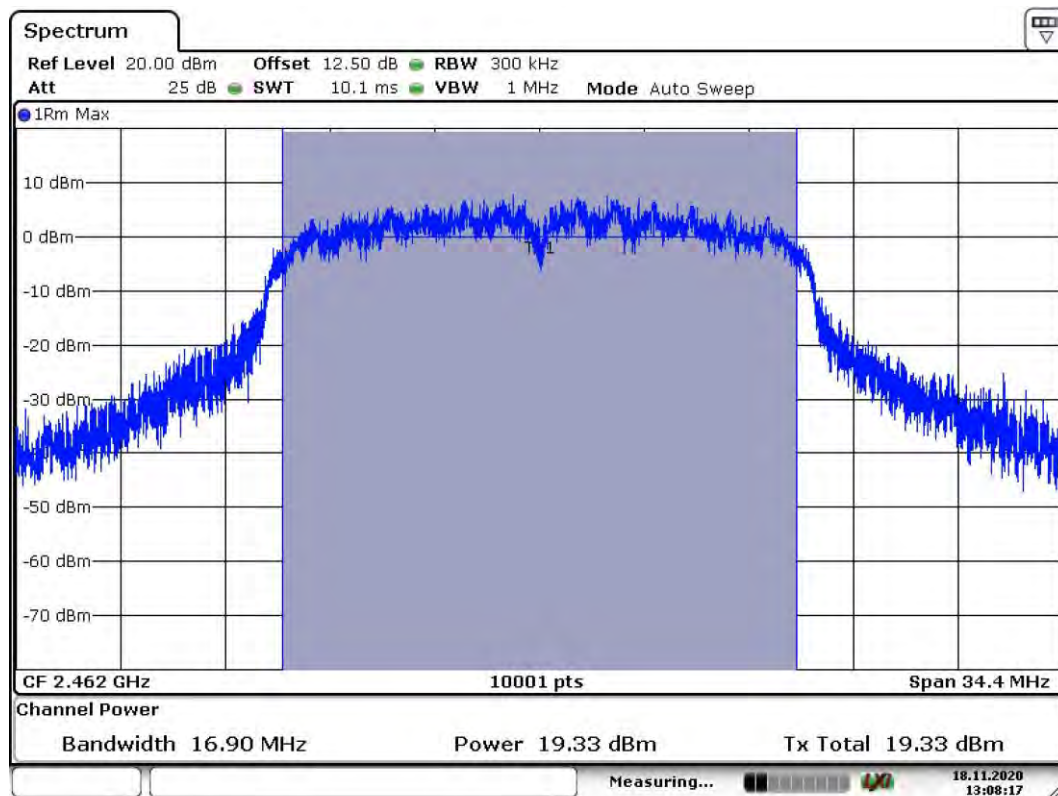
Date: 18.NOV.2020 13:04:03

Screenshot: Output power, low channel, 802.11n MCS0



Date: 18.NOV.2020 13:06:10

Screenshot: Output power, middle channel, 802.11n MCS0



Date: 18.NOV.2020 13:08:17

Screenshot: Output power, high channel, 802.11n MCS0

Test results

Modulation	Channel [MHz]	Bandwidth [MHz]	Output power [dBm]	Margin [dB]
802.11b 1 Mbps	2412	14.0	22.2	7.8
	2437	13.8	22.0	8.0
	2462	13.9	21.6	8.4
802.11g 6 Mbps	2412	16.9	19.2	10.8
	2437	16.8	20.0	10.0
	2462	16.5	21.2	8.8
802.11n MCS0	2412	17.3	19.2	10.8
	2437	16.9	19.2	10.8
	2462	16.9	19.3	10.7

9 OCCUPIED 6 DB BANDWIDTH

Date of test:	2020-11-18	Test location:	Radiolabbet
EUT Serial:	0000 0081 9380 0244	Ambient temp:	21 °C
Tested by:	Robert Hietala	Relative humidity:	48 %
Test result:	Pass	Margin:	8.5 MHz

9.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 11.8.1.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

9.2 Test conditions

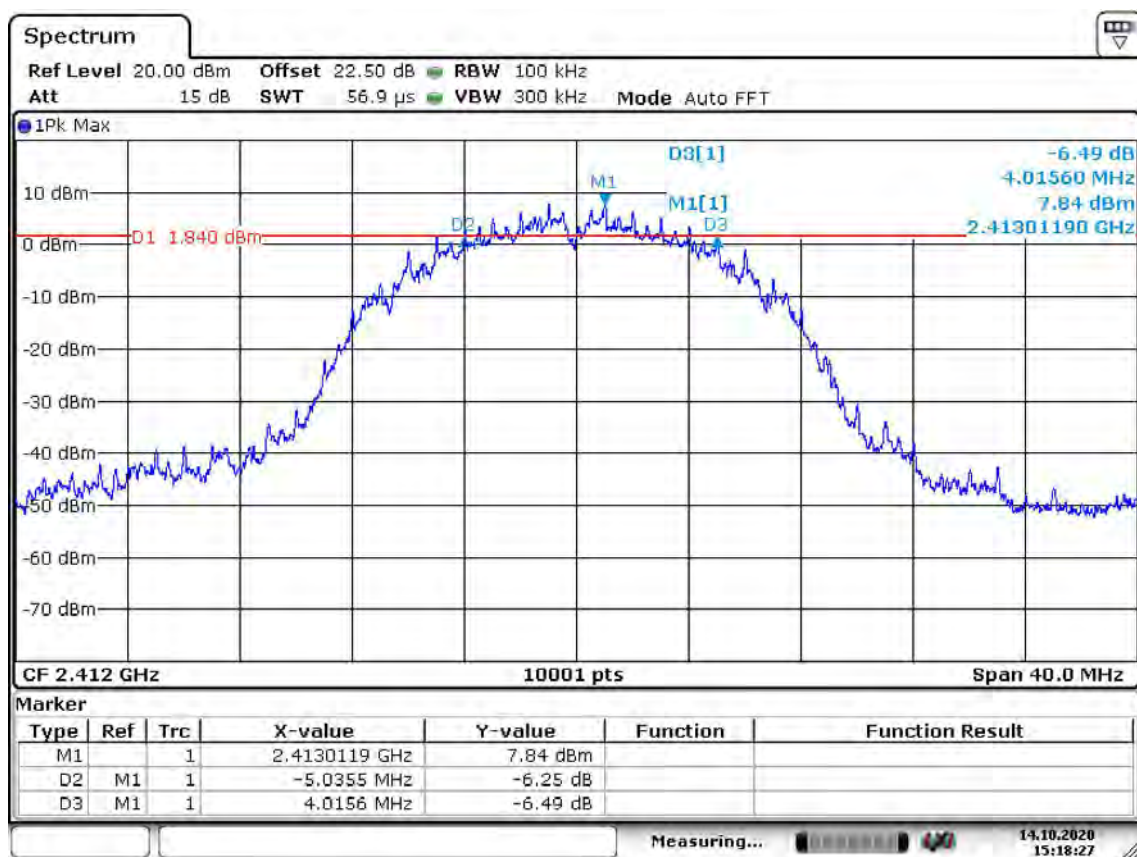
Detector: Peak,
RBW: 100 kHz
VBW: 300 kHz
Span: > 1.5 x OBW

The EUT was set up in order to emit maximum disturbances.

