

RADIO TEST REPORT

No. 2019843STO-306

RF Performance

EQUIPMENT UNDER TEST

Equipment: Remote care solution
Type/Model: Hub
Manufacturer: Pink Nectarine Health AB
Tested by request of: Pink Nectarine Health AB

SUMMARY

Referring to the emission limits, and the operating mode during the tests specified in this report, the equipment complies with the 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: December 15, 2020

Tested by:



Robert Hietala

Approved by:



Björn Utermöhl

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Revision History

Test report number	Date	Description	Changes
2019843STO-306	December 15, 2020	First release	--

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1 CLIENT INFORMATION

The EUT has been tested by request of

Company Pink Nectarine Health AB
Munkbron 11
111 28 Stockholm
Sweden

Name of contact Tobias Linghammar
Phone +46 70 461 48 27

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT

Equipment: Remote care solution

Type/Model: Hub

Brand name: Nectarine Health

Manufacturer: Pink Nectarine Health AB

Transmitter frequency range: 2402 – 2480 MHz

Receiver frequency range: 2402 – 2480 MHz

Modulation technique: ☐ FHSS ☒ Other forms of modulation

Radio technique: Bluetooth Low Energy 1 Mbit
Bluetooth Low Energy 2 Mbit

Number of channels: 40

Nominal channel bandwidth(s): Bluetooth Low Energy 1 Mbit = 1 MHz
Bluetooth Low Energy 2 Mbit = 2 MHz

Antenna: ☒ Internal antenna ☐ External antenna

Antenna connector: ☒ None, internal antenna ☐ Yes

Antenna gain: +0.4 dBi

Rating RF output power: +8 dBm (eirp)

Type of modulation: GFSK

Temperature range: ☐ Category I (General): -20°C to +55°C
☐ Category II (Portable equipment): -10°C to +55°C
☐ Category III (Equipment for normal indoor use): +5°C to +35°C
☒ Other: 0°C to +40°C

Transmitter standby mode supported: ☒ Yes ☐ No

2.2 Additional information about the EUT

The EUT employs a Bluetooth Low Energy chipset with support of 1 Mbit and 2 Mbit data rate. All conducted measurements were performed for both data rates. Spurious emission was performed for 1 Mbit which was determined to be worst-case based on output power and power spectral density.

The EUT also employs a chipset with a Wi-Fi 2.4 GHz as well as a Wi-Fi 5 GHz radio transmitter.

This test report covers Bluetooth Low Energy 1 Mbit and Bluetooth Low Energy 2 Mbit.

Test samples:

Unit	Type	Serial number	Hardware version	Comment
Unit 1	Hub	HNA0101-T203939B4	862603-01-V01-R5_C, 862603-02 MIC Board-V01-A.1	Fitted with SMA connector for conducted emission
Unit 2	Hub	HNA0101-T2039397AI	862603-01-V01-R5_C, 862603-02 MIC Board-V01-A.1	For radiated emission

During the tests the EUT supported following software:

Software	Version	Comment
Bluetooth Low Energy	nRF5_SDK_15.3.0_59ac345	Nordic Semiconductor Radio Test

2.3 Companion device

Unit	Type	Manufacturer	Serial number
Communication tester	CMW 500	Rohde & Schwarz	34164

2.4 Mode of operation during the tests

All conducted tests were performed with the EUT in Direct Test Mode (DTM) controlled by the companion device in section 2.3, using PRBS9 with a payload of 255 bytes.

All radiated tests were performed with Nordic Semiconductors “RF Test Example” (https://infocenter.nordicsemi.com/index.jsp?topic=%2Fcom.nordic.infocenter.sdk5.v15.2.0%2Fnrf_rad_io_test_example.html) with setting “pos8dBm” during transmitter tests.

The tests were performed on the following channels:

Low channel = 2402 MHz

Middle channel = 2440 MHz

High channel = 2480 MHz

2.5 Modifications made to improve EMC-characteristics

No modifications have been made during the tests.

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 #
BJÖRKHALLEN	Semi-anechoic 3 m	2042G-1
Radiohallen	Fully anechoic 3 m	2042G-4

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 2402 – 2480 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 5.3.	
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 EUT complies with the limits. The margin to the limit was at least 10 dB. See clause 6.4.	
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 2.2 dB. See clause 6.5.	
FCC §15.247(a)(2) RSS-GEN 6.6 RSS-247 5.2(1)	Occupied bandwidth	PASS
	The EUT complies with the limits. The margin to the limit is at least 204.9 kHz See clause 9.4.	
FCC §15.247(b) RSS-247 5.4(4)	Conducted output power	PASS
	The EUT complies with the limits. The margin to the limit was at least 10 dB. See clause 8.4.	
FCC §15.247(e) RSS-247 5.2(2)	Peak power spectral density	PASS
	The EUT complies with the limits. The margin to the limit was at least 10 dB. See clause 11.4.	
FCC §15.247(e) RSS-247 5.5	Conducted Band edge	PASS
	The EUT complies with the limits. The margin to the limit was at least 10 dB. See clause 6.4.	

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

Date of test:	November 19, 2020	Test location:	Bur 1
EUT Serial:	HNA0101-T2039397AI	Ambient temp:	22 °C
Tested by:	Robert Hietala, Ala El-Haery	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

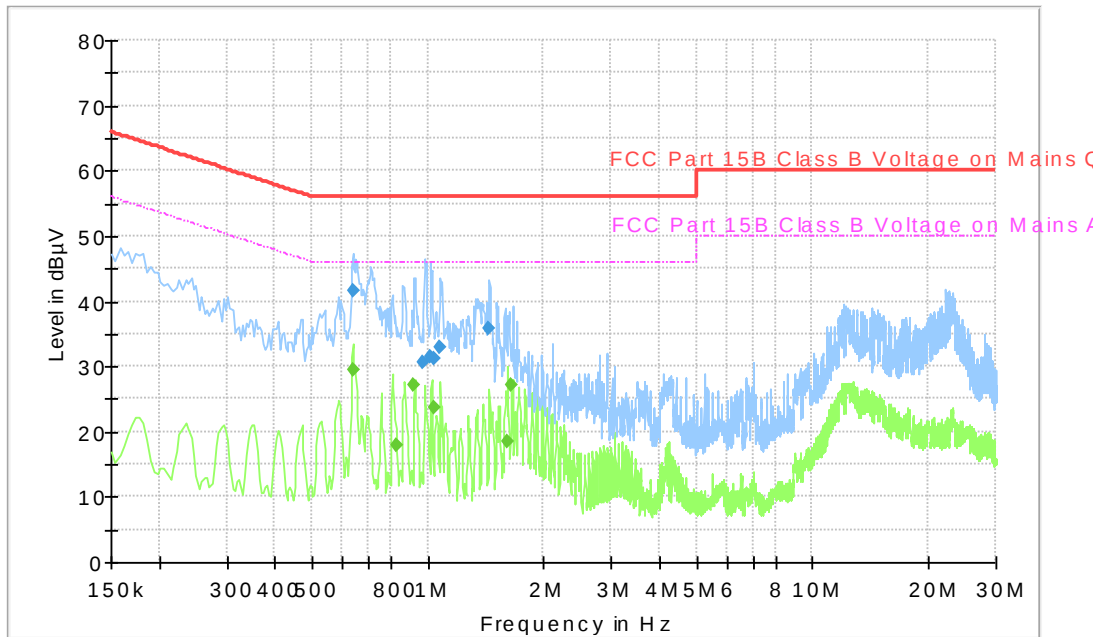
The EUT shall meet the limits for the standards.

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, Bluetooth Low Energy 1 Mbit, middle channel

Measurement results, Quasi-peak

Frequency [MHz]	Level [dBμV]	Limit [dBμV]	Line L/N	Margin [dB]
0.641	41.6	56.0	N	14.4
0.971	30.5	56.0	L1	25.5
1.011	31.6	56.0	L1	24.4
1.034	31.1	56.0	N	24.9
1.073	33.0	56.0	N	23.0
1.440	35.7	56.0	N	20.3

Measurement results, Average

Frequency [MHz]	Level [dBμV]	Limit [dBμV]	Line L/N	Margin [dB]
0.642	29.5	46.0	N	16.5
0.827	18.0	46.0	L1	29.0
0.922	27.3	46.0	N	18.7
1.039	23.7	46.0	N	22.3
1.609	18.5	46.0	L1	27.5
1.650	27.1	46.0	L1	18.9

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:	November 24, 2020	Test location:	Radiohallen, Björkhallen
EUT Serial:	HNA0101-T2039397AI	Ambient temp:	22 °C
Tested by:	Robert Hietala, Ala El-Haery	Relative humidity:	22 %
Test result:	Pass	Margin:	2.2 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 0.8 and 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 detector activated in the frequency-range 30 – 1000 MHz. Above 1 GHz additionally the average detector was 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 – 4 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

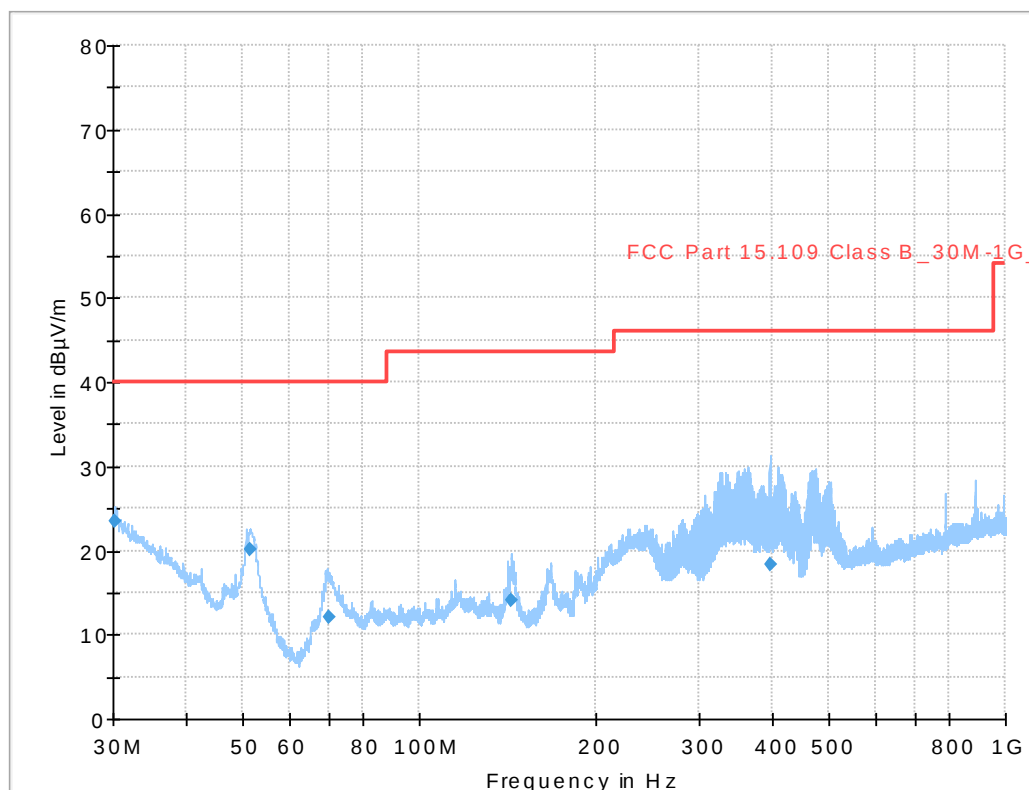
The values for 10 m measuring distance are calculated by subtracting 10.5 dB from the 3 m limit. (i.e. an extrapolation factor of 20 dB/decade according to CFR 47 §15.31(f)(1))

Outside the restricted bands:

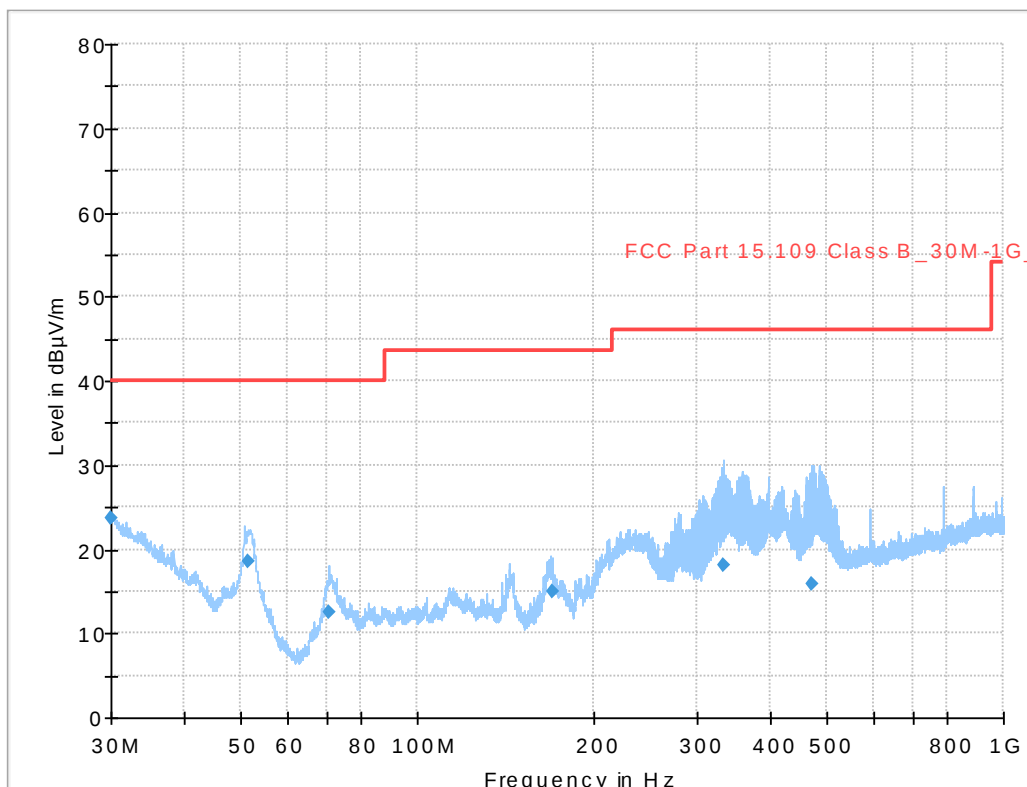
Reference: CFR 47 §15.247(d), RSS-247 5.5,

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.

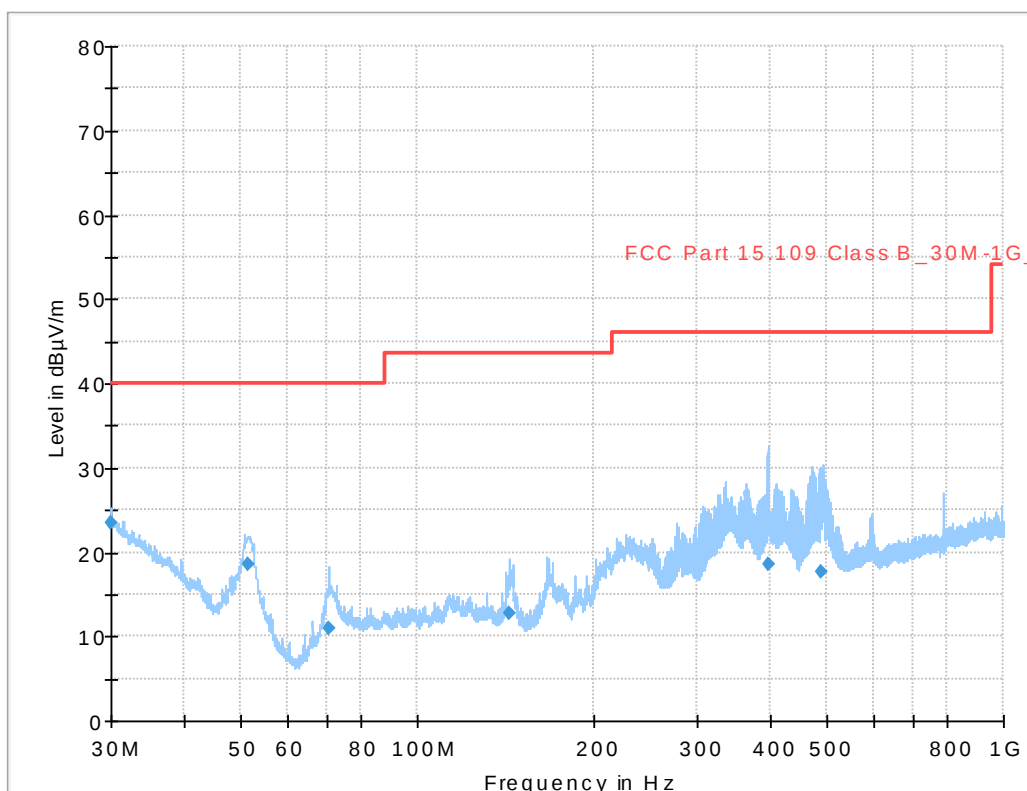
6.4 Test results 30 MHz – 1000 MHz, TX



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 middle channel.