9.3 Requirements

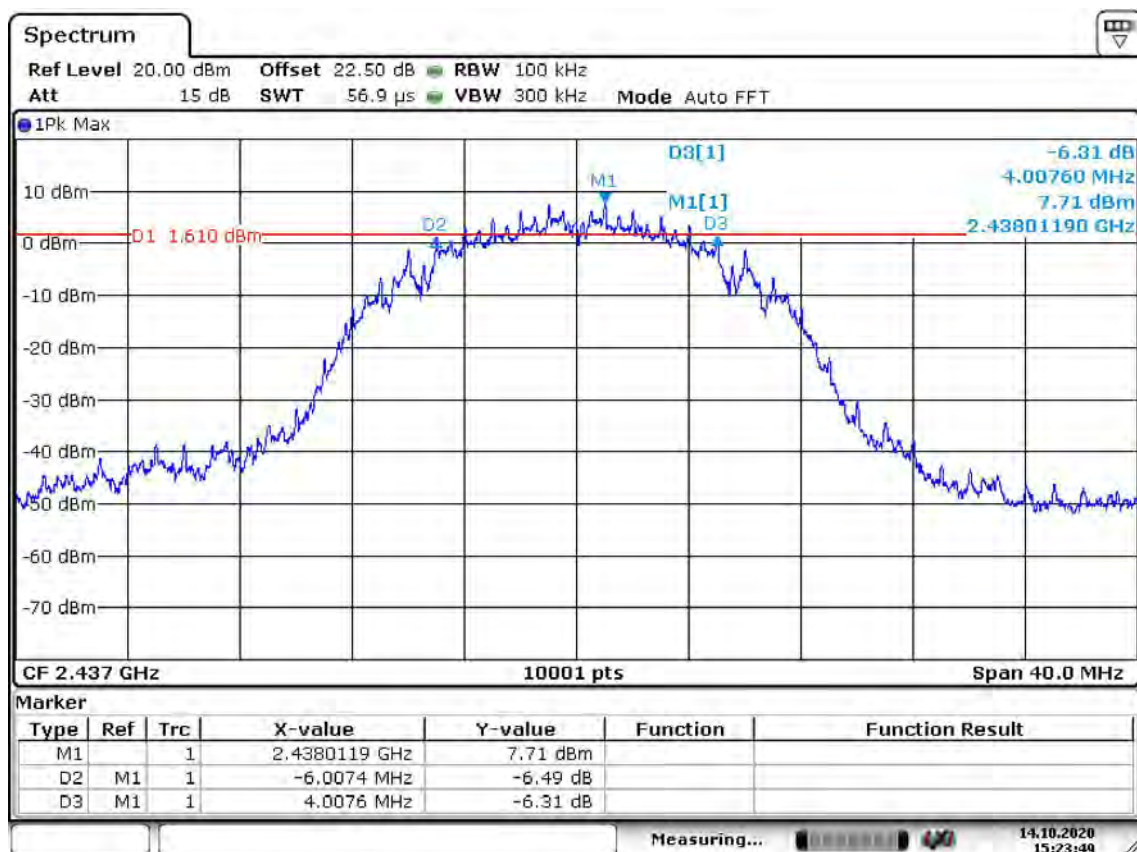
Reference: CFR 47§15.247(a)(2), RSS-247 5.2(1)
The minimum 6 dB bandwidth shall be 500 kHz.