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

Measurement results, Quasi Peak, low channel

Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	Polarization H/V	Margin [dB]
30.240	23.5	40.0	V	16.5
51.600	20.1	40.0	V	19.9
70.050	12.1	40.0	V	27.9
143.850	14.1	43.5	H	29.4
396.000	18.3	46.0	V	27.7

Measurement results, Quasi Peak, middle channel

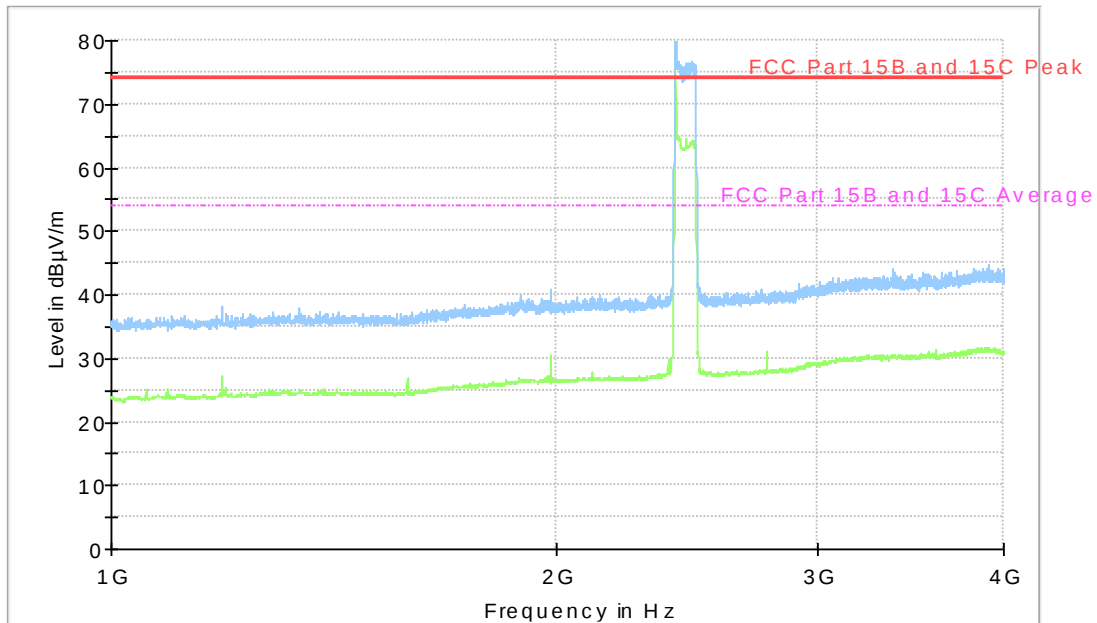
Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	Polarization H/V	Margin [dB]
30.000	23.7	40.0	H	16.3
51.600	18.5	40.0	V	21.5
70.770	12.6	40.0	V	27.4
169.830	15.0	43.5	V	28.5
332.100	18.0	46.0	H	28.0
472.600	15.8	46.0	H	30.3

Measurement results, Quasi Peak, high channel

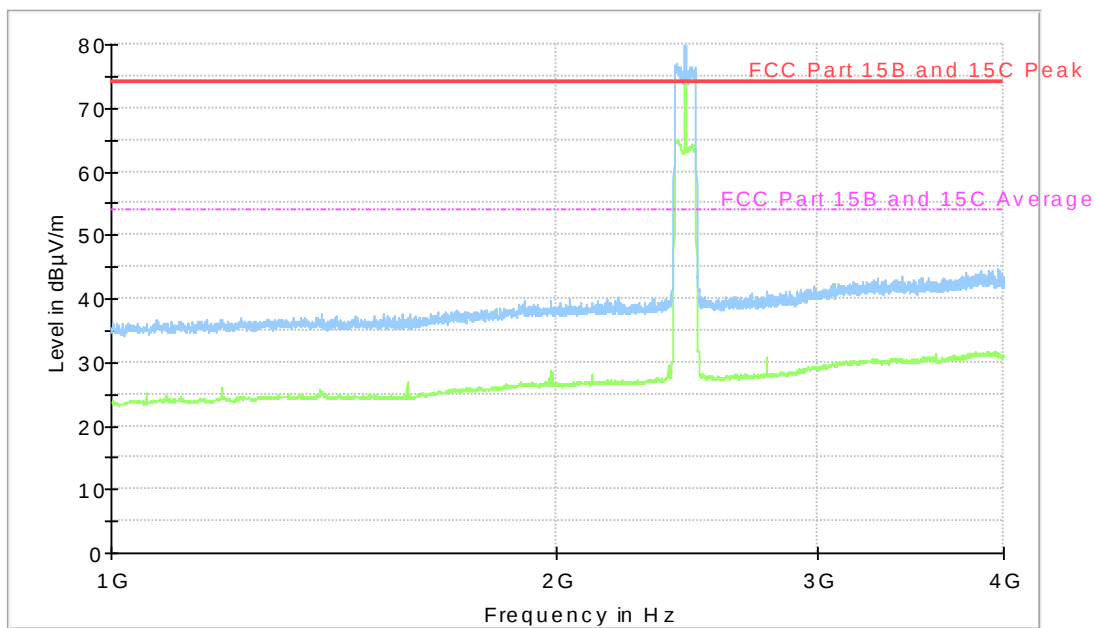
Frequency [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	Polarization H/V	Margin [dB]
30.300	23.6	40.0	H	16.4
51.420	18.5	40.0	V	21.5
70.770	10.9	40.0	V	29.1
143.520	12.7	43.5	H	30.8
396.000	18.5	46.0	V	27.6
487.960	17.7	46.0	H	28.3

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

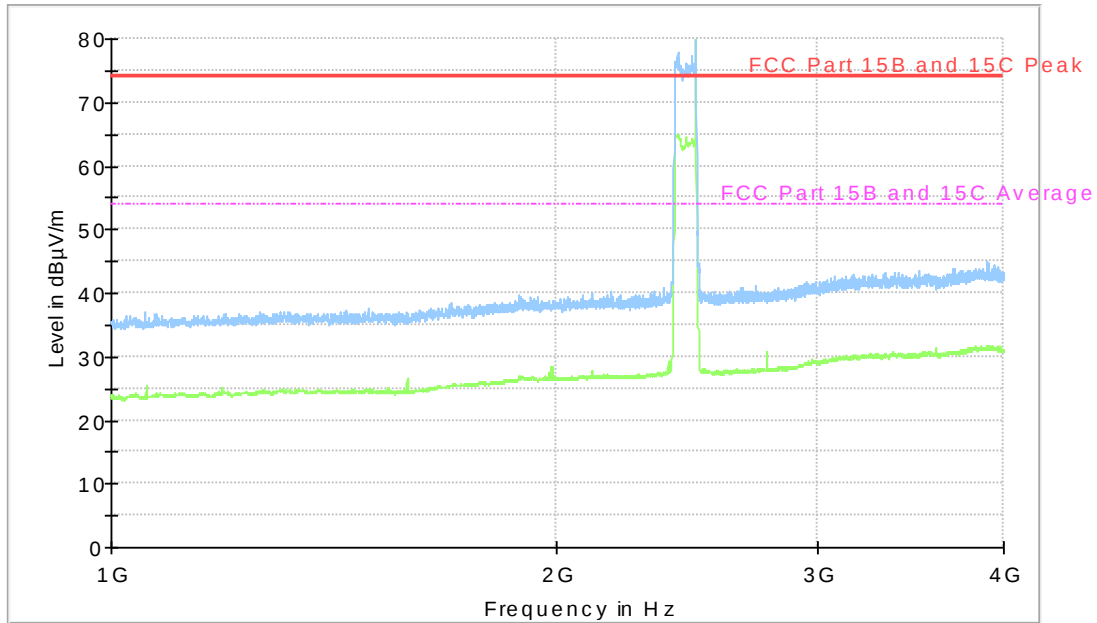
6.5 Test results 1 GHz – 26 GHz, TX



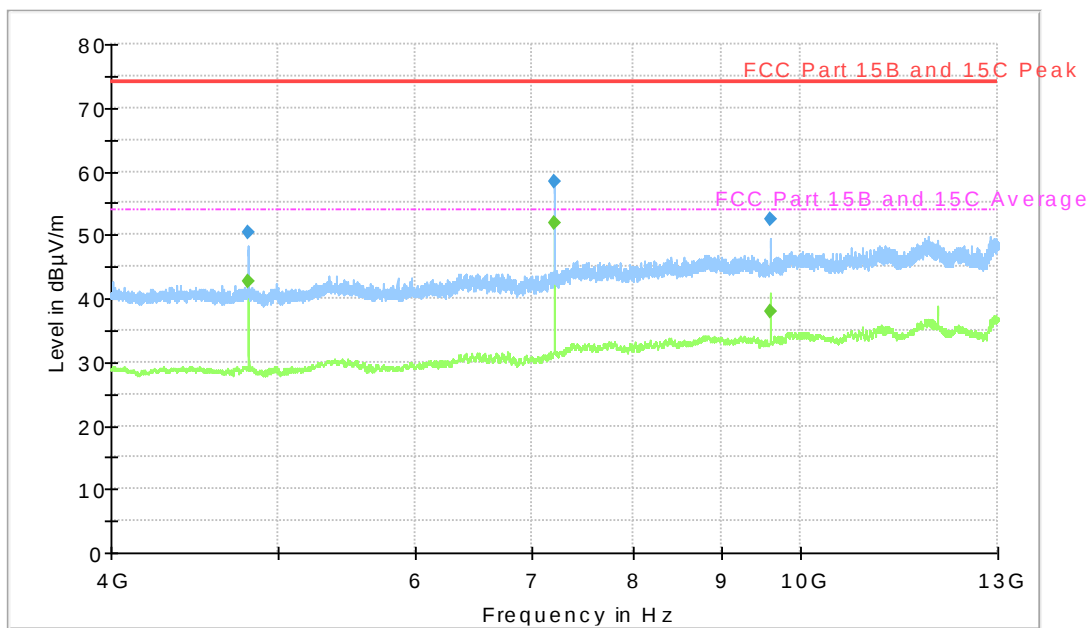
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel. Carrier is attenuated by a band rejection filter.



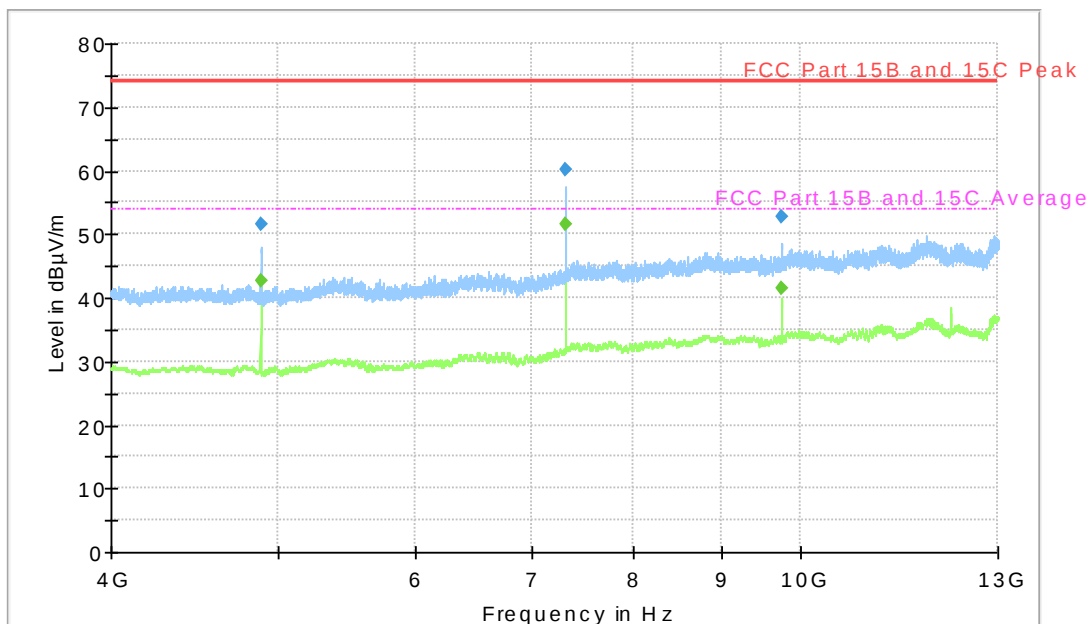
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX middle channel. Carrier is attenuated by a band rejection filter.



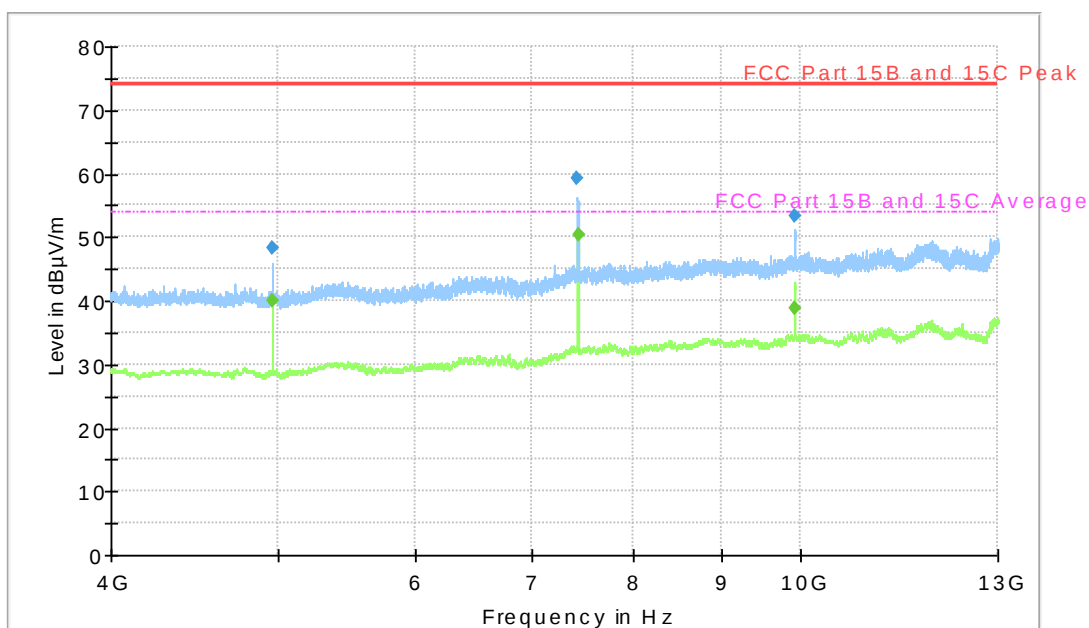
Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX high channel. Carrier is attenuated by a band rejection filter.



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.

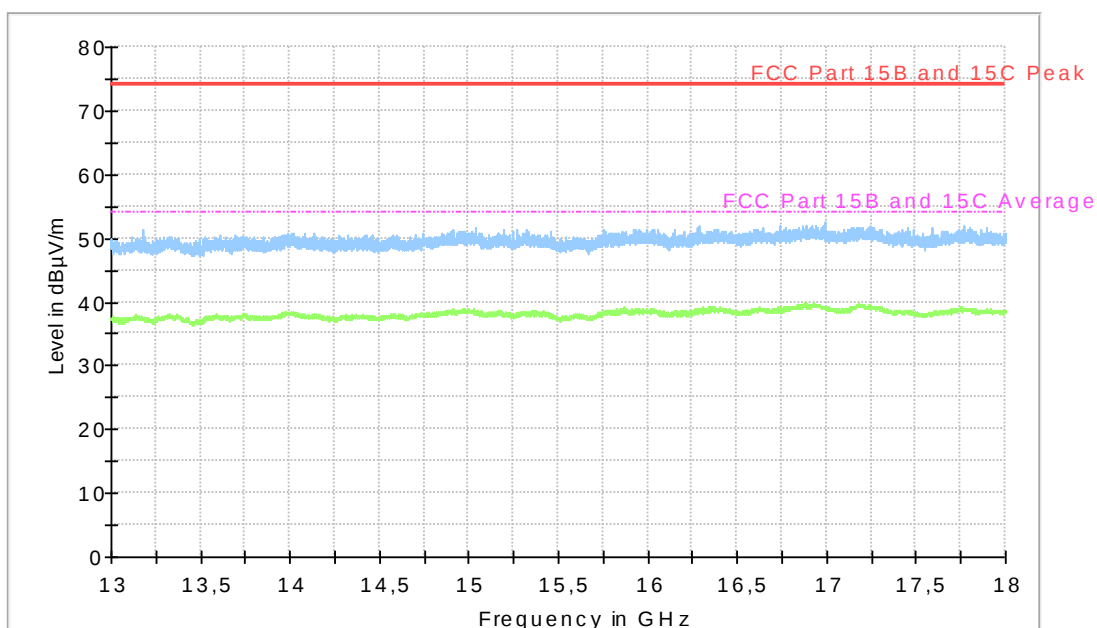


Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX middle channel. Emissions below 4000 MHz are attenuated by a high-pass filter.