9.4 Test results



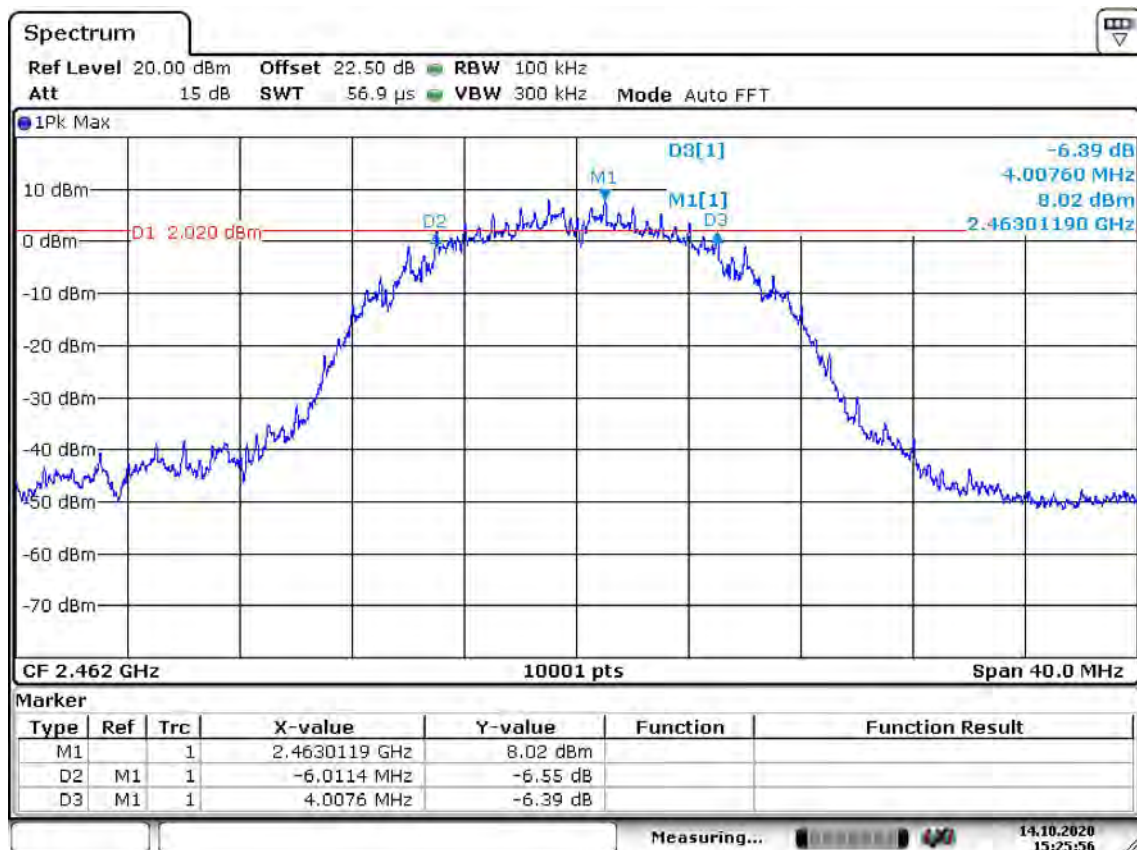
Date: 14.OCT.2020 15:18:27

Screenshot: Occupied 6 dB bandwidth Measurement, low channel, 802.11b 1 Mbps



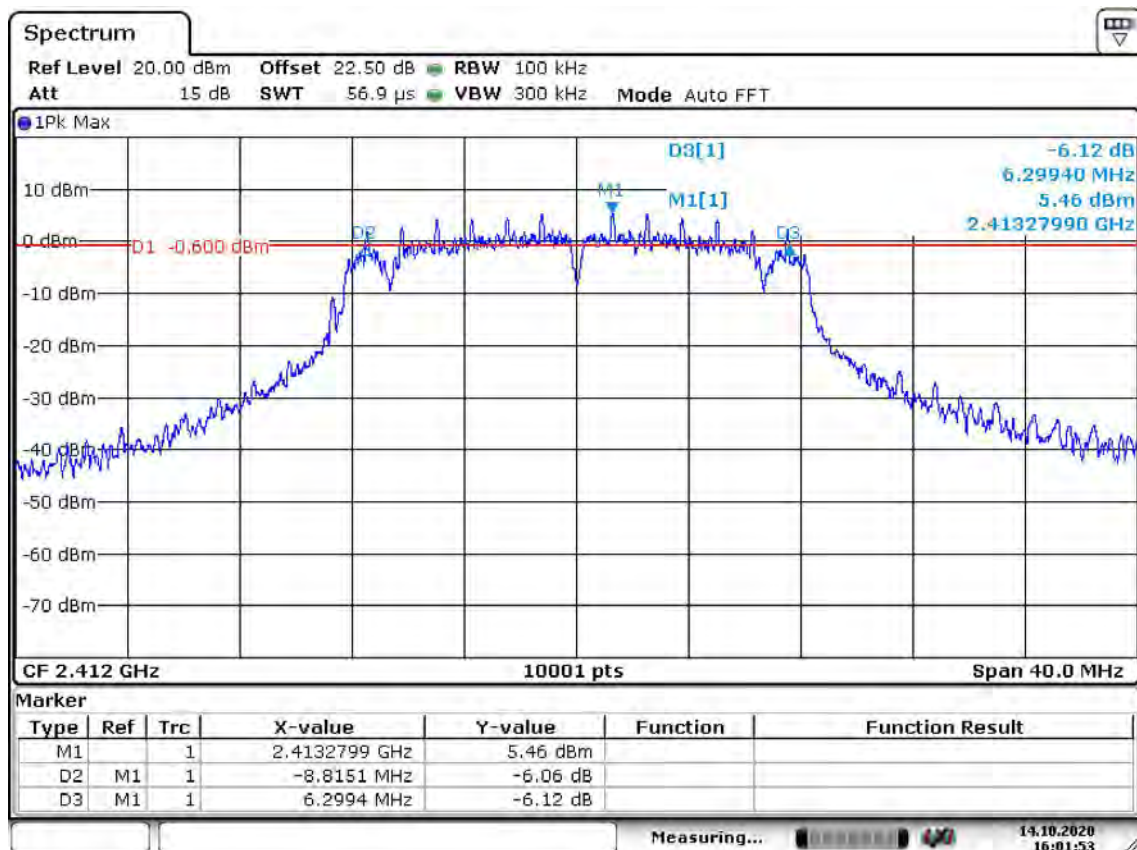
Date: 14.OCT.2020 15:23:50

Screenshot: Occupied 6 dB bandwidth Measurement, middle channel, 802.11b 1 Mbps



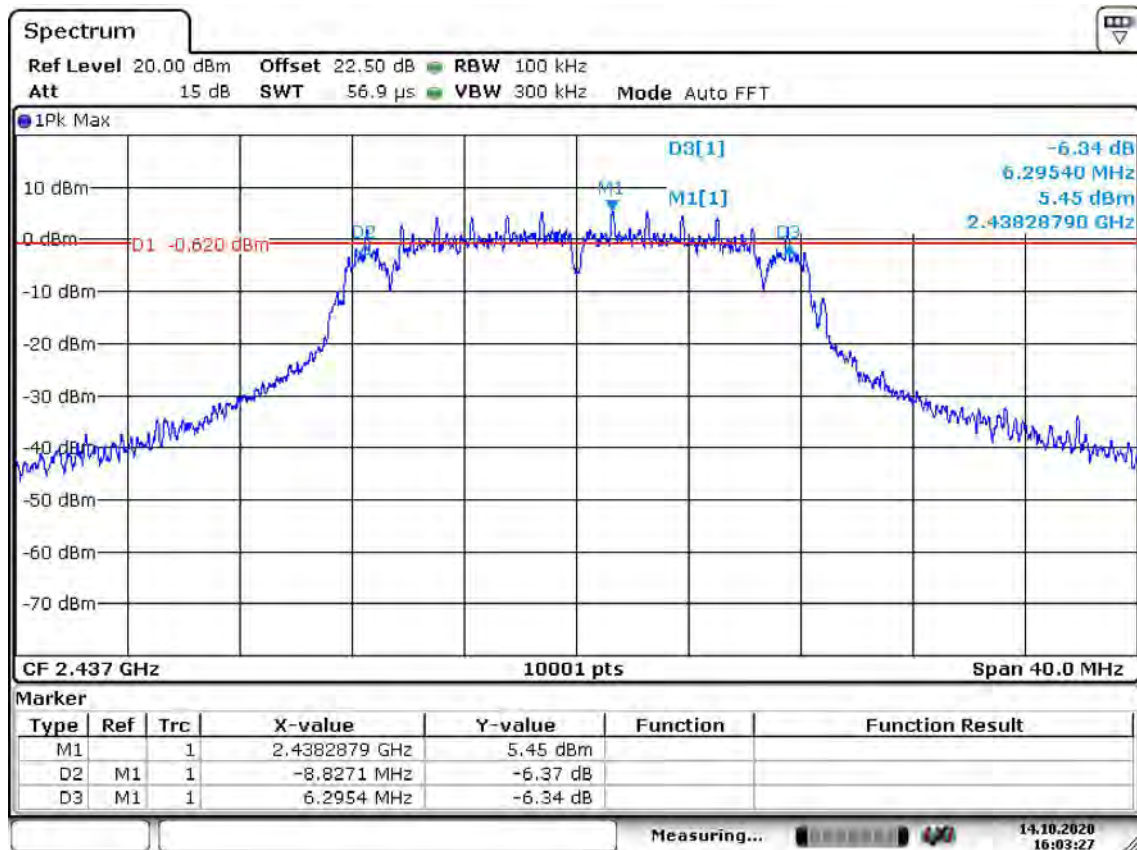
Date: 14.OCT.2020 15:25:56

Screenshot: Occupied 6 dB bandwidth Measurement, high channel, 802.11b 1 Mbps



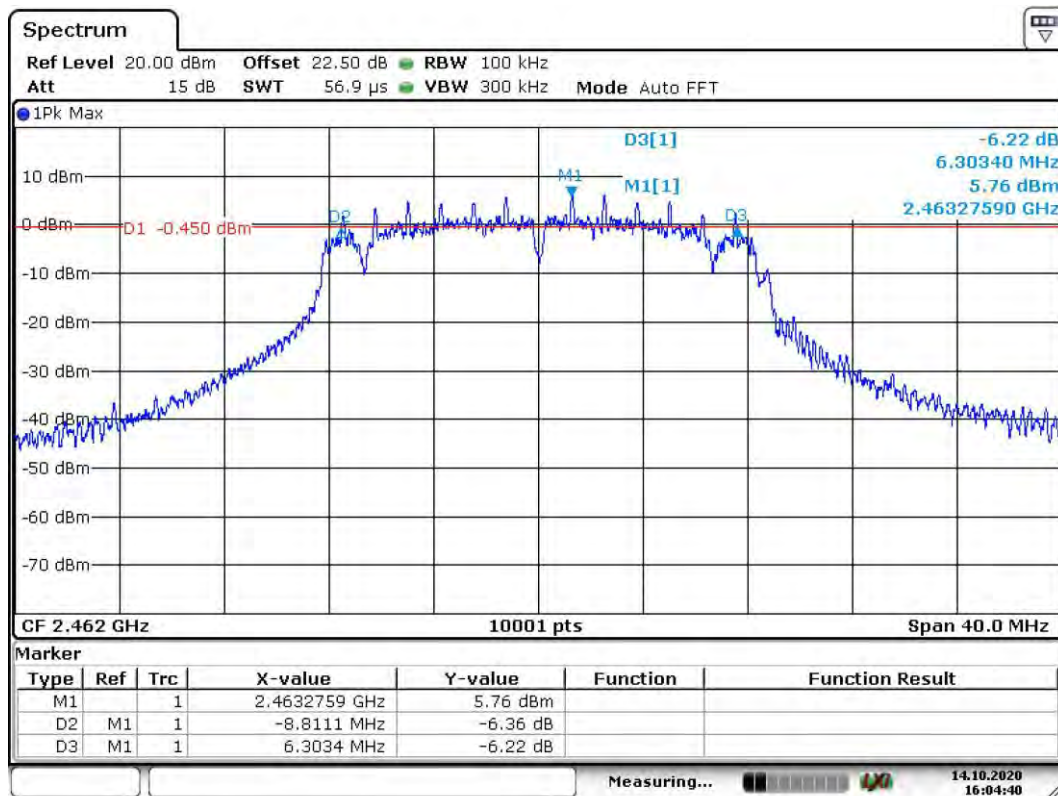
Date: 14.OCT.2020 16:01:53

Screenshot: Occupied 6 dB bandwidth Measurement, low channel, 802.11g 6 Mbps



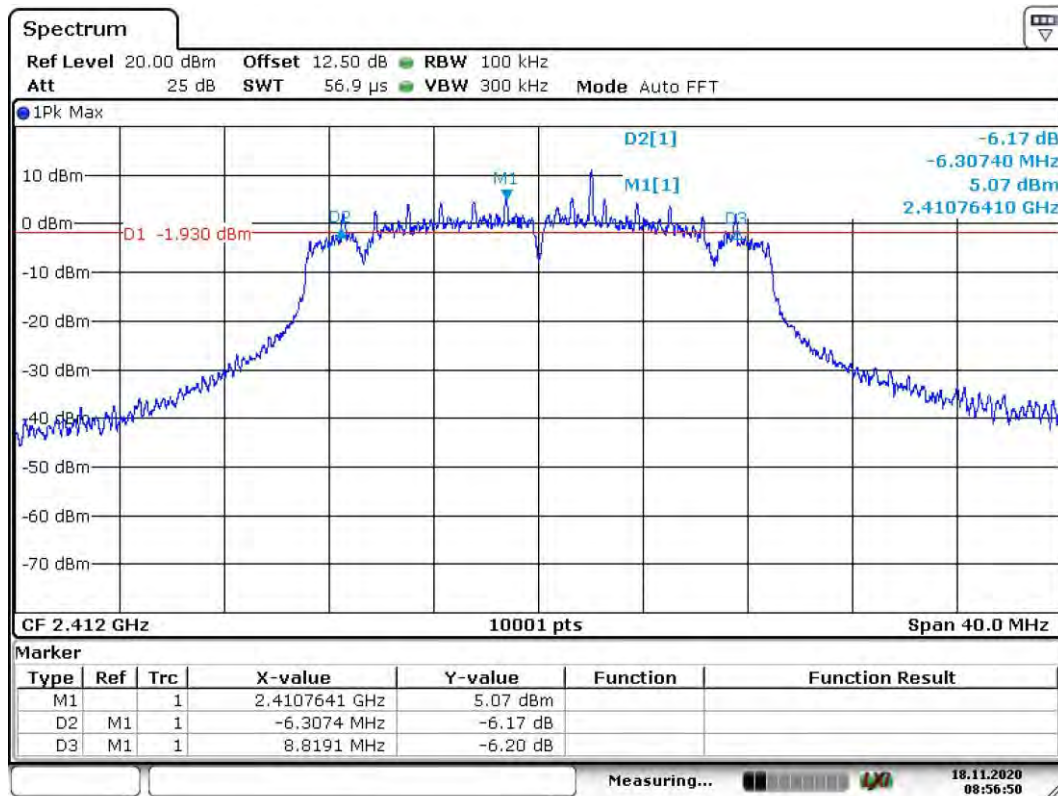
Date: 14.OCT.2020 16:03:27

Screenshot: Occupied 6 dB bandwidth Measurement, middle channel, 802.11g 6 Mbps



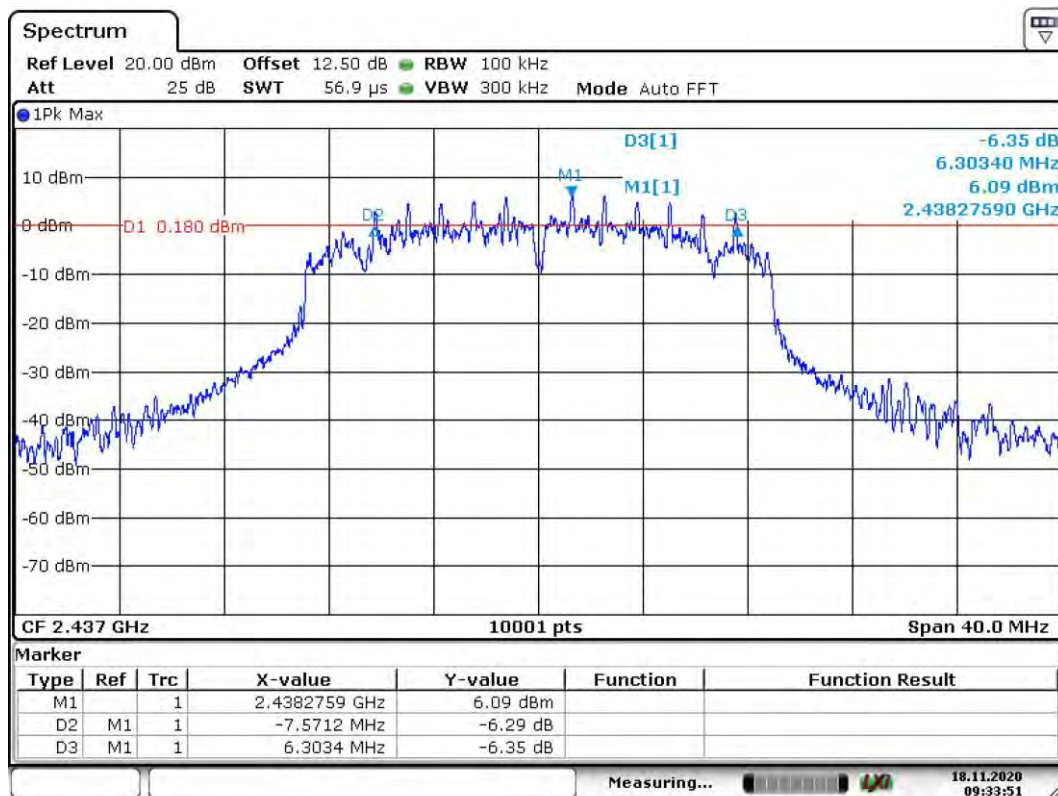
Date: 14.OCT.2020 16:04:41

Screenshot: Occupied 6 dB bandwidth Measurement, high channel, 802.11g 6 Mbps



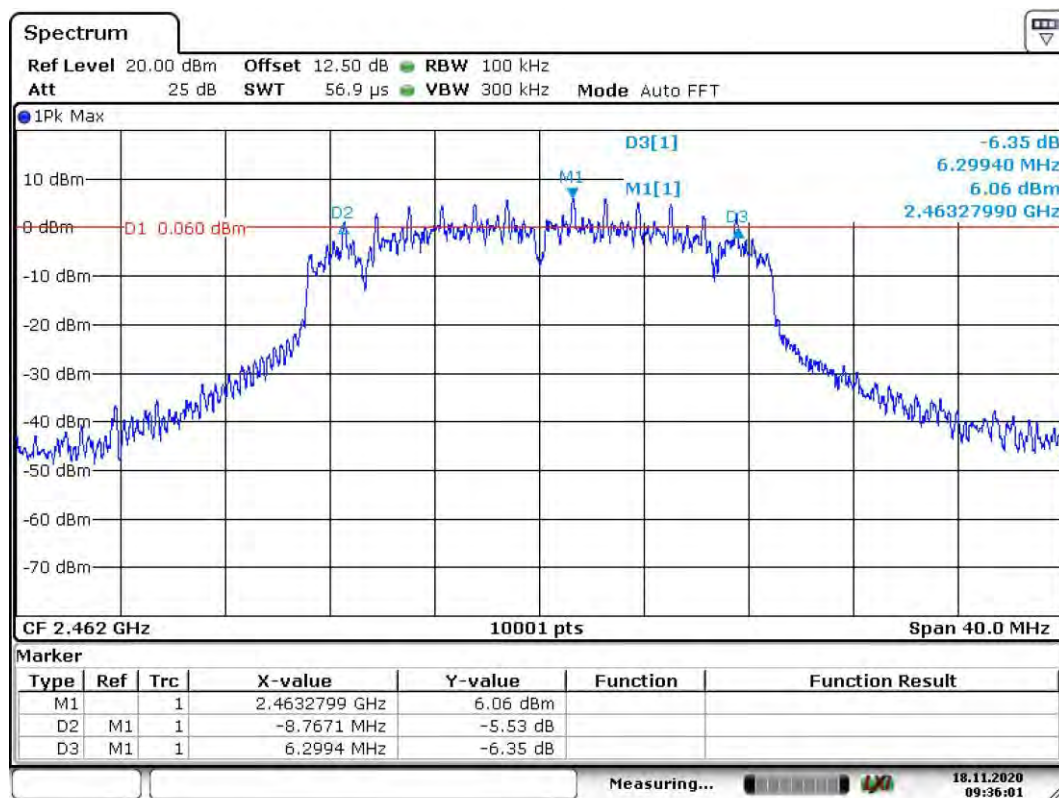
Date: 18.NOV.2020 08:56:51

Screenshot: Occupied 6 dB bandwidth Measurement, low channel, 802.11n MCS0



Date: 18.NOV.2020 09:33:51

Screenshot: Occupied 6 dB bandwidth Measurement, middle channel, 802.11n MCS0



Date: 18.NOV.2020 09:36:01

Screenshot: Occupied 6 dB bandwidth Measurement, high channel, 802.11n MCS0

Test result

Modulation	Channel [MHz]	6 dB BW [MHz]	Margin [MHz]
802.11b 1 Mbps	2412	9.0	8.5
	2437	10.0	9.8
	2462	10.0	9.8
802.11g 6 Mbps	2412	15.1	14.6
	2437	15.1	14.6
	2462	15.1	14.6
802.11n MCS0	2412	15.1	14.6
	2437	13.9	13.4
	2462	15.1	14.6

10 99 % BANDWIDTH

Date of test:	2020-11-18	Test location:	Radiolabbet
EUT Serial:	0000 0081 9380 0244	Ambient temp:	21 °C
Tested by:	Robert Hietala	Relative humidity:	48 %
Test result:	Pass	Margin:	--

10.1 Test set-up and test procedure.

The test method is in accordance with RSS-GEN section 6.7.

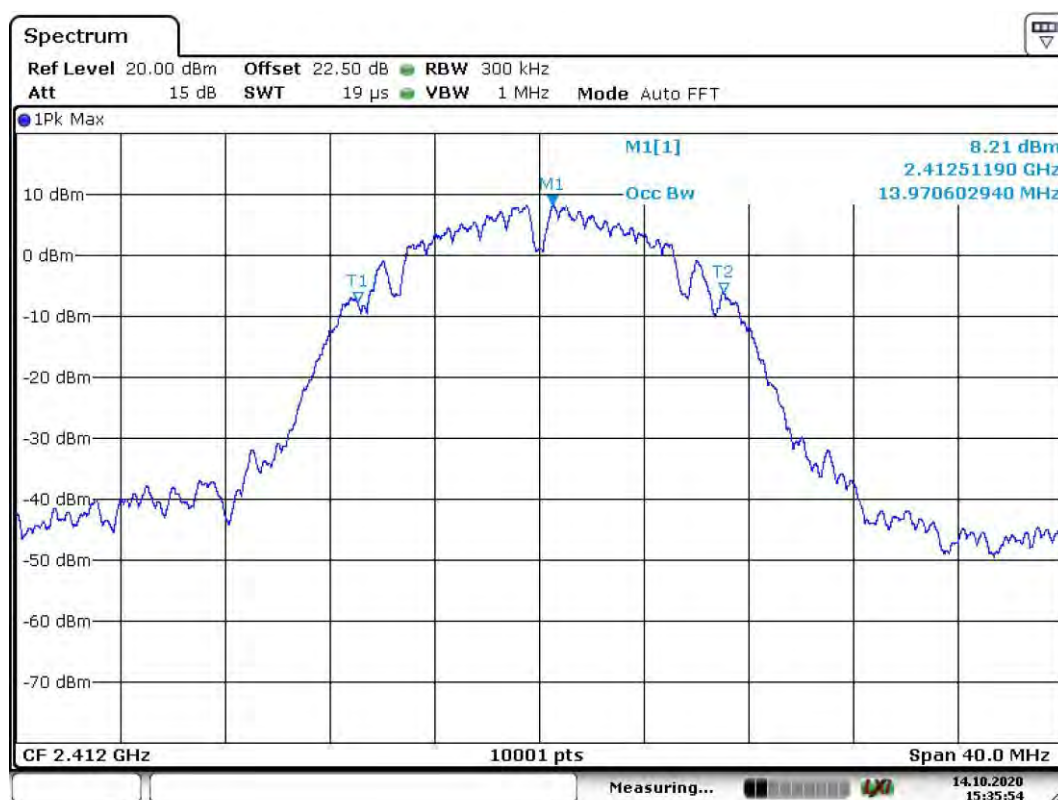
The EUT was connected to spectrum analyser via rf-cable and attenuator. Spectrum analyser with occupied bandwidth measurement function is used to determine the occupied bandwidth.