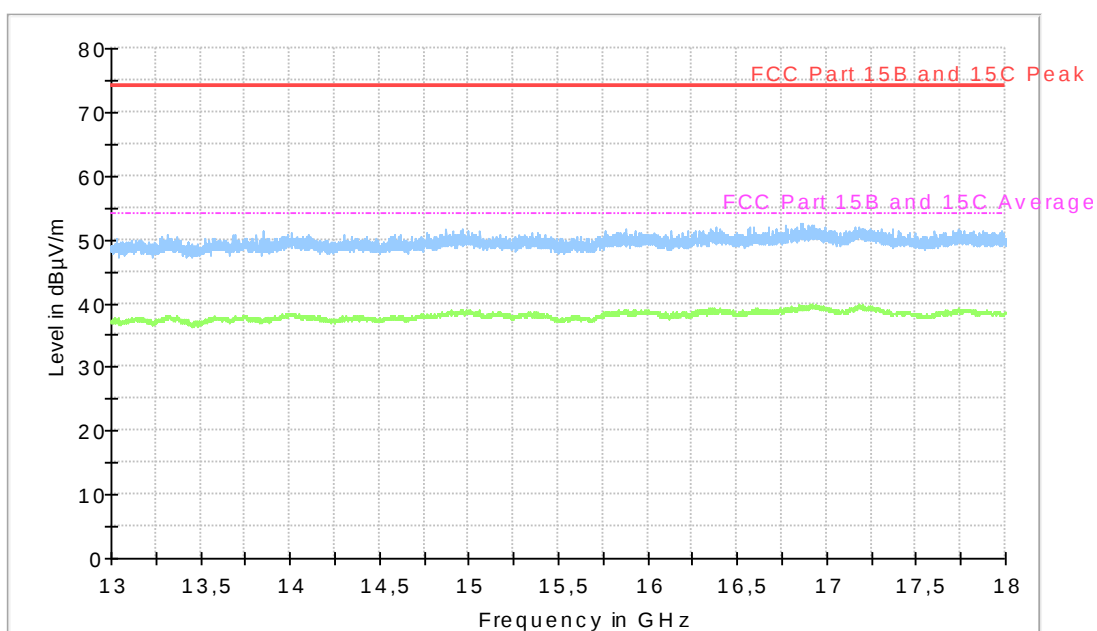
Diagram, Peak overview sweep, 4– 13 GHz at 3 m distance. TX high channel. Emissions below 4000 MHz are attenuated by a high-pass filter.

Full Spectrum



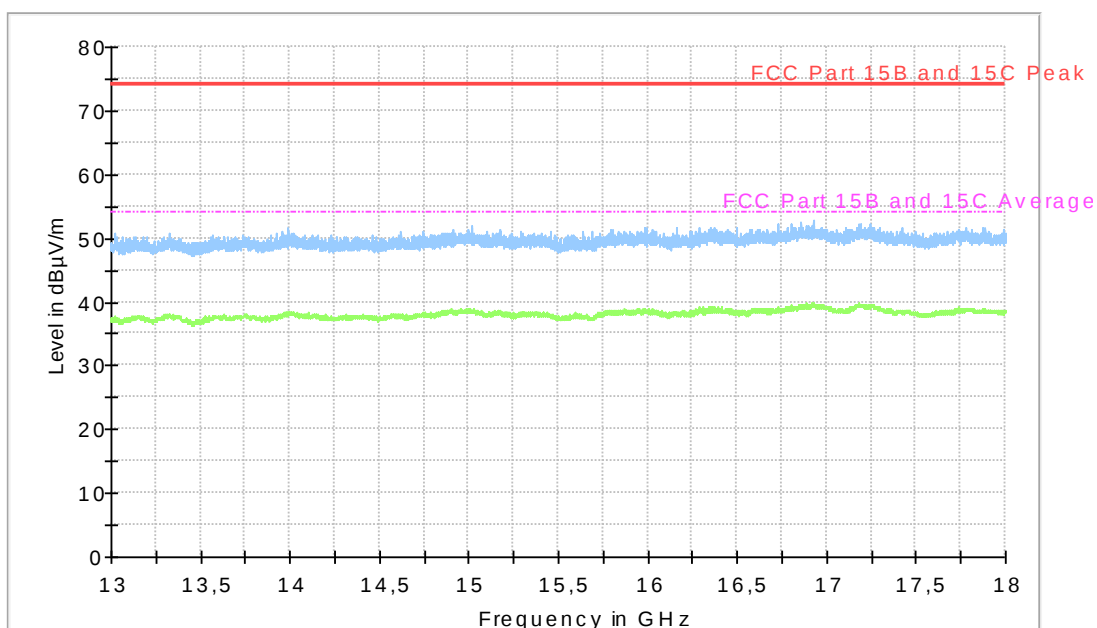
Diagram, Peak overview sweep, 13 – 18 GHz at 3 m distance. TX low channel.

Full Spectrum



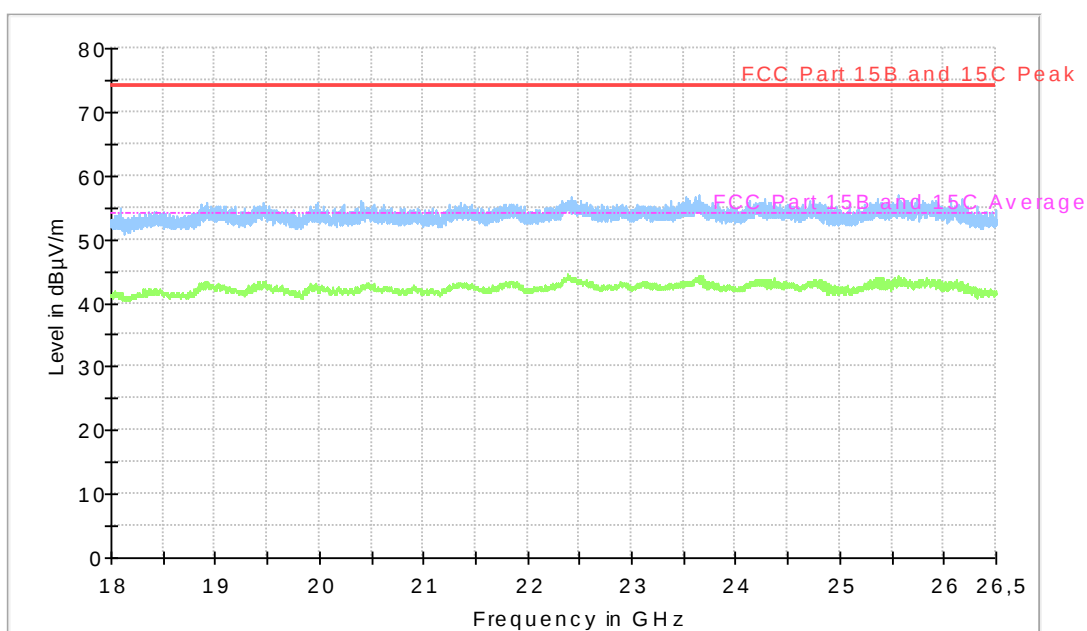
Diagram, Peak overview sweep, 13 – 18 GHz at 3 m distance. TX middle channel.

Full Spectrum



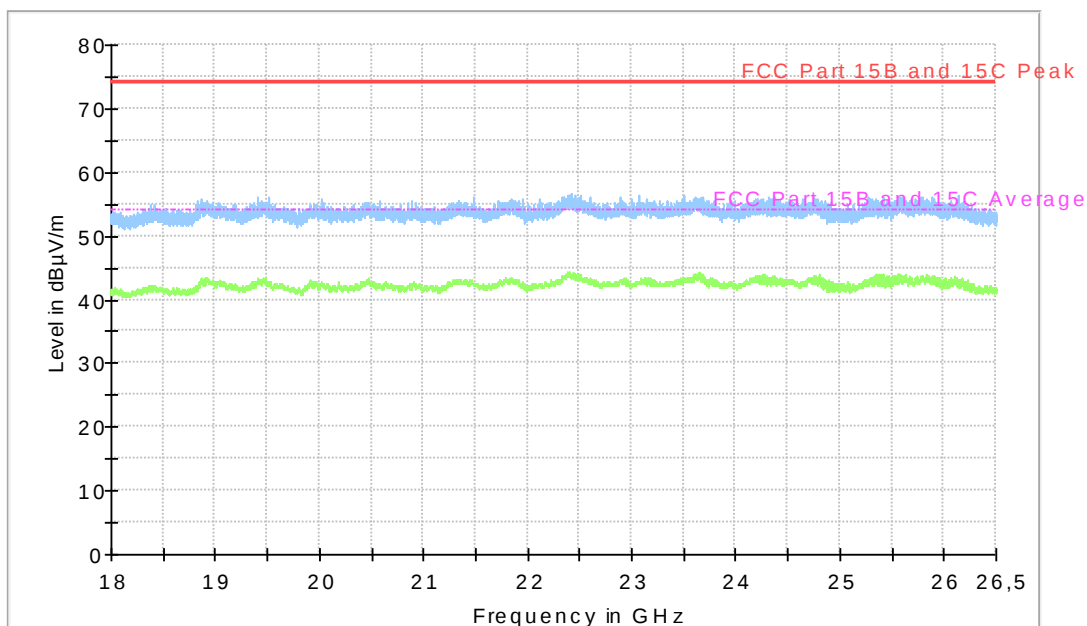
Diagram, Peak overview sweep, 13 – 18 GHz at 3 m distance. TX high channel.

Full Spectrum



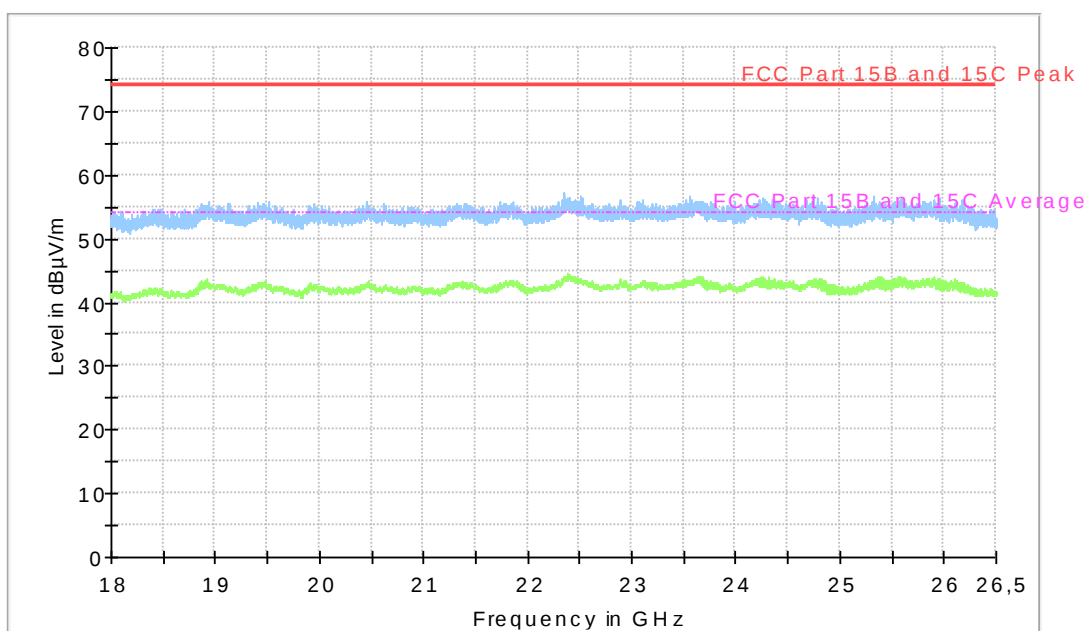
Diagram, Peak overview sweep, 18 – 26 GHz at 3 m distance. TX low channel.

Full Spectrum



Diagram, Peak overview sweep, 18 – 26 GHz at 3 m distance. TX middle channel.

Full Spectrum



Diagram, Peak overview sweep, 18 – 26 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]
4804.5	50.4	74.0	H	23.6
7206.6	58.4	74.0	V	15.6
9608.7	52.6	74.0	H	21.4

Measurement results, Average, TX low channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
4804.0	42.7	54.0	H	11.3
7206.0	51.8	54.0	V	2.2
9607.5	38.0	54.0	H	16.0

Measurement results, Peak, TX middle channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
4879.3	51.5	74.0	H	22.5
7319.2	60.2	74.0	V	13.8
9759.0	52.8	74.0	V	21.2

Measurement results, Average, TX middle channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
4880.0	42.7	54.0	H	11.3
7319.5	51.6	54.0	V	2.4
9759.0	41.5	54.0	V	12.5

Measurement results, Peak, TX high channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
2484.0	59.7	74.0	V	14.3
4959.6	48.3	74.0	V	25.7
7439.3	59.4	74.0	V	14.6
9920.5	53.2	74.0	H	20.8

Measurement results, Average, TX high channel

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Polarization H/V	Margin [dB]
2484.0	50.1	54.0	V	3.9
4960.0	40.1	54.0	V	13.9
7440.5	50.4	54.0	H	3.6
9921.0	39.0	54.0	H	15.0

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

7 CONDUCTED BAND EDGE MEASUREMENT

Date of test:	December 04, 2020	Test location:	Radiolabbet
EUT Serial:	HNA0101-T203939B4	Ambient temp:	22 °C
Tested by:	Robert Hietala, Ala El-Haery	Relative humidity:	33 %
Test result:	Pass	Margin:	> 10 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

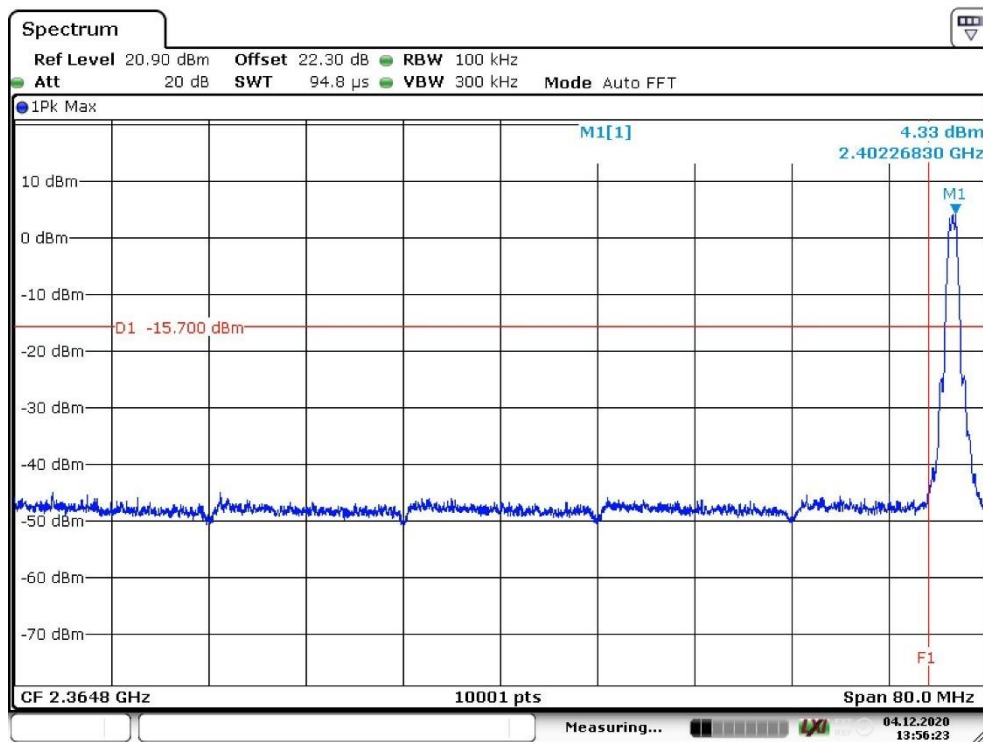
Detector: Peak,
RBW: 100 kHz
VBW: 300 kHz
Span: 80 MHz