10.2 Test conditions

Detector: Peak
 RBW: 1 – 5 % of OBW
 VBW: 3 x RBW

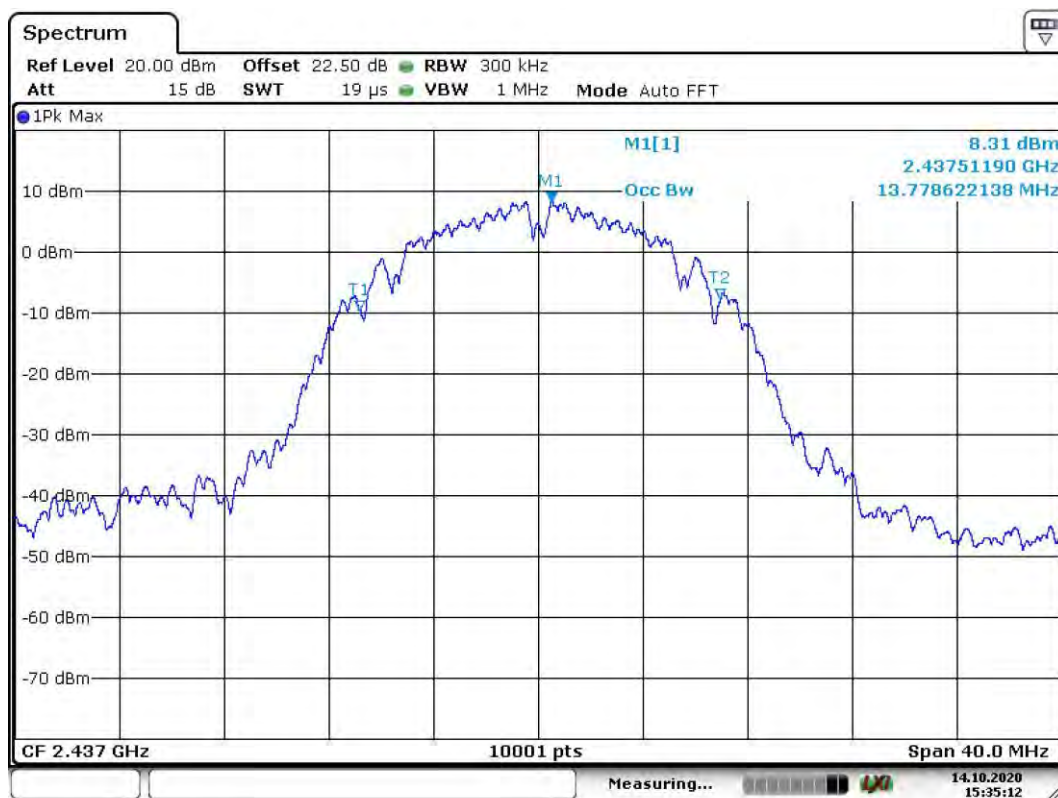
The EUT was set up in order to emit maximum disturbances.

10.3 Test results



Date: 14.OCT.2020 15:35:55

Screenshot: 99 % bandwidth Measurement, low channel, 802.11b 1 Mbps



Date: 14.OCT.2020 15:35:12

Screenshot: 99 % bandwidth Measurement, middle channel, 802.11b 1 Mbps



Date: 14.OCT.2020 15:34:38

Screenshot: 99 % bandwidth Measurement, high channel, 802.11b 1 Mbps



Date: 14.OCT.2020 16:36:23

Screenshot: 99 % bandwidth Measurement, low channel, 802.11g 6 Mbps



Date: 14.OCT.2020 16:34:30

Screenshot: 99 % bandwidth Measurement, middle channel, 802.11g 6 Mbps



Date: 14.OCT.2020 16:14:53

Screenshot: 99 % bandwidth Measurement, high channel, 802.11g 6 Mbps



Date: 18.NOV.2020 10:04:52

Screenshot: 99 % bandwidth Measurement, low channel, 802.11n MCS0



Date: 18.NOV.2020 09:53:18

Screenshot: 99 % bandwidth Measurement, middle channel, 802.11n MCS0



Date: 18.NOV.2020 09:49:48

Screenshot: 99 % bandwidth Measurement, high channel, 802.11n MCS0

Test results

Modulation	Channel [MHz]	99 % BW [MHz]
802.11b 1 Mbps	2412	14.0
	2437	13.8
	2462	13.9
802.11g 6 Mbps	2412	16.9
	2437	16.8
	2462	16.5
802.11n MCS0	2412	17.3
	2437	16.9
	2462	17.1

11 POWER SPECTRAL DENSITY

Date of test:	2020-11-18	Test location:	Radiolabbet
EUT number:	0000 0081 9380 0244	Ambient temp:	21 °C
Tested by:	Robert Hietala	Relative humidity:	48 %
Test result:	Pass	Margin:	> 10 dB

11.1 Test set-up and test procedure.

The test method is in accordance with ANSI C63.10-2013 section 11.10.7 Method AVGPS-3.

The EUT was connected to spectrum analyser via rf-cable and attenuator.

11.2 Test conditions

Detector: RMS
 RBW: 3 kHz
 VBW: 10 kHz
 Span: > 1.5 x OBW

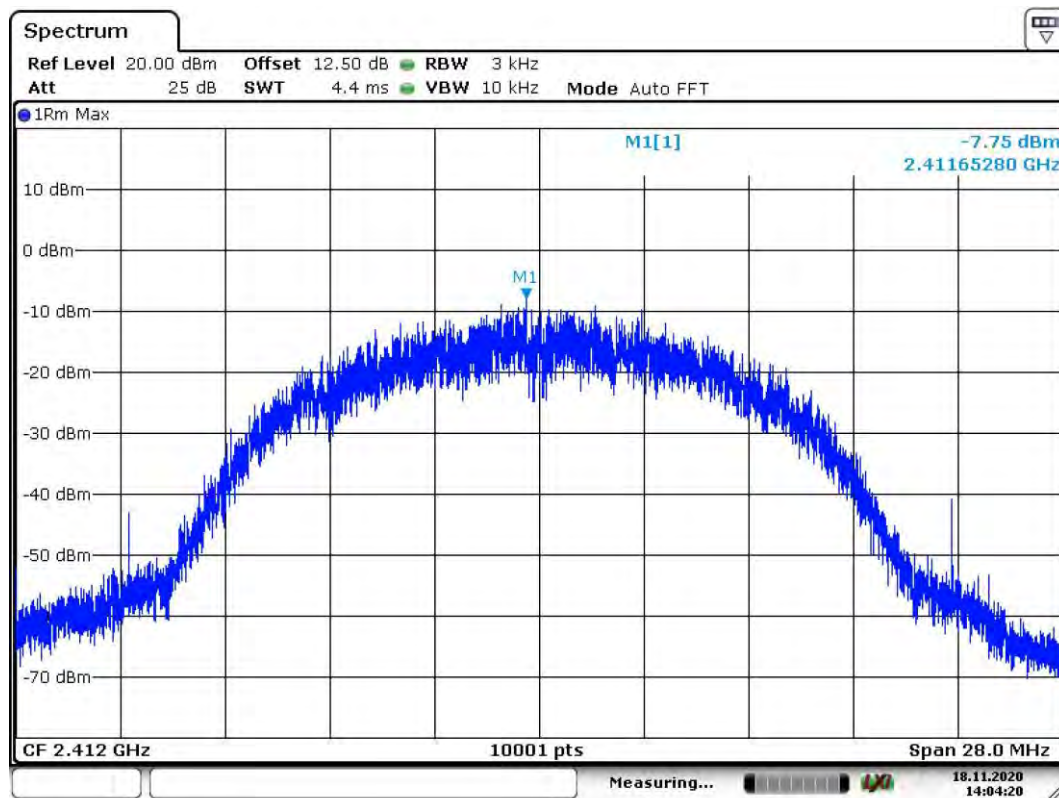
The EUT was set up in order to emit maximum disturbances.

11.3 Requirements

Reference: CFR 47§15.247(3), RSS-247 5.2(2)

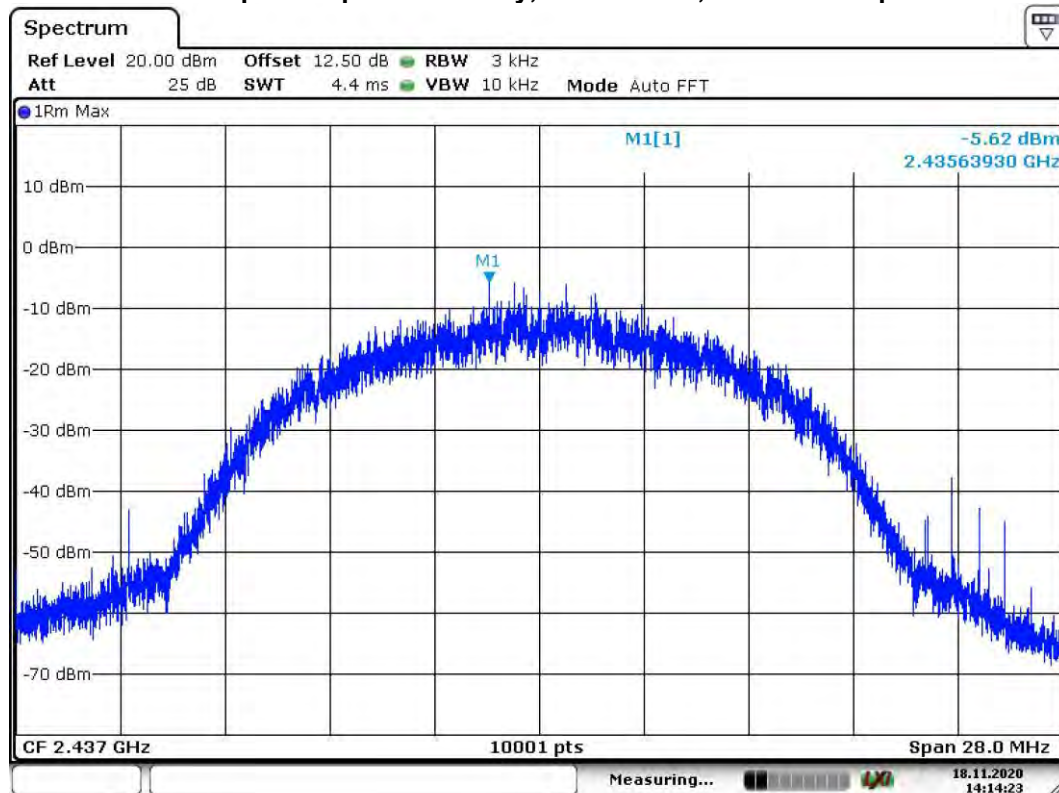
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