7.3 Requirement

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

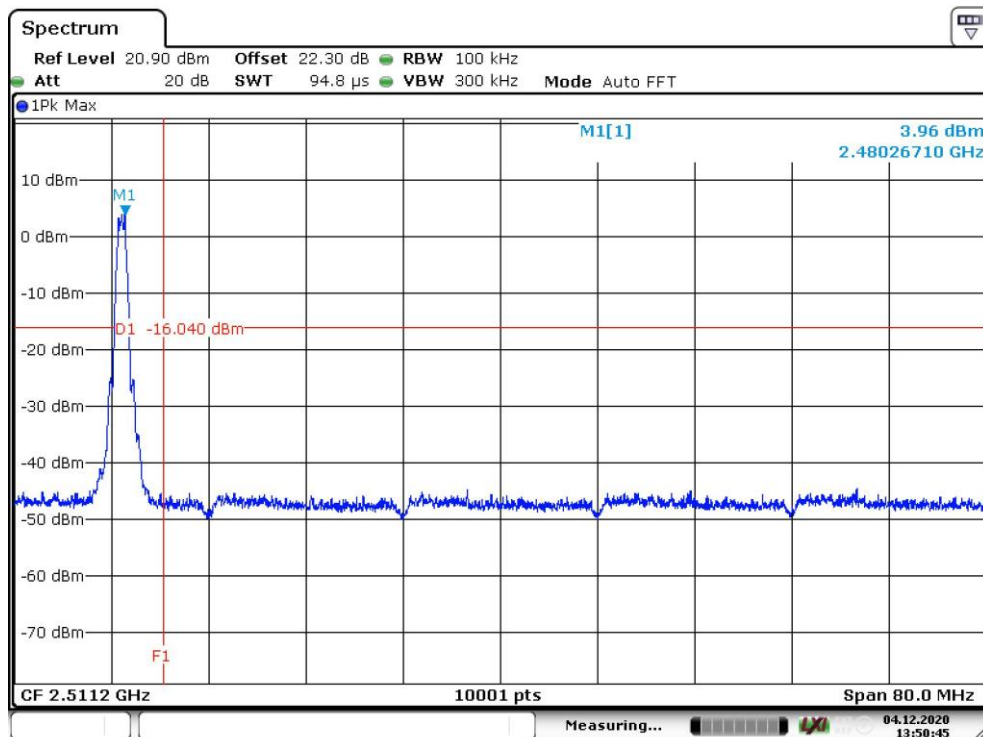
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either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

7.4 Test results



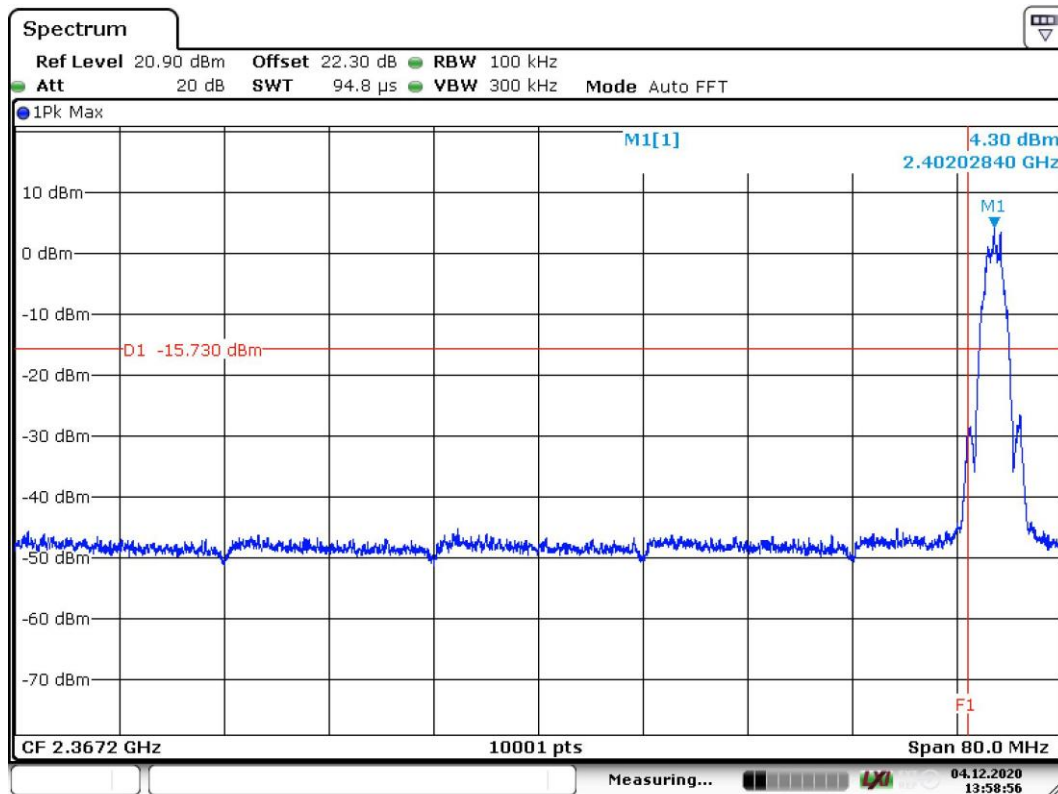
Date: 4.DEC.2020 13:56:23

Screenshot: Lower band edge sweep, Bluetooth Low Energy 1 Mbit



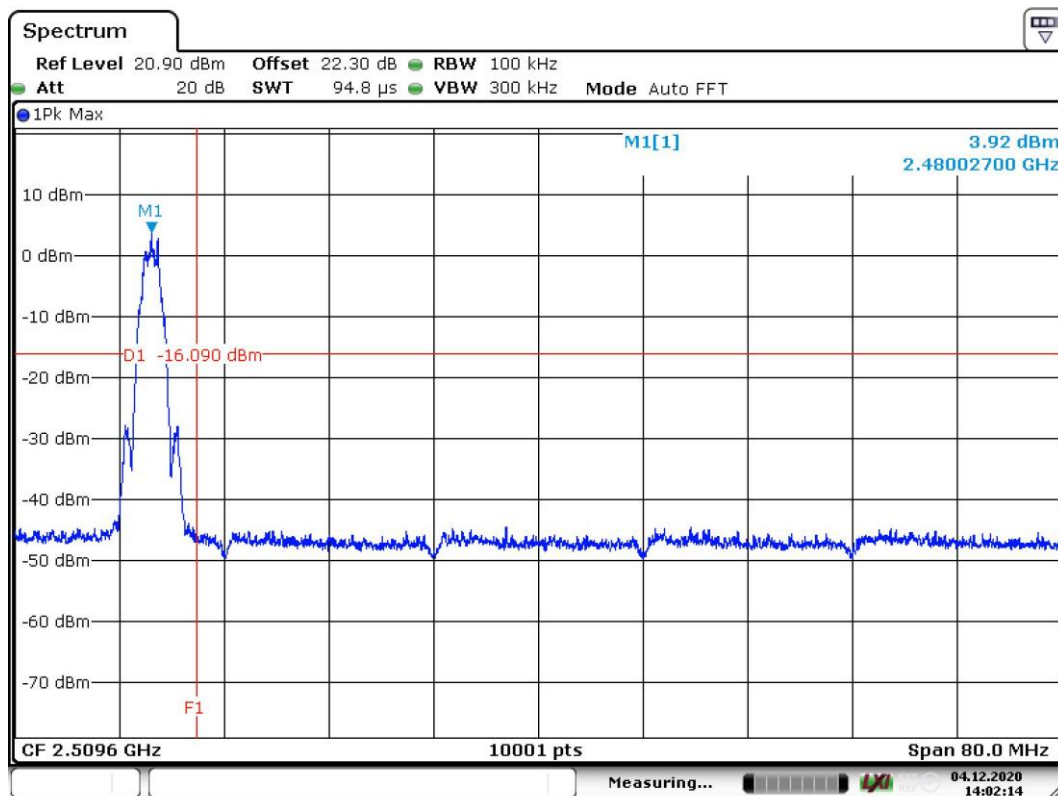
Date: 4.DEC.2020 13:50:45

Screenshot: Upper band edge sweep, Bluetooth Low Energy 1 Mbit



Date: 4.DEC.2020 13:58:56

Screenshot: Lower band edge sweep, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 14:02:14

Screenshot: Upper band edge sweep, Bluetooth Low Energy 2 Mbit

Test results

Data rate	Band edge	Delta [dBc]	Limit [dBc]	Margin [dB]
1 Mbit	Lower	> 40	20.0	> 20
	Upper	> 40	20.0	> 20
2 Mbit	Lower	> 40	20.0	> 20
	Upper	> 40	20.0	> 20

8 PEAK CONDUCTED OUTPUT POWER

Date of test:	December 04, 2020	Test location:	Radiolabbet
EUT Serial:	HNA0101-T203939B4	Ambient temp:	22 °C
Tested by:	Robert Hietala, Ala El-Haery	Relative humidity:	33 %
Test result:	Pass	Margin:	> 10 dB

8.1 Test set-up and test procedure

The test method is in accordance with ANSI C63.10-2013 section 11.9.1.1.

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

8.2 Test conditions

Detector: Peak,
RBW: >OBW
VBW: 3 x RBW
Span: >3 x OBW

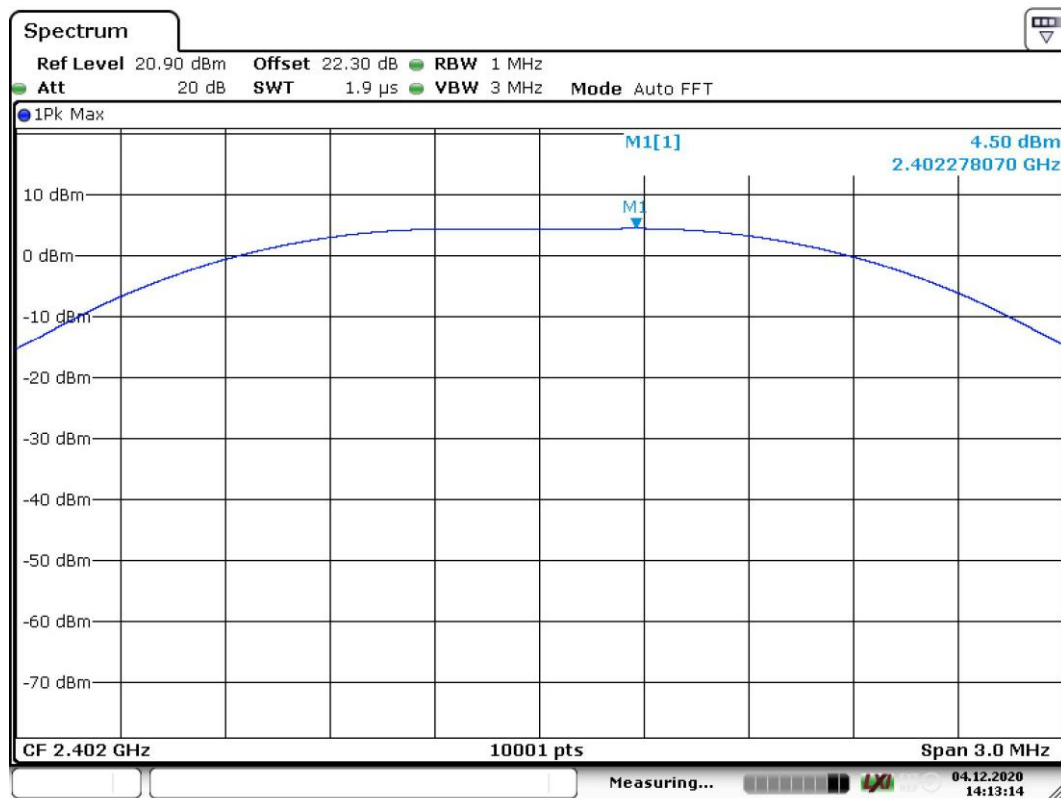
The EUT was set up in order to emit maximum disturbances.

8.3 Requirements

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

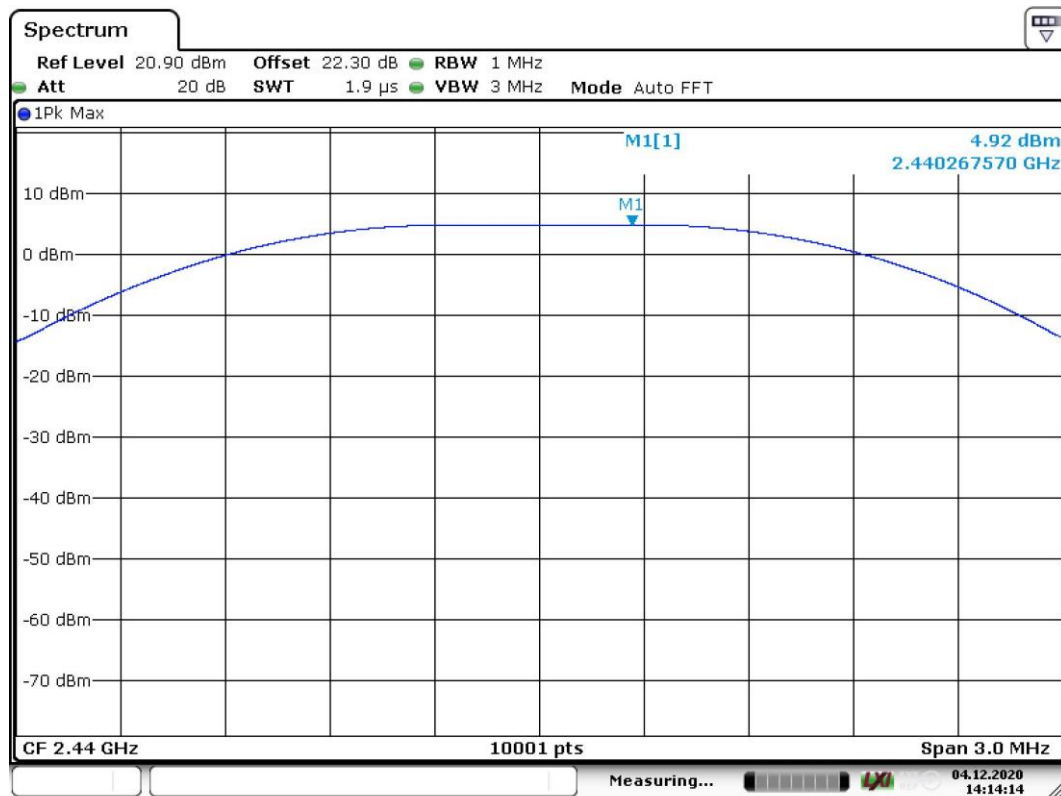
For DTSS employing digital modulation techniques operating in the bands 902 – 128 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz, the maximum peak conducted output power shall not exceed 1W.