11.4 Test results



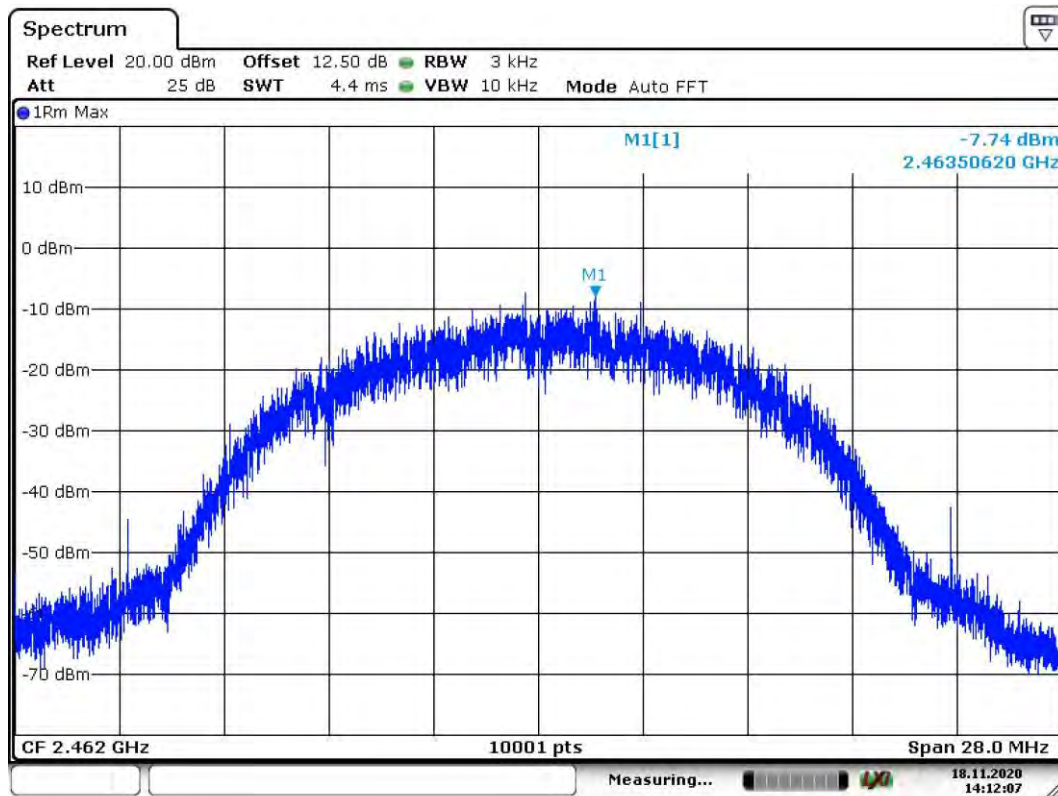
Date: 18.NOV.2020 14:04:21

Screenshot: Peak power spectral density, low channel, 802.11b 1 Mbps



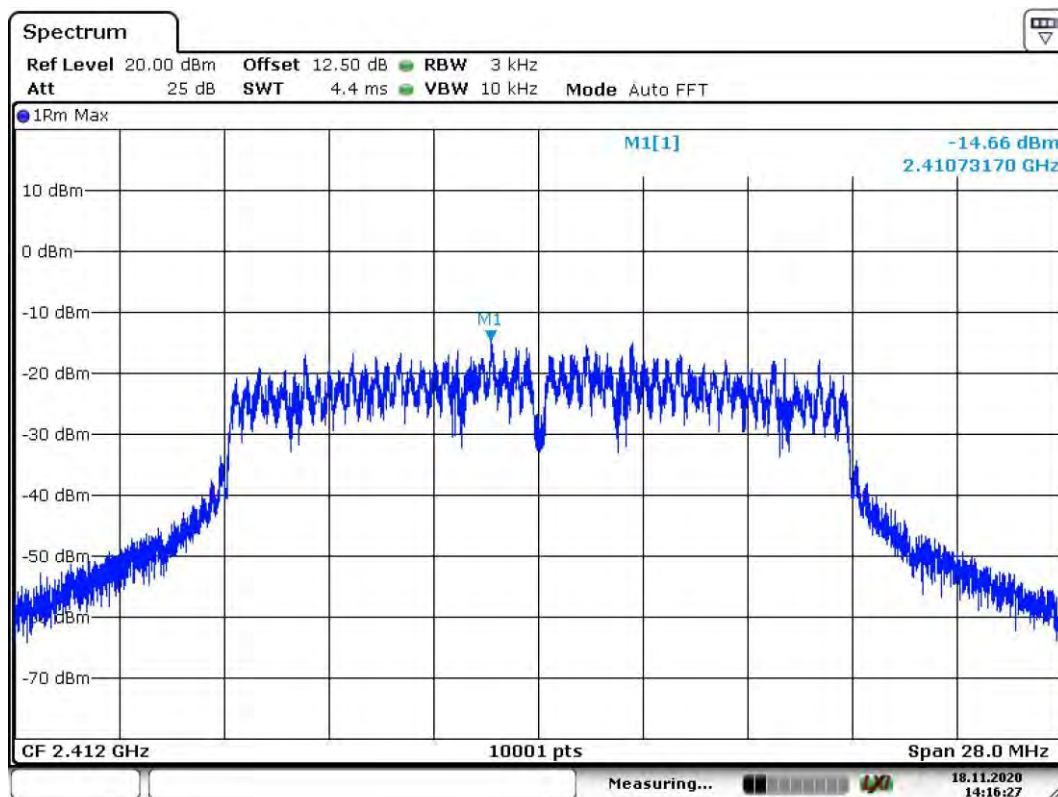
Date: 18.NOV.2020 14:14:23

Screenshot: Peak power spectral density, middle channel, 802.11b 1 Mbps



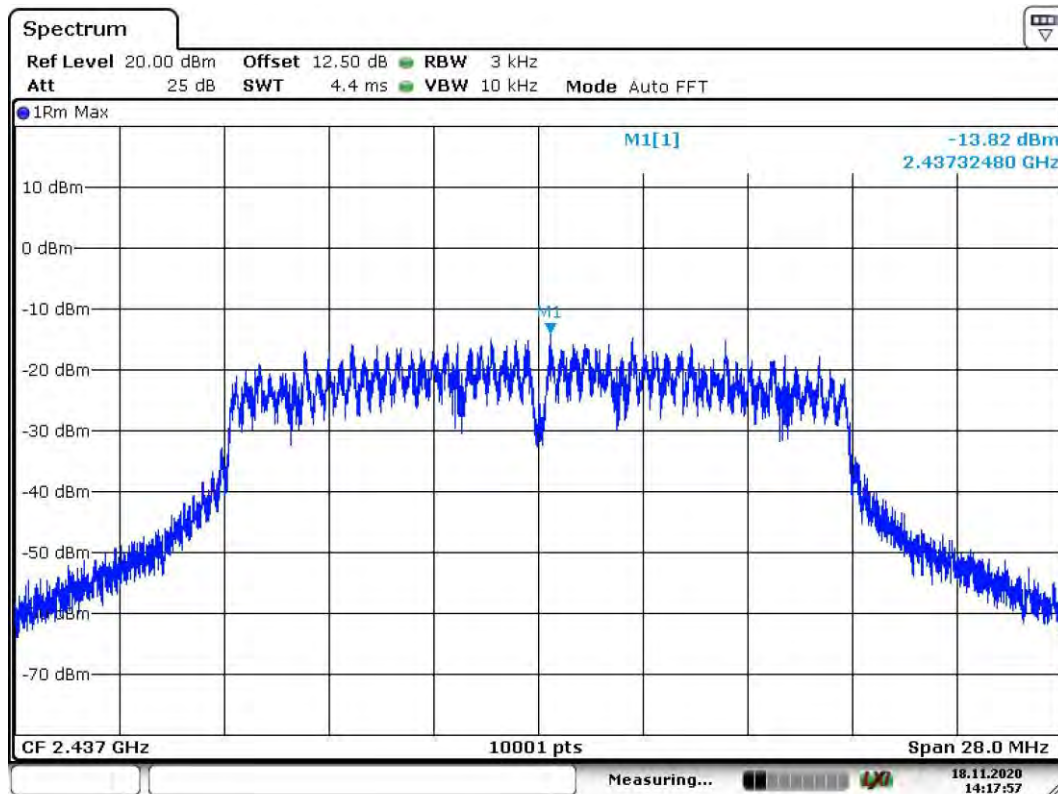
Date: 18.NOV.2020 14:12:07

Screenshot: Peak power spectral density, high channel, 802.11b 1 Mbps



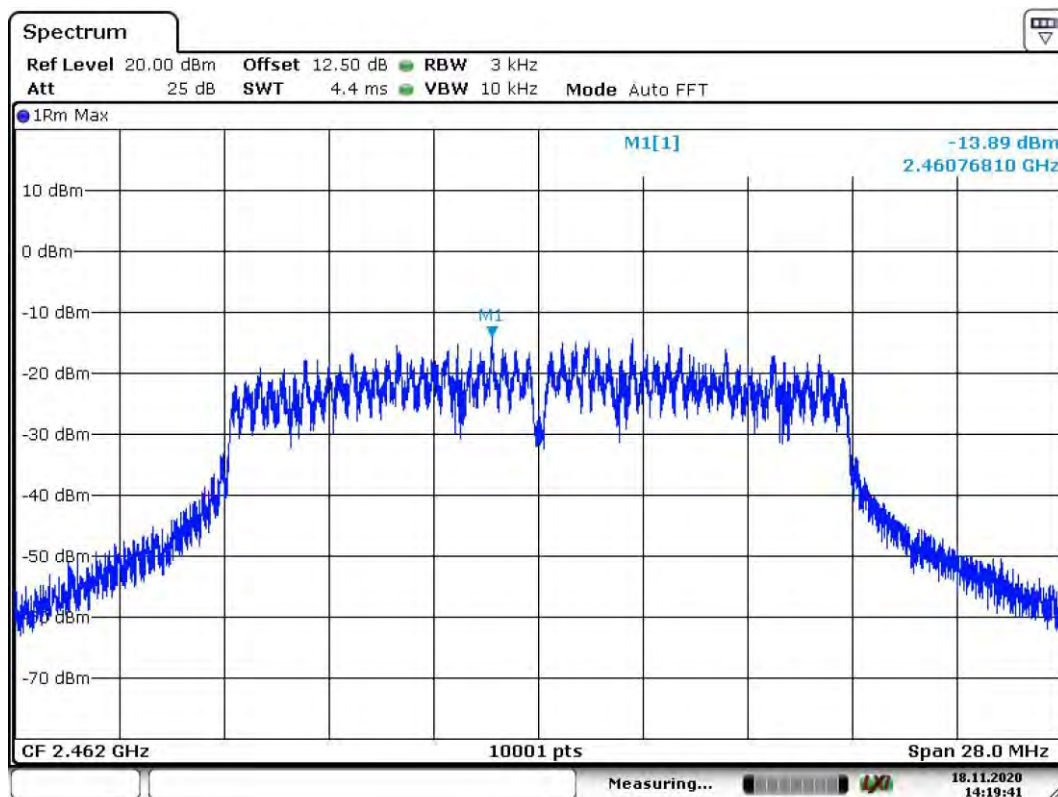
Date: 18.NOV.2020 14:16:28

Screenshot: Peak power spectral density, low channel, 802.11g 6 Mbps



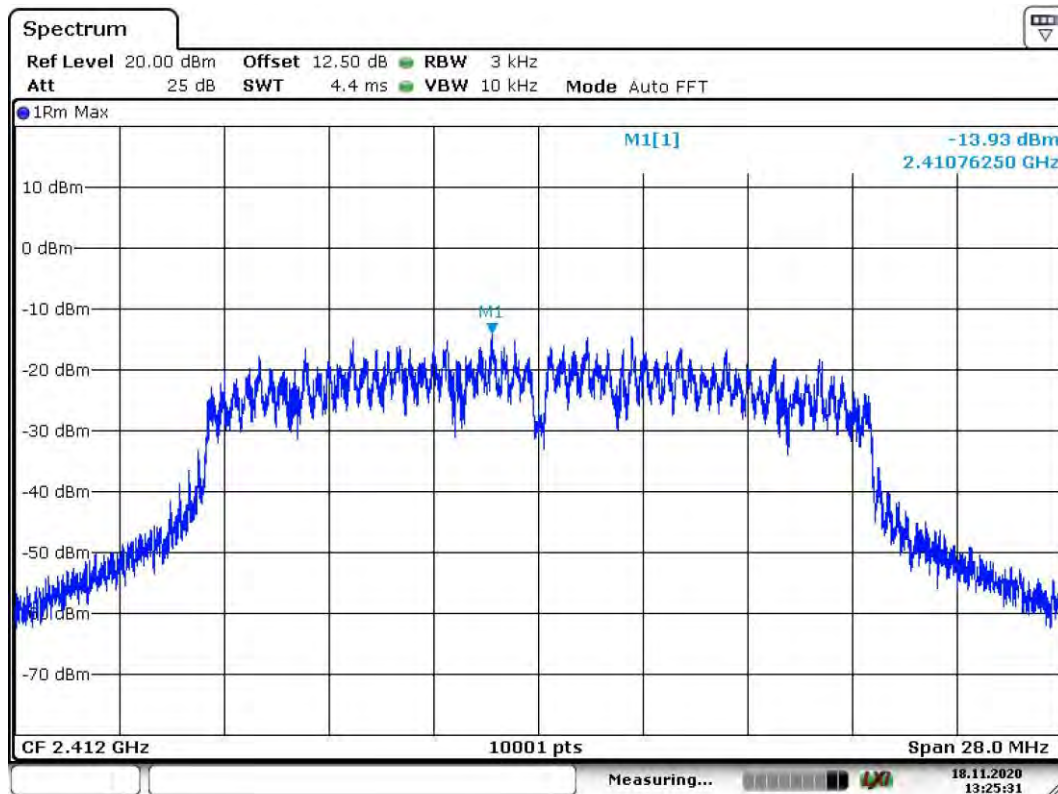
Date: 18.NOV.2020 14:17:57

Screenshot: Peak power spectral density, middle channel, 802.11g 6 Mbps



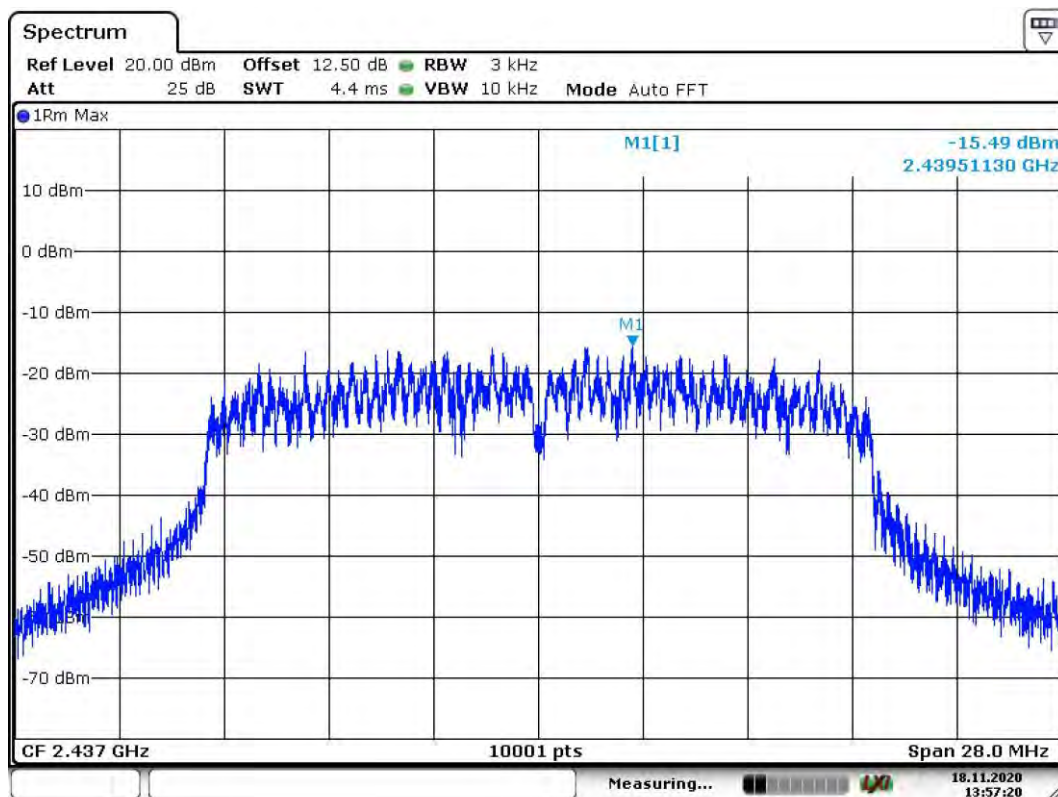
Date: 18.NOV.2020 14:19:41

Screenshot: Peak power spectral density, high channel, 802.11g 6 Mbps



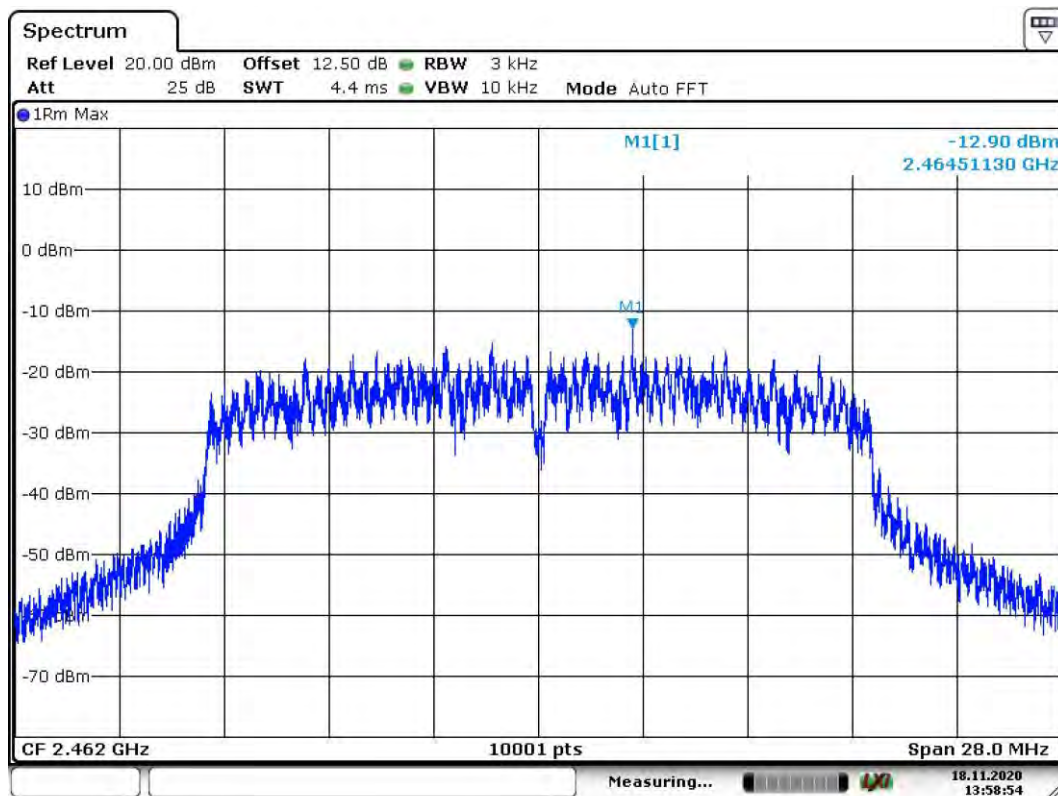
Date: 18.NOV.2020 13:25:31

Screenshot: Peak power spectral density, low channel, 802.11n MCS0



Date: 18.NOV.2020 13:57:20

Screenshot: Peak power spectral density, middle channel, 802.11n MCS0



Date: 18.NOV.2020 13:58:54

Screenshot: Peak power spectral density, high channel, 802.11n MCS0

Test results

Modulation	Channel [MHz]	PSD [dBm/3kHz]	Margin [dB]
802.11b 1 Mbps	2412	-7.8	15.8
	2437	-5.6	13.6
	2462	-7.7	15.7
802.11g 6 Mbps	2412	-14.7	22.7
	2437	-13.8	21.8
	2462	-13.9	21.9
802.11n MCS0	2412	-13.9	21.9
	2437	-15.5	23.5
	2462	-12.9	20.9

12 TEST EQUIPMENT

Radiohallen (3m FAR)

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - 10.50.40	--	--	--
Receiver	Rohde & Schwarz	ESU 40	12793	July-2020	1 year
Measurement cable	Megaphase	G916-K1K1-79	9462	Sep-2020	2 years
Measurement cable	Rosenberger	LU7-S020-4000	39146	Sep-2020	1 year
Measurement cable	Huber+Suhner	Sucoflex 102	39136	Aug-2020	1 year
Measurement cable	Huber+Suhner	Sucoflex 104	5191	Aug-2020	1 year
Horn antenna	EMCO	3115	4936	Sep-2020	3 year
Pre-amplifier	Sangus	00101400-23-10P -6-S ; AFS44-12002400-32-10P -44	12335	Oct-2020	1 year
Horn antenna	EMCO	3160-08	30099	Aug-2020	3 years
Horn antenna	EMCO	3160-09	30101	Aug-2020	3 years
2,4 GHz band reject filter:	Wainwright Instr. GmbH	WRCGV10-2381-2401-2479-2499-40SS	33938	Sep-2020	1 year
4 GHz high pass filter	K&L MICROWAVE INC	4410-X4500/18000 -0/0	5133	Sep-2020	1 year
Temperature reader	Vaisala	HM 40	32879	Sep-2020	1 year

Björkhallen (3m SAC)

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - 10.50.40	--	--	--
Receiver	Rohde & Schwarz	ESW 44	34030	July-2020	1 year
Pre-amplifier	Rohde & Schwarz	TS-PRE1	32306	Sep-2020	1 year
Horn BiLog antenna	Chase	CBL6110A	971	Nov-2019	1 year
Measurement cable	Rosenberger	(UFB293C) LA5-S003-10000	39163	June-2020	1 year
Measurement cable	Rosenberger	LA5-S003-7000 (UFB293C)	39162	Jan-2020	1 year
Temperature reader	Vaisala	HM41	32927	Oct-2020	1 year

13 MEASUREMENT UNCERTAINTY

Continuous conducted disturbances with AMN in the frequency range 9 kHz to 30 MHz ± 3.7 dB

Measurement uncertainty for radiated disturbance

Uncertainty for the frequency range 30 to 1000 MHz at 3 m	± 5.1 dB
Uncertainty for the frequency range 1.0 to 18 GHz at 3 m	± 4.7 dB
Uncertainty for the frequency range 18 to 26 GHz at 3 m	± 4.8 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2:2011.

The measurement uncertainty is given with a confidence of 95 %.

14 TEST SET UP AND EUT PHOTOS

EUT photos are in separate document 2011036STO-302 Annex 1.

Test set up photos are in separate document 2011036STO-303 Annex 2.