8.4 Test results



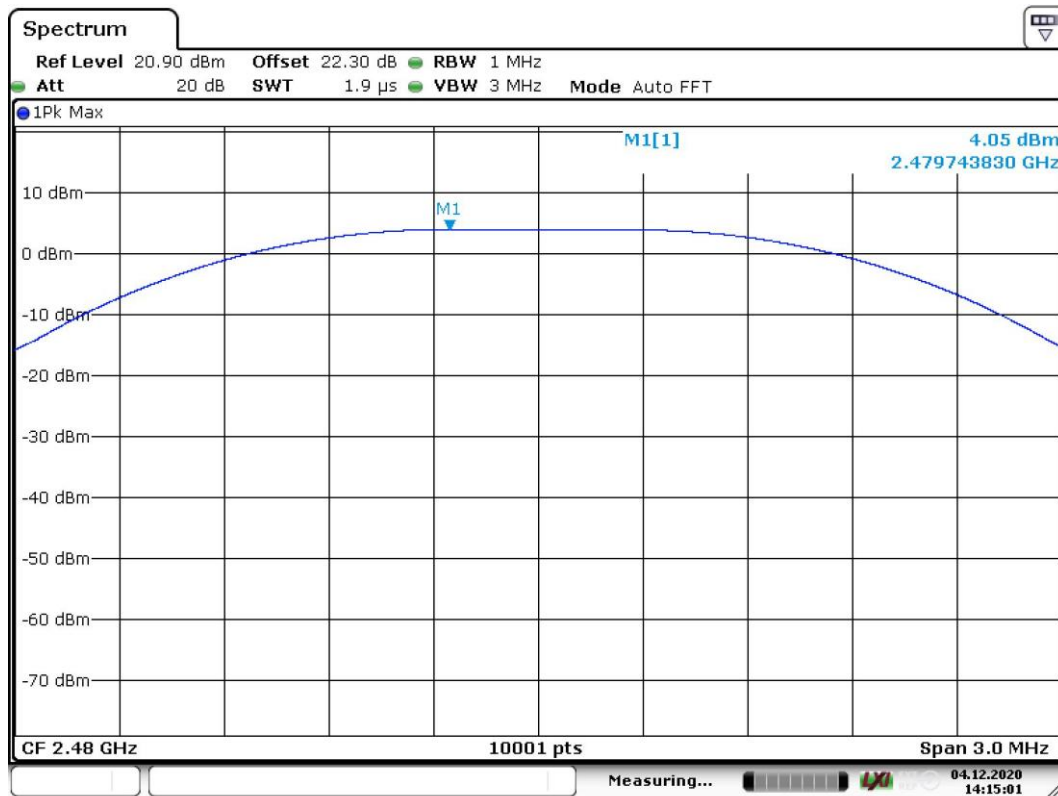
Date: 4.DEC.2020 14:13:14

Screenshot: Output power, low channel, Bluetooth Low Energy 1 Mbit



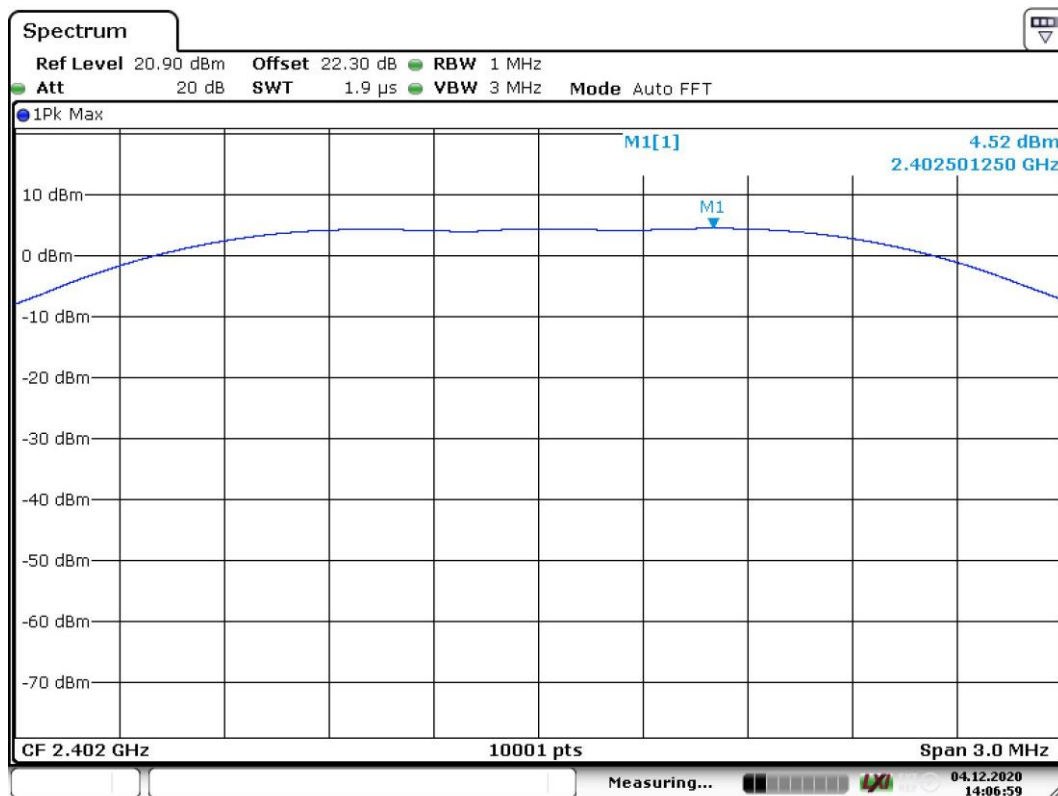
Date: 4.DEC.2020 14:14:14

Screenshot: Output power, middle channel, Bluetooth Low Energy 1 Mbit



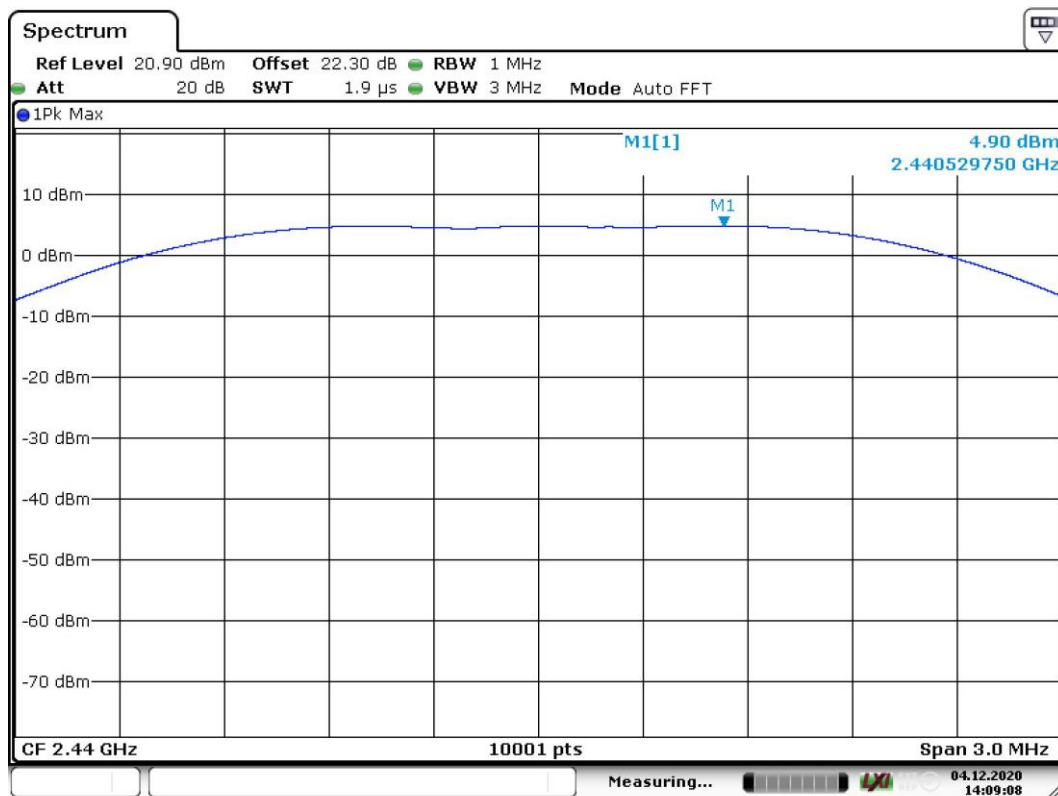
Date: 4.DEC.2020 14:15:02

Screenshot: Output power, high channel, Bluetooth Low Energy 1 Mbit



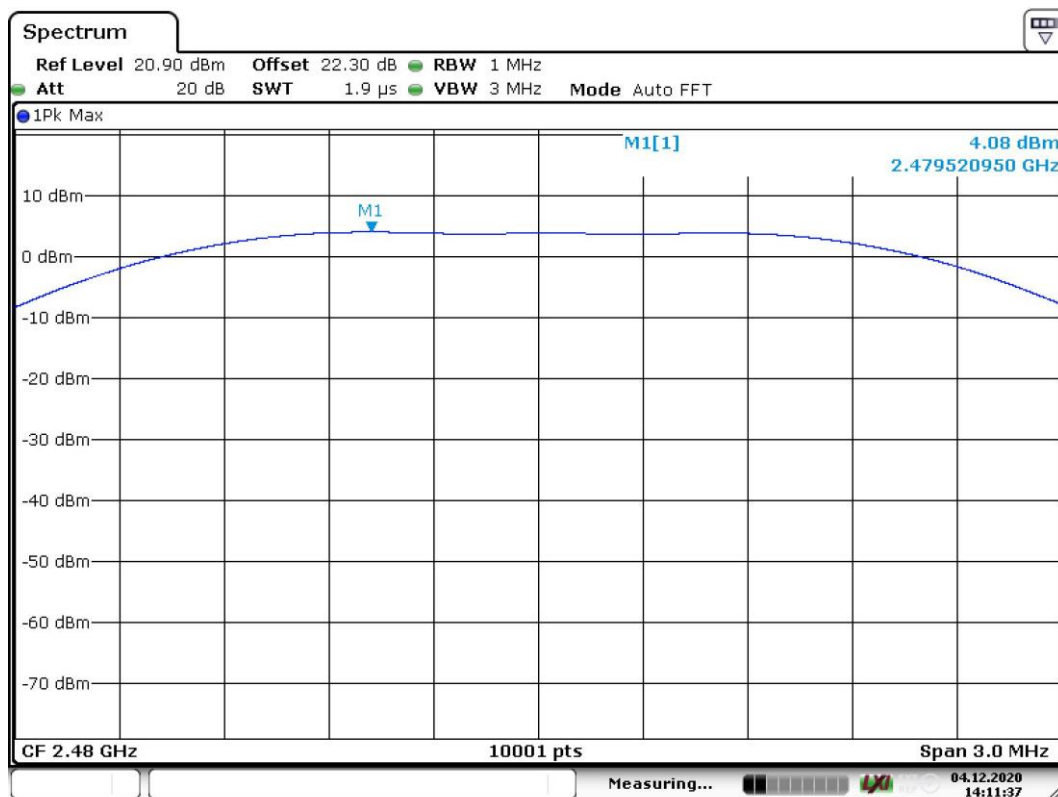
Date: 4.DEC.2020 14:06:59

Screenshot: Output power, low channel, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 14:09:07

Screenshot: Output power, middle channel, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 14:11:37

Screenshot: Output power, high channel, Bluetooth Low Energy 2 Mbit

Test result

Data rate	Channel [MHz]	Output power [dBm]
1 Mbit	2402	4.5
	2440	4.9
	2480	4.1
2 Mbit	2402	4.5
	2440	4.9
	2480	4.1

9 OCCUPIED 6 DB BANDWIDTH

Date of test:	December 04, 2020	Test location:	Radiolabbet
EUT Serial:	HNA0101-T203939B4	Ambient temp:	22 °C
Tested by:	Robert Hietala, Ala El-Haery	Relative humidity:	33 %
Test result:	Pass	Margin:	204.9 kHz

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

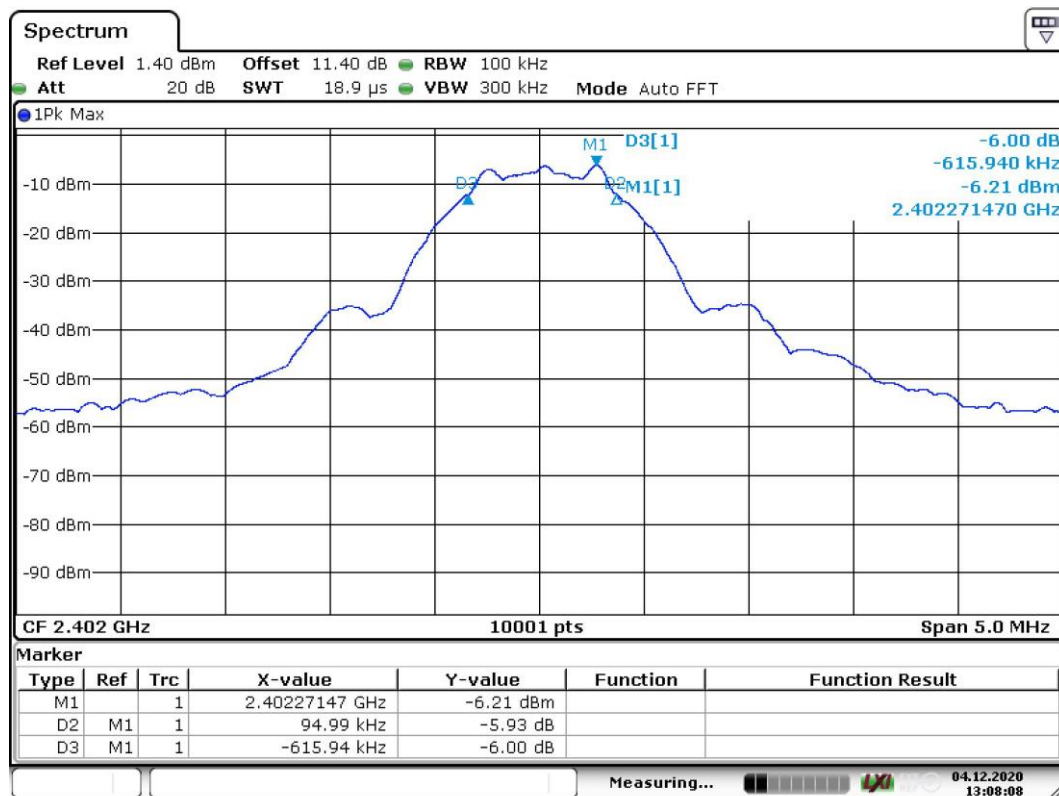
Detector: Peak
 RBW: 100 kHz
 VBW: 3 x RBW
 Span: >1,5 x OBW

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

9.3 Requirements

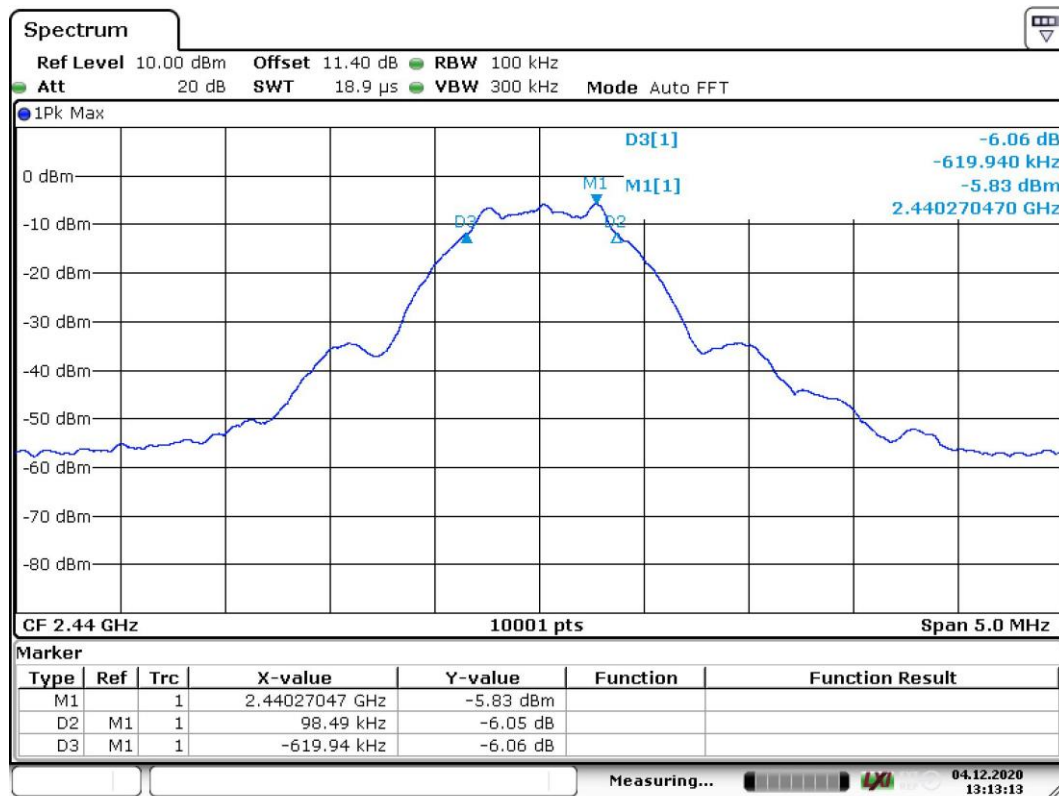
Reference: CFR 47§15.247(a)(2), RSS-247 5.2(1)
 The minimum 6 dB bandwidth shall be 500 kHz.

9.4 Test results



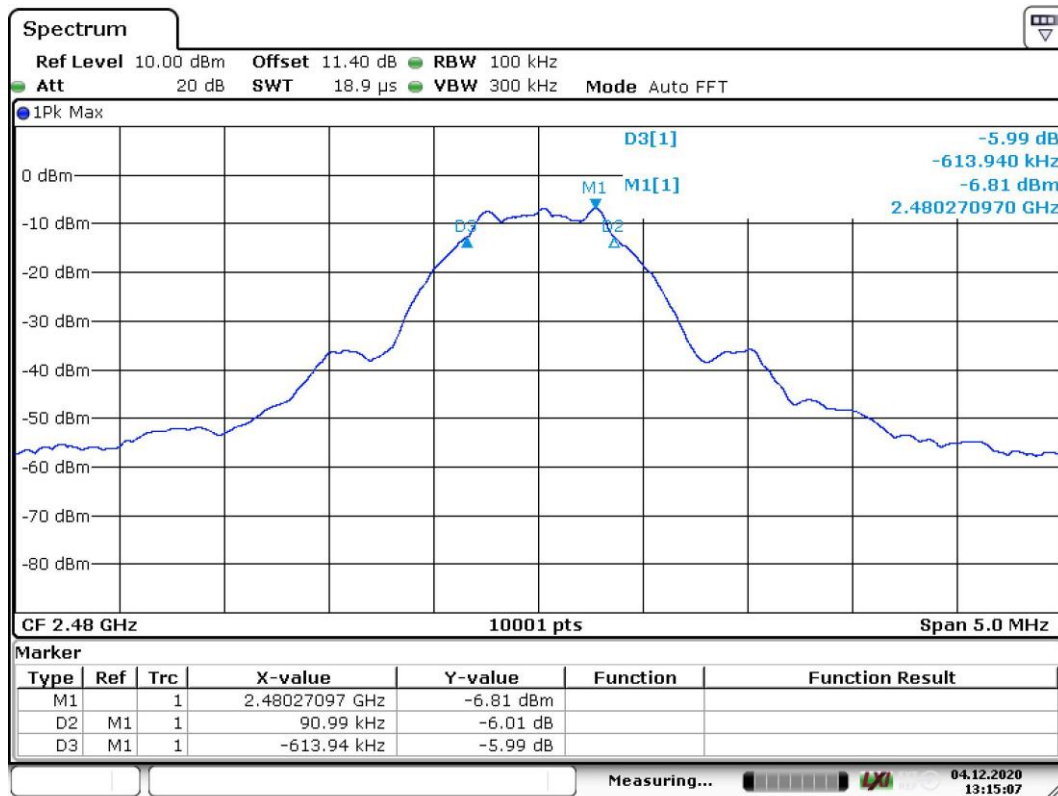
Date: 4.DEC.2020 13:08:08

Screenshot: Occupied 6 dB bandwidth, low channel, Bluetooth Low Energy 1 Mbit



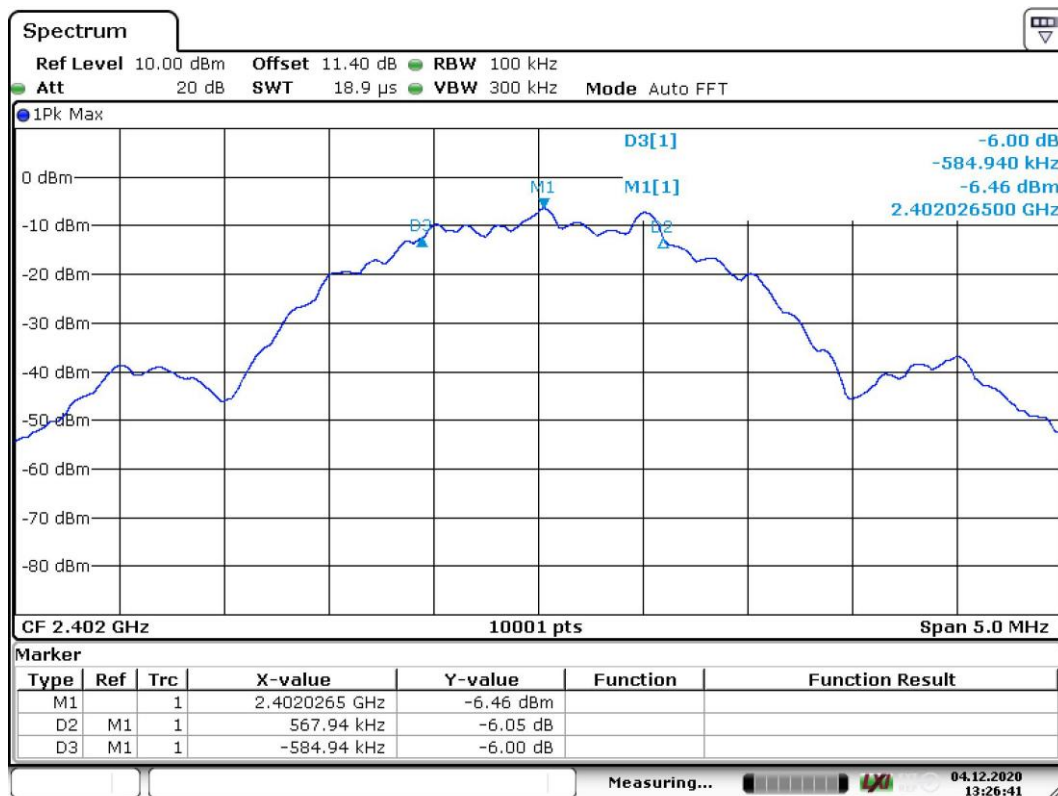
Date: 4.DEC.2020 13:13:14

Screenshot: Occupied 6 dB bandwidth, middle channel, Bluetooth Low Energy 1 Mbit



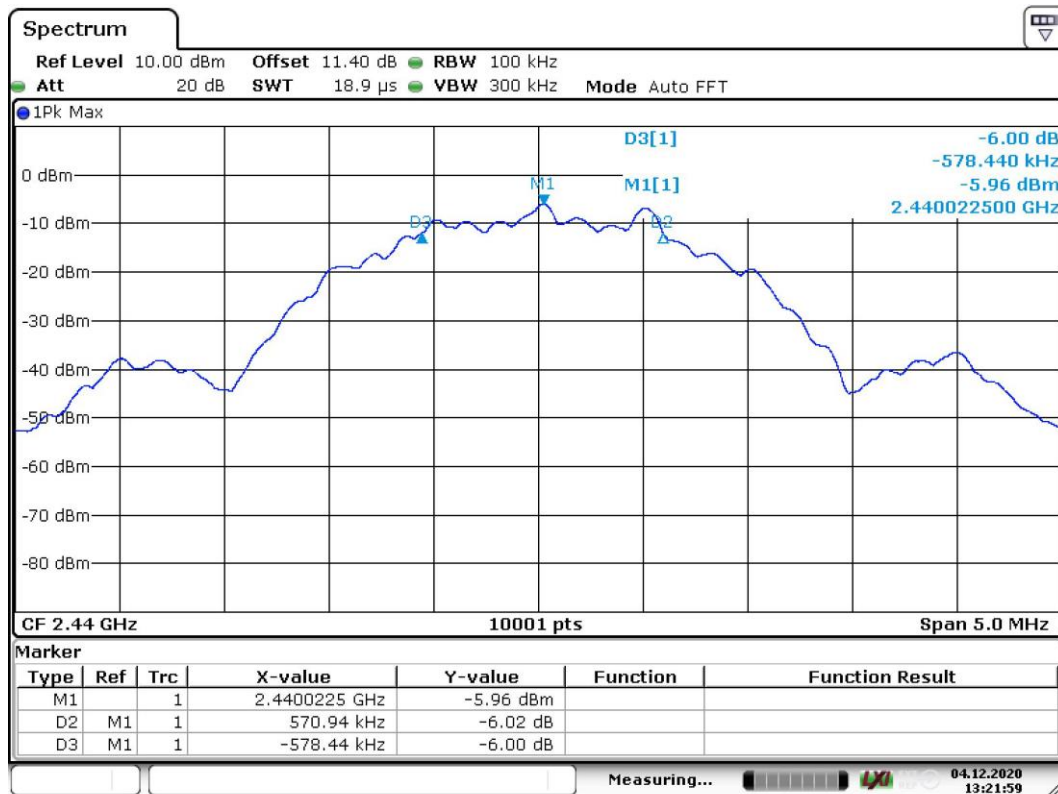
Date: 4.DEC.2020 13:15:07

Screenshot: Occupied 6 dB bandwidth, high channel, Bluetooth Low Energy 1 Mbit



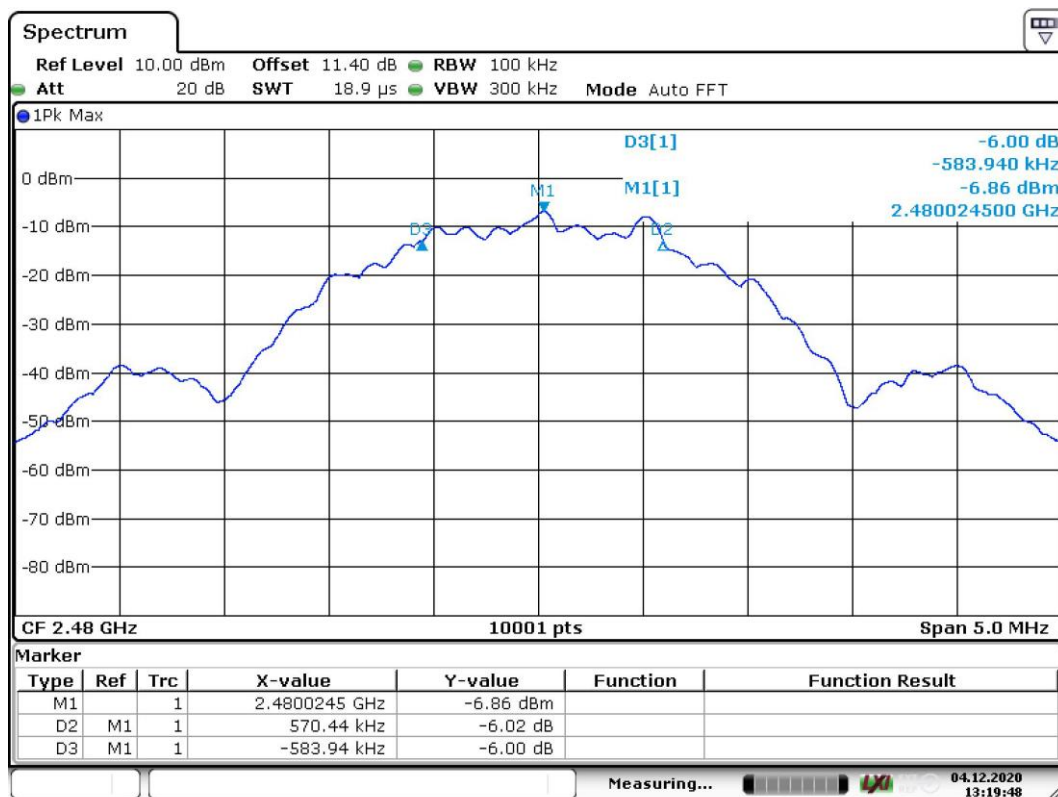
Date: 4.DEC.2020 13:26:41

Screenshot: Occupied 6 dB bandwidth, low channel, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 13:21:59

Screenshot: Occupied 6 dB bandwidth, middle channel, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 13:19:48

Screenshot: Occupied 6 dB bandwidth, high channel, Bluetooth Low Energy 2 Mbit

Test result

Data rate	Channel [MHz]	6 dB BW [kHz]
1 Mbit	2402	710.9
	2440	718.4
	2480	704.9
2 Mbit	2402	1152.9
	2440	1149.4
	2480	1154.4

10 99 % BANDWIDTH

Date of test:	December 04, 2020	Test location:	Radiolabbet
EUT Serial:	HNA0101-T203939B4	Ambient temp:	22 °C
Tested by:	Robert Hietala, Ala El-Haery	Relative humidity:	33 %
Test result:	Pass	Margin:	--

10.1 Test set-up and test procedure

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

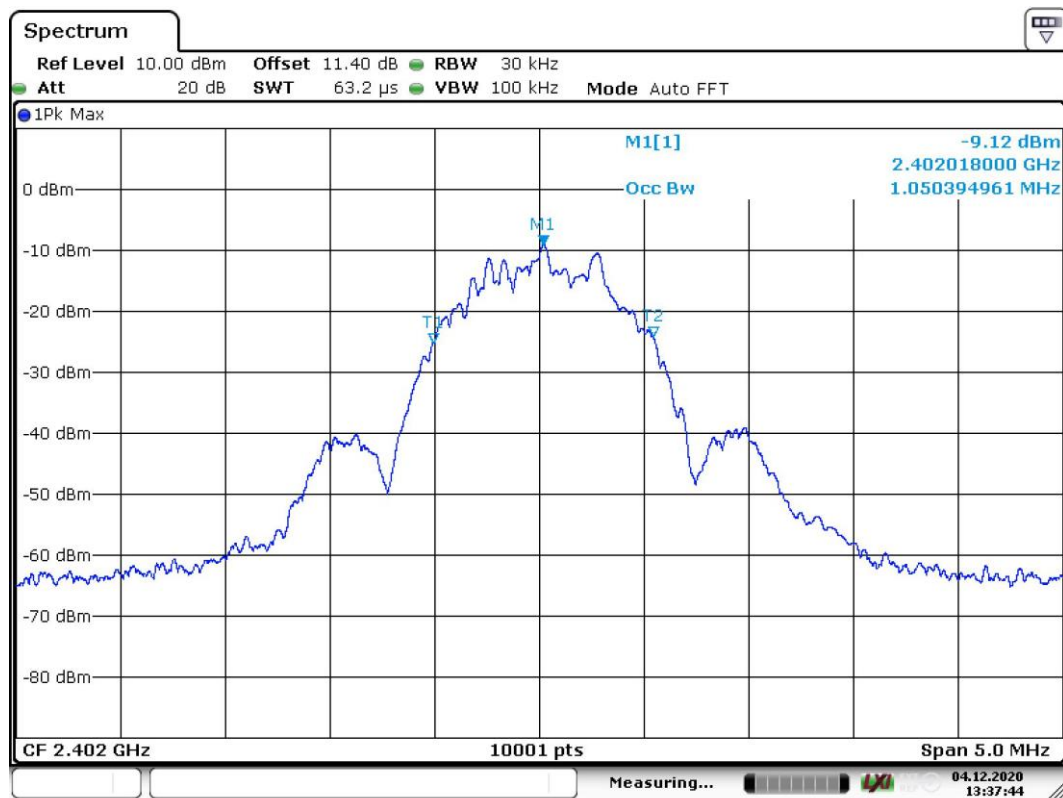
The EUT was connected to spectrum analyser via rf-cable and attenuator. Spectrum analyser with occupied bandwidth measurement function is used to determine the occupied bandwidth.

10.2 Test conditions

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

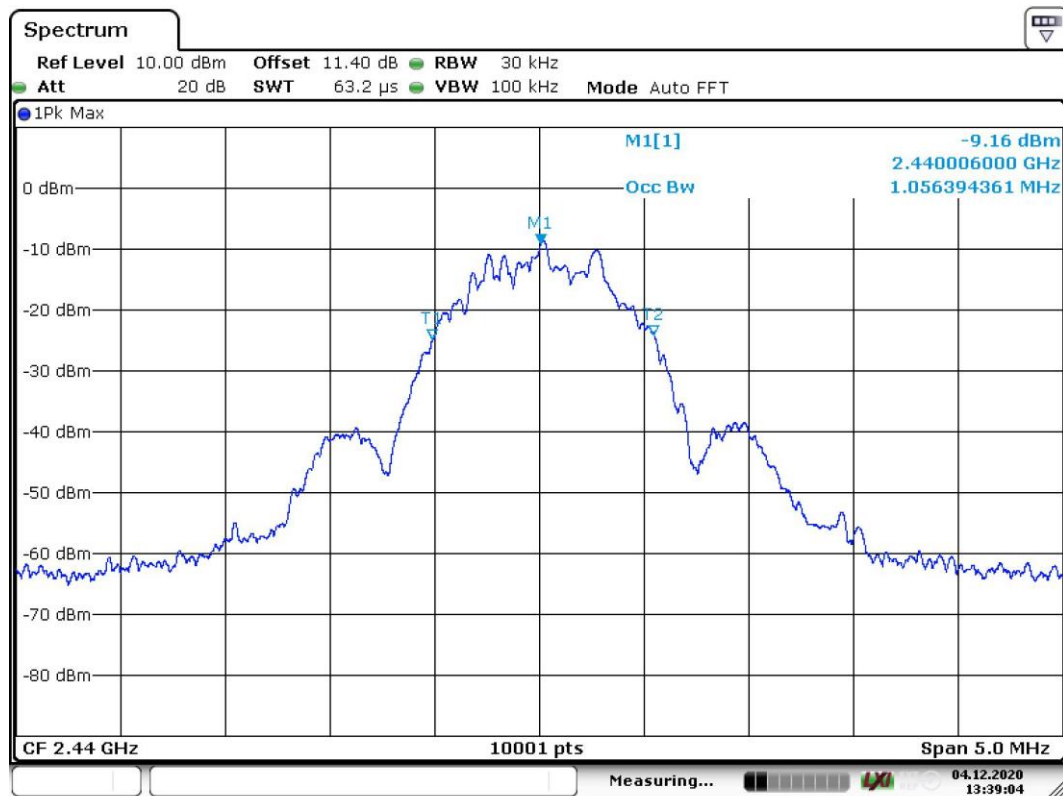
The EUT was set up in order to emit maximum disturbances.

10.3 Test results



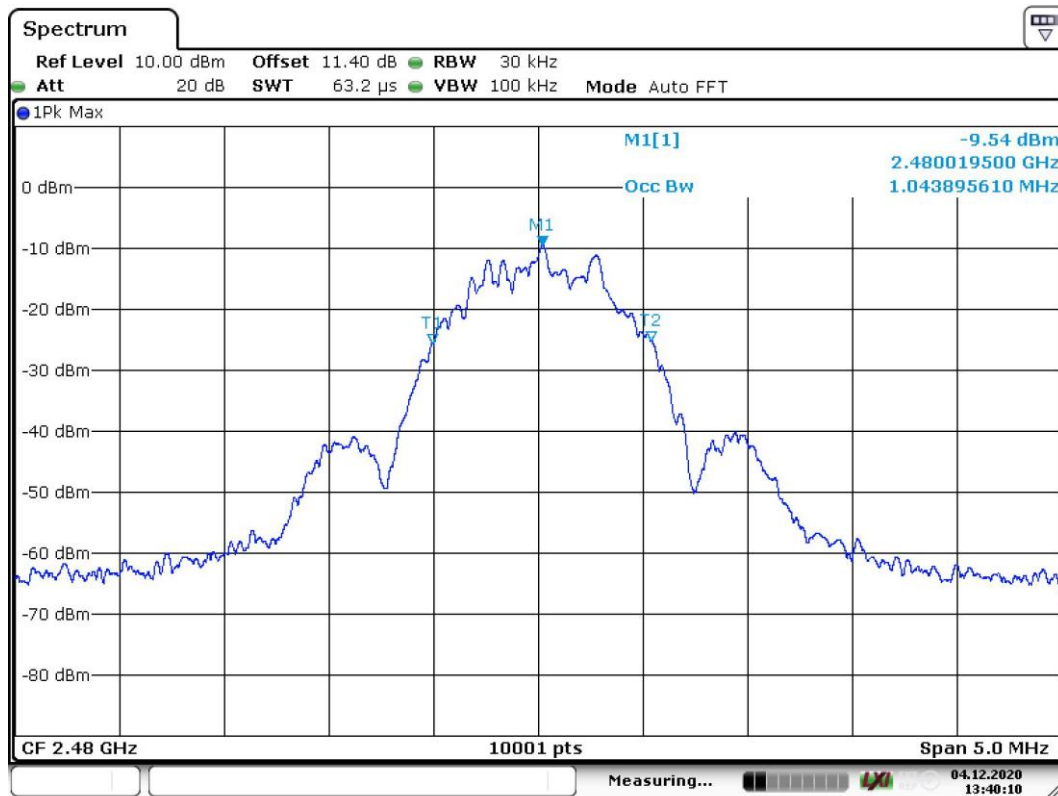
Date: 4.DEC.2020 13:37:44

Screenshot: 99 % bandwidth, low channel, Bluetooth Low Energy 1 Mbit



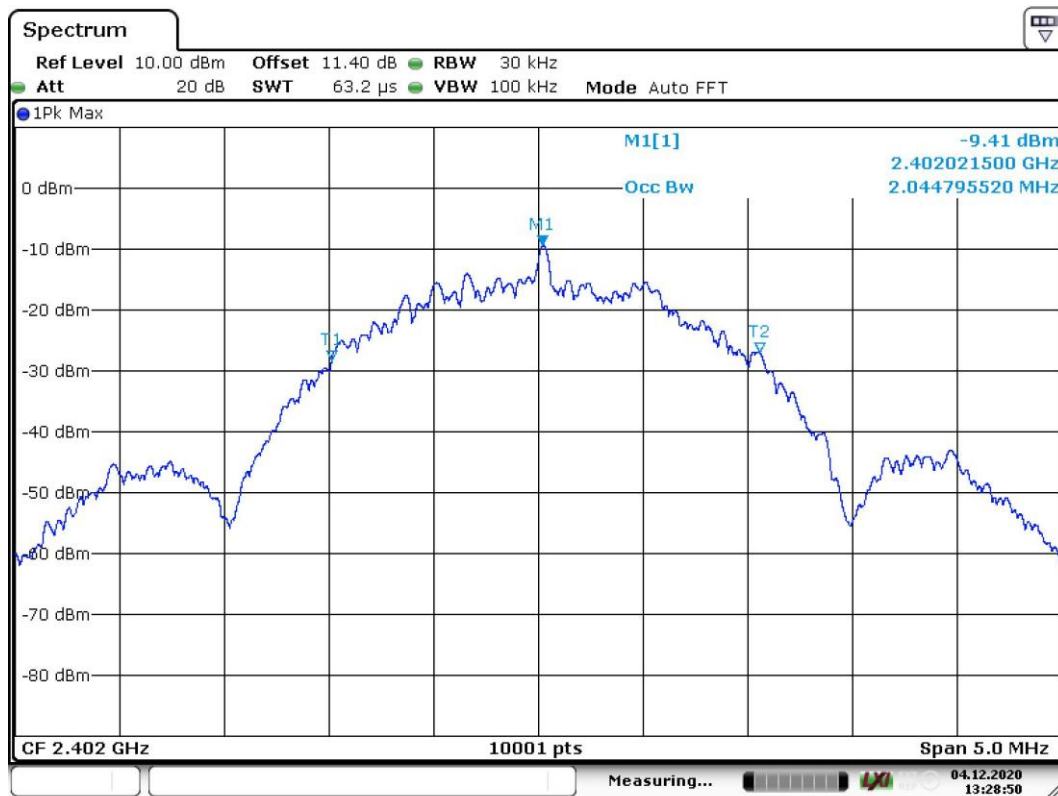
Date: 4.DEC.2020 13:39:04

Screenshot: 99 % bandwidth, middle channel, Bluetooth Low Energy 1 Mbit



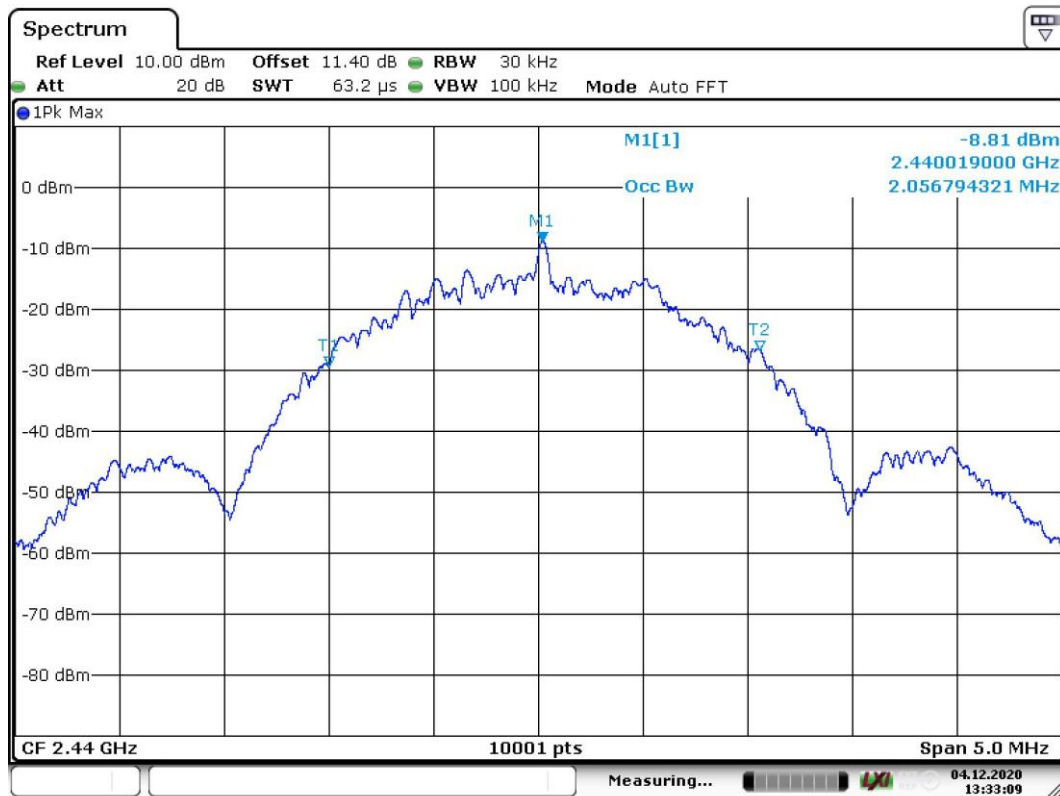
Date: 4.DEC.2020 13:40:10

Screenshot: 99 % bandwidth, high channel, Bluetooth Low Energy 1 Mbit



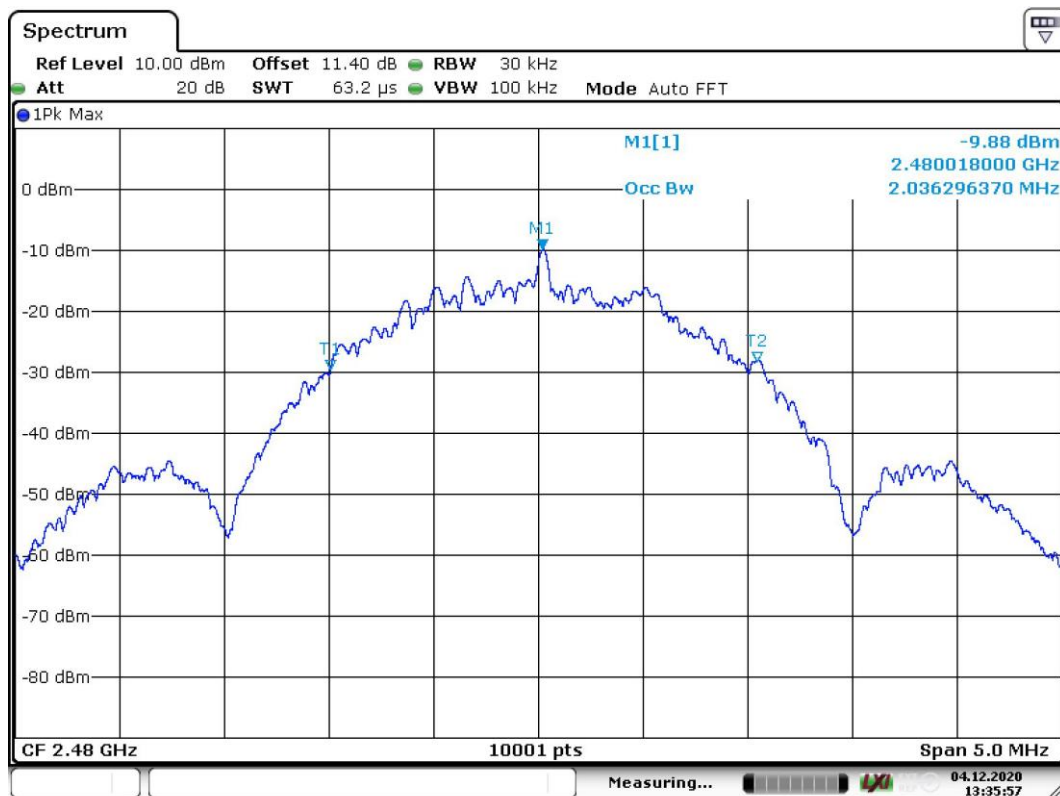
Date: 4.DEC.2020 13:28:50

Screenshot: 99 % bandwidth, low channel, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 13:33:09

Screenshot: 99 % bandwidth, middle channel, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 13:35:57

Screenshot: 99 % bandwidth, high channel, Bluetooth Low Energy 2 Mbit

Test results

Data rate	Channel [MHz]	99 % BW [kHz]
1 Mbit	2402	1050.4
	2440	1056.4
	2480	1043.9
2 Mbit	2402	2044.8
	2440	2056.8
	2480	2036.3

11 PEAK POWER SPECTRAL DENSITY

Date of test:	December 04, 2020	Test location:	Radiolabbet
EUT number:	HNA0101-T203939B4	Ambient temp:	22 °C
Tested by:	Robert Hietala, Ala El-Haery	Relative humidity:	33 %
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 11.10.2.

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

11.2 Test conditions

Detector: Peak
 RBW: 3 kHz
 VBW: >3 x RBW
 Span: 1.5 x 6 dB bandwidth

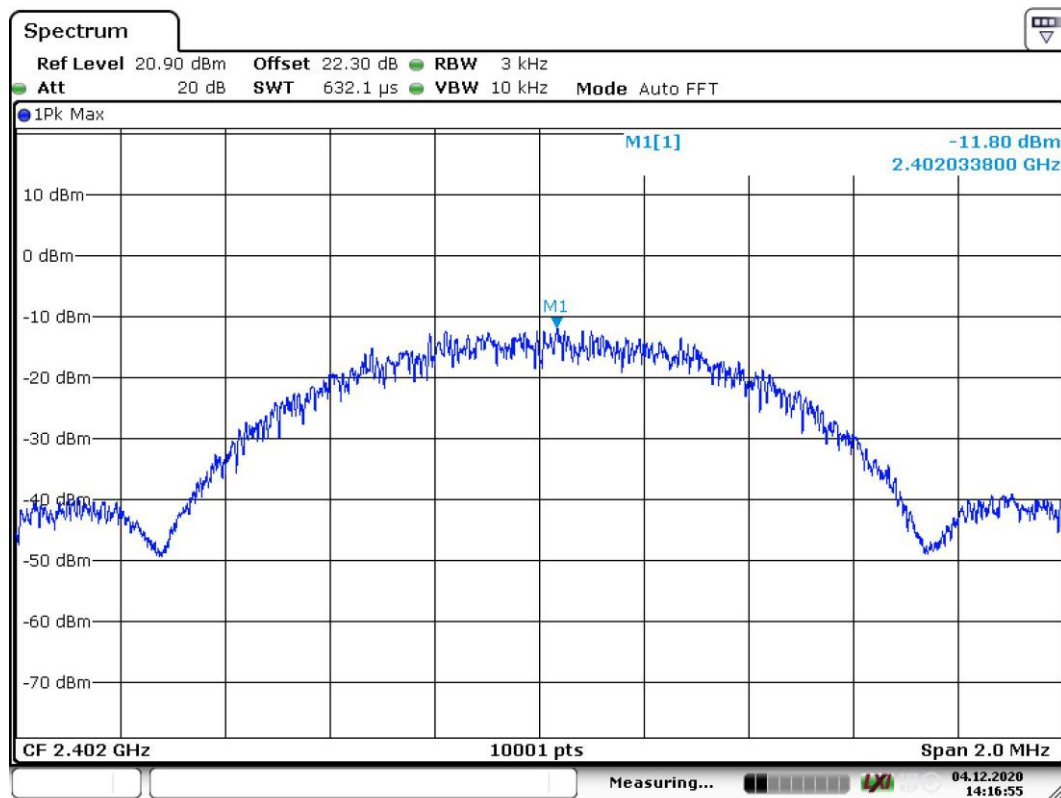
The EUT was set up in order to emit maximum disturbances.

11.3 Requirements

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

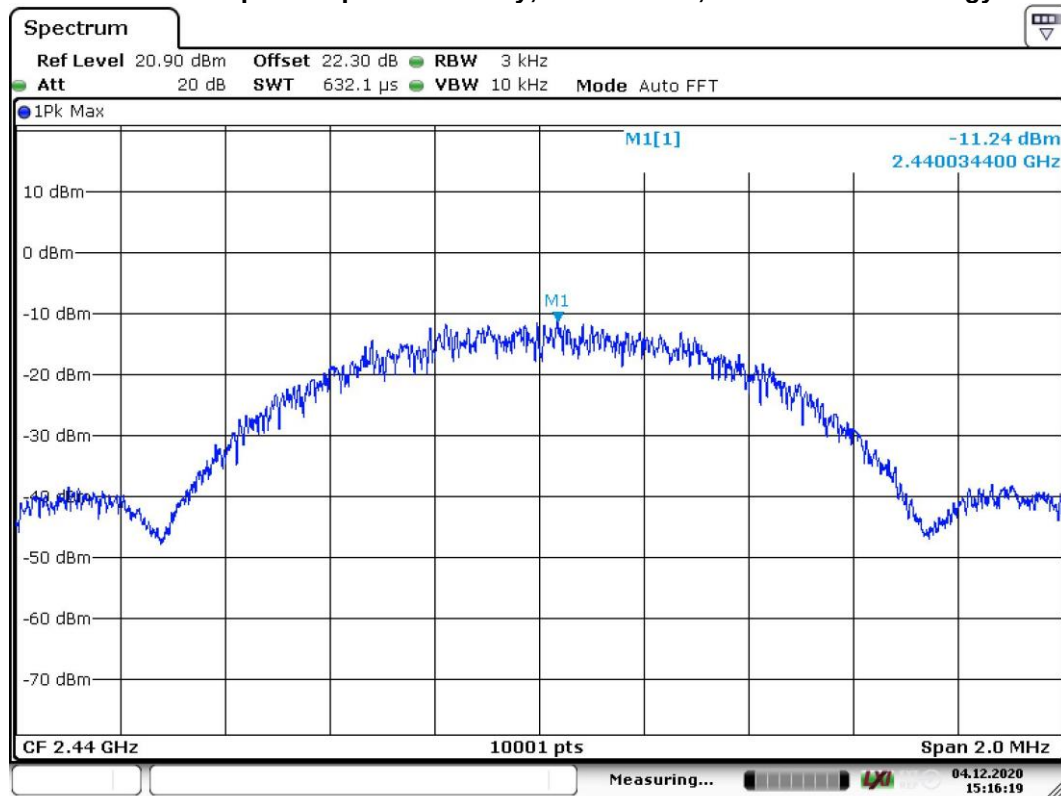
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

11.4 Test results



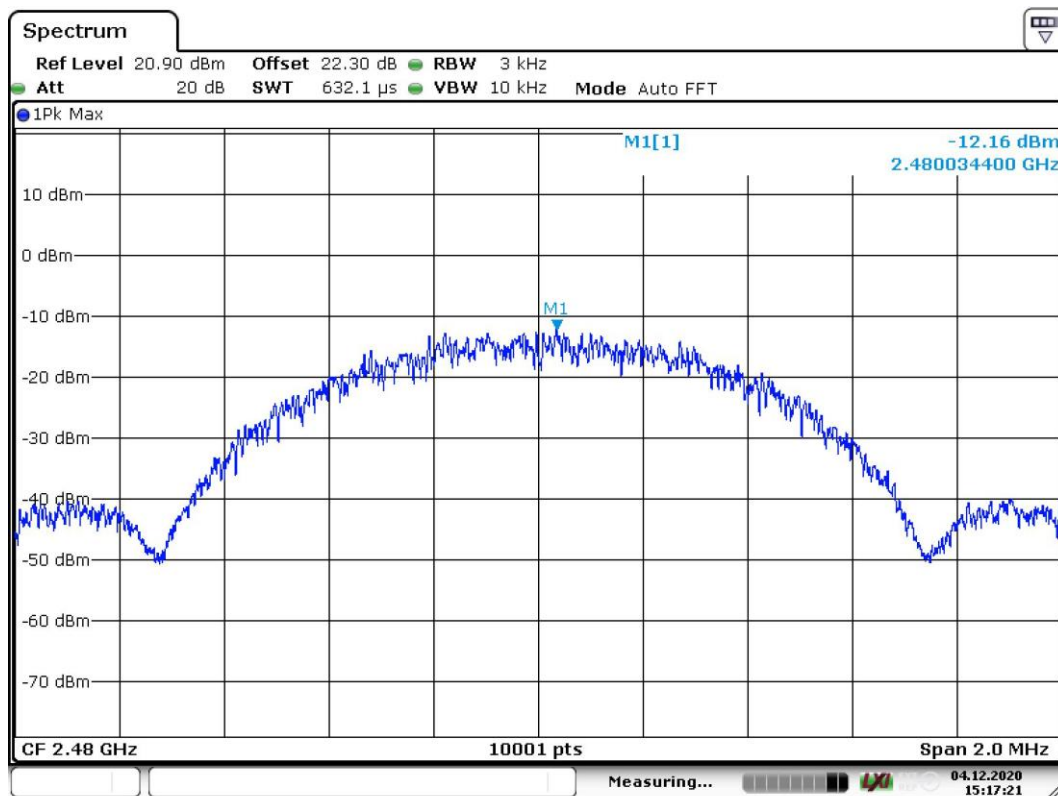
Date: 4.DEC.2020 14:16:56

Screenshot: Peak power spectral density, low channel, Bluetooth Low Energy 1 Mbit



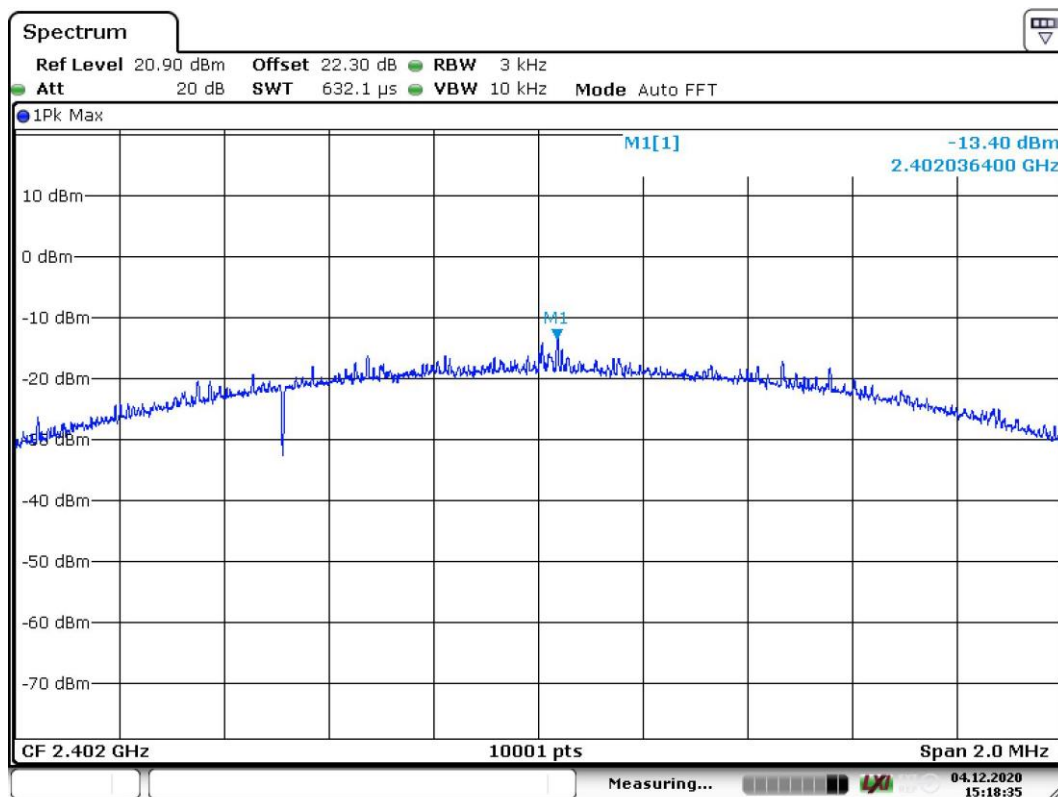
Date: 4.DEC.2020 15:16:20

Screenshot: Peak power spectral density, middle channel, Bluetooth Low Energy 1 Mbit



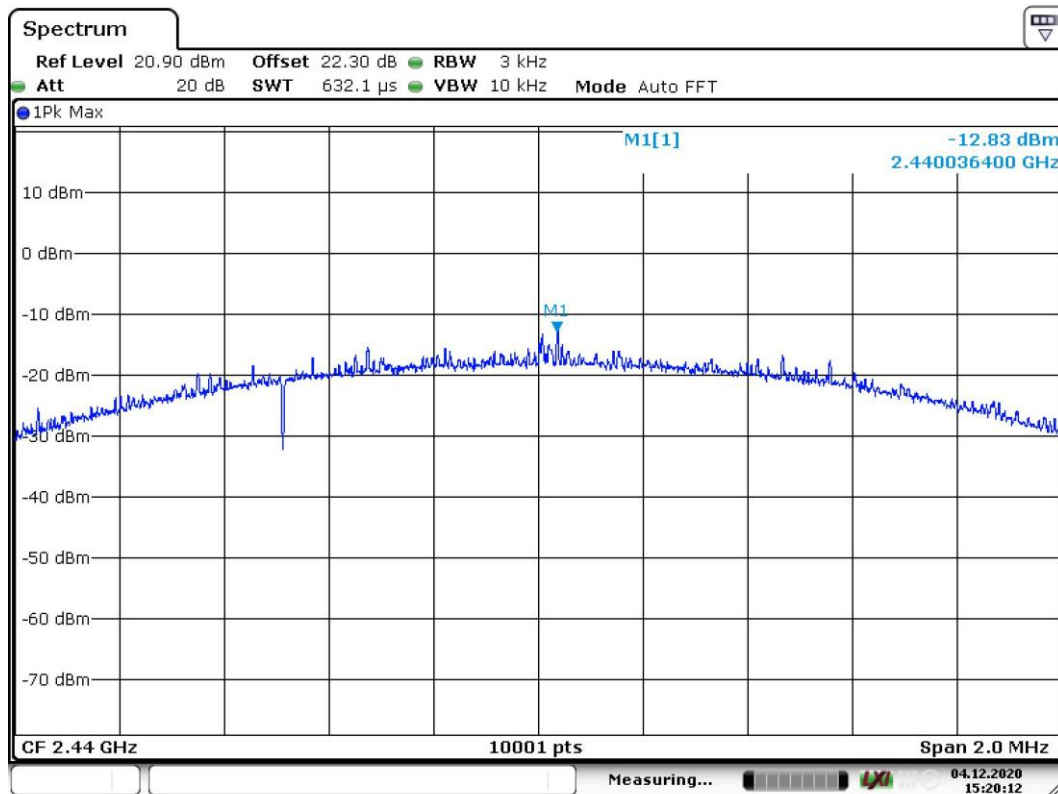
Date: 4.DEC.2020 15:17:22

Screenshot: Peak power spectral density, high channel, Bluetooth Low Energy 1 Mbit



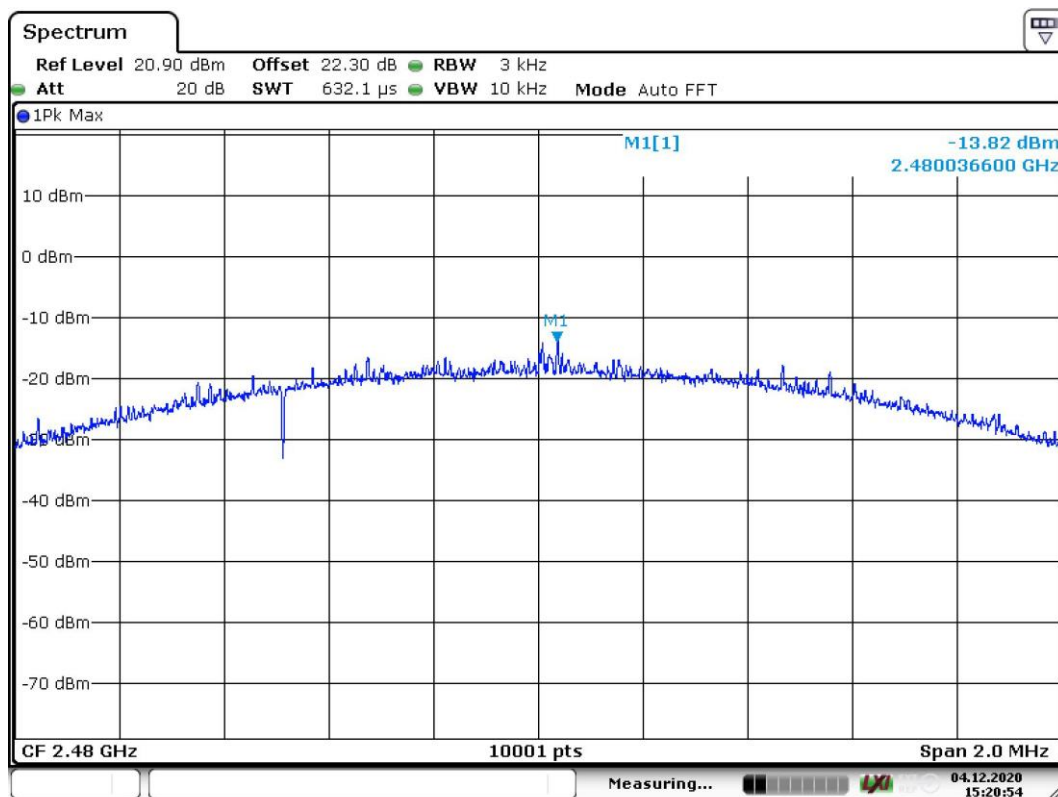
Date: 4.DEC.2020 15:18:35

Screenshot: Peak power spectral density, low channel, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 15:20:13

Screenshot: Peak power spectral density, middle channel, Bluetooth Low Energy 2 Mbit



Date: 4.DEC.2020 15:20:55

Screenshot: Peak power spectral density, high channel, Bluetooth Low Energy 2 Mbit

Test result

Data rate	Channel [MHz]	PSD [dBm/3kHz]
1 Mbit	2402	-11.8
	2440	-11.2
	2480	-12.2
2 Mbit	2402	-13.4
	2440	-12.8
	2480	-13.8

12 TEST EQUIPMENT

Conducted emission test site BUR 1

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - V	--	--	--
Receiver	Rohde & Schwarz	ESCI 3	12741	June-2020	1 year
AMN / LISN	Rohde & Schwarz	ESH3-Z5	5875	June-2020	1 year
Temperature reader	Vaisala	HMP 233	244	Sep-2020	1 year

Björkhallen (3m SAC)

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 -	--	--	--
Receiver	Rohde & Schwarz	ESW 44	34030	July-2020	1 year
BiLog antenna	Chase	CBL6110A	12474	June-2019	3 years
Preamplifier	Rohde & Schwarz	TS-PRE1	32306	Sep-2020	1 year
Ultralog antenna	Rohde & Schwarz	HL562	30711	Jan-2018	3 years
Horn antenna	Rohde & Schwarz	HF307	32306	Aug-2020	3 years
Temperature reader	Vaisala	HM 41	32927	Oct-2020	1 year

Radiohallen (3m FAC)

Equipment type	Manufacturer	Model	Inv. No.	Last Cal. date	Cal. interval
Measurement software	Rohde & Schwarz	EMC32 - V10.50.40	--	--	--
Measurement receiver	Rohde & Schwarz	ESU 40	13178	July-2020	1 year
Horn antenna	EMCO	3115	4936	Sep-2020	3 years
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
Signal analyzer:	Rohde & Schwarz	FSV 30	32594	July-2020	1 year
2,4 GHz band reject filter:	Wainwright	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
Communication tester	Rohde & Schwarz	CMW500	34164	Jan-2020	1 year
10 dB Attenuator:	Huber+Suhner	5910_N-50-010	32696	Apr-2020	1 year
Temperature reader	Vaisala	HM40	32873	Sep-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 2019843STO-320 Annex 1.

Test set up photos are in separate document 2019843STO-321 Annex 2.